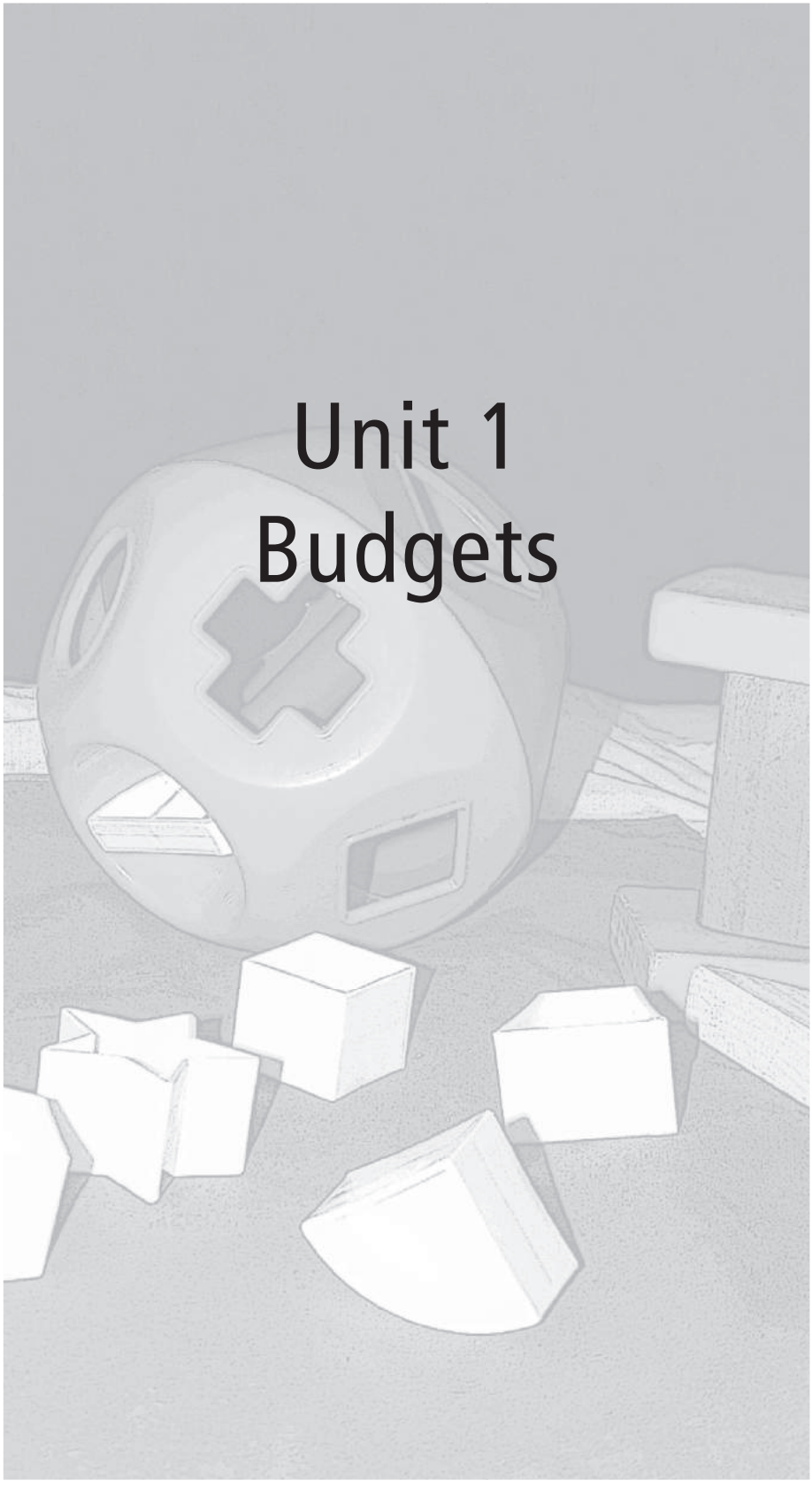
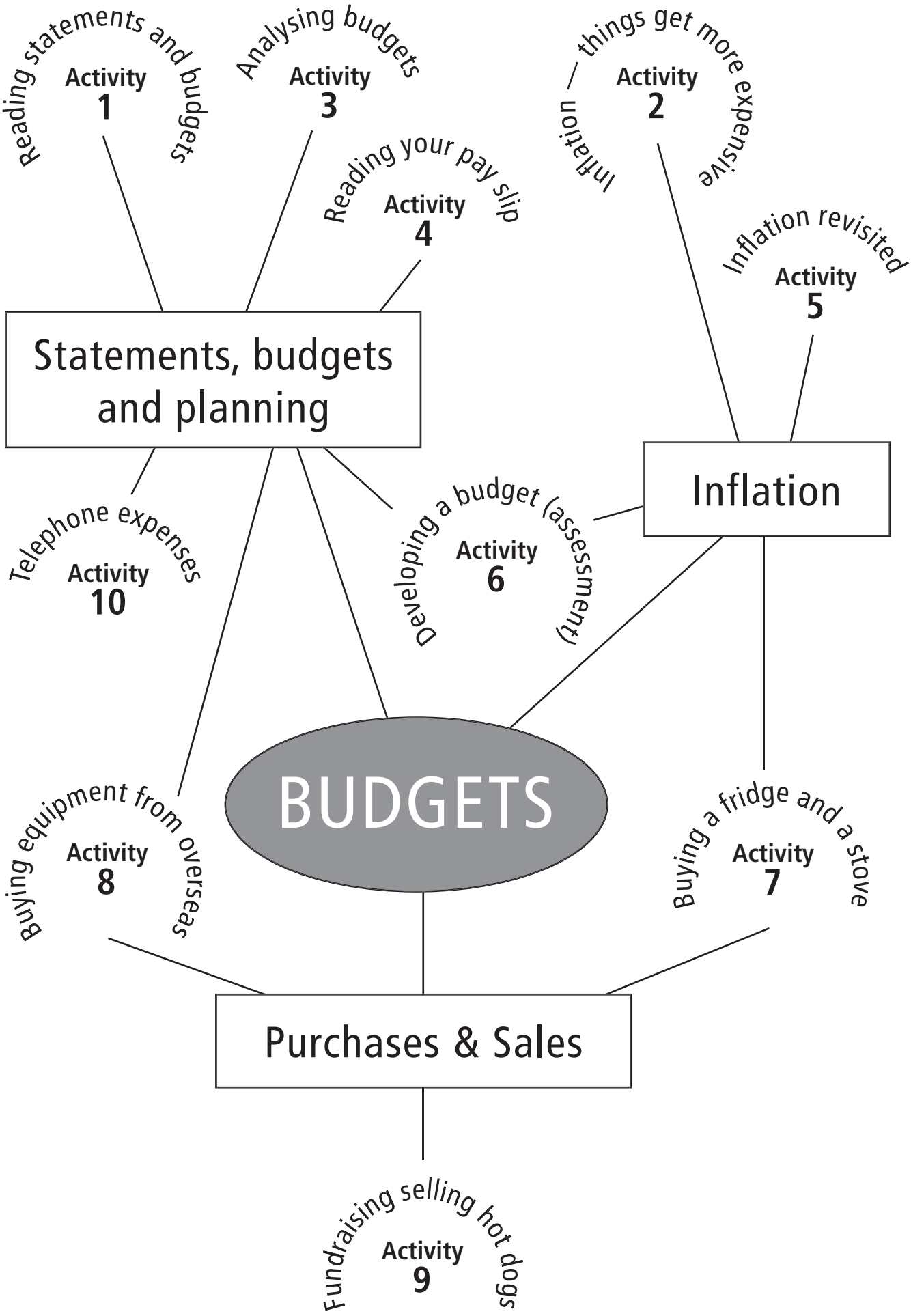
Mathematical Literacy

NQF LEVEL 4



Unit 1
Budgets

Early Childhood Development


Reading statements and budgets
Activity 1
Analysing budgets
Activity 3
Reading your pay slip
Activity 4
things get more expensive
Activity 2
Inflation
Inflation revisited
Activity 5
Statements, budgets and planning
Inflation
Telephone expenses
Activity 10
Developing a budget (assessment)
Activity 6
BUDGETS
Buying equipment from overseas
Activity 8
Buying a fridge and a stove
Activity 7
Purchases & Sales
Fundraising selling hot dogs
Activity 9

Overview

This unit aims to increase students' familiarity and understanding of the financial aspects relating to the running of a crèche.

Students should gain an understanding of what income and expenditure statements are. The relationship between budgets on a small scale business level to those on a large scale national level are drawn out.

Inflation has a significant effect on individuals as well as on all businesses. It is imperative that students gain a clear understanding of what inflation is and how to run a business whilst making allowances for the effects of inflation.

Aspects of national economy are also considered. This unit gives the student an understanding of what the sources of government income are and how it uses it's resources. Government budgeting is also carefully looked at.

This unit consists of ten activities. Each activity is a stand-alone activity, but they rely on an understanding of the concepts that have been raised preceding each activity. Having worked through this unit, students should have a greater ability to deal with some of the financial aspects of running a successful business. They should also have a greater understanding of the country's national budget.

Activity 1: Reading statements and budgets
In this activity we want students to gain an understanding of how to read budget statements. This is because many of the later activities in this unit relate back to budget statements.

We start by asking students to reflect on their own personal income and expenditure statements. Three budget statements are included with the activity: one is for Sunny Days Crèche and the others are the provincial and national income and expenditure statements. It is important for students to recognize the similarities that exist between all budget statements.

Activity 2: Inflation – things get more expensive
This activity introduces the concept of inflation, and gives students the opportunity to discover for themselves that prices go up over time. It allows students to realise that not all items increase in price by the same amount over a fixed period of time. The ideas of simple and compound interest are also introduced.

Activity 3: Analysing budgets
In this activity we will combine the ideas learnt in the first two activities and explore how inflation plays a significant role in preparing and understanding budgets.

Unit outcomes

The following Unit Standards, Specific Outcomes and Assessment Criteria are addressed by this unit:

Use Mathematics to investigate and monitor the financial aspects of personal, business and national issues (9014)

- Use Mathematics to investigate and analyse regional and/or national budgets and income (SO1).
  - Regional and/or national budgets from the media and other sources are accessed, and income and expenditure are described realistically.
  - Calculations are carried out efficiently and correctly using computational tools.
  - Solutions obtained are verified in terms of the context.
  - Different ways of representing budgets are critically analysed and related.
  - Actual income and expenditure is analysed and compared to planned income and expenditure. Variances are identified

- Use compound growth to make sense of inflationary effects on the national economy (SO2).
  - Methods of calculation are appropriate to the problem types.
  - Computational tools are used efficiently and correctly and solutions obtained are verified in terms of the context or problem.
  - Solutions to calculations are interpreted in terms of base rates or indices
  - Appropriate formulae are understood and used to calculate solutions to problems.

- Use Mathematics to critique and debate aspects of the national economy (SO3).
  - Values are calculated correctly.
  - Mathematical tools are used to compare the effects of changes in different sectors of the national economy.
  - Critique and debating points are based on well-reasoned arguments and are supported by mathematical information.

Activity 4: Reading your pay slip
This activity looks at pay slips in detail and gives students the opportunity of understanding the information that is provided on a pay slip. In addition, it shows students how tax and UIF is calculated based on income and takings.

Activity 5: Inflation Revisited
This activity enables students once again to interact with the important concept of inflation. We look at a case study of what can happen when inflation gets out of control. The concepts learned are then applied to the running of a crèche.

Activity 6: Preparing budgets
This activity is designed to be used as an assessment activity. It is intended to recap principles that have been learnt in the first five activities. There is an opportunity for students to make their own judgments about how a business develops and to draw up a budget accordingly. If time allows it may be worthwhile for students to share their budgets with each other, explaining the reasons behind their decisions.
Activity 7: Buying items on hire purchase
In this activity we expose students to the different payment options available when purchasing items on credit. We also consider the various factors at play when deciding which option is most suitable.

Activity 8: Buying items from overseas
In this activity we consider the effect of exchange rates on the cost of purchasing items from foreign countries. We also look at different purchasing options, considering whether to buy in bulk or in smaller quantities as funding allows.

Activity 9: Fundraising selling hot dogs
In this activity we look at an alternative source of income for the crèche through fundraising. The aim of the activity is to allow students to think through the cost of producing the hot dogs for sale. Students should realise that decisions that are made can have far-reaching effects on a business's profits.

Activity 10: Telephone expenses
This activity is completely self-contained. It deals with ways of managing one of the significant budget items: telephone costs.

9014	Use mathematics to investigate & monitor the financial aspects of personal, business and national issues											
		ACTIVITY	1	2	3	4	5	6	7	8	9	10
SO1	Use mathematics to investigate and analyse regional and/or national budgets and income											
	AC1	Regional and /or national budgets from the media and other sources are accessed, and income and expenditure are described realistically.	✓		✓		✓		✓			
	AC2	Calculations are carried out efficiently and correctly using computational tools.		✓	✓	✓		✓	✓	✓	✓	✓
	AC3	Solutions obtained are verified in terms of the context.	✓	✓	✓	✓	✓	✓		✓	✓	✓
	AC4	Different ways of representing budgets are critically analysed and related.	✓		✓			✓				
	AC5	Actual income and expenditure is analysed and and compared to planned income and expenditure. Variances are identified.	✓		✓			✓				
SO2	Use compound growth to make sense of inflationary effects on the national economy.											
	AC1	Methods of calculation are appropriate to the problem types.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	AC2	Computational tools are used efficiently and correctly and solutions obtained are verified in terms of the context or problem.		✓	✓	✓		✓	✓	✓	✓	✓
	AC3	Solutions to problems are interpreted in terms of base rates or indices.		✓		✓	✓	✓	✓	✓		
	AC4	Appropriate formulae are understood and used to calculate solutions to problems.		✓	✓	✓		✓	✓	✓		✓
SO3	Use mathematics to critique and debate aspects of the national economy.											
	AC1	Values are calculated correctly.	✓	✓	✓	✓		✓	✓	✓	✓	✓
	AC2	Mathematics are used to compare the effects of changes in different sectors of the national economy.		✓	✓		✓					
	AC3	Critique and debating points are based on well-reasoned arguments and are supported by mathematical information.	✓	✓	✓		✓	✓	✓	✓		✓

Activity 1 — Reading statements and budgets

ABOUT THIS ACTIVITY

This activity focuses on income and expenditure. Students will represent and analyse their own personal income and expenditure as well as that of the Sunny Days Crèche. They will also look at a national budget statement and make comparisons and identify links between this and the Sunny Days Crèche budget. Basic budget layout and terminology will be introduced in this activity. Students will be expected to extract appropriate values from the budgets – showing their understanding of the various rows and columns shown on a budget.
This activity is aligned with unit standard 9014 and addresses AC 1,3,4,5 of SO1; AC 1 of SO2 and AC 1,3 of SO3.

MANAGING THIS ACTIVITY

For this activity, students will need a set of handouts (5 pages containing Thabita Zola's pay slip, the Sunny Days Crèche budget, Western Cape budget framework and South African budget framework and additional representations of the Western Cape expenditure).

1.1.1 Sources of income could include any of the following: bursary, loan, pocket money, part-time wages.
1.1.2 The main expenses incurred during the month could include the following: rent, groceries, toiletries, electricity, telephone and/or cell phone, transport, entertainment, clothes, birthday presents, sundries.

1.2 Example of a completed income and expenditure table:

Summary of income and expenditure for: Marisa de Klerk
For the period: July 2004

Income			Expenditure		
Date	Description	Amount	Date	Description	Amount
01/07	Withdrawal from savings	R1 000	01/07	Rent	R2 000
05/07	Bursary	R2 000	03/07	Electricity	R 150
	Part-time wages	R1 200		Groceries	R 500
				Transport	R 200
				Entertainment	R 650
			23/07	Telkom account	R 267
			24/07	Truworths acc	R 120
				Sundries	R 213
	Total	R4 200		Total	R4 100

1.3.1 The word "EARNINGS" is used to refer to Thabita's income. She receives a basic salary and she also receives a birthday bonus this month.
1.3.2 The word "DEDUCTIONS" is used to refer to Thabita's expenses. Money is deducted from her income for TAX and for UIF.
1.3.3 For the month of June 2004, Thabita received an income of R5 833,74 after the deductions. This is more than every other month as she only gets a birthday bonus in her birthday month. Every other month she would receive a basic salary of R 3050 and she would have a tax deduction of R102,63 (205,26 ÷ 2) and a UIF deduction of R30,50 (61,002). Therefore, in every other month she would be banking a net pay of R2 916,87.

1.4.1 Other words used to describe earnings are "income" and "revenue".
Examples of different incomes:
- Sunny Days Crèche: Fees and fundraising.
- Provincial: National transfer and own revenue.
- National: Tax revenue and departmental and other receipts.

1.4.2 Other word used to describe deductions are "expenses" and "expenditure".
The 3 largest expenses incurred in 2002:
- Sunny Days Crèche: Salaries, teaching materials and repairs and maintenance.
- Provincial: Education, health and social services and poverty alleviation.
- National: Provincial equitable share, justice and protection services and State dept cost.

1.4.3 If an organisation plans to spend money on certain things then these things are listed in the column labelled "budget" or "estimate". The "budget" or "estimate" column contains descriptions of costs that have not yet been incurred. The figures in this column are, therefore, merely the expected or estimated figures and are determined before payment is actually made. Once an expense is incurred (something is paid for) this expense would then be placed in a column marked "actual" and the figure represented next to this item would now be the "actual" (real/correct) amount incurred for this expense. In summary, a budget is prepared before the start of the year in order to guide behaviour during the year while the income/expenditure statement is a reflection of actual spending and can only be prepared at the end of the financial year.

1.4.4 The financial year for Sunny Days Crèche runs form January – December, therefore simply saying 2002 implies from January 2002 – December 2002. However, the Provincial and National financial year does not run from January – December but runs for a revolving period of 12 months. For example, the tax year runs from the beginning of March in one year till the end of February of the following year.

1.5 Students are expected to identify that the figures in the national and provincial budgets are given in million rands, whereas the Sunny Days Crèche budget figures are simply the rand values.

1.5.1 National Budget: R326 956 000 000, 00

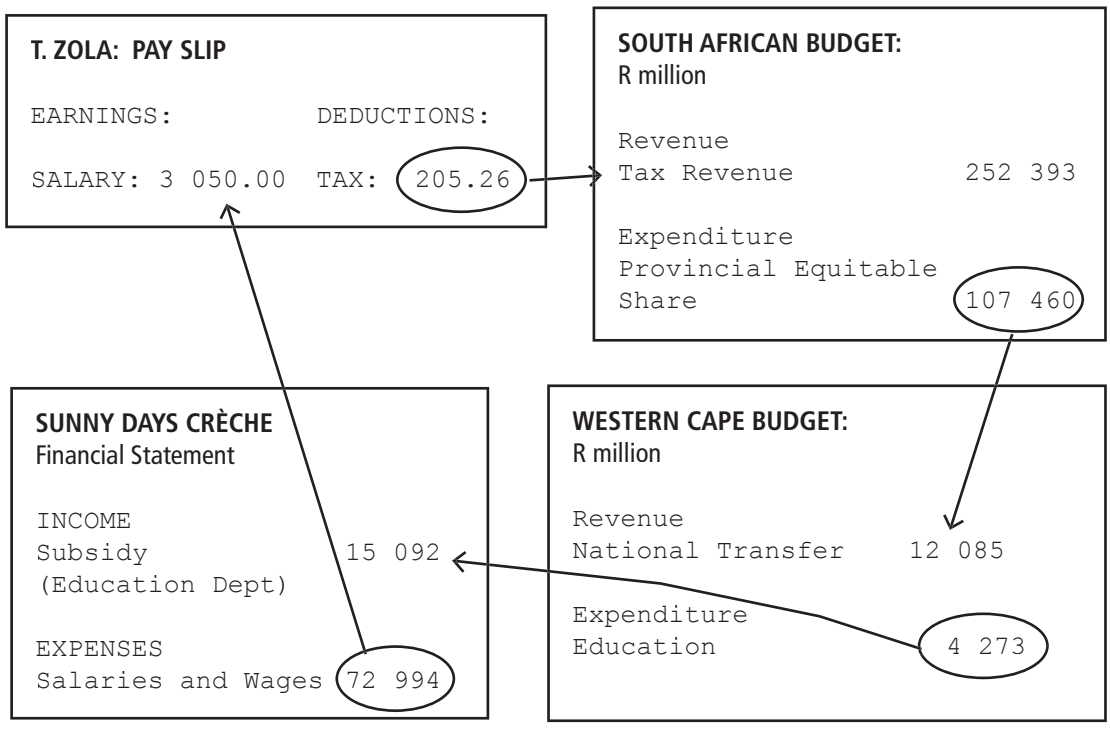
1.5.2 Western Cape Budget: R17 372 000 000,00

1.5.3 Sunny Days Crèche: R113 400,00

1.6 No. The actual amount in the bank would be reflected in a statement of assets and liabilities, which is often another element of a financial report. The income and expenditure statements are plans of reports but are not in themselves an indicator of cash-in-hand.

1.7 No. For example, "salary" tells us the total amount spent on salaries but it does not tell us how many teachers are employed or what each employee earns. Similarly, "telephone" does not tell us how many local/long distance/cellular calls are made, only that the total amount spent on telephone calls.

1.8



1.9 For Thabita to earn a higher salary from Sunny Days Crèche, Sunny Days Crèche would need to receive a larger subsidy from the Education Department, which means that the Western Cape would need to receive more revenue from the national funds, which means that people like Thabita would need to pay more taxes. Of course, this is very simplified.

1.10 Above each box is a total. Inside the box is an itemised list of each of the individual entries that make up this total. Not all statements use this layout. Some statements only show a total at the end of each major section (e.g. on the national and provincial budgets). It is not always necessary to use boxes, especially in larger budgets that do not show as much detail and a breakdown of individual figures.

1.11 One method of showing a deficit/loss is to put brackets around a number e.g. the Sunny Days Crèche statement shows a deficit at the end of the 2003 column as (24 233) meaning –R24 233,00. Another method of showing a deficit/loss is to use a negative sign before the number e.g. the Western Cape statement shows a deficit at the end of the 2002/2003 column as –648, meaning –R648 000 000,00.

Activity 1 — Reading statements and budgets

Money is very important to your crèche—without money you cannot run your business. In this activity we will be looking at financial planning and management. There are two key aspects to managing the finances of your crèche. Firstly, you need to keep a record of actual income and expenditure and secondly, you need to plan ahead. The record is usually summarised on an income/expenditure statement while planning is done by means of a budget, which reflects anticipated (expected) income and expenditure. Income and expenditure statements as well as budgets should be prepared on a monthly and yearly basis for the crèche, as well as for any specific projects undertaken.

1.1 Before we go any further, think about your personal income and expenditure over the last month.

1.1.1 Make a list of all the sources of your income and also the amounts (e.g. bursary, loan, pocket money, part-time wages, etc.).

1.1.2 Make a list of all the main expenses you incurred during the month as well as the amount for each (e.g. rent, transport, groceries, toiletries, entertainment, clothes, etc.).

1.2 Draw and complete a table such as the one below for the income and expenditure you listed above. You will have to add more rows and you will almost certainly not remember the dates—this is not a problem for now.

Summary of income and expenditure for: ___(insert name here)_____ _____ For the period: _____(insert month here)_____					
Income			Expenditure		
Date	Description	Amount	Date	Description	Amount
Total			Total		
Surplus or deficit (total income – total expenses)					

If your income exceeds your expenses you have a surplus: money you can save or carry over to the next month or project. If your expenses exceed you income you have a deficit: money you will have to take out of your savings or cover with a loan.

For the next set of questions you must refer to the handout, which includes the following:

- An income and expenditure statement (in the form of her payslip) for Thabita, a teacher employed by the Sunny Days crèche.
- The income expenditure statement for the Sunny Days crèche.
- The national income and expenditure statement presented by the National Minister of Finance to parliament and by local member of the executive council (MEC) for finance to the Western Cape government.
- Two different representations of how the Western Cape Education Department (WCED) will spend the 2004/2005 Western Cape education allocation.

1.3 Refer to Thabita's pay slip and determine the following:

1.3.1 What word does the pay slip use to refer to income? List the different forms of income that she receives.

1.3.2 What word does the slip use to refer to expenses? List the different types of expenses that she incurs.

1.3.3 How much money did Thabita receive in her bank account at the end of the month? Is this the same for every other month of the year? If not, how much do you think she banks during other months?

1.4 Refer to the financial statement of the Sunny Days Crèche, as well as the national and provincial budgets, and determine the following:

1.4.1 What different words do these documents use to refer to income? List two of the different forms of income that each institution receives.

1.4.2 What different words do these documents use to refer to expenses? List the three largest forms of expense that each institution incurred in 2002.

1.4.3 You will notice that each of these documents has different columns for different years. Some are labelled "actual" while others are labelled "budget" or "estimate." Why are these different labels used?

1.4.4 You will notice that the national and Western Cape budgets refer to years as 2002/2003 etc. while the Sunny Days Crèche refers simply to 2002 and 2003. Why is there this difference?

1.5 Give the total (in rands) of the following amounts of money referred to in each of the following statements:

1.5.1 National budget: 326 956 (estimated revenue 2004/2005)

1.5.2 Western Cape budget: 17 372 (estimated revenue 2004/2005)

1.5.3 Sunny Days Crèche: 113 400 (budgeted income 2004)

1.6 Can you tell from the Sunny Days Crèche statement (or the national and Western Cape statements) how much money is in their bank account at any time?

1.7 Can you tell from the Sunny Days Crèche statement (or the national and Western Cape statements) how the money allocated to a particular expense is actually spent?

1.8 Examine the income and expenditure columns of the four documents. Can you link these together? You should be able to see how some income items on the statements link to specific expenditure items on others. Draw a diagram of this cash flow.

1.9 What are the implications of the links you have identified above for individuals and organisations within a province and country?

1.10 The table below is an extract from the Sunny Days Crèche financial statement. Why are there boxes around some of the entries? Why do these boxes not appear in all the statements?

23 498	23 573
447	585
23 030	23 055
90 779	113 372
12 898	22 021
58 455	70 290
4 334	5 396
15 092	15 666
114 256	**136 945**

1.11 The different statements provided use two different ways to indicate a deficit/loss. What are these?

THORNY DAYS CRÈCHE	EMP. CODE: 007	PERIOD END DATE: 31/06/2004
25 THORNTON ROAD	EMP. NAME: T. ZOLA	DATE ENGAGED: 01/04/2002
CRAWFORD 7780		ID NUMBER: 7505246578083
	JOB TITLE: TEACHER	

ADDITIONAL INFORMATION		EARNINGS		DEDUCTIONS	
BASIC SALARY:	39650.00	BASIC SALARY:	3050.00	TAX	205.26
		BIRTHDAY BONUS:	3050.00	UIF	61.00
LEAVE DAYS DUE:	8				
YEAR-TO-DATE TOTALS					
TAXABLE EARNINGS:	9150.00				
TAX	307.89				
UIF	91.50				
CURRENT PERIOD					
TOTAL PERKS:	0.00	TOTAL EARNINGS:	6100.00	TOTAL DEDUCTIONS	266.26
CO.CONTRIBUTIONS	61.00				
				NET PAY	5833.74

Financial statement and budget of the Sunny Days Crèche presented to the Church Council of St Agnes' Church, Crawford (Cape Town)

	Actual 2002	Actual 2003	Budget 2004
INCOME			
Fee income	23 498	23 573	29 400
Application fees	447	585	600
School fees	23 030	23 055	28 800
Other income	90 779	113 372	84 000
Fundraising	12 898	22 021	15 000
Donations received	58 455	70 290	45 000
Hire of facilities	4 334	5 396	6 000
Subsidy (Education Department)	15 092	15 666	18 000
TOTAL INCOME	**114 256**	**136 945**	**113 400**
EXPENSES			
Bank charges	539	545	540
Capital expenses	0	65 000	0
Electricity	711	749	800
Groceries and cleansing materials	824	948	1 000
Medical tests and first aid	795	782	1 000
Outings	441	671	850
Printing, postage & stationery	2 304	2 409	2 500
Repairs and maintenance	3 992	7 311	5 000
Salaries and wages	72 994	73 638	94 493
Teaching materials	4 699	3 874	5 000
Telephone	2 757	4 026	2 400
Water	1 074	1 225	1 200
TOTAL EXPENSES	**91 130**	**161 178**	**114 783**
NET SURPLUS (DEFICIT)	**23 126**	**(24 233)**	**(1 383)**

Western Cape Budget Framework
Based on the Budget speech of the Provincial Minister of Finance, Economic Development and Tourism Ebrahim Rasool on 3 March 2004[1]

R million	2001/2002 Actual	2002/2003 Actual	2003/2004 Estimate	2004/2005 Estimate
Revenue				
National transfer	12 085	13 314	14 963	16 342
Own revenue	954	834	1 015	1 030
Total Revenue	**13 039**	**14 148**	**15 978**	**17 372**
Expenditure				
Provincial administration	280	396	307	312
Provincial parliament	20	24	29	31
Provincial treasury	48	69	200	145
Community safety	97	118	140	147
Education	4 273	4 678	5 030	5 356
Health	3 581	3 871	4 291	4 504
Social services and poverty alleviation	2 384	3 216	3 762	4 324
Housing	382	460	519	547
Environmental affairs	93	121	122	129
Transport and public works	1 060	1 379	1 543	1 641
Agriculture	114	139	169	198
Local government	30	65	63	63
Economic development and tourism	52	152	80	61
Cultural affairs and sport	90	108	137	143
Total expenditure	**12 504**	**14 796**	**16 392**	**17 601**
Surplus/Deficit(-)	**535**	**-648**	**-414**	**-229**

[1] Based on details sourced at: http://www.capegateway.gov.za/eng/pubs/budgets/2004/52862 (June 2004)

South African Budget Framework

based on the Budget speech of the Minister of Finance, Trevor Manuel, on 18 Feb 2004[1]

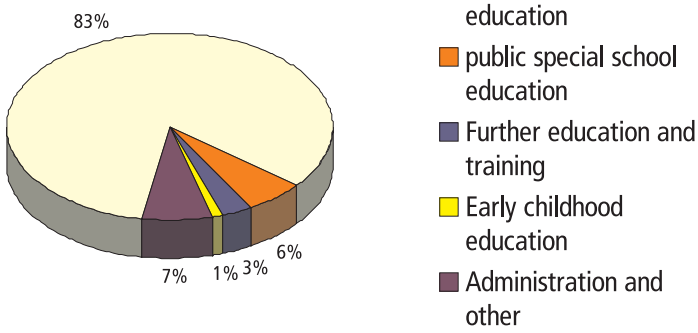
R million	2001/2002 Actual	2002/2003 Actual	2003/2004 Estimate	2004/2005 Estimate
Revenue (National Revenue Fund)				
Tax revenue	252 398	282 180	303 318	333 694
Departmental and other receipts	4 169	4 587	6 704	6 590
Less: SACU	-8 205	-8 259	-9 723	-13 328
Total Revenue	**248 362**	**278 508**	**300 299**	**326 956**
Expenditure				
Statutory appropriations				
State debt cost	47 581	46 808	47 326	50 432
Provincial equitable share	107 460	123 457	144 743	159 971
Skills development funds	2 541	3 259	3 700	4 300
Other	335	350	183	197
Appropriated by vote				
Central government administration	11 841	14 914	19 032	23 188
Financial and administrative services	9 552	10 791	13 113	14 961
Social services	19 806	19 859	23 655	28 573
Arts and culture	442	592	926	1 141
Education	8 616	9 314	10 584	11 344
Health	6 223	7 059	7 695	8 787
Labour	1 396	1 283	1 054	1 191
Science and technology	701	801	1 068	1 276
Social development	2 327	639	2 100	4 548
Sports and recreation	101	171	228	286
Justice and protection services	44 051	49 956	53 792	58 269
Economic services and infrastructure	19 427	22 090	25 922	25 283
Standing appropriations	294	30	46	34
Total expenditure	**262 888**	**291 514**	**331 512**	**365 208**
Surplus/Deficit(-)	**-14 526**	**-13 006**	**-31 213**	**-38 252**

NATIONAL TREASURY

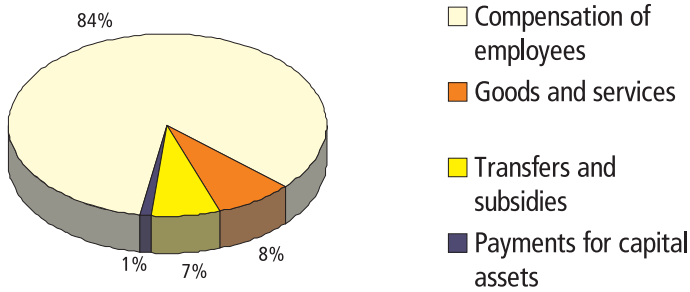
[1] Based on details sourced at: http://www.finance.gov.za/ (June 2004)

Two different representations[1] of how the R 5.356 billion allocated to education by the Western Cape Provincial Government (see budget above) will be spent by the Western Cape Education Department (WCED).

WCED expenditure (2004/2005)



WCED expenditure by economic classification (2004/2005)



[1] Based on details sourced at: http://www.capegateway.gov.za/Text/2004/3/v05_wced_04.pdf (June 2004)

Activity 2 — Inflation — things get more expensive

ABOUT THIS ACTIVITY

This activity focuses on inflation. By looking at some shopping item prices of 1988 and comparing these with current prices for these items (or similar equivalents) students notice that although some items have increased more than others, on average the prices are in line with inflation. We use this context as an opportunity to introduce simple and compound increase.

This activity is aligned with unit standard 9014 and addresses AC 2,3 of SO1; AC 1,2,3,4 of SO2 and AC 1,2,3 of SO3.

MANAGING THIS ACTIVITY

For this activity students are required to collect current prices of certain items from the supermarkets. Therefore, this part of the activity may be given as a homework task (and possibly could be shared out among the students in the class if necessary) in order to save time in class.

2.1 Students are required to do research in order to determine the current prices of each of the items listed in the "shopping basket table". Some of the brands may not be available or may have been discontinued. Where necessary, students should select an appropriate substitute in order to complete the table.

2.2 Students are required to fill in the following information (note: letters have been used in the "current" column in order to show the correct calculations — the students will fill the actual amounts in here):

Comparison of the cost of a 1988 shopping basket with the current cost			
	Total cost (by category) of the items in the basket		2.3 % increase
	1988	Current	
Clothing	R 569,89	C	$\frac{C - 569,89}{569,89} \times 100$
Groceries	R 56,04	G	$\frac{G - 56,04}{56,04} \times 100$
Household	R 1 330,88	H	$\frac{H - 1330,88}{1330,88} \times 100$
Motor	R 87,45	M	$\frac{M - 87,45}{87,45} \times 100$
Sport	R 240,34	S	$\frac{S}{240,34} \times 100$
Total	R2 284, 60	= C+G+H+M+S	$\frac{(C + G + H + M + S) - 2284,60}{2284,60} \times 100$

2.4 The answers to these questions will depend on the current prices.

2.4.1 = the category with the highest % increase (the value in the last column).

2.4.2 = the category with the lowest % increase.

2.4.3 = any of the categories whose % increase is larger than the increase shown here.

2.4.4 = any of the categories whose % increase is less than the total increase.

2.5.1 No, this does not seem reasonable. Students may not yet understand why, but the reason is to do with something called compound increase which is dealt with in the following question.

2.5.2 No, this is still not realistic. If one looks at the year-on-year inflation rates between 1988 – 2003, (see question 2.7), the lowest inflation rate shown is 5,2% (in 1999) and the highest inflation rate shown is 15,6% (in 1991). Therefore 17,8% still seems an unrealistic annual % increase.

2.5.3 The average inflation rate over the past 14 years is approximately 10%. Therefore, a reasonable estimate would be somewhere between 6% and 12%.

2.5.4 Students may not yet know why there is a difference between their estimate and the above calculation, but they will develop a greater understanding of this during the activity.

2.5.5 One example of a very large inflation rate is in Zimbabwe. For more details of this example refer to the handout used in Activity 5.

2.6

	Simple Interest Account		Compound Interest Account	
	Interest earned	Balance	Interest earned	Balance
		100,00		100,00
After 1 year	10,00	100,00	10,00	110,00
After 2 years	10,00	100,00	11,00	121,00

Interest earned = balance × 10% **Balance** = interest + previous balance

Eg: (110 × 10%) = 11,00 11,00 + 110,00 = R 121,00
And: (121 × 10%) = 12,10 12,10 + 121,00 = R133,10 etc

Solutions:

After 3 years	10,00	100,00	12,10	133,10
After 4 years	10,00	100,00	13,31	146,41
After 5 years	10,00	100,00	14,64	161,05

2.7 If we were to show a total column at the end of the table in the previous question it would look like this:

	Simple Interest	Same Balance	Compound Interest	Balance
TOTAL	50,00	100,00	61,05	161,05

Simple interest earned is only R50,00 over the five years, but the compound interest is over R60,00.

Predicted price for items based on the South African inflation figures				
	Year-on-year inflation	Tuna price	Argus price	**1989 tuna price** = 1988 tuna price × 14,5 % + 1988 Tuna price = 1,49 × 14,5% + 1,49 = 1,71 **1992 Argus price** = 1991Argus price × 13,7% + 1991 Argus price = 0,61 × 13,7% + 0,61 = 0,69
1988		1,49	0,40	
1989	14,5	1,71	0,46	
1990	14,3	1,95	0,52	
1991	15,6	2,25	0,61	
1992	13,7	2,56	0,69	

Year-on-year inflation		Students are required to calculate the sum of all the items in the 1988 shopping basket (from the table given at the end of this worksheet) The calculation is then the same as for the others: **1990 price of shopping basket:** = 1988 price × 14,5% + 1988 price = 2 284,58 × 14,5% +2 284,58 = 2 615,84					Shopping basket
Total in 1988							**2 284,58**
1989	14,5						2 615,84
1990	14,3						2 989,91
1991	15,6						3 456,34
1992	13,7						3 929,85
1993	9,9	2,82	0,76				4 318,91
1994	8,8	3,06	0,82				4 698,97
1995	8,7	3,33	0,89				5 107,78
1996	7,3	3,57	0,96				5 480,65
1997	8,6	3,88	1,04				5 951,99
1998	6,9	4,15	1,11				6 362,68
1999	5,2	4,37	1,17				6 693,53
2000	5,4	4,60	1,24				7 054,99
2001	5,7	4,86	1,31				7 457,12
2002	9,3	5,32	1,43				8 150,63
2003	5,8	5,62	1,51				8 623,37
Current price		4,25	3,00				

2.8 Inflation causes the price of commodities to change from year to year (almost always up). Commodities therefore get more expensive from one year to the next. If your income (salary) increases in line with inflation your spending remains unchanged – that is, you can still buy exactly the same shopping basket. If, however, your income (salary) increases at less than inflation, your spending power has decreased – you can no longer afford the same shopping basket even though your salary has increased (you are earning more).

Activity 2 — Inflation: things get more expensive

You will no doubt remember a time when you paid a lot less for an item than you do today. What did you pay for a soft-drink five years ago? Was there a time when you could go to the movies for less than you pay today? Of course! We call the annual increase in prices inflation. Not only does inflation play an important role in our day to day lives, it also impacts on financial planning. That is why you will have noticed that the projected amounts for items in the budgets for any year in Activity 1 are higher than the actual amounts spent on them in earlier years. In this activity we will try to develop a better understanding of what inflation is.

For the next few questions you will have to refer to handout 2, which consists of a table of items as well as the price you would have paid for each of the items in 1988.

2.1 Share the items among the members of your group and collect the current prices for the items by visiting shops near to you. You may have to find similar items if the actual product is no longer available.

Complete the table.

2.1 At the end of this worksheet you will find a table of items that you might have bought during 1988 as well as the price of each of the items.

Share the items among the members of your group and collect the current prices for the items by visiting shops near to you. You may have to find similar items if the actual product is no longer available.

Comparison of the cost of a 1988 shopping basket with the current cost			
	Total cost (by category) of the items in the basket		% increase
	1988	Current	
Clothing			
Groceries			
Household			
Motor			
Sport			
Total			

2.3 It is hard to compare the categories to see which increased the most and which increased the least since the amounts are all different. In order to be able to compare the changes we will calculate the % increase for each category and for the total. Complete the '% increase' column by using the following formula:

$$\%\ \text{increase} = \frac{\text{current price} - 1988\ \text{price}}{1998\ \text{price}} \times 100 \quad \text{or} \quad \%\text{increase} = \frac{\text{current price}}{1998\ \text{price}}$$

2.4 Answer the following questions based on the percentage increases you have calculated in your table:

2.4.1 Which category appears to have increased the most?

2.4.2 Which category appears to have increased the least?

2.4.3 Which categories have shown a greater increase than the increase of the total basket?

2.4.4 Which categories have increased less than the increase of the total basket?

2.5 In completing the '% increase' column for the table you will have calculated some rather large numbers, maybe even as high as 700 or 800%.

In 2004 the calculation for the Cape Argus was:

$$\%\ increase = \frac{3{,}00 - 0{,}40}{0{,}40} \times 100 \approx 650\%$$

and for Pick 'n Pay 'no name brand' tuna the calculation was:

$$\%\ increase = \frac{4{,}25 - 1{,}49}{1{,}49} \times 100 \approx 185\%$$

2.5.1 You might conclude that the Cape Argus increased by
$\frac{650}{16} \approx 40{,}69\%$ per year
(1988 – 2004 is 16 years) Do you think this is correct? Give a reason for your answer.

2.5.2 Do you think that
$\frac{185}{16} \approx 11{,}6\%$
for tuna is more realistic?

2.5.3 What do you think is a reasonable estimate of annual increase?

2.5.4 Try to give a reason for the difference between your expectation and the calculation above?

2.5.5 Do you know of any situations/countries where prices do increase by amounts like 50% per year? If so, make a list of these

While it is true that in South Africa we do not typically experience annual increases of 50% for items, the calculation giving 700% for the 16 year period is not incorrect. How do we explain this? The effect can be explained by the term compound increase.

To understand compound increase, consider a simple example in which we compare two kinds of interest: simple interest and compound interest. Banks offer these two forms of interest on savings accounts. With simple interest you earn interest every year (or month) and the interest is paid out—it is not added to the account. With compound interest you earn interest every year (or month) and the interest earned is added to the amount in the savings account.

2.6 Let us say that the bank offers you 10% interest per year for money in your savings account. Complete the table below for the two kinds of account.

	Simple Interest Account		Compound Interest Account	
	Interest earned and paid out to client	Balance	Interest earned and added to the bank balance	Balance
		100,00		100,00
After 1 year	10,00	100,00	10,00	110,00
After 2 years	10,00	100,00	11,00	121,00
After 3 years				
After 4 years				
After 5 years				

You should notice from the table above that you earned 5 × R 10,00 = R 50,00 interest in the simple interest account over the five year period and the balance remained unchanged. By comparison you earned more than R 60,00 interest in the compound interest account. This is because you earned "interest on interest" in the compound interest account. This principle explains how a much less than 44% increase per year can nonetheless appear to look like 700% over 16 years.

2.7 *Statistics South Africa* is responsible for publishing financial statistics for the country. Among other figures, they publish year-on-year inflation figures.

Use the year-on-year inflation figures provided in the table to complete the table for the Cape Argus newspaper and three other items from your shopping basket, as well as for the entire shopping basket.

Predicted price for items based on the South African inflation figures[1]							
	year-on-year inflation	Tuna price	Argus price	Item 1	Item 2	Item 3	Shopping basket
1988		1,49	0,40				
1989	14,5	1,71	0,46				
1990	14,3	1,95	0,52				
1991	15,6	2,25	0,61				
1992	13,7	2,56	0,69				
1993	9,9	2,82					
1994	8,8	3,06					
1995	8,7	3,33					
1996	7,3	3,57					
1997	8,6	3,88					
1998	6,9	4,15					
1999	5,2	4,37					
2000	5,4	4,60					
2001	5,7	4,86					
2002	9,3	5,32					
2003	5,8	5,62					
Current price		4,25	3,20				

As you can see from the table, some items (*Cape Argus*) have increased more than we may have predicted in terms of inflation, while other items (tuna) have not increased as much as we may have expected. This is because inflation measures the 'average' increase of the shopping basket.

2.8 How does inflation impact on your life? Answer this question by thinking about the cost of living (you may want to refer to the income expenditure statement you prepared in activity 1).

[1] Figures supplied by Statistics South Africa.

Shopping Basket		Price in Rands	
Item	**Category**	**1988**	**Current**
Jeans - Denim	C	39,95	
Ladies' Jackets (pastel shades)	C	19,99	
Ladies' Matching Skirts (to go with above)	C	19,99	
Ladies' Matching Slax (to go with above)	C	19,99	
Men's Suits - Mohair (Monatic), each	C	199,99	
Men's Suits - Pure Wool (Monatic), each	C	139,99	
Men's Suits - Wool & Trevira (Monatic), each	C	129,99	
Ceres fruit juice, 1 litre	G	1,29	
Coke, 2 litre	G	1,69	
Edib Sunflower Oil	G	1,58	
Eggs- large, 1doz.	G	1,66	
Frozen Turkeys (whole), per kg	G	4,68	
Klipdrif Brandy, 750 ml bottle	G	8,77	
Peaches - Koo, 410 g tin	G	0,69	
Peas (Helderberg), 410g tin	G	0,69	
Peas Frozen (I & J), 1 kg	G	3,69	
Picnic Shoulder Ham (DAK), 900 g tin	G	7,29	
Potatoes - Class 1 Medium, 5kg pocket	G	2,49	
Quality Street sweets, 1 kg	G	8,99	
Renown pork sausages, 500 g	G	2,49	
Salticrax - Pyotts, 200 g carton	G	0,99	
Sunshine D Margarine, 500 g block	G	1,58	
Tuna (P&P No Name), 200g tin	G	1,49	
Wine - Bellingham Johannesberger, 750 ml bottle	G	2,99	
Wine - Graca, 750 ml bottle	G	2,99	
Cape Argus	H	0,40	
Duvets, double - Trevira	H	39,99	
Duvets, single - Trevira	H	26,99	
Electric Auto Jug Kettle - 1,7 litre (Safeway De Luxe)	H	59,99	
Electric Fry Pan (Sunbeam Master Fryer)	H	79,99	
Electric Kettle - 2.2 litre	H	19,95	
Electric Sandwich Toaster (Safeway De Luxe)	H	49,99	
Electric Steam Iron (Salton Teflon coated)	H	34,95	
Electric Stove - 4 plate (Westpoint)	H	999,95	
Foreign Exchange - One £ UK Sterling	H	3,52	
Foreign Exchange - One US $	H	0,51	
Non Stick Frying Pan	H	14,65	
Engine Oil - Multigrade, 5 litre	M	8,95	
Tyres - Steel Radials (165 SR x 13), each	M	78,50	
Gym Shoes -Adidas Sportive	S	66,95	
Roller Skates - with boots	S	49,95	
Running Shoes - Reebok Royale	S	99,95	
Skateboard	S	19,99	
Tennis Balls - Slazenger, pack of 2	S	3,50	

Activity 3 — Analysing budgets

ABOUT THIS ACTIVITY

By comparing the national, provincial and crèche budgets the students are introduced to the idea that, generally speaking, the budget items increase with inflation. Students should notice some anomalies, which can be explained in terms of the other items in the respective budget.

This activity is aligned with unit standard 9014 and addresses AC 1,2,3,4,5 of SO1; AC 1,2,3,4 of SO2 and AC 1,2,3 of SO3.

MANAGING THIS ACTIVITY

Students will need to refer back to the handout pages from activity 1 in order to complete this activity.

3.1 Calculated figures in bold.

	2001/2002	Percent increase/ decrease	2002/2003	Percent increase/ decrease	2003/2004	Percent increase/ decrease	2004/2005
Income							
National	248 362	12,14%	278 508	**7,82%**	**300 299**	**8,88%**	**326 956**
W. Cape	13 039	**8,51%**	14 148	**12,93%**	**15 978**	**8,72%**	**17 372**
Sunny Days			114 256	**19,86%**	**114 256**	**-17,19%**	**113 400**
Expenditure							
National	262 888		291 514	**13,72%**	**331 512**	**10,16%**	**365 208**
W. Cape	12 504		14 796	**10,79%**	**16 392**	**7,38%**	**17 601**
Sunny Days			**91 130**	**76,87%**	**161 178**	**-28,78%**	**114 783**

3.2 No, it does not matter, because each time a percentage increase or decrease was calculated we either compared rands with rands (in the Sunny Days row) or billion rands with billion rands (in the National and W.Cape rows). At no point did we compare rands with billion rands – this would be an incorrect calculation.

3.3 Sunny Days Crèche.
From 2002 to 2003 Sunny Days Crèche's income increased by about 20%, but from 2003 to 2004 it decreased by about 17%. From 2002 to 2003 Sunny Days Crèche's expenditure increased by about 78% but from 2003 to 2004 it decreased by about 29%.

3.4 The students should notice that in 2003 Sunny Days Crèche paid out R65 000 on capital expenses. They had not previously incurred such an expense and had not budgeted to do so in 2004. This unusual expense has therefore had a significant effect on the percentage increases/decreases shown in the table.

3.5 Altering the 2003 fundraising amount from 22 021 to 13 000 and the donations received from 22 021 to 45 000 brings the total income to a more realistic R102 702,00.

Financial statement and budget of the Sunny Days Crèche presented to the Church Council of St Agnes' Church, Crawford (Cape Town)

	Actual 2002	Actual 2003	Budget 2004
INCOME			
Fee income	23 498	23 573	29 400
Application fees	447	585	600
School fees	23 030	23 055	28 800
Other income	90 779	113 372	84 000
Fundraising	12 898	13 000	15 000
Donations received	58 455	45 000	45 000
Hire of facilities	4 334	5 396	6 000
Subsidy (Education Department)	15 092	15 666	18 000
TOTAL INCOME	**114 256**	**102 702**	**113 400**
EXPENSES			
Bank charges	539	545	540
Capital expenses	0	0	0
Electricity	711	749	800
Groceries and cleansing materials	824	948	1 000
Medical tests and first aid	795	782	1 000
Outings	441	671	850
Printing, postage & stationery	2 304	2 409	2 500
Repairs and maintenance	3 992	7 311	5 000
Salaries and wages	72 994	73 638	94 493
Teaching materials	4 699	3 874	5 000
Telephone	2 757	4 026	2 400
Water	1 074	1 225	1 200
TOTAL EXPENSES	**91 130**	**96 178**	**114 783**
NET SURPLUS (DEFICIT)	**23 126**	**6 524**	**(1 383)**

By taking out the capital expenses of R65 000 (incurred in 2003) we bring the total expenses down to a more realistic R96 178. This makes the net amount a surplus of R6 526 rather than a deficit of R24 233.

These changes then make the percentage increases more comparable to the national and provincial figures.

	2001/2002	Percent increase	2002/2003	Percent increase	2003/2004	Percent increase	2004/2005
Income							
National	248 362	12,14%	278 508	7,82%	300 299	8,88%	326 956
W. Cape	13 039	8,51%	14 148	12,93%	15 978	8,72%	17 372
Sunny Days			114 256	**-10,11%**	**102 702**	**10,42%**	113 400
Expenditure							
National	262 888		291 514	13,72%	331 512	10,16%	365 208
W. Cape	12 504		14 796	10,79%	16 392	7,38%	17 601
Sunny Days			91 130	**5,54%**	**96 178**	**19,34%**	114 783

3.6 Sunny Days Crèche had a surplus of R23 126, 00 at the end of 2002. Refer back to the earlier comment about balance statements not showing assets and liabilities.

3.7 Generally one would expect that salaries and wages would be increased each year, but the crèche did not significantly increase its salaries and wages expenditure in 2003.

3.8.1 The Provincial Government spent 1% of its expenditure on "early childhood education", which was a total of R53 650 000,00.

(This is calculated as follows: $5\ 365\ 000\ 000 \times 1\% = 53\ 650\ 000$

or $5\ 365\ 000\ 000 \times \frac{1}{100} = 53\ 650\ 000$)

3.8.2 Sunny Days Crèche anticipated (budgeted on) receiving an "educational subsidy" of R18 000,00 (see the 2004 budget income column on the financial statement).

3.8.3 The actual amount of the budget that will be spent on salaries ("compensation of employees") is 84% of its expenditure, which is a total of R4 506 600 000,00.
(This is calculated as follows: $5\ 365\ 000\ 000 \times 84\% = 4\ 506\ 600\ 000$)

3.9 From the Sunny Days Crèche financial statement it is clear that a total of R114 783,00 is budgeted to be spent in 2004, of which salaries and wages makes up R94 493,00.

To calculate a percentage: $\frac{\textit{specific amount}}{\textit{total amount}}\% = \frac{94\ 493}{114\ 783}\%$ or $\left[\frac{94\ 493}{114\ 783} \times 100\right]$

$= 82{,}3\%$

Sunny Days Crèche spent 80% of its expenditure on salaries and wages in 2002, and budgeted to spent 82,3% on salaries and wages in 2004. (2003 was an unusual year where only 46% of the expenditure was spent on salaries and wages but this, as we have already discussed, was due to a large expenditure of R65 000 on capital expenses that year.) So, using 2002 and the budgeted figures for 2004, it seems that Sunny Days Crèche are "in line" with respect to their salaries as a figure of approximately 80% of expenditure spent on salaries is in line with that of the WCED.

Activity 3 — Analysing budgets

In activity 1 we looked at different representations of income and expenditure statements and budgets. In activity 2 we looked at inflation: what it is and the impact it has on the cost of living. In this activity we are going to revisit the income and expenditure statements and budgets of activity 1 in order to analyse them in terms of inflation.

3.1 Use the handouts from Activity 1. Copy and complete the table below and calculate the percentage increase or decrease from year to year (see the sample calculation). We will consider the 2002/2003 financial year on the national and provincial statements as representing the same year as 2002 values (etc.) on the Sunny Days statement.

