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GR 9

MATHS

STUDY GUIDE

TEACHER/STUDENT

1ST PRINT RUN 2008

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Introduction

Mathematics, Queen and servant of the sciences. In fact, Mathematics is queen and servant of pretty much everything. It is, therefore, important for the learner to appreciate this subject and give it the attention it deserves. It is at this stage that you reach the ***crossroad;*** a stage at which you must decide if you will ***continue with Mathematics in Grade 10*** or switch over to Mathematical Literacy. This is a decision that should not and will not be taken lightly. A number of factors inform this decision. Your love (or lack thereof) of the subject, your attitude, your aptitude, your enthusiasm, determination and work ethic play a big role in this choice. However, your envisaged post-school career choice will play probably the biggest role. You should bear in mind that **entrance requirements** for certain degrees like **medicine, engineering, financial mathematics, accounting, require a good mark in Grade 12 Mathematics at higher grade.** It is therefore imperative that you take your work seriously in Grade 9 for a sound grounding to make the **passage to the FET band an easy one.**

One important issue we need to highlight is that Grade 8 and Grade 9 should be viewed as one grade spread over two years. The work done in Grade 9 just continues where Grade 8 left off. Consequently, in this study guide, you will see that some of the exercises require only skills and knowledge that were acquired in Grade 8.

In the course of your studies and everyday life, you make use of many natural resources and interact with the environment and other people; your fellow learners, family, friends and compatriots. The people you interact with and the resources you use make it easier to achieve your goals. It is, therefore important that you respect and appreciate them. Ensure that you take care of the environment by trying as much as possible to use recyclable materials and do not litter by disposing of waste appropriately. Respect the opinions of other people and their constitutional rights.

Mathematics is fun and should be enjoyed. To ensure success you not only work hard but also work smart. If you plan and manage your time properly, you will see that there is more than ample time for studying. You will need to do maths everyday to ensure success. Good luck and enjoy your schoolwork.

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1. Real Numbers

The set of real numbers consists of the rational numbers and the irrational numbers.

- A rational number is any real number x that can be written as a quotient of two integers with the denominator being nonzero, that is $x = \frac{a}{b}$, where a and b are integers with $b \neq 0$.
- Rational numbers include all integers and numbers that contain fractions whose decimal equivalent has finite decimals or have recurring (repeating) decimals.
- An irrational number is a real number that cannot be written in the form $\frac{a}{b}$ where a and b are integers.
- Irrational numbers have nonrecurring infinite decimals.

Exercise 1

1. Consider the following numbers. Determine which are rational numbers and which are irrational numbers.

$$-5, \frac{2}{3}, \pi, \sqrt{2}, 200, \sqrt[7]{99}$$

2. Convert to decimal fractions

a. $\frac{2}{3}$

b. $\frac{123}{78}$

3. Write the following numbers as common fractions

a. $0.\dot{3}$

b. $0.\dot{6}\dot{5}$

c. $2.\dot{4}7\dot{3}$

4. Approximate, correct to two decimal places, the following irrational numbers by rational numbers.

a. $\sqrt[3]{7}$

b. π

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2. Exponents

In the expression a^x, we call a^x a power of a, a is the base and x is the *exponent* or *index.*

Definitions

1. $a^n = a \times a \times ... \times a$, n factors.
2. $a^{-n} = \frac{1}{a^n}$
3. $a^0 = 1$

Laws of exponents

1. $a^x \times a^y = a^{x+y}$
2. $\frac{a^x}{a^y} = a^{x-y}$
3. $(ab)^x = a^x b^x$
4. $(a^x)^y = a^{xy}$

Scientific Notation

As with very large numbers, very small numbers can be expressed in scientific notation.

$$127000000 = 1.27 \times 10^8$$

For example, $0.000237 = 2.37 \times 10^{-4}$

$$-0.00000000000052 = -5.2 \times 10^{-13}$$

Exercise 2

1. Simplify the following

   a. $x^3 x^7$
   b. $3x \times 21x^2$
   c. $(2^{-2})^4$
   d. $(x^2)^5$
   e. $(x^3)^2 \times (x^2)^{-3}$
   f. $\frac{(8x^2)(-4xy^3)}{(-4xy)^2}$

2. Write in scientific notation

   a. 256000000000
   b. 0.00000000832

3. Write as decimals without using a calculator

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a. 2.345×10^{6}
b. -1.26×10^{-3}

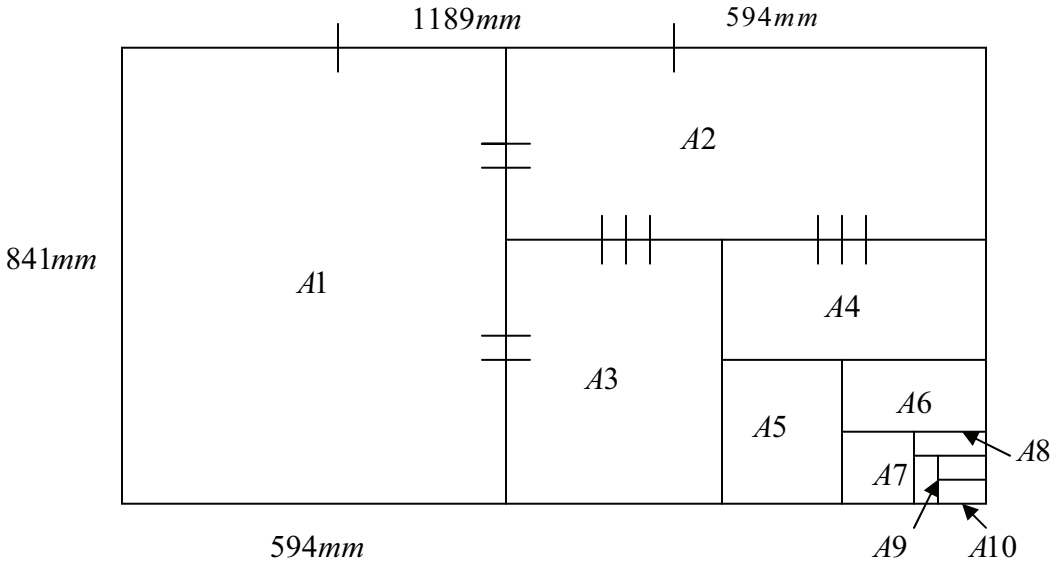
4. Use scientific notation to evaluate the following, without the aid of a calculator. Write your answer in decimal notation.

a. $\left(5.32\times10^{4}\right)-\left(1.67\times10^{4}\right)$
b. $\left(2\times10^{-4}\right)\times\left(5\times10^{-6}\right)$
c. $\left(4.6\times10^{-6}\right)+\left(1.43\times10^{-5}\right)$

