Mathematical Literacy

Unit 5

Fitting the roof frame

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Unit 5

Fitting the roof frame

A course for adults at secondary level by distance education

1. Financial maths: Salaries, budgets and inflation

Introduction

In the previous financial maths lesson in Unit 4, you learned about income tax, accounts and discounts. If you are already working, you will be earning an income (or salary) each month. Depending on the amount you earn per year, you may have to pay a certain amount of annual income tax to the South African Revenue Service (SARS). You probably also have various accounts or bills to pay each month, such as rent, water and electricity, telephone and food. These all affect how much money you earn and spend each month.

In Unit 4, Lesson 2 you learned how to calculate income tax and how to interpret and calculate certain accounts.

In this lesson you will:
- work with a payslip
- draw up a budget
- how to draw up a personal budget
- explore the meaning of inflation
- understand the meaning of a price index

Salary advice slips

At the end of each month, companies give each of their employees a payslip or salary advice slip. Your payslip shows how much you earn per month and any deductions (such as income tax or unemployment fund or pension fund) that are taken off your salary before the remaining amount is paid over to you.
Below is an example of Joel's payslip that he receives each month as an assistant chef at the Pizza Bonanza Bar in Umtata.

The total amount of your salary before deductions is called your gross salary and the salary that is paid out to you after deductions is called your net salary.

UMTATA PIZZA BONANZA BAR PAYMENT ADVICE			
Employee	***Position***	***Date***	***Account details***
J. Chihole	Assistant chef	28 March 2011	Bank: Money bank
			Acc. number: 877960
			Branch: Umtata
			Tax number: 123459
Earnings		***Deductions***	***Amount***
Basic salary	R10 889,55	UIF (unemployment)	R 78,90
Medical scheme	R 478,70	Income tax (PAYE)	R-------------
Pension scheme	R 1 289,45	Funeral premium	R 13,92
		Life insurance fund	R102,40
Total salary (taxable)	R12 657,70	Total deductions	R------------
		NET SALARY	R------------

Use Joel's salary advice slip to complete the following activity.

ACTIVITY 1

1. How much is Joel's basic salary each month?
2. How much is Joel's gross salary per month?
3. How much is added onto Joel's basic salary per month to make up his gross salary? What are these extra amounts for?
4. List the deductions made from Joel's salary. Say what each deduction is for.
5. Use the Income tax table below to calculate the tax (PAYE) that Joel pays each month.

Taxable income			Rates of tax				
R		R	R				R
0	—	140 000			18%	of every R1	
140 001	—	221 000	25 200	+	25%	of the amount over	140 000
221 001	—	305 000	45 450	+	30%	of the amount over	221 000
305 001	—	431 000	70 650	+	35%	of the amount over	305 000
431 001	—	552 000	114 750	+	38%	of the amount over	431 000
552 001		and above	160 730	+	40%	of the amount over	552 000

6. Now that you know how much income tax Joel pays each month, calculate his total deductions.
7. Finally calculate Joel's net salary.

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You will notice that although Joel's gross salary is R12 657,70 per month, his net salary is R10 114,72. The net salary is the amount he gets to take home once his deductions at work have been taken off. But Joel still needs to pay his accounts before he can think of how much money he can save or spend on other things.

Drawing up a plan about how much money you earn and spend per month is called a *budget*. Planning a budget and more importantly, sticking to the budget are two very important principles for managing your money. Without a budget, you may find that your money manages you and you end up spending more than you earn. This can get you into debt quickly which is much more difficult to manage!

Let's look at how to draw up a personal budget.

Budgets

There are two simple rules that can assist you in managing your money effectively.

Rule 1: First pay for the things you need.
Rule 2: Then buy the things you want, if you can afford them.

ACTIVITY 2

1. Write a list of fixed expenses you have each month. For example, rent, school fees and transport costs (if they stay the same each month).

2. Write a list of expenses that occur each month but where the amount varies (for example, electricity, telephone, water and lights, food and groceries, etc.) We call these variable expenses. Write down the amount of each variable expense from last month.

3. Write down the total of your expenses for last month by adding your fixed expenses to your variable expenses.

4. How much do you earn per month? This is the amount that you actually clear; your net salary that you take home.

5. Does your salary cover your total expenses?
   If so:
   a) how much money do you have remaining?
   b) suggest some ideas for saving, investing or using this money.

   If not:
   a) how much is your shortfall? (how much money do you still need to cover your expenses?)
   b) write down any variable (or fixed) expenses that you can cut down on each month if necessary.

Let's look at Zahir and Imran Khan's family budget for August 2011. They rent a three-bed-roomed townhouse and have two teenage children. Zahir works in the mornings as a receptionist and Imran is the store-room manager at a large warehouse.

Khan family budget for August 2011

Expenses	**Amount**
Fixed expenses	
Rent	R4 500,00
School fees	R2 200,00
Children's pocket money	R 500,00
Car payments	R3 486,80
Total	
Variable expenses	
Electricity	R 487,90
Water	R 330,50
Petrol	R 800,00
Groceries	R2 500,00
Telephone Zahir	R 189,00
Telephone Imran	R 477,00
Internet (Prepaid)	R 289,00
Fashion account	R 280,00
Credit card account	R 300,00
Bank charges	R 180,00
Insurance	R 567,15
Total	
Income	
Zahir	R4 780,60
Imran	R16 654,80
Total income	
Total expenditure	
Total remaining/shortfall	

ACTIVITY 3

1. How much are Zahir and Imran's fixed expenses each month?

2. What is the total of the Khan's variable expenses for August 2011?

3. Complete the rest of the table filling in all the totals.

4. Do the Khan's have extra money remaining at the end of August or do they have a shortfall (i.e. they spend more than they earn)?

5. Do you think this is a good financial situation for a family?

6. What other variable expenses do you think may occur some months?

7. The Khan's want to go on holiday in December. They need to save at least R15 000 in order to pay for the petrol, accommodation and fun of the holiday and service their car. They will therefore need to save approximately R5 000 a month over the next three months. How would you advise the Khan's to budget so that they can save R5 000 a month?

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ACTIVITY 4

Now that you have seen an example of a budget, draw up a budget for yourself and/or your family for one month, using the outline of the Khan's budget as an example.

Inflation

Can you remember being able to buy bread and milk for under R10? How many years ago was that? In July 2011 the approximate cost of a loaf of bread was R9,40 and one litre of milk cost about R8,27. This increase in prices is called *inflation* and is linked to a country's economy. Inflation is usually measured in percentages.

Read through the extract below adapted from http://en.wikipedia.org/ about the economy of South Africa.

> In his February 2000 Speech, the Minister of Finance, announced a policy of inflation targeting, helping to bring consumer inflation, which had been running in double digits for over 20 years, under control. Inflation declined from 6.9% in 1998 to less than 6.0% in 2000. The target was set to keep the Consumer Price Index (CPI) a key indicator of inflation between 3% and 6% average per annum. Although initially successful, the Rand's rapid depreciation in late 2001 led to greater inflationary pressure and the South African Reserve Bank missed the target during the course of 2002, with inflation coming in at an average of 9.3% for the year.
>
> From September 2003 to 2005, however, the CPI inflation rate remained consistently within the target range. The average annual rates of CPI for the period 2001-2005 were: 2001 6.6%, 2002 9.3%, 2003 6.8%, 2004 4.3%, 2005 4.3%.

ACTIVITY 5

1. According to this information, what was the inflation rate in South Africa in 1998?
2. How many years did it take for the inflation rate to drop below 6%?
3. What does CPI stand for?
4. What was the target set for the CPI?
5. What was the average inflation during 2002?
6. Did the government manage to keep within the target range?
7. What was the cause of missing the target during 2002?
8. In which of the years from 2001 to 2005 did the government manage to keep the CPI within the target range?
9. What was the average annual CPI rate for 2001?
10. What was the average annual CPI rate for 2004?

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The CPI is an average rate of price changes of various products. This number (written as a percentage) can also show how an *index number* for a single item or a *price* has changed over time. We calculate the *CPI* of index numbers using the following formula:

$$\text{CPI} = \left(\frac{\text{Latest index number}}{\text{Earlier index number}} \times 100\right) - 100$$

Example (Using index numbers to calculate the % change)
The following index numbers are given for bread and meat from June 2010 to June 2011. Compare the CPI of these two products and state which product had a higher increase.

Index description			June 2010	June 2011	Yearly % change
Food			Index no.	Index no.	
	Bread		104,1	113,0	
	Meat		106,4	116,3	

Solution
Bread:

$$\text{CPI} = \left(\frac{\text{Latest index number}}{\text{Earlier index number}} \times 100\right) - 100$$

$$= \left(\frac{113{,}0}{104{,}1} \times 100\right) - 100$$

$$= 8{,}5$$

Therefore the CPI for bread from June 2010 to June 2011 was 8,5%.

Meat:

$$\text{CPI} = \left(\frac{\text{Latest index number}}{\text{Earlier index number}} \times 100\right) - 100$$

$$= \left(\frac{116{,}3}{106{,}4} \times 100\right) - 100$$

$$= 9{,}3$$

Therefore meat prices increased by 9,3%.
Meat prices increased more than bread prices.

We can also calculate the price index (or PI) for the price of individual items, such as a loaf of bread, using the following formula:

$$PI = \frac{\text{New price}}{\text{Old price}} \times 100$$

Example (uses prices to calculate the % change)
If the average price of a loaf of white bread was R3,00 in 2000 and R9,00 in 2011, calculate the PI for a loaf of white bread.

Solution

$$PI = \frac{\text{New price}}{\text{Old price}} \times 100 = \frac{9,00}{3,00} \times 100 = 3 \times 100 = 300\%$$

This means that the price in 2011 is 300% of the price in 2000 or the price in 2011 has increased 200%!

A price index is calculated with respect to a ***base year***. In this example, the base year is 2000.

The price index does not tell us anything about the actual price level. We can use the price index to compare index numbers of two different products, for example a loaf of white bread and a loaf of brown bread

This will help us to see if the price of one product is rising or falling faster or slower than the other. We cannot tell from the price index numbers which price is more expensive.

Example (comparing prices)
Use the price index to compare the increase in prices of a white loaf of bread and a brown loaf of bread. In 2000 the average price of a loaf of brown bread was R2,70 and in 2011 the average price was R8,20.

Solution
PI of white loaf from 2000 - 2011 is 300% (from previous example).
PI of brown loaf from 2000 - 2011 is:

$$PI = \frac{\text{New price}}{\text{Old price}} \times 100 = \frac{8,20}{2,70} \times 100 = 3,037 \times 100 = 303,7\%$$

The price of a loaf of brown bread therefore increased more from 2000 - 2011. Even though the brown bread remained cheaper than the white bread, the price of brown bread increased more rapidly over the past 11 years.

ACTIVITY 6

Use the table below to answer the questions.

Year	White loaf	Brown loaf
Jan 00	R3,20	R2,70
Jan 01	R3,50	R3,00
Jan 02	R3,70	R3,40
Jan 03	R4,40	R3,60
Jan 04	R4,50	R3,70
Jan 05	R4,70	R4,00
Jan 06	R4,60	R4,00
Jan 07	R4,70	R4,50
Jan 08	R5,70	R5,40
Jan 09	R7,80	R7,00
Jan 10	R8,00	R7,40
Jan 11	R9,20	R8,30

(From: http://www.namc.co.za/)

1. What was the average price of a loaf of white bread in January 2002?
2. What was the average price of a loaf of brown bread in January 2002?
3. Compare the price index of a loaf of white bread and a loaf of brown bread from January 2002 to January 2005.
4. Which price increased more rapidly?
5. Draw a line graph representing the information in the table above. Refer to Unit 3, Lesson 6 if you cannot remember what a line graph looks like.

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Summary

In this lesson you learned more about financial mathematics by understanding a payslip, working with budgets determining inflation and calculating the price index.

Self-assessment checklist:

Are you able to:

- understand and work with a payslip (salary advice slip);
- recognise and read a budget;
- draw up a personal budget;
- calculate a price index.

SELF-CHECK EXERCISE

1. Below is Tina's monthly payslip. Write down the missing values for A, B and C.

HYPERSTORE **PAYMENT ADVICE**			
Employee	***Position***	***Date***	***Account details***
Tina Mohle	Cashier	25 November 2011	Bank: Super bank
			Acc. number: 12345
			Branch: Hopetown
			Tax number: 8567
Earnings		***Deductions***	***Amount***
Basic salary	R5 454,40	UIF (unemployment)	R 20,15
Medical scheme	R 147,90	Income tax (PAYE)	R 213,50
Total salary (taxable)	R----**A**---------	Total deductions	R-----**B**-------
		NET SALARY	R------**C**------

2. Below is Patrick's budget for November 2011. Write down the missing values for A, B, C and D.

Expenses	**Amount**
Fixed expenses	
Rent	R2 500,00
Travel expenses to work (taxi)	R1 886,40
Total	**A**
Variable expenses	
Electricity	R 287,50
Levy and rates	R 889,50
Additional travel expenses	R 200,00
Groceries	R1 100,00
Cellphone	R 289,00
Credit card account	R 100,00
Bank charges	R 86,00
Study loan repayment	R 354,00
Total	**B**
Income	
Monthly	R13 544,60
Total expenditure	**C**
Total remaining/shortfall	**D**

3. The following CPI table was provided for South Africa for Health and transport inflation changes for June 2010 to June 2011.

Index description			June 2010	June 2011	Yearly % change
Health			119,8	126,4	
	Medical products		119,5	123,5	
	Medical services		120,0	128,1	
Transport			102,4	108,0	
	Purchase of vehicles		102,1	101,0	
	Private transport operation		98,3	116,4	
		Petrol	93,5	113,5	
		Other costs	117,8	128,1	
	Public transport		109,6	118,8	

a) Calculate the yearly % CPI change for each index description.
b) What was the yearly % CPI change for Health?
c) What was the yearly % CPI change for Transport?
d) Which Index description (of products in the third column of the table) had:
   i. The highest annual percentage increase?
   ii. The lowest annual percentage increase?
e) Which of the Index descriptions (in the second column of the table) decreased over the year rather than increased? Why do you think this happened?
f) Who do you think was more affected by the inflation in transport:
   - people who have their own cars (private transport operation) or
   - people using public transport?

   Give a reason for your answer.

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2. More on graphs of the straight line

Introduction

In this lesson we will look back in history to when graphs were first used. We will look at straight line graphs and parabolas. You studied the foundations of graphs and axes in Unit 2, Lesson 5 and the straight line graph in Unit 3, Lessons 2 and 4. In this lesson we plan to bring in some historical information, revise straight line graphs and discuss more everyday examples where straight line graphs are used. The approach to this work is slightly different from the approach in Units 2 and 3 but the underlying principles of mathematics are the same.

In this lesson you will:

- see how graphs developed
- explain the relationship between equations and lines
- draw a straight line graph from a linear equation using tables
- find the equation of a straight line graph
- see how straight line graphs can solve everyday problems

How did graphs develop?

Descartes pronounced day-cart

What happened in the shipping world in the 16th and 17th century may have led René Descartes, a great philosopher and mathematician, discover of graphs. If this interests you, read more about him in *The Wonderful World of Mathematics* by Lancelot Hogben.

Navigators and engineers in the Western world used mathematics and women in the mountains of Bolivia also applied important mathematical principles while weaving and doing embroidery.

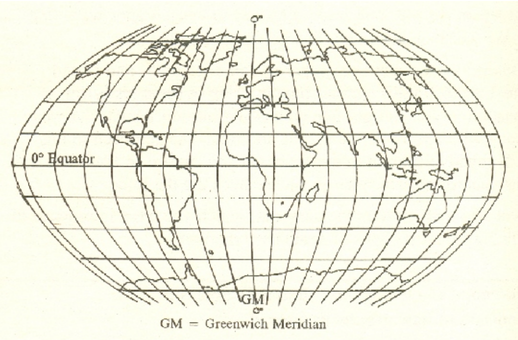
Mathematical thinking can be found in many aspects of daily life. Our aim in this lesson is to introduce you to some mathematical ideas. Some of which may be useful, others interesting.

During the 16th and 17th centuries navigators were responsible for deciding on their ships' routes. They plotted the position of their ships on charts marked with lines of latitude and lines of longitude.

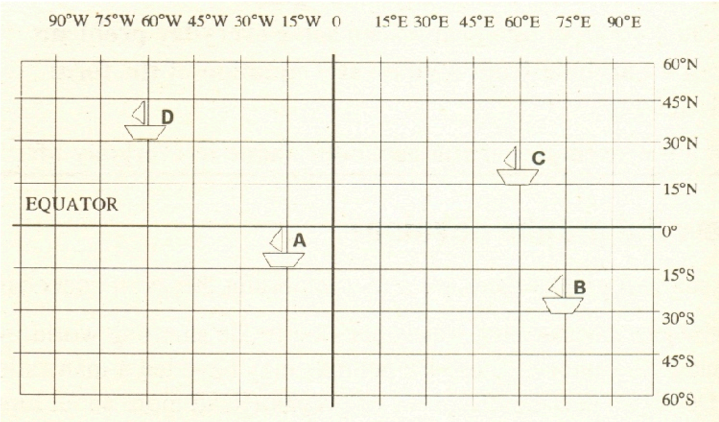
Lines of latiitude and longitude were dealt with briefly in Unit 1 Lesson 6

The lines of longitude go vertically from north to south, while the lines of latitude go horizontally from east to west.

The Greenwich Meridian is the 0 degree line of longitude. The equator is the 0 degree line of latitude.



Look at the chart below. How would you tell a friend where ship A was?



In order to establish their positions, navigators needed two pieces of information. They needed to know how far north or south of the equator they were and how far east or west of the Greenwich Meridian they were.

This is how the navigator of ship A would explain his position: ship A is 15 degrees west of the Greenwich Meridian and 15 degrees south of the Equator.

ACTIVITY 1

Describe the position of Ships B, C, and D in terms of the Greenwich Meridian and the equator.

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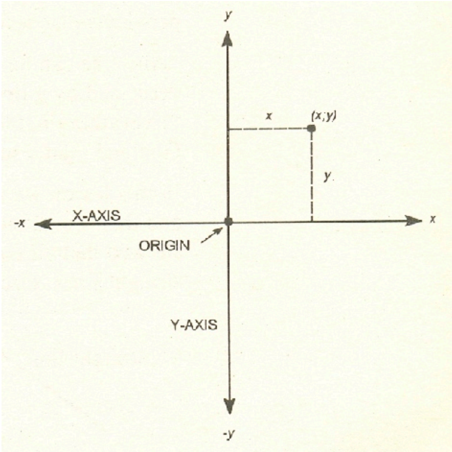
Rene Descartes and cartesian coordinates

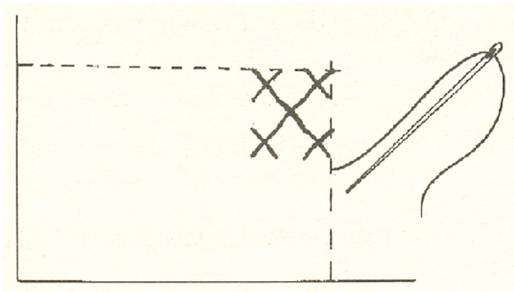
Perhaps Descartes looked at the navigation charts and thought, ‘A ship's position can be described in terms of two distances, the distance from the Equator and the distance from the Greenwich Meridian. This means that any point on a surface can be described by its distance from a horizontal axis and its distance from a vertical axis.’

Descartes used algebra to describe the point. He could call any point $(x; y)$. x was the distance to the left or right, y was the distance up or down. He called the horizontal axis, the x-axis, and the vertical axis the y-axis.

As mentioned in Lesson 4 of Unit 3, we call these axes the Cartesian axes after Descartes.



Descartes and the navigators were the first to set these axes out mathematically. But people from the very earliest times have used systems of axes to find a point. Look at this example of cross-stitch embroidery.



To find the correct position, the needle worker had to count threads up (vertical distance) and count threads across (horizontal distance).

Can you think of other situations where a person finds a position by measuring the vertical distance and the horizontal distance?

What about finding the correct position for a window? You have to measure the distance from the ground and the distance from the door.

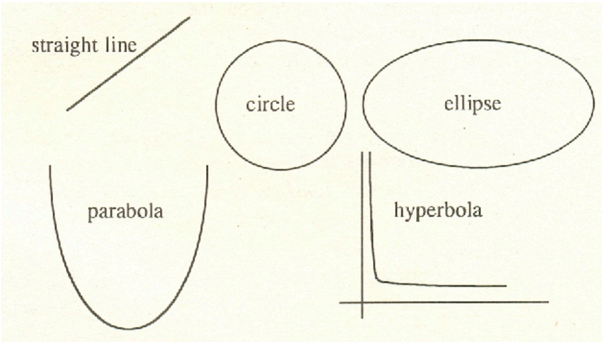
Equations and lines

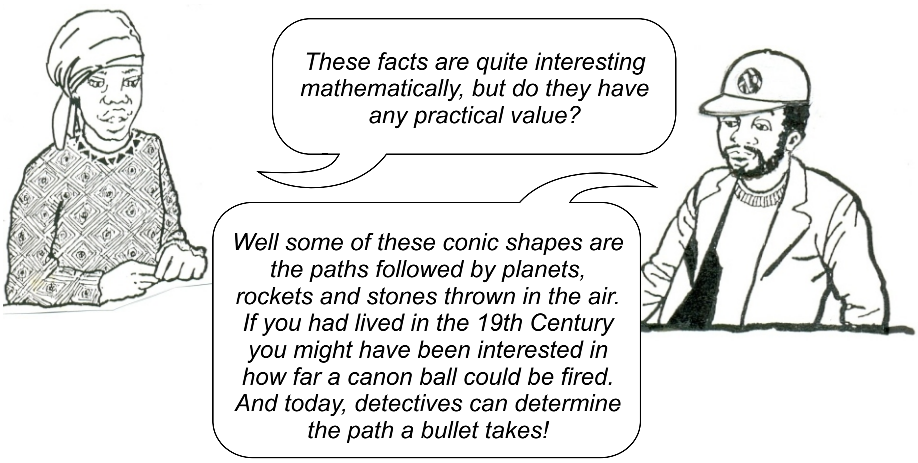
Once Descartes had worked out that algebra could be used to describe geometry, he had made a major breakthrough. He was able to solve many problems that before had seemed impossible.

'Any line can be described by an equation, and any equation can be described by a line,' he said. He also made the bold statement, 'Everything in the universe can be explained mathematically, except God and man's soul.' What do you think about that statement?

In this lesson we are going to look at lines, curves and their equations.

It is interesting that more than a thousand years earlier, Appolonius, a Greek mathematician, investigated conic sections to find straight lines, circles, ellipses, parabolas and hyperbolas.

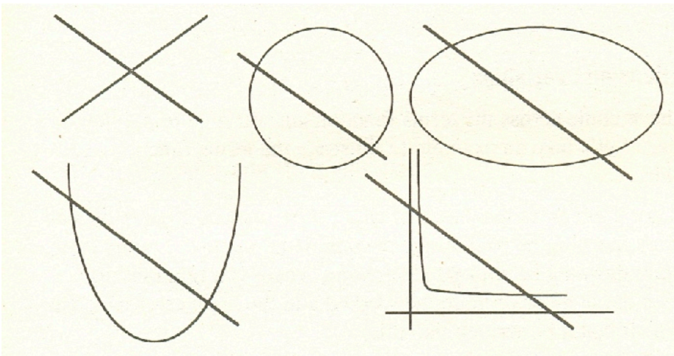




Descartes also found that the degree of an equation determines the number of intersection points with a straight line.

A first degree curve, for example, $y = mx + c$, - that is a straight line, - can intersect (cross) another straight line only once.

A second degree curve - a parabola, circle, hyperbola or ellipse, - can be cut (crossed) by a straight line at only two points. Look at the diagrams below which show this.



A first degree equation, for example $y = 2x + 3$ has x to the power 1, which is x.

A second degree equation, for example $y = x^2 + 3x + 4$ has x raised to the power 2, which is x^2.

A third degree equation, for example $y = 4x^3 + 2x^2 + x + 3$ has x raised to the power 3, which is x^3.

It is important that you can identify all these shapes but when we draw and interpret graphs, we will work only with first degree equations.

ACTIVITY 2

1. Draw the following shapes. Label the drawings clearly
   a) circle
   b) ellipse
   c) parabola.

2. Give examples of where these shapes occur in our environment.

3. Complete these sentences.
   a) A first degree equation has a variable x (or any other symbol) to the power __________.
   b) A second degree equation has the variable x (y or a) to the power __________.