	2001/ 2002	Percent increase/ decrease	2002/ 2003	Percent increase/ decrease	2003/ 2004	Percent increase/ decrease	2004/ 2005
Income							
National	248 362	12,14%	278 508				
W. Cape	13 039		14 148				
Sunny Days			563 606				
Expenditure							
National	262 888		291 514				
W. Cape	12 504		14 796				
Sunny Days			519 736				

Calculated as follows:

$$\frac{278508 - 248362}{248362} \times 100 = 12{,}14\%$$

3.2 You will recall from Activity 1 that the amount 278 505 (income on the national statement for 2002/2003) represents R 278 505 000 000,00, while the amount 114 256 for the Sunny Days Crèche in the same year represents R114 256,00.

Does it matter that when we calculated the percentage increase/decrease in the table above we ignored this difference?

3.1 For which of the three (national, provincial or Sunny Days Crèche) are the percentage increases/decreases from one year`` to the next significantly different from those of the others?

3.2 Study the details of the statement for the organisation you identified above. Why is there this unusual trend?

3.3 Consider the statement for the Sunny Days Crèche. You will have noticed (in 3.4 above) that they had an unusual expense in 2003: "capital expense." In 2003 the crèche built an additional classroom which accounts for this amount. You will notice that they also had higher than usual income from fundraising and donations—they did additional fundraising to pay for part of the building costs.

Remove the capital expense cost from the budget and adjust the fundraising and donations income amounts to be in line with the other years on the statement.

Now recalculate the total income and total expenditure for the year 2003 and recalculate the year-on-year percentage increases/decreases in income and expenditure for the crèche.

How do the figures for the crèche compare to the national and provincial figures now?

3.4 You will notice that the Sunny Days statement suggests that they suffered a great loss in 2003. How do you think they survived this?

3.5 Apart from the fundraising effort and increase in donations during 2003, do you think that the crèche took any other measures to be able to afford the building project?

3.6 Refer to the pie charts in handout 1. These show two different ways of interpreting how the WCED will spend the budget allocation of R 5.365 billion during 2004/2005. Calculate:

3.6.1 The actual amount of the budget that will be spent on early childhood education.

3.6.2 How much of this amount the Sunny Days Crèche anticipates receiving.

3.6.3 The actual amount of the budget that will be spent on salaries.

3.7 Calculate the budgeted percentage of expenditure to be spent on salaries by the Sunny Days Crèche in 2004. How does this compare to the WCED expenditure on salaries for 2004/2005?

Activity 4 — Reading your pay slip

ABOUT THIS ACTIVITY

This activity focuses on analysing pay slips in order for the students to come to realise that their own income and expenditure is also similar to a budgets statement. In particular, this activity concentrates on the deductions on the pay slip. Students will learn where these deductions come from and how they are calculated using the Annual Deduction Table supplied by the South African Revenue Services (SARS).

This activity is aligned with unit standard 9014 and addresses AC 2,3 of SO1; AC 1,2,3,4 of SO2 and AC 1,2,3 of SO3.

MANAGING THIS ACTIVITY

Students will need to refer to the 4 page handout containing the Annual Deduction Table supplied by the South African Revenue Services (SARS) as well as the handout from activity 1 with Thabita's pay slip.

4.1 This pay slip is for the month ending 31 June 2004. At the top right-hand corner of Thabita's pay slip it states "PERIOD END DATE: 31/06/2004".

4.2 Thabita has been working for Sunny Days Crèche for 2 years and 3 months. At the top right-hand corner of Thabita's pay slip, underneath the period end date, it states "DATE ENGAGED: 01/04/2002". This means that she has been employed there since 1 April 2002.

4.3 The first 6 digits of a person's ID number is that person's birth date. It states "ID NUMBER: 7506246578083" underneath the date engaged on Thabita's pay slip. This means that 75/06/24 is Thabita's birth date. Therefore, at the time of receiving this pay slip, Thabita had just had her 29th birthday.

4.4 Sunny Days Crèche deducts TAX and UIF from Thabita's basic (gross) salary.

4.5 R6 100,00 (Thabita's gross salary) – R205,26 (tax) –R 61,00 (UIF) = R5 833,74. Her net pay listed on the pay slip is R5 833,74, meaning she received that exact amount in her bank account that particular month.

4.6 No. This is more than every other month as she got a birthday bonus this month. Every other month she would receive a basic salary of R3 050 and she would have a tax deduction of R102,63 (205,26 ÷ 2) and a UIF deduction of R30,50 (61,002). Therefore, in every other month she would be banking a net pay of R2 916,87.

4.7 Since "The amount of the contribution payable by an employee must be 1% of the remuneration paid to him by his employer", Thabita's UIF contribution should be 1% of her basic (gross) salary which is calculated as follows: 6100 × 1% = 61 (R61,00).

4.8 "CO. CONTRIBUTION: 61.00" means that her employer (Sunny Days Crèche) is also contributing 1% of her salary to UIF on her behalf, as it should do according to SARS guidelines: "The amount of the contribution payable by the employer in respect of any one of its employees must be equal to 1% of the remuneration paid to that employee."

4.9 Thabita earns an annual salary of R39 650,00, calculated as follows: R3 050,00 × 13 payments (12 months + her birthday bonus). Therefore, since her annual salary is between R39 610,00 and R39 659,00 and she is also under 65 years of age, she falls into the category on the annual deductions table shown below (row 9 in the table provided):

Remuneration *Besoldiging*	*Under 65/Onder 65*		
	SITE	PAYE	Total
39610 - 39659	1,334.21	0.00	1,334.21

This means that she is required to pay a total of R1 334,21 per year i.e. R102,63 per payment (R1 334,21 ÷ 13 = R102,63). Since this month is her birthday month, and therefore she receives two monthly payments at once, she is also required to pay two installments of R102,63 in tax. R102,63 × 2 = R205,26 which is why Thabita paid R205,26 in taxes this month.

4.10 A "tax year" runs from the beginning of March in one year till the end of February of the following year. The "taxable earnings" total (R9 150,00) on Thabita's pay slip is made up of three payments of R3050, 00 (R9150, 00 ÷ R3 050, 00 = 3) .

The 2004 "tax year" would have run from 1 March 2004 – 28 February 2005 and, so far, Thabita has been paid:

- R3 050,00 on 31 March 2004 (for working the month of March 2004);
- R3 050,00 on 30 April 2004 (for the working the month of April 2004); and
- R3 050,00 on 31May 2004 (for the working the month of May 2004).

This give a total earnings of R9 150,00 so far for this "tax year" (it does not yet include her payment this month – this is shown in the earnings column).

4.11.1 Thabita would change into the following category:

Remuneration *Besoldiging*	*Under 65/Onder 65*		
	SITE	PAYE	Total
41560 - 41609	1,685.21	0.00	1,685.21

and her annual deduction would then be R1 685,21.

4.11.2 Thabita would change into the following category:

Remuneration *Besoldiging*	*Under 65/Onder 65*		
	SITE	PAYE	Total
43010 - 43059	1,946.21	0.00	1,946.21

and her annual deduction would then be R1 946,21.

4.11.3 Thabita would change into the following category:

Remuneration Besoldiging	Under 65/Onder 65		
	SITE	PAYE	Total
45460 - 45509	2,378.21	0.00	2,378.21

and her annual deduction would then be R2 378,21.

4.12.1 An 8% increase on her annual salary of R39 650,00 can be calculated as follows:

39 650 × 8% + 39 650 = 42 822

= R42 822, 00

She has been given an amount of R3185,00 which is actually 8,03%:

(31 850 ÷ 39 650) % = 8,03%

in other words, the increase is just more than 8%.

4.12.2 Since her new annual salary is R42 835,00, this means that in a typical month, she would receive a basic (gross) salary of R3 295,00 (R42 835,00 ÷ 13). From this, she would have tax and UIF deductions.

Thabita would fall into the following category:

Remuneration *Besoldiging*	*Under 65/Onder 65*		
	SITE	PAYE	Total
42810 - 42859	1,910.21	0.00	1,910.21

and her annual deduction would then be R1 910,21. Therefore, in a typical month she would have to pay R146,94 in taxes (R1 910,21÷ 13)

She would also have to pay 1% of this (R32,95) to UIF.

Therefore her net (take home) salary would be
R3 295,00 – R146,94 –R32,95 = R3 115, 11.

Thabita's pay slip would look something like this:

THORNY DAYS CRÈCHE 25 THORNTON ROAD CRAWFORD 7780	EMP. CODE: 007 EMP. NAME: T. ZOLA JOB TITLE: TEACHER	PERIOD END DATE: ?????????? DATE ENGAGED: 01/04/2002 ID NUMBER: 7505246578083

ADDITIONAL INFORMATION		EARNINGS		DEDUCTIONS	
BASIC SALARY:	42835.00	BASIC SALARY:	3295.00	TAX	146.94
		BIRTHDAY BONUS:	0	UIF	32.95
LEAVE DAYS DUE:	8				
YEAR-TO-DATE TOTALS					
TAXABLE EARNINGS:	???????				
TAX	???????				
UIF	???????				
CURRENT PERIOD					
TOTAL PERKS:	0.00	TOTAL EARNINGS:	3295.00	TOTAL DEDUCTIONS	179.89
CO.CONTRIBUTIONS	32.95				
				NET PAY	3115.11

4.12.3 Her net pay is now R3 115,00 and it used to be R2 916,87 (in a typical month). Therefore, her monthly salary is now R198,13 more per month.
To calculate the % increase: (198,13 ÷ 2916,87) × 100 = 6,79%
Therefore her net pay has increased by only 6,79%.

4.13 The same calculations as for question 4.12 will yield the following answers to 4.13.1 – 4.13.3:
(Remember that Thabita's original monthly salary was R2 916,87)

INCREASE	NEW ANNUAL SALARY	NEW MONTHLY SALARY	DEDUCTIONS	NEW NET SALARY	% increase in NET PAY
5%	R41 600,00	R3 200,00	UIF: R 32,00 TAX: R129,63	R3 038,37	4,17%
10%	R43 615,00	R3 355,00	UIF: R 33,55 TAX: R158,02	R3 163,43	8,45%
15%	R45 630,00	R3 510,00	UIF: R35,10 TAX: R185,71	R3 289,19	12,76%

4.14 Look at the year-on-year inflation statistics given in activity 2 question 2.7. Over the 15 year period 1988 – 2003 the inflation rate averaged 9%. Therefore, Thabita could motivate than an increase of about 10% would be a "fair" increase.

Since she was employed in 2002, inflation has averaged approximately 7,5%, therefore Thabita might motivate than an increase of about 7,5% would be a "fair" increase.

In addition to the inflationary increase she could well argue that she has gained experience and is taking on more responsibility in the school, all of which warrant a further % increase.

In summary, she could probably argue for any percentage between 10-15%.

In the event that the board argues that they cannot afford this kind of increase, Thabita could respond that the Crèche only has only itself to blame, since it did not budget to increase its income enough to cater for this kind of justifiably "fair" increase.

Activity 4 — Reading your pay slip

An employer is obliged to supply every employee with a pay slip at the end of each month. This pay slip must show the employee how his/her salary has been calculated.

Use Thabita Zola's pay slip, supplied with activity 1, to help you answer the following questions.

4.1 For what month is the pay slip? Explain how you worked this out.

4.2 How long has Thabita been working for Sunny Days Crèche? Explain how you determined this.

4.3 How old is Thabita? Discuss how you determined this.

4.4 List the different deductions that the crèche takes from Thabita's salary.

4.5 How much does Thabita actually receive in her bank account for the month represented by the pay slip?

4.6 Is the amount Thabita is being paid this month the same as for every other month? If not, how much does she earn in a typical month?

UIF: UIF stands for "unemployment insurance fund". It is compulsory for all employees and employers to make a monthly contribution to this fund. The South African Revenue Service (SARS) Guidelines for Employers – Tax Year 2005 states: "The amount of the contribution payable by an employee must be 1% of the remuneration paid to him by his employer" and also that: "The amount of the contribution payable by the employer in respect of any one of its employees must be equal to 1% of the remuneration paid to that employee."

4.7 You will notice that Thabita is contributing R61,00 to UIF for this month. Show how this has been calculated.

4.8 In the bottom left hand corner of the pay slip you will notice the entry "Co. Contributions." This stands for "company contribution." Discuss where this amount comes from.

INCOME TAX: Income tax is inevitable—we must all pay tax on the money we earn. To determine the tax liability (how much tax must be paid) of an employee we refer to the tax tables (EMP 10) provided by SARS.

4.9 Use the extract from the 2005 tax tables provided on handout 4 to explain why Thabita is paying R 205,26 in taxes this month.

4.10 How many months of salary are represented by the "taxable earning" in the "year-to-date totals" column? Explain how the number of months represented here and the actual month of the year of this pay slip are different.

4.11 What would Thabita's annual tax deduction be if her annual salary was:
4.11.1 R 41 600,00 ?
4.11.2 R 43 080,00 ?
4.11.3 R 45 500,00 ?

4.12 The Sunny Days Crèche has decided to offer Thabita an increase of 8% per annum. They say that she will now receive an annual salary of R 42 835,00.
4.12.1 Does this increase actually represent 8%?

4.12.2 By calculating the deductions (using the tax tables in the handout provided), determine her net pay in a typical month after the increase.

4.12.3 Does her net pay (the amount she takes home) also increase by 8%? Substantiate your answer.

4.13 Repeat the calculations you did in question 4.12 to determine the actual and percentage increases in monthly net pay for each of the following annual increases:

4.13.1 5% increase, new annual salary: R41 600,00.

4.13.2 10% increase, new annual salary: R 43 615,00.

4.13.3 15% increase, new annual salary: R 45 630,00.

Refer back to the budget and inflation activities completed so far. Develop an argument that Thabita might present to the church council of St Agnes' Church in which she motivates what she considers a "fair" increase in salary for 2005.

EMP 10 – Volume 45 166

ANNUAL DEDUCTION TABLE / JAARLIKSE AFTREKKINGSTABEL

Remuneration Besoldiging			Under 65 / Onder 65			Over 65 / Bo 65		
			SITE SIBW	PAYE LBS	Total Totaal	SITE SIBW	PAYE LBS	Total Totaal
39210	-	39259	1,262.21	0.00	1,262.21	0.00	0.00	0.00
39260	-	39309	1,271.21	0.00	1,271.21	0.00	0.00	0.00
39310	-	39359	1,280.21	0.00	1,280.21	0.00	0.00	0.00
39360	-	39409	1,289.21	0.00	1,289.21	0.00	0.00	0.00
39410	-	39459	1,298.21	0.00	1,298.21	0.00	0.00	0.00
39460	-	39509	1,307.21	0.00	1,307.21	0.00	0.00	0.00
39510	-	39559	1,316.21	0.00	1,316.21	0.00	0.00	0.00
39560	-	39609	1,325.21	0.00	1,325.21	0.00	0.00	0.00
39610	-	39659	1,334.21	0.00	1,334.21	0.00	0.00	0.00
39660	-	39709	1,343.21	0.00	1,343.21	0.00	0.00	0.00
39710	-	39759	1,352.21	0.00	1,352.21	0.00	0.00	0.00
39760	-	39809	1,361.21	0.00	1,361.21	0.00	0.00	0.00
39810	-	39859	1,370.21	0.00	1,370.21	0.00	0.00	0.00
39860	-	39909	1,379.21	0.00	1,379.21	0.00	0.00	0.00
39910	-	39959	1,388.21	0.00	1,388.21	0.00	0.00	0.00
39960	-	40009	1,397.21	0.00	1,397.21	0.00	0.00	0.00
40010	-	40059	1,406.21	0.00	1,406.21	0.00	0.00	0.00
40060	-	40109	1,415.21	0.00	1,415.21	0.00	0.00	0.00
40110	-	40159	1,424.21	0.00	1,424.21	0.00	0.00	0.00
40160	-	40209	1,433.21	0.00	1,433.21	0.00	0.00	0.00
40210	-	40259	1,442.21	0.00	1,442.21	0.00	0.00	0.00
40260	-	40309	1,451.21	0.00	1,451.21	0.00	0.00	0.00
40310	-	40359	1,460.21	0.00	1,460.21	0.00	0.00	0.00
40360	-	40409	1,469.21	0.00	1,469.21	0.00	0.00	0.00
40410	-	40459	1,478.21	0.00	1,478.21	0.00	0.00	0.00
40460	-	40509	1,487.21	0.00	1,487.21	0.00	0.00	0.00
40510	-	40559	1,496.21	0.00	1,496.21	0.00	0.00	0.00
40560	-	40609	1,505.21	0.00	1,505.21	0.00	0.00	0.00
40610	-	40659	1,514.21	0.00	1,514.21	0.00	0.00	0.00
40660	-	40709	1,523.21	0.00	1,523.21	0.00	0.00	0.00
40710	-	40759	1,532.21	0.00	1,532.21	0.00	0.00	0.00
40760	-	40809	1,541.21	0.00	1,541.21	0.00	0.00	0.00
40810	-	40859	1,550.21	0.00	1,550.21	0.00	0.00	0.00
40860	-	40909	1,559.21	0.00	1,559.21	0.00	0.00	0.00
40910	-	40959	1,568.21	0.00	1,568.21	0.00	0.00	0.00
40960	-	41009	1,577.21	0.00	1,577.21	0.00	0.00	0.00
41010	-	41059	1,586.21	0.00	1,586.21	0.00	0.00	0.00
41060	-	41109	1,595.21	0.00	1,595.21	0.00	0.00	0.00
41110	-	41159	1,604.21	0.00	1,604.21	0.00	0.00	0.00
41160	-	41209	1,613.21	0.00	1,613.21	0.00	0.00	0.00
41210	-	41259	1,622.21	0.00	1,622.21	0.00	0.00	0.00
41260	-	41309	1,631.21	0.00	1,631.21	0.00	0.00	0.00
41310	-	41359	1,640.21	0.00	1,640.21	0.00	0.00	0.00
41360	-	41409	1,649.21	0.00	1,649.21	0.00	0.00	0.00
41410	-	41459	1,658.21	0.00	1,658.21	0.00	0.00	0.00
41460	-	41509	1,667.21	0.00	1,667.21	0.00	0.00	0.00
41510	-	41559	1,676.21	0.00	1,676.21	0.00	0.00	0.00
41560	-	41609	1,685.21	0.00	1,685.21	0.00	0.00	0.00
41610	-	41659	1,694.21	0.00	1,694.21	0.00	0.00	0.00
41660	-	41709	1,703.21	0.00	1,703.21	0.00	0.00	0.00

R39210 — R41709 TABLE / TABEL D

SARS *GUIDELINES FOR EMPLOYERS*

EMP 10 – Volume 45

167

ANNUAL DEDUCTION TABLE / JAARLIKSE AFTREKKINGSTABEL

Remuneration Besoldiging			Under 65 / Onder 65			Over 65 / Bo 65		
			SITE SIBW	PAYE LBS	Total Totaal	SITE SIBW	PAYE LBS	Total Totaal
41710	-	41759	1,712.21	0.00	1,712.21	0.00	0.00	0.00
41760	-	41809	1,721.21	0.00	1,721.21	0.00	0.00	0.00
41810	-	41859	1,730.21	0.00	1,730.21	0.00	0.00	0.00
41860	-	41909	1,739.21	0.00	1,739.21	0.00	0.00	0.00
41910	-	41959	1,748.21	0.00	1,748.21	0.00	0.00	0.00
41960	-	42009	1,757.21	0.00	1,757.21	0.00	0.00	0.00
42010	-	42059	1,766.21	0.00	1,766.21	0.00	0.00	0.00
42060	-	42109	1,775.21	0.00	1,775.21	0.00	0.00	0.00
42110	-	42159	1,784.21	0.00	1,784.21	0.00	0.00	0.00
42160	-	42209	1,793.21	0.00	1,793.21	0.00	0.00	0.00
42210	-	42259	1,802.21	0.00	1,802.21	0.00	0.00	0.00
42260	-	42309	1,811.21	0.00	1,811.21	0.00	0.00	0.00
42310	-	42359	1,820.21	0.00	1,820.21	0.00	0.00	0.00
42360	-	42409	1,829.21	0.00	1,829.21	0.00	0.00	0.00
42410	-	42459	1,838.21	0.00	1,838.21	0.00	0.00	0.00
42460	-	42509	1,847.21	0.00	1,847.21	0.00	0.00	0.00
42510	-	42559	1,856.21	0.00	1,856.21	0.00	0.00	0.00
42560	-	42609	1,865.21	0.00	1,865.21	0.00	0.00	0.00
42610	-	42659	1,874.21	0.00	1,874.21	0.00	0.00	0.00
42660	-	42709	1,883.21	0.00	1,883.21	0.00	0.00	0.00
42710	-	42759	1,892.21	0.00	1,892.21	0.00	0.00	0.00
42760	-	42809	1,901.21	0.00	1,901.21	0.00	0.00	0.00
42810	-	42859	1,910.21	0.00	1,910.21	0.00	0.00	0.00
42860	-	42909	1,919.21	0.00	1,919.21	0.00	0.00	0.00
42910	-	42959	1,928.21	0.00	1,928.21	0.00	0.00	0.00
42960	-	43009	1,937.21	0.00	1,937.21	0.00	0.00	0.00
43010	-	43059	1,946.21	0.00	1,946.21	0.00	0.00	0.00
43060	-	43109	1,955.21	0.00	1,955.21	0.00	0.00	0.00
43110	-	43159	1,964.21	0.00	1,964.21	0.00	0.00	0.00
43160	-	43209	1,973.21	0.00	1,973.21	0.00	0.00	0.00
43210	-	43259	1,982.21	0.00	1,982.21	0.00	0.00	0.00
43260	-	43309	1,991.21	0.00	1,991.21	0.00	0.00	0.00
43310	-	43359	2,000.21	0.00	2,000.21	0.00	0.00	0.00
43360	-	43409	2,009.21	0.00	2,009.21	0.00	0.00	0.00
43410	-	43459	2,018.21	0.00	2,018.21	0.00	0.00	0.00
43460	-	43509	2,027.21	0.00	2,027.21	0.00	0.00	0.00
43510	-	43559	2,036.21	0.00	2,036.21	0.00	0.00	0.00
43560	-	43609	2,045.21	0.00	2,045.21	0.00	0.00	0.00
43610	-	43659	2,054.21	0.00	2,054.21	0.00	0.00	0.00
43660	-	43709	2,063.21	0.00	2,063.21	0.00	0.00	0.00
43710	-	43759	2,072.21	0.00	2,072.21	0.00	0.00	0.00
43760	-	43809	2,081.21	0.00	2,081.21	0.00	0.00	0.00
43810	-	43859	2,090.21	0.00	2,090.21	0.00	0.00	0.00
43860	-	43909	2,099.21	0.00	2,099.21	0.00	0.00	0.00
43910	-	43959	2,108.21	0.00	2,108.21	0.00	0.00	0.00
43960	-	44009	2,117.21	0.00	2,117.21	0.00	0.00	0.00
44010	-	44059	2,126.21	0.00	2,126.21	0.00	0.00	0.00
44060	-	44109	2,135.21	0.00	2,135.21	0.00	0.00	0.00
44110	-	44159	2,144.21	0.00	2,144.21	0.00	0.00	0.00
44160	-	44209	2,153.21	0.00	2,153.21	0.00	0.00	0.00

R41710 — R44209

TABLE / TABEL D

RIGLYNE VIR WERKGEWERS

SARS

EMP 10 – Volume 45 168

ANNUAL DEDUCTION TABLE / JAARLIKSE AFTREKKINGSTABEL

Remuneration Besoldiging			Under 65 / Onder 65			Over 65 / Bo 65		
			SITE SIBW	PAYE LBS	Total Totaal	SITE SIBW	PAYE LBS	Total Totaal
44210	-	44259	2,162.21	0.00	2,162.21	0.00	0.00	0.00
44260	-	44309	2,171.21	0.00	2,171.21	0.00	0.00	0.00
44310	-	44359	2,180.21	0.00	2,180.21	0.00	0.00	0.00
44360	-	44409	2,189.21	0.00	2,189.21	0.00	0.00	0.00
44410	-	44459	2,198.21	0.00	2,198.21	0.00	0.00	0.00
44460	-	44509	2,207.21	0.00	2,207.21	0.00	0.00	0.00
44510	-	44559	2,216.21	0.00	2,216.21	0.00	0.00	0.00
44560	-	44609	2,225.21	0.00	2,225.21	0.00	0.00	0.00
44610	-	44659	2,234.21	0.00	2,234.21	0.00	0.00	0.00
44660	-	44709	2,243.21	0.00	2,243.21	0.00	0.00	0.00
44710	-	44759	2,252.21	0.00	2,252.21	0.00	0.00	0.00
44760	-	44809	2,261.21	0.00	2,261.21	0.00	0.00	0.00
44810	-	44859	2,270.21	0.00	2,270.21	0.00	0.00	0.00
44860	-	44909	2,279.21	0.00	2,279.21	0.00	0.00	0.00
44910	-	44959	2,288.21	0.00	2,288.21	0.00	0.00	0.00
44960	-	45009	2,297.21	0.00	2,297.21	0.00	0.00	0.00
45010	-	45059	2,306.21	0.00	2,306.21	0.00	0.00	0.00
45060	-	45109	2,315.21	0.00	2,315.21	0.00	0.00	0.00
45110	-	45159	2,324.21	0.00	2,324.21	0.00	0.00	0.00
45160	-	45209	2,333.21	0.00	2,333.21	0.00	0.00	0.00
45210	-	45259	2,342.21	0.00	2,342.21	0.00	0.00	0.00
45260	-	45309	2,351.21	0.00	2,351.21	0.00	0.00	0.00
45310	-	45359	2,360.21	0.00	2,360.21	0.00	0.00	0.00
45360	-	45409	2,369.21	0.00	2,369.21	0.00	0.00	0.00
45410	-	45459	2,378.21	0.00	2,378.21	0.00	0.00	0.00
45460	-	45509	2,387.21	0.00	2,387.21	0.00	0.00	0.00
45510	-	45559	2,396.21	0.00	2,396.21	0.00	0.00	0.00
45560	-	45609	2,405.21	0.00	2,405.21	0.00	0.00	0.00
45610	-	45659	2,414.21	0.00	2,414.21	0.00	0.00	0.00
45660	-	45709	2,423.21	0.00	2,423.21	0.00	0.00	0.00
45710	-	45759	2,432.21	0.00	2,432.21	0.00	0.00	0.00
45760	-	45809	2,441.21	0.00	2,441.21	0.00	0.00	0.00
45810	-	45859	2,450.21	0.00	2,450.21	0.00	0.00	0.00
45860	-	45909	2,459.21	0.00	2,459.21	0.00	0.00	0.00
45910	-	45959	2,468.21	0.00	2,468.21	0.00	0.00	0.00
45960	-	46009	2,477.21	0.00	2,477.21	0.00	0.00	0.00
46010	-	46059	2,486.21	0.00	2,486.21	0.00	0.00	0.00
46060	-	46109	2,495.21	0.00	2,495.21	0.00	0.00	0.00
46110	-	46159	2,504.21	0.00	2,504.21	0.00	0.00	0.00
46160	-	46209	2,513.21	0.00	2,513.21	0.00	0.00	0.00
46210	-	46259	2,522.21	0.00	2,522.21	0.00	0.00	0.00
46260	-	46309	2,531.21	0.00	2,531.21	0.00	0.00	0.00
46310	-	46359	2,540.21	0.00	2,540.21	0.00	0.00	0.00
46360	-	46409	2,549.21	0.00	2,549.21	0.00	0.00	0.00
46410	-	46459	2,558.21	0.00	2,558.21	0.00	0.00	0.00
46460	-	46509	2,567.21	0.00	2,567.21	0.00	0.00	0.00
46510	-	46559	2,576.21	0.00	2,576.21	0.00	0.00	0.00
46560	-	46609	2,585.21	0.00	2,585.21	0.00	0.00	0.00
46610	-	46659	2,594.21	0.00	2,594.21	0.00	0.00	0.00
46660	-	46709	2,603.21	0.00	2,603.21	0.00	0.00	0.00

R44210 — R46709 TABLE / TABEL D

SARS *GUIDELINES FOR EMPLOYERS*

Activity 5 — Inflation revisited

ABOUT THIS ACTIVITY

Using a newspaper article as a case study, students explore the implications, on consumers and businesses, of inflation. This knowledge is then applied in order to debate and critique certain arguments and appropriate responses to the questions. This activity is aligned with unit standard 9014 and addresses AC 1,3 of SO1; AC 1,3 of SO2 and AC 2,3 of SO3.

MANAGING THIS ACTIVITY

The handout with the case study newspaper article "Zimbabwe shuts private schools over fee hikes" is required for this activity.

5.1 There could be a range of different responses to this question. One option seen in activity 2 was the Cape Argus newspaper, which increased more than we would have been predicted in terms of inflation.

5.2 No. For the school fees to have "trebled, quadrupled and quintupled" over a period of about 8 months does not seem reasonable at all.

5.3 Since Profit = Income – Expenses, if the school's income increased dramatically, over the eight month period, and their expenditure remained the same, this would cause a dramatic increase in the school's profits.

5.4 In January 2003 the annual inflation rate in Zimbabwe was 200% and in April 2004 the inflation rate was 583,7%.

5.5 In general terms, people would experience "economic hardship" if their spending power had decreased (i.e. they are able to buy less and less than they previously could afford to buy). If parents have, in general, not experienced an increase in income then an increase in school fees would increase these parents expenditure and so place them in a position of "economic hardship". Therefore, "the freezing of the school fees" would at least stabilise this one expense for the parents.

5.6 Under these conditions there would be four possible cases to consider:

		Economic Position of Parents
Case 1:	If parents have an increase in income which is proportionate to their increase in expenditure then they …	suffer no "economic hardship" i.e. their spending power remains the same.
Case 2:	If parents have an increase in income which exceeds their increase in expenditure then they …	are thriving i.e. their spending power has increased.
Case 3:	If parents have an increase in income which is less than their increase in expenditure then they …	suffer "economic hardship" i.e. their spending power diminishes.
Case 4:	If parents income remains the same but they have an increase in expenditure then they…	suffer more severe "economic hardship" i.e. their spending power has decreased dramatically.

5.7 If the fees were frozen, this mean that the school's income would remain the same (case 4 above) even though their expenditure would increase, and they would therefore have to cut back on other costs in order to survive. For example, schools may need to reduce the number of teachers that they employ or they may need to increase the student enrolment numbers in order to cope with the financial situation.

5.8 It is unlikely that salaries would have followed this same dramatic inflation trends. The parents' buying power would therefore be seriously diminished, and they would find themselves in a situation of "economic hardship".

5.9 If Mr Chigwedere had not closed the schools but had frozen the school fees, then the schools would not have been able to survive on their income and would be forced to close anyway. Even if the school fees had "trebled, quadrupled and quintupled", any of these cases would still be a lesser increase than the inflation rate of 583,7%.

5.10 The only item on the crèche's budget that would not automatically be linked to the inflationary trends would be salaries and wages. All the other items such as bank charges, electricity, groceries and cleansing materials, medical tests and first aid, printing, postage & stationery, teaching materials, telephone and water are all costs, which are likely to have followed inflationary trends to some extent.

5.11 Provided that parents are earning more (their salaries have increased in line with or more than inflation), then they would be willing to pay more for school fees – if their income is larger then they have more money to use for their expenses.

5.12 It is not necessarily true that all the items in question 5.10 would increase by the same inflationary percentage. Remember in the shopping basket exercise some items increased more while others increased by less. On average, though, it is likely that they would follow inflationary trends.

5.13

ADVANTAGES	DISADVANTAGES
• One would expect that, on the whole, the crèche's expenses are likely to have increased in line with inflation. Therefore, increasing the school fees in line with inflation would help to ensure that the crèche's financial status remains that of Case 1 in question 5.6 where this decision does not place them in a position of economic hardship. • If we assume that the parents' income increases in line with inflation, then increasing the fees in line with inflation (rather than more than inflation) might help to ensure that the parents can still afford to send their children to the crèche.	• If the crèche's school fees are increased in line with inflation, but parents' incomes are not, then parents may no longer be able to afford to send their children to that crèche and therefore the crèche's income may in fact decrease. • If the crèche's school fees are increased in line with inflation, but their expenses have increased more than the inflationary rate (or they have had additional expenses that year i.e. the crèche's "capital expenses" in 2003) then they will be running at a loss because (unless they find extra income/funding from elsewhere) their expenses would exceed their income.

5.14 Some of the students responses to this question could overlap with those of question 5.13 .

If fees are increased significantly less than inflation	If fees are increased significantly more than inflation
• If the crèche's school fees are increased significantly less than inflation, but their expenses have increased in line with or even more than the inflationary rate, then they will be running at a loss because (unless they find extra income/funding from elsewhere) their expenses would exceed their income.	• If the crèche's school fees are increased significantly more than inflation, but parents' incomes are not, then parents may no longer be able to afford to send their children to that crèche and therefore the crèche's income may in fact decrease. • Alternatively, if the crèche's school fees are increased significantly more than inflation, and parents' incomes are also increased significantly more than inflation the crèche may be able to make a profit (provided that their expenses remain relatively constant). This is, however, quite unlikely.

5.15

NATIONAL ECONOMY	PARENTS' INCOME
• If the national economy is such that the government can afford to give the crèche a larger educational subsidy, then the crèche may be able to keep the school fees relatively constant due to the extra income generated from the educational subsidy. • On the contrary, if the national economy is such that the government cannot afford to give the crèche a large enough educational subsidy, then the crèche may be forced to increase the school fees in order to stay open.	• If the crèche's school fees are increased significantly more than the parents' incomes, then parents may no longer be able to afford to send their children to that crèche and therefore the crèche's income may in fact decrease. • Alternatively, if the crèche's school fees are increased proportionately to the parents' incomes then the crèche should be able to maintain its financial position.

5.16 The crèche may have decided to reduce its fees if it receives additional revenue from another source (i.e. donations or fundraising or educational subsidy). Alternatively, if the crèche decided to increase class sizes significantly they would increase the number of parents paying fees and might therefore be able to increase the income generated from school fees, despite fixing or even reducing the fee per student.

Activity 5 — Inflation revisited

In order to understand how inflation can dramatically affect prices, let us study an example of inflationary effects in Zimbabwe schools.

Read through the handout headed "Zimbabwe shuts private schools over fee hikes" from the *Cape Times* (5 May 2004) and answer the following questions.

5.1 Education Minister Chigwedere stated that some schools had "trebled, quadrupled and quintupled fees since September" (a period of approximately eight months). What is the most dramatic price rise for an item or service that you can recall? Does this seem normal (recall back to activity 2 to help you decide)?

5.2 Do you think it sounds reasonable for a school to increase its fees by that amount in such a short space of time?

5.3 If the school's expenses remained the same during the eight month period, what would be the effect on the school's profits?

5.4 What was Zimbabwe's annual inflation figure in January 2003 and in April 2004 respectively? Note: Annual inflation is also referred to by the symbols CPIX (consumer price index excluding mortgage rates) or CPI (consumer price index).

5.5 According to the article, in January 2003 the government froze all school fees in order to "ease economic hardship". Under what personal circumstances will this ruling ease the economic hardship of parents?

5.6 If this ruling had not been introduced, what would be the effect of the school fee hikes on the economic position of parents? You should consider a variety of possibilities, taking into account the possible income changes within families.

5.7 What effect would this ruling have on schools and the quality of the service that they would be able to provide?

5.8 Explain the economic effect on schools and families when inflation is running at 583,7%.

5.9 What do you think about Mr Chigwedere's decision to close schools down becuase some schools had "trebled, quadrupled and quintupled fees since September"?

Let us now consider how inflation affects the running of a crèche.

5.10 In what ways will inflation affect the running of a crèche? Mention as many budget items as possible that you think will be affected by inflation.

5.11 Will parents be prepared to pay more for school fees in a year's time compared to what they are currently paying? Why do you say this?

5.12 Will all of the items mentioned in 5.10 increase by the same inflationary percentage?

5.13 What are the advantages and disadvantages for the crèche of calculating the new school fees by multiplying the current fees by the annual inflationary rate?

5.14 What problems could arise for the crèche if the fees are increased by significantly more or significantly less than inflation?

5.15 In what ways do the national economy and the parents' personal financial situations affect the fees that a crèche can charge?

5.16 Can you think of any circumstances under which a crèche may decide to reduce its fees?

CAPE TIMES

May 5, 2004

Zimbabwe shuts private schools over fee hikes

HARARE — Zimbabwe police yesterday shut down 46 private schools over a fee hike dispute as the education minister branded them "racist" institutions trying to keep out blacks by being prohibitively expensive.

Education Minister Aeneas Chigwedere said he had instructed that 46 schools which raised fees without government approval be closed as the new mid-year term began.

He said the schools, some of which had "trebled, quadrupled, quintupled" fees since September last year, would remain shut until the issue was resolved.

Some schools are charging tuition fees of up to 30 million dollars (R38 313) per annum.

"We are dealing with racist schools. They are all former white schools — all racist," Chigwedere told state television yesterday.

"They throw Africans out simply by hiking fees," he said.

The state-run Herald Daily said at least 30 000 pupils would be affected by the closures.

In his Independence Day address recently, President Robert Mugabe also slammed the fee hikes.

"Our principal goal of attaining education for all appears to be in real jeopardy with some schools charging as much as 10 million dollars a term," Mugabe said.

Yesterday, scores of parents and children were seen standing outside a school close to Mugabe's official residence while half-a-dozen police officers kept guard at the gate.

At a school in Harare's plush suburb of Borrowdale, parents were telephoned about two hours after they had dropped off their children for day one of the term to come and collect them.

"Police instructed us to close the school until an agreement has been reached between the school and the ministry.

"We could re-open within a week," said an official at the school.

"It's very inconveniencing. It's frustrating," said a parent collecting her daughter.

Another angry mother said: "This is a private school. I don't know what government has to do with this. We had a meeting as parents and we agreed on a 94% increase, but government decides to close it."

"It's traumatic. My daughter was crying after we were turned back. She is confused. She does not understand what is happening," another parent said.

Other schools only stuck notices on their gates that they had been closed until further notice, while another had informed parents on Monday not to bother bringing their children to school on Tuesday.

In January last year, when inflation stood at around 200%, the government froze all school fees in wide-ranging price controls that it said were aimed at easing economic hardship.

Boarding schools complained that without fee increases they would not be able to feed children.

Annual inflation last month stood at 583.7%.

For years, Zimbabwe's education system was widely considered among the best in the region. In 2002, police reported that at least 30 schools were closed in two southern districts of Zaka and Bikita, after teachers refused to work for fear of being attacked during the political violence that marked the run-up to presidential polls. — Sapa-AFP

Activity 6 — Developing a budget (assessment task)

ABOUT THIS ACTIVITY

This activity brings together much of the knowledge, skills, attitudes and values acquired in activities 1 – 5 and as such could be used as an assessment activity. Students are required to draw on their understanding of budget statements and inflation in order to prepare a budget for a crèche.

This activity is aligned with unit standard 9014 and addresses AC 2,3,4,5 of SO1; AC 1,2,3,4 of SO2 and AC 1 of SO3.

MANAGING THIS ACTIVITY

Students will need the handout pages from activity 1 which has the budget and actual income and expenditure statements for 2002 and 2003 as well as a blank column for 2004.

6.1 The budgeted number of children for 2002 was 60. The budgeted income generated from fee payments was R22 800,00. However, the statement shows that this figure was calculated from an expected 95% collection.

95% of the total income expected from fees = 22 800

$\therefore$ Total income expected from fees × 95% = 22 800

$\therefore$ Total income expected from fees $= \frac{22\ 800}{95\%}$

$\therefore$ Total income expected from fees = R24 000

> **Note**: 96% of the fees were collected, but this does not mean that 96% of the children's parents paid. (96% of 58 children = 55,68 children?). It means that some parents may have paid only a portion of the fees.

If 100% of the fees had been paid then the school should have received this full total of R2 4000,00.

This would mean that the fee per child was set at $\frac{24\ 000}{60} = 400$.

Therefore, in 2002, the annual school fee per child was R400,00.

6.2 The school had only budgeted to receive 95% of the school fees. The reason for this could be that, in an average year, the school is not able to collect 100% of the school fees from the parents – in other words, not all parents always pay the full amount of school fees owing to the crèche.

6.3 No. 95% of budgeted school fee income in 2003 for 60 people is still R22 800, 00 therefore the school fees have not increased from 2002 – 2003. This is not realistic, but it seems that the crèche had hoped to generate more money from the parents through fundraising and donations, rather than through a fee increase.

6.4 The following points should be included in the argument to answer to this question:

- If the crèche had increased its school fees from 2001 – 2002 by 9,2% (in line with inflation) the school fee per child would have increased from R400,00 to R436,80.

  This is calculated as follows: 400 × 9,2% + 400 = 436,80.
- If the crèche had then further increased its school fees from 2002 – 2003 by 5,8% (in line with inflation) the school fee per child would have increased from R436,80 to R462,13.

  This is calculated as follows: 436,80 × 5,8% + 436,80 = 462,13.
- This would mean that the school fees would increase from R400 to R462,13 from 2002 – 2004, which is an increase of 15,5%.

  This is calculated as follows: $\frac{62{,}13\ \textit{increase}}{400}\ \% = 15{,}5\%$.
- Therefore, it would be appropriate to motivate that the fees be increased by 15,5% for 2004.
- Since 99% of the fee income was collected in 2002 when the school fees stood at R400 per child, it would seem reasonable to expect that an increase of only R62,13 per child would not dramatically impact on the percentage of fees paid. The percentage might drop slightly, but there is no reason for it to drop lower than the crèche's average estimate of 95%.

The "% of fees paid" and the "fee income" should be filled in on the budget for 2004 shown below:

Sunny Days Crèche 2004 budget based on budgeted and actual income and expenses for 2002 and 2003

	Budget 2002	Actual 2002	Budget 2003	Actual 2003	Budget 2004
NOTES					
Number of children enrolled	60	58	60	61	60
% of school fees paid	95%	99%	95%	94%	**95%**
Number of applications	35	30	32	35	35
INCOME					
Fee income	23 325	23 498	23 280	23 580	
Application fees	525	447	480	525	
School fees	22 800	23 030	22 800	23 055	**26 341**

The fee income is calculated as follows: 60 × R462,13 = R27 727,80
of which 95% is collected : R27 727,80 × 95% = R26 341,41

6.5 The Western Cape's budget for education has increased from R9 314 million in 2003 to R10 584 million in 2004, an increase of R1 270 million, which is:

$\frac{1270}{9314}$ % = 13,6%

and so we would expect that the crèche's educational subsidy would have increased in line with this. Up to this point, the crèche has budgeted on receiving R15 000,00 from the Western Cape as a educational subsidy, If we apply a 13,6% increase to this then the crèche could budget on receiving:

15 000 × 13,6% + 15 000 = R17 040,00 for 2004.

However, although the Western Cape's budget for education has increased by 8,1% from 2002 to 2003 the crèche's educational subsidy increased from R15 094 in 2002 to R15 666 in 2003, an increase of only 3,8%. The crèche might be more realistic in expecting an increase of about 6,5% which would be about R16 000,00.

6.6 The over-budgeting of income generated from fundraising and donations must have grown out of the crèche's assumption that since parents were not required to pay more in school fees they would have the means to be more generous in giving money towards fundraising and donations. However, it can be seen from the crèche's statement that it has repeatedly overestimated the expected income in these areas. Therefore, one should almost definitely expect that the income in these areas will not increase in 2004, due to the increased school fees for that year. A more realistic budget figure for 2004 fundraising would be thus about R17 000 and for donations would be about R30 000.

6.7

Sunny Days Crèche 2004 budget based on budgeted and actual income and expenses for 2002 and 2003

	Budget 2002	Actual 2002	Budget 2003	Actual 2003	Budget 2004
NOTES					
Number of children enrolled	60	58	60	61	60
% of school fees paid	95%	99%	95%	94%	95%
Number of applications	35	30	32	35	35
INCOME					
Fee income	23 325	23 498	23 280	23 580	26 866
Application fees	525	447	480	525	525
School fees	22 800	23 030	22 800	23 055	26 341
Other income	64 000	60 779	69 000	67 172	69 000
Fundraising	15 000	12 898	17 000	16 545	17 000
Donations received	30 000	28 455	32 000	29 565	30 000
Hire of facilities	4 000	4 334	5 000	5 396	6 000
Subsidy (Education Department)	15 000	15 092	15 000	15 666	16 000
TOTAL INCOME	**87 325**	**84 277**	**92 280**	**90 752**	**95 866**

6.8 Yes, the teacher has a justifiable claim. This teacher is in a similar position to Thabita (as discussed in activity 4). Looking at the year-on-year inflation statistics, the teacher would be very justified in claiming that she is poorer in 2002 than in 2003 because her buying power has decreased.

In addition to the inflationary increase she could well argue that she has gained experience and is taking on more responsibility in the school, all of which warrant a significant % increase in salary.

6.9

	2002	2003
% expenditure spent on salaries and wages	$\frac{72\ 994}{91\ 130}$ % = approx. 80%	$\frac{73\ 638}{96\ 178}$ % = approx. 77%
Rate of inflation	9,2%	5,8%

Budgeted income for 2004 was R95 866,00. If the crèche attempts to correct its seemingly unfair % of expenditure spent on salaries and wages in 2003 and aims more at an 80% spending in this area for 2004, then this would amount to R76 692,80 (calculated as follows: R95 866,00 × 80%).

However, we are not sure how many people the crèche employs and we remember from activity 4 that a person given a gross increase of 10% would only bank an increase (net increase) of about 8% . These are all factors for the crèche to take into account.

If we consider the inflationary effect over the past two years as being approximately 7,5%, then we would hope that the crèche would also try to ensure that its budgeted figure for salaries and wages in 2004 was at least 7,5% up on that of 2003. This would be R79 160,85 (calculated as follows: 73 638 × 7,5% +73 638).

With all of this taken into account, a reasonable motivation would be for the crèche to budget to spend between R76 000 – R80 000 on salaries and wages for 2004.

6.10

	2002	2003
Expenditure on repairs of fridge and stove	R3 992 × 80% = R3 193,60	R7 311× 80% = R5 848,80
Therefore over the last 2 years they have spent on average about R4000 each year on repairs and maintenance of the fridge and stove.		

To avoid having to incur this expense each year, it would be sensible to allocate money in the budget to purchase new fridge and stove.

It might be sensible to allocate about R1 500,00 into the budget for capital expenses each year, thereby hopefully reducing the maintenance and repairs costs by about 80% (ordinarily used to fix the fridge and stove).

The new budget figure for capital expenses for 2004 would be R1 500,00.

The budget figure for maintenance and repairs increased by 37,5% from 2002 to 2003.If we use the same formula to predict the budget for 3004, we arrive at a figure of R 7 562,50. However, if we buy a new fridge and stove we can alleviate about 80% of this expenditure, leaving us with a budget figure of R6 050,00 for 2004.

6.11 and 6.12

Sunny Days Crèche 2004 budget based on budgeted and actual income and expenses for 2002 and 2003

	Budget 2002	Actual 2002	Budget 2003	Actual 2003	Budget 2004
EXPENSES					
Bank charges	520	539	550	545	590
Capital expenses	0	0	0	0	1 500
Electricity	750	711	800	749	790
Groceries and cleansing materials	900	824	1 000	948	1 090
Medical tests and first aid	600	795	800	782	800
Outings	500	441	550	671	1 000
Printing, postage & stationery	2 500	2 304	2 750	2 409	2 500
Repairs and maintenance	4 000	3 992	5 500	7 311	6 050
Salaries and wages	71 500	72 994	72 000	73 638	78 000
Teaching materials	4 000	4 699	4 250	3 874	4 200
Telephone	3 000	2 757	3 200	4 026	3 400
Water	1 000	1 074	1 100	1 225	1 400
TOTAL EXPENSES	**89 270**	**91 130**	**92 500**	**96 178**	**101 320**

6.13 Total income was: R95 866,00

Total expenditure was: R101 320,00

Therefore there would be a net deficit of R5 454,00.

Any institution would be unhappy with this kind of a deficit. However, the expenditure figures seem to be realistic and it would be hard to cut these figure down too much while still trying to be "fair" to the employees in terms of income expenditure. Therefore a number of strategies would be needed in order to increase the income, for example:

- Increase the application fees, intake of children and/or the school fees.
- Increase the fundraising/ donations received.
- Hire out the facilities more, thereby generating more income in this way.
- Apply to the education department for an increased subsidy in light of the statement deficit.

6.14 Increasing the number of children at the school by three would increase the income generated from school fees as follows:

The number of children becomes 63. New school fees set at R462,13 would then generate an income of R29 114,19 of which they would expect to collect 95%. This would be a total of R27 658,48.

The budgeted expected income was R26 341,00 (from question 6.4) which means the increase in numbers has generated an increased of about R1 300 (about 5%). This would certainly help to alleviate some of the expected deficit.

Activity 6 — Developing a budget (assessment task)

In this activity we will use many of the skills we developed in the earlier activities to produce a budget for a crèche. You will need the handout which has the budget and actual income and expenditure statements for 2002 and 2003 as well as a blank column for 2004. By answering the questions that follow you will develop the budget for 2004.

Fee income:

6.1 Study the budgeted school fees (i.e. not the actual amount collected) for 2002 as well as the notes to the budget. Calculate the annual school fees that each family was expected to pay during 2002. Show your working.

6.2 Why does the school not expect 100% of the fees to be paid?

6.3 Was there an increase in school fees from 2002 to 2003? If not, is this realistic? If yes, was the amount appropriate?

6.4 Remember that the year-on-year inflation for 2001 to 2002 was 9,2% and for 2002 to 2003 was 5,8% (see activity 5). The School Board wants to keep fee increases within the limits of inflation. The Board also acknowledges that the teachers did not get an increase in salary from 2002 to 2003 and wants to do something about this in 2004. Motivate a school fee for 2004. Anticipate the impact that the increase will have on the "% of fees paid." Now complete the "% of fees paid" and "fee income" amounts on the 2004 budget.

Other income:

6.5 Refer to the Western Cape Budget for 2004 (handout for activity 1). In light of the proposed increase in spending on education from 2003 to 2004, predict (with justification) what you anticipate the subsidy from the Education Department will be in 2004.

6.6 Both in 2002 and in 2003, income from fundraising and donations was overestimated. Comment on how you feel the proposed increase in school fees may or may not impact on income from both fundraising and donations. Now budget the anticipated income from fundraising and donations for 2004.

6.7 Complete the remaining income details and complete the total budgeted income for 2004.

NOTE: You may need to review the decisions you have taken so far at a later stage when you have a better sense of the expenses. This is why accountants do a lot of their early work in pencil.

Salaries and wages:

6.8 It is clear that salaries and wages did not increase significantly from 2002 to 2003. The teachers are not happy. One teacher has written a letter to the School Board in which she complains that even though her salary has not changed she is poorer in 2003 than she was in 2002. Do you think the teacher's claim is justified? Support your argument.

6.9 Remember that the crèche's expenses cannot exceed its income.
Consider:
(1) the % of the expenses spent on salaries and wages over the last two years;
(2) the rate of inflation from 2001 to 2002 and from 2002 to 2003;
(3) the income you have budgeted for 2004; and
(4) the impact of taxes on teachers' perceptions about how much they "earn" (recall activity 4)

Now decide how much the crèche should budget for "salaries and wages" in 2004. Motivate your answer.

Other expenses:

6.10 You will notice that after salaries, the next largest expense in 2003 was on repairs and maintenance. Having looked back at the actual invoices posted against repairs and maintenance in 2003, you notice that more than 80% of this amount was spent on repairs to the stove and the fridge. It has been proposed that instead of spending the amount on repairing the stove and fridge again, it might be best to buy new ones. Consider this proposal and budget an amount for each of repairs and maintenance and capital expenses (money to put towards a new stove and fridge—you will revisit this in activity 7).

6.11 The remaining significant expenses for the recent years are: printing, postage and stationery; teaching materials; and telephone. By studying the trend in budgeted and actual expenditure from 2002 to 2003 determine budgeted figures for each item for 2004.

6.12 Complete the remaining expenditure details and complete the total budgeted expenditure for 2004.

Balancing the budget:

6.13 You need to check that the budgeted expenses do not exceed the budgeted income for 2004. Determine the net surplus (deficit) for your budget. Are you happy with the anticipated surplus or deficit? If yes, argue why. If no, propose changes you can make to the budget to address your concern.

6.14 Would it help the budget to increase the number of children in the school by two or three? Discuss.

Sunny Days Crèche 2004 budget
based on
budgeted and actual income and expenses for 2002 and 2003

	Budget 2002	Actual 2002	Budget 2003	Actual 2003	Budget 2004
NOTES					
Number of children enrolled	60	58	60	61	60
% of school fees paid	95%	99%	95%	94%	
Number of applications	35	30	32	35	35
INCOME					
Fee income	23 325	23 498	23 280	23 580	
Application fees	525	447	480	525	
School fees	22 800	23 030	22 800	23 055	
Other income	64 000	60 779	69 000	67 172	
Fundraising	15 000	12 898	17 000	16 545	
Donations received	30 000	28 455	32 000	29 565	
Hire of facilities	4 000	4 334	5 000	5 396	
Subsidy (Education Department)	15 000	15 092	15 000	15 666	
TOTAL INCOME	**87 325**	**84 277**	**92 280**	**90 752**	
EXPENSES					
Bank charges	520	539	550	545	
Capital expenses	0	0	0	0	
Electricity	750	711	800	749	
Groceries and cleansing materials	900	824	1 000	948	
Medical tests and first aid	600	795	800	782	
Outings	500	441	550	671	
Printing, postage & stationery	2 500	2 304	2 750	2 409	
Repairs and maintenance	4 000	3 992	5 500	7 311	
Salaries and wages	71 500	72 994	72 000	73 638	
Teaching materials	4 000	4 699	4 250	3 874	
Telephone	3 000	2 757	3 200	4 026	
Water	1 000	1 074	1 100	1 225	
TOTAL EXPENSES	89 270	91 130	92 500	96 178	
NET SURPLUS (DEFICIT)	**(1 945)**	**(6 853)**	**(220)**	**(5 426)**	

Activity 7 — Buying a fridge and a stove

ABOUT THIS ACTIVITY
In this activity, the context of buying a fridge and a stove for the crèche are used to introduce different purchase options. In particular, a comparison is made between higher purchases and bank loans.

This activity is aligned with unit standard 9014 and addresses AC 1,2 of SO1; AC 1,2,3,4 of SO2 and AC 1,3 of SO3.