5. Simplify

a. $\sqrt{x^{8}y^{10}}$
b. $\sqrt{x^{-2}y^{-4}}$
c. $\sqrt[3]{8\times10^{-6}}$

6. Sheets of paper are provided in standard sizes. The sizes, from the largest to the smallest are A0, A1, A2, A3, A4, A5, A6, A7, A8, A9 and A10. With A0 being the largest, each of the smaller sheets is cut from the A0 sheet as illustrated in the diagram below:



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The size of an A0 sheet of paper is $1189mm$ long and $841mm$ wide and size of an A1 sheet of paper is $594mm$ wide and $841mm$ long. After dividing each side in half, any $0.5mm$ pieces that are left over are disregarded, allowing for trimming.

a. How many of each size of sheet of paper can be cut from one A0 sheet?
b. What fraction of an A0 sheet is each size?
c. Calculate the dimensions of each paper size. Disregard any $0.5mm$ pieces.

7. Calculate the area of each paper size in mm^2 and in m^2, writing your answers in scientific notation correct to two decimal places.

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3. Algebra

1. Note the following with algebraic expressions:
   - Terms with the same powers of the variables are called **like terms**, e.g. x and $-7x$ are *like* terms, $6x^3y^2$ and $10x^3y^2$ are also *like* terms, while $-xy^2$ and x^2y are *unlike* terms.
   - An expression is simplified by adding and/or subtracting like terms.
   - Unlike terms cannot be added together or subtracted from each other.
   - We may simplify an expression by applying the "reverse" of the distributive property, i.e. by taking out a common factor.
2. To multiply two binomials we use the "**FOIL**" method.

Exercise 3

1. Subtract $x^2-3xy-5$ from $3x^2-2x+4xy^2+6xy$
2. Simplify the following expressions:
   a. $1-\left(3x^2y+2xy^2-xy\right)+\left(4xy-xy^2\right)+2xy$
   b. $3x^2+2x+3x^2-\left(x^2-x\right)$
3. Find the products and simplify where necessary:
   a. $(3x-2y)(-3x)-3x(x+y)-3xy$
   b. $(x+1)(x+2)$
   c. $(x+4)(x-6)$
   d. $(3x-2)(5x+1)$
   e. $(3x-2y)^2$
4. Factorise:
   a. $48xy^2-16y^2z^3-32xyz^2$
   b. $x(2x-1)-3(2x-1)$
   c. x^2-121
   d. $25x^2-49y^2$
   e. $2-8(x+1)^2$
   f. $2(x+1)^2-8(x-3)^2$
5. Factorise completely:
   a. $36x^2+25$
   b. $9x^2+3x$
   c. xy^2-xz^2

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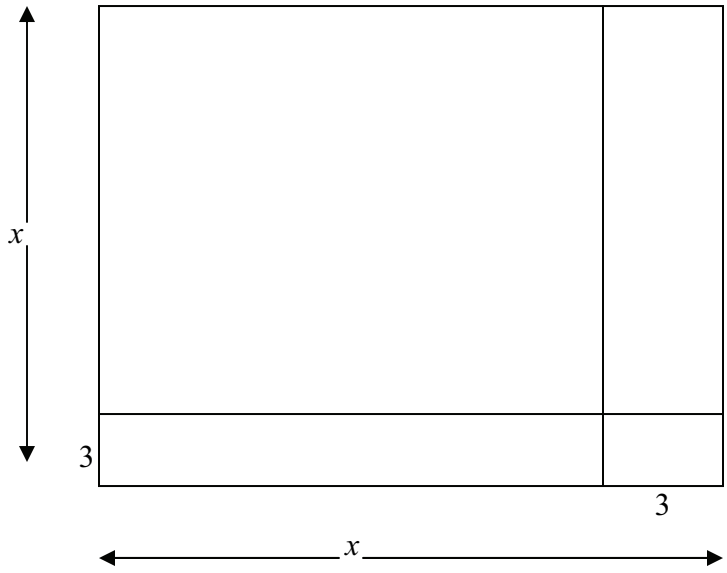
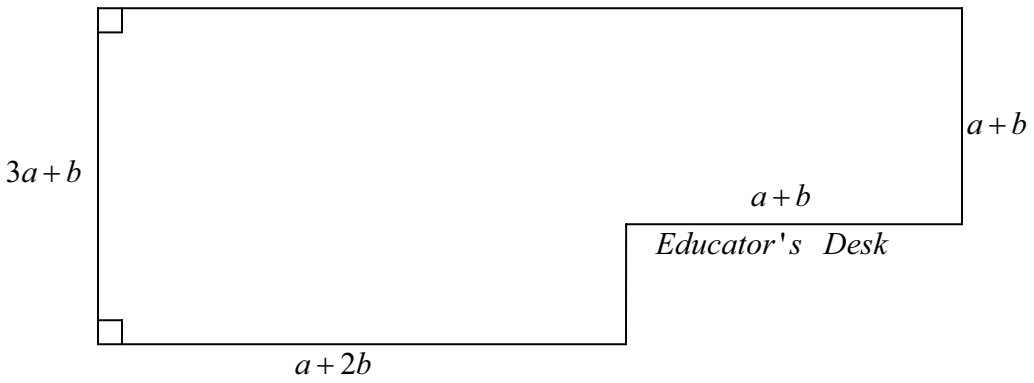
d. $36x^2 - 16x^2y^2 - 4x^2z^2$

6. Consider the diagram below and use it to show that $(x-3)^2 = x^2 - 6x + 9$:



7. A general plan and dimensions of a classroom are given in the diagram below, with a space for the educator's cut out at the side. Give an expression for the area that is available for learners to be seated.