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Functions and variables

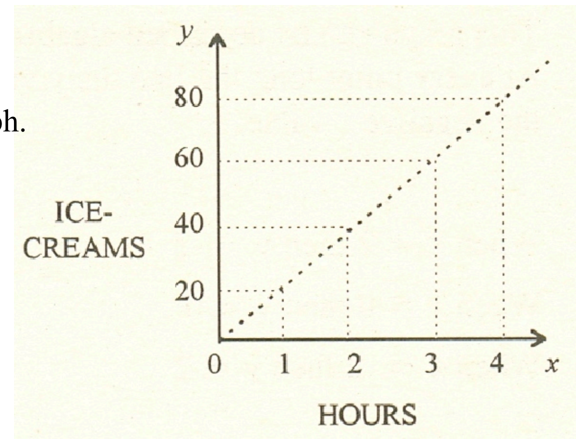
You have come across the terms *function* and *variable* in previous lessons. Let's use these terms as an example to illustrate the terms function and variable.

Example
Jakes got a job as an ice-cream vendor. If he worked 2 hours on a Saturday morning he sold 40 ice-creams. If he worked 4 hours on a Saturday morning he sold 80 ice-creams. There is a relationship between the number of hours he worked and the number of ice-creams he sold. It could be written like this:

ice creams sold = hours worked × 20, or
$y = 20x$
y stands for the number of ice-creams sold and x stands for the hours.

Mathematicians, and that means us, say that the ice-creams sold are a function of the hours worked
or
y is a function of x
x and y are both variables.

This can be shown on a graph.



The number of ice creams sold (y) depends on the number of hours worked (x).

Do you remember from Unit 3, Lesson 4 that y is called the dependent variable and x is called the independent variable? The value of y changes as x changes. Both are variables. The y-value depends on what the value of x is.

Another name for this kind of straight line graph is the linear function (linear means line). The next section deals with linear functions.

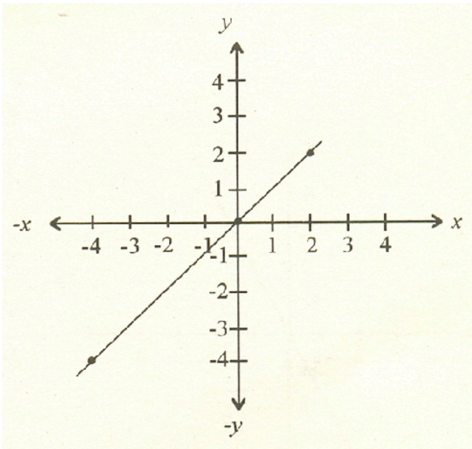
The straight line graph or linear function

For the theory of the straight line graph look back at Unit 2, Lesson 5 and Unit 3, Lessons 2 and 4.

Remember Descartes said: "Any line can be described by an equation and any equation can be drawn as a line." Let's look at the following straight line graphs and their corresponding equations.

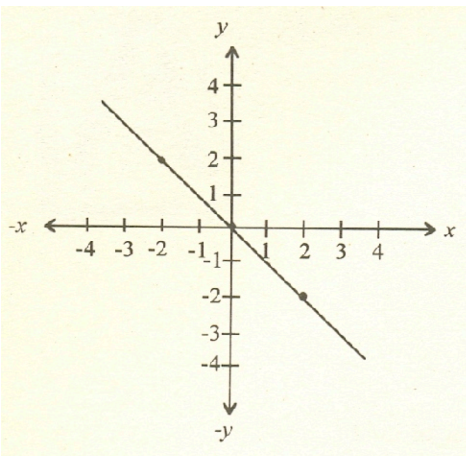
Straight line graphs and their equations

Example 1
This graph can be described algebraically as $y = x$. We can also say that y is a function of x. At every point along the line $y = x$.



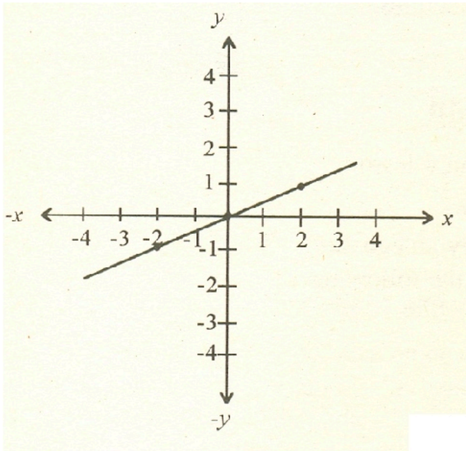
When $x = 2$ then $y = 2$
When $x = 4$ then $y = 4$
When $x = 0$ then $y = 0$
We can say that $y = x$ provides the rule for this graph. Let's look at some other straight line graphs.

Example 2
This graph can be described algebraically as $y = -x$. At every point along the line the y-value is equal to minus the x-value (or (-1) times the x-value.



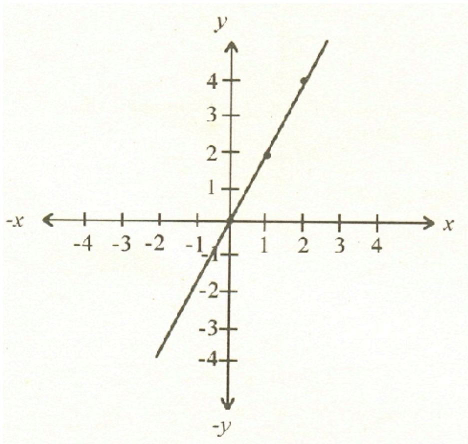
When $x = 2$ then $y = -2$
When $x = 0$ then $y = -0$
When $x = 2$ then $y = -2$

Example 3
This graph can be described algebraically as $2y = x$ or $y = \frac{1}{2}x$



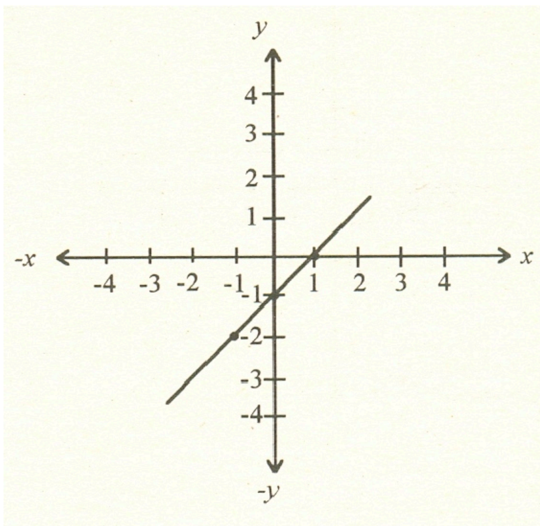
When $x = -2$ then $y = -1$
When $x = 0$ then $y = 0$
When $x = 2$ then $y = 1$

Example 4
This graph can be described algebraically as $y = 2x$



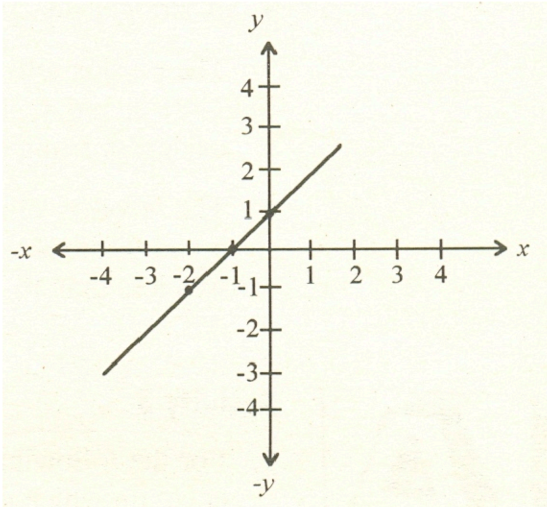
When $x = 0$ then $y = 0$
When $x = 1$ then $y = 2$
When $x = 2$ then $y = 4$

Example 5
This graph can be described algebraically as $y = x - 1$



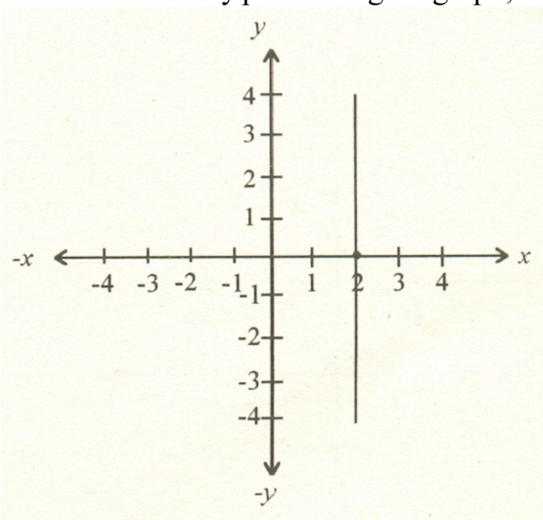
When $x = -1$ then $y = -2$
When $x = 0$ then $y = -1$
When $x = 1$ then $y = 0$

Example 6
This graph can be described algebraically as $y = x + 1$



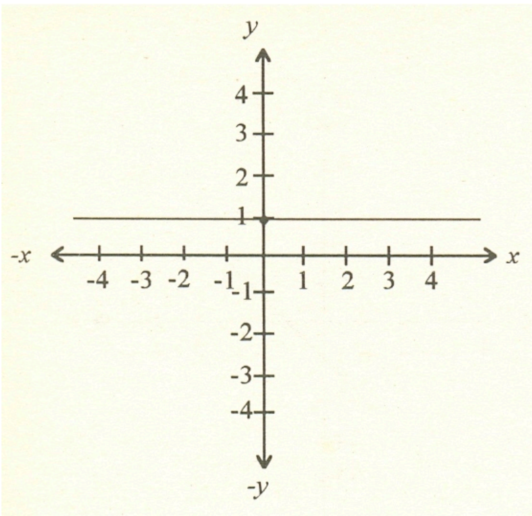
When $x = -1$ then $y = 0$
When $x = 0$ then $y = 1$
When $x = -2$ then $y = -1$

Example 7
This is the graph of $x = 2$. At every point along the graph, $x = 2$



Example 8
This is the graph of $y = 1$. At every point along the graph, $y = 1$.

At every point along the x-axis, y = 0 and at every point along the y-axis, x = 0.

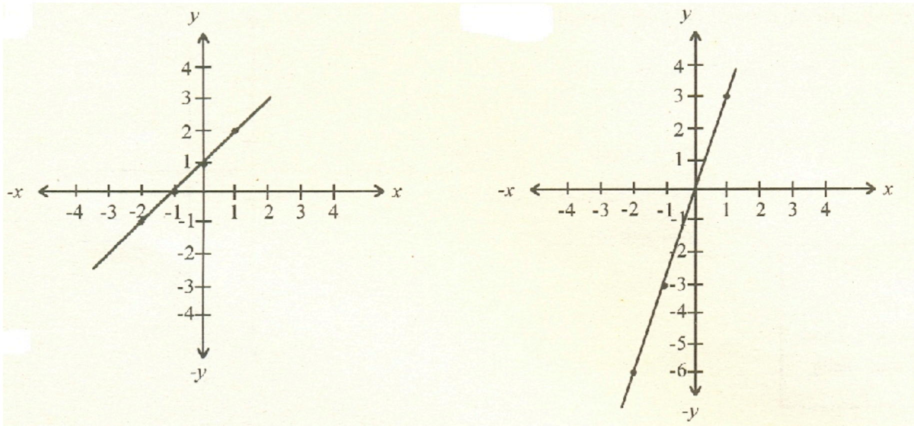


Comment
This is a brief summary of some of what you have learned about straight line graphs.

- A straight line graph can be described by the equation $y = mx + c$
- The c value tells you where the graph cuts the y-axis. In examples 1, 2, 3, and 4, the y-intercept was 0. Look back at the examples. In examples 5 and 6, the y-intercept was 1 and 1.
- The m value tells you the gradient of the line. In examples 1, 3, 4, 5 and 6, the m value was greater than 0. In example 2, the m value was less than 0.

ACTIVITY 3

1. For the following graphs, draw up tables and then work out the equation which describes the graph.



2. Draw the graphs which describe these equations.
   a) $y = x\ 1$
   b) $y = 2$

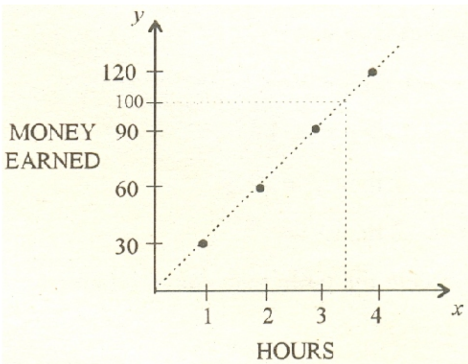
ANSWERS ON PAGE 83

Straight line graphs in everyday life

Example 9
Jane hires a van every Saturday morning. She worked out that on average she earned R30 for each hour she worked. How many hours would she need to work to earn R100?

We call the x-value the independent variable. Jane has some control over the number of hours worked. We call the y-value the dependent variable. The amount of money she gets depends on the number of hours she works. y is the function of x. The amount of money earned is a function of the number of hours put in.

Let's make a graph. We draw an x-axis and a y-axis. Let's put 'hours' along the x-axis, and 'money earned' along the y-axis.



The amount of money earned is a function of the hours worked, so y is a function of x. It is easy to see from the graph that Jane would need to work 3 and a bit hours to make R100.

ACTIVITY 4

How much paint does Jo need?

On the tin it says:
1 litre of paint will cover 16 m^2 for a first coat.
1 litre of paint will cover 24 m^2 for a second coat.

1. How does Jo work out how much paint she needs for 36 m^2?
   A graph will make the problem much clearer. Mark m^2 on the horizontal axis. Mark litres on the vertical axis. Complete the tables and then plot the points on the graph.

   You will have two graphs, one for the first coat of paint, and one for the second coat.

First coat

Litres	1	2	3	4
$metres^2$	16			

Second coat

Litres	1	2	3	4
$metres^2$	24			

2. Can you work out how much paint you would need for 48 m^2 of wall?

ANSWERS ON PAGE 85

Summary

After this lesson you should be able to:
- determine the relationship between equations and graphs
- draw a straight line graph from a linear equation using tables
- find the equation of a straight line graph
- find a solution to a problem graphically

In this lesson we also referred you to other lessons in Unit 2 and Unit 3. This is a good opportunity to revise the lessons on algebra, equations and graphs.

SELF-CHECK EXERCISE

1. Think of an example where the vertical distance and the horizontal distance are needed to find a point. There are examples in this lesson. You may have some other examples.

2. If Jakes works for one hour at a restaurant he gets paid R5. If he works 2 hours he gets paid R10. This is called a 'base rate' as it is what the restaurant pays him. The tips that he earns are over and above the base rate.

   a) Complete the following table:

Time worked	1	2	3	4	5	6	7	8
Base rate	5	10						

   b) Draw a graph and mark hours on the horizontal axis. Then mark money on the vertical axis.
   c) On the graph write in 1 - 8 on the horizontal axis. Then write in R5, R10, R15 on the vertical axis.
   d) Plot some points and draw the graph to show the relationship between the hours worked and the money paid. Refer to the examples in the lesson.
   e) Nolwandle is a head waitress. She gets a base rate of R8 an hour. On the same graph indicate the relationship between hours worked and her base rate.

3. Draw the graph $y = 3x$ and the graph $y = 2x + 1$ on the same set of axes.
   You can draw these graphs using any method you know.

   a) Find the point where the two graphs are equal (intersect) and write down the coordinates of this point.

   b) Show that this point lies on both graphs by substituting the point into both equations and checking that the left hand side (LHS) is equal to the right hand side (RHS) of the equation.

ANSWERS ON PAGE 77

3. More about equations

Introduction

In Lesson 2 we revised the straight line graph. In this lesson we will look at the properties of equations generally and revise simple linear equations that you first learned about in Unit 2, Lesson 4.

All these areas have been discussed in previous lessons. In this lesson, we will give you an overview of previous work and in some cases you will have to refer to previous sections.

In this lesson you will:

- solve linear equations
- solve word problems involving equations

Equations and their solutions

An equation is an algebraic statement that two expressions are equal. We could say that the number of apples is equal to 10. We can make this sentence much shorter by writing $n = 10$.

The important thing is that everybody understands that the n stands for the number of apples.

We could say to you the apples in the packet plus the three apples on the table are equal to 12. We can make this sentence shorter by writing: $n + 3 = 12$

Can you tell how many apples there are in the packet?

The answer is 9. Mathematicians would say you have solved the equation. You have found the value for n which makes that mathematical sentence true.

ACTIVITY 1

Now let's look at the following mathematical statements and decide for which values of x they are true.

Remember that in this case x is a symbol that stands in the place of a number. Use any method to find the value of x.

1.	$x + 3 = 12$	2.	$x - 5 = 8$
3.	$3x = 21$	4.	$\frac{1}{2}x = 4$
5.	$x - 6 = 6$	6.	$2x + 1 = 9$
7.	$3x - 1 = 17$	8.	$2x = 7$

ANSWERS ON PAGE 85

False statements, identities, equations

Example

For which values of x are the following statements true?

1. $3x+7+2x=5x+7$
2. $3x+2=3x+5$
3. $3x+2=17$

Solution

1. $3x + 7 + 2x = 5x + 7$ is true for all values of x. If you substitute 1 in the place of x, the statement will be true. Try substituting a value of 5 in the place of x and see what the answer on each side of the equation is. Are the two sides equal? Yes, in fact whatever value you put in the place of x will make the statement true. We call this an **identity.** Both sides say the same thing; they are identical. If you simplify the left side you will find they are the same.

2. $3x + 2 = 3x + 5$ cannot be true. Whatever value we put in the place of x the statement is **false.** Another way of looking at the statement is 3 times a number plus two cannot possibly be equal to 3 times that same number plus five. We say that there is no real solution for x in this statement.

3. $3x+2=17$ is **true** if $x=5$, and false for any other values of x.

ACTIVITY 2

Without doing any written work, write down the values of x which make the following statements true. If there are no values of x that make the statement true, say **false;** if the statement is true for all values of x, say **identity;** if there is more than one value of x that makes the statement **true,** give them all.

1. $3-x=-5$
2. $2x+1=2x+3$
3. $x+3x-5+1=4x-4$
4. $3x-1=\frac{1}{3}x-1$
5. $2x+4=2(x+2)$

ANSWERS ON PAGE 86

So far we have solved equations by **inspection;** that is by examining them, or by trial-and-error. While it is good to know how to use trial-and-error, it is more efficient to have a general approach that is efficient and works for every situation. In Unit 2, Lesson 4, we solved equations by reversing or undoing the procedure. Now we will look at a more formal approach.

Solving linear equations

Example
Solve $3x - 2 = 13$

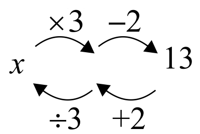
You want to find the value of x which makes the above statement true.
You want to arrive at x = ___(number). You want only x on the left and only a number on the right.
So you must find a way of removing the numbers on the left and any x's there may be on the right.
The two sides of an equation are equal, so they will clearly stay equal if you:

- add the same number to both sides, or
- subtract the same number from both sides, or
- multiply both sides by the same number, or
- divide both sides by the same number.

Solution
Let's solve the equation $3x - 2 = 13$ using these algebraic principles.
$3x - 2 = 13$

Do you remember when we worked with flow digrams in Unit 2? We solved the equation by 'reversing' the procedure until we were left with the solution for x.

$3x - 2 = 13$



$13 + 2 = 15$
$15 \div 3 = 5$
so $x = 5$

Let us now do this more formally but using the same principles.

On the left you want only x; on the right only the number.
To get rid of –2 on the left, add 2 on both sides.
$3x = 15$

You want only x on the left, so divide both sides by 3
$x = 5$

This value of x is called the **solution** of the equation or the **root** of the equation.

When the solution of an equation has been found it can be tested by substituting the solution in place of the symbol. If the equation is then a true statement, the solution is correct.

Left Hand Side (LHS) $= 3(5) - 2$
$= 15 - 2$
$= 13$
Right Hand Side (RHS) $= 13$

Yes, the two sides are equal. $x = 5$ is the solution.
The fundamental principle we use when we solve equations is:
Whatever you do to the one side of an equation you must do to the other side.

So you can:

- add the same number to both sides, or
- subtract the same number from both sides, or
- multiply both sides by the same number, or
- divide both sides by the same number.

ACTIVITY 3

Find the roots, the value of x which makes each statement true, of the following equations.

1. $2x+3=11$
2. $3x-5=16$
3. $4x-3=21$
4. $3x+2=5$
5. $2x+1=4$
6. $5x+2=2$
7. $5x-3=2x+4$

ANSWERS ON PAGE 86

Try the following activity. This will give you practice in removing the terms with x from the right hand side. Look at the example on page 25 and remember to use the algebraic properties of equations.

ACTIVITY 4

Solve the following equations:

1. $4x-3=x+12$
2. $5x-2=3x+8$
3. $3x-8=x+7$
4. $5x+2=3-6x$
5. $3(2x-1)=4x-3+2x$

ANSWERS ON PAGE 87

Equations with brackets

If the equation has brackets multiply them out first.
After that it is best to collect like terms on each side.

Example

Solve: $2(3x-2)+3(2x+1)=4(2x+3)-x+2$

Solution

$6x-4+6x+3=8x+12-x+2$

$12x-1=7x+14$

$5x=15$

$x=3$

ACTIVITY 5

Solve the following equations.

In some cases the equation may be true for all values of x. In other cases it may be true for no value of x.

1. $5(2x-7)+6=2(x+1)\ -7$
2. $2(3x+1)-7=3(2-x)-2$
3. $3x+4(2x-1)=2(3-2x)+5$
4. $4(9x-3)=6+5(6x+3)$
5. $5(x-2)-17=3(3x-4)\ -7x$
6. $2(3x-1)=4x-3+2x$

ANSWERS ON PAGE 87

Word problems involving equations

Example
When you add 7 to a certain number, multiply your answer by 4 and then add 6, you get 70. Find the number.

These word problems may seem difficult at first, but when you work out a method they are really quite easy.

Solution
Let that **certain number**, the number that is unknown, be x. Then as you read each bit of information in the question, add to what you have written.

When you add 7 to a certain number:	$x+7$
multiply your answer by 4:	$4(x+7)$
then add 6:	$4(x+7)+6$
Your answer is 70:	$4(x+7)+6=70$

Now you have to solve the equation.
All you have to write is $4(x + 7) + 6 = 70$, and then find the value of x for which the equation is true. When you have the answer, substitute that value for x and see if the answer is correct.

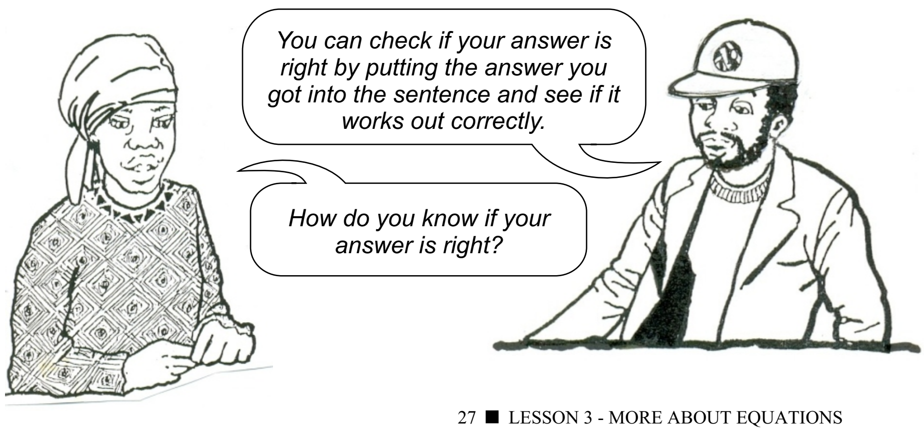
$4(x+7)+6=70$
$4x+28+6=70$
$4x+34=70$
$4x=36$
$x=9$

Let's check the answer:
$9+7=16$
$4 \times 16=64$
$64+6=70$ It is correct because the LHS = RHS.

ACTIVITY 6

1. Find a number such that if you add 5 to it, multiply your answer by 6 and then subtract 2, you get 40.
2. When you add 36 to a certain number, it becomes 5 times bigger than it was before. Find the number.
3. Find a number so that if you multiply the number by 5 and then subtract 15, the answer is double the number you started with.

ANSWERS ON PAGE 88



Word problems leading to equations

In the previous section we gave you a method for changing word problems into equations. The important thing is to look at the information in the problem to help set up an equation. An equation says that two things are equal. So look in the problem to find two things that are equal. Here is an example:

Example
A man is four times as old as his son. In six years time he will be three times as old as his son. Find their ages at present.

Solution
To make an equation we could write:
A man's age = 4 times the age of his son.
Let the son's present age be x. This is the unknown number you want to find out.

Now try to answer the following questions. Write down your answer next to each of these questions.

a) What is the father's present age?
b) What will the father's age be in 6 years time?
c) What will the son's age be in 6 year's time?
d) What two things are equal?

Now we can rewrite the question.

a) The father's present age is $4x$.
b) In 6 year's time the father's age will be $4x + 6$.
c) In six years time his son's age will be $x + 6$.
d) What two things are equal?

The father's age in six years time = 3 times the son's age in six years time.