MANAGING THIS ACTIVITY
Interest calculation will be made in this activity and therefore a calculator would be very useful to speed up the answering process.

7.1 The students will each have different responses to this question. For the purposes of showing the calculations required, the following cash prices will be used:
New fridge cash price: R1 760,00
New stove cash price: R1 990,00

7.2 The total cash price = R3 750,00. To calculate an increase of 20% on R3 750,00:

$3\,750 \times 20\% + 3\,750 = 4\,500$ or $3\,750 \times \frac{20}{100} + 3\,750 = 4\,500$

Therefore, the total non-cash price for the fridge and the stove is R4 500,00.

7.3 The deposit (15% of non-cash price) is R675,00, calculated as follows:
$4500 \times 15\% = 675$.

7.4 You still owe: non-cash price – deposit:
$4\,500 - 675 = R3\,825,00$.

7.5 Amount owing + R100 + R4 = R3 825,00 + R100 + R4 = R3 929,00.

7.6 The calculations are as follows:

Amount owing	**R3 929,00**
Repayment period	6 months
Interest	6,5%
Interest amount	**R255,39**
Total Due:	**R4 184,39**

➲ R3 929,00 × 6,5% = R255,39
➲ R3 929,00 + R255,39 = R4 184,39

Amount owing	R3 929,00	R3 929,00	R3 929,00
Repayment period	12 months	18 months	24 months
Interest	12,5%	17,8%	24%
Interest amount	R491,13	R699,36	R942,96
Total Due:	**R4 420,13**	**R4 628,36**	**R4 871,96**

No, this is not the full amount that you will pay. You also have to pay the deposit therefore the full amount will be more than these totals.

7.7 Monthly payment = $\frac{\text{total due}}{\text{no. of payments}}$

Repayment period	6 months	12 months	18 months	24 months
Total due	R4 184,39	R4 420,13	R4 628,36	R4 871,96
Due per month	**R697,40**	**R368,34**	**R257,13**	**R203,00**

7.8

Repayment period	6 months	12 months	18 months	24 months
Total due	R4 184,39	R4 420,13	R4 628,36	R4 871,96
+ Deposit	R675	R675	R675	R675
Total cost	**R4 859,39**	**R5 095,13**	**R5 303,36**	**R5 546,96**

– original cash price	**R3 750,00**

Extra Paid	**R1 109,39**	**R1 345,13**	**R1 553,36**	**R1 796,96**

Therefore you have to pay this much more for each of the payment plans.

7.9 Students are required to compare the deposit, calculated in question 7.3 and the monthly payment amounts, calculated in question 7.7, with the advertised monthly payment amounts listed in their advertisement. Any of the following responses could be given:

- The deposit in the advert is less/more than 15% (as we calculated it).
- The monthly payments we calculated are less/more than those in the advert.
- The non-cash price in the advert is less/more than 20% (as we calculated it).

7.10 For the purpose of showing the calculations, assume that the cash price was R 4000,00.

7.11 Minimum monthly repayment = $\frac{4\,000}{40}$ = R100,00.

7.12 This table is drawn up as an example based on a cash price of R 4 000,00 and monthly repayment of R710,00, and an interest rate of 21% per annum (this amount will change from time to time).

Previously outstanding total + interest:
4 000,00 + 70,00 = 4 070,00

	Interest on outstanding balance	Outstanding total	Payment	Remaining balance
Start of loan period	0,00	4 000,00	0,00	4 000,00
End of 1st month	70,00	4 070,00	710,00	3360,00
End of 2nd month	58,80	3 418,80	710,00	2 708,80
End of 3rd month	47,40	2 756,20	710,00	2 046,20
End of 4th month	35,81	2 082,01	710,00	1 372,01
End of 5th month	24,01	1 396,02	710,00	686,02
End of 6th month	12,01	698,03	698,03	0.00
		Total paid to the bank	**4 248,03**	

Since the interest rate is quoted per annum but the interest is calculated monthly, the monthly interest rate is $\frac{21\%}{12}$ = 1,75% and: 4000 × 1,75% = 70.

or $4000 \times \frac{1{,}75}{100} = 70$

7.13

	Interest on outstanding balance	Outstanding total	Payment	Remaining balance
Start of loan period	0,00	4 000,00	0,00	4 000,00
End of 1st month	70,00	4 070,00	375,00	3 695,00
End of 2nd month	64,66	3 759,66	375,00	3 384,66
End of 3rd month	59,23	3 443,89	375,00	3 068,89
End of 4th month	53,71	3 122,60	375,00	2 747,60
End of 5th month	48,08	2 795,68	375,00	2 420,68
End of 6th month	42,36	2 463,04	375,00	2 088,04
End of 7th month	36,54	2 124,59	375,00	1 749,59
End of 8th month	30,62	1 780,20	375,00	1 405,20
End of 9th month	24,59	1429,79	375,00	1 054,79
End of 10th month	18,46	1 073,25	375,00	698,25
End of 11th month	12,22	710,46	375,00	335,47
End of 12th month	5,87	341,34	341,34	0.00
		Total paid to the bank	**R4 466,34**	

7.14 Again, each student's responses will be based on his/her own original cash price.

For these calculations, assume the cash price of the fridge and the stove together was R4 000.

This means that the total non-cash price that Table Mt Furnishers would required is R4 800,00 of which you would have to pay a R720 deposit and 6,5% (or 12,5% for 12 months) interest on the remaining R4 080.

	Payments over **6 months**	Payments over **12 months**
Blue Bank Loan	R4 248,03	R4 466,34
Table Mt Hire Purchase	R5 065,20	R5 310,00

7.15 Calculations are done in the same way as those in questions 7.12 and 7.13.

7.16

BLUE BANK LOAN		TABLE MT HIRE PURCHASE	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
• no deposit required • avoid the non-cash price increase • interest payable decreases after every payment • you only have to pay a minimum payment per month	• you have to be 21 years or older, have a clean bank record and be earning a minimum of R 3 000,00 • if you only pay the minimum payment per month it could take a lot longer to pay off than on a 24 month hire purchase plan	• avoid having to arranged finance with the bank first, i.e. purchase straight away	• non-cash price is 20% higher than cash price • deposit of 15% of non-cash price price is required (i.e. you have to pay 18% of the cash price upfront)

Activity 7 — Buying a fridge and a stove

Sometimes we are unable to pay for the things we want to buy because we simply do not have the full amount in cash.

When purchasing a house, for example, very few people have sufficient money to be able to pay the full amount in cash. They need to borrow money from the bank in order to pay the purchase price of the house. An agreement will need to be reached between the purchaser and the bank as to how much money is going to be borrowed, how long the borrower has to pay it back, what the interest rate is going to be and what the monthly payments will be. The agreed repayment period for purchasing a house is usually between 20 and 30 years.

When purchasing items from a furniture or home appliance store the repayment period is likely to be shorter, often no more than 24 months.

Consider the following scenario:
The crèche has decided to buy a new fridge and a new stove for the crèche kitchen. If we look at the crèche's budget for the year it is clear that there is not enough money to pay cash for the fridge and stove. Let us explore two options: (1) you pay the furniture store for the fridge and stove over a period of time, or (2) you take a loan with the bank.

7.1 Look through the newspaper for advertisements for brand-new stoves and fridges. Choose a stove and a fridge that you think you would like to buy for your crèche and determine what the cash price is of the two items.

Buying over 24 months from the furniture store
The questions that follow are based on actual information supplied by a furniture store in Cape Town—let us call the store Table Mountain Furnishers. To determine what the monthly repayments will be for your purchase you need to do the following:

7.2 Step 1: Determine the non-cash price of the item(s). Because you will not be paying cash, Table Mountain Furnishers adds 20% to the cash price. Calculate the non-cash price for the items you have selected.

7.3 Step 2: Determine the deposit you must pay. Table Mountain Furnishers expects you to pay a deposit of 15% of the non-cash price. How much deposit must you pay?

7.4 Step 3: Calculate the outstanding amount. How much do you still owe for the items once you have paid the deposit?

7.5 Step 4: Add standard costs. Before calculating the monthly repayment, Table Mountain Furnishers adds some standard costs to the amount still owing. They add a R100 delivery charge and R4 for stamp duty (on the contract you are about to enter into) to the amount you still owe. What is the total you now owe?

7.6 Step 5: Calculate the interest. Table Mountain Furnishers now add a percentage to the amount owing. They call this interest. The percentage is dependent on the number of months over which you plan to pay for the items. The table below lists the different percentages (these will change from time to time):

Repayment period	6 months	12 months	18 months	24 months
Interest	6,5%	12,5%	17,8%	24%

Calculate the interest amount you owe for each of the different repayment periods and add this to the amount you owe. Is this is the full amount you will pay?

7.7 Step 6: Calculate the monthly repayments. Calculate how much you have to pay Table Mountain Furnishers each month by dividing the full amount owing by the number of months over which you are going to pay the amount.

7.8 For each of the different repayment periods calculate how much you will actually pay for the fridge and the stove. How much more is this than the cash price?

7.9 Return to the advertisements you used at the start of the activity and compare the deposit and monthly repayment amounts you have just calculated with the amount shown in the advertisement.

Buying the fridge and the stove using a bank loan

Instead of entering into a hire-purchase agreement with Table Mountain Furnishers you might choose to take a loan with the bank. Provided you meet certain conditions, such as being 21 years or older, having a clean bank record and earning a minimum of R 3 000,00 per month, the bank will happily give you a loan. The repayment of the loan is, however, calculated quite differently. The questions that follow are based on actual information supplied by a bank in Cape Town—let us call the bank Blue Bank.

7.10 Step 1: Minimum loan amount. Blue Bank sets a minimum amount of R 3 500,00 for a loan. You will not need to pay any deposit. Since you will in effect be paying cash for the fridge and stove, confirm that the total cash price for the fridge and stove exceeds R 3500,00.

7.11 Step 2: Determine the minimum monthly repayment. Blue Bank allows you to determine your own monthly repayment on the loan with the understanding that the monthly repayment exceeds a certain minimum. Calculate the minimum by dividing the amount of the loan by 40[1].

7.12 Step 3: Choose a monthly repayment amount and calculate how long it will take to repay the loan. First choose the monthly repayment that you would have had to pay Table Mountain Furnishers if you had paid for the fridge and stove over 6 months (see question 7.7 above). Draw a table such as the one below and complete it for your amounts—the example is based on a cash price of R 3 750,00, a monthly repayment of R 698,00 (R697,40 rounded up to the nearest rand) and an interest rate of 21% per annum (this amount will change from time to time).

	Interest on outstanding balance	Outstanding total	Payment	Remaining balance
Start of the loan period	0,00	3 750,00	0,00	3 750,00
End of first month	65,63	3 815,63	697,40	3 118,23
End of second month	54.57	3 172,79	697,40	2 475,39
End of third month	43.32	2 518,71	697,40	1 821.31
End of fourth month	31,87	1 853,19	697,40	1 155,79
End of fifth month	20,23	1 176,01	697,40	478,61
End of sixth month	8,38	486,99	486,99	0.00
	Total paid to the bank		3 973,99	

Since the interest rate is quoted per annum but the interest is calculated monthly, the monthly interest rate is $\frac{21\%}{12} = 1{,}75\%$ and: $3\,750 \times \frac{1{,}75}{100} = 65{,}63$

[1] Presumably this number—40—will vary depending on the interest rate.

7.13 Create a table such as the one above for the cash price of your items but this time using the monthly repayment amount if you had paid for the items over 12 months.

7.14 Compare the total amount you would pay for the fridge and stove if you bought them through Table Mountain Furnishers with the amount if you bought them through a loan from the bank, for both the 6 and 12 month periods.

7.15 You could repeat the calculations above for the 18 and 24 month amounts as well. However, you may find that this takes a lot of calculations and a lot of time. If you can use a spreadsheet, you may want to try to use a spreadsheet for these calculations.

7.16 List the advantages and disadvantages of the two ways of financing the purchase.

Activity 8 — Buying equipment from overseas

ABOUT THIS ACTIVITY

This activity focuses on introducing the students to foreign exchange. Students are required to study tables and graphs and to calculate costs using the given exchange rates.

This activity is aligned with unit standard 9014 and addresses AC 1,2,3,4,5 of SO1; AC 1,2,3,4 of SO2 and AC 1,2,3 of SO3.

MANAGING THIS ACTIVITY

A two page handout is required for this activity and if students wish to search the internet for additional educational toys on the on-line catalogue – this may be set as an optional homework task for those with computer and internet facilities at home.

8.1 On Friday 18th June, the Water Blocks would have cost the least in rand terms. You have to multiply by the figure in the table to calculate the rand price. On Friday the figure in the table is the lowest, therefore the rand price would be the least.

8.2

South African Rands to 1 GBP				
Monday 14 June 2004	Tuesday 15 June 2004	Wednesday 16 June 204	Thursday 17 June 2004	Friday 18 June 2004
12,0194	11,8167	11,9434	11,9583	11,7528
Rand Price for Water Blocks (priced at £21,99) on each day				
R264,31	R259,85	R262,64	R262,96	R258,44

8.3 You could use these figures as a gauge – in other words you could expect that the following week's figures would be roughly between 11 and 12 South African rands to 1 GBP, but this would only be an estimate. These exchange rates can fluctuate dramatically over time and therefore you could not accurately predict the exchange rates for the next week or month.

8.4 Students should look this up in their local newspaper which will give the daily exchange rate for the rand against many major currencies.

8.5 This should be calculated as follows:
The rand-British pound exchange rate on 24 July 2004 was 11,40. This means that it would be cheaper to buy the Water Blocks on this particular day than to have bought them in the week in June shown in the table. (Water blocks would cost only R250,69 on 24th July 2004, since 21,99 × 11,40 = 250,69).

8.6

South African Rands to 1 GBP

latest (Jul 12)	**lowest** (Jul 2)	**highest** (Jan 26)
11.2586	11.1859	13.0905

At the most expensive point, the rand-British pound exchange rate was 13.2214.
Therefore the price at this point would have been £21,99 × 13.2214 = R290,74.

At the least expensive point, the rand-British pound exchange rate was 11.074.
Therefore the price at this point would have been £21,99 × 11.074 = R243,52.

8.7

Item	Water blocks	Jumbo beads and cards	Rainbow sound blocks
Weight (in kg)	1,33kg	1,53kg	1,1kg
Weight (in g)	1330g	1530g	1100g
Mailing cost	£5,89	£6,73	£4,84

8.8

Item	Water blocks	Jumbo beads and Cards	Rainbow sound locks	All
Purchase cost	£21,99	£25,99	£19,99	£67,97
Mailing cost	£5,89	£6,73	£4,84	£17,46
Total (in £)	**£27,88**	**£32,72**	**£24,83**	**£85,43**
Total (in R) (× 11.2588)	R313,90	R368,39	R279,56	R961,84
1,5% of R total	R4,71	R5,53	R4,19	R14,43
Fee	R85,00	R85,00	R85,00	R85,00
Bank Charges	**R89,71**	**R90,53**	**R89,19**	**R99,42**

8.8.1 Bank charge for the *Water* blocks only = **R89,71**.
8.8.2 Bank charge for the *Jumbo beads and cards* only = **R90,53**.
8.8.3 Bank charge for the *Rainbow* sound blocks only = **R89,19**.
8.8.4 Bank charge for buying all three of the items at the same time = **R99,42**.

8.9 Since it would be far more economical to purchase all three items at once this should be the preference.

8.10

If the exchange rate is R11 to the Pound

Total purchase cost	£203,91
Total mailing cost	£52,38
Total (in £)	**£256,29**
Total (in R) (× 13)	R2819,19
1,5% of R total	R42,29
Fee	R85,00
Bank charges	R127,29
Total expense (Total in R + Bank charge)	**R2946,47**

If the exchange rate is R13 to the Pound

Total purchase cost	£203,91
Total mailing cost	£52,38
Total (in £)	**£256,29**
Total (in R) (× 11)	R3331,77
1,5% of R total	R49,98
Fee	R85,00
Bank charges	R134,98
Total expense (Total in R + Bank charge)	**R3466,75**

Provided that the rand-British pound exchange rate stays between R11 and R13 to the pound, then the least they should expect to pay is R2946,47 and the most they should expect to pay is R3466,75. Therefore they should budget for the highest amount (R3466,75), hopefully ensuring that they will be able to afford to make the purchase.

Activity 8 — Buying equipment from overseas

Occasionally some specialised equipment for your crèche may not be available in South Africa. It might even be possible to purchase the equipment more economically from overseas. In order to make the purchase from overseas you will have to convert South African rands to the currency of the country from which you are buying in order to pay for the equipment.

Consider the following scenario:
Your crèche wants to buy some educational toys for the children with special needs. After searching the internet you find some toys that are ideal on the website of Philip and Tacey a UK-based company (www.philipandtacey.co.uk). Three of the toys, as well as their descriptions and prices, are shown on the handout attached. You may wish to go to the on-line catalogue to look for more or other examples.

We start out by considering the Water Blocks (product number: B12017)

8.1 Refer to the table below which gives the Rand-British Pound exchange rate for each day of the week starting Monday 14 June. On which day would the Water Blocks have cost the least in rand terms?

South African Rands to 1 GBP				
Monday 14 June 2004	Tuesday 15 June 2004	Wednesday 16 June 204	Thursday 17 June 2004	Friday 18 June 2004
12,0194	11,8167	11,9434	11,9583	11,7528

Data sourced at: http://www.x-rates.com (July 2004)

8.2 Calculate the cost, in rands, of the Water Blocks on each of the days of the week. Do your answers support your answer to question 8.1?

8.3 The exchange rates in the table are for a particular week in June. Can you use these rates to predict the exchange rates for each of the days of the next week? Can you use these rates to predict the exchange rates for each of the days of the next month?

8.4 What is the current rand-British pound exchange rate? You should look this up in your local newspaper which will give the daily exchange rate for the rand against many major currencies.

8.5 Is it more or less expensive to purchase the Water Blocks now compared to the week in June?

8.6

South African Rands to 1 GBP

latest (Jul 12)	**lowest** (Jul 2)	**highest** (Jan 26)
11.2586	11.1859	13.0905

8.6 Refer to the graph above (sourced at http://www.x-rates.com) and determine the most and least that you would have paid for a set of Water Blocks during the first half of 2004.

Postage: We now consider what it would cost for Philip and Tacey to send three different products to you by surface mail. In reality, they may use a shipping company but for the purpose of this activity we will assume they use Royal Mail.

The weight of the three items in the handout is: *Water Blocks*: 1,33kg; *Jumbo Beads and Cards*: 1,53kg; and *Rainbow Sound Blocks*: 1,1kg.

8.7 Refer to the Royal Mail cost table for small packets on the handout and determine what it would cost (in British pounds) to mail each of the items individually.

Bank charges: To make the international payment into the Philip and Tacey's bank account, your local bank charges R85 plus 1,5% of the value of the amount transferred.

8.8 Assume an exchange rate of R 11,2586 : GBP 1,00. Calculate the bank charges for each of the following:

8.8.1 You only buy the Water Blocks (include postage costs).

8.8.2 You only buy the Jumbo Beads and Cards (include postage costs).

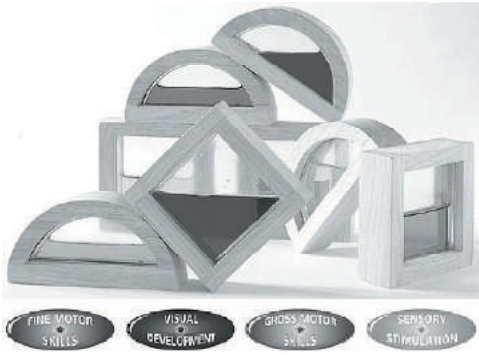
8.8.3 You only buy the Rainbow Sound Blocks (include postage costs).

8.8.4 You buy all three of the items at the same time (include postage costs—assume each item is mailed separately).

8.9 In light of the answers above, would you prefer to buy all three of the items at once or would you prefer to buy them individually?

Scenario

8.10 You and two other crèches decide to each buy one of each of the items—i.e. three of each item. You decide to buy these together in order to be able to reduce the bank charges and possibly use a bank loan to pay for the purchase (refer to activity 7). Taking in account fluctuations in the exchange rate develop a budget for making this purchase. Your budget should show the least you expect to pay and the most you expect to pay for the items.



Water Blocks
Experiment with colour by placing one block in front of the other, and marvel as the coloured water inside changes shape with movement.
An excellent resource for visual development.
Size: Block 35mm

pg 3 (Special Needs) B12017 Set £21.99

Jumbo Beads & Cards
Extra-large wooden beads which provide help with fine motor control. The set comes in three shapes and four colours and is supported by a set of full-colour activity cards.
A visually stimulating resource for reinforcing colour and shape recognition, sequencing and pattern-making. Boxed set of 24 beads, 2 x 900mm laces and 18 double-sided activity cards.
Size: e.g. Square cube 45mm, activity cards 291 x 112mm

pg 28 (Special Needs) B13175 Set £25.99

Rainbow Sound Block
Stimulate gross motor skills, visual development and colour definition while gaining a valuable asset to your sensory room.
Size: Unit 228 x 128 x 68mm

pg 3 (Special Needs) B12029 Set £19.99

Taken from the Philip and Tacey on-line catalogue: www.philipandtacey.co.uk

Weight not over	Letters	Small packets and printed papers
	World zone 1 and 2	All destinations
Postcards	39p	
20g	39p	
60g	66p	
100g	93p	64p
150g	£1.30	85p
200g	£1.67	£1.06
250g	£2.04	£1.27
300g	£2.41	£1.48
350g	£2.78	£1.69
400g	£3.15	£1.90
450g	£3.52	£2.11
500g	£3.89	£2.32
550g	£4.26	£2.53
600g	£4.63	£2.74
650g	£5.00	£2.95
700g	£5.37	£3.16
750g	£5.74	£3.37
800g	£6.11	£3.58
850g	£6.48	£3.79
900g	£6.85	£4.00
950g	£7.22	£4.21
1000g	£7.59	£4.42
1050g	£7.96	£4.63
1100g	£8.33	£4.84
1150g	£8.70	£5.05
1200g	£9.07	£5.26
1250g	£9.44	£5.47
1300g	£9.81	£5.68
1350g	£10.18	£5.89
1400g	£10.55	£6.10
1450g	£10.92	£6.31
1500g	£11.29	£6.52
1550g	£11.66	£6.73
1600g	£12.03	£6.94
1650g	£12.40	£7.15
1700g	£12.77	£7.36
1750g	£13.14	£7.57
1800g	£13.51	£7.78
1850g	£13.88	£7.99
1900g	£14.25	£8.20
1950g	£14.62	£8.41
2000g	£14.99	£8.62*

*for printed papers only up to maximum weight of 5kg
add £0.21 for each additional 50g

Rates published on the UK Royal Mail website: http://www.postoffice.org.za (July 2004)

Activity 9 — Fundraising selling hot dogs

ABOUT THIS ACTIVITY

This focus of this activity is on budgets and budgeting. At each stage of the activity choices must be made and the students should be encouraged to reflect on and explain their choices.
This activity is aligned with unit standard 9014 and addresses AC 2 and 3 of SO1; AC 1 and 2 of SO2 and AC 1 and 3 of SO3.

MANAGING THIS ACTIVITY

This activity can be completely self-contained. No data needs to be collected and students should be able to complete the activity in class or even as a homework assignment. You should supply each student with the handout and provide support to the extent that it is needed.

Of course, you may decide to make the activity more interesting by encouraging students to visit their local stores and to collect their own information on the various ingredients. You could even allow students to run a hot dog stand at the college/technikon or local market.

Anticipated responses to questions

9.1 This question should provide no challenge, though students may want to pay attention to rounding. Using a calculator, the students will get R 0,95625 as one of the answers. You may want to discuss at what point to do the rounding and whether or not you always round up or just off. In the end we will almost certainly divide the cost of the bag of groceries by the number of hot dogs rather than adding component values.

Shop brand 1kg (24 sausages)	22,95 ÷ 24 = R 0,96
Shop brand ½ kg (12 sausages)	12,25 ÷ 12 = R 1,02
Enterprise 1kg (24 sausages)	25,99 ÷ 24 = R 1,08

9.2 Considerations could include the following:

- You want to reduce the number of leftover sausages. Rather than being left with 12 unused sausages (a wastage of 22,95 ÷ 2 = R 11,48), you would rather pay 6c more per sausage and buy the smaller package.
- You may have special needs within your school such as Muslim and/or Jewish children and you may find that only the Enterprise sausages are both Halaal and Kosher.

9.3

All Joy (Family Pack)	2l = 2 000ml and 1Tsp = 15ml
	2 000ml ÷ 15ml/serving = 133 servings*
All Joy (600ml)	600ml ÷ 15ml/serving = 40 servings*
Kiddie Squeeze	425ml ÷ 15ml/serving = 28 servings*

*In these problems rounding off should not even be a consideration—firstly, you must always round down because we are interested in whole servings and secondly, you will never get the full number of servings anyway because of spillage and other wastage.

9.4 The words "most economical" hint at a rate—we want to know the cost per serving for each option.

All Joy (Family Pack)	Cost = R 16,99 + R 11,99 = R 28,98
	R 28,98 ÷ 133 servings = R 0,22 per serving*
All Joy (600ml)	R 9,69 ÷ 40 servings = R 0,24 per serving*

*The same issue regarding rounding that we encountered in question 9.3 arises here.

9.5 This question requires us first to convert mass to volume—we do this using the ratio provided, namely:

230g of margarine = 250ml of margarine

$\therefore$ 250g ≈ 272ml (multiply both sides of the ratio by $\frac{250}{230}$)

1½ tsp = 7,5ml

and 272ml ÷ 7,5ml/serving = 36 servings.

9.6 -7 Students will develop different responses to this question as a result of the different choices they make. One possible response could be:

Deciding on how many hot dogs to make:
- Since the sausages are by far the most costly part of the hot dog let the number of sausages determine the number of hot dogs we make. We can either make 36 (24 +12) or 48 (24 × 2) hot dogs.
- ½kg of margarine corresponds to 36 servings and the 600ml bottle of tomato sauce is enough for 40 servings.
- It seems that making 36 hot dogs will result in less wastage because you would not have to buy additional margarine and tomato sauce.

Other choices:
- We will use Floro margarine since it comes in a tub that makes for easier use.

Shopping list:

Item	Number	Unit cost	Total cost
Hot dog rolls	36	0,55	19,80
Sausage (Shop brand 1kg)	1	22,95	22,95
Sausage (Shop brand ½kg)	1	12,25	12,25
Tomato sauce (All Joy 600ml)	1	9,69	9,69
Serviettes (Shop brand 100)	1	11,95	11,95
Margarine (Floro ½ kg)	1	11,99	11,99
		Total	R 88,63

Cost per hot dog = 88,36 ÷ 36 = R 2,46.

9.8 In deciding on how much to charge per hot dog we need to weigh up how much profit we will make per hot dog and how much we expect people to be willing to pay. Furthermore, since we do not want to work with too much change we should decide to charge in whole rand units or at most in half rand units (50c).

Options: 1. R2,50 $\Rightarrow$ R 0,04 profit per hot dog and R 1,44 profit per day.
2. R3,00 $\Rightarrow$ R 0,54 profit per hot dog and R 19,44 profit per day.
3. R3,50 $\Rightarrow$ R 1,04 profit per hot dog and R 37,44 profit per day.
4. R4,00 $\Rightarrow$ R 1,54 profit per hot dog and R 55,44 profit per day.
5. R4.50 $\Rightarrow$ R 2,04 profit per hot dog and R 73,44 profit per day.

Students would at this stage recommend an option.

9.9-10 Again, you need to first make a decision about how many hot dogs to make per week. One possible response could be:
Deciding on how many hot dogs to make:
- Based on the success of the first week and the small saving that can be realised by buying the larger package of sausages we will make 48 per week.
- 48 hot dogs per week represents 48 × 4 = 192 hot dogs over the four weeks.

Other choices:
- We will use Floro margarine since it comes in a tub that makes for easier use. We will buy two 1kg tubs and one ½kg tub. This represents 2 × 72 + 36 = 180 servings. By spreading the margarine a little thinner we should be able to butter all 192 rolls.
- We will buy one Family Pack (2l) of tomato sauce and a set of squeeze bottles (as this is most economical per serving) and one 600ml bottle to reduce wastage. Together with the 4 servings of tomato sauce left over from the trial week, we will now have 133 + 40 + 4 = 177 servings of tomato sauce. This should be enough as we discovered in the trial week that not all of the children want tomato sauce on their hot dog!
- We cannot avoid buying 200 serviettes because we do not have enough left over from the trial week to only buy 100 (100 + (100-36) = 164 and 164 < 192).

Shopping list:

Item	Number	Unit cost	Total cost
Hot dog rolls	192	0,55	105,60
Sausage (Shop brand 1kg)	8	22,95	183.60
Tomato sauce (All Joy 2l)	1	16,99	16,99
Squeeze bottles	1	11,99	11,99
Tomato sauce (All Joy 600ml)	1	9,69	9,69
Serviettes (Diamond 200)	1	22,75	22,75
Margarine (Floro 1 kg)	2	21,95	43,90
Margarine (Floro ½ kg)	1	11,99	11,99
Total			R 406,51

Cost per hot dog = 406,51 ÷ 192 = R 2,12 (a saving of R 0,34 per hot dog!)

9.11 Assuming we went for option 4 i.e. R4,00 per hot dog (in 8 above) and sold all of the hot dogs each week, then we would have a balance sheet something like the one below:

Income		
Sales of hot dogs (228 @ R4,00)		912,00
Expenditure		
Purchase for the trial week	88,63	
Purchase for other 4 weeks	406,51	495.14
Profit		**R 416.86**

It is important that students do not determine the profit using the following calculation:

$$36 \times (4{,}00 - 2{,}46) + 192 \times (4{,}00 - 2{,}12) = \text{R } 416{,}40$$

Although the difference in the two calculations is only R0,46, the first approach is correct from an accounting perspective, while the second approach is wrong—the error arising from the rounding we did when calculating the profit per hot dog.

Activity 9 – Fundraising selling hot dogs

The income and expenditure statement of the school shows that in addition to income from fees, the school raises some income through fundraising. A popular fundraising activity at many schools is to sell hot dogs at the end of the day on a Friday. Our school has decided to explore this.
Before we can decide on the price for which we will sell the hot dogs we need to determine how much it costs to make a hot dog. The hot dog that we are going to sell will consist of the following:

1 buttered hot dog roll
1 vienna sausage
1 serving of tomato sauce
1 serviette

One of the mothers has kindly collected the following prices on a recent visit to the local supermarket:

Component	Description	Quantity	Price
Hot dog roll		per roll	55c
Vienna sausage	Shop brand	1kg (24 sausages)	R 22,95
		½ kg (12 sausages)	R 12,25
	Enterprise	1kg (24 sausages)	R 25,99
Tomato sauce	All Joy (Family Pack)*	2l	R 16,99
		600ml	R 9,69
	Kiddie Squeeze	425ml	R 9,69
Serviettes	Shop brand	100s	R 11,95
	Diamond	200s	R 22,75
Margarine	Shop brand	1kg block	R 12,45
		½ kg block	R 4,89
	Floro	1kg tub	R 21,95
		½ kg tub	R 11,99
* The mother recommends that if you buy this bottle you should also buy a squeeze bottle to dispense the tomato sauce. Squeeze bottles are sold in packs of 2 for R 11,99.			

9.1 For each of the three vienna sausage options calculate the price per sausage.

9.2 Discuss why you might decide to buy either of the more expensive options.

9.3 How many servings of tomato sauce can you get out of each of the bottles in the table above? (Assume that 1 serving = 1Tsp and 1Tsp = 15ml)

9.4 Which is more economical: the 2l bottle of tomato sauce and a set of squeeze bottles (as recommended) or the 600ml bottle?

9.5 How many hot dog rolls can you butter using ½ kg of margarine if you assume that you use 1½ tsp (1 tsp = 5ml) per bread roll? (The Reader's Digest South African Cookbook states that 230g of margarine is equivalent to 250ml)

Because it is not known how successful the hot dog sales will be, the school decides to run a trial on a particular Friday. It is not expected that each child will buy a hot dog, so the school decides to cater for approximately 40 of the 60 children on the trial day.

9.6 Develop a shopping list for the trial Friday, assuming that you want as little of any of the components left over at the end of the day as possible. You should explain the choices that you make.

9.7 Determine the cost of the shopping list you develop and hence the cost per hot dog.

9.8 Based on your answer to 9.7, how much do you think you should charge per hot dog?

The trial on the first Friday is a success. All the hot dogs were sold and it seemed as if a few more would have been bought had there been extras. However, it does not seem as if all of the 60 children would have bought. Hotdogs. The school decides to repeat the trial for the remaining 4 weeks of the term. At the end of the 4 weeks you would again like to have as few left-over components as possible.

9.9 Develop a shopping plan to cater for the remaining 4 weeks.

9.10 Based on your shopping plan, determine the cost per hot dog over the 4 weeks.

9.11 If you keep the price per hot dog the same (i.e. the price you determined in 1.8) and assume that all of the hot dogs are sold each week, determine how much profit you will make over the five weeks (i.e. the trial week and the further four weeks).

Activity 10—Telephone expenses

ABOUT THIS ACTIVITY

This focus of this activity is on making choices based on an investigation. While the students do not perform the investigation themselves they must make a recommendation based on information provided. One of the characteristics of this activity is that the responses depend on the assumptions made—a feature of all modelling. At each stage of the activity choices must be made and the student should be encouraged to reflect on and explain their choices.
In addition to focus on financial decision making, students will be performing many calculations that involve knowledge, skills, values and attitudes described in the Unit Standards.

This activity is aligned with unit standard 9014 and addresses AC 2 of SO1; AC 1,2,4 of SO2 and AC 1,3 of SO3.

MANAGING THIS ACTIVITY

This activity is completely self-contained. No data needs to be collected and students should be able to complete the activity in class or even as a homework assignment. You should supply each student with the handout and provide support to the extent that it is needed. You may decide to ask the students to do the activity with more recent tariff tables if you like though this will not affect the spirit of the activity.

Anticipated responses to questions

10.1 This question has been very carefully structured to include a number of each of the different types of calls: conventional vs cellular; minimum charge calls vs rate based calls; local vs long distance etc. Students will have to use the tariff table and information very carefully to avoid making mistakes. It may be a good idea to demonstrate one or two of the calculations for the class.

The examples have also been deliberately chosen to help students see the influence of factors such as the time of day, the length of a call etc on the cost of a call. You may want to ask questions such as: 'Why is call (b) less expensive than call (a) even though it is so much longer?' or 'Look at the difference that 45 minutes make when you compare (d) and (e)?'

10.1.1 Cellular call
Day = Sunday ∴ Rate 2
58 sec (i.e. call does not exceed first 60 sec.) ∴ **R 0,97** (VAT excl)

10.1.2 National call (0-50 km)
Day = Sunday ∴ Callmore rate
5 min: 2 sec = 302 sec
302 × 0,204 = 61,608 cents
61,608 cents is less than the minimum call charge ∴ **R 0,86** (VAT excl)

10.1.3 National call (>50 km)
Day = Sunday ∴ Callmore rate
4 min: 54 sec = 294 sec
294 × 0,724 = 212,856 cents
212,856 cents is greater than the minimum call charge ∴ **R 2,13** (VAT excl)

10.1.4 National call (0-50 km)
Day = Monday before 07:00 ∴ Callmore rate
3 min: 24 sec = 204 sec
204 × 0,204 = 41,616 cents
41,616 cents is less than the minimum call charge ∴ **R 0,48** (VAT excl)

10.1.5 National call (0-50 km)
Day = Monday between 07:00 and 19:00 ∴ Standard rate
1 min: 35 sec = 95 sec
95 × 0,542 = 52,06 cents
52,06 cents is greater than the minimum call charge ∴ **R 0,52** (VAT excl)

10.1.6 Cellular call
Day = Monday between 07:00 and 20:00 ∴ Rate 1
1 min: 48 sec = 1 "First 60 sec" and 2 lots of "Next 30 sec"
1,598 + 2 × 0,799 = **R 3,20** (VAT excl)

10.1.7 National call (>50 km)
Day = Tuesday after 19:00 ∴ Callmore rate
1 min: 52 sec = 112 sec
112 × 0,724 = 81,088 cents
81,088 cents is less than the minimum call charge ∴ **R 0,87** (VAT excl)

10.1.8 Cellular call
Day = Tuesday between 07:00 and 20:00 ∴ Rate 1
1 min: 28 sec = 1 "First 60 sec" and 1 "Next 30 sec"
1,598 + 1 × 0,799 = **R 2,40** (VAT excl)

10.1.9 Cellular call
Day = Tuesday after 20:00 ∴ Rate 2
1 min: 52 sec = 1 "First 60 sec" and 2 lots of "Next 30 sec"
0,973 + 2 × 0,487 = **R 1,95** (VAT excl)

10.1.10 National call (0-50 km)
Day = Tuesday after 19:00 ∴ Callmore rate
9 min: 45 sec = 585 sec
585 × 0,204 = 119,34 cents
119,34 cents is greater than the minimum call charge ∴ **R 1,19** (VAT excl)

10.1.11 National call (>50 km)
Day = Wednesday between 07:00 and 19:00 ∴ Rate 1
2 min: 14 sec = 134 sec
134 × 1,447 = 193,898 cents
193,898 cents is greater than the minimum call charge ∴ **R 1,94** (VAT excl)

10.1.12 National call (>50 km)
Day = Thursday between 07:00 and 19:00 ∴ Rate 1
55 × 1,447 = 79,585 cents
79,585 cents is less than the minimum call charge ∴ **R 0,87** (VAT excl)

10.1.13 National call (0-50 km)
Day = Friday after 19:00 ∴ Callmore rate
4 min: 52 sec = 292 sec
292 × 0,204 = 59,57 cents
59,57 cents is less than the minimum call charge ∴ **R 0,87** (VAT excl)

10.1.14 Cellular call
Day = Friday between 07:00 and 20:00 ∴ Rate 1
5 min: 11 sec = 1 "First 60 sec" and 9 "Next 30 sec"
1,598 + 9 × 0,799 = **R 8,79** (VAT excl)

10.2 Instead of allowing students to compare their answers in groups you may wish to discuss them as part of a whole class activity — this is fine. The important thing is for all students to understand how to calculate call costs properly.

10.3.1 Case 1: Local (0-50km) & Standard time: 48,4 ÷ 0,542 = 89 sec
Case 2: Long distance (>50 km) & Standard time: 86,8 ÷ 1,447 = 59 sec
Case 3: Local (0-50km) & Callmore time: 48,4 ÷ 0,204 = 237 sec
Case 4: Long distance (>50 km) & Callmore time: 86,8 ÷ 0,724 = 119 sec

10.3.2 Case 1: Rate 1 time: 89 sec = 1,598 + 1 × 0,799 = R 2,40
Case 2: Rate 1 time: 59 sec = R1,60
Case 3: Rate 2 time: 237 sec = 0,937 + 3 × 0,487 = R 2,40
Case 4: Rate 2 time: 119 sec = 0,937 + 2 × 0,487 = R 1,91

10.4.1 It is safe to assume that a preschool teacher will make all of her calls during Standard Time (Rate 1--cellular).

10.4.2 This question can lead to some debate but to complete this activity we have to assume that all of the calls are of about the same length — without such assumption we cannot do any of the calculations.

10.4.3 It is safe to assume that all of the calls made by a preschool teacher to parents of children will be 0-50 km (NOTE: this is only important in the case of conventional (landline) calls).

10.5 The calculations are the same as those done in question 1 with the answers shown in the table below:

60 sec calls		Week I		Week II		Week III		Week IV		Total
		calls	cost (c)	calls	cost (c)	calls	cost (c)	calls	cost (c)	
Teacher A	Landline	2	96,8	1	48,4	4	193,6	3	145,2	
	Cellular	12	1917,6	15	2397	10	1598	16	2556,8	
	Total		2014,4		2445,4		1791,6		2702	R 89,53
Teacher B	Landline	14	677,6	16	774,4	14	677,6	10	484	
	Cellular	5	799	6	958,8	8	1278,4	5	799	
	Total		1476,6		1733,2		1956		1283	R 64,49

10.6 Instead of allowing students to compare their answers in groups you may wish to discuss them as part of a whole class activity—this is fine. The important thing is for all students to understand how to calculate call costs properly.

10.7 The calculations are the same as those done in question 1 with the answers shown in the tables below:

90 sec calls		Week I		Week II		Week III		Week IV		Total
		calls	cost (c)	calls	cost (c)	calls	cost (c)	calls	cost (c)	
Teacher A	Landline	2	97,56	1	48,78	4	195,12	3	146,34	
	Cellular	12	2876,40	15	3595,50	10	2397,00	16	3835,20	
			2973,96		3644,28		2592,12		3981,54	R131,92
Teacher B	Landline	14	910,56	16	1040,64	14	910,56	10	650,40	
	Cellular	5	1198,50	6	1438,20	8	1917,60	5	1198,50	
			2109,06		2478,84		2828,16		1848,90	R 92,65

120 sec calls		Week I		Week II		Week III		Week IV		Total
		calls	cost (c)	Calls	cost (c)	calls	cost (c)	calls	cost (c)	
Teacher A	Landline	2	130,08	1	65,04	4	260,16	3	195,12	
	Cellular	12	3835,20	15	4794,00	10	3196,00	16	5113,60	
			3965,28		4859,04		3456,16		5308,72	R175,89
Teacher B	Landline	14	910,56	16	1040,64	14	910,56	10	650,40	
	Cellular	5	1598	6	1917,60	8	2556,80	5	1598,00	
			2508,56		2958,24		3467,36		2248,40	R111,83

150 sec calls		Week I		Week II		Week III		Week IV		Total
		calls	cost (c)	calls	cost (c)	calls	cost (c)	calls	cost (c)	
Teacher A	Landline	2	162,60	1	81,30	4	325,20	3	243,90	
	Cellular	12	4794,00	15	5992,50	10	3995,00	16	6392	
			4956,60		6073,80		4320,20		6635,90	R219,87
Teacher B	Landline	14	1138,20	16	1300,80	14	1138,20	10	813,00	
	Cellular	5	1997,50	6	2397,00	8	3196,00	5	1997,50	
			3135,70		3697,80		4334,20		2810,50	R139,78

180 sec calls		Week I		Week II		Week III		Week IV		Total
		calls	cost (c)	calls	cost (c)	calls	cost (c)	calls	cost (c)	
Teacher A	Landline	2	195,12	1	97,56	4	390,24	3	292,680	
	Cellular	12	5752,80	15	7191,00	10	4794,00	16	7670,40	
			5947,92		7288,56		5184,24		7963,08	R263,84
Teacher B	Landline	14	1365,84	16	1560,96	14	1365,84	10	975,60	
	Cellular	5	2397,00	6	2876,40	8	3835,20	5	2397,00	
			3762,84		4437,36		5201,04		3372,60	R167,74

10.8 At this stage students should be encouraged to notice that the predicted costs (with the exception of week 3) are always less for Teacher B. Furthermore, the ratio of costs for the trial period seems reasonably independent of the assumed call length.

	Teacher A : Teacher B
Based on calls of 60 seconds	1,39 : 1
Based on calls of 90 seconds	1,42 : 1
Based on calls of 120 seconds	1,57 : 1
Based on calls of 150 seconds	1,57 : 1
Based on calls of 180 seconds	1,57 : 1

NOTE: An important observation that students should make is that Teacher A is not only more expensive in terms of actual costs, but actually makes fewer calls over the trial period (63 vs. 78 calls by Teacher B).

10.10 Students should be able to motivate their responses to these questions. The test of the quality of the motivation should be the extent to which they are able to 'convince' somebody else of their argument.

Activity 10 — Telephone expenses

One of the significant expenses on the the income and expenditure statement for the school is telephone costs. On investigation the following is revealed:

- The school records have the home, work and cell phone numbers for almost all of the parents of the children in the school.
- However, the two teachers in the school each have a different habit when it comes to phoning parents and each believes that the other one is wasting money. How can we resolve this?

I seldom phone parents on their home or work landline (Telkom) phone. I used to find that I would never find the parents at these numbers. If you phone the parents on their cell phones, you usually get through first time. I only phone parents on their cell phones, unless they don't have one.

Teacher A

I always try a landline number first. Only if I get an answering machine or a reply to tell me that the parent is not there will I try the cellular telephone number. I also use the cellular telephone number if there is no reply on the landline—but this does not happen very often.

Teacher B

The two teachers have decided to keep a record of all of the telephone calls they each make over a four week period. Their records are illustrated below:

		Week I	Week II	Week III	Week IV
Teacher A	Landline	//	/	////	///
	Cellular	~~////~~ ~~////~~ //	~~////~~ ~~////~~ ~~////~~	~~////~~ ~~////~~	~~////~~ ~~////~~ ~~////~~ /
Teacher B	Landline	~~////~~ ~~////~~ ////	~~////~~ ~~////~~ ~~////~~ /	~~////~~ ~~////~~ ////	~~////~~ ~~////~~
	Cellular	~~////~~	~~////~~ /	~~////~~ ///	~~////~~

Before we can decide which teacher spends more money on phone calls, we must establish how much telephone calls cost. Telkom has a detailed tariff sheet that is more than 70 pages long (it can be downloaded from the Telkom website on the Internet). An extract from the tariff sheet that deals with domestic (i.e. not international) phone calls is printed on handout 10. This extract does not include the monthly service rental charge since that is constant every month irrespective of the number of calls that you make, and our problem deals with trying to save money through the types of calls we make.

10.1 Before comparing the cost profiles for the two teachers, try to determine the costs of each of the calls listed in table 2, printed on your handout. You will need to refer to table 1 as well as the calendar provided to assist you in this exercise.

10.2 Before going on to the next question compare your answers to question 10.1 with at least three other students.

10.3 Based on your work in questions 10.1 and 10.2, determine:

10.3.1 For how long can you talk when making a conventional (landline) call and only pay the minimum charge (there are four different cases)?

10.3.2 For each of the cases identified above, determine the cost of a cellular call of the same duration.

10.4 We are now ready to study the telephone records for each of the teachers. To do so we must make some assumptions. What do you think we should assume about the following:

10.4.1 **The call rate that applies to the phone calls recorded in their table?** Should we assume that they are all standard time or all callmore time for the landline calls and what rate (rate group 1 or rate group 2) should we apply for the calls to cellular phones?

10.4.2 **The duration of each of the calls?**

10.4.3 **The distance of each call?**

10.5 For this question we make the following assumptions:

- all calls are made between 08:00:00 and 14:00:00 on normal weekdays;
- all calls are 60 seconds in duration; and
- all calls are local (i.e. the 0-50 km rate applies).

Calculate the costs that each of the two teachers will incur for each week of the trial and for the whole four week trial.

10.6 Before going on to the next question, compare your answers to question 10.5 with at least three other students.

10.7 As a member of a group of 4 students repeat the calculations you did in question 10.5, with each student doing the calculations for one of the different durations: 90 seconds; 120 seconds; 150 seconds; and 180 seconds.

10.8 Share the answers that each of the different group members gets for question 10.7.

Based on the work that you have done in this activity, answer the following questions:

10.9 Is there a significant difference in the costs that the two teachers incur as a result of their different phoning habits?

10.10 What would you recommend in terms of a phoning policy for the teachers? You must, of course, motivate your answer.

Table 1: TELKOM's DOMESTIC TELEPHONE CALL CHARGES

	Minimum charge cents (Excl VAT)	Minimum charge cents (Incl VAT)	Cents per second (Excl VAT)	Cents per second (Incl VAT)	Minimum charge cents (Excl VAT)	Minimum charge cents (Incl VAT)	Cents per second (Excl VAT)	Cents per second (Incl VAT)
	Standard Time: Monday to Friday 07:00 to 19:00				Callmore time: Monday to Friday 19:00 to 07:00 and Friday 19:00 to Monday 07:00			
Conventional calls (National)								
Local (0-50km)	48.4	55.2	0.542	0.618	48.4	55.2	0.204	0.233
Long distance (>50km)	86.8	99	1.447	1.65	86.8	99	0.724	0.825
Outgoing calls to Mobile Cellular (MTN & Vodacom & Cell C)								
	Price Rand (Excl VAT)	Price Rand (Incl VAT)			Price Rand (Excl VAT)	Price Rand (Incl VAT)		
	Rate group 1: Weekdays from 07:00 to 20:00				Rate group 2: Weekdays from 20:00 to 07:00 and from Friday 20:00 to Monday 07:00			
First 60 sec	1.598	1.82			0.973	1.11		
Next 30 sec	0.799	0.91			0.487	0.56		
Calls are charged in increments of one minute for the first minute and in increments of 30 seconds thereafter								

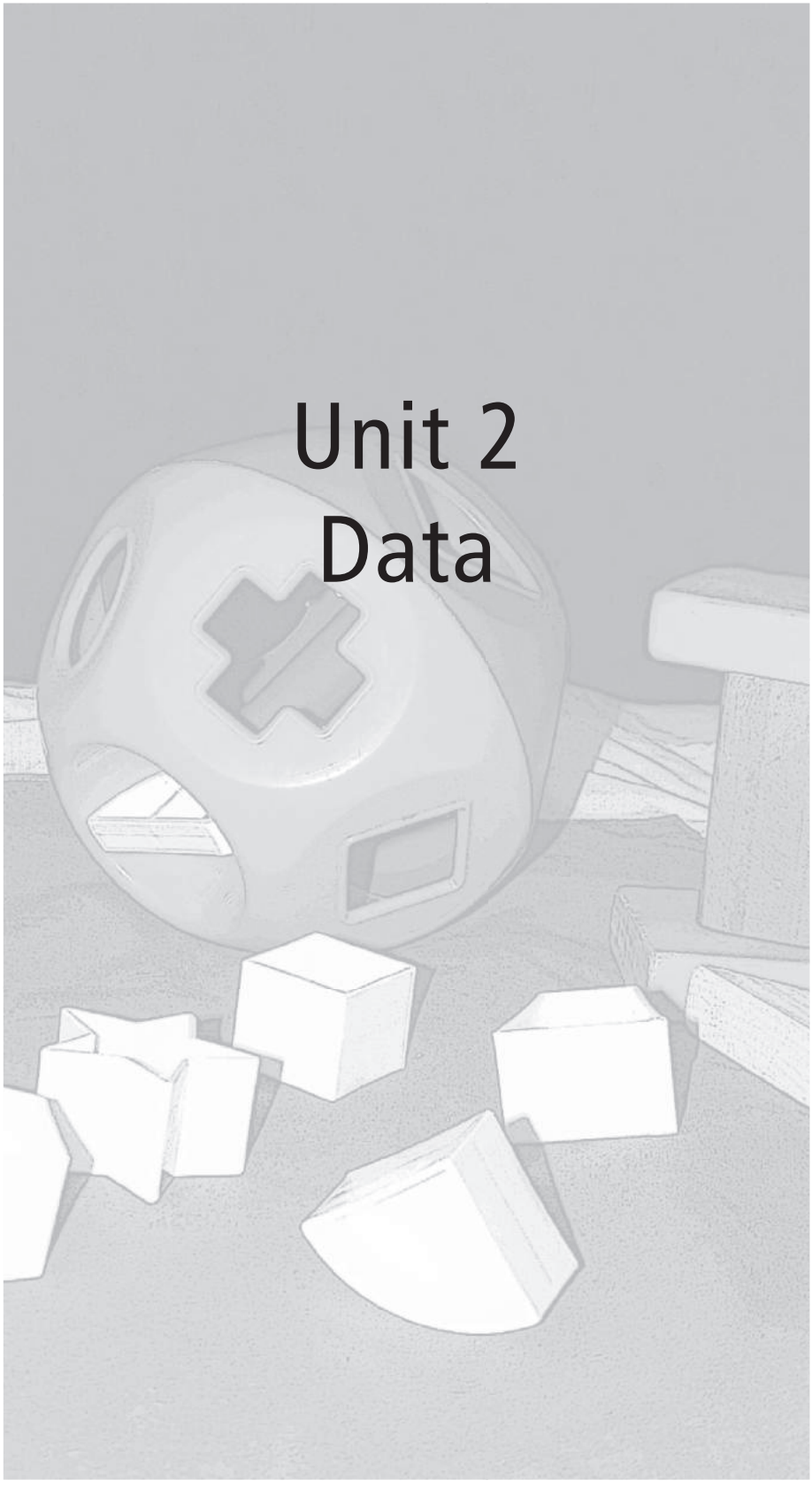
Table 2: Calculation of telephone costs for January 2004.
Note: the conventions used in the table below are:
Time is given as: hh:mm:ss Duration is given as: mm:ss

Call	Date	Time	Duration	Call type	Distance
10.1.1	4 Jan 04	11:09:41	00:58	Cellular	
10.1.2	4 Jan 04	16:34:35	05:02	National	0-50 km
10.1.3	4 Jan 04	20:13:22	04:54	National	>50 km
10.1.4	5 Jan 04	06:30:15	03:24	National	0-50 km
10.1.5	5 Jan 04	07:15:12	01:35	National	0-50 km
10.1.6	5 Jan 04	11:10:14	01:48	Cellular	
10.1.7	6 Jan 04	19:15:03	01:52	National	>50 km
10.1.8	6 Jan 04	19:25:36	01:28	Cellular	
10.1.9	6 Jan 04	20:13:22	01:52	Cellular	
10.1.10	6 Jan 04	20:22:11	09:45	National	0-50 km
10.1.11	7 Jan 04	14:26:13	02:14	National	>50 km
10.1.12	8 Jan 04	10:14:43	00:55	National	>50 km
10.1.13	9 Jan 04	19:05:21	04:52	National	0-50 km
10.1.14	9 Jan 04	19:13:18	05:11	Cellular	

January 2004						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

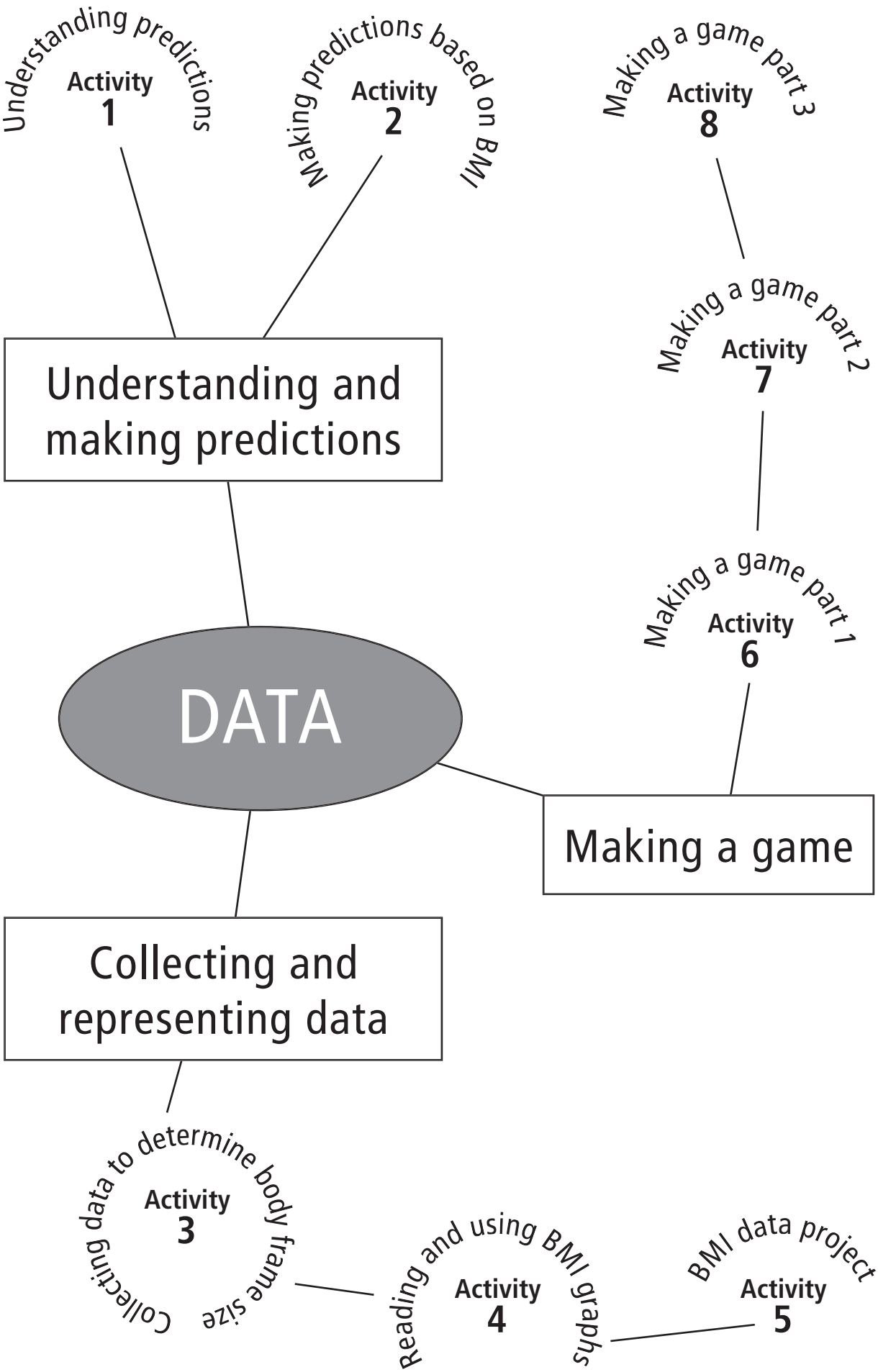
Mathematical Literacy

NQF LEVEL 4



Unit 2
Data

Early Childhood Development


Understanding predictions
Activity 1
Making predictions based on BMI
Activity 2
Making a game part 3
Activity 8
Making a game part 2
Activity 7
Making a game part 1
Activity 6
Understanding and making predictions
DATA
Making a game
Collecting and representing data
Collecting data to determine body frame size
Activity 3
Reading and using BMI graphs
Activity 4
BMI data project
Activity 5

Overview

In this unit student's develop a variety of mathematical skills needed for working with data.