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4. Equations

1. An equation is a mathematical statement that two expressions are equal. For example, $3x = 2$.
2. A solution or root of the equation is a value of the variable which makes the equation true. The process of finding such a value is called solving the equation. In the example above, the solution of the equation is $x = \frac{2}{3}$.
3. An equation in which the variable has exponent 1 is called a linear equation.
4. An equation in which the highest index of the variable is 2 and there are no negative or fractional indices is called a quadratic equation. For example, $x^2 - 3x + 2 = 0$ is a quadratic equation.
5. To solve a quadratic equation, we first factorise the expression and then use the rule: if the product of two or more numbers is zero, then at least one of the numbers must be zero. In symbols, if $ab = 0$ then $a = 0$ or $b = 0$.
6. Remember the following points when solving equations:
   - If the equation is linear, ensure that the expression containing the variable is on the left hand side

Note that it is possible for an equation not have a solution. That is, there is no value for the value that will make the equation true. Examples are $x + 3 = x - 2$ and $\frac{1}{x} = 0$

Exercise 4

1. Solve the following equations. Verify your answers by substituting into the equation to see if the value you found makes the equation true.
   a. $3x = 36$
   b. $2x + 3 = 5$
   c. $9 - 3x = 6$
   d. $21 = 8y - 11$
   e. $\frac{y}{7} - 3 = 1$
   f. $3x + 5 = x + 9$
   g. $3(x - 4) + 5 = x + 3$
   h. $4(x - 1) + 2(2x - 3) - 2 = 15 - x + 3(3 - x)$

2. Find the roots of the following equations, if they exist. If a root does not exist, explain why.
   a. $\frac{1}{2}x = -x + 1$

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b. $\frac{t}{3}+\frac{1}{2}=\frac{-t}{6}-\frac{1}{2}$

c. $\frac{y}{2}-2(y-1)=\frac{4y+7}{2}+2$

d. $\frac{2x-4}{6}-3=\frac{x}{3}-\frac{1}{3}$

3. Solve the following nonlinear equations

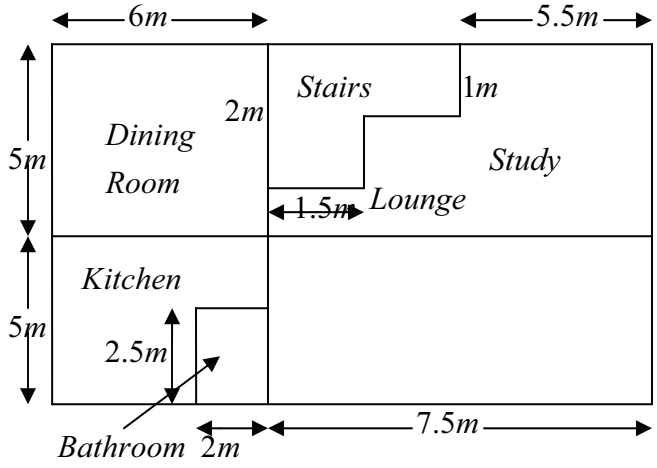
   a. $x(x-1)=0$

   b. $x^2-4=0$

   c. $16x^2=4$

   d. $(x-1)(x+1)(x-6)=0$

4. A man's age is 25 more than his son's age. If 3 years ago the man was 30 years old, find the ages of the man and his son.
5. Piet uses a certain type of lawnmower to mow a large field. It takes him five hours to mow the entire field. Now, Sally uses a larger mower and can mow a similarly sized field in three hours. How long would it take to mow the field if the two mowers were used at the same time?
6. Lindi and her friend Zoë own a carpet fitting company. The carpet fitter uses a formula $A=l\times b+0.5$ to calculate the area of carpet needed for a room, where l is the length and b is the breadth of the room. Below is the ground floor plan of the house they are currently working on.



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a. Calculate how many square metres of carpet will be needed for each room on the ground floor, excluding the kitchen, bathroom and stairs.
b. Upstairs there are two bedrooms each with a width of $4m$ and one having an area of $28.5m^2$, while the other bedroom has an area of $26.5m^2$. Calculate the length of each bedroom.

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5. Ratio, rate and Proportion

1. Two quantities in direct proportion have a constant quotient.
2. Two quantities in inverse proportion have a constant product.
3. The graph of quantities that are in direct proportion is a straight line that passes through the origin, whose slope is the constant of proportionality.
4. The graph of quantities that are in inverse proportion is a hyperbola.

Exercise 5

1. Express each of the following comparisons as ratios in their simplest form:

    a. The age of a 36 year old mother to the age of her 10 year old son.
    b. A company's expenditure of R150000 on advertising to a profit of R1200000 it makes.
2. Three friends, Tinyiko, Steve and Zodwa bought lottery tickets together. They made an agreement that should any of the tickets win the lottery they will share the prize money in the same ratio as the number of tickets each one has bought. Zodwa bought 16 tickets, Tinyiko bought 12 tickets and Steve bought 8 tickets. One of the tickets hit the jackpot which was R20 million. Determine how much each will receive.
3. A certain firm has hit hard times and they request their employees to work 4 days instead of 5 days per week. Nadia is one of the employees and earns R6000 per month, when working a normal 5-day week. Calculate what her salary will now be when she works 4 days in a week.
4. The price of a house was R240 000. When house prices started rising, the house was now valued at R300 000. Calculate the ratio by which the price was increased.
5. The distance between Johannesburg and Cape Town is about 1400 km.
    a. Serumula leaves Johannesburg at 08:00 a.m. and arrives in Cape Town at 09:30 p.m. If he stops five times for 30 minutes on his way, what was the average speed at which he was driving?
    b. If you drive at an average speed of 120 km/h, calculate how long the trip will last. Assume that you are driving non-stop.
    c. Say whether or not Serumula exceeded the speed limit on national roads. Give reasons for your answer.
6. Americans use pounds (lb) as the unit of mass, while in South Africa we use kilograms (kg). The relationship between the units is given by the formula $1kg = 2.2lb$.

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a. Draw a graph for converting pounds to kilograms. On the graph, use a scale of 1cm to represent 1 kg on the x-axis and 1 cm to represent 2.2 *lb* on the y-axis.
b. From the graph determine the following:
    i. the number of pounds in 13*kg*
    ii. the number of kilograms in 19.6*lb*
c. Does the relationship between kilograms and pounds illustrate direct or indirect proportion? Explain your answer.

7. A litre of petrol costs R7. Tiro's car has a 60 litre petrol tank
    a. Calculate how much it costs Tiro to fill up the tank.
    b. If Tiro's car consumes petrol at the rate of 6.7 litres per 100 kilometres, calculate how far a full tank of petrol will take him.
    c. If Tiro takes a trip from Johannesburg to Cape Town, which is 1400 km long, how much petrol will he use for the trip?
8. It takes 5 people 3 months to build a house. Calculate how long it will take 8 people to build the same house.
9. A driver takes $5\frac{1}{4}$ hours to complete a journey travelling at an average speed of 90 km/h. Calculate how long it would take to complete the same journey if she increased her average speed to 120 km/h.