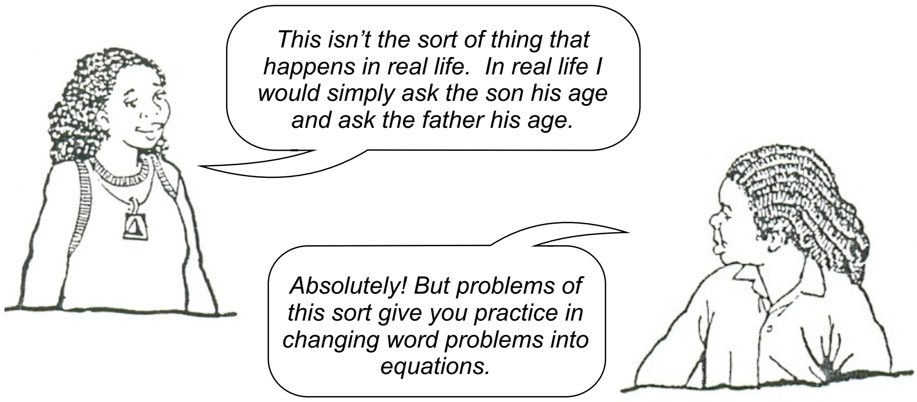
$4x + 6 = 3(x + 6)$

Now we are ready to solve this equation.

$4x + 6 = 3x + 18$
$4x - 3x = 18 - 6$
$x = 12$

Therefore, the son's age is 12.
Let's see if this works.
The son is 12.
The father is $(4 \times 12) = 48$ years.
In six year's time the father is 54.
Is $3 \times 18 = 54$? Yes it is.

ANSWERS ON PAGE 88



Try the following activity.

ACTIVITY 7

1. A man is now nine times as old as his son. In four year's time, he will be five times as old as his son is in four year's time. What are their present ages?

2. Ask these questions and make a word problem:
   - how old are you?
   - how old is your daughter?
   - in 5 year's time, how old will you be?
   - and how old will your daughter be?

3. Two brothers owned some cattle. Jim had three times as many cattle as Robert. If Jim gives Robert 17 head of cattle he will have twice as many as Robert. How many did Robert have to start with? Let Robert start with x cattle. How many did Jim start with?

ANSWERS ON PAGE 89

Summary

In this lesson, we built on what you learned about equations in Unit 2, Lesson 4, and looked at a more formal algebraic approach to solving linear equations. You also learned about identities, equations that are true for all real values of x, and that there are also equations that have no solution as they are false.

Self-assessment checklist:

After this lesson you should be able to:
- solve linear equations algebraically
- decide whether an equation is true, false or an identity
- use linear equations to solve word problems

SELF-CHECK EXERCISE

1. Solve the following equations
   a) $x + 4 = 16$
   b) $2x = 9$
   c) $2x + 3 = 13$
   d) $2x + 3 = 8$
   e) $4x - 3 = x + 15$
   f) $3(2x - 1) = 9$
   g) $3x + 4(2x - 1) = 2(3 - 2x) + 5$

2. Change the following word problem into an equation.

   The length of a rectangle is 1 metre longer than the breadth. If the perimeter is 38 metres, what are the length and the breadth?

3. The perimeter of a rectangle is 24 metres. The length is twice the breadth. Work out the length and the breadth.

ANSWERS ON PAGE 79

4. Area and volume in everyday life

Introduction

In this lesson we are going to revise what we have done in Unit 2, Lesson 6 and Unit 4, Lesson 4 about area and volume. We are also going to relate the mathematics we learn to things we do every day. The lesson will be divided into two topic areas: **area** and **volume**. We will first work through surface area by looking at everyday activities in the home, and revise volume by looking at some transport problems.

In this lesson you will:
- use standard units of area
- estimate the surface area of walls, floors, and ceilings
- work out surface areas accurately
- apply what you have learned to a particular situation
- use standard units of volume
- estimate the volumes of boxes, large containers, and trucks
- work out volumes accurately
- apply what you have learned to a particular situation

Area

Finding out

The first thing Joe had to do was calculate the area of the walls. He decided to do this room by room.

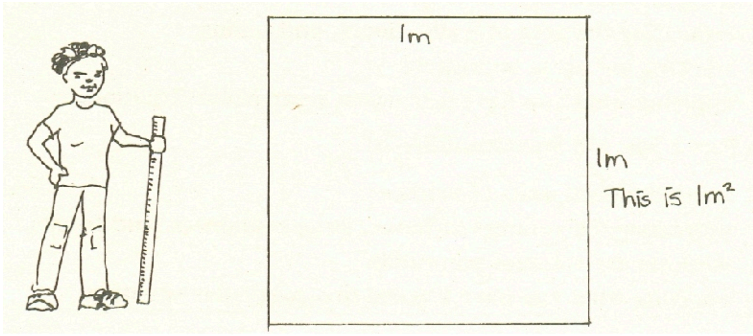
Put yourself in Joe's position. Stand in one of the rooms in your house. Look at one of the walls. Estimate the area of the wall.

Estimation

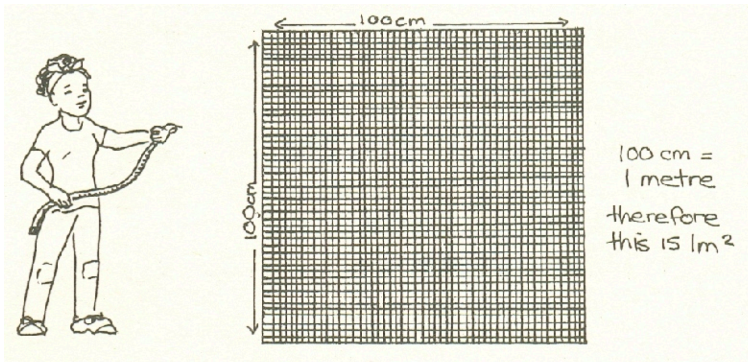
What does estimate mean? It means to picture roughly how many square metres will fit onto the wall. In order to do this you have to know the size of a square metre.

Standard Units

Remember that the standard unit for measuring area is a square metre. Take a metre stick and mark out a square 1 m × 1 m

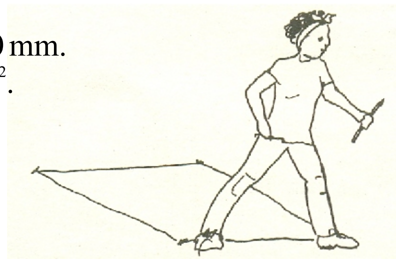


If you haven't got a metre stick, find a tape measure which dressmakers use. Find the mark 100 cm. Mark out a square 100 cm × 100 cm.



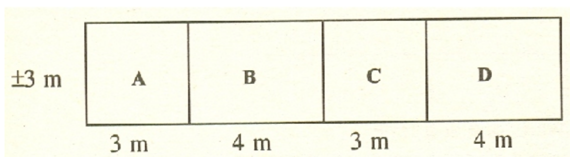
You may find a measure which carpenters and builders use. Find the mark which says 1 metre, or 1 000 mm.

And mark out a square 1 000 mm × 1 000 mm.
1 000 mm = 1 metre therefore this is 1 m^2.



If you haven't got a metre stick, or a tape measure, make a mark on the floor, take one large stride, and make another mark. Join the marks with a line. Draw a line at right angles to the first line. Mark off a large stride on this line. You should have roughly 1 square metre.

Draw a rough plan of the four walls in your room, like this:



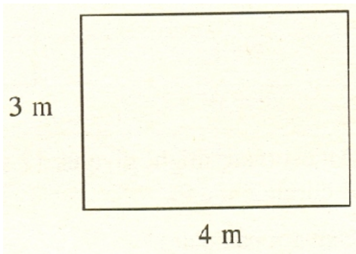
Estimate the area for each wall.
Area of A =
Area of B =
Area of C =
Area of D =

Once Joe had estimated the area of the walls, he could find out the price of paint and wallpaper. However for the purpose of this exercise let's go on to some mathematics and measure the area of the walls accurately.

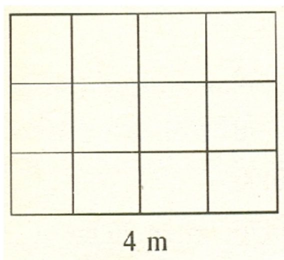
In this activity we will work only with square metres. It is very seldom that things work out exactly in real life, but let's leave parts of metres, centimetres and millimetres for another activity.

Working accurately

Look at the following rectangle. The width is 4 m, and the height 3 m. How many square metres can you fit onto the rectangle?

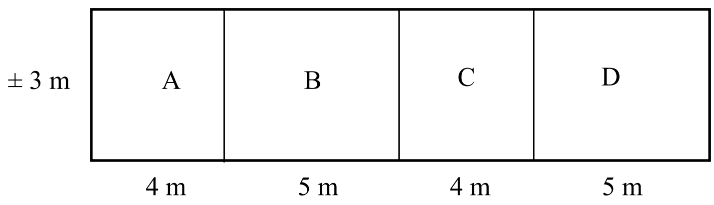


Now draw lines across the rectangle and you will see that there are 12 square metres. You get the answer by multiplying the width by the height. If you cannot remember this, then revise Lesson 6 of Unit 2.



ACTIVITY 1

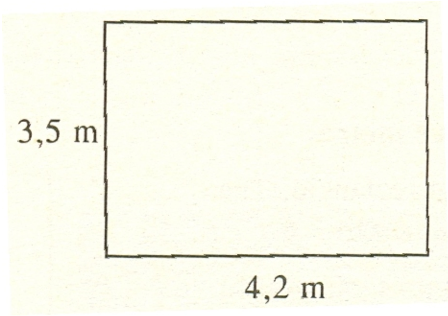
In this activity, work out accurately the total area of the walls. You will notice that the walls have been put side-by-side to make it easier to see the answer.



ANSWERS ON PAGE 90

Working with parts of metres

For the following exercise you can use a calculator.
Look at the following rectangle. It measures 3,5 m× 4,2 m.



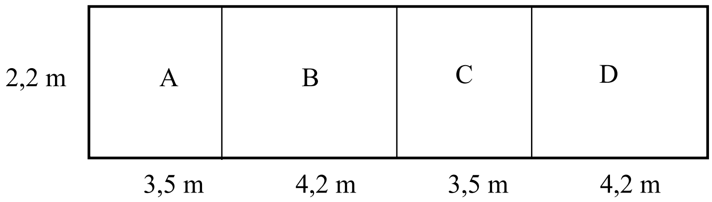
An estimate might give us 12 square metres, but in some cases this isn't accurate enough.

If we use a calculator:

Press 3,5 x 4,2
= 14,7 m^2

ACTIVITY 2

Note that the walls of the room have been laid out alongside each other in the drawing. Estimate the area of each wall and fill in the table below. Then work out the area of each wall. (Use a calculator, and check your answer against the estimate.)



	Estimate	Actual Area
Wall A		
Wall B		
Wall C		
Wall D		
Total		

ANSWERS ON PAGE 90

Working with smaller units

When working with lengths smaller than a metre, you can work in parts of a metre, or in centimetres. For example you could use 0,5 metres or 50 centimetres.

When great accuracy is needed, for example in carpentry, you can use millimetres, for example 655 mm, instead of 0,655 metres.

Standard Units

1 metre can be divided into 100 smaller parts called centimetres ('cent' is the Latin word for a hundred).
1 metre can also be divided into 1 000 smaller parts called millimetres ('milli' is the Latin word for a thousand).
1 centimetre is therefore equal to 10 millimetres.
1 metre is equal to 100 centimetres.

Therefore $1\ m^2$ (1 m × 1 m) $= 100\ cm \times 100\ cm$
$= 10\ 000\ cm^2 = 1 \times 10^4\ cm^2$

1 metre is equal to 1 000 millimetres.

Therefore $1\ m^2$ (1 m × 1 m) $= 1\ 000\ mm \times 1\ 000\ mm$
$= 1\ 000\ 000\ mm^2 = 1 \times 10^6\ mm^2$

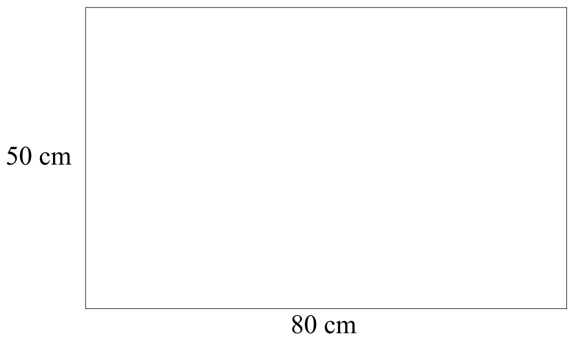
1 centimetre is equal to 10 millimetres.

Therefore $1\ cm^2$ (1 cm × 1 cm) $= 10\ mm \times 10\ mm$
$= 100\ mm^2$

1 m = 100 cm
$1\ m^2 = 10\ 000\ cm^2$
$1\ m^2 = 1\ 000\ 000\ mm^2$
$1\ cm^2 = 100\ mm^2$

Example

Work out the area of the following table top. When Joe measured it, he measured it in centimetres.



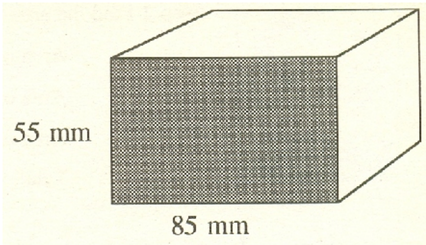
Step 1: Estimate. The length is less than a metre, and so is the width. Therefore the area is going to be less than 1 square metre. The area is going to be less than $10\ 000\ cm^2$.

Step 2: Work accurately: area $= \text{length} \times \text{breadth}$
$= 80\ cm \times 50\ cm$
$= 4\ 000\ cm^2$
(which is less than $10\ 000\ cm^2$. It is less than half. Would you expect it to be? Try making a rough sketch.)

Another way of working this out is using metres.
80 cm = 0,8 m and 50 cm = 0,5 m
$0{,}8\ m \times 0{,}5\ m = 0{,}40\ m^2$

Example

Suppose a carpenter had to work very accurately to make a drawer for a desk. He would measure in millimetres. To find the area of wood needed he would have to find the total area of all the parts. Find the area of the shaded part.



Step 1: Estimate: area = length × breadth, $80 \times 50 = 4\ 000\ mm^2$

Step 2: Work accurately: $85\ mm \times 55\ mm = 4\ 675\ mm^2$

This can also be worked out in metres.

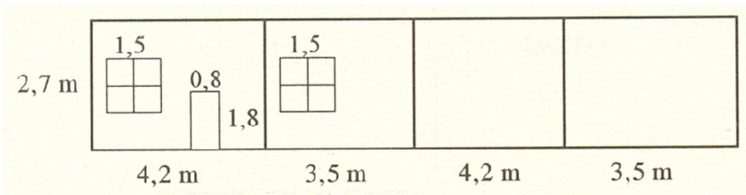
area = length× breadth
= 0,085 m× 0,055 m
= 0,004675 m^2

Estimating the area of the walls might be good enough in the planning stages. Some builders may estimate very accurately. They might know the amount of paint needed for a wall of that size. But in some cases it may be necessary to work things out accurately. In the following activity we will work out accurately the area to be painted.

ACTIVITY 3

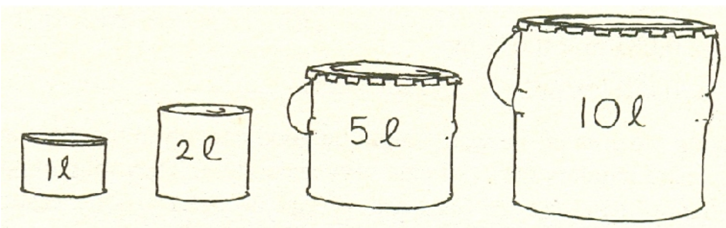
Work out the area of wall to be painted.

ANSWERS ON PAGE 90



The next step

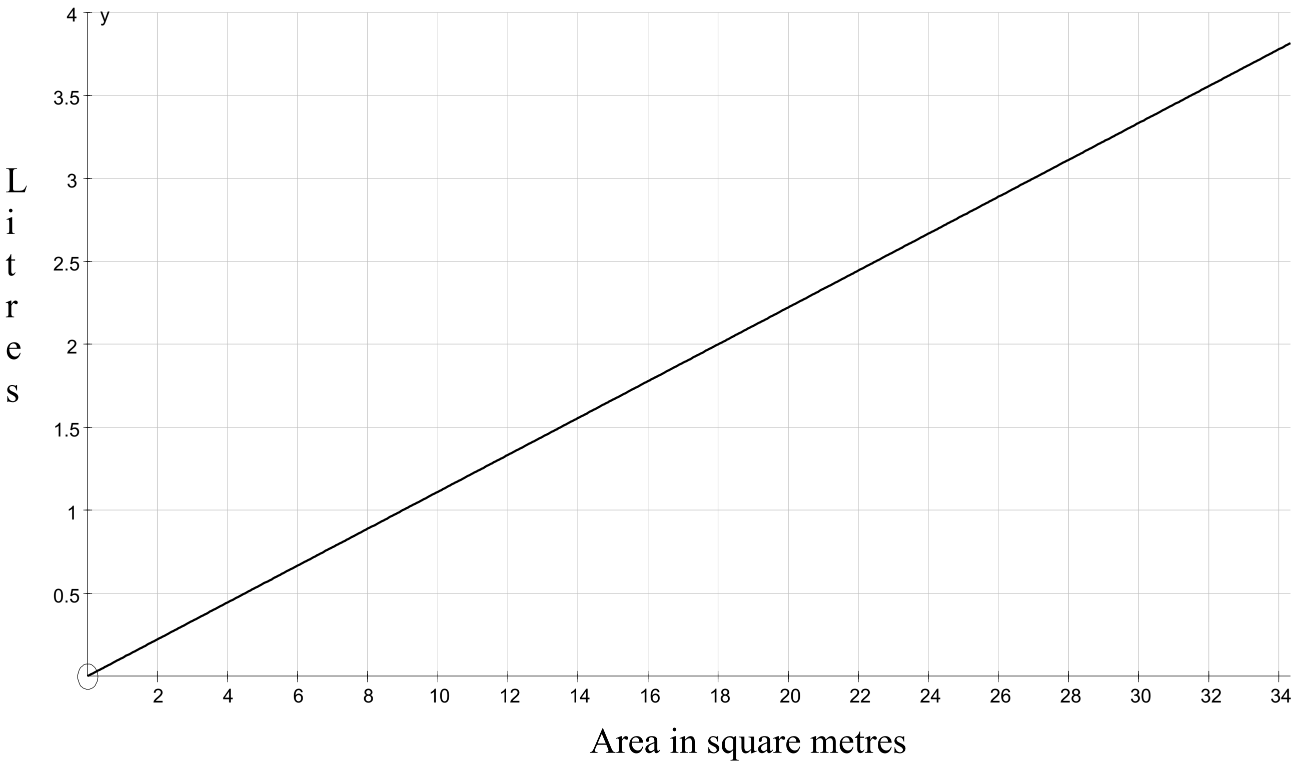
Joe is now in a position to buy the amount of paint he needs. Of course the amount he buys depends on what is available in the shop.



R30 R50 R120 R200

The assistant tells him that 1 litre will cover 9 m^2. We can then work out that 2 litres will cover 18 m^2 and 3 litres will cover 27 m^2.

This can be shown on a graph.



From the graph Jakes can work out that he needs just over 4 litres. The paint comes in 5 litre and 2 litre containers. Which is cheaper? One 5*l* container or two 2*l* containers plus one 1*l* container? He can check the prices to see which is the more economical.

ACTIVITY 4

Use the graph above to find out approximately how many litres of paint you would need to cover an area of:

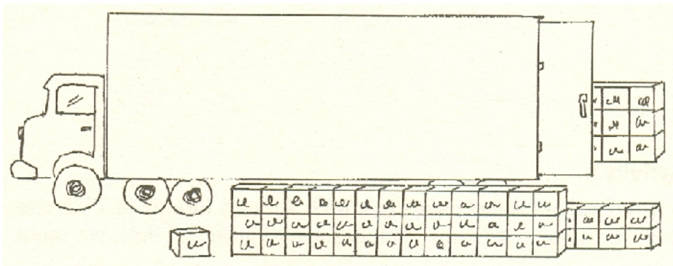
a) $16\,m^2$ b) $28\,m$ c) $35\,m^2$? ANSWERS ON PAGE 91

ACTIVITY 5

A 5 litre tin of enamel paint costs R89, and a 5 litre tin of PVA costs R47. Jakes paints 4 rooms, and uses approximately 5 litres per room.

1. What will be the total cost using PVA?
2. What will the total cost be using enamel paint?
3. What is the difference?
4. Are there other considerations beside the cost? Which paint lasts longer?
5. What other substances can you use to cover walls? ANSWERS ON PAGE 91

Volume and Transport



Problem: How many of these boxes can be packed into this truck? The inside of the truck is 8 m long, 2 m wide and 3 m high. The boxes are 30 cm× 25 cm× 40 cm.

Planning and finding out

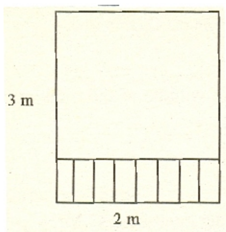
There are a number of ways to solve this problem. One way is to start packing and carry on until the truck is full. Another way is to work it out mathematically. How would you solve this problem? Write down your ideas.

We need to find out the volume of the container truck. To work out the volume, we have to know the standard units.

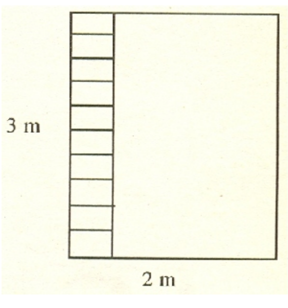
Estimating

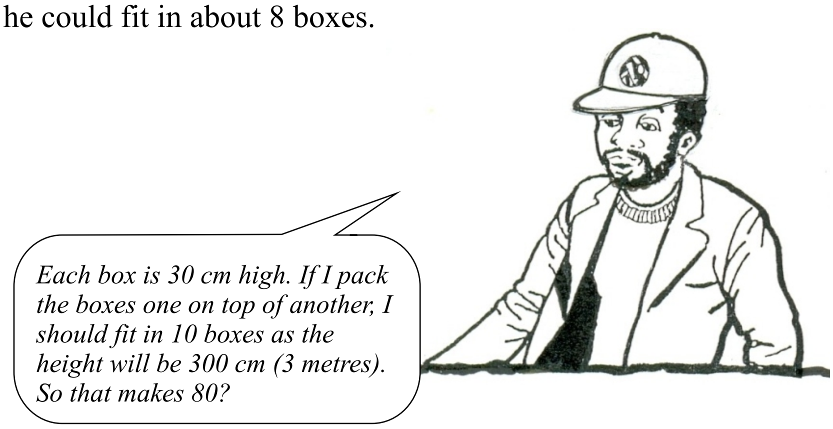
The first thing to do is to estimate. Your estimate can be quite rough. What would you guess? 10, 100, 1 000?

Joe imagined climbing into the truck. He looked at the proportions of the boxes, and the proportions of the truck.



Each box is 25 cm wide. If he packed them along the front, which is 2 m, he could fit in about 8 boxes.



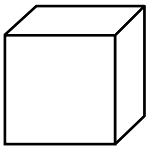


Thoughts on mathematics

Most people use mathematical skills when solving problems. There are formal ways of doing things which are correct mathematically. You may work differently from the formal way taught at school. That doesn't mean you can't do mathematics. Look at the formal way. Think about your way. See in what way each can help you to do things more efficiently.

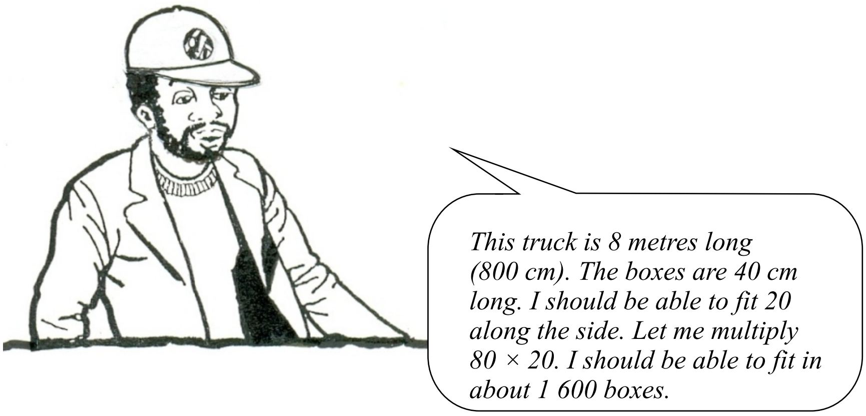
Standard Units

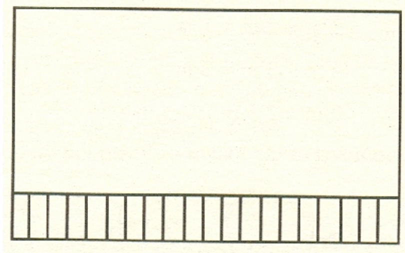
The volume of a box is 1 m × 1 m × 1 m which is 1 cubic metre or 1 m^3



Take a metre stick or a measuring tape. Mark out a square metre on the floor, then measure a height of 1 metre. A box with those measurements contains 1 cubic metre (m^3*).*

Then he looked at the long side.