Students should gain an understanding of how to formulate questions in surveys to obtain data, how to collect and organise data and how to draw and interpret graphical representations of the data using tables, bar graphs and pie charts.

In addition to the ordinary graphical representations of data, mentioned above, students will also be exposed to other forms of data including newspaper/ magazine articles and medical charts etc….
Students will be required to analyse data to answer questions and to make predictions. They will also develop an understanding of cumulative data and will use and interpret different kinds of frequency tables.

Students will use theoretical and experimental probability to develop models, make predictions and study problems. They will also critically interrogate and use probability in problem solving and decision making in real-world situations. They will also be required to make comparisons between predictions and actual occurrences.

This unit consists of eight activities. Each activity is a stand alone activity, but they rely on an understanding of the concepts that have been raised preceding each activity. Having worked through this unit, learners should have a greater ability to work intelligently with data of many shapes and forms.

Activity 1: Understanding predictions
This activity focuses on understanding/ interpreting statistical information about different situations represented in charts, tables or newspaper/magazine articles. Student will be introduced to the idea of using the statistics in order to make predictions about the future.

Activity 2: Making predictions based on BMI
In this activity we deal with BMI (Body Mass Index) – which is a measure used by doctors to determine the best weight range for your health. We explore BMI over the next several activities. In particular, we will collect data for the learners in our crèche to establish their BMI and then compare this to norms for children of their age.

Unit outcomes

The following Unit Standards, Specific Outcomes and Assessment Criteria are addressed by this unit:

Apply knowledge of statistics and probability to critically interrogate and effectively communicate findings on life-related problems. (9015).

- Critique and use techniques for collecting, organising and representing data. (SO1)
  - Situations or issues that can be dealt with through statistical methods are identified correctly.
  - Appropriate methods for collecting, recording and organising data are used so as to maximise efficiency and ensure the resolution of a problem or issue.
  - Data sources and databases are selected in a manner that ensures the representativeness of the sample and the validity of resolutions.
  - Activities that could result in contamination of data are identified and explanations are provided of the effects of contaminated data.
  - Data is gathered using methods appropriate to the data type and purpose for gathering the data.
  - Data collection methods are used correctly.
  - Calculations and the use of statistics are correct.
  - Graphical representations and numerical summaries are consistent with the data, are clear and appropriate to the situation and target audience.
  - Resolutions for the situation or issue are supported by the data and are validated in terms of the context
- Use theoretical and experimental probability to develop models. (SO2)
  - Experiments and simulations are chosen and/or designed appropriately in terms of the situation to be modelled.
  - Predictions are based on validated experimental or theoretical probabilities.
  - The results of experiments and simulations are interpreted correctly in terms of the real context.
  - The outcomes of experiments and simulations are communicated clearly.
- Critically interrogate and use probability and statistical models.
  - Statistics generated from the data are interpreted meaningfully and interpretations are justified or critiqued.
  - Assumptions made in the collection or generation of data and statistics are defined or critiqued appropriately.
  - Tables, diagrams, charts and graphs are used or critiqued appropriately in the analysis and representation of data, statistics and probability values.
  - Predictions, conclusions and judgements are made on the basis of valid arguments and supporting data, statistics and probability models.
  - Evaluations of the statistics identify potential sources of bias, errors in measurement, potential uses and misuses and their effects.

Activity 3: Collecting data to determine body frame index
In this activity we explore body frame size (we return to BMI in the next activity). Students are required to draw up a data sheet in order to collect data for investigating body frame size. Using measurements which the students acquire in a collection process, students must then classify peoples body frame size according to certain specified criteria, calculate the percentage over/underweight and draw pie charts and bar graphs to represent the data.

Activity 4: Reading and using BMI graphs
In this activity we return to Body Mass Index (BMI). Students are required to calculate various children's BMI from given information, determine what percentile the child's BMI falls into (using the body mass index-for-age percentiles chart), and classify the child's health status indicated by this percentile placing. Students are also required to perform calculations which are applications of knowing a child's BMI or percentile placing.

Activity 5: BMI data project
This activity is well-suited to be used as an assessment activity (in the form of a project). It is intended to recap principles/skills that have been learnt in the first four activities. There is an opportunity for learners to make their data collection sheet, collect data, analyse this data and summarise the data using tables and graphs in your summary.

Activity 6: Making a game part 1
In this activity we begin the process of making a mathematical game. Students first experiment with ordinary dice; calculating the probability and the relative frequency and comparing these. The activity then moves onto using specifically designed dice with different colours on each of the faces. Using their knowledge of statistics, students are required to make predictions about how many times they expect the dice to land on the different colours. Following this, students record experiments and collect cumulative frequencies for each of the colours and represent this in table and graphical form.

Activity 7: Making a game part 2
In this activity we extend the process of making a mathematical game but experimenting with 2 colour results at the same time. Students are required to complete a tree diagram in order to examine theoretical predictions (probabilities) and compare these to experimental findings.

Activity 8: Making a game part 3
In this activity students are given specific criteria and, using the skills developed in activity 6 and 7, are required to make the boards for

9015	Apply knowledge of statistics and probability to critically interrogate and effectively communicate findings on life related problems									
	ACTIVITY		1	2	3	4	5	6	7	8
SO1	Critique and use techniques for collecting, organising and representing data.									
	AC1	Situations or issues that can be dealt with through statistical methods are identified correctly.					✓	✓		✓
	AC2	Appropriate methods for collecting, recording and organising data are used so as to maximise efficiency and ensure the resolution of a problem or issue.			✓		✓	✓	✓	
	AC3	Data sources and databases are selected in a manner that ensures the representativeness of the sample and the validity of resolutions.			✓	✓	✓	✓	✓	✓
	AC4	Activities that could result in contamination of data are identified and explanations are provided of the effects of contaminated data.	✓	✓		✓		✓		
	AC5	Data is gathered using methods appropriate to the data type and purpose for gathering the data.			✓		✓	✓	✓	
	AC6	Data collection methods are used correctly.			✓		✓	✓	✓	
	AC7	Calculations and the use of statistics are correct.	✓	✓	✓	✓		✓	✓	✓
	AC8	Graphical representations and numerical summaries are consistent with the data, are clear and appropriate to the situation and target audience.	✓	✓	✓	✓	✓	✓		✓
	AC9	Resolutions for the situation or issue are supported by the data and are validated in terms of the context	✓	✓	✓	✓	✓	✓		✓
SO2	Use theoretical and experimental probability to develop models.									
	AC1	Experiments and simulations are chosen and/or designed appropriately in terms of the situation to be modelled.					✓	✓	✓	✓
	AC2	Predictions are based on validated experimental or theoretical probabilities.	✓	✓		✓		✓	✓	✓
	AC3	The results of experiments and simulations are interpreted correctly in terms of the real context.		✓	✓	✓	✓	✓	✓	✓
	AC4	The outcomes of experiments and simulations are communicated clearly.		✓	✓	✓	✓	✓	✓	✓
SO3	Critically interrogate and use probability and statistical models.									
	AC1	Statistics generated from the data are interpreted meaningfully and interpretations are justified or critiqued.	✓	✓	✓	✓	✓	✓	✓	
	AC2	Assumptions made in the collection or generation of data and statistics are defined or critiqued appropriately.			✓		✓	✓	✓	
	AC3	Tables, diagrams, charts and graphs are used or critiqued appropriately in the analysis and representation of data, statistics and probability values.	✓	✓	✓	✓	✓	✓	✓	✓
	AC4	Predictions, conclusions and judgements are made on the basis of valid arguments and supporting data, statistics and probability models.	✓	✓		✓	✓	✓	✓	✓
	AC5	Evaluations of the statistics identify potential sources of bias, errors in measurement, potential uses and misuses and their effects.				✓				✓

Activity 1 — Understanding predictions

ABOUT THIS ACTIVITY

This activity focuses on understanding/interpreting statistical information about different situations represented in charts, tables or newspaper/magazine articles. Student will be introduced to the idea of using the statistics in order to make predictions about the future.

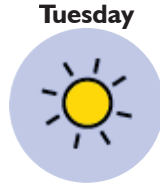
This activity is aligned with unit standard 9015 and addresses AC 4, 7, 8 and 9 of SO1; AC 2 of SO2 and AC 1, 3 and 4 of SO3.

MANAGING THIS ACTIVITY

Many of the questions in this activity will stir up good classroom discussion and it is therefore important to allow time for this to be possible. Encourage the students to think carefully about the situations represented in the different questions in order to interpret the statistics accurately.

1.1

Detailed Forecast: Cape Town

the week ahead	Friday	Saturday	Sunday	Monday	Tuesday
					
	Stormy Hi: 13 Low: 11	Showers Hi: 16 Low: 07	P/cloudy Hi: 16 Low: 04	Windy Hi: 16 Low: 13	Sunny Hi: 18 Low: 14

1.1.1 The information provided shows us the that the weather predictions for Friday and Saturday are not ideal conditions for outdoor activities (stormy and rainy); that there may be some warmer weather on Sunday; that Monday is not a good day for a picnic but may be a good day to go sailing (windy); and that Tuesday would be the best day of this week to plan an outdoor activity such as a trip to Robben Island. Knowing the weather predictions can influence your decisions by helping you to make appropriate plans for the week.

1.1.2 Not very confident. It is, after all, only a prediction ("forecast" or "calculated guess"). There is little difference between the high and low predicted temperatures on the Tuesday, therefore I would be fairly confident that this day would indeed be sunny.

1.1.3 The weather predictions are merely "calculated guesses". Whoever predicts these temperatures has no actual control over the weather conditions and therefore cannot know for sure what, in fact, the temperatures will be on these particular days.

1.2.1 No. It is more hygienic to wash your hands, of course, but there are many ways of contracting 'flu which will not be eliminated simply by washing your hands.

1.2.2 Essentially, this means that your risk of contracting 'flu has been halved.

1.3.1 This means that, on average, an adult is likely to have 2-4 colds a year. In other words, if you asked four different adults, one may have had only one cold, another two adults may have had 3 colds each and the fourth adult 5 colds in the year. Therefore, 4 people had 12 colds altogether. The average is 12÷4=3 colds. Therefore on average an adult may have between 2 and 4 colds per year.

1.3.2 The article suggests that the vaccine is 70%-90% effective in preventing the disease. Therefore if you take the vaccine, you have only a 10%-30% chance of contracting 'flu. Your risk has thus been considerably reduced.

1.3.3 Nursing homes generally accommodate a number of elderly people. Elderly people who live in nursing homes are more frail and therefore are unlikely to be outside very often. As it says in the article, if you spend more time indoors and close to other people there is more opportunity for "bugs" to spread.

1.3.4 Yes. If I get the vaccine, then I considerably reduce my risk of infection.

1.4.1 Increased by 40%.

1.4.2 It is expected that there would be 14 twins born out of 1 000 without folate supplements and 19 twins born out of 1 000 pregnancies with folate supplementation – therefore 5 more twins out of a 1 000.

1.4.3 No. If there are 5 more twins expected, then this is an increase of ± 36%. This is calculated as follows:

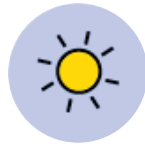
$\frac{5}{14} = 35{,}7\%$ …and one can check by saying $14 \times 35{,}7\% = 5$.

Activity 1 — Understanding Predictions

In this unit of work we will be "applying knowledge of statistics and probability to critically interrogate and effectively communicate findings on life related problems" (Unit Standard 9105). Statistics (and probability) play an important part in our lives in that they give us the power to make predictions about situations. In this activity we will look at different forms of predictions.

1.1 Consider the weather forecast for Cape Town below:

Detailed Forecast: Cape Town

the week ahead	Friday	Saturday	Sunday	Monday	Tuesday
					
	Stormy Hi: 13 Low: 11	Showers Hi: 16 Low: 07	P/cloudy Hi: 16 Low: 04	Windy Hi: 16 Low: 13	Sunny Hi: 18 Low: 14

1.1.1 Discuss in what ways the information provided in the forecast could influence your week?

1.1.2 How confident are you that the weather will follow the forecast for the week? Is there any day of the five for which you are more confident than the others?

1.1.3 Discuss why, in reality, the weather is not always the same as the forecast.

1.2 Consider the newspaper headline and extract from the article below.

> **Reduce your chance of flu infection by 50% — wash your hands!**
>
> Washing your hands four times a day, can reduce your risk of exposure to flu by 50 percent, says the medical

1.2.1 Do you believe that you can reduce your chance of getting flu by washing your hands?

1.2.2 What does it mean to reduce the chance by 50%?

1.3 Here is another newspaper cutting about 'flu:

Reduce the risk of death from 'flu by having a 'flu injection

It's that time of year again when many of us come down with "a bug", a cold, the 'flu or even pneumonia. Because we spend more time indoors and close to other people, there is more opportunity for the "bugs" to spread.

Children often get up to 6 or 8 colds a year, while adults may average 2-4 colds a year. And the 'flu typically causes over 100,000 hospitalizations, and more than 20,000 deaths each year.

But there are steps you can take to reduce the risk of you or your family becoming sick this year. Key to reducing the number of colds is to wash your hands, and wash them often.

To prevent the 'flu, there is a vaccine available. Studies have shown that the vaccine is 70%-90% effective in preventing the disease in healthy young adults. The vaccine can also reduce hospitalisation by about 70%, and death by 85%, when taken by elderly people who do not reside in nursing homes. Even among nursing home residents, the 'flu vaccine can reduce the risk of hospitalization by about 50%, reduce the risk of pneumonia by 50% - 60%, and reduce the risk of death by 80%.

1.3.1 What does it mean to say that adults may "average 2-4 colds a year"?

1.3.2 What does the article suggest that the impact of taking the flu vaccine (injection) will be?

1.3.3 Why do you think the article predicts different results for the elderly who live in nursing homes and for those who do not?

1.3.4 Would the article convince you to get the 'flu vaccine? Why/why not?

1.4 This article comes from a medical journal.

Folate may increase chance of twins

New research has shown that folate supplements, widely recommended for women planning pregnancy, may increase the chances of having twins.

Professor Judith Lumley, from the Centre for the Study of Mothers' Health at La Trobe University examined three folate supplement trials and found women who took folate before falling pregnant had a 40 per cent greater chance of having twins.

"The increased risk of having twins and the greater health problems they face could make recommending folate a dilemma," she said. "Your likelihood of having twins is about 1,4 per cent, so a 40 per cent increase in that takes it up to about 1,9 per cent, so from 14 per 1 000 to about 19 per 1 000," she said.

1.4.1 It would appear as if folate supplements can increase a woman's chance of having twins. By how much does the article say the chance is increased?

1.4.2 Read the article carefully and discuss how many more twins are actually expected to be born as a result of women taking the folate supplement.

1.4.3 Does this number seem to agree with the percentage given in the second paragraph?

Activity 2 — Making predictions based on BMI

ABOUT THIS ACTIVITY

In this activity students are introduced to Body Mass Index Measurements. Students begin this activity by studying a BMI-for-Age graph and demonstrate their understanding of what is represented in this graph. They then are introduced to the idea of a percentile and how we can measure predictions about children's by calculating into which percentile the child falls. The graphs used in this activity were published by The Centre for Disease Control and Prevention (CDC) in the United States (http://www.cdc.gov)

This activity is aligned with unit standard 9015 and addresses AC 7, 8 and 9 of SO1; AC 2, 3 and 4 of SO2 and AC 1, 3 and 4 of SO3.

MANAGING THIS ACTIVITY

This activity is the first of a series of activities which look at Body Mass Index as the context for experimenting with data.

2.1 The horizontal axis represents the children's ages. The unit used on this axis to measure age is years.

2.2 The vertical axis represents the proportion/fraction of the children who will be obese when they are adults. The unit used on this axis to measure this proportion/fraction is percentage.

2.3 The uncoloured bar represents a Body Mass Index (BMI) of less than the 85th percentile; the grey bar represents a BMI of greater than or equal to the 85th percentile; and the black bar represents a BMI of greater than or equal to the 95th percentile for a particular age category.

2.4 Yes. The 19 above the middle bar for the children in the "1 to 3" age group represents 19% of the children aged 1 to 3, with a BMI of greater than or equal to the 85th percentile, who will be obese as adults.

2.5 If an infant's head circumference falls within the 90th percentile for his/her age, this means that 10% of the children of the same age will have a head circumference that is larger and 90% will have a head circumference that is smaller than or equal to this infant's head circumference.

2.6 If a child's BMI is at the 85th percentile for her age, 15% of children of the same age will have a greater BMI and 85% will have the same or lower BMI.

2.7 No, these children are not considered to be overweight or at risk of being overweight. Their weights are fine/normal.

2.8 No, these children are not overweight but they are at risk of becoming overweight.

2.9 Yes, these children are overweight.

2.10 If a child's BMI is greater than or equal to the 85th percentile but less than the 95th percentile, this means that this child's BMI is greater than or equal to the BMI of 85%-95% of children. Therefore, this means that 10% (from 5%-15%) of children are at risk of being overweight (or are already \overweight).

2.11 If a child's BMI is greater than or equal to the 95th percentile, this means that this child's BMI is greater than or equal to the BMI of 95% of children. Therefore, this means that 5% of children are already overweight.

2.12.1 Children whose weight is acceptable (or possibly underweight, since there is not a separate category/bar on this graph for those whose BMI is the less than the 5th percentile of children).

2.12.2 Children who are at risk of being overweight.

2.12.3 Children who are overweight.

2.13.1 15% of the children in the 1 to 3 year old age group, whose weight is currently acceptable, are likely to be obese when they are 25.

2.13.2 19% of the children in the 1 to 3 year old age group, who are currently at risk of being overweight, are likely to be obese when they are 25.

2.13.3 26% of the children in the 1 to 3 year old age group, who are currently overweight, are likely to be obese when they are 25.

2.14.1 69% of children in the age group 6 to 10, who are overweight, are likely to be obese at age 25.

2.14.2 75% of children in the age group 10 to 15, who are at risk of being overweight, are likely to be obese at age 25.

2.14.3 9% of children in the age group 15 to 18, whoseweight is acceptable or below average, are likely to be obese at age 25.

2.15.1 The CDC most likely studied the trends in BMI and obesity of many generations of children and used this information to predict the most likely outcome for each weight category.

2.15.2 Yes. They can be a clear indicator of whether your body is healthy or whether you should consider trying to reduce your risk of becoming obese by attempting to correct your BMI (by eating better and/or exercising more).

2.16 Basically, the longer you maintain an overweight or at risk-of-being-overweight status as a child, the more likely it is that by the time you are 25 you will be obese. Therefore, the BMI is a clear indicator of your chances of ending up as an obese adult.

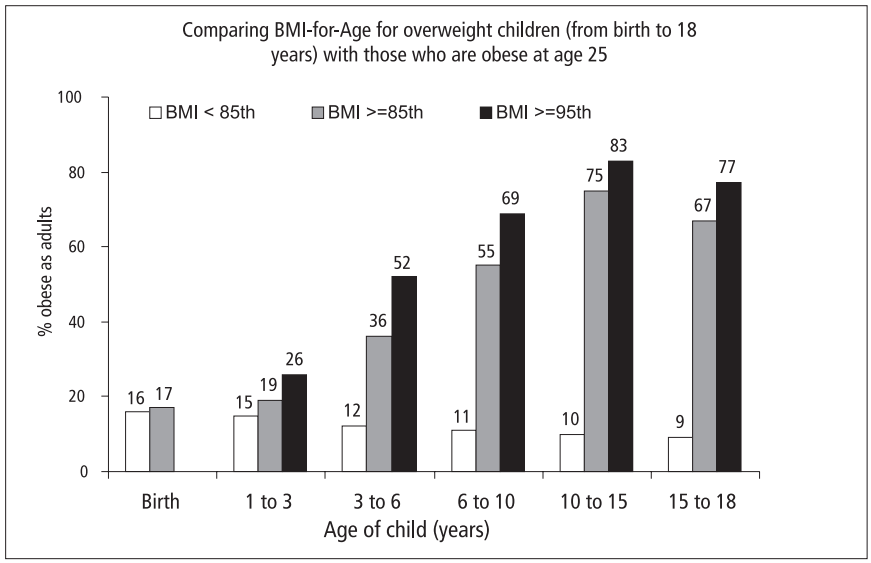
Activity 2 — Making predictions based on BMI

BMI (Body Mass Index) is a measure used by doctors to determine the best weight range for your health. A person's BMI relates quite closely to the amount of body fat that he/she has. With the exception of body builders and pregnant women, differences in BMI between people of the same age and sex are usually due to fat.

We are going to explore BMI over the next several activities. In particular, we will collect data for the learners in our crèche to establish their BMI and then compare this to norms for children of their age. Comparing BMI-for-Age for overweight children (from birth to 18 years) with those who are obese at age 25.

The Centre for Disease Control and Prevention (CDC) in the United States (http://www.cdc.gov) has published the graph printed below. We will study the graph in this activity to establish some important ideas about statistics and the use of statistics in making predictions.

By working through the questions that follow you will make sense of this graph.



2.1 What does the horizontal axis represent? What is the unit used on this axis?

2.2 What does the vertical axis represent? What is the unit used on this axis?

2.3 For each of the age ranges on the horizontal axis you will notice three bars (hence this is called a triple bar graph). Look at the legend for the graph and determine what the legend says each bar represents (we will make sense of what that actually means later in this unit).

2.4 On top of each bar in the graph there is a number. Can you see that this number corresponds to the height of the bar measured on the vertical axis? To be sure, what does the 19 above the middle bar for the children in the "1 to 3" age group represent?

Before we can continue you need to understand what percentiles are. Read the explanation below and answer the questions that follow.

Percentiles A percentile is a measure that tells us what percentage of the population scored at or below a given value. If a 6-year-old's weight at a checkup falls within the 20th percentile it means that the child's weight is greater than or equal to the weight of 20% of the children of the same age in the country. The remaining 80% of children of the same age are heavier than the child.
Doctors and nurses at children's clinics in South Africa often plot the weight of children on a Road to Health Chart distributed by the Department of Health. We will look at these in a later activity. On those charts we see lines representing the weight of children at the 3rd, 50th and 97th percentile. We will also consider the significance of falling outside of these lines.

2.5 If an infant's head circumference falls within the 90th percentile for his/her age, what percentage of the children of the same age will have a head circumference that is larger and what percentage will have a head circumference that is the same or smaller than this infant?

2.6 If a child's BMI is at the 85th percentile for her age, what percentage of children of the same age will have a greater BMI and what percentage will have the same or a lower BMI?

The Centre for Disease Control and Prevention (CDC) says the following about children's BMI:
- If their BMI is greater than or equal to the 95th percentile, they are overweight;
- If their BMI is greater than or equal to the 85th percentile but less than the 95th percentile then they are at risk of being overweight; and
- If their BMI is less than the 5th percentile they are underweight.

2.7 Refer back to the graph. The uncoloured bar (for each age group) represents children whose BMI is below the 85th percentile. Do these children fit into the "overweight" category or the "at risk of being overweight" category, or not?

2.8 The grey bar on the graph represents children whose BMI is greater than or equal to ( ) the 85th percentile but below the 95th percentile. Are these children overweight?

2.9 The black bar on the graph represents children whose BMI is greater than or equal to ( ) the 95th percentile. Are these children overweight?

Let's check that you are keeping up:

2.10 The CDC says that children whose BMI is greater than or equal to the 85th percentile but less than the 95th percentile are at risk of being overweight. What percentage of children at any age are considered to be at risk of being overweight?

2.11 The CDC says that children whose BMI is greater than or equal to the 95th percentile are overweight. What percentage of children at any age are considered to be overweight?

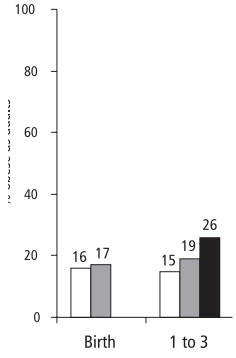
We are now ready to understand the graph.

2.12 We begin by referring to the part of the graph printed alongside. You will notice three bars for the children in the 1 to 3 year old age group.

2.12.1 Which children are represented by the uncoloured bar (on the left)? Are they children whose weight is acceptable, children who are at risk of being overweight or children who are overweight?

2.12.2 Which children are represented by the grey bar (in the middle)? Are they children whose weight is acceptable, children who are at risk of being overweight or children who are overweight?

2.12.3 Which children are represented by the black bar (on the right)?



2.13 The number on top of each bar corresponds to the value on the vertical axis. The vertical axis tells us what percentage of children will be obese when they are 25.

2.13.1 What percentage of the children in the 1 to 3 year old age group whose weight is currently acceptable will be obese when they are 25?

2.13.2 What percentage of the children in the 1 to 3 year old age group who are currently at risk of being overweight will be obese when they are 25?

2.13.3 What percentage of the children in the 1 to 3 year old age group who are currently overweight will be obese when they are 25?

2.14 Now consider the full graph and answer the following questions:

2.14.1 What percentage of children in the age group 6 to 10 who are overweight will end up being obese at age 25?

2.14.2 What percentage of children in the age group 10 to 15 who are at risk of being overweight will end up being obese at age 25?

2.14.3 What percentage of children in the age group 15 to 18 whose weight is acceptable will end up being obese at age 25?

2.15 In the previous question we looked at the graph to decide what percentage of a group of children will be obese when they are 25. This is only a prediction.

2.15.1 How do you think the CDC has made this prediction?

2.15.2 Since these are all predictions, do you think people should take notice of them?

2.16 Look at the trends in the bars on the graph and write a short paragraph about whether or not being overweight (or at risk of being overweight) at a young age is a good predictor of whether or not you will be obese when you reach 25.

Activity 3 — Collecting data to determine body frame size

ABOUT THIS ACTIVITY

In this activity students are required to draw up a data sheet in order to collect data for investigating body frame size. Using the measurements which the students acquire in a collection process, students must then classify peoples body frame size according to certain specified criteria, calculate the percentage over/underweight and draw pie charts and bar graphs to represent the data.

This activity is aligned with unit standard 9015 and addresses AC 2, 3, 5, 6, 7, 8 and 9 of SO1; AC 3 and 4 of SO2 and AC 1, 2 and 3 of SO3.

MANAGING THIS ACTIVITY

For question 3.3 of this activity student's are required to collect information from at least 10 adults. It would be a good idea to set this question as a homework task and to give the students a few days to collect the relevant information. For question 3.8 collected data should then be shared among all the students in the class – time must be allocated for arranging this.

3.1 No, this is not a reasonable statement to make. A person who is very tall and weighs 90kg may be very thin, but someone who is very short and weighs 90kgs would most probably be overweight.

3.2 A sample data collection sheet is shown below. Other data collection sheets such as a questionnaire could also be used. Students must have each of the columns listed below and must indicate the units of measurement.

DATA COLLECTION TABLE FOR INVESTIGATING BODY FRAME SIZE

Person no.	M/F	Height (in cm)	Weight (in kg)	Wrist circ (in cm)	Elbow breadth (in cm)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

3.3 Students should collect the required data for at least 10 people and record it on their data collection sheets..

3.4.1 The body frame size for each person is calculated according to table 1. For example:

- Person no. 2 (female) has a height of 165cm and a wrist measurement of 160mm and would be considered a MEDIUM body frame size.
- Person no. 6 (male) has a height of 165cm and a wrist measurement of 160mm and would be considered a SMALL body frame size.
- Person no. 9 (female) with a height of 155cm and a wrist measurement of 160mm would be considered a LARGE body frame size.

NOTE: The male body frame size measurements are only given for those who are taller than 163cm (information taken directly from the internet). Encourage the students to make a sensible choice for a male who is not as tall as this.

3.4.2 The body frame size for each person is calculated according to table 2. For example:

- Person no. 3 (female) has a height of 165cm and an elbow breadth of 55mm and would be considered a SMALL body frame size.
- Person no. 5 (male) has a height of 165cm and an elbow breadth of 72mm and would be considered a MEDIUM body frame size.
- Person no. 9 (female) has a height of 155cm and an elbow breadth of 65mm and would be considered a LARGE body frame size.

3.5 This will differ for each sample group used. In the example above, person no. 9 has the same body frame size for both methods of calculation.

A well-motivated choice is acceptable for the selected "better option".

3.6 The desirable body weight for each person is calculated according to table 3. For example:

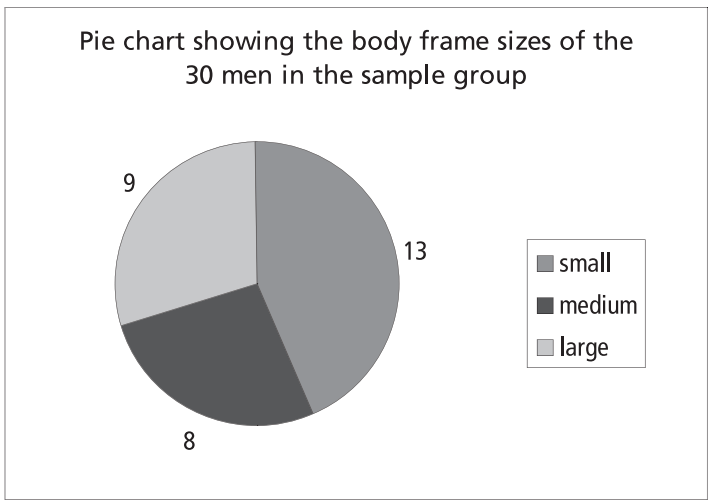
- Person no. 9 (female) with a height of 155cm and a LARGE body frame size should ideally be 56,8 – 63,6kg.

3.7 An example calculation for person no. 9, whose actual weight is 65kg. (Since the ideal weight is 56,8 – 63,6 we can take the average. Desirable weight is thus 60,2kg.)

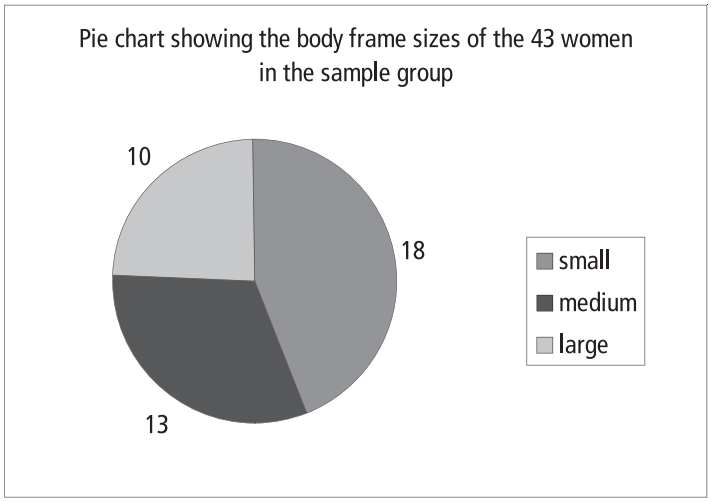
$$\frac{\text{actual weight} - \text{desirable weight}}{\text{desirable weight}} \times 100 = \frac{65 - 60{,}2}{60{,}2} \times = 9\% \text{ overweight}$$

3.8 Each graph should have a title, a key (and/or correctly labeled axes), and a scale (or measurements given on the graphs where appropriate).

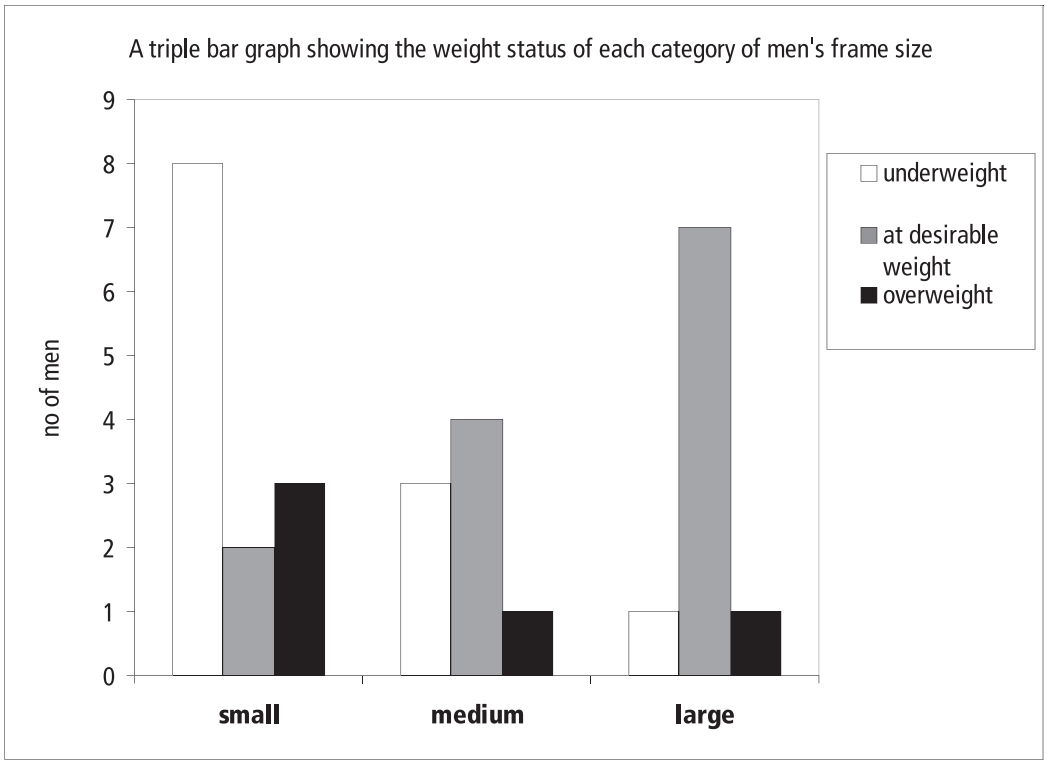
3.8.1 An example of a pie chart to show the frame sizes of the men in the combined data group.



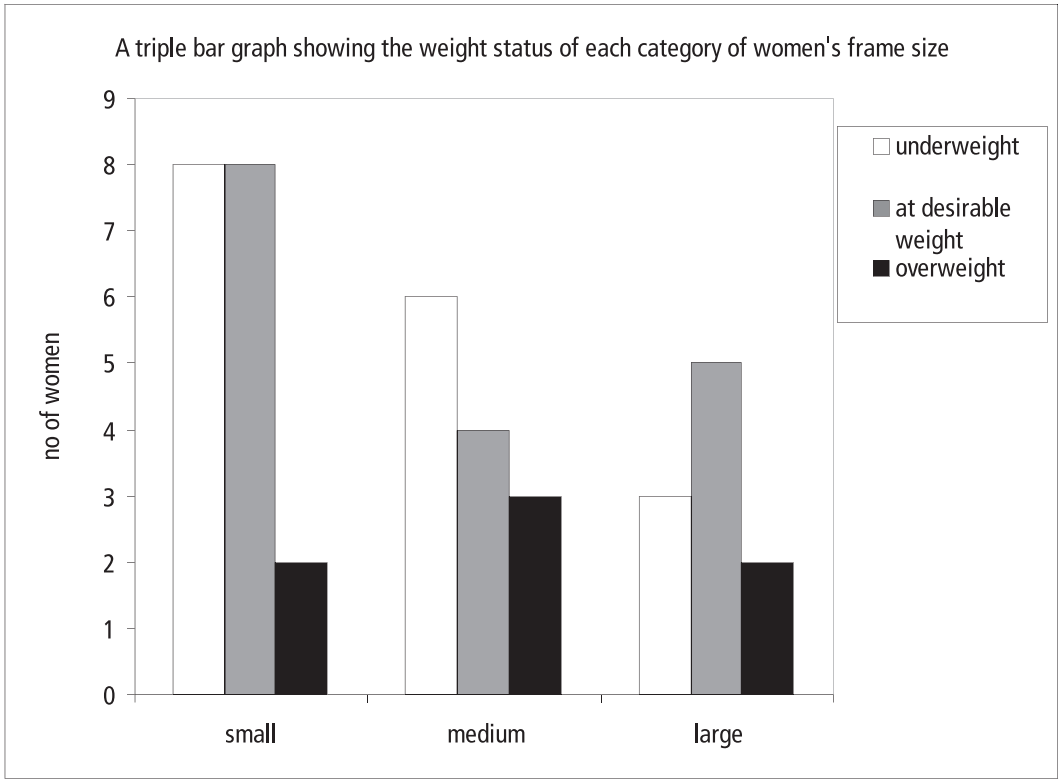
3.8.2 An example of a pie chart to show the frame sizes of the women in the combined data group.



3.8.3 An example of a triple bar graph for the men to show how many of them have a weight that is less than desirable, desirable or more than desirable for their frame size:



3.8.4 An example of a triple bar graph for the women to show how many of them have a weight that is less than desirable, desirable or more than desirable for their frame size:



Female Wrist Measurements			
Body Frame Size	Height less than 155 cm	Height 155 cm – 163 cm	Height more than 163 cm
Small	Less than 140 mm	Less than 152mm	Less than 159 mm
Medium	140 – 146 mm	152 - 159mm	159 – 165 mm
Large	More than 146 mm	More than 159mm	More than 165 mm

Male Wrist Measurements	
Body Frame Size	Height more than 163 cm
Small	140 – 165 mm
Medium	165 – 191 mm
Large	More than 191 mm

Table 1: Body Frame Sizes in terms of wrist measurements

Elbow Measurements for Medium Frame			
If your elbow breadth is less than those in the table for a specific height, you are small framed. Similarly, if your elbow breadth is bigger than those in the table, you are large framed.			
Female Elbow Measurements		Male Elbow Measurements	
Height (cm)	Elbow Breadth (mm)	Height (cm)	Elbow Breadth (mm)
146 - 148	57 - 64	155 - 158	64 - 73
150 - 158	57 - 64	160 - 168	67 - 73
160 - 168	60 - 67	170 - 178	70 - 75
170 - 178	60 - 67	180 - 188	70 - 79
180 - 190	63 - 70	190 - 198	73 - 83

Table 2: Body Frame Sizes in terms of elbow measurements

Activity 3 — Collecting data to determine body frame size

We will be returning to BMI (Body Mass Index) in the next activity but for now we are going to explore body frame size.

3.1 Consider the following statement: "All people who weigh 90 kg are overweight." Do you think that this is a reasonable statement to make? Make sure that you are ready to defend your answer.

Hopefully you will have realised, or through a class discussion been convinced, that the statement in 3.1 is too general. It does not take account of age, gender and in particular something doctors call body frame size. Although BMI is more commonly used these days to determine the best weight range for your health, doctors previously used body frame size to make the same predictions. There are three categories: small frame, medium frame and large frame. The definitions of a small, medium and large frame are quite obviously different for men and women.

There are two different ways of determining body frame size. These are described below:

a) **Using wrist circumference.** In this case we measure the wrist circumference and height of the person and use a table (see later) to determine his/her body frame.

b) **Using elbow breadth.** This is considered to be the more accurate method, although it is also the more difficult. In this case you need to measure the person's elbow width and height and again to use a table (see later) to determine his/her body frame. To measure a person's elbow width make him/her:

- Extend his/her arm so that it is horizontal and parallel to the ground.
- Turn his/her hand so that the palm is uppermost.
- Bend his/her elbow so that the forearm is at 90° to the ground.

Now use the thumb and forefinger of your hand to locate the narrow part of the elbow joint. Keep your thumb and forefinger steady and measure the distance between them.

We are now going to collect data for a large number of people in order to determine their body frame sizes. It is important that you remember that this is a data handling activity—we are neither doctors nor nutritionists and are not making judgments about people. For this reason you should be careful not to upset people and you should certainly not collect data from people who are unwilling to participate in our survey.

3.2 Before we can collect data we need a data collection sheet on which to do so. We want to collect appropriate data in order to determine body frame size by each of the two methods. We also need the weights of all the person so that we can later compare their weight with their desirable body weight. Finally, remember that the criteria for the different body frame sizes is different for men and women so you will have to record if the person is a man or a woman.

Design a data collection sheet for at least 10 people. You will be expected to show this to your lecturer before you begin to collect the data.

3.3 You are now ready to collect the data we need. You will need a measuring tape and a bathroom scale. Each member of the class should collect data for at least 10 different adults. NOTE: Height and weight tables we will use later assume that the people are wearing indoor clothing—so you do not have to ask the people you are "measuring" to take off their clothes .

3.4 Having collected the data you should now do the following:

3.4.1 Determine the body frame size for each person in your survey based on the wrist measurement (see table 1).

3.4.2 Determine the body frame size for each person in your survey based on the elbow measurement (see table 2).

3.5 For how many of the people in your study is their frame size the same (i.e. small, medium or large) irrespective of the method you use to determine it? Which method do you think is best? Discuss.

3.6 Using the frame size (based on the method you think is best) determine the desirable body weight for each person by referring to the height and weight data provided in table 3.

3.7 Calculate the percentage that each person is over/underweight for each person in your study as follows:

$$\frac{\text{actual weight} - \text{desirable weight}}{\text{desirable weight}} \times 100$$

3.8 You should now combine the data for all of the members of the class. You may want to share out the following tasks between the members of the class. Draw the following graphs:

3.8.1 A pie chart to show how many men in the combined data had small, medium and large body frames.

3.8.2 A pie chart to show how many women in the combined data had small, medium and large body frames.

3.8.3 A triple bar graph for the men to show how many of them have a weight that is less than desirable, desirable or more than desirable for their frame size.

3.8.4 A triple bar graph for the women to show how many of them have a weight that is less than desirable, desirable or more than desirable for their frame size.

Female Wrist Measurements			
Body Frame Size	Height less than 155 cm	Height 155 cm – 163 cm	Height more than 163 cm
Small	Less than 140 mm	Less than 152mm	Less than 159 mm
Medium	140 – 146 mm	152 - 159mm	159 – 165 mm
Large	More than 146 mm	More than 159mm	More than 165 mm

Male Wrist Measurements	
Body Frame Size	Height more than 163 cm
Small	140 – 165 mm
Medium	165 – 191 mm
Large	More than 191 mm

Table 1: Body Frame Sizes in terms of wrist measurements

Elbow Measurements for Medium Frame			
If your elbow breadth is less than those in the table for a specific height, you are small framed. Similarly, if your elbow breadth is bigger than those in the table, you are large framed.			
Female Elbow Measurements		Male Elbow Measurements	
Height (cm)	Elbow Breadth (mm)	Height (cm)	Elbow Breadth (mm)
146 - 148	57 - 64	155 - 158	64 - 73
150 - 158	57 - 64	160 - 168	67 - 73
160 - 168	60 - 67	170 - 178	70 - 75
170 - 178	60 - 67	180 - 188	70 - 79
180 - 190	63 - 70	190 - 198	73 - 83

Table 2: Body Frame Sizes in terms of elbow measurements

1999 Metropolitan Height and Weight (in kg) Tables for Men and Women according to frame, ages 25 - 59							
Women				Men			
Height (cm)	Small Frame	Medium Frame	Large Frame	Height (cm)	Small Frame	Medium Frame	Large Frame
148	46.4 - 50.5	49.6 - 55.1	53.7 - 59.8	158	58.3 - 61.0	59.6 - 64.2	62.8 - 68.3
149	46.6 - 51.0	50.0 - 55.5	54.1 - 60.3	159	58.6 - 61.3	59.9 - 64.5	63.1 - 68.8
150	46.7 - 51.3	50.3 - 55.9	54.4 - 60.9	160	59.0 - 61.7	60.3 - 64.9	63.5 - 69.4
151	46.9 - 51.7	50.7 - 56.4	54.6 - 61.4	161	59.3 - 62.0	60.6 - 65.2	63.8 - 69.9
152	47.1 - 52.1	51.1 - 57.0	55.2 - 61.9	162	59.7 - 62.4	61.0 - 65.6	64.2 - 70.5
153	47.4 - 52.5	51.5 - 57.5	55.6 - 62.4	163	60.0 - 62.7	61.3 - 66.0	64.5 - 71.1
154	47.8 - 53.0	51.9 - 58.0	56.2 - 63.0	164	60.4 - 63.1	61.7 - 66.5	64.9 - 71.8
155	48.1 - 53.6	52.2 - 58.6	56.8 - 63.6	165	60.8 - 63.5	62.1 - 67.0	65.3 - 72.5
156	48.5 - 54.1	52.7 - 59.1	57.3 - 64.1	166	61.1 - 63.8	62.4 - 67.6	65.6 - 73.2
157	48.8 - 54.6	53.2 - 59.6	57.8 - 64.6	167	61.5 - 64.2	62.8 - 68.2	66.0 - 74.0
158	49.3 - 55.2	53.8 - 60.2	58.4 - 65.3	168	61.8 - 64.6	63.2 - 68.7	66.4 - 74.7
159	49.8 - 55.7	54.3 - 60.7	58.9 - 66.0	169	62.2 - 65.2	63.8 - 69.3	67.0 - 75.4
160	50.3 - 56.2	54.9 - 61.2	59.4 - 66.7	170	62.5 - 65.7	64.3 - 69.8	67.5 - 76.1
161	50.8 - 56.7	55.4 - 61.7	59.9 - 67.4	171	62.9 - 66.2	64.8 - 70.3	68.0 - 76.8
162	51.4 - 57.3	55.9 - 62.3	60.5 - 68.1	172	63.2 - 66.7	65.4 - 70.8	68.5 - 77.5
163	51.9 - 57.8	56.4 - 62.8	61.0 - 68.8	173	63.6 - 67.3	65.9 - 71.4	69.1 - 78.2
164	52.5 - 58.4	57.0 - 63.4	61.5 - 69.5	174	63.9 - 67.8	66.4 - 71.9	69.6 - 78.9
165	53.0 - 58.9	57.5 - 63.9	62.0 - 70.2	175	64.3 - 68.3	66.9 - 72.4	70.1 - 79.6
166	53.6 - 59.5	58.1 - 64.5	62.6 - 70.9	176	64.7 - 68.9	67.5 - 73.0	70.7 - 80.3
167	54.1 - 60.0	58.7 - 65.0	63.2 - 71.7	177	65.0 - 69.5	68.1 - 73.5	71.3 - 81.0
168	54.6 - 60.5	59.2 - 65.5	63.7 - 72.4	178	65.4 - 70.0	68.6 - 74.0	71.8 - 81.8
169	55.2 - 61.1	59.7 - 66.1	64.3 - 73.1	179	65.7 - 70.5	69.2 - 74.6	72.3 - 82.5
170	55.7 - 61.6	60.2 - 66.6	64.8 - 73.8	180	66.1 - 71.0	69.7 - 75.1	72.8 - 83.3
171	56.2 - 62.1	60.7 - 67.1	65.3 - 74.5	181	66.6 - 71.6	70.2 - 75.8	73.4 - 84.0
172	56.8 - 62.6	61.3 - 67.6	65.8 - 75.2	182	67.1 - 72.1	70.7 - 76.5	73.9 - 84.7
173	57.3 - 63.2	61.8 - 68.2	66.4 - 75.9	183	67.7 - 72.7	71.3 - 77.2	74.5 - 85.4
174	57.8 - 63.7	62.3 - 68.7	66.9 - 76.4	184	68.2 - 73.4	71.8 - 77.9	75.2 - 86.1
175	58.3 - 64.2	62.8 - 69.2	67.4 - 76.9	185	68.7 - 74.1	72.4 - 78.6	75.9 - 86.8
176	58.9 - 64.8	63.4 - 69.8	68.0 - 77.5	186	69.2 - 74.8	73.0 - 79.3	76.6 - 87.6
177	59.5 - 65.4	64.0 - 70.4	68.5 - 78.1	187	69.8 - 75.5	73.7 - 80.0	77.3 - 88.5
178	60.0 - 65.9	64.5 - 70.9	69.0 - 78.6	188	70.3 - 76.2	74.4 - 80.7	78.0 - 89.4
179	60.5 - 66.4	65.1 - 71.4	69.6 - 79.1	189	70.9 - 76.9	74.9 - 81.5	78.7 - 90.3
180	61.0 - 66.9	65.6 - 71.9	70.1 - 79.6	190	71.4 - 77.6	75.4 - 82.2	79.4 - 91.2
181	61.6 - 67.5	66.1 - 72.5	70.7 - 80.2	191	72.1 - 78.4	76.1 - 83.0	80.3 - 92.1
182	62.1 - 68.0	66.6 - 73.0	71.2 - 80.7	192	72.8 - 79.1	76.8 - 83.9	81.2 - 93.0
183	62.6 - 68.5	67.1 - 73.5	71.7 - 81.2	193	73.5 - 79.8	77.6 - 84.8	82.1 - 93.9

Table 3: Desirable body weight by height and frame size

Activity 4 — Reading and using BMI graphs

ABOUT THIS ACTIVITY

In this activity we return to Body Mass Index (BMI). Students are required to calculate various children's BMI from given information, determine what percentile the child's BMI falls into (using the body mass index-for-age percentiles chart), and classify the child's health status indicated by this percentile placing. Students are also required to perform calculations which are applications of knowing a child's BMI or percentile placing.

This activity is aligned with unit standard 9015 and addresses AC 3, 4 7, 8 and 9 of SO1; AC 2, 3 and 4 of SO2 and AC 1, 3, 4 and 5 of SO3.

MANAGING THIS ACTIVITY

Students require the 2-page handout with the Boy and Girl Body mass index-by-age percentile chart.

4.1 BMI is always measured in kg/m^2, calculated as follows: $\text{BMI} = \dfrac{\text{Weight } (kg)}{(\text{Height } (m))^2}$

BUT, if your height measurement is given in cm,
remember that 1m = 100cm therefore cm ÷100 = m

$$\text{BMI} = \frac{kg}{\left(\frac{cm}{100}\right)^2} = \frac{kg}{\frac{cm^2}{10000}} = \frac{kg}{cm^2} \times 10000$$

Child	Gender	Age (yrs)	Weight (kg)	Height (cm)	BMI (kg/m2)
Dean	Male	15	50	158,5	19,9
Jonathan	Male	7	30	121	20,5
Joseph	Male	11	29,6	143	14,5
Megan	Female	19	66,8	163	25,1
Nisha	Female	4	19,1	101	18,7
Rachel	Female	15	68,3	151,5	29,8
Taariq	Male	4	16,2	102,5	15,4
Tamsyn	Female	7	23,3	121,5	15,8
Wesley	Male	19	88	178	27,8
Zibya	Female	11	32,5	153	13,9

4.2 The BMI provides you with an indicator of the child's health. On its own, however, it is less useful for children than for adults.

For children in the 2 to 20 year old age group we use the following guidelines (recall worksheet 1) developed by The Centre for Disease Control and Prevention (CDC):

- If a child's BMI is greater than or equal to the 95th percentile, he/she is overweight.
- If the BMI is greater than or equal to the 85th percentile but less than the 95th percentile then the child is at risk of being overweight.
- If the BMI is less than the 5th percentile the child is underweight or malnourished.