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6. Functions, patterns and graphs

Relationships between variables can be represented in several different ways:

- Flow diagrams
- Tables
- Formulas
- Verbal descriptions
- Graphs

Exercise 6

1. Find the gradient of the line that passes through the given points:

   a. $(0,1)$ and $(1,4)$
   b. $(-1,2)$ and $(3,2)$
   c. $(2,2)$ and $(2,-5)$
   d. $(2a,b)$ and $(3a,2b)$

2. Use the table method to sketch the given graphs. Note that some graphs may not be continuous lines through the points. In such a case, explain why this is so.

   a. $y = x - 3$, x is a real number.
   b. $y = x - 3$, $x \in \{-3,-2,-1,0,1,2,3\}$
   c. $y = -\frac{1}{2}x + 2$, x is a real number.
   d. $y = -6$
   e. $x = 5$

3. One of the highlights of visiting the zoo or game reserves is seeing the "Big Five". On of the big five is the elephant, whose numbers have gone down quite drastically over the years. Amongst the reasons for this id poaching, human encroachment on the animals' natural habitat, and the consequent culling of the animals. It is estimated that from 1970, an average of 200 elephants were killed daily. It also estimated that in 1979 there were 1.3 million elephants in Africa and that by 1989 this number had dropped to an estimated 600 000.

Use the information in the above passage to answer the following questions

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a. Complete the table below.

Estimated number of elephants	Days	Estimated number killed	Remaining
1.3 million	1	200	1.3 million - … =
1.3 million	10	…×200 = …	1.3 million - . . . =
1.3 million	150	…× … =…	1.3 million - … =
1.3 million	x	…×x =…	….

b. Find and write down the meanings of the words: culling, natural habitat, poaching, encroach.
c. Why do you think poaching is rife and what can be done to discourage it?
d. Write down an equation that gives the relationship between the number of days x and the number of elephants remaining y .
e. How many elephants would remain after one year if the slaughter of the elephants continued unchecked?

Calculate the number of elephants that would have remained after a decade from 1979 and compare this number to the estimate in the story. Why are these numbers different?

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7. Two-dimensional Shapes, Solids and Measurements

1. Volume of a cone is given by $V = \frac{1}{3}\pi r^2 h$
2. Volume of a cylinder is given by $V = \pi r^2 h$
3. Volume of a sphere, $V = \frac{4}{3}\pi r^3$
4. Volume of a pyramid is equal to $\frac{1}{3}\times$ (area of base)$\times$(height of pyramid).
5. Total surface area = $2\times$(area of base)+(perimeter of base$\times$height of prism).
6. To find the volume of an irregular prism, proceed in one of the following ways:
   - Add the volumes of the prisms that were used to build the object.
   - Imagine the prism that was cut away to form the object. Calculate the volume of the regular prism and subtract the volume of the portion that was cut away.

Exercise 7

1. Calculate the height, h, of the triangle shown below whose area is $A = 30$

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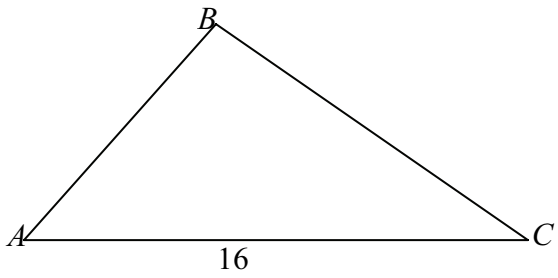

2. Nikesh has designed a kite as shown below. He uses wooden sticks for the sides and diagonals. He then covers these with plastic on one side. Note that $AB = BC$ and $AD = CD$.

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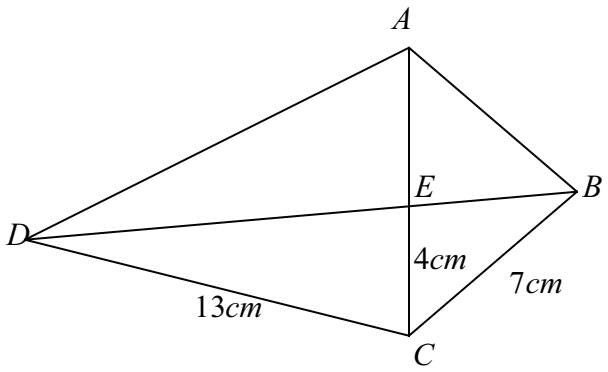

Calculate, correct to two decimal places and using correct units:

a. The perimeter of the kite.
b. The area of the plastic needed to completely cover the kite.
c. The total length of the stick needed to make the kite.

3. The side view of a house is as shown in the diagram below. The base of the house is $15m$ wide, the height of the gable is $1.5m$ and the height from the floor to the ceiling is $2.5m$.

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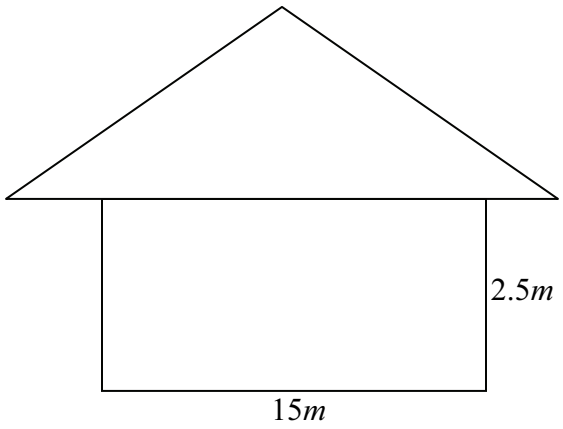

a. What is a gable?
b. Calculate the perimeter of the side view of the house.
c. Calculate the total area of the side of the house.
d. If one brick has height $7cm$, length $10cm$ and breadth $20cm$, how many bricks, laid double, are needed to build the side view from the floor to the ceiling?

4. For the shape below, calculate
   a. the perimeter
   b. the area

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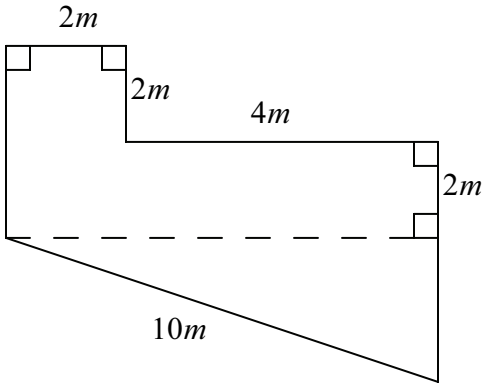

5. Show that the area of a trapezium with $AB \parallel CD$ and height h is $A = \frac{h}{2}(AB + CD)$.
6. Calculate the area and the perimeter of each figure given below:

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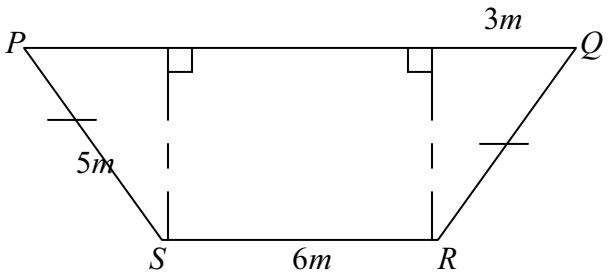

a.