This way may be quick if someone is good at picturing things, but suppose you were sitting in an office and you were told to work this out. Let's see if mathematics can provide some short cuts.

Working accurately

Work in the same units throughout. Either convert all the measurements to metres or all the measurements to centimetres.

Step 1: Work out the volume of the truck.

Volume $= \text{length} \times \text{breadth} \times \text{height}$
$= 8\text{ m} \times 2\text{ m} \times 3\text{ m}$
$= 48\text{ m}^3$

Step 2: Work out the volume of a box.

Convert centimetres to metres.
Volume $= 0{,}3\text{ m} \times 0{,}4\text{ m} \times 0{,}25\text{ m}$
$= 0{,}03\text{ m}^3$

Step 3: To find the number of boxes, divide the volume of the truck by the volume of the boxes.

$$\frac{48}{0{,}03} = 1600 \text{ boxes}$$

Why don't you try working this out using centimetres? Mr A might physically pack some boxes into the truck, and then make an intelligent guess. Ms B might form a mental picture or draw the boxes. Ms J might do a quick mathematical calculation. Someone with a lot of experience may just know how many boxes will fit into a truck.

Mathematics involves taking the general truths about volume and then applying those truths to all volume problems.

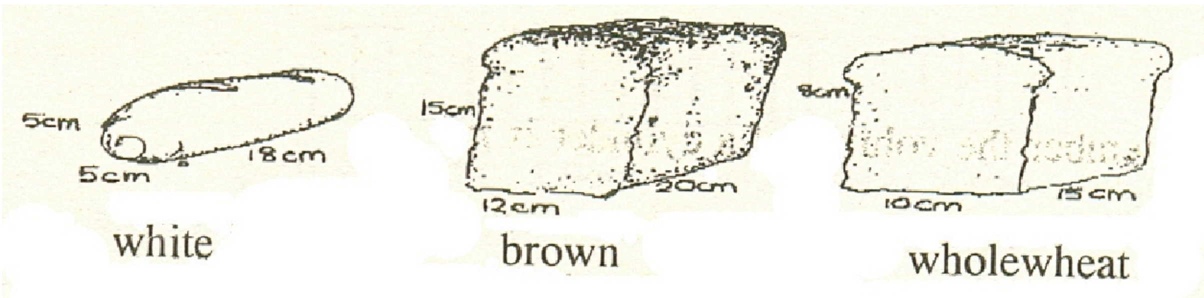
ACTIVITY 6

1. Jonty has a bakery. He owns 3 delivery vans. How many loaves of bread could he fit into each van?

   a) Find the volume of storage space of each delivery van.

   van A: $3\ m \times 2\ m \times 1\ m$
   van B $4\ m \times 3\ m \times 3\ m$
   van C: $2\ m \times 1,5\ m \times 2,5\ m$

   b) Find the volumes of the loaves of bread drawn below.



   c) How many brown loaves (15 × 12 × 20 cm) will fit into van B?

ANSWERS ON PAGE 91

Volume and Density

Themba was filling shelves in the supermarket in which he worked. He carried 3 boxes of exactly the same size from the delivery van into the shop. Themba found that one of the boxes was much heavier than the other two.

Another box was much lighter and easier to carry than the other two boxes. When Themba opened the boxes, he found that each box was completely filled, with no empty space at all.

We commonly and incorrectly talk of 'weight' instead of 'mass', although the 'weight' of an object is the combination of mass with the force of gravity.

The light box was filled with boxes of tissues; the middle weight box was filled with packets of peanuts, and the heaviest box was filled with boxes of fruit juice.

The boxes were of the same **volume**, but their masses were different – each was heavier or lighter than another.

The mass of water is usually taken as 1 g/cm or 1 000 kg/m.

The masses of the boxes were different, because the contents of the boxes had different density. The density of any substance is the mass of a unit volume of the substance.

ACTIVITY 7

List the following substances in order of increasing density:
milk; flour; tea leaves; steel; soap; bread; cotton wool; plastic; bricks

ANSWERS ON PAGE 91

Volume of cans

The volume of a box (cuboid or rectangular prism) is found by multiplying 1 × b × h.

Another way of putting this is:
Volume = area of base × height

The volume of a can (cylinder) is also found by multiplying the area of the base by the height.
Does it matter whether we find the area of the base or the top?

The area of a circle is: πr^2
Therefore the volume of a can $= \pi r^2 \times h$
Volume of rectangular prism = $l \times b \times h$
Volume of prism = area of base × height
Volume of cylinder = $\pi r^2 \times h$

Did you know?

- *Huge container trucks seem to get longer and longer, but stay the same height and width. Why is that?*
- *Container ships are built to take an exact number of containers of a standard size.*
- *Railway trucks and container trucks are also built to take an exact number of containers.*

ACTIVITY 8

1. Find the volume of: (use $\pi = 3{,}142$)

   a) a can of beans, radius 4 cm, height 6 cm.
   b) a can of tomatoes, radius 5 cm, height 10 cm.
   c) a can of pineapple, radius 6 cm, height 8 cm.

ANSWERS ON PAGE 91

Summary

In this lesson we have looked at some practical situations where mathematics may be applied. We have focused on the particular aspects of the situation which relate to mathematics. When you are working mathematically, sometimes pictures can help to get a clearer idea of the problem.

Self-assessment checklist:

Are you able to:

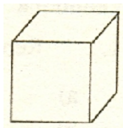
- apply mathematics to practical problems involving area
- calculate volumes of rectangular prisms and cylinders

SELF-CHECK EXERCISE

1. Lindi decided to tile the wall above her bath. The wall is 1,8 m high and 2,4 metres long. Each tile she bought was 10 cm × 10 cm.

   a) Draw a picture of one tile. Imagine the tile is lying on paper marked off in square centimetres. What is the area of the tile?
   b) How many tiles would fit over an area of one square metre?
   c) What is the area of the wall? How many tiles are needed to cover the whole wall?
   d) The tiles are sold in boxes of 100 tiles. Each box costs R400,00. How many boxes shoud Lindi buy? What will this cost her?
   e) The cement to stick the tiles to the wall costs R20 a tube. Each tube covers 1 square metre. How many tubes will Lindi need? How much will they cost?
   f) What is the total cost of the tiles and cement?

2. A small sugar cube is 1 cm × 1 cm × 1 cm, that is 1 cm^3. A box of sugar cubes is 10 cm long, 6 cm wide and 5 cm deep.



   a) How many sugar cubes are there on the top layer?
   b) How many layers are there in the box?
   c) How many cubes fit in the whole box?
   d) What is the volume of the box?
   e) How many small boxes of sugar cubes would fit into a container, 60 cm × 50 cm × 50 cm?

ANSWERS ON PAGE 80

5. More about bar graphs

Introduction

We have already dealt with data handling in Unit 2, Lesson 7, Unit 3, Lesson 6 and Unit 4, Lesson 7. We have looked at frequency tables, representing and interpreting data and averages and spread. In the next lesson of this unit, you will continue with data handling by conducting a survey. You will need to understand all these previous units to do that survey. In this lesson you will learn about more complicated bar graphs.

In this lesson you will:

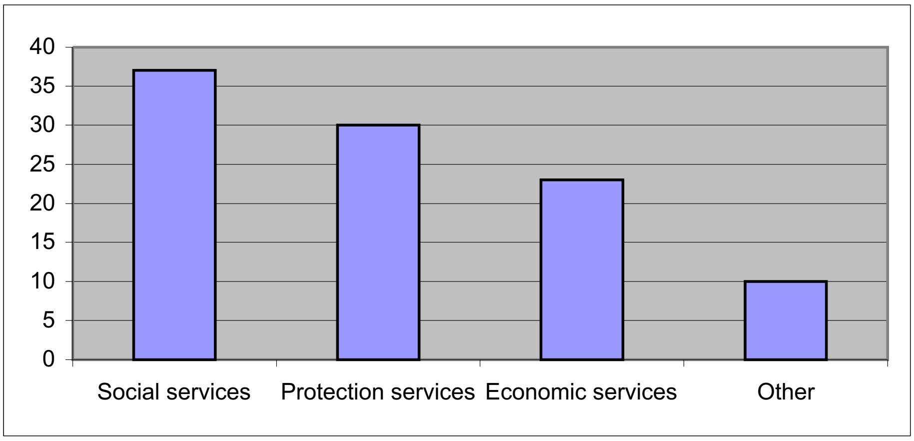
- learn to draw and interpret more bar graphs

Bar graphs

Bar graphs are a common type of graph used to represent statistics. The other types of graphs you have also learned about are pie charts and line graphs. We have already dealt with two types of bar graphs in Unit 3, Lesson 6.

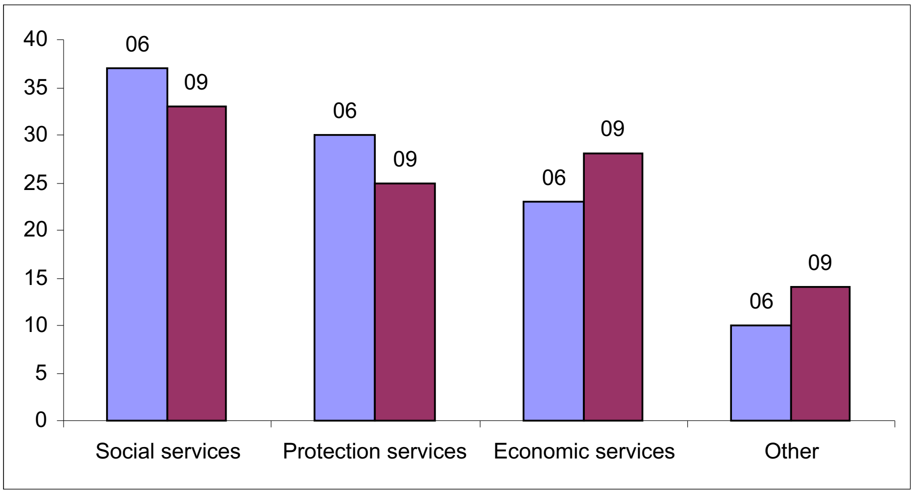
Variables were dealt with in Unit 3, Lesson 2.

The first one is a **simple bar graph** and we use it when we have one independent and one dependent variable. In the example below, taken from Unit 3, Lesson 6, Activity 5,we looked at the government's spending in one year with regard to the categories of 'social services', 'protection services', 'economic services' and 'other'.



Simple bar graph

The second is a **grouped bar graph** where we have more sets of data for the same categories, for example data over two or three years. In the example below, taken from Unit 3, Lesson 6, Activity 6 of we compared the same categories of expenditure between 2006 and 2009. We used labels to show the difference between the two years. Sometimes a key or a code is used instead. You can find two other examples of grouped bar graphs in the "self-check" exercise of Unit 3, Lesson 6.



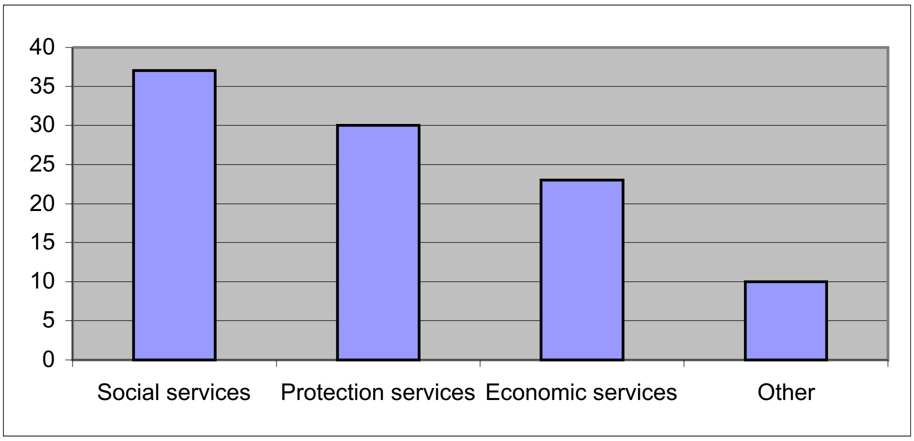
Grouped bar graph

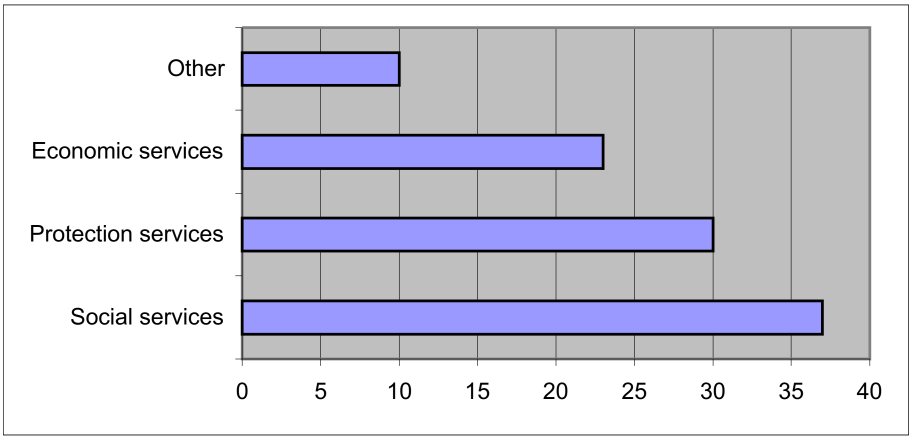
You do not need to know the names of these different types of bar graphs. But you should be able to draw and interpret them. Other types of bar graphs we will learn about in this lesson are:

- Horizontal bar graphs
- Histograms
- Compound/composite bar graphs

Horizontal bar graphs

The layout of the horizontal bar graph is similar to that of a simple bar graph. Look at examples of the two graphs below.





The same information is contained in both graphs but the first one has vertical bars and the second graph has horizontal bars. That is why the second is called a **horizontal bar graph**.

ACTIVITY 1

This was the information given to show the average temperatures in Port Elizabeth during January, February, March and April of 2009.

January = 25°C
February = 24°C
March = 19°C
April = 17°C

Draw a horizontal bar graph to show how the temperatures changed over the months. You drew a simple bar graph of this in Unit 3, Lesson 6, Activity 7.

ANSWERS ON PAGE 92

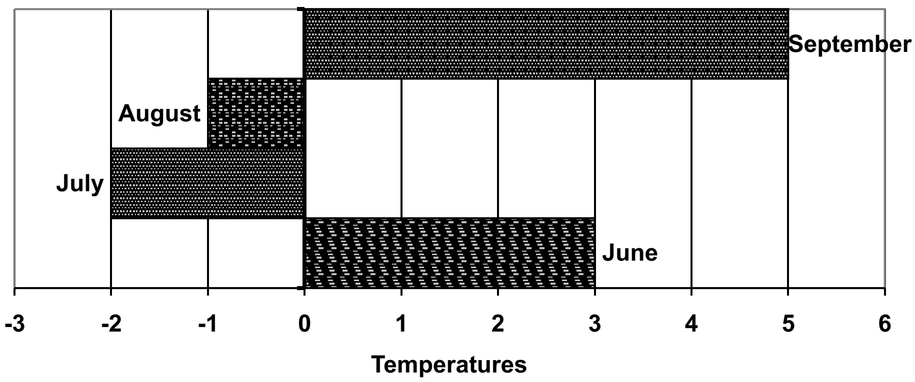
Horizontal bar graphs are especially useful when you also have negative values in your data.

Example
A travel company provides the following average minimum temperatures for Lesotho from June to October.

June: 3°C
July: -2°C
August: -1°C
September: 5°C

We can represent this on a horizontal bar graph.

Solution



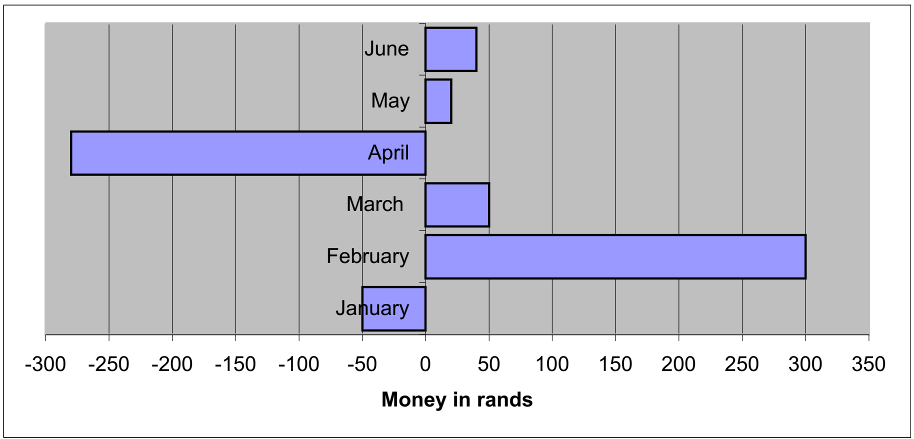
Notice that this horizontal bar graph contains positive and negative values.

ACTIVITY 2

1. The table on the next page is a summary of the amount of money in Luka Nkosi's bank account over 6 months. Draw a horizontal bar graph to represent this data.

Month	Bank balance
January	–R120,00
February	R200,00
March	R180,00
April	–R180,00
May	R150,00
June	R80,00

2. The following horizontal bar graph shows the money in Vejay Nkosi's account for the same six months.

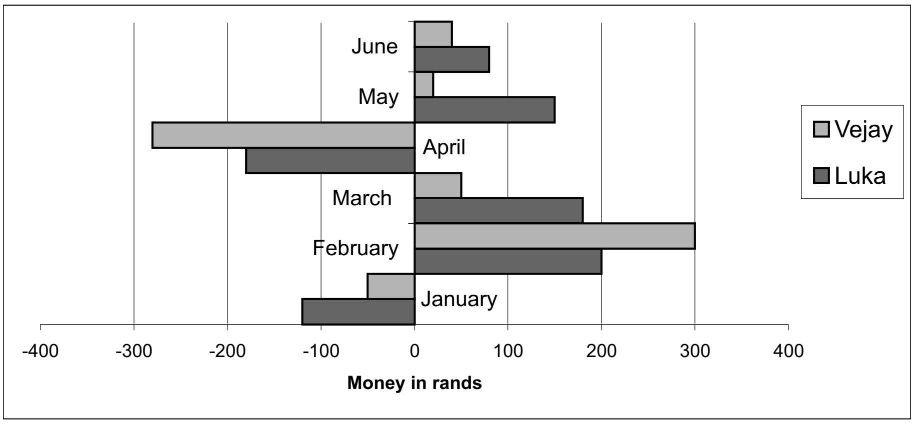


a) At the end of which month did Vejay have the most money in her account? How much?
b) At the end of which month was Vejay in the most debt? By what amount?
c) Why do you think Vejay was in debt at the end of January and April?
d) How much money did Vejay have in the bank at the end of March?
e) How much money did Vejay have in her account at the end of June?

ANSWERS ON PAGE 92

Below is the grouped data horizontal bar graph of Luka's and Vejay's bank amounts.

Notice the "key" on the right hand side of the graph showing which bars indicate Luka's data and which ones indicate Vejay's data. Now it is easy to do a quick monthly comparison of the money in each of their bank accounts at the end of the month.



ACTIVITY 3

1. From the graph answer the following questions.
   a) In which months did Luka have more money remaining in his bank account?
   b) In which months were both Vejay and Luka in debt to the bank?
   c) Who had the most money in their bank account during a single month? How much money did they have? Which month was that?
   d) Who had the most debt in a single month in their account? Which month was that? How much money did they owe the bank?

ANSWERS ON PAGE 92

The simple and horizontal bar graphs on the previous page were used to show either individual values or items or grouped items so that comparisons could be made. Sometimes it is necessary to group a range of data together. In order to represent such data, we use a bar graph called a **histogram.**

Histograms

Histograms are similar to simple bar graphs except that each bar represents a range of independent variable values rather than just a single value. Let's refer to Unit 2, Lesson 7 for an example.

Example

The following marks were obtained by a class of 30 students when they wrote their first test in Mathematical Literacy.
54 56 50 44 58 55 49 64 44 48
50 48 59 47 58 54 51 56 51 37
54 40 51 44 53 43 38 51 60 54

1. Construct a frequency table to find out how many students got marks in each of the groups: 36 - 40, 41 - 45, 46 - 50, 51 - 55, 56 - 60, 61 - 65.
2. Draw a histogram to represent this information.

Solution

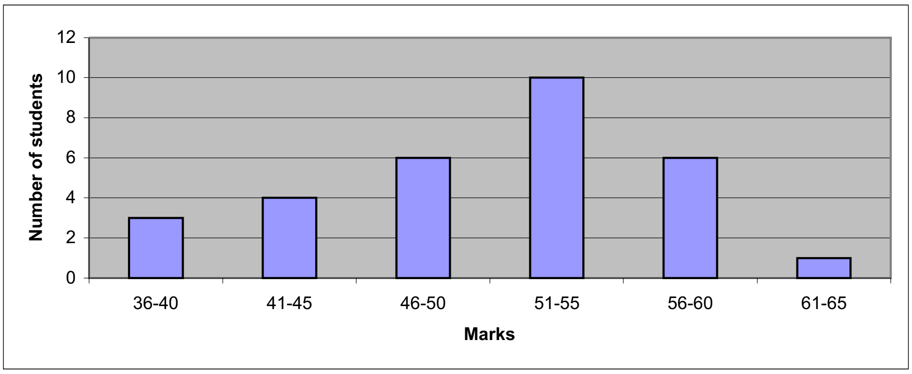
Do you remember how to construct a frequency table? As you cross out a value, you mark the tally next to the group to which the value belongs. Then you add up the tallies to get the frequency for each group.

54	56	50	44	58	55	49	64	44	48
50	48	59	47	58	54	51	56	51	37
54	40	51	44	53	43	38	51	60	54

1.

Marks	Tally	Frequency
36-40	|||	3
41-45	||||	4
46-50	~~||||~~ |	6
51-55	~~||||~~ ~~||||~~	10
56-60	~~||||~~ |	6
61-65	|	1
Total		30

2. To draw our histogram, we have our groups of marks as the independent variable and the frequency as the dependent variable. In this graph, the independent variable (the range of marks) will each form a bar of the graph. Here is what the graph should look like.



ACTIVITY 4

Use the histogram above to answer the following questions.

1. In which range of marks did most of the students score? State how many students had a test score in this range.
2. In which range of marks did the least number of students score? State how many students had a test score in this range.
3. How many students scored above 40 marks in the test?
4. How many students scored 50 or less than 50 marks for the test?
5. How many students scored between 40 and 61 marks?
6. If a total of 30 students wrote the test, what percentage of the students scored more than 50 marks?

The word "between indicates that you exclude the 40 and 61 and that you look for students who scored from 41– 60 marks.

ANSWERS ON PAGE 92

Now let us revise compiling frequency tables and practice drawing a histogram using another exercise from Unit 2, Lesson 7.

ACTIVITY 5

A statistics student was asked to do a project of his choice. He decided to find the heights of 20 people standing near him. He obtained the following heights in cm, to the nearest cm.

151	162	174	168	185	156	172
167	144	162	148	174	176	166
171	160	168	181	157	174	

1. Complete this grouped frequency table for the heights.

Height (cm)	Tally	Frequency
140-149	||	2
150-159		
160-169		
170-179		
180-189		

2. Draw a histogram to represent this information.

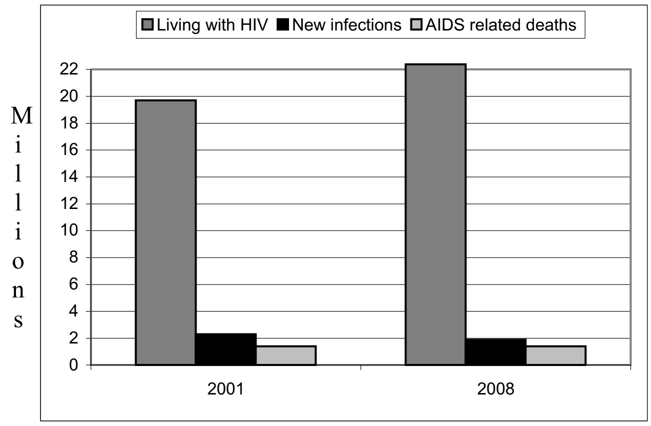
ANSWERS ON PAGE 93

The final bar graph we will deal with in this lesson is the composite bar graph.