The CDC developed these guidelines by comparing the BMI data for an extremely large sample of children. Based on their sample, the CDC has developed a graph of BMI-for-age percentiles for both boys and for girls (see handout).

4.3 The percentile placing for each child according to the handout: (answers in bold)

Child	M/F	**Age (yrs)**	Weight (kg)	Height (cm)	**BMI (kg/m2)**	**Percentile Placing**
Dean	M	**15**	50	158,5	**19,9**	**= 50th**
Jonathan	M	**7**	30	121	**20,5**	**> 95th**
Joseph	M	**11**	29,6	143	**14,5**	**< 5th**
Megan	F	**19**	66,8	163	**25,1**	**> 75th (but < 85th)**
Nisha	F	**4**	19,1	101	**18,7**	**> 95th**
Rachel	F	**15**	68,3	151,5	**29,8**	**>95th**
Taariq	M	**4**	16,2	102,5	**15,4**	**<50th**
Tamsyn	F	**7**	23,3	121,5	**15,8**	**> 50th (but < 85th)**
Wesley	M	**19**	88	178	**27,8**	**> 90th (but < 95th)**
Zibya	F	**11**	32,5	153	**13,9**	**< 5th**

4.4

Child	M/F	BMI (kg/m2)	Percentile Placing	**Classification**
Dean	M	19,9	= 50th	**fine**
Jonathan	M	20,5	> 95th	**obese**
Joseph	M	14,5	< 5th	**underweight**
Megan	F	25,1	> 75th (but < 85th)	**fine**
Nisha	F	18,7	> 95th	**obese**
Rachel	F	29,8	>95th	**obese**
Taariq	M	15,4	<50th	**fine**
Tamsyn	F	15,8	> 50th (but < 85th)	**fine**
Wesley	M	27,8	> 90th (but < 95th)	**at risk of being overweight**
Zibya	F	13,9	< 5th	**underweight**

4.5.1 Yes, a BMI of between 18 and 19. For an 18, 19 or 20 year old boy this is classified as underweight, but for a 4 or 5 year old this is classified as overweight (obese).

4.5.2 A girl with a BMI of 18 would be:
- Overweight if she is 4 years old.
- At risk of being overweight if she is 2, 3, 5, or 6 years old.
- Fine if she is aged 7 – 20 years old.
- Not be considered underweight or malnourished.

4.5.3 For a 5½ year old boy, an acceptable BMI range would be greater than 13,8kg/m2 but no more than 16,8kg/m2.

If he is 1,05m tall, then the corresponding acceptable weight range would be calculated as follows:

$$\text{Since: BMI} = \frac{\text{Weight } (kg)}{(\text{Height } (m))^2} \text{ Then BMI} \times (\text{Height } (m))^2 = \text{Weight } (kg)$$

$$13{,}8 \times (1{,}05)^2 = 15{,}2\text{kg} \quad \text{and} \quad 16{,}8 \times (1{,}05)^2 = 18{,}5\text{kg}$$

Therefore the corresponding acceptable weight range would be 15,2kg – 18,5kg

4.5.4 For a 6¾ year old girl, an acceptable BMI range would be greater than 13,4kg/m2 but less than 17,5kg/m2. If she is 1,15m tall then the corresponding acceptable weight range would (calculated as in question 4.5.2) would be 17,7kg – 23,1kg.

4.5.5 A 4¼ year old boy with a weight of 19kg and a BMI placing him at the 50th percentile for his age means that his corresponding BMI must be 15,6kg/m2. Therefore, his height would be calculated as follows:

$$\text{Since:} \quad \text{BMI} = \frac{\text{Weight } (kg)}{(\text{Height } (m))^2} \text{ Then } \frac{\text{Weight } (kg)}{\text{BMI}} = (\text{Height } (m))^2$$

Therefore: $\frac{19}{15,6}$ = (Height (*m*))^2 ∴ (Height)^2 = 1,22 ∴ Height = 1,104m

4.5.6 If the weight of the 3¾ year old girl is 1kg and she is undernourished, then she must have a BMI of less than 13,8kg/m2. Therefore her height would be calculated (as in question 4.5.5) as at least 0,27m.

4.6 Very important.

4.6.1 You have weighed her and found her to be 23,5kg and have measured her height as 118 cm, therefore you would calculate her BMI to be 16,8kg/m2.

But, since your colleague has weighed her and also found her to be 23,5kg but has measured her height as 116 cm, he/she would calculate her BMI to be 17,5 kg/m2. This is a difference of 0,7 kg/m2. More importantly, if Rose's BMI is 16,8kg/m2 then, for her age, her health status would be considered fine, but if Rose's BMI is 17,5kg/m2 then she would be considered at risk of becoming overweight.

4.6.2 You have weighed him and found him to be 17,750kg and have measured his height as 114 cm. You would thus calculate his BMI to be 13,66kg/m2 and he would therefore be considered underweight for his age.

But, since your colleague has weighed him and also found him to be 17,750kg but has measured his height as 110 cm, he/she would calculate Thabang's BMI to be 16,67kg/m2 therefore his health status would be fine for his age.

4.6.3 You have weighed her and found her to be 19,3kg and have measured her height as 120 cm. You would thus calculate her BMI to be 13,4kg/m2 and she would therefore be considered underweight for her age. But, since your colleague has weighed her and found her to be 21,02kg although she has also measured her height as 120 cm, she would calculate Portia's BMI to be 14,6kg/m2 and therefore her health status would be fine for her age.

4.6.4 You have weighed him and found him to be 20,09kg and have measured his height as 110 cm. You would thus calculate his BMI to be 16,6kg/m2 and his health status would be considered fine for his age.

But, since your colleague has weighed him and found him to be 21,78kg, although she has also measured his height as 110 cm, she would calculate Jacob's BMI to be 18kg/m2 and therefore he would be considered obese for his age.

4.6.5 You have established the following: weight = 14,60kg and height = 98cm

∴ BMI = 15,2 kg/m2 and her health status would be considered fine for her age.

But, your colleague has established the following:

weight = 14,20kg and height = 102cm BMI = 13,6 kg/m2 and she would be considered underweight for her age.

4.6.6 You have established the following: weight = 25,80kg and height = 118cm

∴ BMI = 18,53 kg/m2 and he would be considered at risk of becoming overweight.

But, your colleague has established the following:

weight = 25,40kg and height = 121cm. BMI = 17,35 kg/m2 and his health status would be considered fine.

If Teboho is 7¾ years old, then both of these BMI calculations would be considered fine.

Activity 4 — Reading and using BMI graphs

We now return to BMI (Body Mass Index) which we introduced in activity 2. As we stated in activity 2, BMI is a measure used by doctors to determine the best weight range for a person's health—it is an approximate measure of your total body fat. It is calculated using a person's height and weight (see later). Although weight lifters, pregnant women and one or two other special categories of people are considered exceptions, a person's BMI relates quite closely to the amount of body fat that he/she has. As a crèche teacher you are obviously concerned with the welfare of the children in your school. While medical check-ups are not part of your job description, you may nevertheless want to monitor the "health" of the children in your care and to refer to a doctor those children that are a cause of concern to you. BMI provides you with one objective way of looking at one aspect of health—the weight of children.

BMI is calculated as follows:

$$\text{BMI} = \frac{\text{Weight } (kg)}{(\text{Height } (m))^2} \text{ or}$$

$$\text{BMI} = \frac{\text{Weight } (kg)}{(\text{Height } (cm))^2} \times 1000 \text{ if you measure the height of the child in centimeters.}$$

4.1 Calculate the BMI for each of the following children and fill it in on the table:

Child	Gender	Age (yrs)	Weight (kg)	Height (cm)	BMI (kg/m^2)
Dean	Male	15	50	158,5	
Jonathan	Male	7	30	121	
Joseph	Male	11	29,6	143	
Megan	Female	19	66,8	163	
Nisha	Female	4	19,1	101	
Rachel	Female	15	68,3	151,5	
Taariq	Male	4	16,2	102,5	
Tamsyn	Female	7	23,3	121,5	
Wesley	Male	19	88	178	
Zibya	Female	11	32,5	153	

4.2 Does the BMI tell you anything about each child? Discuss.

For adults we say that a BMI of:
- below 18,5 suggests that you are very underweight or malnourished;
- under 20 indicates that you are underweight;
- between 20 and 24,9 corresponds to a healthy weight range for young and middle aged adults while a BMI between 23 and 28 corresponds to a healthy weight range for older adults;
- between 25 and 29,9 suggests that you are overweight; and
- over 30 indicates that you are overweight or obese.

However, the same does not apply for children under 20. For children in the 2 to 20 year old age group we use the following guidelines (recall worksheet 1) developed by the Centre for Disease Control and Prevention (CDC):
- If a child's BMI is greater than or equal to the 95th percentile, he/she is overweight.
- If the BMI is greater than or equal to the 85th percentile but less than the 95th percentile then the child is at risk of being overweight.
- If the BMI is less than the 5th percentile the child is underweight or malnourished.

The CDC developed these guidelines by comparing the BMI data for an extremely large sample of children. Based on their sample the CDC has developed a graph of BMI-for-age percentiles for both boys and for girls (see handout).

4.3 For each of the children in the table in question 4.1 determine, from the appropriate graph (see handout), at what percentile their BMI places them.

4.4 In terms of the CDC guidelines on being overweight etc., determine which of the children are:
- overweight.
- at risk of being overweight.
- fine.
- underweight or malnourished.

4.5 By referring to the appropriate graph, answer each of the questions below:

4.5.1 Is there a BMI for boys that would correspond to being overweight at one age yet underweight for another? If so, what is the BMI and what are the corresponding ages?

4.5.2 For what age ranges would we think of a girl with a BMI of 18 as being:
overweight?
- at risk of being overweight?
- fine?
- underweight or malnourished?

4.5.3 Consider a 5½ year old boy:
- What would be an acceptable BMI range if he is at risk of being neither overweight nor malnourished?
- If he is 1,05m tall, to what weight range does the acceptable BMI range correspond?

4.5.4 Consider a 6¾ year old girl:
- What would be an acceptable BMI range if she is at risk of being neither overweight nor malnourished?
- If she is 1,15m tall, to what weight range does the acceptable BMI range correspond?

4.5.5 You weighed a 4¼ year old boy and recorded his weight as 19kg. After doing your calculations you established that his BMI placed him at the 50th percentile for his age. How tall was the boy?

4.5.6 You have recorded the weight of a 3¾ year old girl as 1kg. You have told the parents that according to your calculations her BMI suggests that she is undernourished. How tall can the girl be?

4.6 How important is it to take the measurements you use to determine a child's BMI accurately? Consider the following cases to help you decide.

4.6.1 Rose is a 6¼ year old girl.
You have weighed her and found her to be 23,5kg and have measured her height as 118 cm.
Your colleague has weighed her and also found her to be 23,5kg but has measured her height as 116 cm.
How will your different values for her height impact on your analyses of Rose's BMI?

4.6.2 Thabang is a 5¾ year old boy.
You have weighed him and found him to be 17,750kg and have measured his height as 114 cm.
Your colleague has weighed him and also found him to be 17,750kg but has measured his height as 110 cm.
How will your different values for his height impact on your analyses of Thabang's BMI?

4.6.3 Portia is a 7¼ year old girl.
You have weighed her and found her to be 19,3kg and have measured her height as 120 cm.
Your colleague has weighed her and found her to be 21,02kg.She has also measured her height as 120 cm.
How will your different values for her weight impact on your analyses of Portia's BMI?

4.6.4 Jacob is a 4½ year old boy.
You have weighed him and found him to be 20,09kg and have measured his height as 110 cm.
Your colleague has weighed him and found him to be 21,78kg. She has also measured his height as 110 cm.
How will your different values for his weight impact on your analyses of Jacob's BMI?

4.6.5 Jo-Anne is a 4 year old girl.
You have established the following: weight = 14,60kg and height = 98cm.
Your colleague has established the following: weight = 14,20kg and height = 102cm. How will your different values impact on your analyses of Jo-Anne's BMI?

4.6.6 Teboho is a 7 year old boy.
You have established the following: weight = 25,80kg and height = 118cm.
Your colleague has established the following: weight = 25,40kg and height = 121cm. How will your different values impact on your analyses of Jo-Anne's BMI?
Would it make a difference if you later establish that Teboho was 7 years and 9 months old on the day you and your colleague took the measurements?

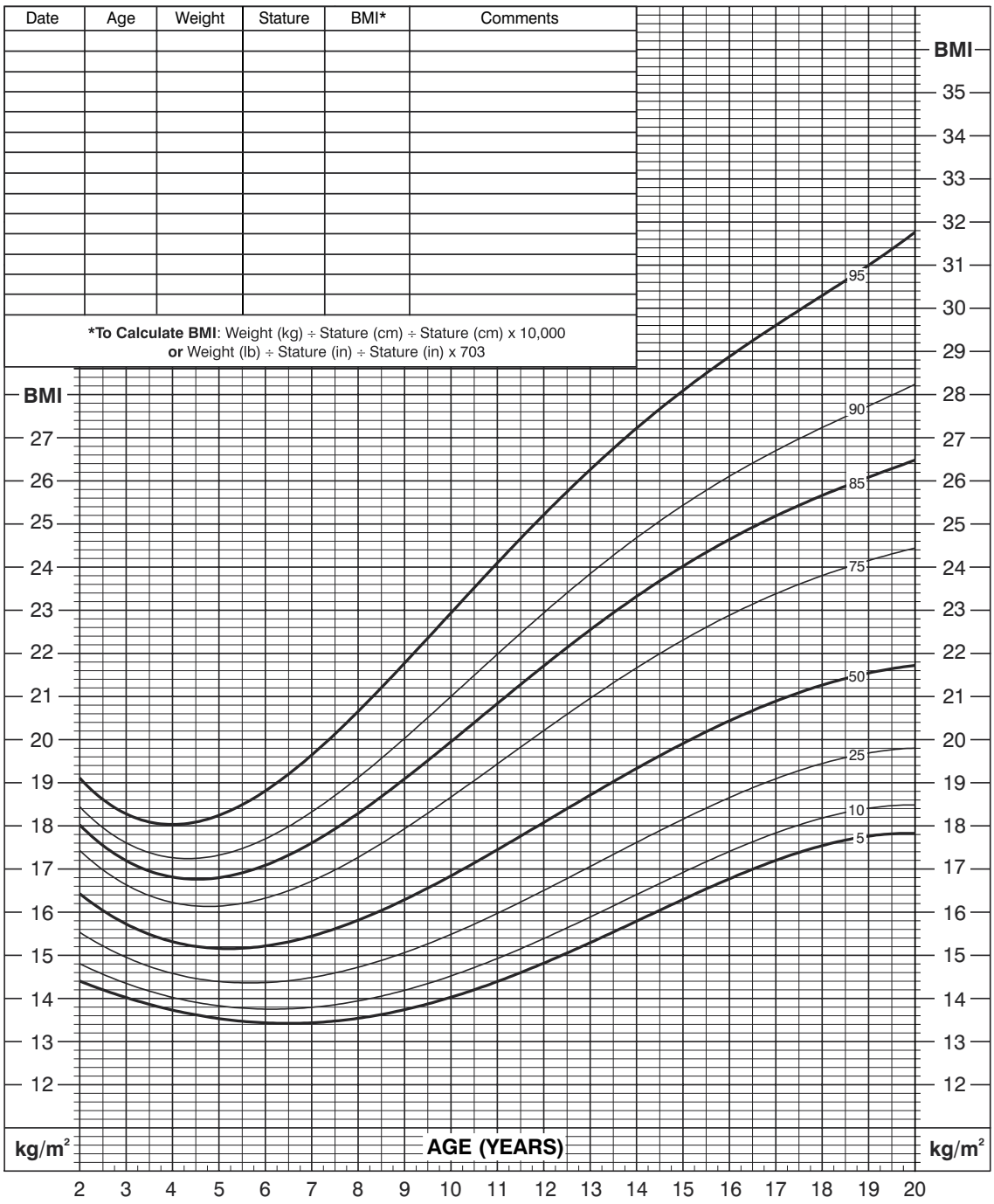
2 to 20 years: Girls
Body mass index-for-age percentiles

NAME _____

RECORD # _____

Date	Age	Weight	Stature	BMI*	Comments

***To Calculate BMI**: Weight (kg) ÷ Stature (cm) ÷ Stature (cm) x 10,000
or Weight (lb) ÷ Stature (in) ÷ Stature (in) x 703



Published May 30, 2000 (modified 10/16/00).
SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).
http://www.cdc.gov/growthcharts

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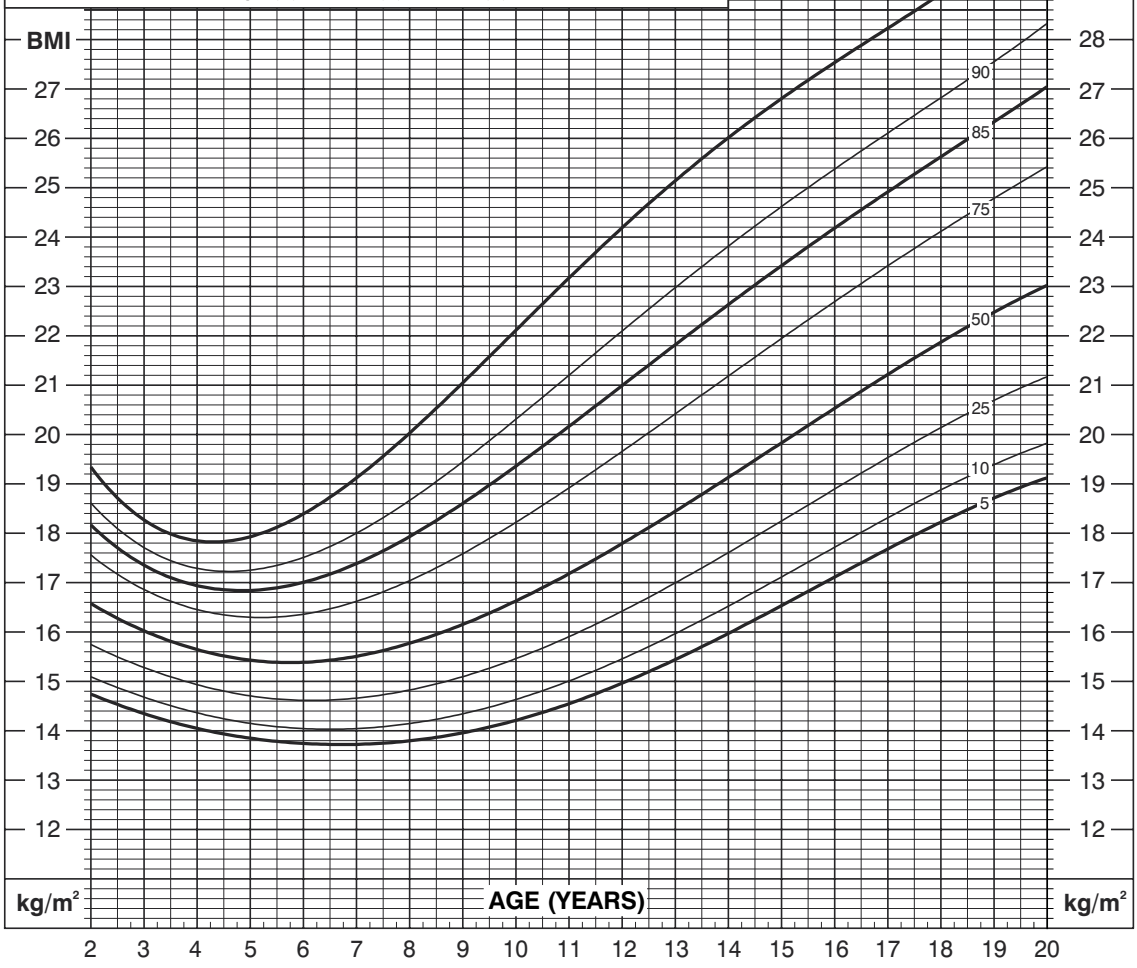
2 to 20 years: Boys
Body mass index-for-age percentiles

NAME _____

RECORD # _____

Date	Age	Weight	Stature	BMI*	Comments

***To Calculate BMI**: Weight (kg) ÷ Stature (cm) ÷ Stature (cm) x 10,000
or Weight (lb) ÷ Stature (in) ÷ Stature (in) x 703



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Activity 5 — BMI data project

ABOUT THIS ACTIVITY

This activity is well-suited to be used as an assessment activity (in the form of a project). It is intended to recap principles/skills that have been learnt in the first four activities. There is an opportunity for learners to make their data collection sheet, collect data, analyse this data and summarise the data using tables and graphs in your summary.

This activity is aligned with unit standard 9015 and addresses AC 1, 2, 3, 5, 6, 7, 8 and 9 of SO1; AC 1, 2, 3 and 4 of SO2 and AC 1, 2, 3 and 4 of SO3.

MANAGING THIS ACTIVITY

It is not possible to provide complete solutions to this activity as each student's collected data will be different. However, the principles follow directly from the previous activities. An example of a data collection sheet is given below, with a sample child's information.

BMI DATA COLLECTION SHEET										
No.	M/F	Age (yrs)	Age (mths)	Height (cm)	Weight (kg)	BMI (kg/m2)	BMI-for-age percentile	BMI classification	"Road to Health" percentile	"Road to Health" classification
1	*F*	*2,5*	*29*	*94,8*	*15.35*	*17,08*	*< 85th*	*fine*	*>50th*	*fine*
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										

Activity 5 — BMI data project

It is now time for you to do your own data collection and analysis.

In this activity you must collect data on a large group of children between the ages of 2 and 5 years. You will then analyse the data and draw conclusions and/or make predictions from it.
The South African Department of Health (DoH) has developed a "Road to Health Chart." This chart is given to young mothers by doctors and by the nursing staff at the various children's clinics around the country. Mothers use this to record their infant's weight between the ages of 0 and 60 months (five years). This chart has three important lines on it: the 3rd, 50th and 97th percentile lines for infants' weight.

To complete this project you should:

- Get your own copy of the "Road to Health Chart".
- Identify a community, for example the infants at a Sunday school, the children of your friends and family or even the children in a local crèche.
- Complete the following tasks:
- Describe the community that you have studied in terms of its BMI profile with particular reference to the number of children who seem to be overweight, at risk of being overweight and/or underweight or malnourished.
- Describe the community that you have studied in terms of its weight profile with particular reference to the number who are below the 3rd percentile, between the 3rd and 50th percentile, between the 50th and 97th percentile and above the 97th percentile.
- Compare the two ways of analysing the wellbeing of infants—namely by means of their BMI or their weight on the "Road to Health Chart".

NOTE: This is a data handling activity—you are NOT passing judgments on a community and/or its health. You are not qualified to do so! For this reason you should not force anybody to participate against his/her wishes. You should probably also not write down the names of any of the participants.
To complete the project you should include the following steps:

5.1 Develop an appropriate data collection sheet. You will be expected to hand this in.

5.2 Collect the data. You will be expected to hand in your completed data collection sheet. In addition you should write a paragraph in which you describe the precautions you took to ensure that the data you collected was as accurate as possible.

5.3 Analyse the data. You should do the necessary calculations to determine the BMI for each infant and then classify each infant according to the BMI-for-age percentile. Based on this you should classify the weight risk (overweight, at risk of being overweight and/or underweight or malnourished etc.) You should also plot his/her weight on the DoH "Road to Health Chart" and classify this weight in terms of the percentile into which it falls.

5.4 Summarise the data. You must describe the community you surveyed based on the data you have collected and your analyses.

- Your description should tell the reader/audience about the trends you have identified in the community and the implications for health programmes. For example, you might want to motivate for a feeding programme at the crèche etc.
- It would be a good idea to include graphs and tables in your summary/presentation.
- Your summary/presentation must also be clear about the limitations of your research. For example, if you only collected data for 10 children out of a community of 1 000, you cannot tell us that much about the whole community. However, if you collected data for each child in a crèche and 90% of the children are at risk of being underweight, you have a stronger case.

Activity 6 — Making a game part 1

ABOUT THIS ACTIVITY

In this activity we begin the process of making a mathematical game. Students first experiment with ordinary dice calculating the probability and the relative frequency and comparing these. The activity then moves onto using specifically designed dice with different colours on each of the faces. Using their knowledge of statistics, students are required to make predictions about how many times they expect the dice to land on the different colours. Following this, students record experiments and collect cumulative frequencies for each of the colours and represent this in table and graphical form.

This activity is aligned with unit standard 9015 and addresses AC 1, 2, 3, 4, 5, 6, 7 and 8 of SO1; AC 1, 2, 3 and 4 of SO2 and AC 1, 2, 3 and 4 of SO3.

MANAGING THIS ACTIVITY

Students are required to make 2 special dice each. They should come to class with 2 ordinary dice; colouring pens and some white sticky labels that can be cut up and stuck onto the faces of the dice.

6.1.1 1 die has 6 faces.

6.1.2 No. You have a 1 in 6 chance of getting each of the numbers.

6.1.3 A set of possible results are shown below

Possible outcomes	Tally	Frequency
1	////	4
2	///	3
3	~~////~~	5
4	//	2
5	////	4
6	~~////~~ /	6

6.2 Total number of blue faces = 4 Total number of orange faces = 3

Total number of red faces = 3 Total number of purple faces = 2

6.2.1 You should expect to the blue face more often because there are more blue faces than the other colours. The two dice will behave differently. If you roll only the first die, you are more likely to get a blue face than the other colours and if you roll the second die you would expect to get an orange or a red face more often than a blue or a purple face.

6.2.2 For die 1: 3/6 faces are blue, therefore you expect to get 12 blues in 24 rolls; 1/6 faces are orange/red/purple, therefore you expect to get 4 oranges, 4 reds and 4 purples in 24 rolls.

6.2.3 If the results are not what we expected it is because we have only rolled 24 times. The more throws we record, the closer the results will be to the expected results.

6.2.4 Yes, the results should be more accurately similar to those that we predicted.

6.3 The table should be completed accordingly.

Die being studied: 1								
Results for 24 rolls per group						Cumulative frequency		
Group no	Blue	Orange	Red	Purple	Total	Total blue	Total rolls	Fraction blue
Gloria	10	5	4	5	24	10	24	10/24
Thandi	13	4	3	4	24	23	48	23/48
Lydia	15	2	6	1	24	38	72	38/72
Mpumi	9	6	3	4	24	47 →	96 →	47/96
					Always 24	Column 1 total	Multiples of 24	total blue / total rolls

6.4 The table should be completed accordingly.

6.5.1 If you roll a die 24 times, the maximum number of outcomes 24. If this is shown as a fraction then the maximum is $\frac{24}{24}$ =1. This is why the vertical axis only goes up to 1 .

6.5.2 It is likely that the graph might look quite erratic to begin with but it will start to stabilize eventually.

6.5.3 The trend is that if you roll one dice you have "half" (0,5) a chance of getting a blue face.

6.6 Die 1

- P(blue) = $\frac{\text{no. of blue faces}}{\text{total no. of faces}} = \frac{3}{6}$
- P(orange) = $\frac{\text{no. of orange faces}}{\text{total no. of faces}} = \frac{1}{6}$
- P(red) = $\frac{\text{no. of red faces}}{\text{total no. of faces}} = \frac{1}{6}$
- P(purple) = $\frac{\text{no. of purple faces}}{\text{total no. of faces}} = \frac{1}{6}$

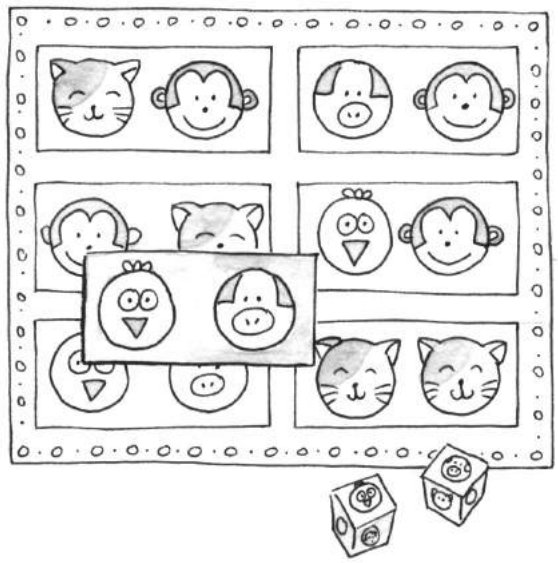
Die 2

- P(blue) = $\frac{\text{no. of blue faces}}{\text{total no. of faces}} = \frac{1}{6}$
- P(orange) = $\frac{\text{no. of orange faces}}{\text{total no. of faces}} = \frac{2}{6}$
- P(red) = $\frac{\text{no. of red faces}}{\text{total no. of faces}} = \frac{1}{6}$
- P(purple) = $\frac{\text{no. of purple faces}}{\text{total no. of faces}} = \frac{1}{6}$

Activity 6 — Making a game part 1

Over the next few activities we are going to make a board game. The game is similar to Bingo and is intended for young children aged 3 and up. It can be played by two or three children at a time. It is an educational game intended to help children develop several skills, including matching shapes.
Our interest in these activities is, however, limited to the design of the game. We want to design the game in such a way that it is as fair as possible and at the same time exciting. The game is explained briefly below.

Animal Bingo



The game will consist of:
- 3 different playing boards.
- Each board is a different colour.
- Each board has 6 places on it with each place having two animal pictures.
- There are 6 cards for each board with each of the cards matching one of the places on the board.
- 2 dice—each die has the pictures used on the boards and cards on its faces.

The game is played as follows:
- Each player is given a board and the cards for the board.
- The players take turns to roll the two dice.
- After the roll of the dice, each player that is playing looks to see if he/she has a card with the two pictures that match the two pictures on the die that have come up. If this is the case, the player takes take the card and covers the corresponding space on the board with it. NOTE: more than one player might pick up a card and place it on his/her board.
- The first player to cover all of his/her places wins.

We are going to start by designing the die that we will use for the game.

6.1 You will need one die. Answer the following questions regarding the die:

6.1.1 How many faces does the die have?

6.1.2 When you roll a die do you expect any of the numbers to come up more or less frequently than the others? In other words: do you think that there are some numbers that are "easier to get" than others? Discuss.

6.1.3 Roll the die 24 times and record the results of each roll. Do the results compare with your "predictions" above? If not, why do you think this is?

6.1.4 Combine the results of your 24 rolls with each of the other members in the class. Do the combined results compare more favourably with your predictions? Discuss.

The dice that we are going to use in the game we are developing are different. To make the dice, you should take two ordinary dice and stick stickers onto the faces as follows. When you make your own game later on you can use your own choice of animals, shapes etc. For now we will use colours so that the rest of the worksheet makes sense.

Die 1: Face 1, face 2 and face 3: **BLUE**
Face 4: **ORANGE**
Face 5: **RED**
Face 6: **PURPLE**

Die 2: Face 1: **BLUE**
Face 2 and face 3: **ORANGE**
Face 4 and face 5: **RED**
Face 6: **PURPLE**

6.2 Answer the following questions regarding the dice you have manufactured:

6.2.1 When you roll each of these die do you expect each colour to come up as often as the others or do you expect one or more of the colours to come up more often than the others? Discuss, focusing on whether you expect the two dice to behave differently or not.

For one of the die:

6.2.2 Predict how many times you expect to get each of the colours when you roll the die 24 times.

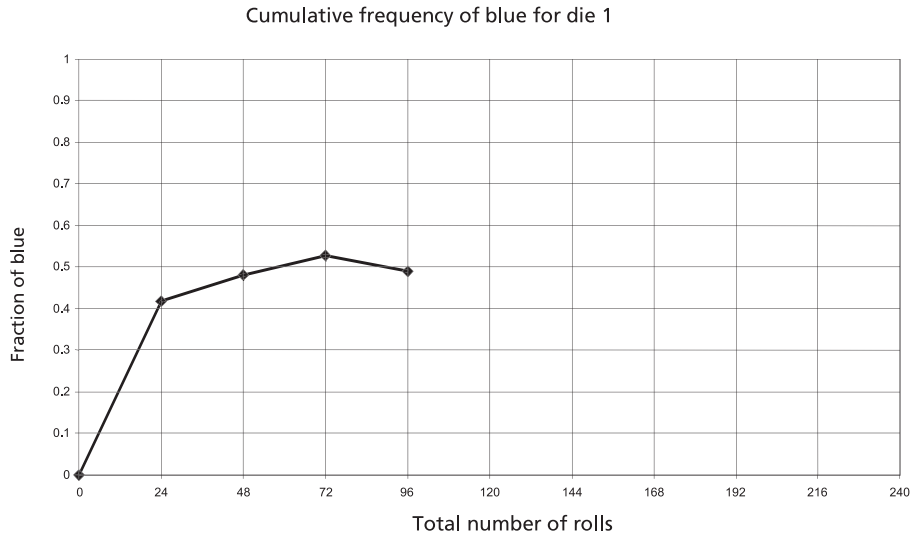
6.2.3 Roll the die 24 times and record the results of each roll. Do the results compare with your prediction above? If not, why do you think this is the case?

6.2.4 Combine the results of your 24 rolls with each of the other members in the class who worked on the same die. Do the combined results compare more favourably with your predictions? Discuss.

6.3 Draw and complete a table like the one below for the die that you worked on in 6.2 (four sample rows have been completed for clarity):

Die being studied: __1__								
Results for 24 rolls per group						Cumulative frequency		
Group no	Blue	Orange	Red	Purple	Total	Total blue	Total rolls	Fraction blue
Gloria	*10*	*5*	*4*	*5*	*24*	*10*	*24*	*10/24*
Thandi	*13*	*4*	*3*	*4*	*24*	*23*	*48*	*23/48*
Lydia	*15*	*2*	*6*	*1*	*24*	*38*	*72*	*38/72*
Mpumi	*9*	*6*	*3*	*4*	*24*	*47*	*96*	*47/96*
					Always 24	*Column 1 total*	*Multiples of 24*	total blue / total rolls

6.4 Use the cumulative frequency data collected in your table to complete the graph below. The sample data from the table above has been plotted to show you what is expected.



6.5 Answer the following questions based on your graph:

6.5.1 Why does the vertical axis only go up to 1?

6.5.2 Describe the trend for your data.

6.5.3 What does this trend tell you about the likelihood of getting a blue face when you roll die 1?

6.6 The likelihood of getting a blue face (or the probability of getting a blue face, expressed as P(blue)) is usually expressed as a simple fraction (or percentage)—for example, "The likelihood that it will rain tomorrow is 1 in 4 (¼) or 25%".

Based on your experimentation and understanding of the two die complete the following statements:

Die 1

- P(blue) =
- P(orange) =
- P(red) =
- P(purple) =

Die 2

- P(blue) =
- P(orange) =
- P(red) =
- P(purple) =

Activity 7 — Making a game part 2

ABOUT THIS ACTIVITY

In this activity we extend the process of making a mathematical game but experimenting with 2 colour results at the same time. Students are required to complete a tree diagram in order to examine theoretical predictions (probabilities) and compare these to experimental findings.

This activity is aligned with unit standard 9015 and addresses AC 2, 3, 5, 6, and 7 of SO1; AC 1, 2, 3 and 4 of SO2 and AC 1, 2, 3 and 4 of SO3.

MANAGING THIS ACTIVITY

It is a good idea to clarify at some stage during the activity (perhaps only necessary after some experimentation in the first few questions) that the colour pair Blue-Red and the colour pair Red-Blue, for example, are considered the same outcome/result. This explains why there are in fact only 10 possible colour pair options.

7.1

Only 10 Colour Pair options		
1. Blue – Blue		
2. Blue – Red	or	Red – Blue
3. Blue – Orange	or	Orange – Blue
4. Blue – Purple	or	Purple – Blue
5. Orange – Red	or	Red – Orange
6. Orange – Purple	or	Purple - Orange
7. Orange – Orange		
8. Red – Purple	or	Purple – Red
9. Red – Red		
10. Purple – Purple		

7.2 The lists should all be the same, but if not perhaps the point should be made that in fact Blue – Red is the same as Red – Blue.

7.3 Here is a sample:

Colour pair	Tally	Frequency	Fraction of results
Blue – Blue	///	3	$\frac{3}{75}$
Blue – Red	~~////~~ ~~////~~ ~~////~~	15	$\frac{15}{75}$
Blue – Orange	~~////~~ ~~////~~ ~~////~~ /	16	$\frac{16}{75}$
Orange – Orange	~~////~~	5	$\frac{5}{75}$
Orange – Red	~~////~~ ////	9	$\frac{9}{75}$
Orange – Purple	~~////~~	5	$\frac{5}{75}$
Red – Red	////	4	$\frac{4}{75}$
Red – Purple	~~////~~ /	6	$\frac{6}{75}$
Purple – Purple	////	4	$\frac{4}{75}$

Make sure that the total for the frequency column is 75.

7.4 Students' results will vary.

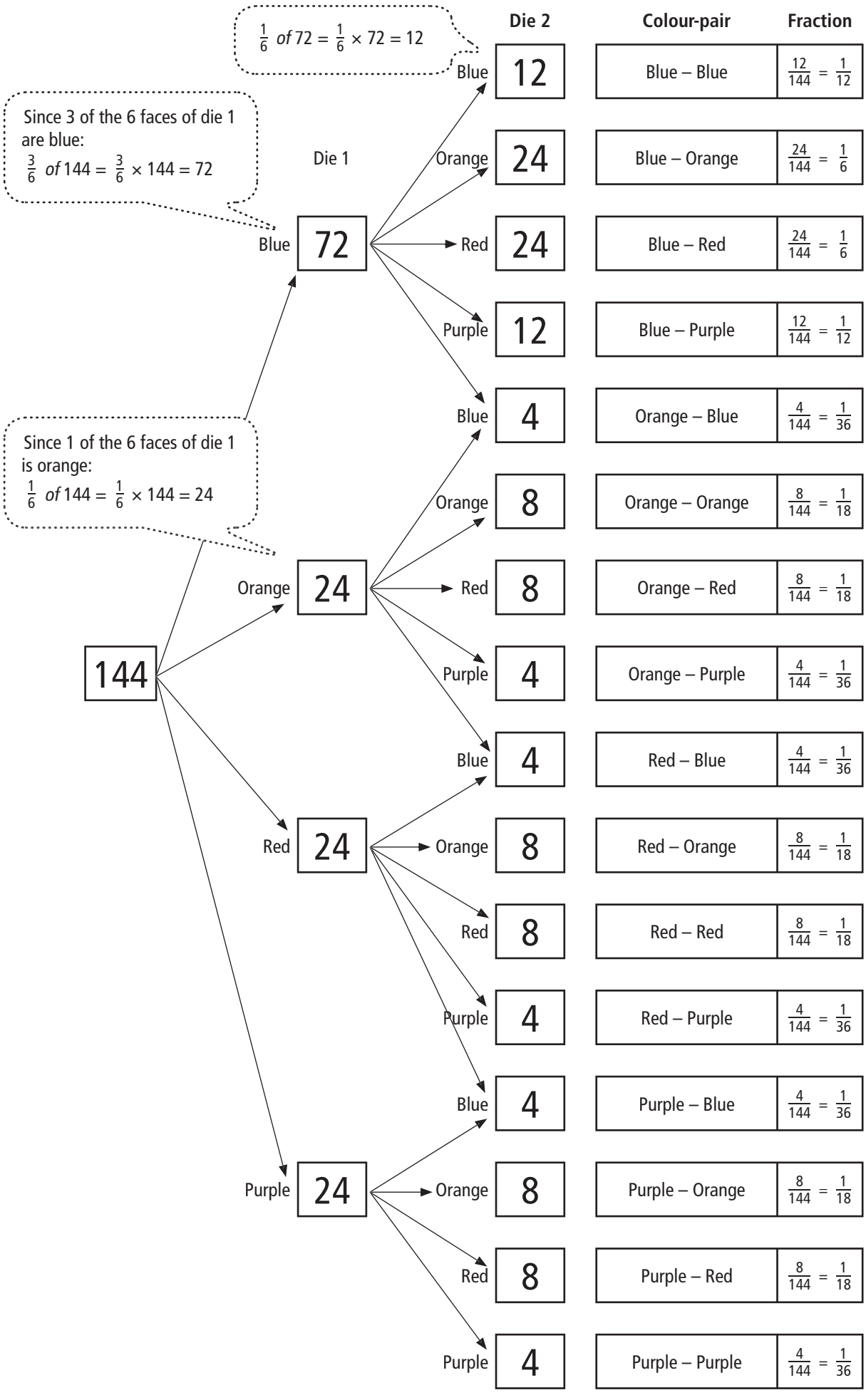
7.5 See the previous table.

7.6.1 Some colour-pairs occur more often than others. Each person's results are different, but most of the scores are quite similar.

7.6.2 Yes. It is most unlikely that there was a colour-pair that did not occur, unless there is an incorrectly named colour-pair in your list e.g. White – Yellow or something odd.

7.6.3 Yes. Blue – Orange (Orange – Blue) and Blue – Red (Red – Blue) came up more often. Three out of the 6 faces on die 1 are blue, and of the 6 faces on die 2 two are orange and two are red, therefore there is a much greater chance of getting these combinations.

7.7– 7.9 See the table on the following page.


$\frac{1}{6}$ of 72 = $\frac{1}{6}$ × 72 = 12
Since 3 of the 6 faces of die 1 are blue:
$\frac{3}{6}$ of 144 = $\frac{3}{6}$ × 144 = 72
Since 1 of the 6 faces of die 1 is orange:
$\frac{1}{6}$ of 144 = $\frac{1}{6}$ × 144 = 24
144
Die 1
Blue 72
Orange 24
Red 24
Purple 24
Die 2
Colour-pair
Fraction
Blue 12 Blue – Blue $\frac{12}{144} = \frac{1}{12}$
Orange 24 Blue – Orange $\frac{24}{144} = \frac{1}{6}$
Red 24 Blue – Red $\frac{24}{144} = \frac{1}{6}$
Purple 12 Blue – Purple $\frac{12}{144} = \frac{1}{12}$
Blue 4 Orange – Blue $\frac{4}{144} = \frac{1}{36}$
Orange 8 Orange – Orange $\frac{8}{144} = \frac{1}{18}$
Red 8 Orange – Red $\frac{8}{144} = \frac{1}{18}$
Purple 4 Orange – Purple $\frac{4}{144} = \frac{1}{36}$
Blue 4 Red – Blue $\frac{4}{144} = \frac{1}{36}$
Orange 8 Red – Orange $\frac{8}{144} = \frac{1}{18}$
Red 8 Red – Red $\frac{8}{144} = \frac{1}{18}$
Purple 4 Red – Purple $\frac{4}{144} = \frac{1}{36}$
Blue 4 Purple – Blue $\frac{4}{144} = \frac{1}{36}$
Orange 8 Purple – Orange $\frac{8}{144} = \frac{1}{18}$
Red 8 Purple – Red $\frac{8}{144} = \frac{1}{18}$
Purple 4 Purple – Purple $\frac{4}{144} = \frac{1}{36}$

7.9 Add the fractions as follows:

$$\frac{1}{12} + \frac{1}{6} + \frac{1}{6} + \frac{1}{12} + \frac{1}{36} + \frac{1}{18} + \frac{1}{18} + \frac{1}{36} + \frac{1}{36} + \frac{1}{18} + \frac{1}{18} + \frac{1}{36} + \frac{1}{36} + \frac{1}{18} + \frac{1}{18} + \frac{1}{36} = 1$$

7.10 Of the 16 colour-pairs, some are "repeated." There are only 10 different colour-pairs.

Colour – Pairs		How many out of 144?
1. Blue – Blue		$= \frac{12}{144}$
2. Blue – Red	or Red – Blue	$= \frac{4+24}{144} = \frac{28}{144}$
3. Blue – Purple	or Purple – Blue	$= \frac{12+4}{144} = \frac{16}{144}$
4. Blue – Orange	or Orange – Blue	$= \frac{24+4}{144} = \frac{28}{144}$
5. Orange – Orange		$= \frac{8}{144}$
6. Orange – Red	or Red – Orange	$= \frac{8+8}{144} = \frac{16}{144}$
7. Orange – Purple	or Purple - Orange	$= \frac{4+8}{144} = \frac{12}{144}$
8. Red – Red		$= \frac{8}{144}$
9. Red – Purple	or Purple – Red	$= \frac{4+8}{144} = \frac{12}{144}$
10. Purple – Purple		$= \frac{4}{144}$

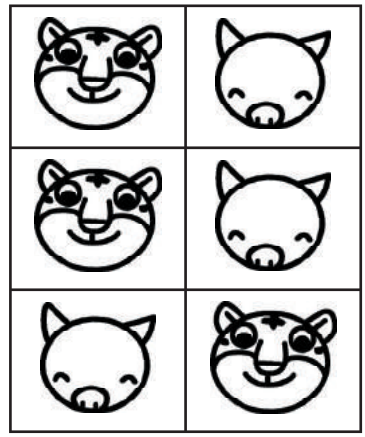
7.11 Here is the list for all the possible colour pairs:

- P(Blue-Blue) $= \frac{1}{12}$
- P(Blue-Red) $= \frac{7}{36}$
- P(Blue-Purple) $= \frac{1}{9}$
- P(Blue-Orange) $= \frac{7}{36}$
- P(Orange-Orange) $= \frac{1}{18}$
- P(Orange-Red) $= \frac{1}{9}$
- P(Orange-Purple) $= \frac{1}{12}$
- P(Red-Red) $= \frac{1}{18}$
- P(Red-Purple) $= \frac{1}{12}$
- P(Purple-Purple) $= \frac{1}{36}$

7.12 Blue-Red (or Red-Blue) and Blue-Orange (or Orange-Blue) are most likely and Purple-Purple is least likely.

7.13 The results are very similar.

Activity 7 — Making a game part 2



In this part of making the game we will consider the boards and cards. You will remember from the description of the game in activity 6 that there are three boards and that each board has six places (with a matching card for each of the six places). Each place on the board has two pictures on it. When the players roll the two dice two pictures will "come up." If the two pictures that come up match the two pictures in any one of the places on a player's board he/she covers the place on his/her board with the appropriate card.

To be clear, if the players rolled the dice and a tiger and a pig came up either of the places alongside could be covered. In other words, we are not worried about the position of the picture on the card—only that the two pictures (on the die) appear together.

We are now concerned with how many different combinations there are for the places on for the boards, as well as trying to establish the comparative likelihood of a player rolling the die for each place. For the remainder of this activity we will refer to the place as the "colour-pair", that is the pair of colours at each specific place.

7.1 Working as logically as you can, make a list of all the colour-pairs that are possible when we roll our two dice (developed in activity 6).

7.2 Compare your list with the list of a neighbour. Do you both have the same list? How did you organise the information to ensure that you have all the possibilities on your list?

Make a table such as the one below for all of the possible pairs you have listed (some sample data has been entered).

Colour pair	Tally	Frequency	Fraction of results
Blue – Blue	///	3	$\frac{3}{75}$
Blue – Red	~~////~~ ///	8	$\frac{8}{75}$

7.4 Roll the dice that you made in the previous activity 75 times. Using tally marks, record each time that a particular pair of colours appears. When you have completed the 75 rolls fill in the frequency and fraction for each colour-pair on the table.

7.5 Compare your table of values with at least three other members of the class. Answer the following questions:

7.5.1 Do you notice any trend or trends in the data that you have collected?

7.5.2 Has each colour-pair on your table come up at least once on your dice? If not, why do you think this is the case?

7.5.3 Are there any colour-pairs that seem to have come up significantly more often than the other pairs? If yes, which one(s)? Can you explain why this has happened?

Hopefully you have noticed (a) that some colour-pairs come up more often than others do, and (b) that there are more than 6 possible colour-pairs.

You should recall from the description of the game that each of the three game boards has 6 places on it. Obviously we cannot have a game in which all three boards are exactly the same—if we did all the players would finish at exactly the same time and there would be no winner (this is why it is important to have more than 6 possible colour-pairs). We are, however, happy that some of the colour-pairs appear on more than one board—this is true of all Bingo-type games (for this reason we can still make the game even though there are not 18 different colour-pairs).

To make the boards involves selecting 6 colour-pairs out of all of the possible colour-pairs in such a way that the boards are:

- sufficiently different to ensure that there will be a winner for most games; and
- fair—we do not want one board to have all the colour-pairs that happen more often while another board has those colour-pairs that happen less often.

By rolling the dice and recording your findings you have performed an experiment (more accurately—a series of experiments). Based on this you have a sense of which colour-pairs come up more than others. By comparing with the other members in the class you have increased the number of experiments and gained confidence in the trends that you are seeing. The fractions in the table are known as the experimental probability for each of the colour-pairs.

It is possible to design the game based on the experimental probability for the colour pairs but this is not desirable—you will have noticed that all the members of the class had different experimental probabilities for each of the colour-pairs. What we are going to do is to develop the theoretical probability for each colour-pair. To do so we are going to use a tree diagram and rather than actually rolling the dice we will think about what we would expect to happen.

At the end of activity 6 we established the following:

Die 1	Die 2
• P(blue) = $\frac{3}{6}$	• P(blue) = $\frac{1}{6}$
• P(orange) = $\frac{1}{6}$	• P(orange) = $\frac{2}{6}$
• P(red) = $\frac{1}{6}$	• P(red) = $\frac{1}{6}$
• P(purple) = $\frac{1}{6}$	• P(purple) = $\frac{1}{6}$

7.6 In the tree diagram (on the next page) we are going to predict what will happen when we roll our pair of dice 144 times. Use the theoretical probabilities above to fill in exactly how many times we will get blue, orange, red and purple from die 1 for 144 rolls of the die. Fill these numbers in under the heading "die 1."

7.7 To complete the second column you need to treat the numbers in column 1 as the number of times you are going to roll die 2. You then need to fill in exactly how many times we will get blue, orange, red and purple from die 2 for the specified number of rolls. Complete column 2.

7.8 By following the arrows write down the 16 colour-pairs in the third column and calculate what fraction of the 144 rolls will yield each colour-pair (express this as a simple fraction—not a decimal fraction).

7.9 To check that you have done things correctly, add up all of your fractions. Your answer should be 1. Is it? Why should the answer be 1?

7.10 You will notice that while we have 16 colour-pairs, some are "repeated." After all we agreed earlier that Red-Blue is exactly the same as Blue-Red in our game. Make a list of the different possible colour-pairs and by referring to the tree diagram calculate how many of the 144 rolls of the two die give each pair.

7.11 Simplify the fractions and write down (and complete) the following list for all the possible colour pairs:

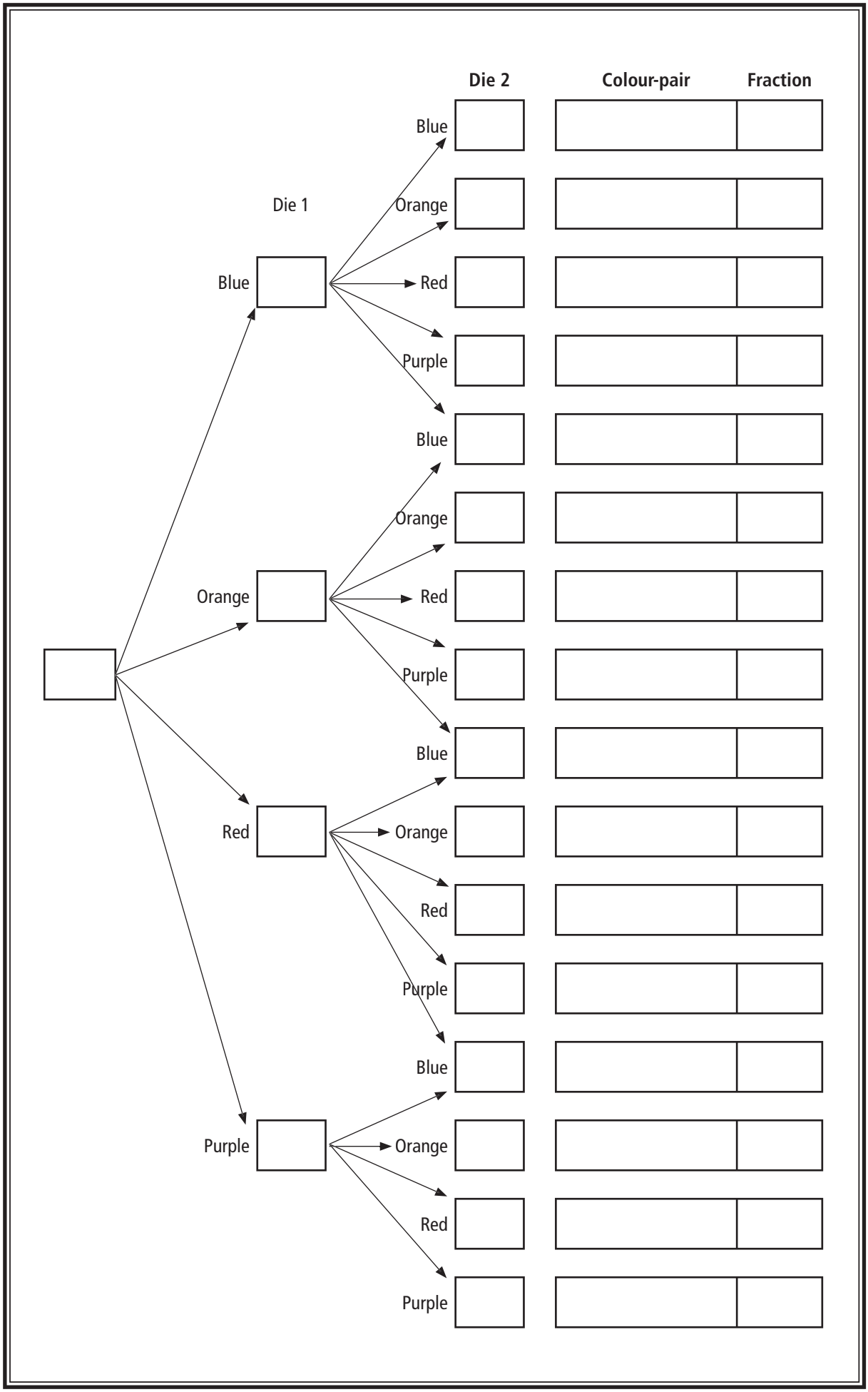
P(Blue-Blue) =

P(Blue-Red) =

P(Blue-Purple) =

7.12 Which colour-pairs are most likely and which are least likely?

7.13 How do the theoretical predictions compare with the experimental findings you made earlier?


Die 2
Colour-pair
Fraction
Die 1
Blue
Orange
Red
Purple
Blue
Orange
Red
Purple
Blue
Orange
Red
Purple
Blue
Orange
Red
Purple
Blue
Orange
Red
Purple

Activity 8 — Making a game part 3

ABOUT THIS ACTIVITY

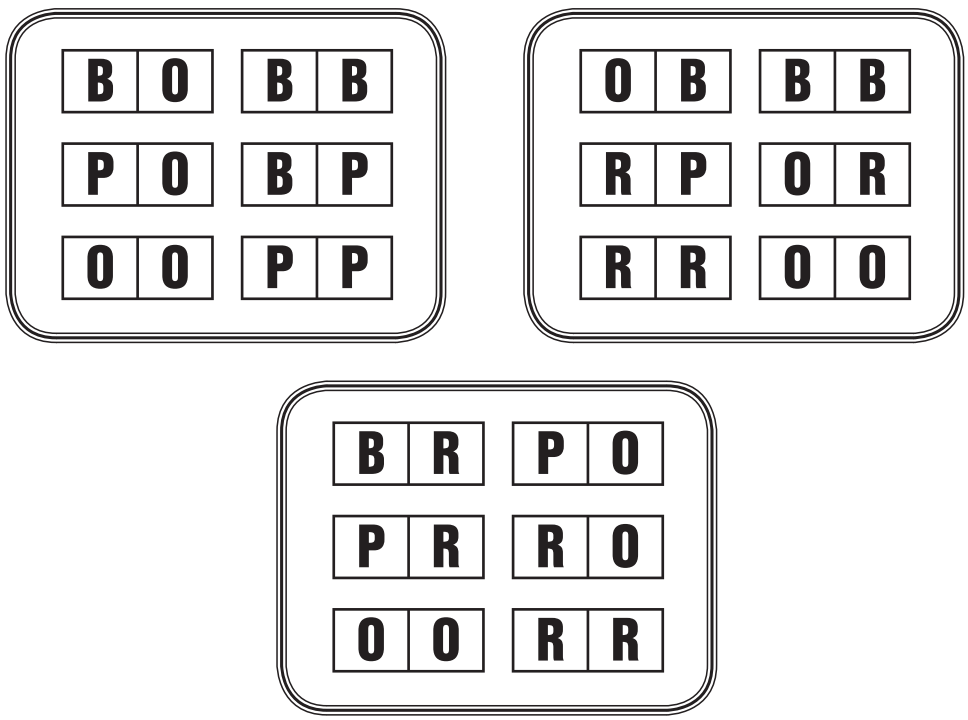
In this activity students are given specific criteria and, using the skills developed in activity 6 and 7, are required to make the boards for the game adhering to these criteria.