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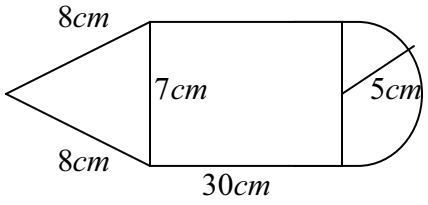

b.

7. Complete the following table by writing the appropriate formula for each object.

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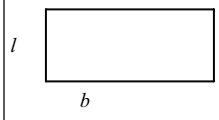
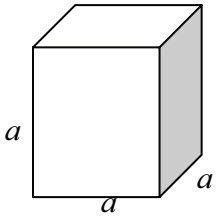
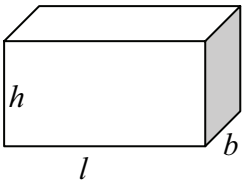
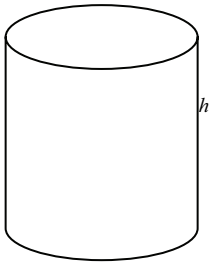
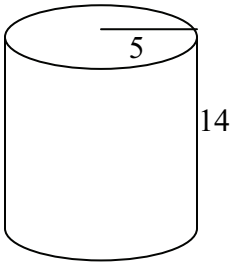
			radius = r 
Perimeter	Volume	Volume	Volume
Area	Surface area	Surface area	Surface area

8. Determine the surface area of the given prism. Give your answer correct to two decimal places and using the correct units of measurement. Note that the measurements are in centimetres

a. The cylinder



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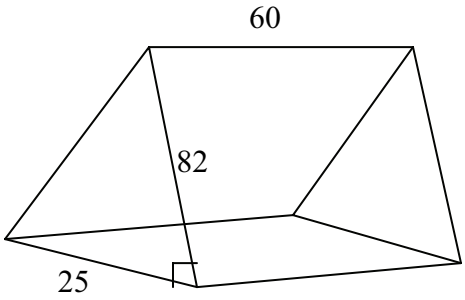
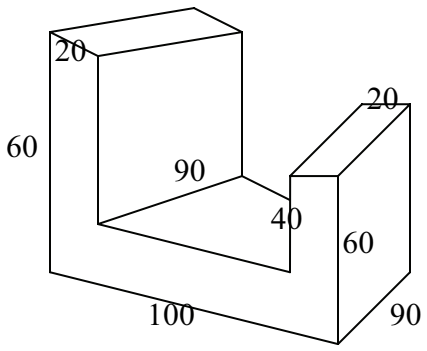
b. The prism



9. Calculate the volume of each irregular prism. Give your answer correct to decimal places and use correct units of measurement. Note that the measurements are in centimetres.

a.



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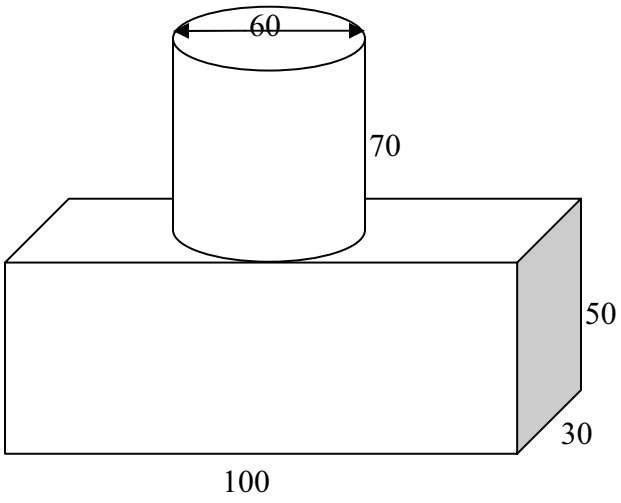

b.

10. Water has recently become a very scarce natural resource. It has, therefore become very important for us to save water as much as we practically can. To do this, we avoid certain habits like washing the car using a garden hose, watering the garden with tap water using sprinklers. One way of saving water would be to collect water in a huge container during the rainy season. This water can then be used for washing the car, watering the garden and for any other use were purified water is not necessary. One can always buy a suitable container from the local hardware store. Suppose that Nthabiseng goes to the hardware store to buy a container and she is shown two containers. One container has a square base, where each side of the base is $800mm$, and has height $1300mm$. The second container has a circular base of diameter $800mm$ and has height $1600mm$.

    a. Calculate the volume of each container and determine which one will hold more water.
    b. Calculate the amount of water, in litres, that each container can hold. Give your answer correct to the nearest whole number.
    c. Which container would you advise Nthabiseng to buy? Why?

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8. Statistics and Probability

Statistics is a that branch of mathematics that pertains to the collection, analysis, interpretation and presentation of data

There are a number of concepts that are related to the handling and use of data.

1. **Measures of central tendency** give an idea of the general behaviour of a set of data. These are the mean, mode and median.

- The **mean,** denoted by $\bar{x}$, is defined as the average value of all the data. We have $\bar{x}$ = sum of values divided by the total number of values.
- The **median** is the value that lies halfway through the data set, where the data set has been arranged from lowest to highest in value.
- The **mode** is the value that appears most often in the data set. It may be viewed as the "most popular" value.

2. **Measures of dispersion** help with determining how spread out the data values are.

   - Range = highest value – lowest value
   - The **first quartile** one quarter of the way through the data set when ordered from lowest to highest.
   - The **second quartile** is the same as the median, that is, it is halfway through the data set.
   - The **third quartile** is three quarters of the way through the data set.
   - The **interquartile** = third quartile – first quartile.

3. **Relative frequency** = the number of times an event occurs divided by the total number of trials or experiments.
4. **Probability** is the measure of how likely an event is.
5. Note the usage of the words "die" and "dice". "Dice" is the plural of "die". 1 die, many dice.

Exercise 8

1. At the end of the term Grade 9 learners wrote a term test. Below are the percentages that they obtained:

   30 42 28 15 26 51 81 43 45 56 61 21 53 45 46 52 55 34 42 51 54 33 42 51
   36 41 34 28 34 19 21 36 55 26 29 40 33 31 29 32 36 39 63 28 98 59 89 99

   a. Group the data into intervals.
   b. Draw a frequency table for the data.
   c. Draw a histogram for the distribution.
   d. Determine the modal class for the distribution.
   e. Calculate the mean, mode and median of the given data.