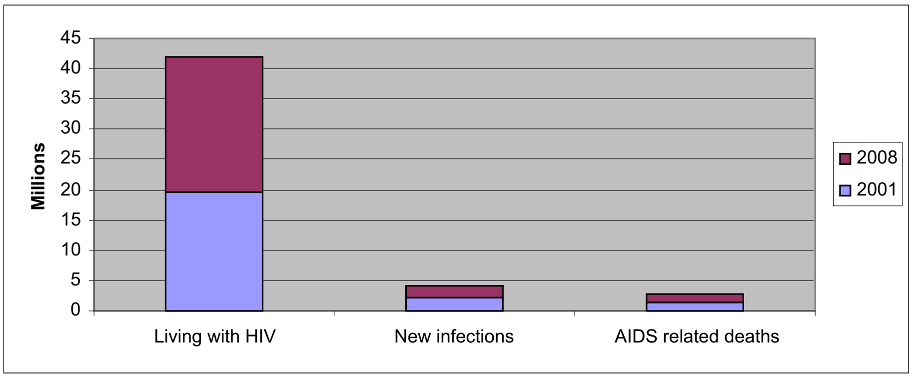
Compound/composite bar graphs

Compound or composite bar graphs are similar to grouped bar graphs in that they compare more than one item or category. Grouped bar graphs have the categories next to each other while with composite bar graphs the different categories are stacked on top of each other in the same bar. Let us use an example of data from Unit 3, Lesson 6.

The grouped bar graph below was taken from the United Nations AIDS website. It compares HIV/AIDS statistics in Sub-Saharan African in 2001 and 2008. Note that the vertical column indicates the number of people in millions.



If we draw the above graph as a compound bar graph, it will look like this.



Can you see the differences? The years 2001 and 2008 are now in the key and the three categories 'living with HIV', 'New infections' and 'AIDS related deaths' are on the *x*-axis.

This graph clearly indicates that there are many more millions of people living with HIV than there are new infections or AIDS related deaths overall. But it is more difficult to see the difference between the number of occurrences in 2001 and 2008.

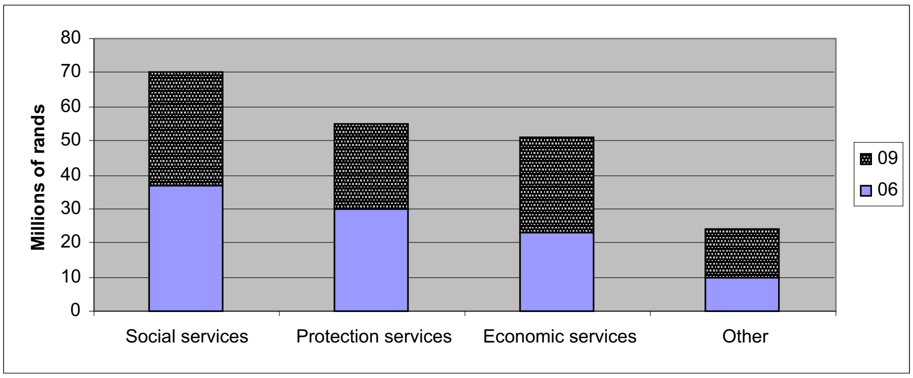
In the 'Living with HIV' category, there were just below 20 million people in 2001. In 2008 there appear to be just more than 20 million people. You read this by looking at the range of numbers that the 2008 part (top part) of the 'Living with HIV' bar spans.

You will notice that it starts just below 20 million and extends up to above 40 million, hence we are able to say that there were just more than 20 million people living with HIV in Sub-Saharan Africa in 2008.

If you look at the grouped bar graph, it is easy to see that there were actually slightly more than 2 million people living with HIV in 2008 than in 2001. This detail is less obvious on the composite bar graph.

ACTIVITY 6

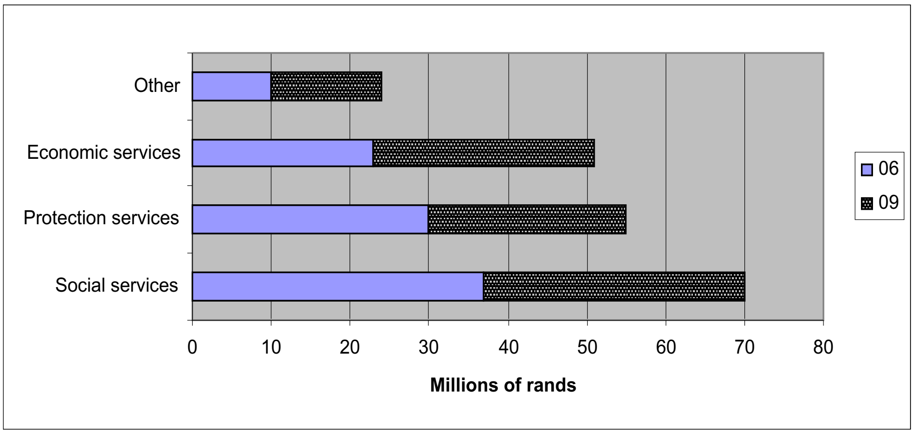
Here is a compound bar graph comparing the national expenditure in South Africa in 2006 and 2009. Study the graph and answer the questions that follow.



1. On which of the services was the most money spent overall?
2. On which of the services was the least money spent overall?
3. Was more money spent on social services in 2006 or in 2009?
4. Was more money spent on economic services in 2006 or 2009?

ANSWERS ON PAGE 93

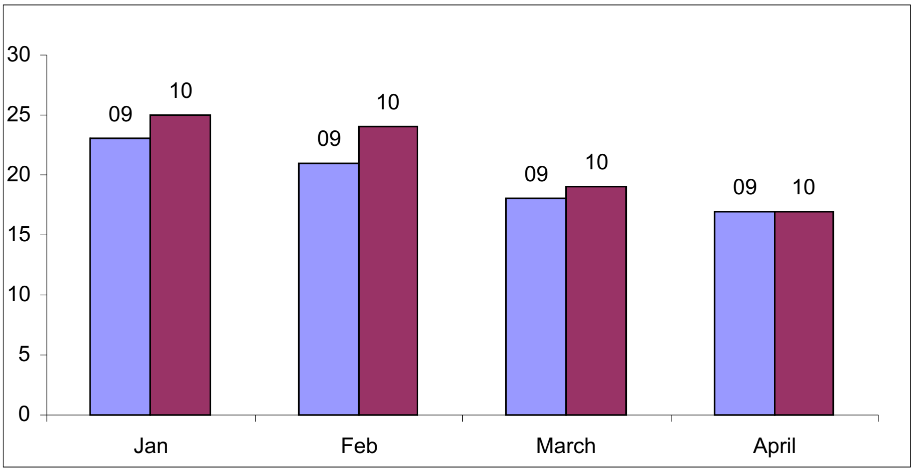
So far we have worked with composite bar graphs that have vertical columns. You can also draw composite horizontal bar graphs as shown in the example below.



ACTIVITY 7

1. Use the data from the grouped bar graph below to draw:

    a) A composite bar graph (with columns) and
    b) A composite horizontal bar graph



2. The original context of this graph was a comparison of temperatures in a city over the first four months of two consecutive years. Do you think it is more practical and easier to read to use a grouped bar graph or a compound bar graph? Why?

ANSWERS ON PAGE 93

Summary

In this lesson you learned to draw and interpret three more types of bar graphs that are used to represent data. You should now be able to work with any of the following five bar graphs:

- Simple bar graphs
- Grouped bar graphs
- Histograms
- Composite bar graphs

Self-assessment checklist:

Are you able to:

- recognise the various graphs
- read information from the different charts

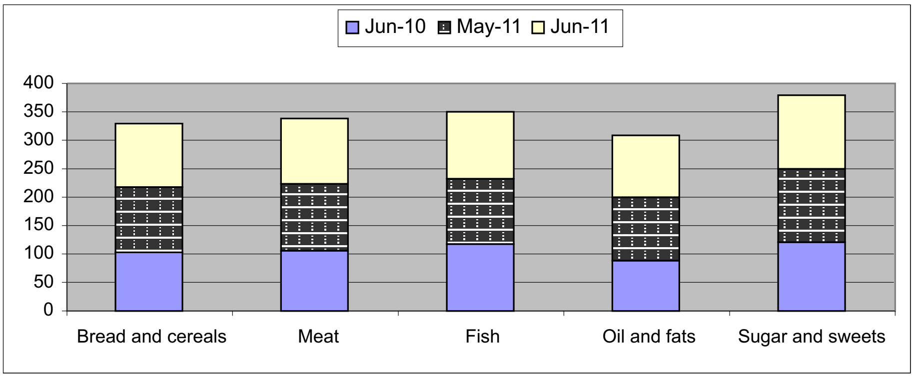
SELF-CHECK EXERCISE

In Lesson 1 of this unit, we looked at the CPI (Consumer Price Index) which tells us the rate of inflation on various products and our economy in general. The table below compares the CPI for food products between June 2010, May 2011 and June 2011.

1. Use the table to draw a grouped bar graph of the data.

Food	**June 2010**	**May 2011**	**June 2011**
Bread and cereals	104,1	112,6	113,0
Meat	106,4	115,8	116,3
Fish	116,4	115,9	116,9
Oils and fats	88,3	111,1	110,0
Sugar and sweets	119,8	130,6	130,4

2. Below is a composite bar graph of the CPI data in question 1.



a) Which food had the highest CPI increase between June 2010 and June 2011?

b) Which food had the highest CPI increase between May 2011 and June 2011?

ANSWERS ON PAGE 80

6. Conducting a statistical survey

Introduction

In this lesson you are going to conduct a survey. But before you conduct the survey you need to make sure that you understand the statistics covered in Unit 2, Lesson 7, Unit 3, Lesson 6 and Unit 4, Lesson 7.

Then you will revise statistical methods and identify problems that can affect statistical research.

Next, you will plan and implement a statistical project based on the survey that you will conduct.

Finally, you will write a report based on your survey.

In this lesson you will:

- plan a survey
- conduct a survey on your own
- write a report on your survey

What is a survey?

You have already come across the word survey. In Unit 2, Lesson 7 we talked about a transport officer of a firm who conducted a survey to find out how the workers of the firm come to work. He did this to find out how he could make it easier for the workers to get to work. A survey is therefore conducted to find out about a problem in a situation. Usually the aim of the survey is to show how the problem can be solved.

You have also met many examples of surveys in your notes, even though you did not read the word survey in the examples. In Unit 2, Lesson 7, Activity 6, a farmer wanted to study the way birds, in a certain area, breed. He did this by choosing a sample of 20 nests of birds at the start of the breeding season and counted the eggs found in each nest. This was a type of survey.

Problems of a survey

Sometimes there are difficulties involved in conducting a survey. For example, when the transport officer planned his survey, how did he choose the headings: walk, cycle, bus, train, car?

What about the worker who walks a long distance to the bus stop before catching the bus? Does she fall under the heading 'walk' or 'bus' or should we create a new heading, 'walk and bus' for her?

What about those workers who cycle when the weather is fine, but drive when it rains? These are only a few problems. The person conducting the survey must decide on where to put these workers. This is where the interest of the person conducting the survey comes in. For example, if the transport officer wants to tell the workers that the transportation system is bad, he will prefer to put these same people under 'walk'. The best way to solve this problem is to put these people in the group they belong to most often.

Another way in which the person conducting the survey will show his interest is by choosing to interview certain people and not others. Usually it takes too long and costs too much money for the researcher to interview everybody. So he takes a section of the total population affected - in this example, all the workers in the factory. This section is called a 'sample'.

To go back to our example, the 36 workers that the transport officer interviewed may not be all the workers of the firm. He chose a sample. If he wants to show that the transportation system is good, he will choose the rich people of the firm. These people are likely to come to work in their own cars. If he wants to prove that the transportation system is bad, he will choose the poor workers. Neither of these samples gives good results. They give results which are 'biased', or not fair.

To get a fair result, the researcher should choose a random sample. This means choosing anybody who he sees – either rich or poor. He should also choose as many people as money and time will allow.

The more people you choose for your survey the better the result you will get. Remember this when you plan how to collect your statistics.

Data and charts

In Unit 2 you learned about tallies, frequency tables and pie charts. Bar charts are also an important way to show your data. You learned about bar charts in Unit 3 and more complicated bar charts in Lesson 5 of this unit. Let's do an example to refresh your memory. Let's go back to the example of the survey conducted by the transport officer of the firm.

Example
A survey conducted by the transport officer of a small firm of 36 workers showed that 13 of the workers walked to the firm, 8 cycled, 4 came by bus, 9 by train and 2 by car.

Walk	Cycle	Bus	Train	Car
13	8	4	9	2

In this example we showed the data on a pie chart. We can show the same data on a bar chart. This will look like the diagram in Figure 1.

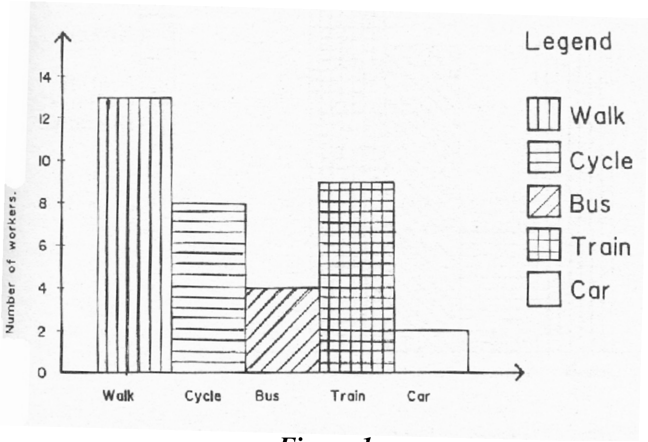


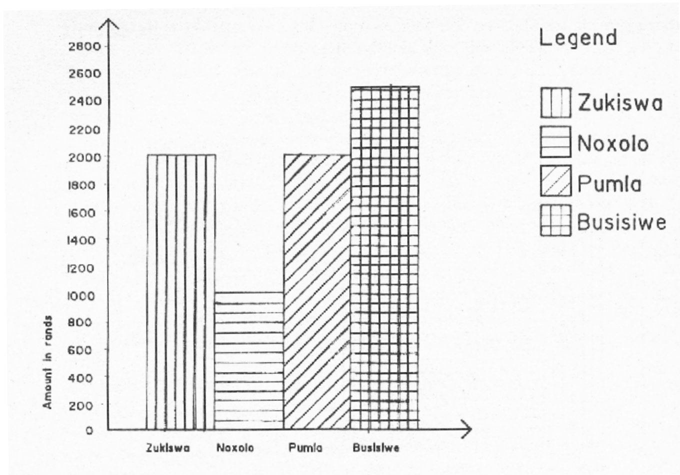
Figure 1

Bar charts are mostly used to compare facts. From this bar chart we can say that many of the workers walk to work while only a few go to work by car.

ACTIVITY 1

The weekly income of four friends is shown on the bar chart below. Use the chart to answer these questions:

1. Who earns the most per week?
2. Who earns the least per week?
3. Two of the friends earn the same amount per week. Who are they?



ANSWERS ON PAGE 94

Figure 2. Weekly income of four friends.

The first step in conducting a survey is to decide what questions you want to ask people, to ask the questions and to write down the answers.

The next step is to show the answers you get on a frequency table if it is possible and then on a chart. You can choose to show your results on a pie chart or a bar chart.

Averages and spread

You should also calculate the averages and the range of your results. This was dealt with in Unit 4, Lesson 7. Then you must interpret the values you get in your report. Let's re-look at the survey conducted by the farmer to study the way birds breed in a certain area. He counted the eggs found in the 20 different nests and got the following:

0	1	0	3	1	0	0	0	2	2
1	2	0	3	2	0	1	2	3	1

ACTIVITY 2

Find the range, the mode, the median and the mean of the number of eggs found in the nest and interpret your results.

Can you find the range, the mode, the median and the mean for the survey conducted by the transport officer of the firm? The answer is ‘no’. You do not have the right kind of information to do this. So you cannot always find the averages for your survey. In the surveys where the averages cannot be found you only have to represent your results on a chart and interpret them.

ANSWERS ON PAGE 94

Interpreting the results

When you have shown your statistics on a chart, and calculated the average, mean, mode and range, you need to interpret the results. You do this by writing a few sentences in which you explain in a general way what your survey has shown. You can also say why you think you got these results in your survey.

Summary of how you conducted your survey

You are now ready to carry out your own survey. You can do this in four stages.

Stage 1

Make a list of the topics you would like to investigate. The transport officer chose to find out how the workers of his firm come to work. You should choose topics that you are interested in and that will be easy to get information about. If you cannot think of a topic, here are some ideas:

- How many people in your street are in these age groups: 0 - 5, 6 - 12, 13 - 19, 20 - 50, 51 - 90?
- How many people in your street are employed full-time, part-time, unemployed, studying?
- How do you spend your money every month?
- What level of education do the people in your community have?

Stage 2

Decide how you will carry out the survey. You should decide:

- the number of people you will interview
- how to choose these people
- what questions you will ask.

Stage 3

Carry out your survey.
Go through all the steps explained in this lesson.

Stage 4

Write a report on your survey. The report should include:

- An explanation of what you planned to do.
- The problems you experienced, how you took your decisions and why you took those decisions.
- Charts and tables to show your results.
- Interpretation of your results.

Here's the report of the survey conducted by the transport officer of the small firm.

Example
A survey on how the workers of a firm come to work
My main aim for this survey is to find out how the workers of this firm come to work. I decided to interview the first 36 workers of the firm I met.

I asked each one of the 36 workers how they usually come to work. I had problems with some of the responses because some of the workers had more than one means of transportation. When this happened, I asked them how often they came to work by each means of transport. I chose the type of transport they use most often. I decided to put the information I got in a form of a table and this is what I got:

Means of transportation	Number of workers
Walk	13
Cycle	8
Bus	4
Train	9
Car	2
Total	36

I then represented the date on a pie chart, shown below, and a bar chart, shown earlier in this lesson.

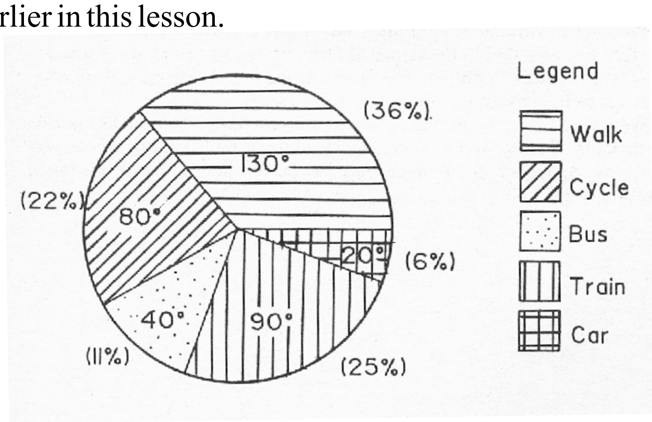


Figure 3

Interpretation of results

From the table and charts I concluded that many of the workers walked to work and only a few came to work by car. We should therefore try to find out if these workers like walking to work, or if they cannot afford the bus-fare. We should also find out if the workers who walk are tired and do their jobs less efficiently than the workers who use other forms of transport.

Summary

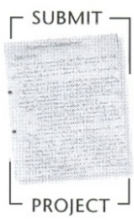
Hopefully you now know what statistics is all about and you will be able to interpret the statistics you see in the newspapers and the magazines. We hope you have enjoyed this lesson and the unit. The final lesson of this unit is the revision and consolidation lesson that follows.

Self-assessment checklist:

Are you able to:

- plan a statistical survey
- draw up a frequency table of your results
- calculate averages and spread of your results
- interpret the results
- present your findings in pie charts or bar charts.

SELF-CHECK EXERCISE



You are now ready to carry out your project. Choose a topic you are interested in or use one of the examples in this lesson and conduct a survey. Follow the steps shown in this lesson.

Write up all your results and a report, and send it in for assessment. Please remember to include your name, student number and this unit and lesson number with your report.

7. Revision and consolidation

Introduction

The objective of this final lesson is to revise and consolidate the skills you learnt in Unit 4 and to help prepare you for the exam. This is a 'test-yourself' lesson and the answers are not contained in this unit but in a separate booklet entitled 'Revision and consolidation answer booklet'.

Section A is revision of the whole unit combined to see that you are able to understand and integrate the various topics dealt with in the unit.

Section B is in an examination form and the questions are taken from previous Mathematical Literacy tests and exams. Try to stick to the time given in Section B to ensure that you are working fast enough. If you find that you are not able to finish, continue working through problems in the units so that your calculation and interpretation speed will improve. This will also help you improve your confidence, accuracy and timing in the examinations.

Summary of unit

In this unit we covered the following knowledge and skills:

- Finance
  - Payslips
  - Budgets
  - Inflation

- Patterns, relationships and representations including:
  - Graphs
  - Equations

- Measurement
  - Surface area and volume in context

- Data handling
  - Bar graphs
  - Conducting a survey

Section A

1. Write down a brief explanation of the following terms:
   a) a payslip
   b) a budget
   c) inflation
   d) CPI

2. Study the payslip and answer the questions that follow:

Bheka Books (PTY) LTD.				
PAYMENT ADVICE				
EMPLOYEE NAME			**November 2007**	
S.T. Tenza			Date of payment	25.11.07
			Tax number	044154
			Dependants	3
			Bank (name)	Red Bank
			Account no	26781
			Date of next payment	23.12.07
EARNINGS			**DEDUCTIONS**	
Description	**Taxable**	**Payable**	**Description**	**Amount**
Cash salary	R 15 771,93	R 15 771,93	Insurance: group life	R 389,61
Taxable (medical)	R 470,33	R 0,00	Insurance UIF	R 88,36
Taxable (car scheme)	R 1 585,42	R 0,00	Funeral premium	R 8,61
			Lifestyle premium	R 82,00
			Insurance: spouse	R 125,33
			Union membership	R 18,00
			Income tax (PAYE)	R 4 313,77
	R 17 827,68	R 15 771,93	**TOTAL DEDUCTIONS**	R 5 025,68
			NET PAY:	R 10 746,25

http://www.thutong.doe.gov.za/ResourceDownload.aspx?id=36152

a) On which date did Mr Tenza get paid in November 2007?
b) On which date did Mr Tenza get paid in December 2007?
c) How much is Mr Tenza's gross income?
d) How much is Mr Tenza's net income?
e) What percentage of his gross income does Mr Tenza take home as his net income?
f) In April 2008 Mr Tenza is given a 5% increase on his current gross salary. How much will he earn in April 2008?

3. On the next page is the monthly budget of Bayani, a student at university who waiters at a local pizza parlour on weekends. Answer the questions that follow.

a) How much pocket money does Bayani get each month from his parents?
b) What is Bayani's total income each month?
c) What fraction of his income does the pocket money make up?
d) What percentage of his income does the pocket money make up?
e) Bayani's current expenses are more than his income by R85. Write down two suggestions of how he can solve this problem so that his total income is more than his total expenditure.
f) If inflation remains constant at 8% per year, calculate what each of Bayani's variable expenses might be in a year's time.

FIXED EXPENSES	
transport	R 300
savings	R 70
rent	R 600
TOTAL FIXED EXPENSES	**R 970**
VARIABLE EXPENSES	
food	R 300
entertainment	R 180
clothes	R 220
stationery and books	R 80
TOTAL VARIABLE EXPENSES	**R 780**
TOTAL COSTS	**R 1 750**
INCOME	
pocket money from parents	R 200
earnings (as a waiter)	R 1 000
interest on savings	R 15
monthly bursary allowance	R 450
TOTAL INCOME	**R 1 665**
SHORTFALL	**-R 85**

4. Calculate the annual (yearly) CPI % (A E) for the following food products from June 2010 to June 2011.

Food item	June 2010	May 2011	June 2011	Annual %
Bread and cereals	104,1	112,6	113,0	A
Meat	106,4	115,8	116,3	B
Fish	116,4	115,9	116,9	C
Oils and fats	88,3	111,1	110,0	D
Sugar and sweets	119,8	130,6	130,4	E

5. If a television costs R4 200 and inflation remains constant at 7% per year, what will the price of the television be next year?

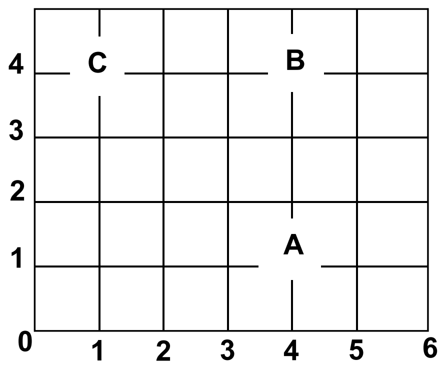
6. If house prices are increasing at 10% per year and your house is now worth R805 000, approximately how much will your house be worth in one year's time?

7. a) Work out the price index for each of the items in the table on the next page for 2006 and 2007, using 2005 as the base year. Round off your answers to one decimal place.