This activity is aligned with unit standard 9015 and addresses AC 1, 3, 7, 8 and 9 of SO1; AC 1, 2 and 4 of SO2 and AC 3, 4 and 5 of SO3.

MANAGING THIS ACTIVITY

Students are required to make the boards for the game and they will need: paper/cardboard, coloured pens, and the coloured dice that the student's made in the previous activity.

8.1 Below is an example solution. (B=Blue, O=Orange, R=Red, P=Purple).



The following reasoning is used to come up with an appropriate and "fair" solution:

- Remember that Blue – Orange and Orange – Blue are exactly the same (and there are several pairs like this), therefore placing a Blue – Orange on one card and an Orange – Blue on another card will be completely "fair".
- Blue – Blue and Orange – Purple are both as likely to occur and therefore placing a Blue – Blue on one card and an Orange – Purple on another card will be completely "fair".

  Since we are only permitted to repeat one of the colour-pairs on all three boards, it would be a pity to use the Purple – Purple colour-pair on all three boards, since this is the least likely to occur and therefore the game might take a long time to complete if the players are all waiting for this outcome.
- In the example solution the Orange – Orange colour-pair is used on all three boards but the other colour-pairs appear on at most two of the boards as instructed.
- To show the how close the "fairness" of each board is, the theoretical probabilities are shown on each board.

8.2 It would be sensible to play the game at least more than 36 times. A multiple of 36, such as 72 or 108 or 144) would be even more helpful.

Activity 8 — Making a game part 3

In activities 6 and 7 we did the thinking and ground work. We are now ready to make the boards. Remember:

- We do not want all three boards to be the same otherwise we would not have a game—all three players would finish at the same time!
- We want the game to be as fair as possible. In other words, players should not feel that one board favours wining above another.

8.1 Develop the three boards—that is, decide which six colour-pairs to place on each board—taking into account the following constraints:

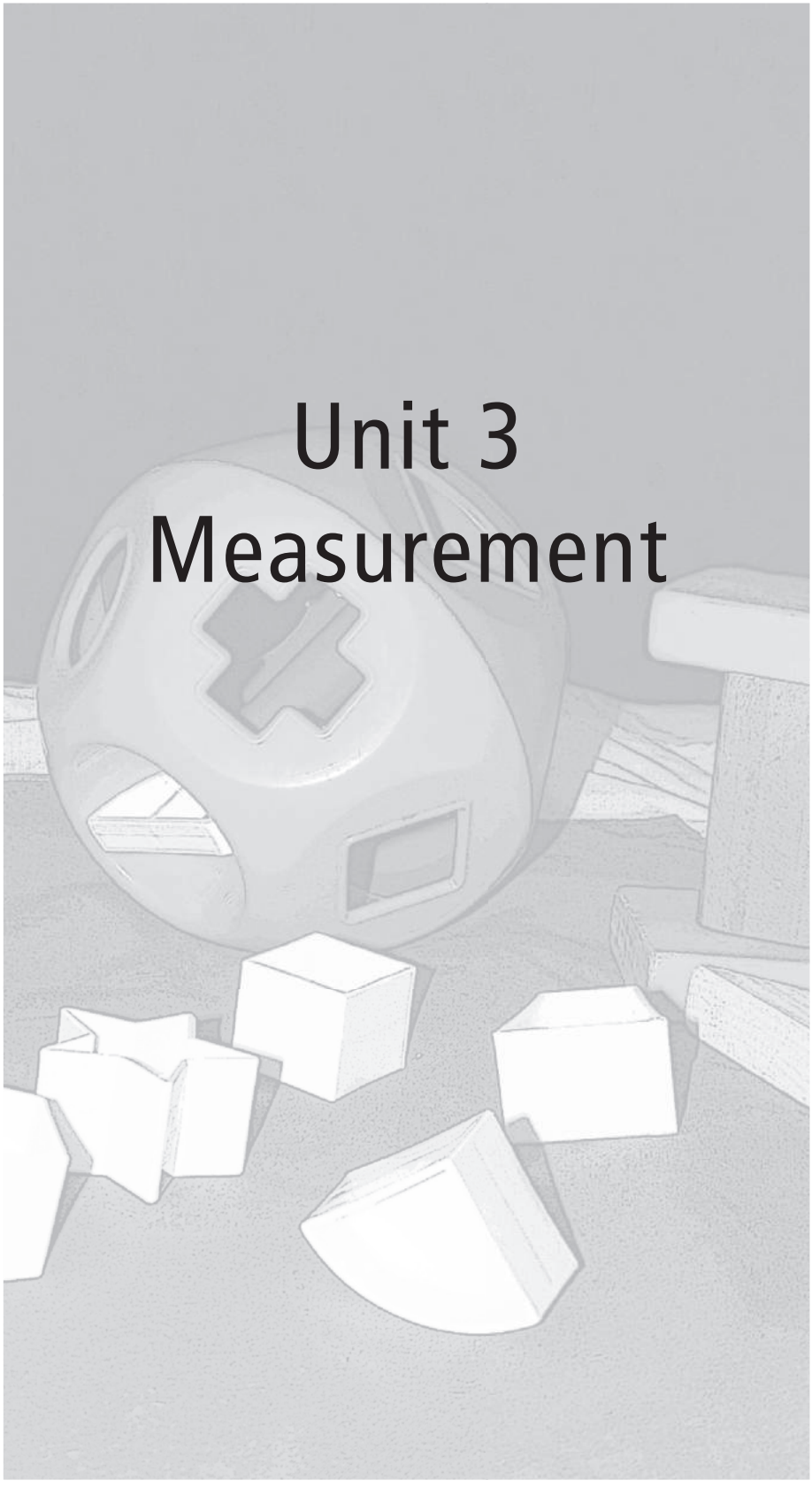
- You may only use one colour-pair on all three boards. For the rest you may use a colour-pair on at most two boards.
- The combination of colour-pairs you select should result in three boards that are "fair." One way of thinking about this is that you should be able to show that each board has the same number (as far as it is possible) of colour-pairs that are more likely and the same number of colour-pairs that are less likely to come up as we roll the dice.
- To make certain that the boards "look different" you can swap the order of the colour-pair from one board to the next.

You should be ready to explain how you selected the colour-pairs for each board.

8.2 Having developed the three boards you should play the game a large number of times to see if the boards are indeed fair. How large do you think is large enough for this test? You should record how many times each board wins and based on this decide whether or not you have achieved the objective—a fair game.

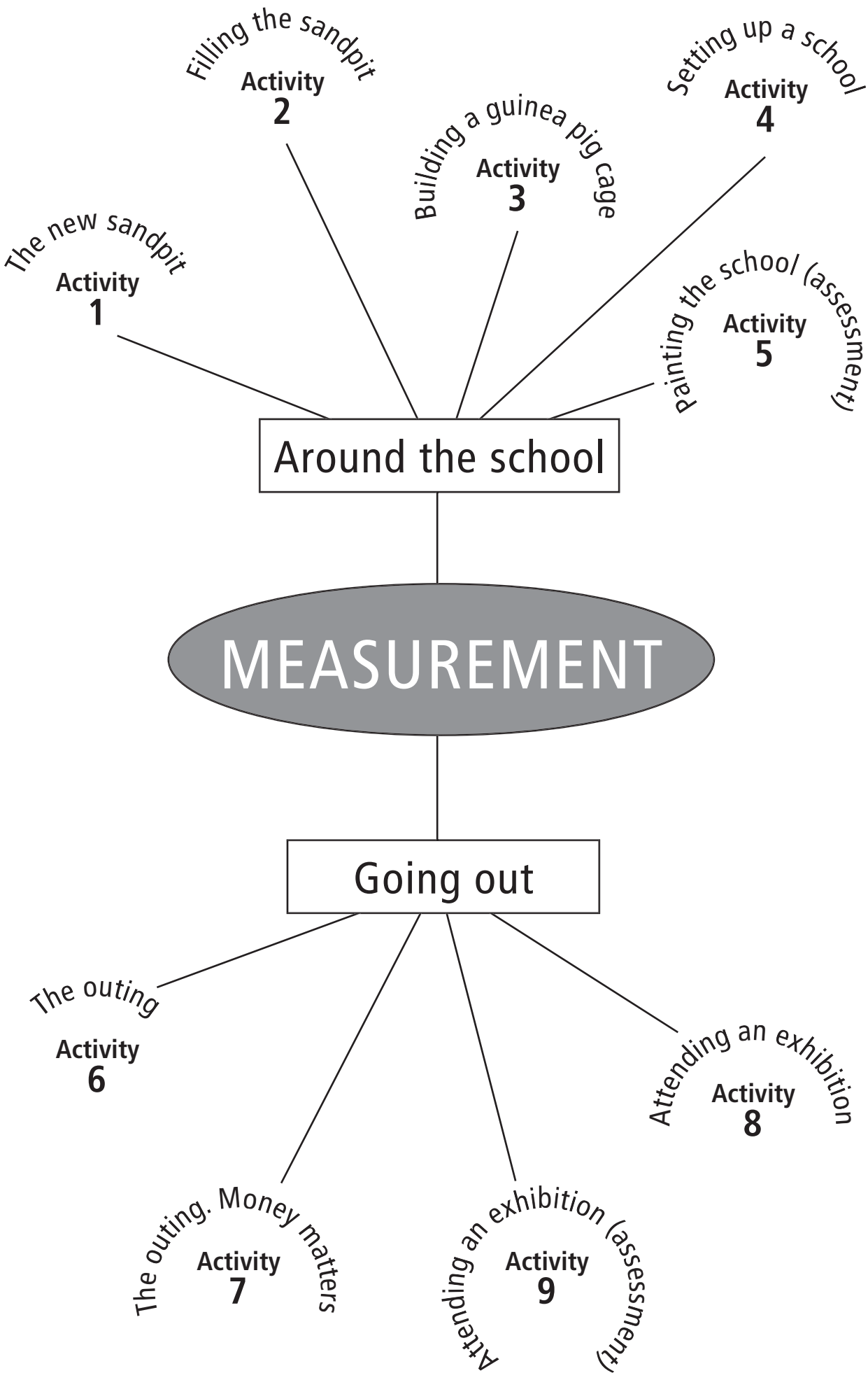
Mathematical Literacy

NQF LEVEL 4



Unit 3
Measurement

Early Childhood Development


Filling the sandpit
Activity 2
Setting up a school
Activity 4
Building a guinea pig cage
Activity 3
The new sandpit
Activity 1
Painting the school/ (assessment)
Activity 5
Around the school
MEASUREMENT
Going out
The outing
Activity 6
Attending an exhibition
Activity 8
The outing. Money matters
Activity 7
Attending an exhibition (assessment)
Activity 9

Overview

This unit uses the contexts of the school building, the school grounds, a school outing and an exhibition to develop mathematical skills including:

- Estimating dimensions to plan the use of space efficiently.
- Working with total surface areas.
- Using formulae and Pythagorus' theorem.
- Working with ratios and percentages.
- Reading plans.
- Looking at three dimensional objects from different aspects.
- Drawing diagrams to scale.
- Working with co-ordinates.
- Reading information from tables and maps.
- Calculations with distance, speed and time.
- Planning routes and estimating time.

In addition to developing the mathematical skills of students, this unit is also intended to give students an opportunity to develop an understanding of:

- Using space efficiently.
- Reading architectural plans.
- How to estimate the quantity of paint needed to paint a room.
- How to plan a route and decide on modes of transport.
- How to estimate materials needed for a woodwork project.

The unit consists of nine activities. The first three deal with making items for the school playground. The next two deal with the school building. The next two deal with organising an outing and the last two deal with attending an exhibition.

Activity 1 – The new sandpit
This activity deals with designing a new sandpit. We explore various sizes of rectangular sandpits as well as a circular sandpit. The purpose of this activity is to find the shape that gives the maximum playing area for the children.

Activity 2 – Filling the sandpit
In this activity we calculate the amount of sand needed to fill the sandpit that we designed in activity 1. We determine the best place from which to purchase the sand.

Activity 3 – Building a guinea pig cage
In this activity we calculate the amount of wood needed to build a guinea pig cage. We also calculate the amount of wire mesh needed to cover the wooden frame. Wood is sold in specific lengths and mesh in specific widths. We estimate the quantities of each that we need to buy.

Unit outcomes

The Following Assessment Standards are addressed by this unit. We know this when the student:

Use Mathematics to represent, analyse and calculate shape and motion in 2- and 3-dimensional space in different contexts (MathLit 9016)

- Measure, estimate, and calculate physical quantities in practical situations relevant to the adult (SO1).
  - o Scales on the measuring instruments are read correctly (AC1)
  - o Quantities are estimated to a tolerance justified in the context of the need (AC2)
  - o The appropriate instrument is chosen to measure a particular quantity (AC3)
  - o Appropriate formulae are selected and used (AC4)
  - o Calculations are carried out correctly and the least steps of instruments are taken into account when reporting final values (AC5)
  - o Symbols and units are used in accordance with SI conventions and are appropriate to the situation (AC7)

- Explore, analyse and critique, describe and represent, interpret and justify geometrical relationships
  - o Descriptions are based on a systematic analysis of the shapes and reflect the properties of the shapes accurately, clearly and completely (AC1)
  - o Descriptions include quantitative information appropriate to the situation and need (AC2)
  - o 3-dimensional objects are represented by top, front and side views (AC3)
  - o Different views are correctly assimulated to describe 3-dimensional objects (AC4)
  - o Available and appropriate technology is used in producing and analysing representations AC5)
  - o Relations of distance and position between objects are analysed from different views (AC6)
  - o Conjectures as appropriate to the situation, are based on well-planned investigations of geometrical properties (AC7)
  - o Representations of the problems are consistent with and appropriate to the problem context. The problems are represented comprehensively and in mathematical terms (AC8)
  - o Results are achieved through efficient and correct analysis and manipulation of representations (AC9)
  - o Problem-solving methods are presented clearly, logically and in mathematical terms (AC10)
  - o Reflections on the chosen problem solving strategy reveal strengths and weaknesses of the strategy (AC11)

Alternative strategies to obtain the solution are identified and compared in terms of appropriateness.

Activity 4 – Setting up a school
This activity deals with interpreting architectural plans. We look at various seating arrangements in order to accommodate the maximum number of children.

Activity 5 – Painting the school
This activity deals with painting the outside of the school. We estimate the amount of paint needed. We use the floor plans from activity 4 to calculate the surface area that is to be painted. We look at different ways of estimating the amount of paint needed for the job. This activity can be used as an assessment.

Activity 6 –The outing
In this activity we organise an outing to the beach. We want to be at the beach at low tide and therefore need to co-ordinate school times, train times and tide times. We read data from different tables in order to sequence the day correctly.

Activity 7 - The outing. Money matters
In this activity we calculate the cost of the outing for each child. We include transport and food costs.

Activity 8 – Attending an exhibition
This activity deals with reading maps and train timetables. We determine the best route to get to an exhibition from our school. We then work out the time taken to travel this route by car and train. We also determine the cost of both modes of transport.

Activity 9 – Attending an exhibition (assessment)
This activity uses the same context as activity 8 but our school is much further away from the exhibition. This activity can be used for assessment.

9016	Represent, analyse and calculate shape and motion in 2-and 3-dimensional space in different contexts									
		ACTIVITY	1	2	3	4	5	6	7	8	9
SO1	Measure, estimate, and calculate physical quantities in practical situations relevant to the adult.										
	AC1	Scales on the measuring instruments are read correctly.							✓	✓	✓
	AC2	Quantities are estimated to a tolerance justified in the context of the need.	✓	✓	✓	✓		✓	✓	✓	✓
	AC3	The appropriate instrument is chosen to measure a particular quantity							✓	✓	✓
	AC4	Quantities are measured correctly to within the least step of the instrument.	✓	✓		✓			✓	✓	
	AC5	Appropriate formulae are selected and used.	✓	✓	✓		✓		✓	✓	✓
	AC6	Calculations are carried out correctly and the least steps of instruments used are taken into account when reporting final values.			✓	✓			✓	✓	✓
	AC7	Symbols and units are used in accordance with SI conventions and as appropriate to the situation.	✓	✓	✓		✓		✓	✓	✓
SO2	Explore, analyse & critique, describe & represent, interpret and justify geometrical relationships.										
	AC1	Descriptions are based on a systematic analysis of the shapes and reflect the properties of the shapes accurately, clearly and completely.	✓	✓	✓	✓	✓				
	AC2	Descriptions include quantitative information appropriate to the situation and need.	✓	✓	✓	✓	✓	✓			
	AC3	3-dimensional objects are represented by top, front and side views.			✓	✓	✓				
	AC4	Different views are correctly assimilated to describe 3-dimensional objects			✓	✓	✓				
	AC5	Available and appropriate technology is used in producing and analysing representations.	✓	✓		✓	✓				
	AC6	Relations of distance and positions between objects are analysed from different views.	✓		✓	✓	✓		✓	✓	
	AC7	Conjectures as appropriate to the situation, are based on well-planned investigations of geometrical properties.	✓	✓	✓		✓				
	AC8	Representations of the problems are consistent with and appropriate to the problem context. The problems are represented comprehensively and in mathematical terms.	✓	✓	✓	✓	✓	✓	✓	✓	✓
	AC9	Results are achieved through efficient and correct analysis and manipulation of representations.	✓	✓	✓	✓	✓	✓		✓	✓
	AC10	Problem-solving methods are presented clearly, logically and in mathematical terms.	✓	✓	✓		✓	✓		✓	✓
	AC11	Reflections on the chosen problem solving strategy reveal strengths and weaknesses of the strategy.	✓	✓			✓	✓		✓	
	AC12	Alternative strategies to obtain the solution are identified and compared in terms of appropriateness and effectiveness.	✓	✓	✓		✓	✓		✓	

1 The new sandpit
2 Filling the new sandpit
3 Building a guinea pig cage
4 Setting up a school
5 Painting the school
6 The outing
7 The outing. Money matters
8 Attending an exhibition
9 Attending an exhibition (assessment)

Activity 1 – The new sandpit

We begin this unit by exploring the relationship between the perimeter and the area of different shapes. The context in which this happens is the designing of a new sandpit. The problem set is to find the best shape for maximum area.

ABOUT THIS ACTIVITY

In this activity the students will explore the problem physically using small rectangular blocks and then formalise it mathematically. Area formulae will be used and calculations made. The students then need to decide which design they would chose. This activity is aligned with unit standard 9016 and addresses AC 2, 3, 7 of SO1 and AC 1, 2, 5, 6, 7, 8, 9, 10, 11, 12 of SO2.

MANAGING THIS ACTIVITY

The facilitator needs to supply small rectangular blocks (Lego or other) which the students can use to explore the problem and some tape measures. Students should be given worksheet 1, handout 1 and some squared paper.

The students will need to know how to calculate the areas of rectangles and circles as well as the circumference of circles. Manipulation of the circle formulae is also required. This activity could be extended by allowing shapes other than rectangles and circles to be used.

1.1 6 dozen blocks will be $6 \times 12 = 72$ blocks. This means that each layer will have $\frac{72}{3} = 24$ blocks.

1.2 Enough blocks need to be available for the students.

1.3 The perimeter of the shape remains constant but the area will differ for each design. There are 2 main ways in which to arrange the blocks (see diagrams A and B). Within these main divisions there are a further 5 ways to arrange the bricks for method A and 6 ways for method B. So the students should have got a total of 11 options. See options on the squared paper.

1.4 This is an important check.

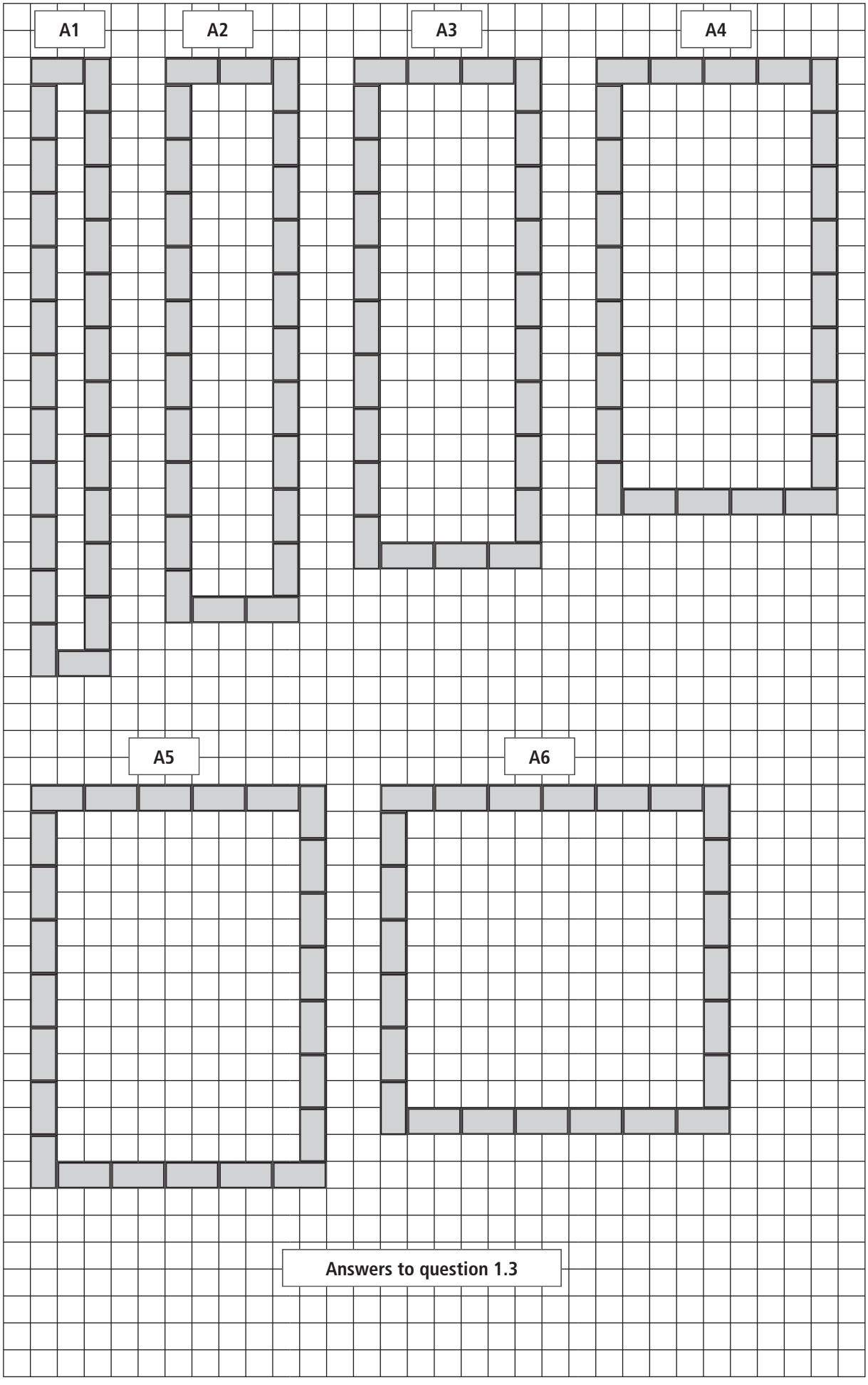
1.5 This question requires some thought as the blocks overlap at the corners so the number of blocks in the side will be half a brick less in diagram A and needs to be adjusted in diagram B.

The area of the sandpit is calculated by multiplying the length by the breadth of the rectangle. The results are presented in the table below:

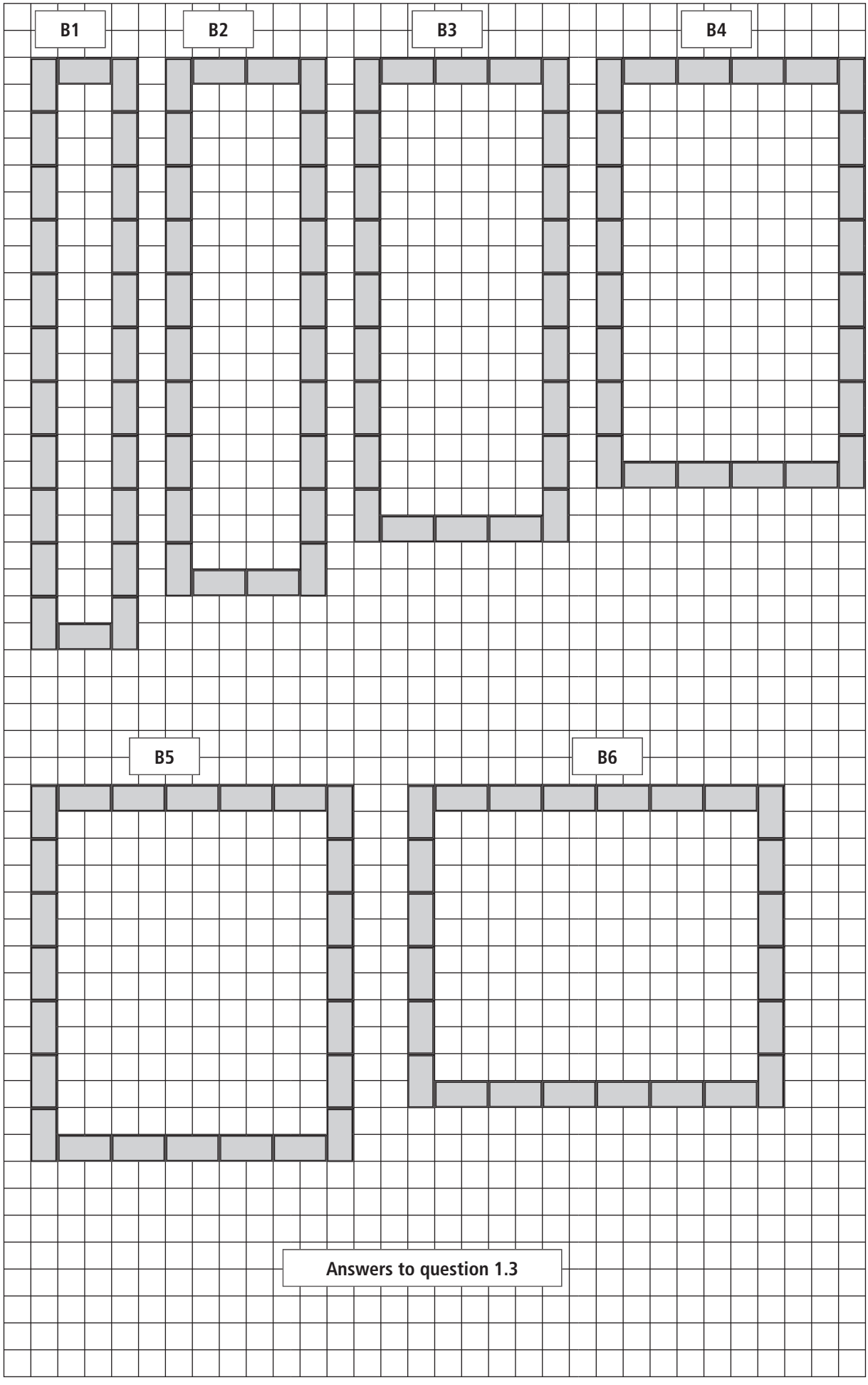
Option	Number of blocks on the inside of the breadth	Length in metres	Number of blocks on the inside of the length	Length in metres	Area in m^2 A $= l \times b$
A1	½	0,15	10½	3,15	0,51m^2
A2	1½	0,45	9½	2,85	1,28m^2
A3	2½	0,75	8½	2,55	1,91m^2
A4	3½	1,05	7½	2,25	2,36m^2
A5	4½	1,35	6½	1,95	2,63m^2
A6	5½	1,65	5½	1,65	2,72m^2
B1	1	0,3	10	3	0,9m^2
B2	2	0,6	9	2,7	1,62m^2
B3	3	0,9	8	2,4	2,16m^2
B4	4	1,2	7	2,1	2,52m^2
B5	5	1,5	6	1,8	2,7m^2

1.6 The students need to choose from the options. The very best option according to the above table is A6.

1.7 This is an important exercise to enable the students to visualise the size of the sandpit.

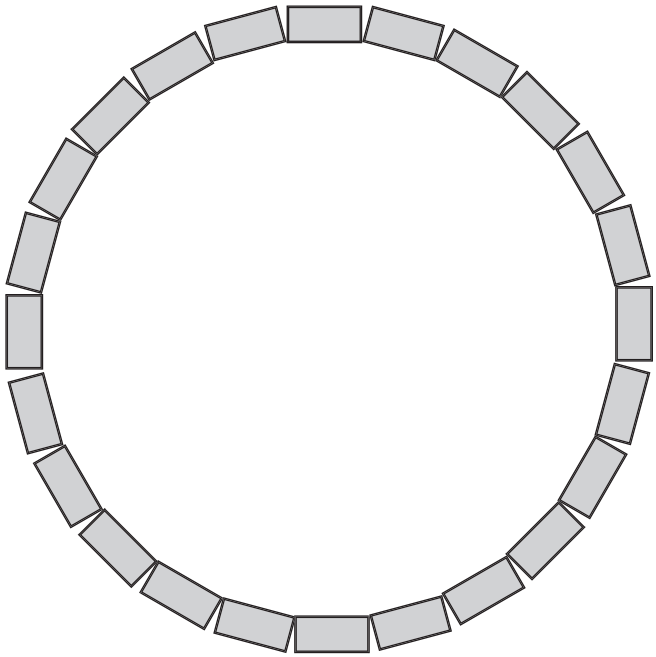


Answers to question 1.3



Answers to question 1.3

1.8 The sketch does not have to be to scale but should depict the awkwardness of placing rectangular blocks in a circle. See the diagram below.



1.9 To get a curve the blocks are at an angle to each other so they don't fit as nicely as rectangular or square shapes.

1.10 Circumference of the sandpit = 24 blocks 0,30m = 7, 2 m

1.11 To find the radius the students need to be able to manipulate the formula:

$C = 2\pi r$ where C = circumference; r = radius and $\pi = 3{,}14$

You need to find r, so

$$r = \frac{C}{2\pi}$$

$$r = \frac{7{,}2}{2 \times 3{,}14}$$

$r = 1{,}1467\text{m}$

$r \approx 1{,}15\text{m}$

You might want to talk about rounding off to appropriate values at this stage.

1.12 To find the area of the circular sandpit, students need to use the formula:

Area of sandpit = πr^2

$A = 3{,}14 \times (1{,}15\text{m})^2$

$A = 4{,}15265\text{m}^2$

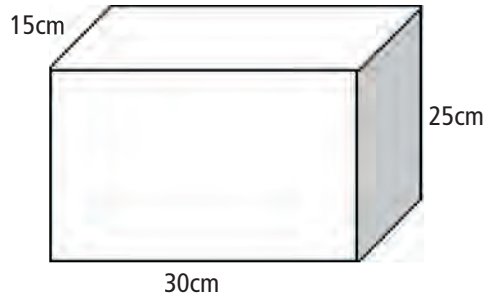
$A \approx 4{,}15\text{m}^2$

1.13 If we compare this to the rectangular designs, we can see that the circular sandpit gives a much greater surface area and so would be the best design.

1.14 Again, this is a worthwhile exercise to give the students a feel for the relationship between actual size and a dimension on paper.

Activity 1 — The new sandpit

It was decided at the parents' committee meeting that the school needed to build a more permanent sandpit. It was decided that the sandpit would be sunk into the ground with a cement base and sides bricked with large concrete blocks. A parent who is a builder can organise a donation of six dozen concrete blocks with the following dimensions:



1.1 Work out how many blocks will be available for each layer if it was decided to have three layers of concrete blocks.

1.2 Count out this number of blocks from the small blocks provided.

1.3 Using these small blocks, design as many different options as you can think of for the shape of the top of the sandpit i.e. squares and rectangles with sides of different lengths. Draw these options on the squared paper provided. Two have been done for you. Try to get all the possible options even if some of the options will not really be suitable for a sandpit. Number your options. Remember that you want the biggest possible sandpit, so use all the blocks available.

1.4 Check that you have got all possible options by comparing with 3 other students.

1.5 You must work out the area for each option so you can see which one gives the biggest possible area of sand for the children to play in. Redraw and fill in the following table. Two have been done for you.

Option	Number of blocks on the inside of the breadth	Length in metres	Number of blocks on the inside of the length	Length in metres	Area in m^2 $A = l \times b$
A1	½	0,15	10½	3,15	0,51m^2
B1	1	0,3	10	3	0,9m^2

1.6 Which design gives the maximum area of sand for the children to play in?

1.7 Take a tape measure and measure out this area on the ground to get an idea of the actual size.

1.8 After all your hard work designing the sandpit, someone suggests that maybe a round sandpit would be better. You decide to look at this suggestion. Take 24 blocks and arrange them into a circle. Make a sketch of your blocks. It does not have to be to scale.

1.9 Write down any difficulties that you encountered.

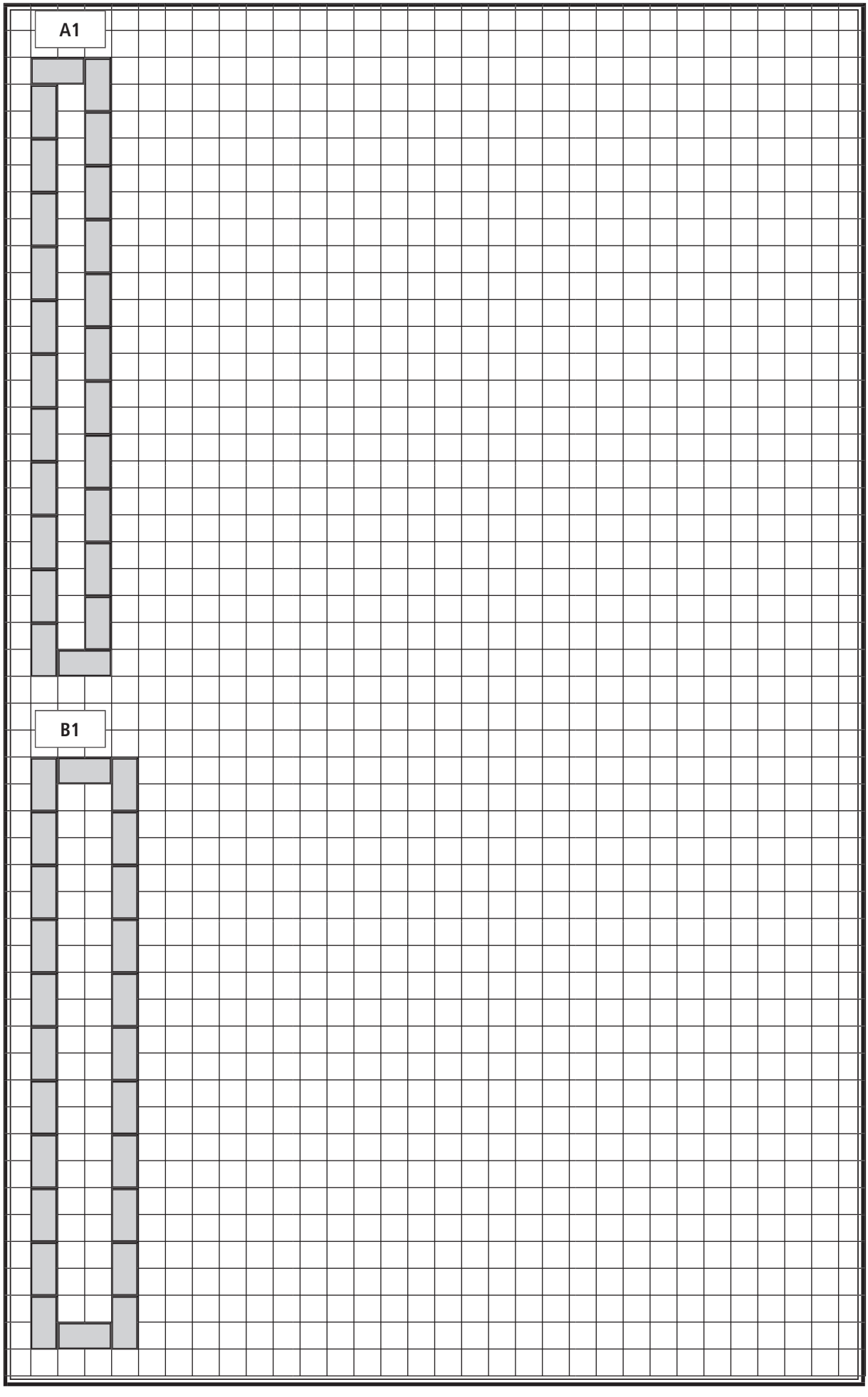
1.10 Calculate the circumference of the sandpit in metres.

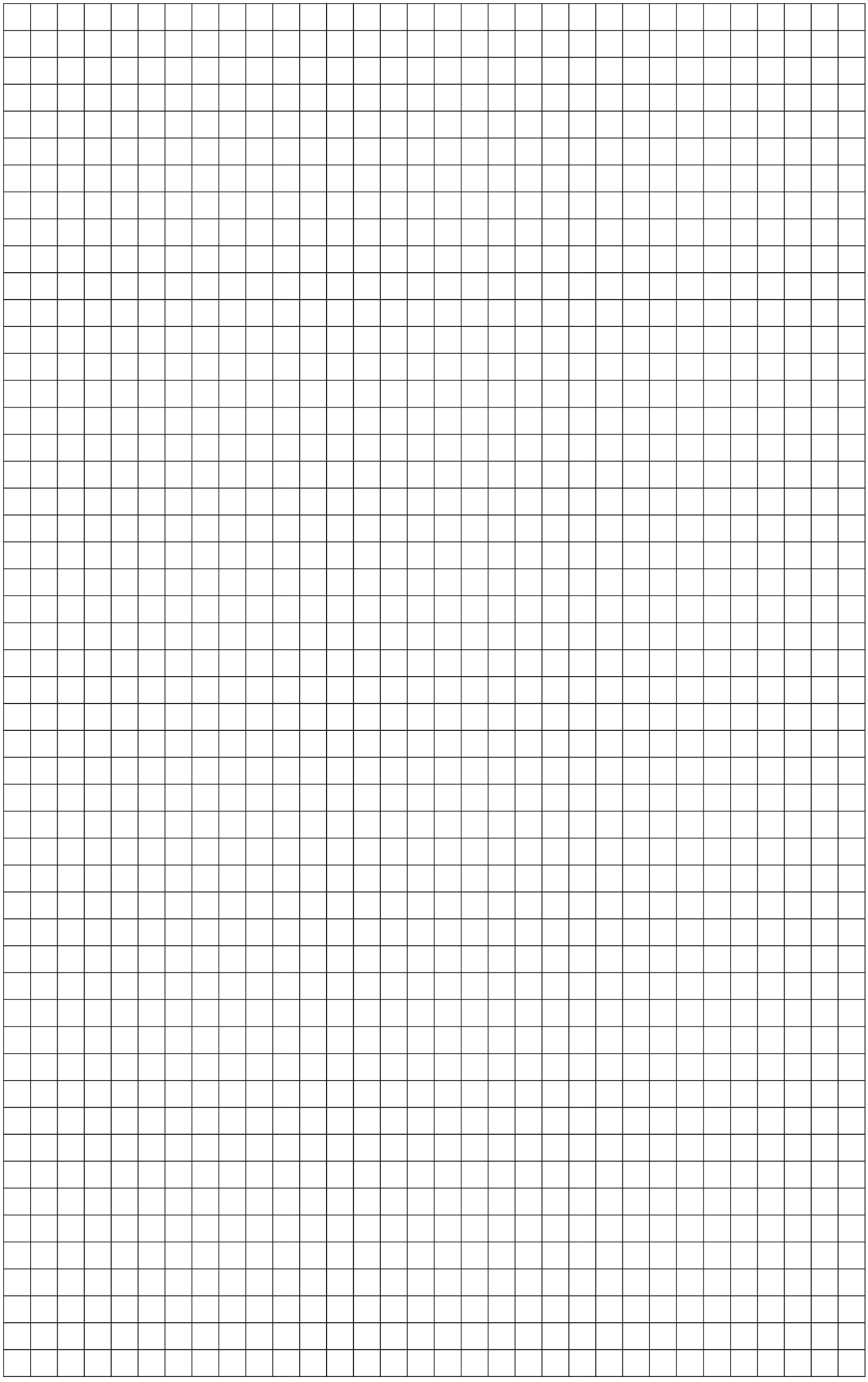
1.11 Now work out the radius of the sandpit.
(Circumference = $2\pi r$ where r = radius and $\pi = 3{,}14$).

1.12 Work out the area of sand available for the children to play in (Area = πr^2).

1.13 Compare this to the answers that you got in question 1.6. Which design gives a larger area in which to play?

1.14 Take a tape measure and measure the diameter of the circle to get a feel for the size of the sandpit (Diameter = 2 × radius).


A1
B1



Activity 2 – Filling the sandpit

This activity follows on from activity 1. The students explore the sandpit in three-dimensions, calculate volumes, work out costs and work with SI units. The students reconsider their choice from the previous activity in the light of costs and practical considerations.

ABOUT THIS ACTIVITY

The students will explore a problem mathematically and then write a short proposal using the results of their investigations. This activity deals with volumes of different shapes. It is aligned with unit standard 9016 and addresses AC 2, 5, 7 of SO1 and AC 1, 2, 5, 7, 8, 9, 10, 11, 12 of SO2.

MANAGING THIS ACTIVITY

This activity consists of a worksheet which contains all the information needed to do this activity. The students will need to know how to calculate the volumes of rectangular prisms and cylinders, how to work with percentages and how to convert from one unit to another.

2.1 Volume of sand = area of base (square) × depth of sandpit

Depth of sandpit = $3 \times 0{,}25\text{m}$

$= 0{,}75\text{m}$

Volume of sand = $2{,}72\text{m}^2 \times 0{,}75\text{m}$

$= 2{,}04\text{m}^2$

2.2 Volume of sand area of base (circle) depth of sandpit

Depth of sandpit = $3 \times 0{,}25\text{m}$

$= 0{,}75\text{m}$

Volume of sand = $4{,}15\text{m}^2 \times 0{,}75\text{m}$

$= 3{,}1125\text{m}^2$

$\approx 3{,}11\text{m}^3$

2.3 There are two methods of doing this calculation.

Method 1: Find 14% of the amount and then add it to the original amount.

$$\frac{14}{100} \times \text{R}25{,}50 = \text{R}3{,}57$$

Total including VAT = R25,50 + R3,57

= R29,07

Method 2 : Find 114% of the amount.

$$\frac{114}{100} \times \text{R}25{,}50 = \text{R}29{,}07$$

2.4 To convert dm3 to m3 :

$1\text{m} = 10\text{dm}$

$1\text{m}^3 = 1000\text{dm}^3$

This means that $25\text{dm}^3 = \frac{25}{1000}\text{m}^3$

$= 0{,}025\text{m}^3$ per bag

2.5

	Square	**Circular**
Volume of sand in m^3	2,04m3	3,11m3
Number of bakkie loads	2	3
Price of sand if bought from builder suppliers	2 bakkies × R10 = R20 (delivery) 2 × R29,07 = R58,14 ∴ Total = R20 + R58,14 = **R78,14**	3 bakkies R10 = R30 (delivery) 3 × R29,07 = R87,21 ∴ Total = R30 + R87,21 **= R117,21**
Number of bags needed	$\frac{2,04}{0,025}$ = 81,6 bags Round down as you don't want sand left over ∴ 81 bags	$\frac{3,11}{0,025}$ = 124,4 bags ∴ 124 bags
Price of sand if bought from nursery	81 × R1,25 = **R101,25**	124 × R1,25 = **R155,00**

2.6 The students need to motivate their choice using the information in the table above. They need to look at cost as well as space available for the children to play in and any other pros or cons of the 2 shapes.

Activity 2 — Filling the sandpit

The two options that gave the biggest area for the children to play in were the square design (area of 2,72 m^2) and the circular design (area of 4,15 m^2). You need to determine what volume of sand is required to fill each sandpit so that you can budget for the costs of the sand.

The builder suppliers sell sand by the m^3 and will deliver the sand for a small fee.

The Nursery sells sand in 25dm**3** bags which they will deliver free of charge.

Prices are as follows:

	Builder suppliers	**Nursery**
Delivery	R10 per bakkie load Bakkie load = $1m^3$ MUST take a FULL bakkie load	Free delivery
Price	R25,50 per m^3 excluding VAT (VAT = 14%)	R1,25 per $25dm^3$ bag including VAT

2.1 Calculate the volume of sand needed, in m^3, to fill the square sandpit. Remember that the sandpit will be 3 blocks deep and that each block has a height of 25cm. (Volume = area of base × height)

2.2 Calculate the volume of sand needed, in m^3, to fill the circular sandpit. This sandpit is the same depth as the square one. (Volume = area of base × height)

2.3 What would be the price per m**3**, including VAT, if we bought the sand from the builder suppliers?

2.4 Calculate the amount of sand per bag, in m**3** , that the nursery supplies.

2.5 Copy and complete the table. This will help you to compare the amount of sand needed for the two options and also help you decide where to buy the sand from.

	Square	**Circular**
Volume of sand in m^3		
Number of bakkie loads		
Price of sand if bought from builder suppliers		
Number of bags needed		
Price of sand if bought from nursery.		

2.6 Using the information in the above table, write a proposal to the committee advising them on what shape sandpit to build and where to get the sand from.

Activity 3 — Building a guinea pig cage

This activity looks at a 3-dimensional object from different views. The students need to do calculations using Pythagoras' Theorem. The problem that they will explore is to calculate the materials needed to build a cage in which to keep guinea pigs.

ABOUT THIS ACTIVITY

In this activity the students need to estimate the amount of wood needed to build a cage as well as the amount of mesh needed. They will need to draw the cage viewed from all sides. The constraints on this activity are practical in that the hardware stores sell wood and mesh in certain sizes only. One needs to fit one's measurements into those sizes. This activity is aligned with unit standard 9016 and addresses AC 2, 5, 6, 7 of SO1 and AC 1, 2, 3, 4, 6, 7, 8, 9, 10, 12 of SO2.

MANAGING THIS ACTIVITY

Students should be given the worksheet for this activity as well as squared paper (see end of file).The students will need to know how to calculate sides using Pythagoras' theorem, so it may help to do some practice examples before this activity. The students will also need a calculator to do the calculations. The measurements often have to be rounded off so it would be worthwhile to discuss this.