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2. Recently, the South African government, through the Department of Health, has expressed concern about the general health of the population. Amongst the most worrisome issues is the increase in the incidence of heart disease, hypertension, stroke and diabetes. These diseases can be linked, in the majority of cases, to obesity which is a result of bad eating habits. The proliferation of fast food outlets and the sedentary lifestyle of many South Africans contribute to this problem. To have an indication of a person's risk of these ailments, we measure the percentage of body fat to determine if the person is underweight, has normal weight, is overweight or is obese. However, we should also note that one can also be underweight, which in itself is a health risk. It is therefore important that we watch what we eat, making sure that we always have a balanced diet. A balanced diet ensures that we obtain all the necessary nutrients and avoid fatty and sugary foods. One measure is called body mass index or BMI in short. BMI measures the ratio of a person's mass to the square of their height: $BMI = \frac{mass}{(height)^2}$, where the mass is measure in kilograms (kg) and the height is measured in metres (m). The following BMI categories have been established:
   - Underweight: $BMI \leq 18.5$
   - Normal weight: $18.5 \leq BMI \leq 24.9$
   - Overweight: $25 \leq BMI \leq 29.9$
   - Obese: $BMI \geq 30$

   Consider the table below and answer the questions that follow (BMI is always given correct to one decimal place):

Name	Height (cm)	Mass (kg)	BMI
Lesego	169	71	24.9
Jabulile	153		17.5
Hazel	159	62	
Ahmed	150	51	22.7
Sally	167		23.3
Karabo	164	70	
Thabo	170	75	26.0
Miriam	175	80	
Lerato	183	80	
Faizel	158		26.4
Sello	162	62	23.6
Nadia	158	65	

   a. What are the units of measurement for BMI?
   b. Complete the table by calculating the missing numbers.
   c. Classify each person using the table below:

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Underweight	Normal weight	Overweight	Obese

d. Suppose that Kobus stands at $1.9m$ tall. What is his ideal mass range for him to be classified as of normal weight?
e. Calculate the mean BMI
f. What is the mode of the BMI's?
g. Determine the median of the BMI's.
h. What is the minimum mass in kilograms that Thabo must lose to reach "normal weight"?

3. A fair die is rolled. Calculate the probability of getting an odd number.
4. A card is drawn from a pack of 52. Calculate the probability that it is
    a. a picture card (ace, king, queen or jack).
    b. a numbered card.

5. The Premier Soccer League is made up of 16 teams. At the end of the season, there will be only one champion.
    a. What is the probability of each team winning the championship?
    b. What is the probability that one of Bidvest Wits, Chiefs or Platinum Stars will win the championship?

6. The letters H, A and T are used to form three-letter "words", without using any of the letters more than once. For example, HAT, AHT. Draw a tree diagram that shows all the words that can be formed.

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9. Financial Mathematics

1. **Simple interest**

The formula to calculate the amount accumulated when simple interest is charged or paid is given by:

$A = P(1+in)$. Here, P is the initial amount invested or borrowed. It is also referred to as the *capital* amount; A is the accumulated amount, i is the percentage interest rate per annum and n is the loan or investment period.

2. **Compound interest**

The formula for the accumulated amount when interest is compounded annually is $A = P(1+i)^n$.

3. The formula for **reducing balance depreciation** is $A = P(1-i)^n$

Exercise 9

1. A savings account of $R10000$ earns simple interest at 5% per annum. Calculate
   a. The amount accumulated after six years.
   b. The total interest earned after six years.
2. In five years' time you will be going to university. It is estimated that at that time fees will cost, on average, R50000. Calculate the amount you should put away today if the bank pays a compound interest of 6.5% p.a.
3. A company has motor vehicles which are worth R500000 today. The accountant uses straight-line depreciation to reduce the value of the vehicles by R100000 every year.
   a. Calculate the percentage depreciation each year on the original cost.
   b. Calculate the value of the vehicles at the end of the first, second, third, fourth and fifth years.
   c. Draw a graph showing the change in value of the computers over the five years.
4. Thabile invests R1.5 million in machinery for her company which depreciates at 8% per annum.
   a. Calculate how much the machinery will be worth in 10 years' time.
   b. What is the total amount of depreciation?
5. A book is priced at 20 US dollars.
   a. Calculate the price in rand if \$1=R7.15.
   b. Calculate the price of the book in Euros if 1 euro =R9.50
6. In sales and marketing, employees are usually paid in two forms. A basic salary, which is a fixed amount, plus commission which is paid according to the amount of sales that the employee has generated. Usually, the basic salary is a relatively

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small amount and people work in sales make the bulk of their income on commission.

a. Discuss the advantages and disadvantages of being paid on commission.
b. Devan is a sales agent for a life insurance company. He earns a basic salary of R2000 p.m. and commission of 30% of the monthly premium of any policy he sells. If he sells four policies paying monthly premiums of R1000, R400, R660 and R10000, respectively, calculate what his monthly income will be.

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10. Lines and triangles

Congruency, similarity and proportionality

1. Any polygon can be transformed as follows:
    - By translation
    - Reflection
    - Rotation
    - Glide reflection
    - Enlargement
2. Two polygons are **congruent** if they are equal in size and have the same shape. That is, all corresponding angles and all corresponding sides are equal.
3. Two polygons are **similar** if they have the same shape but differ in size. This means that corresponding angles are equal and corresponding sides are proportional.
4. A transformation that preserves shape and size is called an **isometry**.

- When two polygons have the same shape, but not necessarily the same size, they are said to be similar. In this case they are equiangular and corresponding sides are in proportion.
- Two polygons are said to be congruent if they have the same size and shape. This happens when they are equiangular and corresponding sides are equal.

There are four conditions of congruency, namely,

1. Three sides of one triangle are equal to the three corresponding sides of another triangle. This condition is usually referred to as side, side, side and abbreviated by SSS.
2. If two angles and one side of one triangle are equal to two angles and the corresponding side of another triangle, then the two triangles are congruent. This condition is called two angles and a side and is symbolised as AAS or ASA.
3. If two sides and the included angle (the angle made by the two sides under consideration) of one triangle are equal to two sides and the included angle of another triangle, then the two triangles are congruent. This condition is called side, angle, and side and in symbols is represented as SAS.
4. In two right-angled triangles, if the hypotenuse and one side of one triangle are equal to the hypotenuse and one side of another triangle, then the two triangles are congruent. The condition is referred to as right angle, hypotenuse and a side, or in symbols, RHS.