ITEM	AVERAGE PRICE 2005	AVERAGE PRICE 2006	AVERAGE PRICE 2007	2006 PRICE INDEX	2007 PRICE INDEX
12 Eggs	R9,80	R12,40	R13,60		
1 kg maize	R9,20	R11,30	R12,20		
1 litre milk	R4,90	R7,90	R8,40		
500 g tea	R6,50	R12,30	R15,00		

b) Which item had the highest price increase from 2005 – 2006? What was the price increase?
c) Which item had the highest percentage (PI) increase from 2005 – 2006? What was the percentage increase?
d) Which item had the highest price increase from 2006 – 2007? What was the price increase?
e) Which item had the highest percentage (PI) increase from 2006 – 2007? What was the percentage increase?
f) Which item had the lowest price increase from 2005 – 2006? What was the price increase?
g) Which item had the lowest percentage (PI) increase from 2005 – 2006? What was the percentage increase?
h) Which item had the lowest price increase from 2006 – 2007? What was the price increase?
i) Which item had the lowest percentage (PI) increase from 2006 – 2007? What was the percentage increase?

8. Answer the following questions based on the grid below.



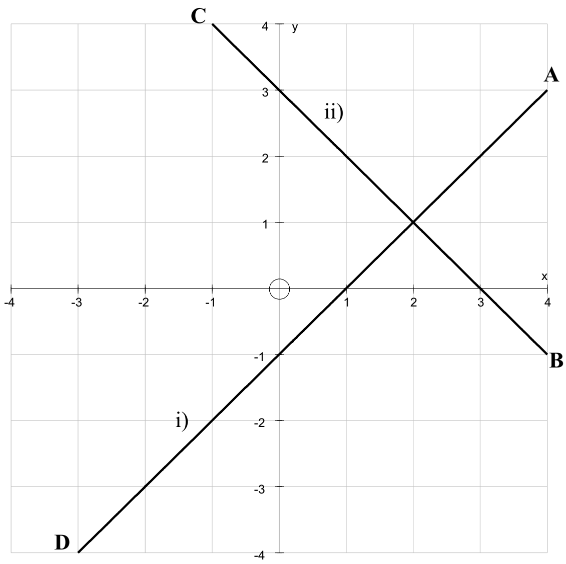
a) Fill in the missing co-ordinate; A(_____; 1)
b) Give the co-ordinates of B.
c) Give the co-ordinates of C.

9. Draw the following graphs on the same set of axes:
a) $x = 2$
b) $y = -1$

10. Complete the following table and then use the values to plot the necessary points to draw the graph.

x	1	2	3	4	5
y	2	4	6		

11. Given: $y = x - 1$ and $y = x + 3$



a) Write down which of the equations is for line:
i) and ii)

b) What is the y-intercept of line i)?

c) What is the gradient of line ii)?

d) Write down the coordinates of points A, B, C and D.

e) Find the point where the two lines intersect and write down the coordinates of this point.

f) Show that this point lies on both graphs by substituting the point into both equations and checking that the left hand side (LHS) is equal to the right hand side (RHS) of the equation .

12. Given: $y = x - 4$

a) Write down the y-intercept (where $x = 0$)

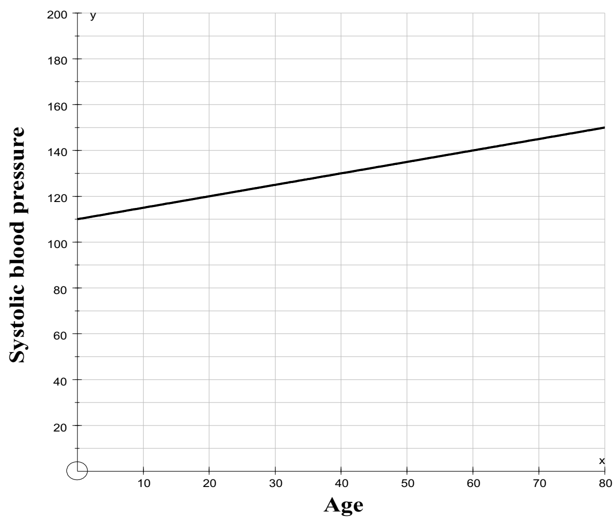
b) Write down the x-intercept (where $y = 0$)

c) Use a table to assist you to draw the graph

d) Read from the graph the y co-ordinate of the point at which $x = 2$.

e) Read the x co-ordinate of the point at which $y = 1$.

13. The graph below illustrates an adult's systolic (top) blood-pressure in millimetres, and is determined by the equation $y = 110 + \frac{1}{2}x$, where x is the person's age in years.



a) If a person is 40 years old, what should their systolic blood pressure be?
b) If that same person's blood pressure is 165 after working through Unit 5, what can you deduce from that?
c) A person's blood pressure is normal and measures 120. What is the approximate age of the person?
d) At 30 years of age, what should your systolic blood pressure be?

14. Sophie rents out umbrellas on a Durban beach at R10 per hour.
a) Copy and complete the following table.

Time (hours)	1	2	3	4	5	6	7	8
Cost of umbrella	10	20						

b) How much does it cost to rent one umbrella for 6 hours?
c) How much does it cost to rent one umbrella from 12h00 to 16h00?
d) How much will it cost Tsepang to rent two umbrellas for 8 hours?
e) If it costs R70 to rent one umbrella, how many hours did the person rent it for?

15. For which values of x are the following statements true?
a) $x+4+2x=3x+4$
b) $x+2=x-5$
c) $x+2=7$

16. Solve the following equations:
a) $x+9=20$
b) $2x=16$
c) $5x+5=x+1$
d) $2+x=x-1$
e) $2(x+1)=x-8$
f) $3(x-2)+1=4(2x+1)$

17. Given that: $\frac{x}{2}+\frac{1}{4}=\frac{3}{4}$, then $x=\ldots$

A) 3
B) 1
C) 2
D) 0

18. This table shows the estimated building costs for the different floor areas. Similar tables are used by some building contractors to give quotations.

Floor area (m^2)	1	2	3	4	5	6	7	8
Building cost (R)	450	900						

a) Complete this equation for finding the building costs of various areas in R per m^2.
Cost $=$ Area $\times$ ________
b) Calculate the estimated cost of a classroom with an area of 168 m^2.

c) A school is building a gymnasium with an area of 576 m^2. Use the formula and find the estimated cost of the building.

d) The estimated building cost for a certain building is R145 800,00. Use the formula to find the floor area.

19. Translate the following statements into equations. Then solve the equations to find the number.

Example: A certain number plus 8 is equal to three times that certain number. What is the number?
$x + 8 = 3x$

a) The sum of a certain number and 4 is equal to 10. What is the number?

b) A certain number minus 4 is equal to 9. Find the certain number.

c) A certain number increased by 9 is equal to three times the certain number. Calculate the number.

d) The sum of 5 and a certain number is equal to the sum of double the certain number and 10. What is the certain number?

e) When you add 5 to a certain number, multiply your answer by 4 and then add 6, you get 30. Find the number.

20. The length of a rectangle is 2 metres longer than the width. If the perimeter of the rectangle is 24 cm, calculate the length and width of the rectangle.

21. The length of an Olympic pool is 50 m, the width 16 m and the depth 3 m.

a) If the pool has 8 lanes, what is the width of each lane?

b) A boundary rope was placed around the pool. Calculate the length of the rope.

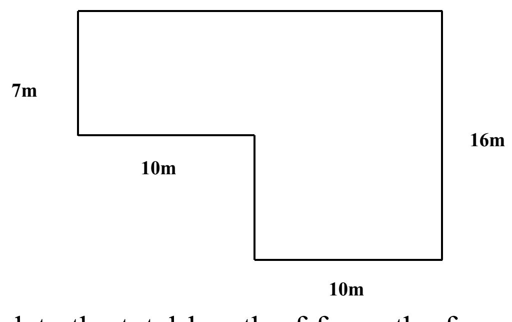
c) Calculate the volume of the pool.

22. The Olympic soccer field is 100 m by 50 m.

a) What is the area of the field?

b) Give half the area of the soccer field in cm^2

23. A farmer wants to fence-off a field. The dimensions of the field are shown in the diagram below.

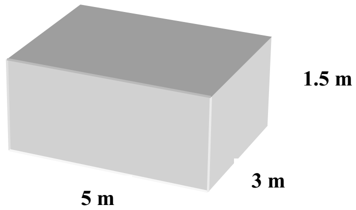


a) Calculate the total length of fence the farmer will need to buy.

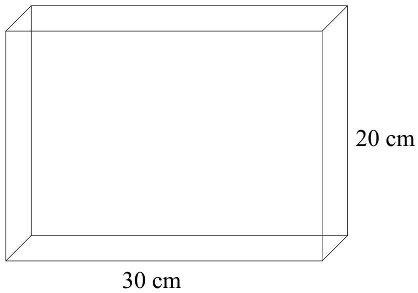
b) The fencing costs R 23,50 per metre. Calculate the total cost for fencing the field.

c) Calculate the total area the farmer will fence off.

d) The farmer places a rectangular shaped drinking trough in the field. The dimensions of the drinking trough are shown in the diagram below. What is the volume of this trough?



24. Mr Wesley owns a pizza take-away shop. He packs his pizzas in a box measuring 30 cm in length and 20 cm in width.



a) Is the box he uses 2-dimensional or 3-dimensional? Explain your answer.

b) Calculate the perimeter of the box?

c) Calculate the volume of the box if it is 5 cm thick.

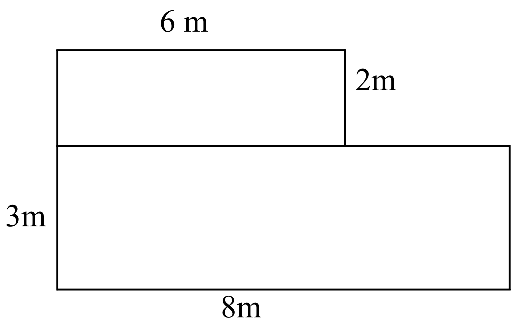
d) Mr Wesley sells maxi pizzas which are cut into eight slices. How many slices of pizza are there in half a maxi pizza?

e) How many slices are there in a quarter of a maxi pizza?

f) Mr Wesley uses motorbikes, with special delivery containers on the back, to make his pizza deliveries. How many of the pizza boxes shown above can Mr Wesley fit into a motorbike delivery container if the dimensions of the delivery container are:

$$0{,}5 \text{ m} \times 0{,}6 \text{ m} \times 0{,}3 \text{ m?}$$

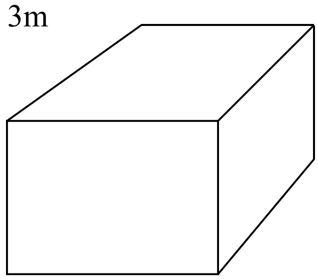
25. Daniel wants to tile his kitchen floor. The floor plan of the kitchen is presented below.



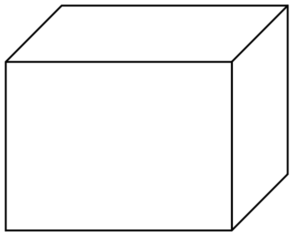
a) Calculate the area of the kitchen.

b) Daniel finds tiles that he likes at 'Tons of Tiles' which cost R56,40 per m^2. How much will it cost Daniel to buy enough tiles to cover his kitchen floor?

26. Find the volume of the back of this cargo truck indicated below.



27. The height of this box is 5 m, the width is 3 m and the length is three times the width. Calculate the volume of the box.



28. Two learners wrote four mathematics tests. The following information was taken from their results. Draw a bar graph to represent this information.

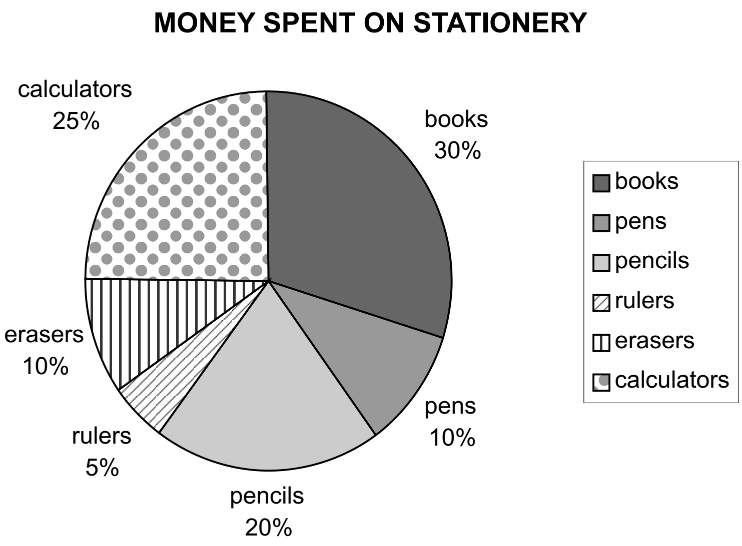
Peter 's results:	Test 1	20 sums correct
	Test 2	15 sums correct
	Test 3	14 sums correct
	Test 4	11 sums correct
Zodwa 's results:	Test 1	18 sums correct
	Test 2	17 sums correct
	Test 3	19 sums correct
	Test 4	18 sums correct

29. A high school of 600 students had a survey of their sports activities. The following information was collected.

Sport	**Participants**	**Males**	**Females**
Rugby	240	240	0
Hockey	120	40	80
Swimming	60	32	28
Cricket	180	146	34

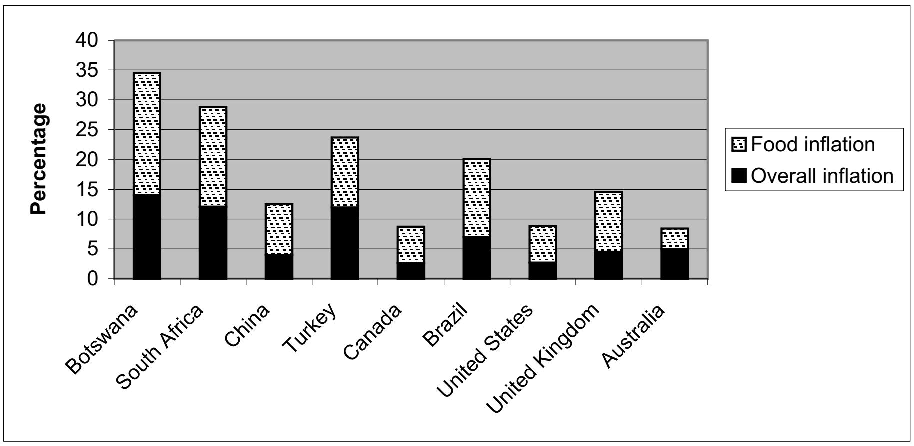
a) Draw a grouped bar graph of this data.
b) Draw a composite bar graph of this data.

30. Pelo had R1 000 to spend on stationery. This is how he spent it.



a) How much money was spent on books?
b) What percentage of the money was spent on rulers?
c) What cost the least amount of money?
d) What cost the most money and how much was it?
e) If Pelo bought 5 calculators, what was the cost of each calculator?
f) Draw a horizontal bar graph from the information in the pie chart.

31. The graph below compares the overall inflation of certain countries to the food inflation in 2008. Answer the questions that follow.



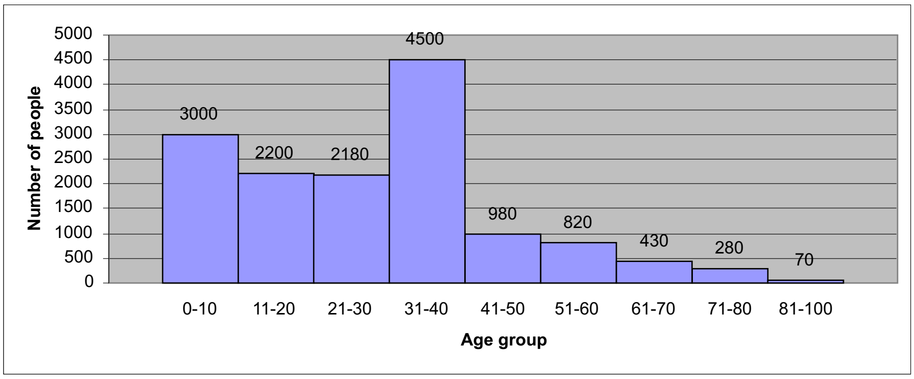
a) Was food inflation generally higher or lower than the overall inflation of these countries in 2008?
b) Which one of these countries had the highest overall inflation in 2008?
c) Which one of the countries had the lowest overall inflation in 2008?
d) Which one of these countries had the highest food inflation in 2008?

e) Which one of the countries had the lowest food inflation in 2008?

f) What is the ranking of South Africa compared to these other countries in the overall inflation?

32. In 2011 a terrible drought forced many Somalians to flee as refugees to Kenya. In one of the camps the following numbers of people in the various age groups were recorded for food distribution purposes.

 a) How many people were there recorded in the refugee camp?
 b) How many people were from 11 to 30 years old?
 c) How many people in this refugee camp were older than 50?
 d) How many people were younger than 31?
 e) If it costs approximately R100 to feed someone under 11 years old for one month, how much money is needed to feed a group of 0 - 10 year olds for 6 months?



Section B

Time: 3 hours
Marks: 150

QUESTION 1 **[35]**

1.1 Calculate the following. Write down the answers only.

1.1.1 $\frac{1}{10}$ of 17 000 (2)

1.1.2 $260 + 75 \times 2$ (1)

1.1.3 $6 \times \frac{2}{3} + 15 \times \frac{1}{3}$ (2)

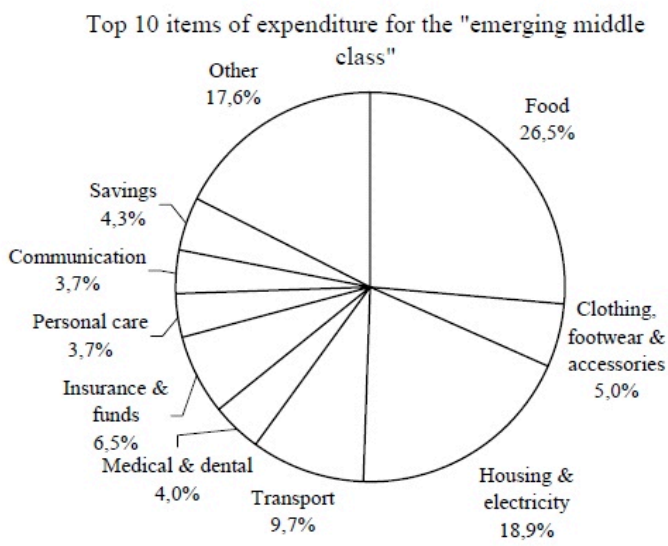
1.1.4 $(2{,}3 + 3{,}7) \div 0{,}6$ (1)

1.2 There are 11 people in a soccer team. There are 49 boys in Grade 11 at MM high school who play soccer.

1.2.1 What is the maximum number of soccer teams that can be made? (2)

1.2.2 The ratio of soccer players to non-soccer players in Grade 11is 1 : 3. What is the total number of learners in Grade 11? (2)

1.3 Luka works for a hotel chain and earns a net income of R7009,51 per month. According to market researchers, people in Luka's income bracket typically spend their money as shown in the pie chart below.



Assume that Luka's money is spent as shown in the graph and calculate, to the nearest Rand, how much of Luka's net salary of R7009,51 is spent on the following each month: (8)

a) food
b) clothing, footwear and accessories
c) housing and electricity
d) transport

1.4 The table below lists the change in CPI for the groups listed from 2006 to 2007.

Determine the missing values of a - e in the table, you need only write down the values and show your calculations. (10)

Expenditure group	Typical monthly spend by Luka in January 2006	Percentage change in CPI for expenditure group	Anticipated monthly spend by Luka in January 2007
Food	See answer in 1.3	9,3 %	a
Clothing, footwear and accessories	See answer in 1.3	–10,9 %	b
Housing and electricity	See answer in 1.3	9,2 %	c
Transport	See answer in 1.3	6,8 %	d
Medical and dental	R280,00	5,6 %	R296,00
Insurance and funds	456,00	-	R480,00
Personal care	R259,00	5,0 %	R272,00
Communication	R259,00	0,2 %	R260,00
Savings	R301,00	-	R395,00
Other	R1 234,00	6,9 %	R1 319,00
	R7 003,00	-	e

1.5 Calculate the percentage change in total expenses for Luka from 2006 to 2007. (4)

1.6 Luka's gross annual salary is currently R97 575,00. Luka's employer offers Luka an 'inflation-linked' salary increase of 5 % for 2007. What will Luka's monthly gross income be after the increase? (3)

QUESTION 2 [14]

A herbal medicine dosage pamphlet gives the following rule for determining a child's dosage in terms of the adult dosage.

<u>Young's rule:</u> Divide the child's age by the child's age plus 12.

Example: dosage for a 4 year old:

4 divided by (4 + 12) = $\frac{4}{16} = \frac{1}{4}$ or 0,25 of the adult dosage.

Answer the questions that follow which refer to doses of herbal medicine using this formula.

2.1 What fraction of an adult dosage must a 12 year old take? (3)
2.2 If the adult dosage of a certain medicine is 60 drops, how many drops should an eight year old child be given? (5)
2.3 A mother gives her child 4 drops of medicine. The adult dosage is 20 drops. How old is the child? (6)

QUESTION 3 **[30]**

World Vision (www.worldvision.org) tells the story of Liber, a six year old Bolivian boy, who was forced, together with his family, to flee his home as a result of flooding. He and his family have taken up temporary accommodation in a camp with some 300 other people. Liber and his family lost everything as a result of the flood. To help his family make ends meet, Liber and his father Esteban get up at 6 a.m. each morning to purchase bulk ice cream supplies, which they bring back to the camp in a white cart. They spend the rest of the day pushing the cart around selling ice cream.

Thabo lives in Johannesburg and is exploring selling ice cream in order to pay for his college fees. He has established the following information.

EXPENSES

- R3 000,00 monthly payment for the first 12 months to pay for the bicycle and franchise fee.
- R3,50 per ice-cream to the company.
- R0,50 franchise fee per ice-cream to the company.
- R25,00 per day for the block of ice that he uses to keep the container cold.

INCOME

- R10,00 per ice-cream that he sells.

3.1 Identify Thabo's fixed monthly costs. (1)
3.2 Identify Thabo's variable costs. (2)
3.3 Identify Thabo's source(s) of income and classify it as a fixed or variable. (2)
3.4 Show that Thabo's variable expenses for a day on which 30 he sells ice-creams is R160. (3)
3.5 Now complete the table below. Only write down the values of a, b and c and your working for each value. (6)

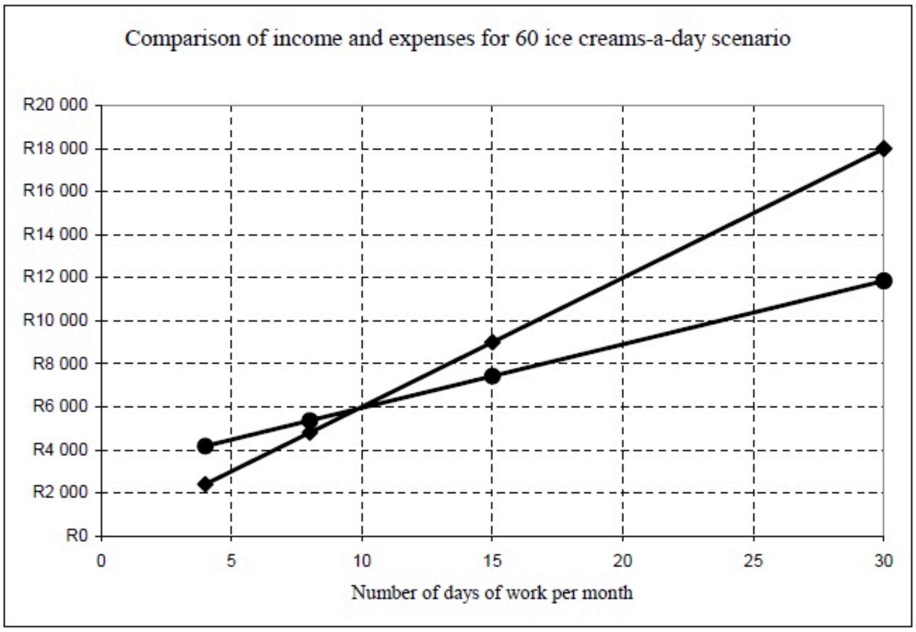
Monthly expenses				
No. of days worked in the month	4	8	15	30
30 ice-creams sold per day	R3 640,00	a	b	c
60 ice-creams sold per day	R4 180,00	R5 360,00	R7 425,00	R11 850,00

3.6 Complete the following table. Only write down the values of a, b and c and your working for each value. (6)

Monthly income				
No. of days worked in the month	4	8	15	30
30 ice-creams sold per day	R1 200,00	a	b	c
60 ice-creams sold per day	R2 400,00	R4 800,00	R9 000,00	R18 000,00

3.7 Thabo has used the values from the tables above to draw the graph below to compare the monthly income and expenses for the 60 ice-creams-a-day scenario.