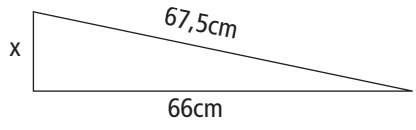
3.1 Reinforcements are necessary as a 4-sided figure is not rigid but will move if pressure is applied to it. The cross-pieces stabilise the base. See answer sheet for diagram.

$$\begin{aligned}
\text{Length of inside of frame} &= 100\text{cm} \\
\text{Length of base of triangle} &= \frac{100-3}{2} \quad \text{(the 3cm is the centre piece)} \\
&= 48{,}5\text{cm} \\
\text{Length of centrepiece} &= 60\text{cm} \\
x &= \text{length of cross-piece} \\
x^2 &= (48{,}5)^2 + (60)^2 \quad \text{(Pythagoras)} \\
x^2 &= 5953{,}25 \\
x &= \sqrt{5953{,}25} \\
x &\approx 77\text{cm}
\end{aligned}$$

3.2 See diagram sheet. The back view must include the legs.

3.3 See diagram sheet. The solid top has dimensions of 106cm by 67,5cm and is at an angle to the base. This means that from the side, the top forms a right-angled triangle with the crossbeam. The students need to use Pythagoras to calculate the height of the front leg. This is an approximate length as the top of the leg will have to be angled to fit the top snugly. However, this is usually dealt with at the time of construction. The calculation is as follows:

$$\begin{aligned}
\text{Width of the base + front and back leg} &= 60\text{cm} + 3\text{cm} + 3\text{cm} \\
&= 66\text{cm} \\
\text{Width of the lid} &= 67{,}5\text{cm} \\
\text{Let the extra height} &= x \\
x^2 &= (67{,}5)^2 - (66)^2 \quad \text{(Pythagoras)} \\
x^2 &= \sqrt{200{,}25} \\
x &= 14{,}1509\text{cm} \\
x &= 14{,}1509\text{cm} \\
x &\approx 14\text{cm} \\
\text{Therefore length of front leg} &= 83\text{cm} + 14\text{cm} \\
&= 97\text{cm}
\end{aligned}$$



3.4 The front view is complicated by the gate. Again Pythagoras should be used to calculate the length of the reinforcement beam. This means that the students have to work out the measurement of the inside frame of the gate first.

$$\begin{aligned}
\text{Width of inside of gate} &= 40\text{cm} - (2 \times 3\text{cm}) \\
&= 34\text{cm} \\
\text{Length of inside of frame} &= 97 - (2 \times 3\text{cm}) - 10\text{cm} \\
&= 81\text{cm} \\
\text{Length of inside of frame} &= 81\text{cm} - (2 \times 3\text{cm}) \\
&= 75\text{cm} \\
\text{Length of inside of gate} &= 14{,}1509\text{cm} \\
&= 14{,}1509\text{cm}
\end{aligned}$$

$$\begin{aligned}
\text{Length of cross-piece} &= x \\
x^2 &= (34)^2 - (75{,}2)^2 \quad \text{(Pythagoras)} \\
x^2 &= 6781 \\
x &= \sqrt{6781} \\
x &\approx 82\text{cm}
\end{aligned}$$

3.5 Amount of wood needed (table continues on next page):

VIEW	3cm pieces of wood	1,5cm wood
Front legs	2 × 97cm = 194cm	
Back legs	2 × 83cm = 166cm	
Bottom	2 × 100cm = 200cm 3 60cm = 180cm	2 × 77cm = 154cm
Back	1 × 100cm = 100cm	None
Front Gate	1 × 100cm = 100cm 1 × 81cm = 81cm 2 × 40cm = 80cm 2 × 75cm = 170cm	1 × 82cm = 82cm
TOTAL	1271cm	236cm

3.6 Lengths needed to be bought from shop:

Lengths needed	Lengths	Available in shop
3cm wood: Two front legs + Two back legs	97cm + 83cm = 180cm	2 1,8m
Four 1m lengths (2 back and 2 front)		1 × 3m and one 1,8m (waste 0,8m)
Three 60cm lengths (3 bottom)	1,8m	1 × 1,8m
One length for front and 2 for gate	81cm + 40cm + 40cm = 161cm	1 × 1,8m (waste 0,19m)
2 lengths for the gate	2 75cm = 170cm	1 × 1,8m (waste 0,10m)
1,5cm wood: 2 cross-pieces for bottom	77cm + 77cm = 154cm	1 × 1,8m (waste 0,26m)
1 cross-piece for gate	82cm	1 × 1m (waste 0,18m)

To summarize:
3cm wood needed: 5 × 1,8m and 13m
1,5cm wood needed: 11,8m and 11m

3.7 The rectangle must have dimensions 16cm by 14,2cm

3.8 Mesh needed is shown in the table. See diagram for arrangement of mesh.

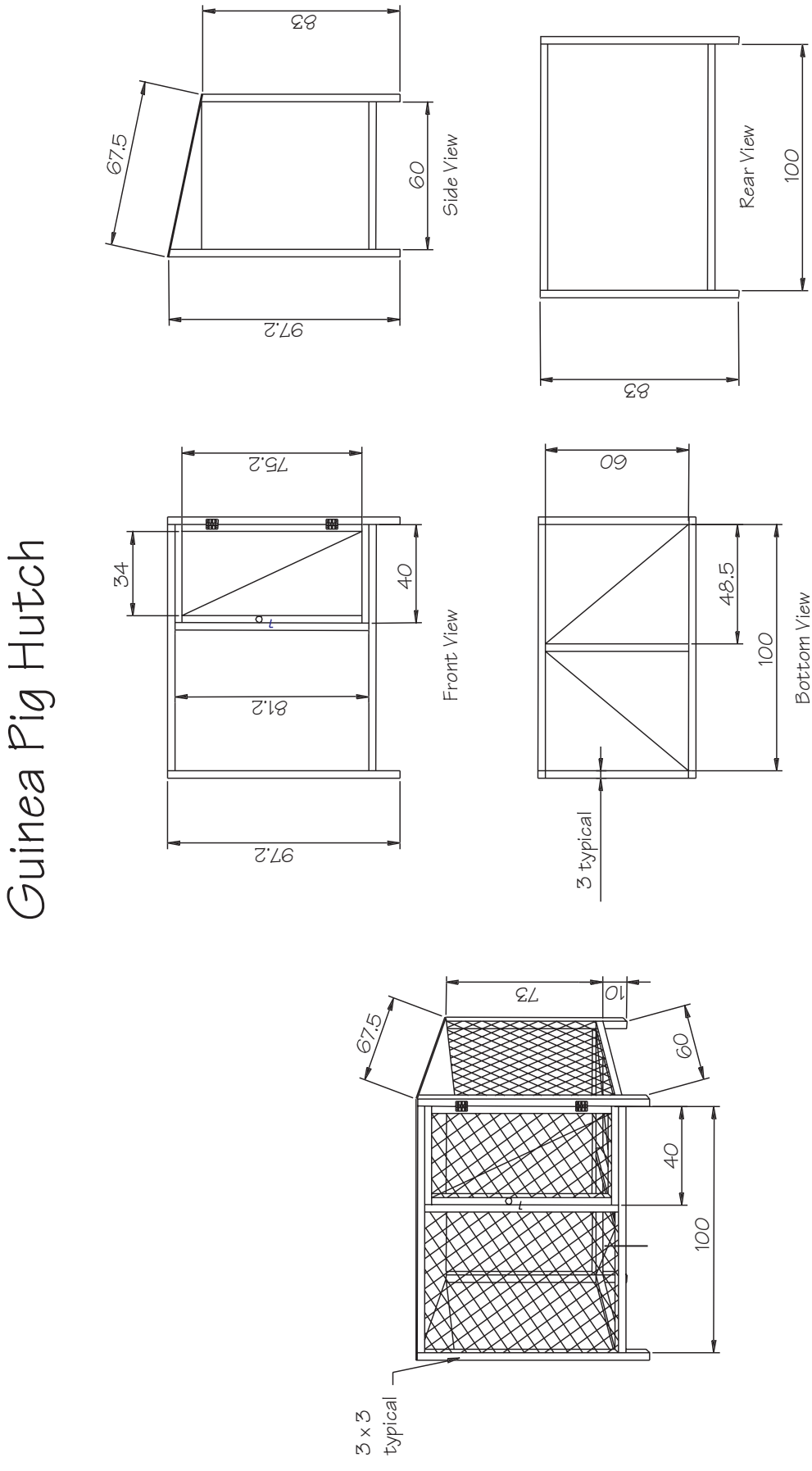
(a)

View	Mesh needed
Bottom	62cm × 102cm
Back	73cm × 102cm
Side2	2 × 62cm × 73cm
Front Gate	60cm × 87 40cm × 81cm

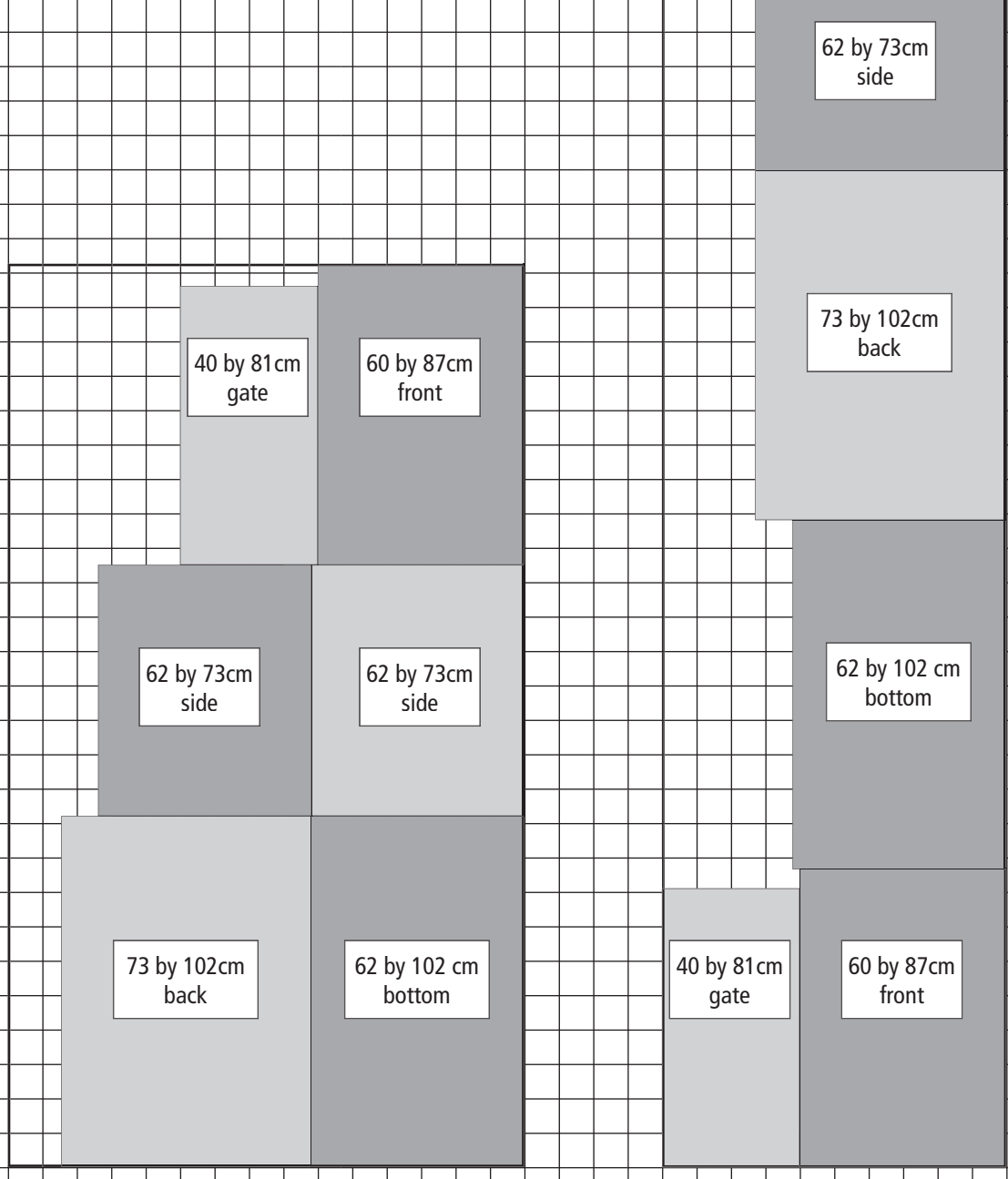
(b) From the diagram, you can deduce that you would need about 2,7 m.

3.9 From the diagram you can deduce that you would need about 3,9m.

Answers to questions 3.1; 3.2; 3.3 and 3.4



Answers to questions 3.8 and 3.9

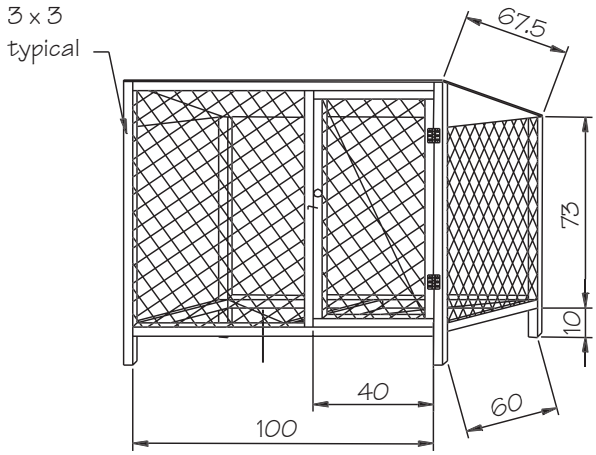


1 square = 10cm
This is the 1,5m mesh
You will need about 2,7m

1 square = 10cm
This is the 1m mesh
You will need about 4,2m

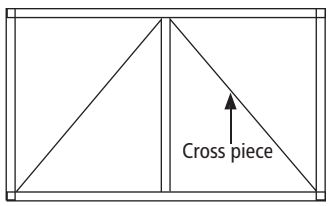
Activity 3 — Building a guinea pig cage

To teach the children about pet care, the school decides to get two guinea pigs. They can be kept in a cage outside. You need to estimate the materials needed to build the cage. (see diagram below). The cage is made of a wooden frame covered with chicken wire (mesh). It has a solid wooden top with dimensions, 106cm by 67,5cm. The sides have 2 solid triangles to support the top. In order to work out the materials needed, you need to draw a diagram of every view of the cage and fill in the measurements.



3.1 A diagram of the base (not to scale) of the cage has been drawn for you. Why do you think there is a need for the reinforcement beams or cross pieces?

Redraw the diagram and fill in all the measurements from the diagram above. Calculate the length of the cross pieces and fill these in as well.



The thickness of the wood used for the frame is 3cm and for the cross pieces is 1,5cm

3.2 Draw a diagram of the back view of the cage and fill in the dimensions (measurements) on the diagram.

3.3 Draw a diagram of the side view. Fill in all the measurements that you can get from the original diagram and then calculate the length of the front leg. Fill it in on the diagram.

3.4 Draw a diagram of the front view of the cage and calculate all the unknown sides. Fill them in on the diagram.

3.5 Look carefully at the original diagram of the cage to help you fill in this table. The side view has been left out as all the pieces are already included in the bottom and the legs. You should need 16 pieces of wood.

VIEW	Lengths of 3cm by 3cm pieces of wood	1,5cm by 1,5cm pieces of wood (for the cross pieces)
Front legs		
Back legs		
Bottom		
Back		
Front		
Gate		
TOTAL		

3.6 The wood comes in the following lengths : 1,8m ; 2,4m and 3m. What lengths of wood would you need to buy to make sure you can cut all the right pieces? Show how you worked out your answer and say how much wood if any was wasted.

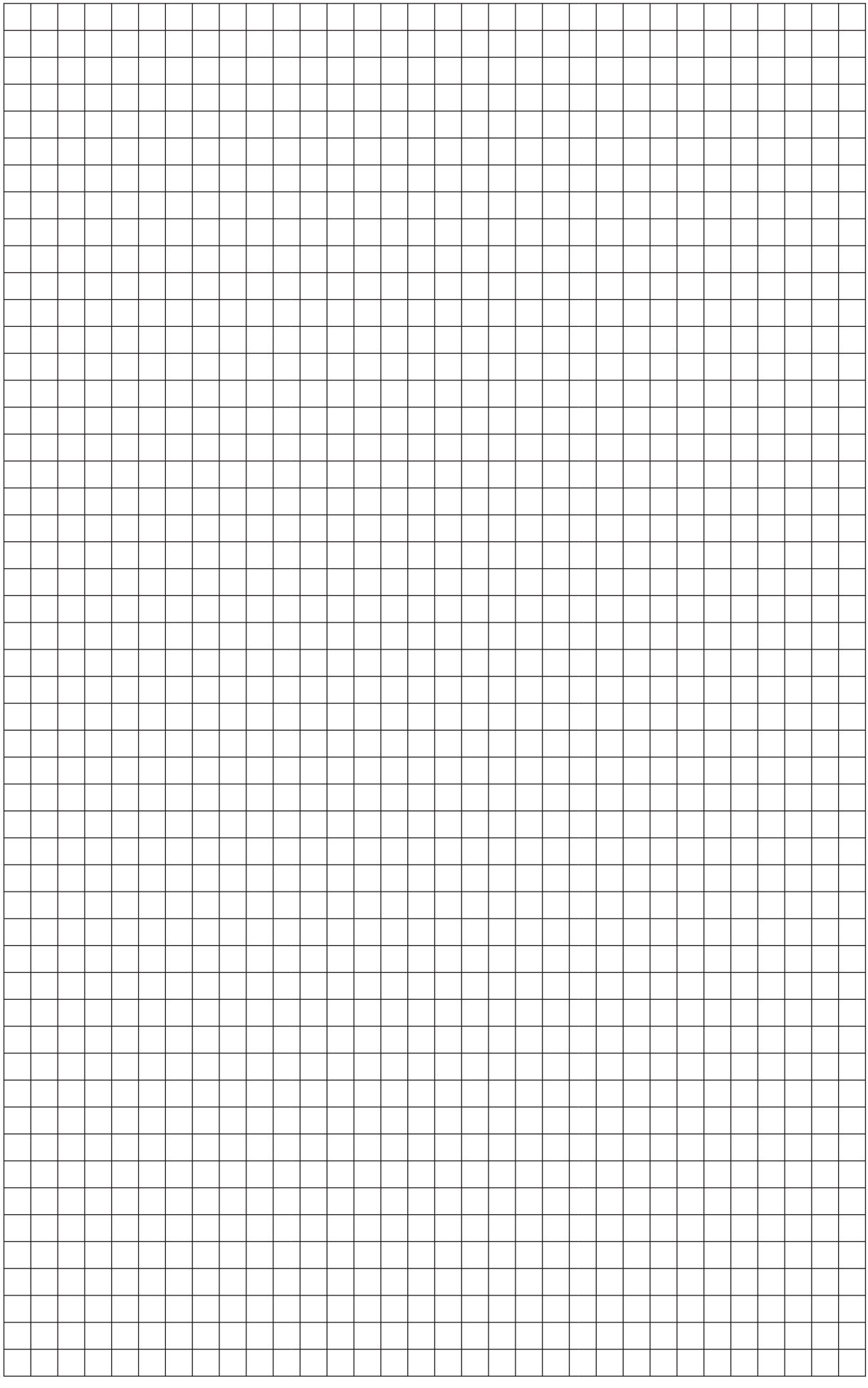
3.7 What must the dimensions (measurements) of the rectangle be from which the 2 side triangles must be cut?

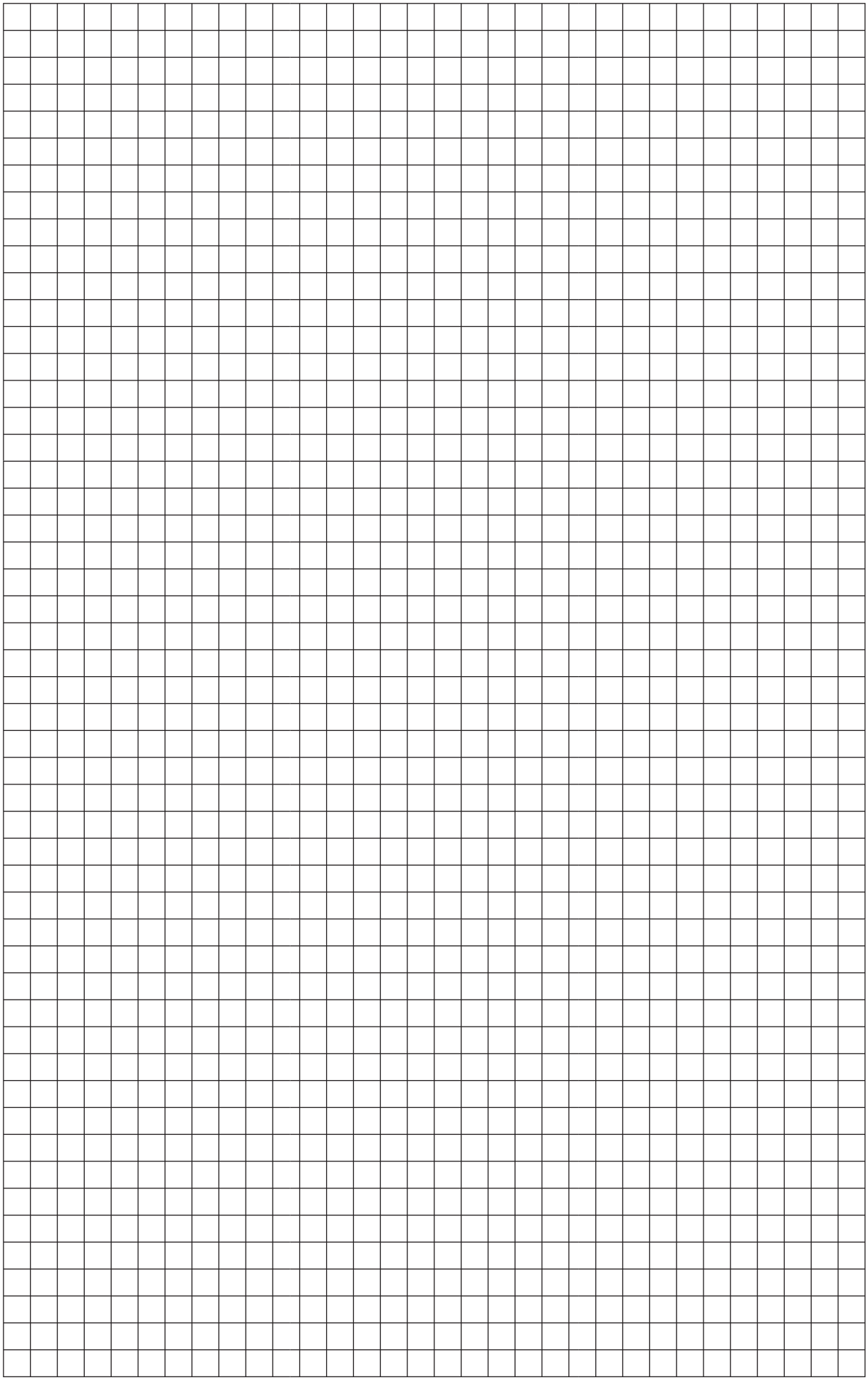
3.8 For this question you need to look carefully at your drawings.

(a) Find the length and breadth of 6 pieces of mesh which will be used to cover the frame. The pieces must be slightly bigger(1cm) than the actual size so that it can be hammered into the frame. Using a suitable scale draw these pieces on the square paper provided. Colour them in and cut them out.

(b) The mesh comes in 1,5m wide rolls. On a new piece of squared paper and using the same scale as in (a), draw a piece of chicken mesh 1,5m wide. Now arrange your pieces on this diagram so that you take up the smallest possible area. Approximately how much mesh must you buy.

3.9 If the mesh comes in 1m wide rolls, how much mesh would you use?





Activity 4 — Setting up a school

This activity focuses on two dimensional space. The students have to interpret the plans of a community centre and work out how to use the space to run a school. The plan of the community centre is used 2-dimensionally in this activity and 3-dimensionally in the next activity.

ABOUT THIS ACTIVITY

The aim of this activity is for the students to get a feel for the size of rooms. They are asked to pace out the actual size of rooms. The dimensions of the room are read off a plan. They investigate effective use of space using different arrangements of tables and chairs. Three- dimensional objects are viewed from the top. This activity is aligned with unit standard 9016 and addresses AC 2, 3, 4, 7 of SO1 and all of the AC of SO2.

MANAGING THIS ACTIVITY

This activity has one handout on which has the plans of the Community Centre are drawn. The students will need squared paper(see end of file), a ruler and a pencil. This activity requires the students to get a feel of the size of rooms so they will need space in which to move. This is an important exercise to help the students to visualise the area in which they are planning their school.

4.1 The students will have their own ideas here but they need to include an office and a space for each year group.

4.2 The ablution area has:
(a) 3 toilets
(b) 3 basins

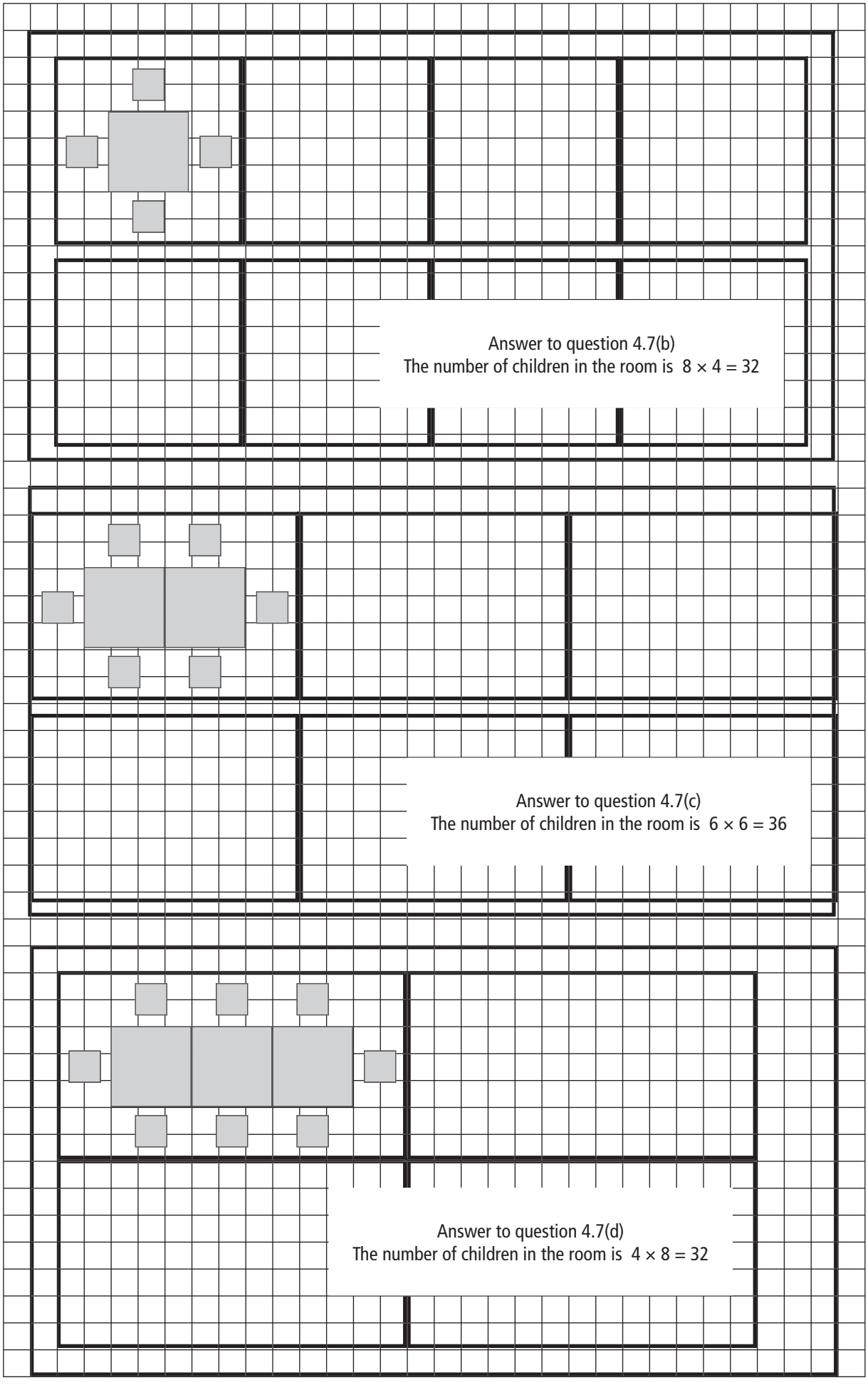
4.3 Dimensions are:
(a) 7,5m by 4m
(b) 6,4m by 4m
(c) 4,4m by 4m
(d) 25m by 11m
(e) 5m by 11m

4.4 This is an important exercise as it gives the students a chance to get a feel for the actual size of the room.

4.5 Answers will vary.

4.6 See diagram on next page.

4.7 See diagram for answers to questions (a), (b), (c) and (d).
(e) The 6-children arrangement gives the most seating.


Answer to question 4.7(b)
The number of children in the room is 8 × 4 = 32
Answer to question 4.7(c)
The number of children in the room is 6 × 6 = 36
Answer to question 4.7(d)
The number of children in the room is 4 × 8 = 32

4.8 The dimensions of the hall are 25m by 11m. The number of children that can fit into the hall is calculated as follows:

Arrangement 1

$$\text{No. of groups in length} = \frac{25}{1{,}75\text{m}}$$
$$= 14$$
$$\text{No. of groups in width} = \frac{11}{1{,}75\text{m}}$$
$$= 6$$
$$\text{Therefore no. of groups} = 14 \times 6$$
$$= 84 \text{ groups}$$
$$\text{Therefore number of children} = 84 \times 4$$
$$= 336 \text{ children}$$

Arrangement 2

$$\text{No. of groups in length} = \frac{25}{2{,}5\text{m}}$$
$$= 10$$
$$\text{No. of groups in width} = \frac{11\text{m}}{1{,}75\text{m}}$$
$$= 6$$
$$\text{Therefore no. of groups} = 10 \times 6$$
$$= 60 \text{ groups}$$
$$\text{Therefore number of children} = 60 \times 6$$
$$= 360 \text{ children}$$

Arrangement 3

$$\text{No. of groups in length} = \frac{25}{3{,}25\text{m}}$$
$$= 7$$
$$\text{No. of groups in width} = \frac{11\text{m}}{1{,}75\text{m}}$$
$$= 6$$
$$\text{Therefore no. of groups} = 7 \times 6$$
$$= 42 \text{ groups}$$
$$\text{Therefore number of children} = 42 \times 8$$
$$= 336 \text{ children}$$

4.9 Using the 2-table arrangement :

For room 2

$$\text{No. of groups in length} = \frac{6{,}4\text{m}}{2{,}5\text{m}}$$
$$= 2$$
$$\text{No. of groups in width} = \frac{4\text{m}}{1{,}75\text{m}}$$
$$= 2$$
$$\text{Therefore no. of groups} = 2 \times 2$$
$$= 4 \text{ groups}$$
$$\text{Therefore number of children} = 4 \times 6$$
$$= 24 \text{ children}$$

For stage

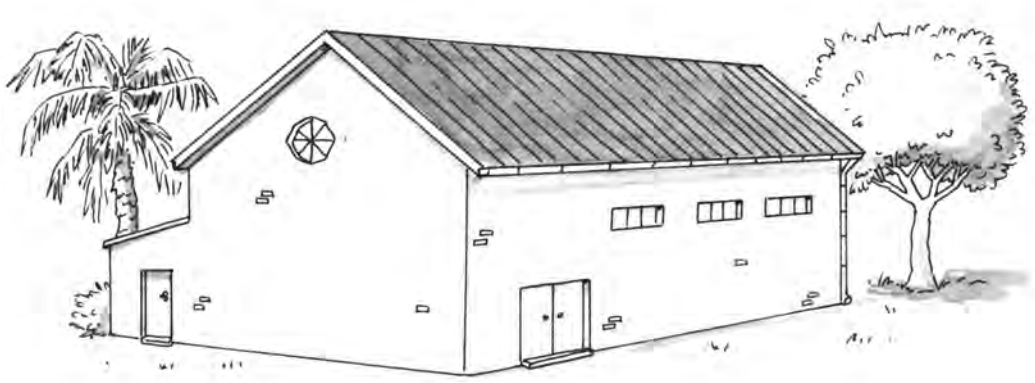
$$\text{No. of groups in length} = \frac{11\text{m}}{2{,}5\text{m}}$$
$$= 4$$
$$\text{No. of groups in width} = \frac{4\text{m}}{1{,}75\text{m}}$$
$$= 2$$
$$\text{Therefore no. of groups} = 8 \times 2$$
$$= 32 \text{ groups}$$
$$\text{Therefore number of children} = 32 \times 6$$
$$= 192 \text{ children}$$
$$\text{Total number of children} = 36 + 360 + 24 + 192 = 600 \text{ children}$$

4.10 This is far too many children for the available ablutions. There is also a need for floor area in which to play as well as space for equipment, book cases etc.

4.11 This is a chance for the students to use what they have learnt to design what they would do (could be a good discussion point).

Activity 4 — Setting up a school

You have got permission from the local authorities to use the Community Centre as a venue to set up a new preschool. You have got the plans of the centre from the council and now need to plan how you are going to use the space available (see handout 4). The agreement is that you may use all the smaller rooms. You may also use the stage and hall but only in such a way that they can be easily cleared if there is to be another function in the centre.



Answer the following questions using the plans of the centre on the handout.

4.1 Before you begin to allocate space for various activities, decide what spaces you would need for your school eg office space, space for each year group etc. The number of children will be decided on once you have looked at the plans. Make a list of the spaces you need.

4.2 Find the ablution area on the plan.
(a) How many toilets are there?
(b) How many basins are there?

4.3 What are the dimensions (length and breadth) of :
(a) Room 1?
(b) Room 2?
(c) Room 3?
(d) The hall?
(e) The stage?

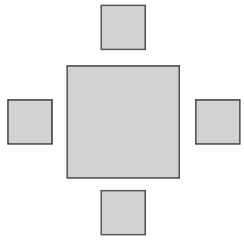
4.4 Use a tape measure to mark off I metre on the floor. Using the marked metre, step out a metre. This should give you a feel as to how long a metre is. Now step out the dimensions of room 1 which is the biggest of the 3 rooms.

4.5 Step out room 3. Does it feel much smaller. What would you use these two rooms for? Give reasons for your answers.

4.6 On the squared paper provided and using a scale of 4 squares to represent 1m, draw the outline of room 1.

4.7 The dimensions of the little square plastic tables that you have available are 75cm by 75cm. The chairs have dimensions 30cm by 30cm. There needs to be an open area of about 50cm around each table so that the children have room to get in and out of the chairs.

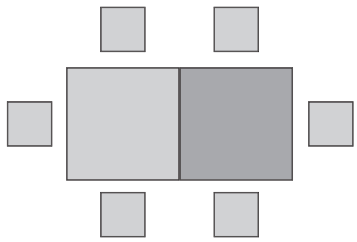
(a) The tables and chairs could be arranged as follows:



On a second piece of squared paper and using the same scale as you used in question 4.6, draw this arrangement with a 50cm border around the table. Cut it out. Make a few more.

(b) Place your cut out table arrangements in the room you drew in question 4.6. What is the maximum number of arrangements that you could fit into the room? How many children is this?

(c) The tables and chairs could also be arranged as follows:



Draw this arrangement in the same way as you did the other. What is the maximum number of groups with this arrangement can you fit into the room ? How many children is this?

(d) Now make an arrangement with 3 tables pushed together and repeat the process.

(e) Which arrangement gives seating for the most children?

4.8 Calculate (you don't need to draw) how many children you could fit into the hall using each of the three arrangements used in 4.7.

4.9 Using the arrangement that gives you the most children, work out the maximum number of children that you could fit into the school if you used room 2 and the stage for groups of children as well as the hall and room 1.

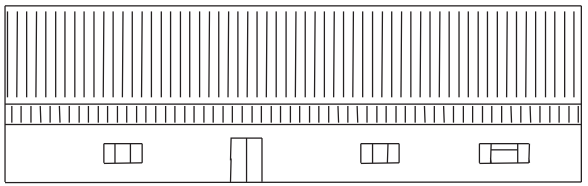
4.10 Do you think you could have this many children in your school? Discuss your answer.

4.11 Now that you have some idea of the size of your school, take the plans and show how you would arrange the space for the first day of school.

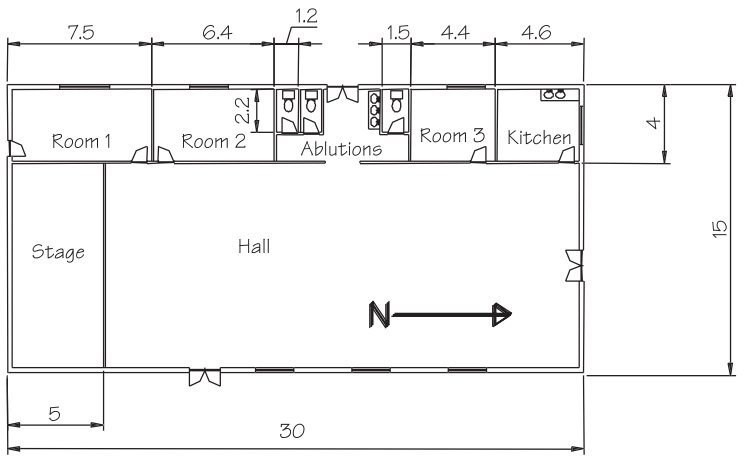
Plan of Community Centre

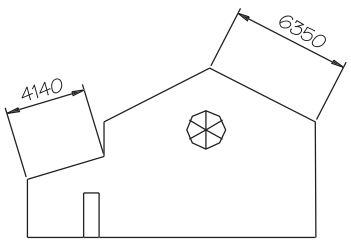
Bought out items

- Window 2.6 x 1.0m
- Window 2.0 x 1.0m
- Window 2.0 x 0.5m
- Window Diameter 2.0m
- Door 0.8m wide x 2.3m high
- Door 1.6m wide x 2.3m high

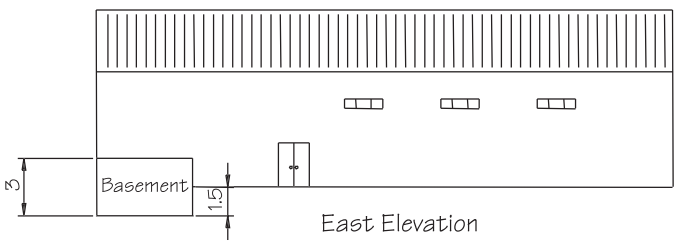


West Elevation

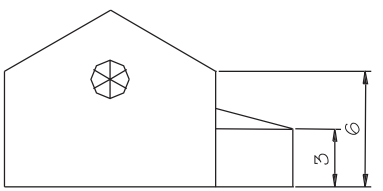




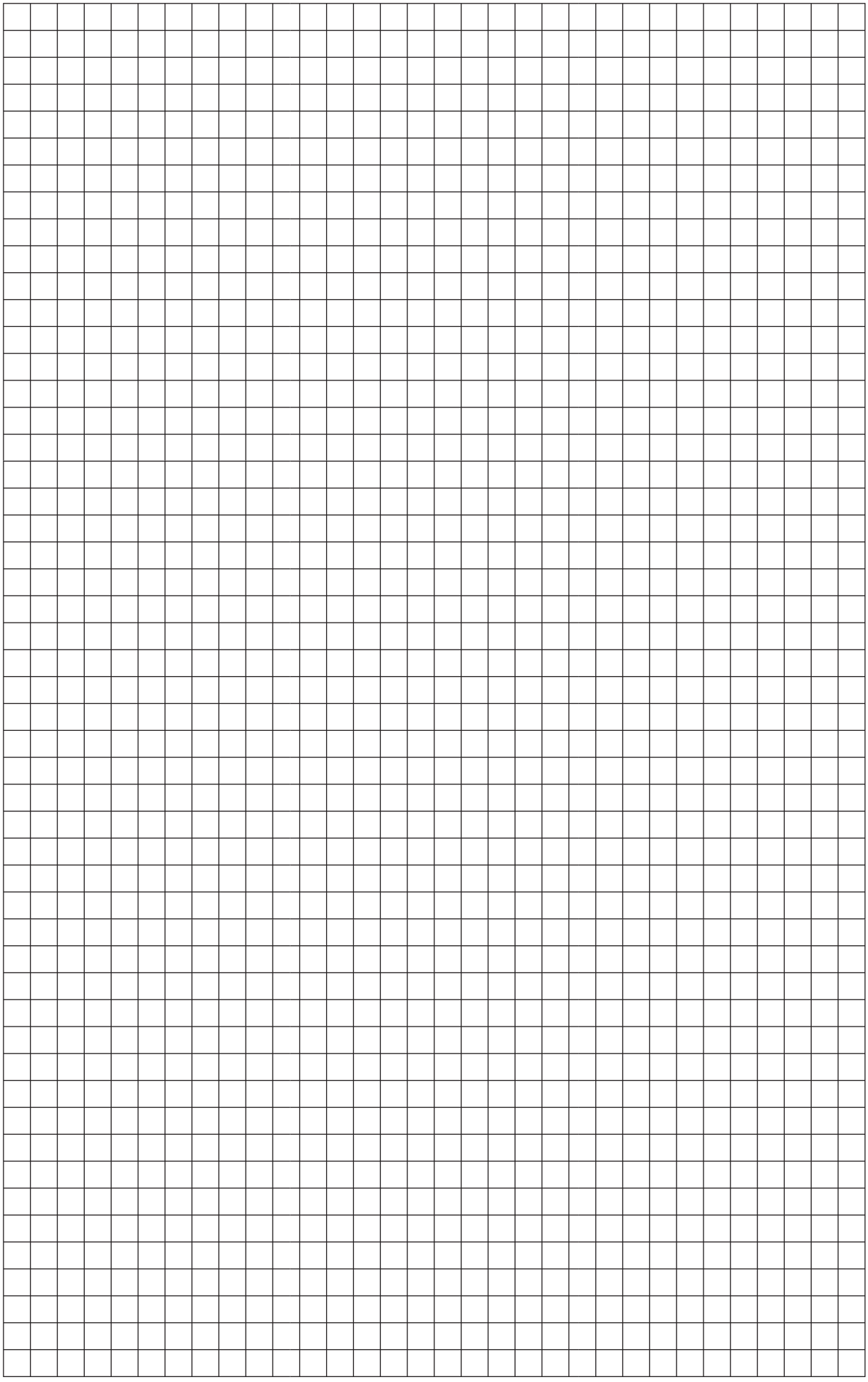
South Elevation

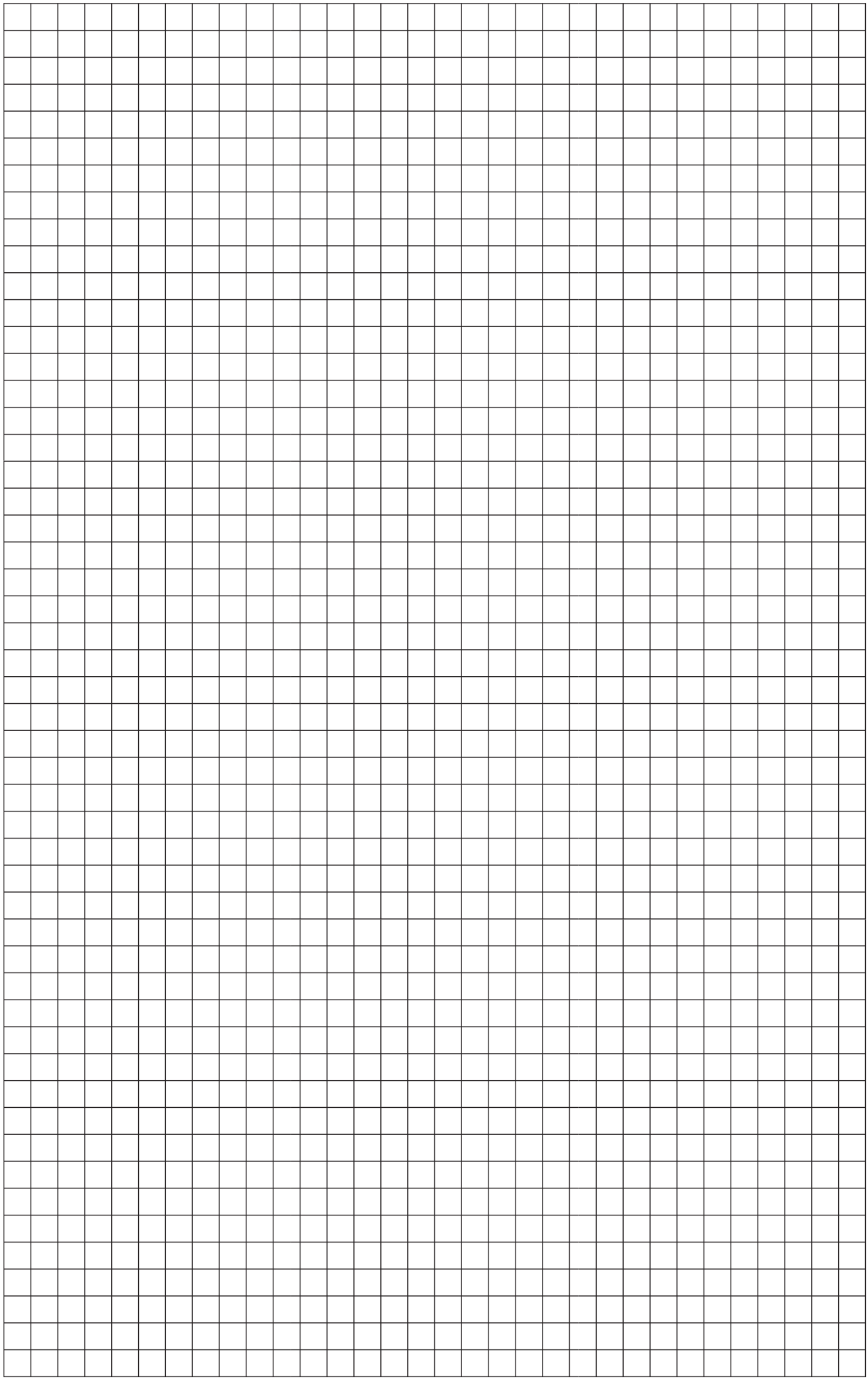


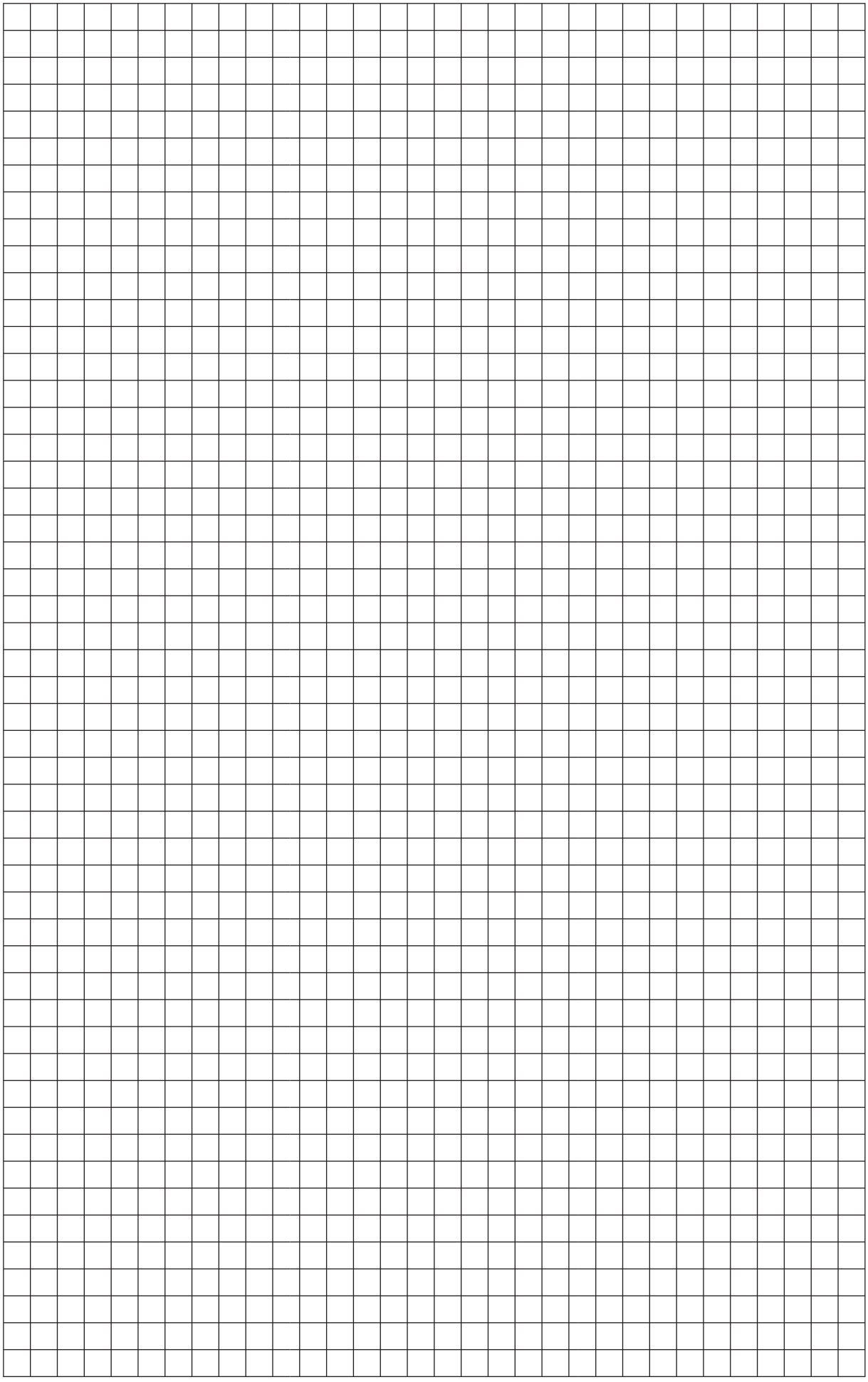
East Elevation



North Elevation







Activity 5 — Painting the school.

This activity requires the students to read plans and work out the surface area of the walls. This is done in the context of estimating the volume of paint needed to paint the exterior of the school building.

ABOUT THIS ACTIVITY

The students will be expected to find the exact area to be painted using the plans of the Community Centre used in the previous activity. They will then revisit the problem and calculate the area without taking all the doors and windows into account. The two methods will be compared to see if any paint is wasted if a rough estimate is used. This activity is aligned with unit standard 9016 and addresses AC 5, 7 of SO1 and all ACs of SO2. This activity could be used as an assessment task as all the calculations have been covered in the previous activities and it addresses all the critical outcomes of SO2 of unit standard 9016.

MANAGING THIS ACTIVITY

Students should be given the worksheet for this activity and a copy of the handout from the previous activity (the plans of the Community Centre). The students are required to calculate areas of rectangles, triangles and circles and need Pythagoras' theorem in order to find the height of triangles.

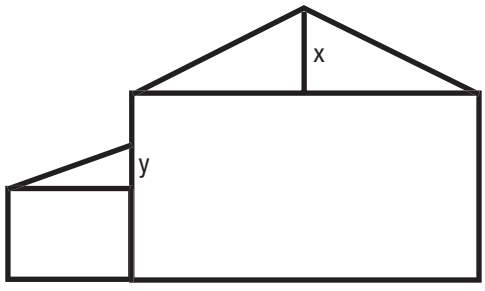
5.1 West elevation:

$$\begin{aligned} \text{Area of wall} &= 3\text{m} \times 30\text{m} \\ &= 90\text{m}^2 \\ \text{Area of door} &= 1{,}6\text{m} \times 2{,}3\text{m} \\ &= 3{,}68\text{m}^2 \\ \text{Area of smaller windows} &= (2\text{m} \times 1\text{m}) \times 2 \\ &= 4\text{m}^2 \\ \text{Area of big window} &= 2{,}6\text{m} \times 1\text{m} \\ &= 2{,}6\text{m}^2 \\ \text{Area to be painted} &= 90\text{m}^2 - (3{,}68 + 4 + 2{,}6) \\ &= 79{,}72\text{m}^2 \end{aligned}$$

5.2 East elevation:

$$\begin{aligned} \text{Area of wall} &= 6\text{m} \times 30\text{m} \\ &= 180\text{m}^2 \\ \text{Area of door} &= 1{,}6\text{m} \times 2{,}3\text{m} \\ &= 3{,}68\text{m}^2 \\ \text{Area of windows} &= (2\text{m} \times 0{,}5\text{m}) \times 3 \\ &= 3\text{m}^2 \\ \text{Area to be painted} &= 180\text{m}^2 - (3{,}68 + 3) \\ &= 173{,}32\text{m}^2 \end{aligned}$$

5.3



Let the height of the main roof = x

$x^2 = (6{,}35)^2 - (5{,}5)^2$ (pythagoras)

$x^2 = 10{,}07$

$x = \sqrt{10{,}07}$

$x = 3{,}17\text{m}$

Let the height of the side roof = y

$y^2 = (4{,}14)^2 - (4)^2$ (pythagoras)

$y^2 = 1{,}1396$

$y = \sqrt{1{,}1396}$

$y = 1{,}07\text{m}$

5.4 Using the above dimensions:

Area of main rectangle = $6\text{m} \times 11\text{m}$

$= 66\text{m}^2$

Area of main triangle = $\frac{11 \times 3{,}17}{2}$

$= 17{,}44\text{m}^2$

Area of smaller rectangle = $3\text{m} \times 4\text{m}$

$= 12\text{m}^2$

Area of smaller triangle = $\frac{4 \times 1{,}07}{2}$

$= 2{,}14\text{m}^2$

Total area = $66\text{m}^2 + 17{,}44\text{m}^2 + 12\text{m}^2 + 2{,}14\text{m}^2$

$= 97{,}58^2$

Area to be subtracted:

Area of circular window = πr^2

radius of window = $\frac{2\text{m}}{2}$

$= 1\text{m}$

Therefore area = $3.14(1)^2$

$= 3{,}14\text{m}^2$

Area of door = $0{,}8\text{m} \times 2{,}3\text{m}$

$= 1{,}84\text{m}^2$

Area to be painted = $97{,}58\text{m}^2 - (3{,}14\text{m}^2 + 1{,}84\text{m}^2)$

$= 92{,}6\text{m}^2$

5.5 Area of front of centre to be painted

Total area = $97{,}58\text{m}^2$

Area of door = $1{,}6\text{m} \times 2{,}3\text{m}$

$= 3{,}68\text{m}^2$

Area of window = $2\text{m} \times 1\text{m}$

$= 2\text{m}^2$

Area of round window = $3{,}14\text{m}^2$

Area to be painted = $97{,}58\text{m}^2 - (3{,}68\text{m}^2 + 2\text{m}^2 + 3{,}14\text{m}^2)$

$= 88{,}76\text{m}^2$

5.6 Combining all the results:

$$\text{Total area to be painted} = 79{,}72m^2 + 173{,}32m^2 + 92{,}6m^2 + 88{,}76m^2)$$
$$= 434{,}4m^2$$

5.7 Amount of paint needed:

$$\text{Amount of paint needed for 1 coat} = \frac{434{,}4}{9}$$
$$= 48{,}26\ell$$
$$\text{Amount of paint needed for 2 coats} = 48{,}26\ell \times 2$$
$$= 96{,}5\ell$$

5.8 You would need to buy five 20ℓ tins.

5.9 Area of wall to be painted worked out without subtracting all the windows and doors:

$$\text{Area to be painted} = 90m^2 + 180m^2 + 97{,}58m^2 + 97{,}58m^2$$
$$= 465{,}16m^2$$
$$\text{Amount of paint needed for 1 coat} = \frac{465{,}16m^2}{9}$$
$$= 51{,}68\ell$$
$$\text{Amount of paint needed for 2 coats} = 51{,}68\ell \times 2$$
$$= 103{,}37\ell$$

One would still buy five 20ℓ as you would know you have over-estimated.

5.10 It appears that one can get a good estimate by just working out roughly how much each wall would take regardless of the doors and windows. Of course each case would be decided on merit. You could not use the same estimate approach for a large shop with glass frontage.

5.11 Area to be painted treating the front and back as rectangles and not working out the actual triangles.

$$\text{Area of front and back} = 11m \times (3{,}17m + 6m) + 4m \times (1{,}07 + 3)$$
$$117{,}15m^2$$
$$\text{Area to be painted} = 90m^2 + 180m^2 + 117{,}15m^2 + 117{,}15m^2$$
$$= 504{,}3m^2$$
$$\text{Amount of paint needed for 1 coat} = \frac{504{,}3m^2}{9}$$
$$= 56\ell$$
$$\text{Amount of paint needed for 2 coats} = 56\ell \times 2$$
$$= 112\ell$$

This means that you will have to buy five 20ℓ tins plus three 5ℓ tins. This is an over- estimation so you have to be careful not to be too loose with the dimensions. However knowing that you have overestimated a lot, you would almost certainly buy 5 × 20ℓ tins and anticipate maybe trying to stretch the paint. The big lesson here is that it makes a lot more sense to estimate rather than calculate in too much detail, all the time remaining vigilant to overestimation.

Activity 5 — Painting the school

The parents are happy to help you paint the school. Your job is to estimate the amount of paint needed and to purchase it. You will need to look at the plan of the Community Centre on the handout from the previous activity. It will be easier to consider each elevation separately.

5.1 Work out the area of wall which must be painted on the West elevation (side view). You don't paint doors and windows with the same paint as the walls.

5.2 Work out the area to be painted on the east elevation (other side view).

5.3 Draw a rough sketch of the south view (back of the hall) and divide it into rectangles and triangles to make calculations easier. Fill in all the dimensions of the walls on your sketch. Calculate the height of the roof of the main hall and then the height of the side roof.

5.4 Using your dimensions determined in 5.3, calculate the area of the south wall that needs to be painted ($\pi = 3{,}14$)

5.5 The north elevation (front of the hall) is the same as the south except it has different windows and doors. Work out the area to be painted.

5.6 Determine the total area to be painted.

5.7 The instructions on the paint tin state that the rate of paint usage is $9m^2$ per litre. Calculate the number of litres of paint you will need if you plan to do two coats of paint.

5.8 The paint comes in $20l$, $5l$ and $1l$ tins. What will you need to purchase for the job?

5.9 The above exercise was a lot of hard work. An alternative approach would be to work out the areas of the walls and not worry about the doors and windows. Do this and work out the amount of paint needed.

5.10 Compare your answers for 5.7 and 5.9. How useful is the approach used in 5.9?

What would happen if you regarded the front and the back of the centre as two rectangles and didn't worry about working out the triangles? Explore this. Is it a good estimation? Give reasons for your answers.

Activity 6 — The outing

This activity focuses on measuring time. The problem set is for the students to organise a day at the beach within their school day. The constraints are that they need to catch the train as well as be on the beach at low tide.

ABOUT THIS ACTIVITY

The students are required to read both tide tables and train timetables and then sequence events. Reading these data sheets requires the students to work with 2 co-ordinates. This activity is aligned with unit standard 9016 and addresses AC 2 of SO1 and AC 6, 8, 9, 10, 11, 12 of SO2.