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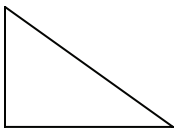
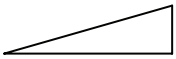
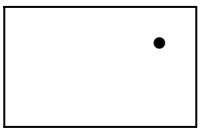
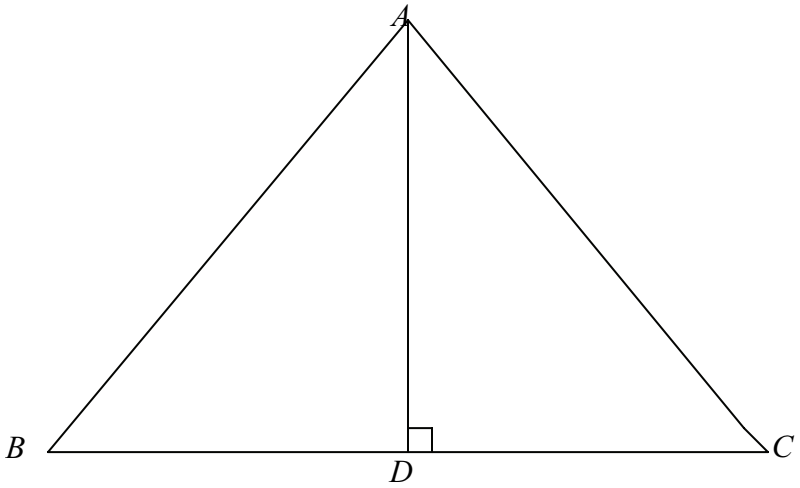
Exercise 10

1. Complete the table by drawing one image for each shape to illustrate the transformation indicated.

Translation	Reflection	Rotation (90°)	Enlargement	Reduction
				

2. In the following, ΔABC is an isosceles triangle. Prove that $\Delta ABD \equiv \Delta ACD$



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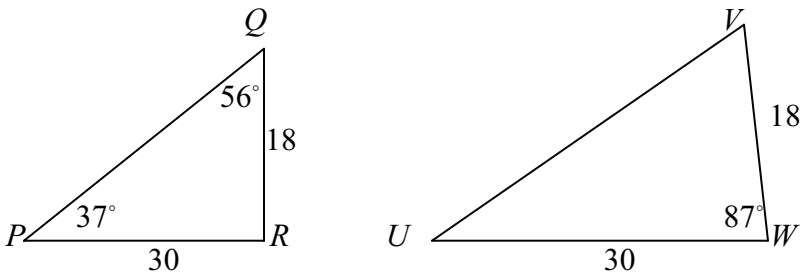
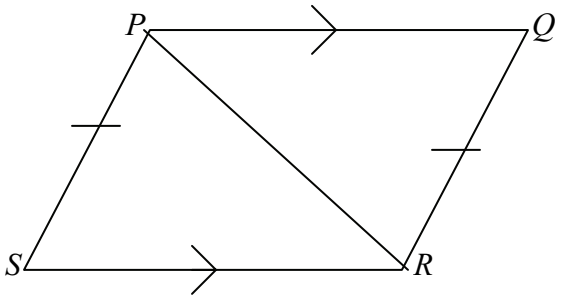
3. In the following, determine if the pairs of triangles are congruent, similar or neither. If the triangles are congruent, state which congruency condition is satisfied.

a.





b

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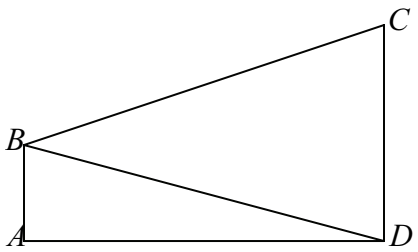
c. In the trapezium below,
$\angle ABD = \angle CDB = 90^\circ$



Answers

Exercise 1

3.

a. $\frac{1}{3}$

b. $\frac{65}{99}$

c. $\frac{2471}{999}$

Exercise 2

2.1

a. x^7

b. $63x^3$

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e. 1

f. $8xy$

4.

a. 3.65×10^{4}

b. 10^{-9}

c. 1.89×10^{-5}

5.

a. $x^{4}\square y^{5}$

b. $x^{-1}\square y^{-2}$

c. 2×10^{-2}

6.

a. Two A1 sheets, four A2 sheets, eight A3 sheets, sixteen A4 sheets, thirty-two A5 sheets, sixty four A6 sheets, one hundred and twenty A7 sheets, two hundred and fifty-six A8 sheets, five hundred and twelve A9 sheets, 1024 A10 sheets.
b. A1 is half of A0, A2 is a quarter of A0, A3 is one-eighth of A0, and so on.
c. A1 has dimensions 841 mm by 594 mm, A2 is 420 mm by 297 mm, A1 is 210 mm by 148 mm, and so on.

Exercise 3

1. $2x^{2}-2x+9xy+4xy^{2}-5$
2. a. $1-3x^{2}y-3xy^{2}+7xy$
   b. $5x^{2}+3x$
3. a. $-12x^{2}$

   b. $x^{2}+3x+2$

   c. $x^{2}-2x-24$

   d. $15x^{2}-7x-2$

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e. $9x^2 - 12x + 4y^2$

4.

e. $2\left(1-2\left(x+1\right)\right)\left(1+2\left(x+1\right)\right)$

f. $2\left(-x+7\right)\left(3x-5\right)$

5. a. No factors. (Why?)

Exercise 4

1. a. $x = 12$

b. $x = 1$

c. $x = 1$

d. $y = 4$

e. $y = 28$

f. $x = 2$

g. $x = -5$

h. $x = \frac{9}{2}$

2. a. $x = \frac{2}{3}$

b. $t = -2$

c. $y = -1$

d. No solution.

3. a. $x = 0$ or $x = 1$

b. $x = 2$ or $x = -2$

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c. $x = \frac{1}{2}$ or $x = -\frac{1}{2}$

4. The man is now 33 years old and his son is 8 years old.

5. $1\frac{7}{8}$ hours

6. a. $37.5m^2$ for the lounge, $30m^2$ for the dining room and $34m^2$ for the study.

   b. The one bedroom has length 7.13 m and the other has length 6.63 m.