Draw a similar graph for the 30 ice-creams-a-day scenario. (6)



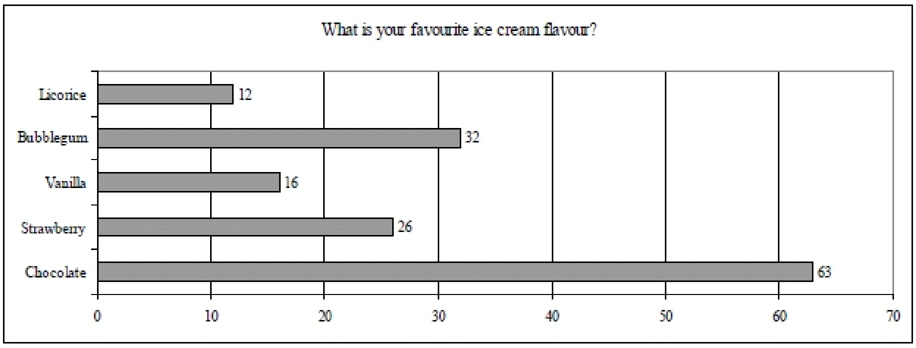
3.8 Use your graph and Thabo's graph above to answer the following questions.

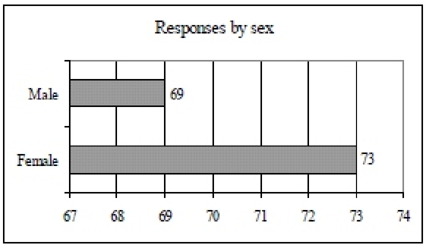
3.8.1 Roughly how many days should Thabo work in order to cover his expenses in each scenario? (2)

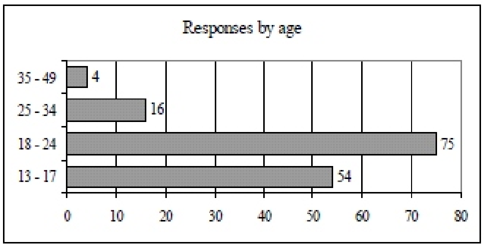
3.8.2 Roughly how many days should Thabo work for each scenario to make a profit of at least R2 000,00 per month? (2)

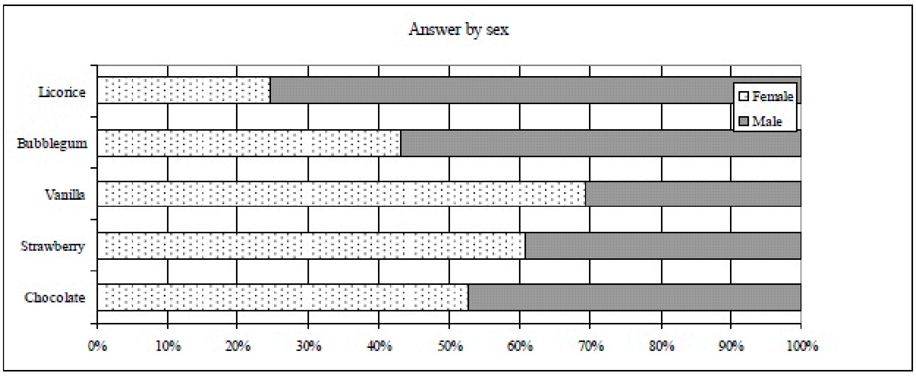
QUESTION 4 **[29]**

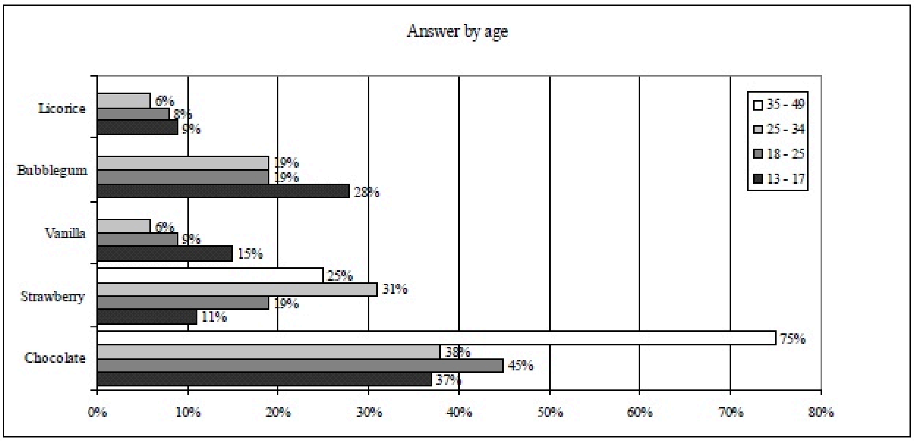
In order to assist him in planning which flavours of ice-cream to buy, Thabo conducted a survey. The results are shown below. The questions that follow are based on the information in these graphs.











4.1 How many people participated in the survey according to the graphs above?
4.1.1 'What is your favourite ice-cream flavour'
4.1.2 'Responses by sex'
4.1.3 'Responses by age' (3)

4.2 Suggest a possible reason for the difference between the number of participants in these graphs. (1)

4.3 Why is the 'Response by sex' graph misleading? What impression does it create? What is this the result of? (4)

4.4 From the survey it appears that 35+ year olds do not like bubble gum flavoured ice-cream. By referring to the sample size comment on how reliable you think this observation is? (2)

4.5 Thabo has used a compound bar graph to represent the 'Answer by sex' data.
What has he gained and what has he lost by doing this instead of using a bar graph as he has in the other graphs? (2)

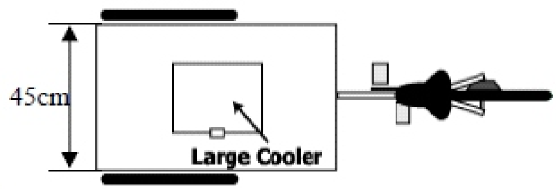
4.6 Use the information provided to determine the actual number of respondents by age for chocolate and strawberry ice-creams. Then draw a bar graph of 'Answer by age' based on actual numbers. (8)

4.7 Compare the two representations of 'Answer by age' data and identify an advantage or disadvantage of each representation. (4)

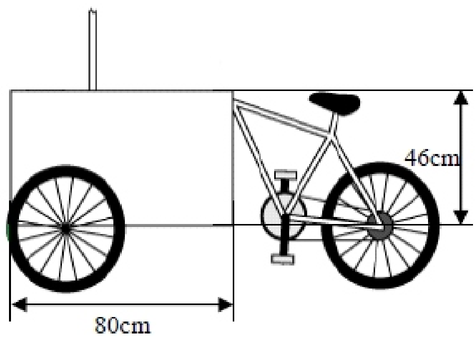
4.8 Thabo buys the ice-creams in boxes of 24 ice-creams. He has enough money to buy 20 boxes which he keeps in a freezer at his home. Use the data collected in this survey to help him decide on how many boxes of each flavour he should buy. (6)

QUESTION 5 **[19]**

A drawing of Thabo's bicycle appears below with the dimensions of the cooler box marked.



Top View



Side View

5.1 If the cooler box is drawn to scale, determine the dimensions of the lid of the cooler box. Show all working. (5)

5.2 If the walls of the cooler box are 8 cm thick to ensure good insulation, what are the internal (inside) dimensions of the cooler box? (4)

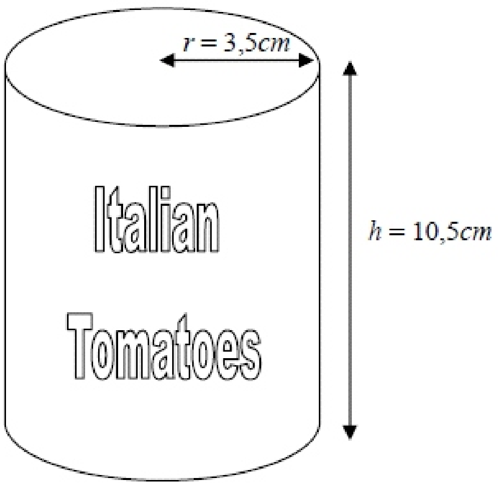
The ice-creams that are sold by the company come in tubs with a diameter of 7 cm and a height of 5,4 cm.

5.3 Use the formula for the volume of a cylinder (volume $=\pi \times r^2 \times h$) to show that the tubs can hold the 200 ml of ice-cream marked on the side of the tub.
Use $\pi = 3,14$ (4)

5.4 If Thabo places a single ice block with dimensions 20 cm × 20 cm × 20 cm in the cooler box at the start of each day, estimate showing detailed calculations and/or diagrams how many ice-cream tubs will still be able to fit inside the cooler box. (6)

QUESTION 6 **[11]**

Below is a diagram of a tin of Italian tomatoes. The label is pasted around the tin but does not overlap at all. The radius of the tin is 3,5 cm and the height of the tin is 10,5 cm.



Use the following to answer the questions below:
$\pi = 3,14$
Volume of cylinder $= \pi \times r^2 \times h$
Circumference of a circle $= 2 \times \pi \times r$

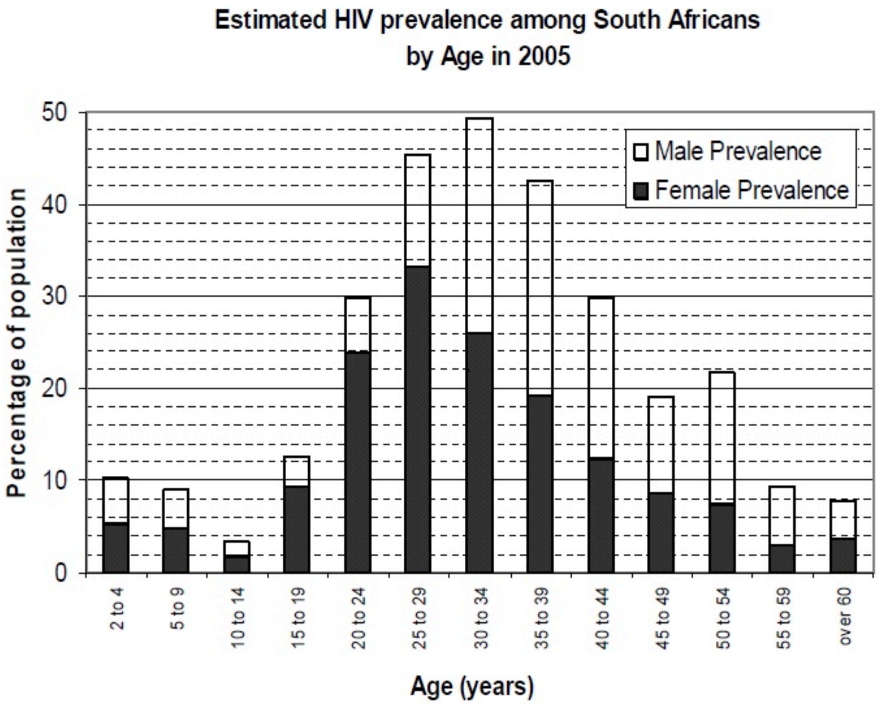
6.1 Calculate the volume of the tin? (3)

6.2 Determine the length and breadth of the label. (3)

6.3 If the dimensions of the sheet of printing paper are 75 cm by 65 cm, determine the maximum number of labels that can be printed on one sheet. (5)

QUESTION 7 **[12]**

A number of people from each age group listed below were tested for HIV in 2005. Use the information in the bar chart below to answer the questions that follow.



SOUTH AFRICAN NATIONAL HIV SURVEY, 2005. http://www.avert.org/safricastats.htm

7.1 Which age group had the highest prevalence of HIV in 2005? (1)

7.2 Amongst which two age groups was the HIV prevalence the same? (2)

7.3 Amongst which age group was HIV most prevalent in woman? (2)

7.4 If 132 people were tested in the age group between 15 and 19 years, calculate how many people in this age group were HIV positive in 2005, according to this survey. (3)

7.5 Compare the prevalence of HIV in men and women aged between 25 and 29. (4)

Feedback to self-check exercises

Lesson 1

1. A = R5 602,30
   B = R233,65
   C = R5 368,65

2. A = R4 386,40
   B = R3 306,00
   C = R7 692,40
   D = R5 852,20

3. a)

Index description			June 2010	June 2011	Yearly % change
Health			119,8	126,4	5,5
	medical products		119,5	123,5	3,3
	medical services		120,0	128,1	6,8
Transport			102,4	108,0	5,5
	purchase of vehicles		102,1	101,0	–1,1
	private transport operation		98,3	116,4	18,4
		petrol	93,5	113,5	21,4
		other costs	117,8	128,1	8,7
	public transport		109,6	118,8	8,4

   b) 5,5%
   c) 5,5%
   d) i. petrol
      ii. medical products
   e) Purchase of vehicles. The worldwide economy crisis meant fewer people were buying cars. And perhaps the increasing cost of petrol.
   f) Private transport. The inflation was higher overall even though the purchase of vehicles CPI decreased.

Lesson 2

1. To find the best place to hang a picture, look for the vertical distance from the ground and the horizontal distance from the edge of the wall.

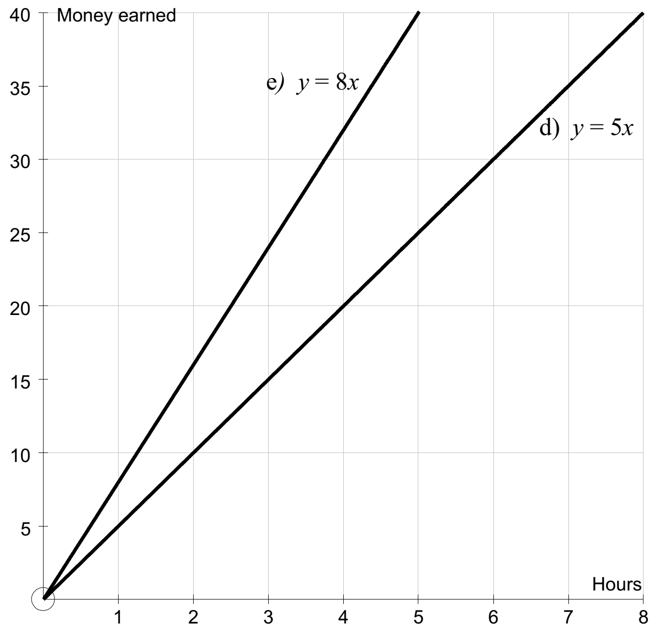
   On paper we can represent the vertical distance and the horizontal distance by using a drawing.

   On a graph we can represent the relationship between two things like time and money. One we can represent on the horizontal axis and the other on the vertical axis.

2. a)

Time worked	1	2	3	4	5	6	7	8
Base rate	5	10	15	20	25	30	35	40

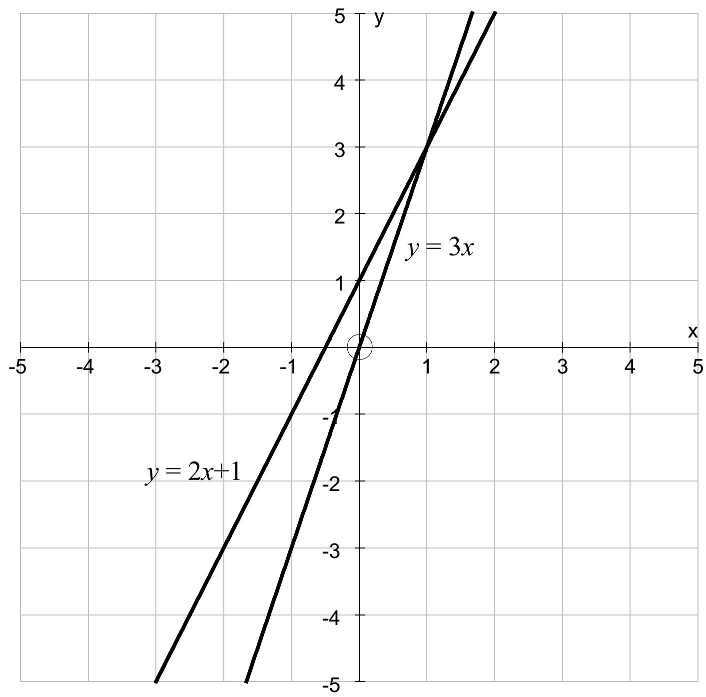
b) and c)



3.

x	–2	–1	0	+1	+2
$y = 3x$	–6	– 3	0	+3	+6

x	–2	–1	0	+1	+2
$2x$	–4	–2	0	2	4
$y = 2x + 1$	–3	–1	1	3	5



a) (1; 3)

b) $y = 3x$

LHS = y = 3

RHS = $3x = 3(1) = 3$

Therefore LHS = RHS so this point lies on this graph.

$y = 2x + 1$

LHS = y = 3

RHS = $2x + 1 = 2(1) + 1 = 3$

Therefore LHS = RHS so this point also lies on this graph.

Lesson 3

1. a) $x = 12$

   b) $x = 4\frac{1}{2}$

   c) $x = 5$

   d) $x = 2\frac{1}{2}$

   e) $4x - 3 = x + 15$
   $4x - x = 18$
   $3x = 18$
   $x = 6$

   f) $3(2x - 1) = 9$
   $6x - 3 = 9$
   $6x = 12$
   $x = 2$

   g) $3x + 8x - 4 = 6 - 4x + 5$
   $15x = 15$
   $x = 1$

2. Let x be the length of the rectangle
   Then $x - 1$ is the breadth
   P $= x + x - 1 + x + x - 1$
   $= 4x - 2$
   but P = 38 m
   $\therefore$ $4x - 2 = 38$
   $4x = 40$
   $x = 10$
   $\therefore$ the length is 10 metres and the breadth is 9 metres

3. Let the breadth be x
   $\therefore$ the length is $2x$
   $\therefore$ $2x + x + 2x + x = 24$ m
   $6x = 24$
   $x = 4$
   $\therefore$ The breadth is 4 m and the length is 8 m.

Lesson 4

1. a) 100 cm^2
   b) 100 tiles for 1 m^2
   c) Area of wall $= 1{,}8\text{ m} \times 2{,}4\text{ m} = 4{,}32\text{ m}^2$
      To cover 1 m^2 we need 100 tiles
      To cover $4{,}32\text{ m}^2$ we need $100 \times 4{,}32 = 432$ tiles

   d) 5 boxes
      $5 \times \text{R}400$
      $= \text{R}2000{,}00$

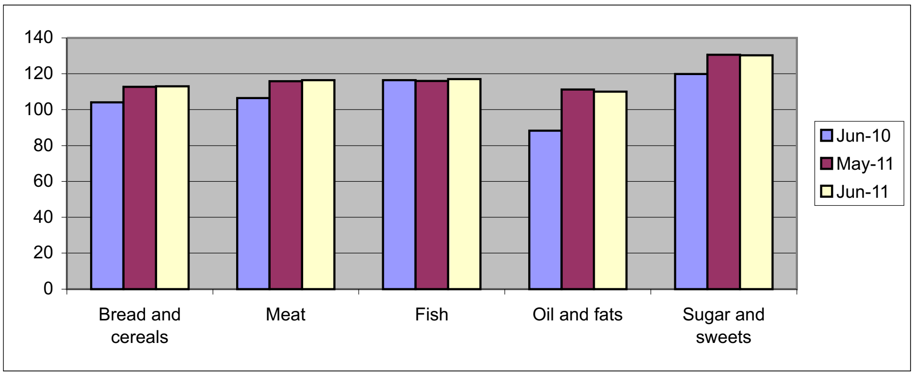
   e) 5 tubes cost R100
   f) Total cost $= \text{R}2000{,}00 + \text{R}100 = \text{R}2100{,}00$

2. a) 60 sugar cubes
   b) 5 layers
   c) 300
   d) 300 cm^3
   e) Volume of box $= 150\,000\text{ cm}^3$
      Volume of small box $= 300\text{ cm}^3$
      No. of boxes =

$$\frac{\text{volume of box}}{\text{volume of small box}} = \frac{150000}{300} = 500\text{ boxes}$$

Lesson 5

1.



2. a) Sugar and sweets
   b) Fish

Feedback from Activities

Lesson 1

Activity 1

1. R10 889,55
2. R12 657,70
3. R1 768,15 for his medical and pension schemes.

4. R78,90 for UIF (unemployment insurance fund)
   R------ for income tax
   R13,92 for funeral premium
   R102,40 for life insurance fund

5. R12 657,70 × 12 = R151 892,40
   Annual income tax:
   R25 200 + 25% of (R151 892,40 – R140 000)
   = R25 200 + 25% of R11 892,40
   = R25 200 + R2 973,10
   = R28 173,10
   Monthly income tax: R28 173,10 ÷ 12 = R2 347,76

6. Total deductions:
   R78,90 + R2 347,76 + R13,92 + R102,40 = R2 542,98

7. Net salary = Gross salary – total deductions
   = R12 657,70 – R2 542,98
   = R10 114,72

Activity 3

1. R10 686,80
2. R6 400,55
3.

Expense	Amount
Fixed expenses	
Rent	R4 500,00
School fees	R2 200,00
Children's pocket money	R 500,00
Car payments	R3 486,80
Total	***R10 686,80***
Variable expenses	
Electricity	R 487,90
Water	R 330,50
Petrol	R 800,00
Groceries	R2 500,00
Telephone Zahir	R 189,00
Telephone Imran	R 477,00
Pre-paid internet	R 289,00
Fashion account	R 280,00
Credit card account	R 300,00
Bank charges	R 180,00
Insurance	R 567,15
Total	***R6 400,55***
Income	
Zahir	R4 780,60
Imran	R16 654,80
Total income	**R21 435,40**
Total expenditure	**R17 087,35**
Total remaining	R 4 348,05

4. The Khan's have R4 348,05 remaining in August 2011.

5. It is a good situation to be able to have remaining money each month but this amount does not leave too much available in case anything goes wrong, for example additional medical bills or car expenses.

6. Car expenses, medical costs, clothes, holidays, school tours, etc.

7. They could try to cut R100 off their electricity and water accounts. And try to bring down Imran's telephone bill by R100. They could also try to use less internet so that the R289,00 will last them two months rather than one month. And if they can reduce their grocery bill to R2 000 (for example buy less meat each month), they could save R5 000 a month.

Activity 5

1. 6.9%
2. 2 years
3. Consumer Price Index.
4. Between 3% and 6%
5. 9.3%
6. Not until 2004
7. The Rand's rapid depreciation
8. From September 2003 to 2005
9. 6.6%
10. 4.3%

Activity 6

1. R3,70
2. R3,40
3. White bread:

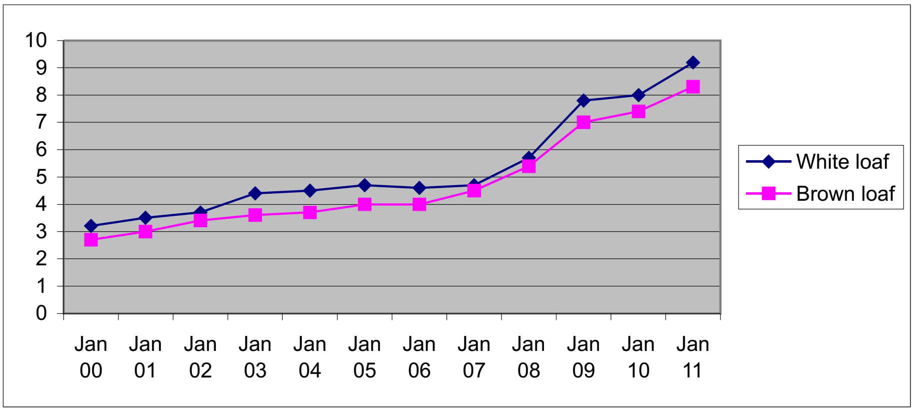
$$PI = \frac{\text{New price}}{\text{Old price}} \times 100 = \frac{4,70}{3,70} \times 100 = 1,27 \times 100 = 127\%$$

Brown bread:

$$PI = \frac{\text{New price}}{\text{Old price}} \times 100 = \frac{4,00}{3,40} \times 100 = 1,176 \times 100 = 117,6\%$$

4. White bread

5.

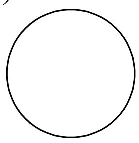
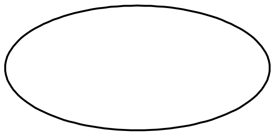
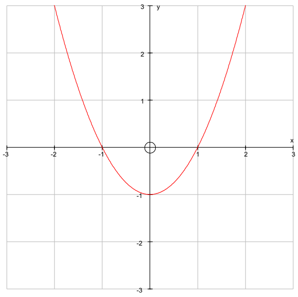


Lesson 2

Activity 1

Ship B is 75 degrees east of the Greenwich Meridian, and 30 degrees south of the equator.
Ship C is 60 degrees east, and 15 degrees north.
Ship D is 60 degrees west and 30 degrees north.