MANAGING THIS ACTIVITY

Students should be given worksheet 6 and 2 handouts. The tide table and calendar are for 2003 but could be updated if so wished. The tide table and train timetable can be found at the following websites respectively: http://www.diveinsa.co.za/tides.htm and http://www.capemetrorail.co.za.

The facilitator can specify the month with which the students must work with. This would narrow the responses of the students.

6.1 Weather obviously plays a big part here so some comment on this is necessary. Other considerations could be that January/February are not good months as the students are still settling in to the routine of the school and educators need to get to know them. They might want to choose a month at the end of the year so as to end the year with a party. We will select March for the purposes of this exercise.

6.2 The train journey is about 40 minutes. Students need to find the difference between the time the train leaves Observatory and the time it leaves St James. This will give them an approximate time for the journey.

6.3 Train no 0151 at 08:49 or 0153 at 09:19 are suitable. The earlier train, no 0147, leaves at 08:24 which is too early and train no 0155 leaves at 09:44 which is getting late because we want to make the most of the low tide.

Considerations could include the following :

- Young children are unpredictable so the later train is better, allowing for a calmer start to the day.
- We want to spend as much time as possible on the beach so the sooner we leave the better.

6.4 The tide table gives only high tide times so students will need to know that low tide is 6 hours after high tide. We will arrive at St James station at about 09:30 or if the later train is taken at about 10:00. We need the tide to be low soon after we arrive so according to the tide table the 4th March (low tide at 10:07), 5th March (low tide at 10.36), 6th March (low tide at 11.04), 20th March (low tide at 10:29) and possibly the 19th March (low tide at 09:53) are options. We need to consult the calendar to make sure that these days are not on the weekend. All these options are fine. The students need to choose one day. For this exercise let us choose Wednesday 5th March.

6.5 Students need to give some reasons why this day was chosen. Considerations could include the following :

- We will arrive at the beach at about 10h00 and low tide is at 10h40 so that the children will benefit from this. The tide will then be coming in which is better than having it going out while the children are swimming.
- We chose Wednesday so that if it rained we could still go on the Thursday.

6.6 In order to work out the time by which we must leave the beach we must consider the following:

- The journey takes 40 minutes.
- There is a 15 minute walk back to the school from Observatory station.
- This is a total of 55 minutes.
- We need to be back at the school by 16h00.
- The latest we can catch the train is about 15h00.
- Look at the train timetable. There are 2 options: either train no. 0208 at 14:36 or train no. 0210 at 14:56.

6.7 A look at our day:

WHAT'S HAPPENING	TIME	ALLOCATED TIME	TRAIN NUMBER
Leave school	8h50		
Walk to Observatory Station		15 minutes	
Catch train to St James	9h19	40 minutes	0153
Arrive at St James	9h59		
Walk to beach from station		15 minutes	
Spend time on beach	10h15	4 hours	
Walk back to St James station	14h15	15 minutes	
Catch train to Observatory	14h36	40 minutes	0208
Arrive at Observatory	15h16		
Walk back to school		15 minutes	
Return to school	15h30		

Activity 6 — The outing

The annual outing to the beach is always a highlight but requires careful planning. We always go to St James because it has grass, sand and a tidal pool. The beach is within easy walking distance from the station. However, the only problem is the TIDE! High tide means high risk. So we always choose the day well in advance.

We need to transport 60 students and 6 adults (2 educators and 4 parents) from our school in Observatory to St James by train. We need to arrive so that the tide is low and will start coming in while we are there. We need to leave before the sea becomes dangerous. The earliest we can leave the school is 8h30 and we must be back at the school at 16h00. It takes 15 minutes to walk to the Observatory station. Remember that our children are still small, so we don't want to wait too long for a train but don't want to rush either.

6.1 Decide on a month in which you want to go on the outing. Discuss your choice giving reasons why you chose that particular month and why you didn't choose others.

6.2 Using the train timetable, find out how long the journey will take.

6.3 Decide on a suitable train. Make sure you reread the problem information. Motivate your decision.

6.4 Now go to the tide tables and find a suitable day. You will need to consult a calendar to check that the day chosen is not on a weekend.

6.5 Motivate why you have chosen this day.

6.6 Decide on the time to catch the train back. Remember that you don't want to be on the beach at high tide.

6.7 Put all your information down on a time line and fill in the train numbers so that your colleagues will know exactly what to do.

Train timetable for Cape Town – Wynberg – Simon's town line

TRAIN NO.	0143	0145	0147	0151	0153	0155	0157	0161	0163	0165	0167	0173	0175
CAPE TOWN	07:47	07:55	08:15	08:40	09:10	09:35	10:00	10:25	10:50	11:15	11:40	12:20	12:40
WOODSTOCK	07:50	07:58	08:18	08:43	09:13	09:38	10:03	10:28	10:53	11:18	11:43	12:23	12:43
SALT RIVER	07:53	08:01	08:21	08:46	09:16	09:41	10:06	10:31	10:56	11:21	11:46	12:26	12:46
OBSERVATORY	07:56	08:04	08:24	08:49	09:19	09:44	10:09	10:34	10:59	11:24	11:49	12:29	12:49
MOWBRAY	07:58	08:06	08:26	08:51	09:21	09:46	10:11	10:36	11:01	11:26	11:51	12:31	12:51
ROSEBANK	08:00	08:08	08:28	08:53	09:23	09:48	10:13	10:38	11:03	11:28	11:53	12:33	12:53
RONDEBOSCH	08:01	08:09	08:29	08:54	09:24	09:49	10:14	10:39	11:04	11:29	11:54	12:34	12:54
NEWLANDS	08:04	08:12	08:32	08:57	09:27	09:52	10:17	10:42	11:07	11:32	11:57	12:37	12:57
CLAREMONT	08:06	08:14	08:34	08:59	09:29	09:54	10:19	10:44	11:09	11:34	11:59	12:39	12:59
HARFIELD RD	08:08	08:16	08:36	09:01	09:31	09:56	10:21	10:46	11:11	11:36	12:01	12:41	13:01
KENILWORTH	08:10	08:17	08:37	09:02	09:32	09:57	10:22	10:47	11:12	11:37	12:02	12:42	13:02
WYNBERG	08:12	08:19	08:39	09:04	09:34	09:59	10:24	10:49	11:14	11:39	12:04	12:44	13:04
WITTEBOME	08:15	08:22	08:42	09:07	09:37	10:02	10:27	10:52	11:17	11:42	12:07	12:47	13:07
PLUMSTEAD	08:17	08:24	08:44	09:09	09:39	10:04	10:29	10:54	11:19	11:44	12:09	12:49	13:09
STEURHOF	08:18	08:25	08:45	09:10	09:40	10:05	10:30	10:55	11:20	11:45	12:10	12:50	13:10
DIEPRIVIER	08:20	08:27	08:47	09:12	09:42	10:07	10:32	10:57	11:22	11:47	12:12	12:52	13:12
HEATHFIELD	08:22	08:29	08:49	09:14	09:44	10:09	10:34	10:59	11:24	11:49	12:14	12:54	13:14
RETREAT	08:25	08:32	08:52	09:17	09:47	10:12	10:37	11:02	11:27	11:52	12:17	12:57	13:17
STEENBERG		08:35	08:55	09:20	09:50	10:15	10:40	11:05	11:30	11:55	12:20	13:00	13:20
LAKESIDE		08:37	08:57	09:22	09:52	10:17	10:42	11:07	11:32	11:57	12:22	13:02	13:22
FALSE BAY		08:40	09:00	09:25	09:55	10:20	10:45	11:10	11:35	12:00	12:25	13:05	13:25
MUIZENBERG		08:42	09:02	09:27	09:57	10:22	10:47	11:12	11:37	12:02	12:27	13:07	13:27
ST JAMES		08:44	09:04	09:29	09:59	10:24	10:49	11:14	11:39	12:04	12:29	13:09	13:29
KALK BAY		08:46	09:06	09:31	10:01	10:26	10:51	11:16	11:41	12:06	12:31	13:11	13:31
FISH HOEK		08:51	09:11	09:36	10:06	10:31	10:56	11:21	11:46	12:11	12:36	13:16	13:36
SUNNY COVE		08:53		09:38		10:33		11:23		12:13			13:38
GLENCAIRN		08:58		09:43		10:38		11:28		12:18			13:43
SIMON'S TOWN		09:02		09:48		10:43		11:33		12:23			13:48

source: http://wwww.capemetrorail.co.za

Train timetable for Simon's Town – Wynberg – Cape Town line

TRAIN NO.	0194	0196	0198	0200	0204	0206	0208	0210	0212	0214	0216	0218	0222	0224	0226
SIMON'S TOWN		12:33		13:18		13:58		14:38			15:15				15:55
GLENCAIRN		12:38		13:23		14:03		14:43			15:20				16:00
SUNNY COVE		12:43		13:28		14:08		14:48			15:25				16:05
FISH HOEK	12:20	12:45	13:10	13:30	13:50	14:10	14:30	14:50	15:05		15:27		15:45		16:07
KALK BAY	12:24	12:49	13:14	13:34	13:54	14:14	14:34	14:54	15:09		15:31		15:49		16:11
ST JAMES	12:26	12:51	13:16	13:36	13:56	14:16	14:36	14:56	15:11		15:33		15:51		16:13
MUIZENBERG	12:28	12:53	13:18	13:38	13:58	14:18	14:38	14:58	15:13		15:35		15:53		16:15
FALSE BAY	12:30	12:55	13:20	13:40	14:00	14:20	14:40	15:00	15:15		15:37		15:55		16:17
LAKESIDE	12:33	12:58	13:23	13:43	14:03	14:23	14:43	15:03	15:18		15:40		15:58		16:20
STEENBERG	12:35	13:00	13:25	13:45	14:05	14:25	14:45	15:05	15:20		15:42		16:00		16:22
RETREAT	12:38	13:03	13:28	13:48	14:08	14:28	14:48	15:08	15:23	15:35	15:45	15:55	16:03	16:15	16:25
HEATHFIELD	12:41	13:06	13:31	13:51	14:11	14:31	14:51	15:11	15:26	15:38	15:48	15:58	16:06	16:18	16:28
DIEPRIVIER	12:43	13:08	13:33	13:53	14:13	14:33	14:53	15:13	15:28	15:40	15:50	16:00	16:08	16:20	16:30
STEURHOF	12:45	13:10	13:35	13:55	14:15	14:35	14:55	15:15	15:30	15:42	15:52	16:02	16:10	16:22	16:32
PLUMSTEAD	12:47	13:12	13:37	13:57	14:17	14:37	14:57	15:17	15:32	15:44	15:54	16:04	16:12	16:24	16:34
WITTEBOME	12:48	13:13	13:38	13:58	14:18	14:38	14:58	15:18	15:33	15:45	15:55	16:05	16:13	16:25	16:35
WYNBERG	12:50	13:15	13:40	14:00	14:20	14:40	15:00	15:20	15:35	15:47	15:57	16:07	16:15	16:27	16:37
KENILWORTH	12:52	13:17	13:42	14:02	14:22	14:42	15:02	15:22	15:37	15:49	15:59	16:09	16:17	16:29	16:39
HARFIELD RD	12:54	13:19	13:44	14:04	14:24	14:44	15:04	15:24	15:39	15:51	16:01	16:11	16:19	16:31	16:41
CLAREMONT	12:56	13:21	13:46	14:06	14:26	14:46	15:06	15:26	15:41	15:53	16:03	16:13	16:21	16:33	16:43
NEWLANDS	12:58	13:23	13:48	14:08	14:28	14:48	15:08	15:28	15:43	15:55	16:05	16:15	16:23	16:35	16:45
RONDEBOSCH	13:00	13:25	13:50	14:10	14:30	14:50	15:10	15:30	15:45	15:57	16:07	16:17	16:25	16:37	16:47
ROSEBANK	13:02	13:27	13:52	14:12	14:32	14:52	15:12	15:32	15:47	15:59	16:09	16:19	16:27	16:39	16:49
MOWBRAY	13:04	13:29	13:54	14:14	14:34	14:54	15:14	15:34	15:49	16:01	16:11	16:21	16:29	16:41	16:51
OBSERVATORY	13:06	13:31	13:56	14:16	14:36	14:56	15:16	15:36	15:51	16:03	16:13	16:23	16:31	16:43	16:53
SALT RIVER	13:09	13:34	13:59	14:19	14:39	14:59	15:19	15:39	15:54	16:06	16:16	16:26	16:34	16:46	16:56
WOODSTOCK	13:12	13:37	14:02	14:22	14:42	15:02	15:22	15:42	15:57	16:09	16:19	16:29	16:37	16:49	16:59
CAPE TOWN	13:15	13:40	14:05	14:25	14:45	15:05	15:25	15:45	16:00	16:12	16:22	16:32	16:40	16:52	17:02

source: http://wwww.capemetrorail.co.za

2003

January							February							March							April						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
			1	2	3	4							1							1			1	2	3	4	5
5	6	7	8	9	10	11	2	3	4	5	6	7	8	2	3	4	5	6	7	8	6	7	8	9	10	11	12
12	13	14	15	16	17	18	9	10	11	12	13	14	15	9	10	11	12	13	14	15	13	14	15	16	17	18	19
19	20	21	22	23	24	25	16	17	18	19	20	21	22	16	17	18	19	20	21	22	20	21	22	23	24	25	26
26	27	28	29	30	31		23	24	25	26	27	28		23	24	25	26	27	28	29	27	28	29	30			
														30	31												

May							June							July							August						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
				1	2	3	1	2	3	4	5	6	7			1	2	3	4	5						1	2
4	5	6	7	8	9	10	8	9	10	11	12	13	14	6	7	8	9	10	11	12	3	4	5	6	7	8	9
11	12	13	14	15	16	17	15	16	17	18	19	20	21	13	14	15	16	17	18	19	10	11	12	13	14	15	16
18	19	20	21	22	23	24	22	23	24	25	26	27	28	20	21	22	23	24	25	26	17	18	19	20	21	22	23
25	26	27	28	29	30	31	29	30						27	28	29	30	31			24	25	26	27	28	29	30
																					31						

September							October							November							December						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
	1	2	3	4	5	6				1	2	3	4							1		1	2	3	4	5	6
7	8	9	10	11	12	13	5	6	7	8	9	10	11	2	3	4	5	6	7	8	7	8	9	10	11	12	13
14	15	16	17	18	19	20	12	13	14	15	16	17	18	9	10	11	12	13	14	15	14	15	16	17	18	19	20
21	22	23	24	25	26	27	19	20	21	22	23	24	25	16	17	18	19	20	21	22	21	22	23	24	25	26	27
28	29	30					26	27	28	29	30	31		23	24	25	26	27	28	29	28	29	30	31			
														30													

High Tide in Table Bay in 2003

Day	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	Mg	Aft	Mg	Aft	Mg	Aft	Mg	Aft	Mg	Aft	Mg	Aft	Mg	Aft	Mg	Aft	Mg	Aft	Mg	Aft	Mg	Aft	Mg	Aft
1	208	1418	327	1537	234	1448	314	1529	312	1532	348	1611	407	1630	508	1730	616	1835	650	1910	909	2148	954	2233
2	254	1504	403	1613	309	1522	342	1557	341	1600	421	1644	443	1707	550	1812	708	1930	757	2025	1041	2320	1106	2346
3	337	1547	437	1646	341	1553	409	1624	410	1629	456	1719	523	1748	636	1900	813	2041	930	2208	1150	-	1203	-
4	418	1628	508	1717	411	1622	437	1652	440	1659	534	1759	606	1833	730	1956	943	2214	1108	2341	24	1241	39	1248
5	457	1706	541	1748	440	1650	505	1721	511	1733	618	1848	656	1925	837	2105	1118	2344	1218	-	109	1321	121	1326
6	535	1743	612	1820	508	1718	535	1735	547	1812	713	1947	755	2026	959	2225	1231	-	45	1308	146	1355	156	1400
7	613	1820	646	1856	536	1748	608	1829	629	1900	821	2058	906	2136	1124	2344	52	1325	131	1348	218	1426	228	1433
8	653	1859	727	1943	606	1820	649	1918	727	2008	940	2212	1024	2248	1235	-	143	1408	208	1422	248	1456	259	1504
9	737	1948	821	2053	640	1858	748	2034	848	2134	1056	2319	1138	2355	51	1332	224	1446	241	1454	317	1525	329	1535
10	833	2057	940	2237	723	1951	921	2218	1018	2254	1202	1202	1242	-	147	1420	301	1520	311	1523	346	1553	359	1607
11	944	2227	1109	-	829	2121	1059	2339	1133	2356	17	1259	55	1338	234	1503	334	1552	340	1551	415	1623	431	1640
12	1058	2347	4	1218	1010	2312	1210	-	1232	-	111	1350	150	1428	317	1542	405	1622	408	1619	445	1653	504	1714
13	1201	-	101	1311	1141	-	36	1303	48	1323	202	1439	241	1515	355	1619	435	1651	436	1647	517	1727	541	1754
14	45	1251	144	1355	24	1244	122	1349	136	1409	250	1525	328	1559	431	1653	504	1720	505	1716	553	1806	623	1840
15	129	1334	222	1435	113	1332	205	1433	222	1455	338	1611	412	1640	505	1726	534	1750	536	1749	638	1858	715	1940
16	207	1414	259	1515	155	1415	247	1515	307	1540	425	1657	454	1721	537	1759	606	1823	612	1828	740	2013	820	2056
17	242	1451	337	1554	234	1455	329	1557	352	1624	511	1742	533	1801	610	1833	644	906	659	1924	905	2148	934	2218
18	318	1529	415	1634	313	1536	411	1640	438	1710	557	1829	612	1841	646	1912	737	2013	815	2100	1029	2308	1045	2331
19	354	1608	455	1716	353	1617	454	1724	525	1758	645	1920	652	1924	731	2005	911	2201	1004	2245	1132	-	1148	-
20	432	1648	536	1758	433	1658	539	1812	614	1850	738	2017	738	2015	840	2123	1105	2333	1125	2354	9	1224	32	1244
21	512	1730	619	1845	514	1741	629	1906	710	1952	841	2123	839	2119	1023	2256	1213	-	1218	-	59	1311	126	1336
22	554	1815	707	1939	558	1827	727	2014	818	2106	956	2231	1000	2234	1151	-	31	1258	45	1301	145	1355	215	1426
23	640	1904	805	2051	645	1920	846	2144	941	2224	1111	2332	1124	2341	7	1248	116	1336	128	1341	230	1440	303	1514
24	737	2004	922	2226	743	2031	1024	2312	1103	2330	1212	-	1227	-	59	1329	155	1412	209	1421	314	1525	349	1602
25	834	2118	1056	2358	903	2209	1149	-	1206	-	23	1259	36	1314	141	1405	233	1449	249	1501	359	1611	435	1648
26	949	2246	1221	-	1047	2343	16	1247	22	1254	106	1340	122	1353	219	1440	311	1526	331	1543	445	1658	521	1734
27	1110	-	105	1323	1214	-	103	1329	103	1332	145	1415	202	1429	256	1515	350	1605	413	1625	533	1747	607	1821
28	7	1223	154	1409	48	1312	140	1403	139	1406	222	1448	239	1503	333	1551	431	1645	457	1710	624	1841	656	1911
29	111	1324	-	-	135	1355	213	1434	213	1438	256	1521	315	1537	411	1629	513	1728	544	1759	724	1945	750	2008
30	203	1414	-	-	212	1429	243	1503	245	1509	331	1555	352	1613	450	1708	558	1814	637	1855	834	2105	852	2121
31	247	1458	-	-	244	1500	-	-	316	1539	-	-	429	1650	531	1749	-	-	743	2010	-	-	1003	2245

Walvis Bay	+ 10 mins	Simon's Town	- 4 mins
Luderitz	- 1 min	Hermanus	- 1 min
Port Nolloth	- 5 mins	Mossel Bay	+ 19 mins
Saldanha	+ 1 min	Knysna	+ 39 mins
Port Elizabeth	+ 21 mins	East London	+ 28 mins
Durban	+ 27 mins	Richards Bay	+ 26 Mins

Source: http://www.diveinsa.co.za/tides.htm

Activity 7 — The outing. Money matters.

This activity follows on from activity 6. The students now measure the volume of juice needed for the day at the beach and calculate the cost of the day per child. The aim of the activity is to plan quantities for a large group of people.

ABOUT THIS ACTIVITY

The students will decide on what quantity of juice is needed for the day by actually measuring volumes using measuring cups. The purpose of this is for the students to get a feel for how much a particular volume actually is. This activity also deals with dilutions so the students will be working with ratios. Although the cost of the outing is calculated the main aim is to work with volumes, ratios, percentages and appropriate rounding off. This activity is aligned with unit standard 9016 and addresses all the assessment criteria of SO1.

MANAGING THIS ACTIVITY

Students should be given the worksheet for this activity. Other items that must be available are children's juice cups and measuring cups/cylinders. The students will need to be able to work with ratios and percentages.

7.1 The students will need to select the appropriate rate from the information provided.

$$\begin{aligned} \text{Cost of children} &= 60 \times R2{,}80 \\ &= R168{,}00 \\ \text{No. of adults going free} &= \frac{60}{15} \text{ (making use of the special)} \\ &= 4 \text{ adults} \\ \text{Therefore cost of adults} &= 2 \times R5{,}50 \\ &= R11{,}00 \\ \text{Total cost} &= R168 + R11 \\ &= R179{,}00 \end{aligned}$$

7.2 This response will vary depending on the type of cups provided for this experiment. The students must decide if it would be wise to fill the cup to the top for each drink or to give each child less to avoid spilling and children perhaps not finishing a full cup. The amount chosen for the rest of this exercise is 150ml.

7.3 Juice is provided 3 times during the day.

$$\begin{aligned} \text{Number of cups of juice needed} &= 3 \times 66 \\ &= 198 \text{ cups} \end{aligned}$$

7.4 Amount of juice needed:

$$\begin{aligned} &= 198 \times 150\text{ml} \\ &= 29700\text{ml} \\ \text{To convert to litres} &= \frac{29700}{1000} \\ &= 29{,}7l \end{aligned}$$

7.5 The dilution instructions are 1 part concentrate to 3 parts water, therefore every litre of concentrate will make 4 litres of diluted juice.

Each bottle is 2 liters, therefore each bottle makes 8 liters of juice.

$$\begin{aligned} \text{Number of bottles needed} &= \frac{29{,}7}{8} \\ &= 3{,}7125 \text{ bottles} \end{aligned}$$

Therefore we need at least 4 bottles of concentrate.

7.6 Cost of food:

$$\text{Cost of juice} = 4 \times R12,49$$
$$= R49,96$$
$$\text{Number of Niknak strips needed} = \frac{66}{4}$$
$$= 16,5 \text{ strips}$$
$$\text{Therefore number of strips} = 17 \text{ strips}$$
$$\text{Cost of Niknaks} = 17 \times R3,49$$
$$= R59,33$$
$$\text{Number of Fizzers needed} = 2 \times 66$$
$$= 132 \text{ Fizzers}$$
$$\text{Number of packets needed} = \frac{132}{24}$$
$$= 5,5 \text{ packets}$$
$$\text{Therefore number of packets} = 6$$
$$\text{Cost of Fizzers} = 6 \times R12,99$$
$$= R77,94$$
$$\text{Number of apples in packet} = \frac{1500g}{120g}$$
$$= 13 \text{ apples}$$
$$\text{Therefore number of apples per packet} = 13 \text{ apples}$$
$$\text{Number of packets needed} = \frac{66}{13}$$
$$= 5,1 \text{ packets}$$
$$\text{Therefore number of packets} = 6 \text{ packets}$$
$$\text{Cost of apples} = 6 \times R8,99$$
$$= R53,94$$
$$\text{TOTAL FOOD COST} = R49,96 + R59,33 + R77,74 + R53,94$$
$$= R241,17$$

7.7 Cost of outing:

$$\text{Total} = R241,17 + R179 = R420,17$$
$$\text{Therefore each child pays} = \frac{420,17}{60}$$
$$= R7,0028$$
$$\text{Therefore cost per child} = R7,00$$

7.8 Number of families = 60

$$12\% \text{ of } 60 = \frac{12}{100} \times 60$$
$$= R7,2 \text{ families}$$

Assume that 8 families will not pay . The amount the committee needs to pay is worked out as follows:

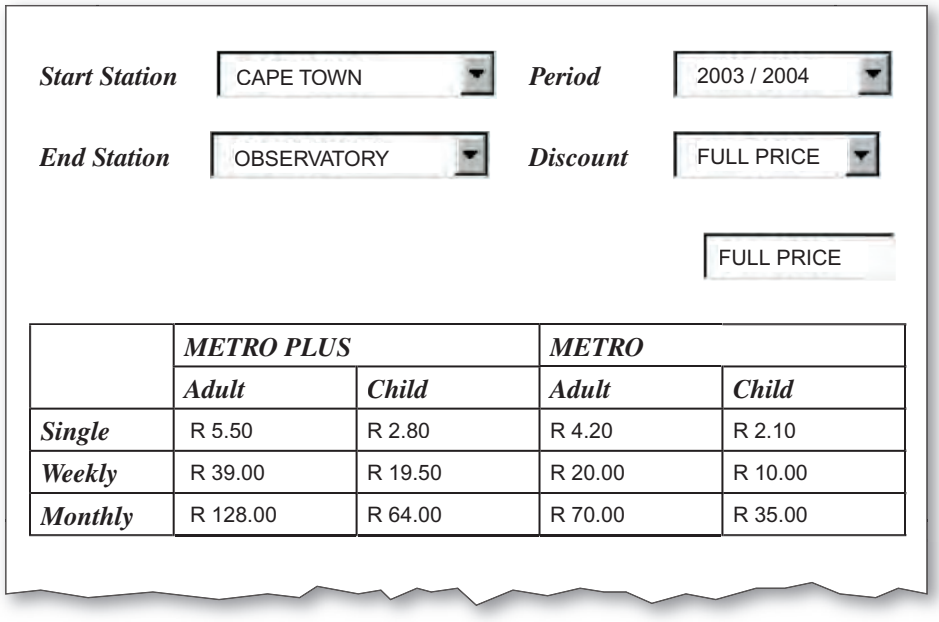
Each child should pay R7,00 but will only pay R2,00. This means the committee needs to pay
R5,00 × 8 = R40,00

Activity 7 — The outing. Money matters

Now that we have a day sorted out, we need to start budgeting for it. The parents will need to contribute to the costs of transport, juice and snacks including the costs for the adults going. Our school will provide the sandwiches. Remember that there are 60 students and 6 adults (2 educators and 4 parents).

Transport costs
Train fares are as follows:

Metrorail fare calculator



	METRO PLUS		METRO	
	Adult	Child	Adult	Child
Single	R 5.50	R 2.80	R 4.20	R 2.10
Weekly	R 39.00	R 19.50	R 20.00	R 10.00
Monthly	R 128.00	R 64.00	R 70.00	R 35.00

Metrorail have given us a special discount and have said that for every 15 students, 1 educator can go free.

The following food is to be provided for everyone on the day.

Arrive	Juice and an apple
Lunch	Juice, 2 sandwiches, packet of niknaks, a fizzer
Afternoon	Juice and another fizzer

Food costs.

Component	Quantity	Price
Orange concentrate	2 litre jug	R 12,49
Niknaks	Strip of 4	R 3,49
Fizzer	Pack of 24	R 12,99
Apples: Star King	1,5kg each apple about 120g	R 8,99

7.1 Calculate the transport costs.

7.2 We are going to take the school's plastic cups along with us. Go and fetch a plastic cup that will be provided by the facilitator and determine the volume of juice per cup if the cup is filled. Use the measuring equipment provided to do this. Decide if you are going to fill the cup or how much juice per cup you are going to give each child. Give a reason for the amount chosen.

7.3 How many cups of juice must we cater for?

7.4 What many litres of juice is this?

7.5 If the dilution instructions on the orange squash are 1:3, determine how many bottles of concentrate are needed.

7.6 Calculate the cost of the food.

7.7 Find the total cost for the outing and then decide what you are going to charge each student.

7.8 We know from our books that about 12% of the families won't be able to pay the full amount. They will be expected to pay a nominal fee of R2,00 each. The school committee will subsidise these children. Work out how much the school committee must contribute.

Activity 8 — Attending an exhibition

This activity takes the students through an exercise in finding their way on a map, working out a sensible route, calculating distances and time as well as costing a trip. The skills learnt here can be applied to the planning of any journey.

ABOUT THIS ACTIVITY

The following two activities use the same context. The first one deals with travel choices in the city and the second with travel from outside the city. The aim of this activity is to expose the students to reading street maps, using grid references (working with co-ordinates) and measuring and working out distances. They should learn from this activity about planning a route and working out the approximate distance using ratios and time of travel. This activity is aligned with unit standard 9016 and addresses all the assessment criteria of SO1 and AC 6, 8, 9, 10, 11 of SO2.

MANAGING THIS ACTIVITY

There are two handouts in this activity which will be needed for both this activity and activity 9.The first handout contains a train timetable. The second handout is a street map of Cape Town city centre and the surrounding suburbs. The students will fill in on the map their responses to certain questions. The facilitator needs to explain the difference between highways, roads and railway lines to the students to help them interpret the maps. Each student will need a piece of string and a ruler.

8.1 See map.

8.2 Observatory.

8.3 Cape Town International Convention Centre. CTICC.

8.4 See map.

8.5 See map.

8.6 Using the route shown on the map, distance = 33cm. This may differ from student to student depending on the route chosen. To convert to km :
Must know 100cm = 1m
1000m = 1km

The scale is 1:20 000
This means

Distance on map	Distance on ground
1 cm	20 000cm
33cm	33 × 20 000cm = 660 000cm
33cm	6 600cm
33cm	6,66km

8.7 To work out time taken :

$$\text{Time} = \frac{\text{distance}}{\text{speed}}$$

$$t = \frac{6{,}6\text{km}}{40\text{km/h}}$$

$$t = 0{,}15\,\text{hours}$$

$$\text{Therefore } t = 0{,}15\,\text{h} \times 60\,\text{minutes}$$

$$= 9\,\text{minutes}$$

You would need to leave the CTICC about 3:30pm as you need time to pay for parking, find your car and also need a bit of leeway in case of traffic.

8.8 Observatory Station or Salt River Station. See map.

8.9 Distance to Observatory station = 6,2 cm × 0,2 km = 1,24 km
Distance to Salt River station = 4,6 cm × 0,2 km = 0,92 km

Salt River Station is closest. Yes, one could walk this distance.

8.10 CA 24

8.11 See the possible route on the map.

8.12 Distance from station to CTICC = 7.3 cm × 0,2 km
= 1,46 km

8.13 Using the train timetable one can see that the time taken for the train trip is about 6 minutes.

To walk about 1,5km from the CTICC to the station will take about 20 minutes
To walk about 1 km from Salt River Station back to the school will take about 12 minutes. These times are estimated values. The students should be encouraged to make reasonable estimations.

This makes the total trip about 40 minutes.

The latest train that you could catch would be train no. 197 at 15:38. This means you would arrive at the station at 15:44 and still have time to walk back to the school.

8.14 Cost if travelling by car:

$$\begin{aligned}
\text{Petrol consumption} &= 10 \text{ litres per } 100\text{km} \\
\text{Therefore 1 km needs } \frac{10}{100}\,l &\approx 0{,}1\,l \\
\text{6,6 km needs 6,6 km} \times 0{,}1 &= 0{,}66\,l \\
\text{Amount needed for return journey} &= 2 \times 0{,}66 \\
&= 1{,}32\,l \\
\text{cost of petrol} &= 1{,}32\,l \times \text{R}4{,}36 \\
&\approx \text{R}5{,}76 \\
\text{cost of parking 5 – 6 hours} &= \text{R}35 \\
\text{Total cost} &= \text{R}5{,}76 + \text{R}35 \\
&= \text{R}40{,}76
\end{aligned}$$

Cost of return journey by train = R5,50 × 2 = R11,00

8.15 If 4 educators were going then it would be more viable to take the car as the train fare is now R44 whereas the car costs don't change.

Activity 8 — Attending an exhibition

EARLY CHILDHOOD TEACHERS

This is an invitation to you to join us in a most innovative and exciting exhibition of books, equipment, audio-visual aids, computer programmes and ideas! International and local exhibitors.

WHEN: Monday 14th till Saturday 19th May

TIME: 10am – 5pm

WHERE: CAPE TOWN INTERNATIONAL CONFERENCE CENTRE

ENTRANCE: No charge

The advertisement above was sent to all Early Childhood Development Centres. You are going to attend the exhibition. You decide to get to the exhibition as soon as it opens and to be back at school in time for the late aftercare session at 4 o'clock. You have a choice of taking your own car or going by train. Your school is on the corner of Lower Main and Nelson Street. For this part of the activity you need to use handouts 1 and 2.

Answer the following questions using the information given in the handouts.

8.1 If the grid reading for Nelson Street is CC 29, find it on the map (handout 1) and mark your school with an *.

8.2 In what suburb is the school found?

8.3 Where is the exhibition being held and what is this name usually shortened to?

8.4 The grid reading for the venue is BZ 24. Find it on the map and mark it with a *.

8.5 Work out a route from your school to the venue if you are going by car and mark it on the map.

8.6 The scale for the map is 1:20 000, which means that 1cm on the map represents 20 000 cm on the ground. Using a piece of string, measure the distance of your route in cm on the map and then convert this to the distance on the ground in km using the scale of the map.

8.7 The speed limit on most city roads is 60km/h. On the highway you can travel at 100km/h. For this activity let your average speed be 40km/h. Calculate approximately how long it would take you to get to the exhibition. What time would you leave the exhibition in order to get back to school in time? Explain your answer.

These formulae might help:

$$\text{distance} = \text{speed} \times \text{time}$$

$$\text{time} = \frac{\text{distance}}{\text{speed}}$$

8.8 If you decided to go by train, there are 2 possible stations from which you could catch the train. Which stations are they? Indicate them on your map and mark on the map the route you would walk from the school to each station.

8.9 Find out which station is closer by working out the distance to each station in km. Would you be able to walk to the station?

8.10 The train stops at Cape Town station. Give the grid reading of Cape Town station.

8.11 You now need to walk to the CTICC. Mark a route on the map.

8.12 Work out the distance in km.

8.13 Using the train timetable provided, work out the approximate time the train journey will take. Find the time taken for the whole journey by adding the time you think you will need to get from the school to the station and the time taken to get from the station to the CTICC. Which is the latest train that you can catch in order to get back in time for the aftercare session?.

8.14 Using the information given below, work out the cost of the trip for each type of transport.

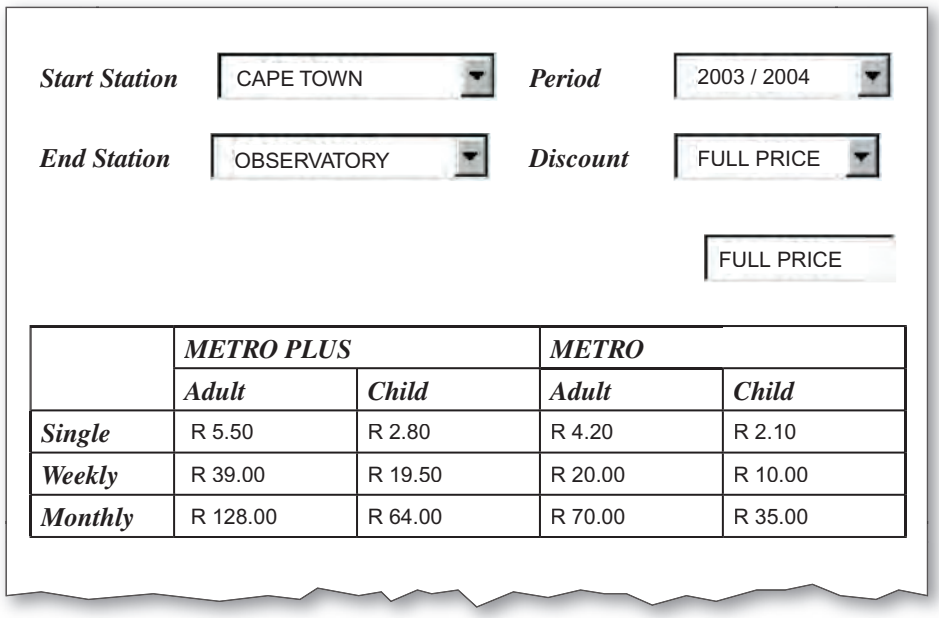
Petrol consumption	Your car uses 10 litres of petrol for every 100km
Petrol costs	R4,36 per litre

The following table shows the parking rates for the CTICC:

PARKING RATES

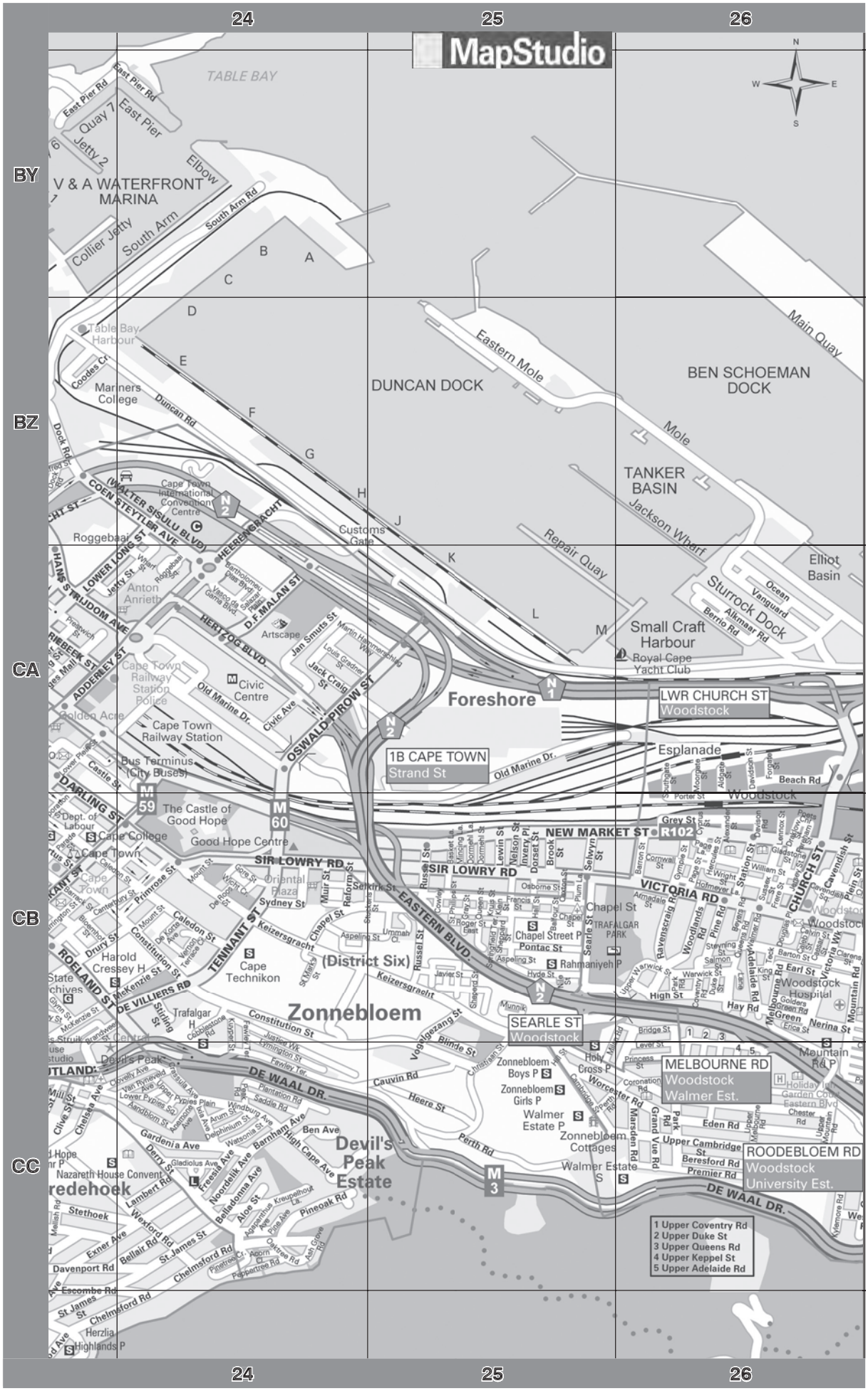
Hours	Fee
0 – ½	Free
½ – 2½	R10
2½ – 3½	R15
3½ – 4	R20
4 – 4½	R25
4½ – 5	R30
5 – 6	R35
6 – 8	R40
8 – 24	R50
Lost ticket	R50

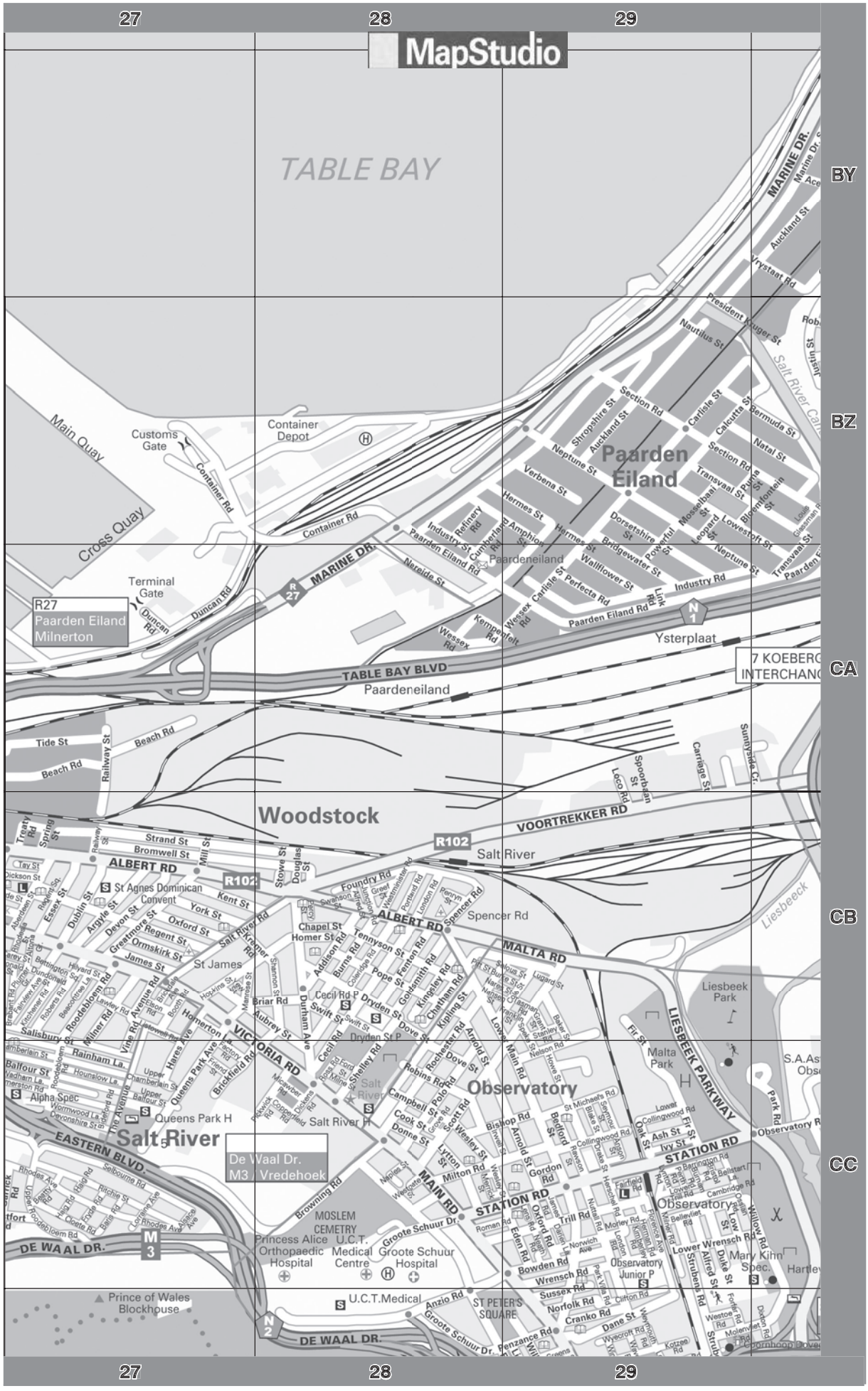
Metrorail fare calculator



	METRO PLUS		METRO	
	Adult	Child	Adult	Child
Single	R 5.50	R 2.80	R 4.20	R 2.10
Weekly	R 39.00	R 19.50	R 20.00	R 10.00
Monthly	R 128.00	R 64.00	R 70.00	R 35.00

8.15 From the above calculations you can see that If you were the only educator going to the exhibition, it would be more economical to go by train. How many educators would need to travel together to make going by car less expensive than going by train? Explain how you arrived at your answer.





Train timetable for Cape Town – Simonstown line

PLATFORM NO.	1	6	5	4	3	6	2	3	5	4	1	6	3	4
TRAIN NO.	169	173	175	177	179	181	183	187	189	191	193	195	197	199
CAPE TOWN	12:00	12:20	12:40	13:00	13:20	13:40	14:00	14:20	14:40	14:55	15:10	15:25	15:38	15:50
WOODSTOCK	12:03	12:23	12:43	13:03	13:23	13:43	14:03	14:23	14:43	14:58	15:13	15:28	15:41	15:53
SALT RIVER	12:06	12:26	12:46	13:06	13:26	13:46	14:06	14:26	14:46	15:01	15:16	15:31	15:44	15:56
OBSERVATORY	12:09	12:29	12:49	13:09	13:29	13:49	14:09	14:29	14:49	15:04	15:19	15:34	15:47	15:59
MOWBRAY	12:11	12:31	12:51	13:11	13:31	13:51	14:11	14:31	14:51	15:06	15:21	15:36	15:49	16:01
ROSEBANK	12:13	12:33	12:53	13:13	13:33	13:53	14:13	14:33	14:53	15:08	15:23	15:38	15:51	16:03
RONDEBOSCH	12:14	12:34	12:54	13:14	13:34	13:54	14:14	14:34	14:54	15:09	15:24	15:39	15:52	16:04
NEWLANDS	12:17	12:37	12:57	13:17	13:37	13:57	14:17	14:37	14:57	15:12	15:27	15:42	15:55	16:07
CLAREMONT	12:19	12:39	12:59	13:19	13:39	13:59	14:19	14:39	14:59	15:14	15:29	15:44	15:57	16:09
HARFIELD RD	12:21	12:41	13:01	13:21	13:41	14:01	14:21	14:41	15:01	15:16	15:31	15:46	15:59	16:11
KENILWORTH	12:22	12:42	13:02	13:22	13:42	14:02	14:22	14:42	15:02	15:17	15:32	15:47	16:00	16:12
WYNBERG	12:24	12:44	13:04	13:24	13:44	14:04	14:24	14:44	15:04	15:19	15:34	15:49	16:02	16:14
WITTEBOME	12:27	12:47	13:07	13:27	13:47	14:07	14:27	14:47	15:07	15:22	15:37	15:52	16:05	16:17
PLUMSTEAD	12:29	12:49	13:09	13:29	13:49	14:09	14:29	14:49	15:09	15:24	15:39	15:54	16:07	16:19
STEURHOF	12:30	12:50	13:10	13:30	13:50	14:10	14:30	14:50	15:10	15:25	15:40	15:55	16:08	16:20
DIEPRIVIER	12:32	12:52	13:12	13:32	13:52	14:12	14:32	14:52	15:12	15:27	15:42	15:57	16:10	16:22
HEATHFIELD	12:34	12:54	13:14	13:34	13:54	14:14	14:34	14:54	15:14	15:29	15:44	15:59	16:12	16:24
RETREAT	12:37	12:57	13:17	13:37	13:57	14:17	14:37	14:57	15:17	15:32	15:47	16:03	16:15	16:27
STEENBERG	12:40	13:00	13:20	13:40	14:00	14:20	14:40	15:00	15:20	15:35	15:50		16:18	16:30
LAKESIDE	12:42	13:02	13:22	13:42	14:02	14:22	14:42	15:02	15:22	15:37	15:52		16:20	16:32
FALSE BAY	12:45	13:05	13:25	13:45	14:05	14:25	14:45	15:05	15:25	15:40	15:55		16:23	16:35
MUIZENBERG	12:47	13:07	13:27	13:47	14:07	14:27	14:47	15:07	15:27	15:42	15:57		16:25	16:37
ST JAMES	12:49	13:09	13:29	13:49	14:09	14:29	14:49	15:09	15:29	15:44	15:59		16:27	16:39
KALK BAY	12:51	13:11	13:31	13:51	14:11	14:31	14:51	15:11	15:31	15:46	16:01		16:29	16:41
FISH HOEK	12:56	13:16	13:36	13:56	14:16	14:36	14:56	15:16	15:36	15:51	16:06		16:38	16:46
SUNNY COVE	12:58		13:38		14:18		14:58		15:38		16:08		16:40	
GLENCAIRN	13:03		13:43		14:23		15:03		15:43		16:13		16:45	
SIMON`S TOWN	13:08		13:48		14:28		15:08		15:48		16:18		16:49	

source: http://wwww.capemetrorail.co.za

Activity 9—Attending an exhibition (Assessment)

This activity uses the same context as activity 8 except that the people going to the exhibition are coming from out of town. This activity can therefore be used as an assessment activity as all work has been covered before.

ABOUT THIS ACTIVITY
See notes on activity 8. This activity is aligned with unit standard 9016 and addresses all the assessment criteria of SO1 and AC 6, 8, 9, 10 of SO2.

MANAGING THIS ACTIVITY
The students need to be given the worksheet as well as the maps they worked on in activity 8. They will also need the handout from this activity which is a map of the Western Cape. The students will also need string and a ruler. They will mark some of their answers on the map. The facilitator needs to explain the different types of roads shown on the map.

9.1 See map. AI

9.2 See map. CI

9.3 See map.

9.4 Using the route shown on the map, the approximate distance = 9 cm. This may differ from student to student depending on the route chosen. To convert to km :

$$\begin{aligned}
\text{Must know } 100\text{cm} &= 1\text{m} \\
1000\text{m} &= 1\text{km} \\
\text{Therefore } 100 \times 1000 &= 100\,000\text{cm} \\
&= 1\text{km} \\
\text{The scale is } 1{:}500\,000 & \\
\text{This means } 1\text{cm} &= 500\,000\text{cm} \\
1\text{cm} &= \frac{500\,000}{100\,000} \\
1\text{cm} &= 5\text{km} \\
\text{Therefore distance to CTICC} &\approx 9\,\text{cm} \times 5\text{km} \\
&\approx 45\text{ km}
\end{aligned}$$

9.5 The costs for the day :

$$\begin{aligned}
\text{Petrol consumption} &= 10 \text{ litres per } 100\text{km} \\
\text{Therefore 1km needs } \frac{10}{100}\text{l} &\approx 0{,}1l \\
45 \text{ km needs } 45\text{km} \times 0{,}1 &= 4{,}5 \\
\text{Amount needed for return journey} &= 9l \\
\text{cost of petrol} &= 9l \text{ x R4,36} \\
&= \text{R39,24} \\
\text{cost of parking for 6 hours 10 min} &= \text{R40} \\
\text{Total cost} &= \text{R39,24} + \text{R40} \\
&= \text{R79,24} \\
\text{This means each stylist paid} &= \frac{\text{R79,24}}{2} \\
&= \text{R39,62}
\end{aligned}$$

9.6 "Average speed" is calculated when the distance travelled is divided by the total time taken. This will include stopping times.

9.7 The teachers from Atlantis could travel most of the way by National Road which has a speed limit of 120km/h, whereas the teachers from Observatory had at least half of their journey inside the city.

9.8 To work out time taken :

$$\text{Time} = \frac{\text{distance}}{\text{speed}}$$

$$t = \frac{45\text{km}}{90\text{km/h}}$$

$$t \approx 0{,}5 \text{ hours}$$

$$\text{Therefore } t = 0{,}5\text{h} \times 60 \text{ minutes}$$

$$\approx 30 \text{ minutes}$$

9.9 The first 2½ hours are cheapest with each half hour costing only R2. The next hour costs you R5 but then each half hour cost R5 so this means that the parking rate between 3½ and 5 hours is the most expensive. The rate gets cheaper again with each hour costing R5 then 2 hours costing R5 and then 16 hours costs only R10.

Some possible reasons for the different price structure:

- It encourages people to deliver goods, drop off or fetch people in less than half an hour. This frees up the car park.
- It encourages people to pop back and buy something if they know that they do not have to pay for parking.
- The management must have decided that 2½ to 5 hours is a popular amount of time to spend at the exhibition so they can earn more money per half hour.
- Making it cheaper to stay longer encourages people to spend the day at the exhibition.

Activity 9 — Attending an exhibition. Assessment task

Two teachers from Atlantis also see the advertisement and decide to go to the exhibition. They will travel together and share the costs. Use the handout of the map of Cape Town that you used for the previous for question 7.2

9.1 Find Atlantis on the map in Handout 3 and mark it with a * . Write down the grid reference.

9.2 Using the more detailed map of Cape Town from the previous exercise to help you, decide where the CTICC is on the map of the Western Cape and mark it. Write down the grid reference.

9.3 Fill in on the map the route that the teachers would take to get to the exhibition.

9.4 If the scale of this map is 1:500 000, work out the approximate distance (in km) that the teachers traveled.

9.5 Using the following information, work out how much each teacher must contribute if they are sharing the costs.

Petrol consumption	Your car uses 10 litres of petrol for every 100km
Petrol costs	R4,36 per litre
Time spent at exhibition	10:30am till 4:40pm

9.6 The teachers' average speed for the journey is 90km/h. What is meant by the term "average speed" ?

9.7 Why is it reasonable to say that the teachers' average speed for the journey was 90km/h when in the previous activity your average speed was only 40km/h?

9.8 Calculate approximately how long it took them to get from Atlantis to the CTICC..

The table below shows the parking rates for the CTICC:

PARKING RATES

Hours	Fee
0 – ½	Free
½ – 2½	R10
2½ – 3½	R15
3½ – 4	R20
4 – 4½	R25
4½ – 5	R30
5 – 6	R35
6 – 8	R40
8 – 24	R50
Lost ticket	R50

9.9 Looking at the parking rates table, what do you notice about the way the price changes for different time periods? Give reasons why you think it is done in this way.