Exercise 5

2. Zodwa will receive R8.89 million, Steve will receive R4.44 million and Tinyiko will receive R6.67 million.

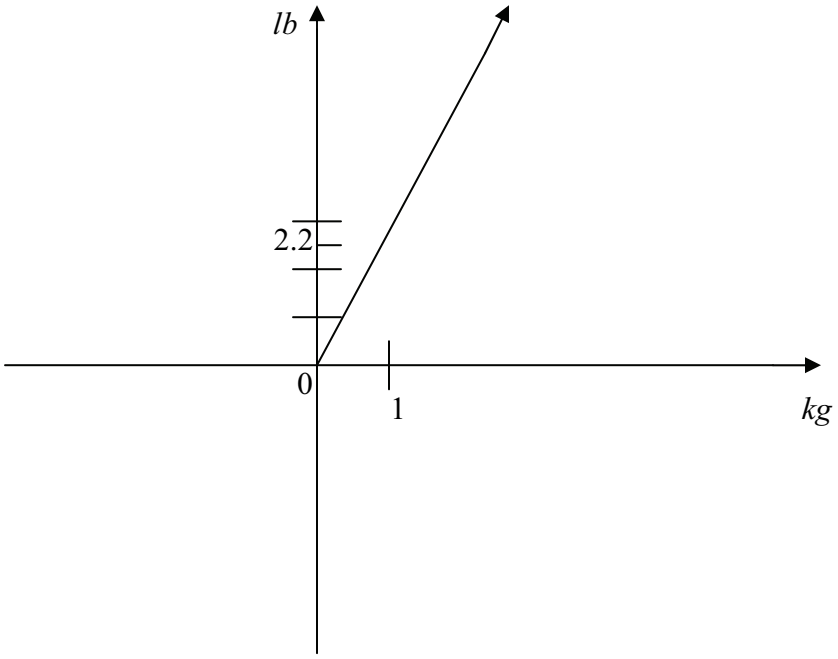
3. R4800

4. 5 : 4

5. a. 127.27 km/h

   b. 11 hours 40 minutes.

6. a.



   b. i. 28.6 *lb*

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ii. 8.91 *kg*

7. a. R420

   b. 895.5 km

   c. About 94 litres.

8. One month twenty six days.

9. 3 hours fifty six minutes.

Exercise 6

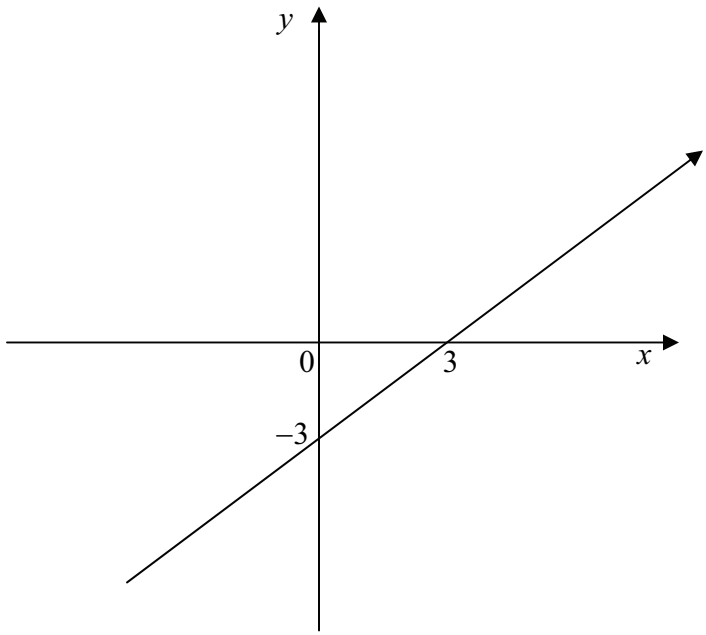
1. a. 3

   b. 0

   c. undefined

   d. $\frac{b}{a}$

2. a.



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3. a.

Estimated number of elephants	Days	Estimated number killed	Remaining
1.3 million	1	200	1.3 million - 200… =1299800
1.3 million	10	$10\times200=2000$	1.3 million -2000 . . . =1298000
1.3 million	150	$150\times200=30000$…	1.3 million -30000 = 1270000
1.3 million	x	$200\times x=200x$	1300000-200x

e. 1227000

f. 570 000

Exercise 7

1. $h=3.75$

2. a. 40

   b. 72.6 cm^2

   c. about 59 cm

3. b. 35 metres

   c. 37.5 m^2

   d. 5357 bricks

4. a. 32 m

   b. $40m^2$

5.

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6. a. $A = 36m^2,\ P = 22m$

   b. $A = 85.5cm^2,\ P = 105.7$

7.
8. a. 596.9

   b. 13390

9. a. 324000

   b. 347920

10. a. The container with a square base has volume 832000 cm^3 and the one with a circular base has volume 804248 cm^3.

    b. The container with a square base can hold 832 litres of water and the one a circular base can hold 804 litres.

Exercise 8

3. 0.5
4. a. $\frac{4}{13} = 0.31 = 31\%$

   b. $\frac{9}{13} = 0.69 = 69\%$
5. a. $\frac{1}{16} = 0.0625 = 6.25\%$

   b. $\frac{3}{16} = 0.1875 = 18.75\%$

Exercise 9

1. a. R13000

   b. R3000

2. R36494.04

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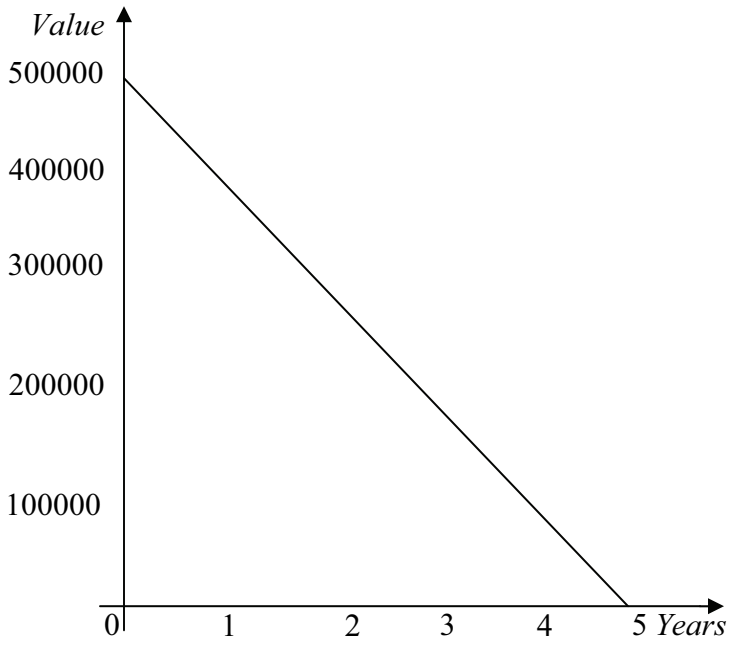
3. a. 20%

   b. R400000, R300000, R200000, R100000, R0

   c.



4. a. R651582.68

   b. 848417.32

5. a. R143

   b. 15.05 euros

6. b. R5618

Exercise 10

3. a. Neither

   b. $\Delta PQR \equiv \Delta PSR$

   c. Similar

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