Activity 2

1. a)  b)  c) 

2. Here are some examples. You may have thought of different ones.
   Circles: clock, wheels, the earth.
   Ellipses: the path of the earth around the sun.
   Parabolas: the path of a cannon ball, or of a ball through the air.

3. a) one
   b) two

Activity 3

1. a) When $x = -2$ then $y = -1$
   $x = -1$ then $y = 0$
   $x = 0$ then $y = 1$
   $x = 1$ then $y = 2$
   In each case the y-value is the x-value + 1
   $\therefore$ the equation is $y = x + 1$

   b) When $x = -2$ then $y = -6$
   $x = 1$ then $y = 3$
   $x = 0$ then $y = 0$
   $x = -1$ then $y = -3$
   We see a pattern here and the pattern is $y = 3x$
   $\therefore$ the equation is $y = 3x$

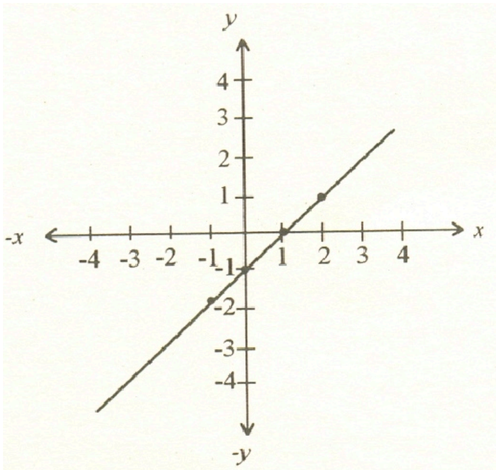
2. a) Draw up a table.

x					
y					

Fill in some x-values.

x	-2	-1	0	1	2
y					

Ask yourself:
In the equation $y = x - 1$
if $x = 0$ then $y = -1$
if $x = 1$ then $y = 0$
if $x = 2$ then $y = 1$
if $x = -1$ then $y = -2$
if $x = -2$ then $y = -3$
Complete the table then draw the graph.



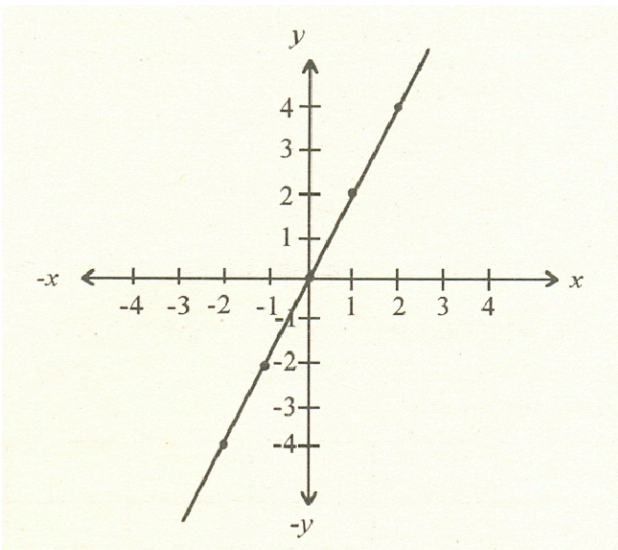
b) Follow the same steps.
Draw up a table.

x					
y					

Fill in some x-values.

x	-2	-1	0	1	2
y					

Ask yourself:
In the equation $y = 2x$
if $x = 0$ then $y = 2(0) = 0$
if $x = 1$ then $y = 2(1) = 2$



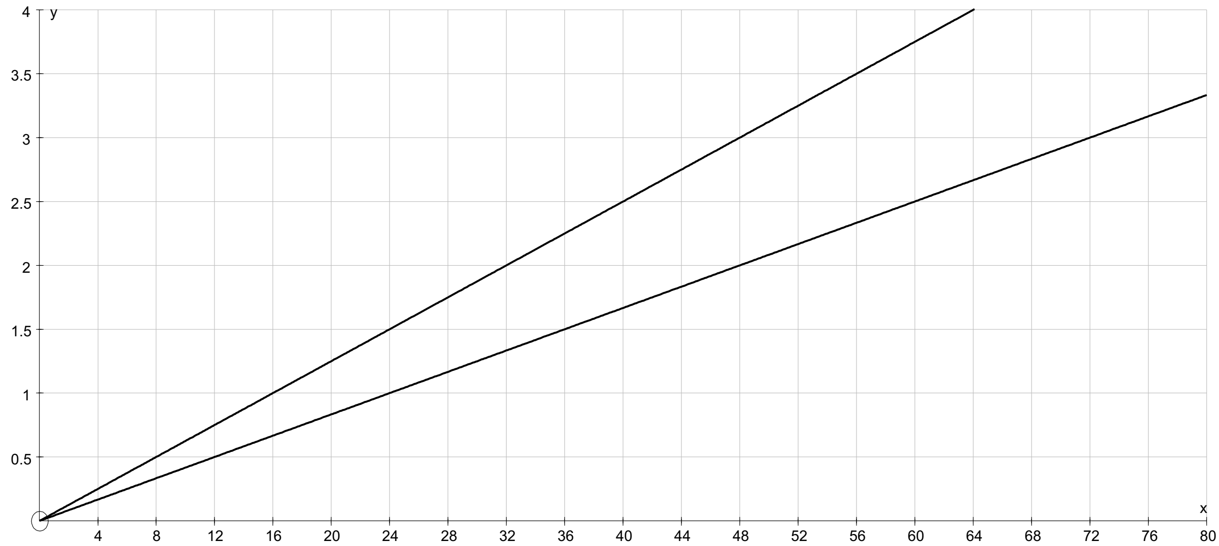
Activity 4

First coat

Litres	1	2	3	4
metres^2	16	32	48	64

Second coat

Litres	1	2	3	4
metres^2	24	48	72	96



Now the situation is much clearer.

1. Find 36 m2 on the horizontal axis. Move vertically up to the line which says first coat. Then move horizontally to find how many litres are necessary for a first coat. The answer is $2\frac{1}{4}$ litres.

   For the second coat move vertically from the 36 m^2 mark to the second coat graph. Then move horizontally to find the number of litres needed. $1,5 = 1\frac{1}{2}$ litres are needed. In total Jo would need $2\frac{1}{4}+1\frac{1}{2}=3\frac{3}{4}$ litres of paint. So he should buy 4 litres of paint.

2. For 48 m^2, you need 3 litres for the first coat and 2 litres for the second coat. So you need 5 litres of paint.

Lesson 3

Activity 1

In solving any equation we ask ourselves the question: 'For what value of *x* is the equation true?'

1. $x = 9$. The only value for *x* which makes the equation true is 9. If we substitute 9 in the place of *x*, the answer will be 12 which is correct. $9 + 3 = 12$. Any other number in the place of *x* will make the equation false.

   OR $x \xrightarrow{+3} 12$, $12 \xrightarrow{-3} x$

   $12 - 3 = 9$

2. $x = 13$. The value for x which makes the equation true is 13. $13 - 5 = 8$. Any other number substituted in the place of x will make it wrong.

   OR $x \underset{+5}{\overset{-5}{\rightleftarrows}} 8$ $\quad 8 + 5 = 13$

3. $x = 7$. We ask ourselves, 'What value of x will make this equation true?' If we substitute 7 in the place of x, the equation will be true.

   OR $x \underset{\div 3}{\overset{\times 3}{\rightleftarrows}} 21$ $\quad 21 \div 3 = 7$

4. $x = 8$
5. $x = 12$

6. $x = 4$. Think to yourself: 2 times a number + 1 = 9. What's the number?

   OR $x \underset{\div 2}{\overset{\times 2}{\rightleftarrows}} \underset{-1}{\overset{+1}{\rightleftarrows}} 9$ $\quad 9 - 1 = 8$
   $8 \div 2 = 4$

7. $x = 6$

8. $x = 3\frac{1}{2}$

Activity 2

1. If $x = 8$ then $3 - x = -5$ is **true.**

2. $2x + 1 = 2x + 3$ cannot be true. Whatever value we put in place of x the statement is **false.**

3. $x + 3x - 5 + 1 = 4x - 4$ is true for all values of x. Whatever value you put in the place of x will make the statement true therefore it is an *identity*.
   An equation that is true for all the values of the variable is called an identity

4. $3x - 1 = \frac{1}{3}x - 1$ is only **true** if $x = 0$.

5. $2x + 4 = 2(x + 2)$ is true for all values of x therefore it is an **identity.**

Activity 3

Remember that you can check your solution by substituting your solution in the place of the symbol.

1. $2x + 3 = 11$
   $2x = 11 - 3$
   $2x = 8$
   $x = \frac{8}{2}$
   $x = 4$

2. $3x - 5 = 16$
   $3x = 16 + 5$
   $x = \frac{21}{3}$
   $x = 7$

3. $4x-3=21$
$4x=21+3$
$x=\frac{24}{4}$
$x=6$

4. $3x+2=5$
$3x=5-2$
$x=\frac{3}{3}$
$x=1$

5. $2x+1=4$
$2x=3$
$x=\frac{3}{2}$

(You can leave your answer as an improper fraction or a mixed number.)

6. $5x+2=2$
$5x=0$
$x=0$ (If 5 times a number is equal to 0, the number must be 0.)

7. If there are any x's on the right, get rid of them by adding or subtracting, but remember that whatever you do to the right you must also do to the left.
Solve $5x-3=2x+4$
Subtract $2x$ from both sides: $3x-3=4$
Add 3 to both sides: $3x=7$
Divide both sides by 3: $x=\frac{7}{3}$

Activity 4

1. $4x-3=x+12$
$4x-3-x=12$ (subtract x from both sides)
$4x-x=12+3$ (add 3 to both sides)
$3x=15$
$x=5$ (divide both sides by 3)

2. $5x-2=3x+8$
$5x-3x=3x+8$
$2x=10$
$x=5$

3. $3x-8=x+7$
$3x-x=8+7$
$2x=15$
$x=\frac{15}{2}$ or $x=7\frac{1}{2}$

4. $5x+2=3-6x$
$5x+6x=3-2$
$11x=1$
$x=\frac{1}{11}$

5. If the equation has brackets, multiply them out first.

$3(2x-1)=4x-3+2x$

$6x-3=6x-3$

On the left we have multiplied both terms inside the bracket by 3. On the right we have added like terms together. Now we see that the above is an identity. For every value of *x* the equation is true.

Activity 5

1. $5(2x-7)+6=2(x+1)-7$ (multiply out the brackets)

$10x-35+6=2x+2-7$ (collect like terms on either side)

$10x-29=2x-5$

$10x-2x=29-5$

$8x=24$

$x=3$

2. $2(3x+1)-7=3(2-x)-2$

$6x+2-7=6-3x-2$

$6x-5=4-3x$

$6x+3x=4+5$

$9x=9$

$x=\frac{9}{9}$

$x=1$

3. $3x+4(2x-1)=2(3-2x)+5$

$3x+8x-4=6-4x+5$

$11x-4=-4x+11$

$11x+4x=11+4$

$15x=15$

$x=\frac{15}{15}$

$x=1$

4. $4(9x-3)=6+5(6x+3)$

$36x-12=6+30x+15$

$36x-12=30x+21$

$36x-30x=21+12$

$6x=33$

$x=\frac{33}{6}=\frac{11}{2}$

5. $5(x-2)-17=3(3x-4)-7x$

$5x-10-17=9x-12-7x$

$5x-27=2x-12$

$5x-2x=12+27$

$3x=15$

$x=5$

6. $2(3x-1)=4x-3+2x$
$6x-2=6x-3$ Note that this statement is false.
$6x-6x=3+2$
$0=1$
This is impossible so it means that there is no solution.

Activity 6

1. Let the number, which is unknown, be x.
Add 5: $x+5$
Multiply by 6: $6(x+5)$
Subtract 2: $6(x+5)-2$
Answer is 40: $6(x+5)-2=40$

Then solve the equation:
$6x+30-2=40$
$6x+28=40$
$6x=40-28$
$6x=12$
$x=2$

2. Let the number be x
When you add 36 to a number it becomes 5 times bigger.
"It becomes" is another way of saying "is equal to".
$x+36=5x$
$x-5x=-36$
$4x=-36$
$4x=+36$ (multiply both sides by -1)
$x=9$
The number is 9

3. Let the number be x
$5x-15=2x$
$5x-2x=15$
$3x=15$
$x=5$
The number is 5

Activity 7

1. A man is equal to nine times his son's age.
Let the son's age be x.
The man's age is $9x$.
In four year's time the man will be $9x+4$.
The son's age in 4 year's time will be $x+4$.
In four years time the man will be five times as old as the son.
$9x+4=5(x+4)$
Solve the equation.
$9x+4=5x+20$
$9x-5x=20-4$
$4x=16$
$x=4$
The son's age is 4.

Let's see if this is right.
The son's age is 4.
The man's age is 36 which is 9×4.
In 4 year's time the son will be $4 + 4$ which is 8.
In 4 year's time the man will be 40 which is 5×8.
Therefore it is right.

2. What don't we know? We don't know the number of cattle Robert owns.
Let's call the cattle Robert owns x.
So Jim has $3x$.
If Jim gives Robert 17 cattle, Robert will have $x + 17$ cattle and Jim will have $3x - 17$.
Now Jim will have twice as many as Robert.

What is equal?
$3x - 17 = 2(x + 17)$
$3x - 17 = 2x + 34$
$3x - 2x = 34 + 17$
$x = 51$

So Robert has 51 cattle.

Lesson 4

Activity 1

Take the walls one at a time.

A $4 \times 3 = 12\text{m}^2$
B $5 \times 3 = 15\text{m}^2$
C $4 \times 3 = 12\text{m}^2$
D $5 \times 3 = 15\text{m}^2$

Total 54m^2

Note: There are many ways of doing this.

Activity 2

	Estimate	**Actual Area**
Wall A	6 m^2	7,70 m^2
Wall B	8 m^2	9,24 m^2
Wall C	6 m^2	7,70 m^2
Wall D	8 m	9,24 m^2
Total	28 m^2	33,88 m^2

Activity 3

There are many different approaches to solving this problem. Ask a painter how he works out how much paint he needs. You might have your own method. This is one method.

Step 1: Find the total area.		
	Area	= length × breadth
	Length	= 4,2 + 3,5 + 4,2 + 3,5
		= 15,4 m
	Breadth/Height	= 2,7 m
(Estimate)	Area	= 15 × 3 = 45 m^2
(Working accurately)	Area	= 15,4 m × 2,7 m
		= 41,58 m^2

Step 2: Find the area which is not to be painted.

Area of door:	0,8 × 1,8	= 1,44 m^2
Area of window:	1,5 × 1	= 1,5 m^2
Area of window:	1,5 × 1	= 1,5 m^2
Total:	4,44 m^2	

Step 3: Subtract area not to be painted from total area.
41,58 m^2 – 4,44 m = 37,14 m^2

Activity 4

a) $1\frac{3}{4}l$ b) $3\frac{1}{8}l$ c) $3\frac{3}{4}l$

Activity 5

1. R940
2. R1780
3. R840

4. The more expensive paint may be of better quality. It might be interesting to check what kind of paint builders and painters recommend.

5. There may be alternatives to paint. What methods were used in the past? Are there advantages to using whitewash? Wallpaper is an option. Some people use cloth coverings.

Activity 6

a) van A: 6 m^3
van B: 36 m^3
van C: 7,5 m^3

b) 450 cm^3
3 600 cm^3
1 200 cm^3

c) Change brown loaf into m^3:
0,15 m × 0,12 m × 0,2 m
V = 0,0036 m^3
number of loaves = $\frac{\text{volume of truck}}{\text{volume of loaf}} = \frac{36\ m^2}{0,0036} = \frac{360\ 000}{36} = 10\ 000$

Activity 7

Cotton wool; bread; tea leaves; plastic; flour; soap; milk; bricks; steel (There may be variations depending on the types of plastic, soap, bricks, etc.).

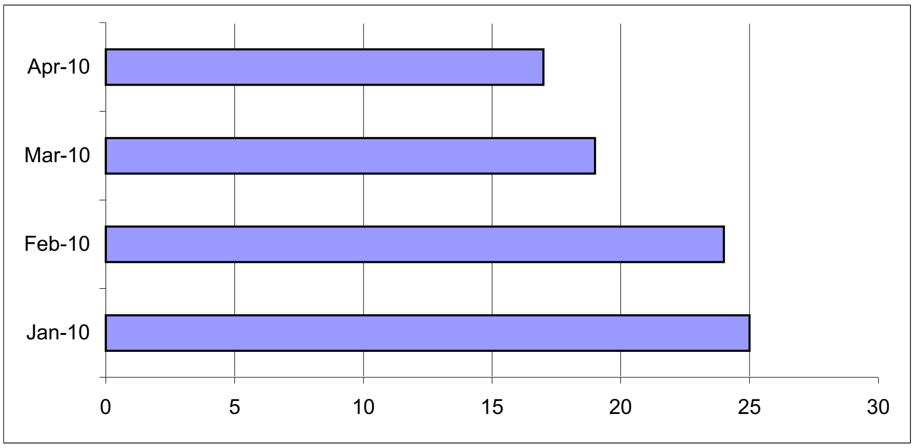
Activity 8

1. Remember the volume of a cylinder is

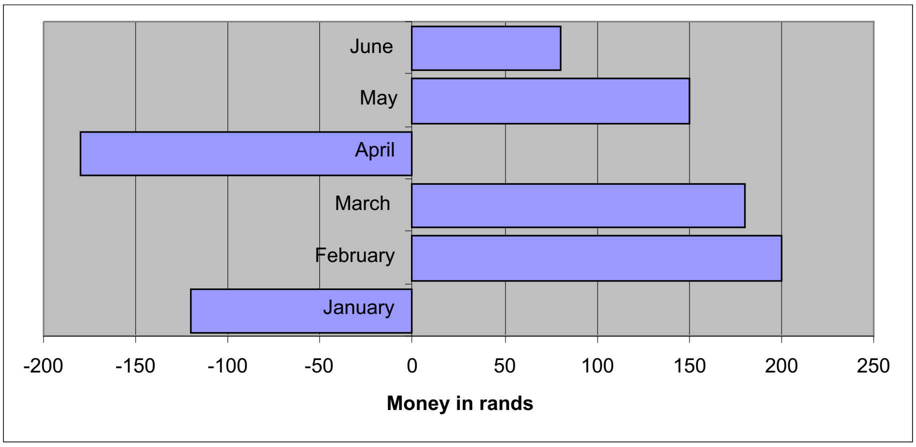
   a) Volume of can of beans: $\pi \times 4 \times 4 \times 6 = 301{,}6\ cm^3$
   b) Volume of can of tomatoes: $\pi \times 5 \times 5 \times 10 = 785{,}5\ cm^3$
   c) Volume of can of pineapple: $\pi \times 6 \times 6 \times 8 = 904{,}9\ cm^3$

Lesson 5

Activity 1



Activity 2



2. a) February. R300
   b) April. Approximately R280
   c) Probably due to holiday periods.
   d) R50
   e) Approximately R40

Activity 3

1. a) February, April, May and June.
   b) January and April
   c) Vejay. R300. In February.
   d) Vejay. April. R280 or we could write –R280.

Activity 4

1. 51-55 range. 10 students
2. 61-65. 1 student.
3. $4 + 6 + 10 + 6 + 1 = 27$ students
4. $6 + 4 + 3 = 13$ students
5. $4 + 6 + 10 + 6 = 26$ students
6. $10 + 6 + 1 = 17$ students scored above 50 marks.
   30 students wrote the test.

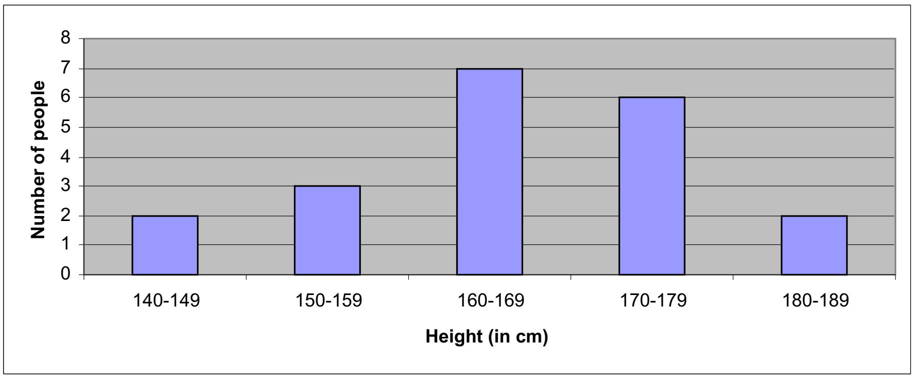
   So $\frac{17}{30} \times 100 = 56{,}666... \approx 57\%$ students scored more than 50 marks.

Activity 5

1.

Height (cm)	Tally	Frequency
140-149	||	2
150-159	|||	3
160-169	𝍸 ||	7
170-179	𝍸 |	6
180-189	||	2

2.

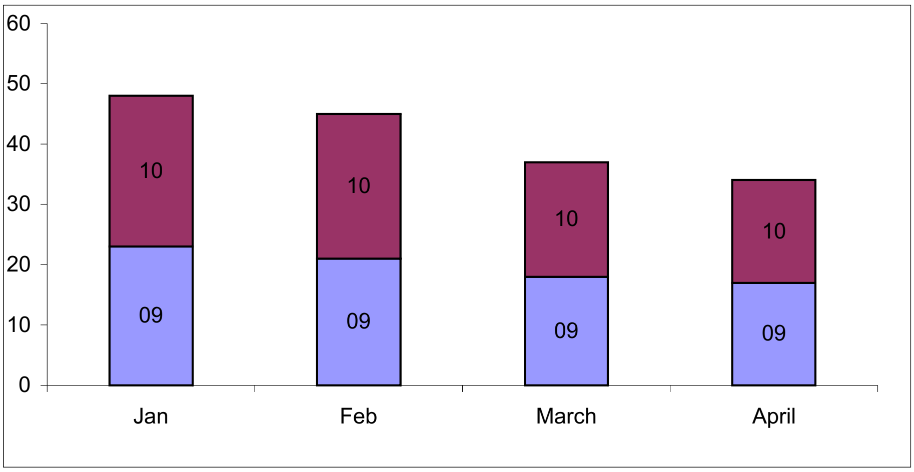


Activity 6

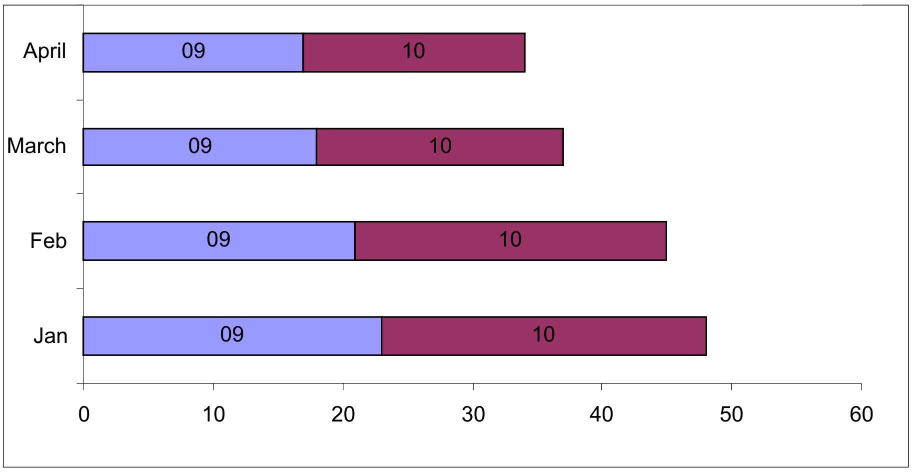
1. Social services
2. Other
3. 2006
4. 2009

Activity 7

1.



2.



2. A grouped bar graph is easier to read in terms of the context of weather as it is easier to immediately see the comparison between the temperatures. With the composite bar graph you have to do some subtraction to find the temperatures in 2010, making this a more difficult graph to read for this context.

Lesson 6

Activity 1

1. Busisiwe
2. Noxolo
3. Zukiswa and Pumla

Activity 2

We had this frequency table from Activity 6 of lesson 7 in Unit 2:

Number of eggs	Frequency
0	7
1	5
2	5
3	3
Total	20

From this we see that:

1. The range is 3 – 0 = 3. This means that the nest with the largest number of eggs contained 3 eggs and the nest with the lowest number of eggs had no eggs.

2. The mode is 0. This means that there were more nests with no eggs than any of the nests with eggs.

3. The median is 1. This means if you arrange the nests from the ones with no eggs to the ones with 3 eggs, the middle nest will contain 1 egg.

4. The mean is:

$$\frac{7 \times 0 + 1 \times 5 + 2 \times 5 + 3 \times 3}{20}$$

$$= \frac{0 + 5 + 10 + 9}{20} = \frac{24}{20} = 1{,}2$$

As you only get whole eggs (and not decimal parts of an egg), this means that the farmer is likely to find on average 1 egg in each nest at the beginning of the breeding season.