# Grade 11
# Assessment Exemplars
# 2008

# Grade 11 Assessment Exemplars

## 1 Learning Outcomes 1 and 2



## 2 Learning Outcomes 3 and 4

# Information Sheet: Mathematics

$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$

$$A=P(1+i.n) \qquad A=P(1+i)^n$$

$$A=P(1-i)^n \qquad A=P(1-i.n)$$

$$\sum_{i=1}^{n}1=n \qquad \sum_{i=1}^{n}i=\frac{n(n+1)}{2} \qquad \sum_{i=1}^{n}\left(a+(i-1)d\right)=\frac{n}{2}\left(2a+(n-1)d\right)$$

$$\sum_{i=1}^{n}ar^{i-1}=\frac{a\left(r^n-1\right)}{r-1}\ ;\ r\neq 1 \qquad \sum_{i=1}^{\infty}ar^{i-1}=\frac{a}{r-1}\ ;\ -1<r<1$$

$$F=\frac{x[(1+i)^n-1]}{i} \qquad P=\frac{x[1-(1+i)^{-n}]}{i} \qquad f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$$

$$d=\sqrt{(x_2-x_1)^2+(y_2-y_1)^2} \qquad M\left(\frac{x_1+x_2}{2};\frac{y_1+y_2}{2}\right) \qquad y=mx+c$$

$$y-y_1=m(x-x_1) \qquad m=\frac{y_2-y_1}{x_2-x_1} \qquad m=\tan\theta \qquad (x-a)^2+(y-b)^2=r^2$$

$$In\ \Delta ABC;\quad \frac{a}{\sin A}=\frac{b}{\sin B}=\frac{c}{\sin C}$$

$$a^2=b^2+c^2-2bc.\cos A$$

$$area\ \Delta ABC=\frac{1}{2}ab.\sin C$$

$$\sin(\alpha+\beta)=\sin\alpha.\cos\beta+\cos\alpha.\sin\beta$$

$$\sin(\alpha-\beta)=\sin\alpha.\cos\beta-\cos\alpha.\sin\beta$$

$$\cos(\alpha+\beta)=\cos\alpha.\cos\beta-\sin\alpha.\sin\beta$$

$$\cos(\alpha-\beta)=\cos\alpha.\cos\beta+\sin\alpha.\sin\beta$$

$$\cos 2\alpha=\cos^2\alpha-\sin^2\alpha \qquad \cos 2\alpha=1-2\sin^2\alpha \qquad \cos 2\alpha=2\cos^2\alpha-1$$

$$\sin 2\alpha=2\sin\alpha.\cos\alpha$$

$$\bar{x}=\frac{\sum x}{n} \qquad \bar{x}=\frac{\sum fx}{n} \qquad \text{var}=\frac{\sum_{i=1}^{n}(x_i-\bar{x})^2}{n}$$

$$SD=\sqrt{\frac{\sum_{i=1}^{n}(x-\bar{x})^2}{n}} \qquad P(A)=\frac{n(A)}{n(s)} \qquad P(A\ or\ B)=P(A)+P(B)-P(A\ and\ B)$$

## Instructions and Information

Read the following instructions carefully before answering this question paper:

1 This question paper consists of …… questions. Answer ALL questions.

2 Clearly show ALL calculations, diagrams, graphs, et cetera, which you have used in determining the answers.

3 An approved scientific calculator (non-programmable and non-graphical) may be used, unless stated otherwise.

4 If necessary, answers should be rounded off to TWO decimal places, unless stated otherwise.

5 Number your answers correctly according to the numbering system used in this question paper.

6 Diagrams are not necessarily drawn to scale.

7 It is in your own interest to write legibly and to present your work neatly.

## Grade 11 Assignment: Functions **Marks: 95**

**Question 1:**

1.1 What do you understand by
- 1.1.1 the asymptote of a function; (2)
- 1.1.2 the axis of symmetry of a function; (2)
- 1.1.3 the zeros of a function? (2)

1.2 $g(x)= f(-x)$ and $h(x)=-f(x)$. Write down the equation of the line about which:
- 1.2.1 $g(x)$ is a reflection of $f(x)$ (1)
- 1.2.2 $h(x)$ is a reflection of $f(x)$ (1)

1.3 What does it mean if $f(2)=g(2)$? (2)

1.4 How do you test whether or not the point $(a;b)$ lies on the graph of $y= f(x)$? (2)

1.5 Write down a formula for the average gradient of a curve $y=g(x)$ between the points $(a_1;b_1)$ and $(a_2;b_2)$ (2)

**[14]**

**Question 2:**

2.1 Sketch the graph of $xy=4-2x$ showing all axes of symmetry, asymptotes, intersection with the axes and any other critical points. (7)

2.2 Give the equation of;
- 2.2.1 the horizontal asymptote (1)
- 2.2.2 the axis of symmetry that has a negative gradient (2)
- 2.2.3 the graph that would result if you shifted your sketch up by 4 units (2)

**[12]**

**Question 3:**

3.1 Sketch the graphs of $y= f(x)=-x^2$ , $y=g(x)=-(x-1)^2$ and $y=h(x)=-(2x-1)^2$ on the same system of axes. Label each graph, any lines of symmetry or asymptotes that may exist as well as at least 2 points on each graph. (11)

3.2 Describe, in words, the effect on the graph of $y= f(x)=-x^2$ of the parameters *a*, *c* and *d* in the equation $y= p(x)=-a(x+c)^2+d$ . (8)

**[19]**

**Question 4:** Given $h(x)=\left(\frac{1}{4}\right)^{x-1}-2$

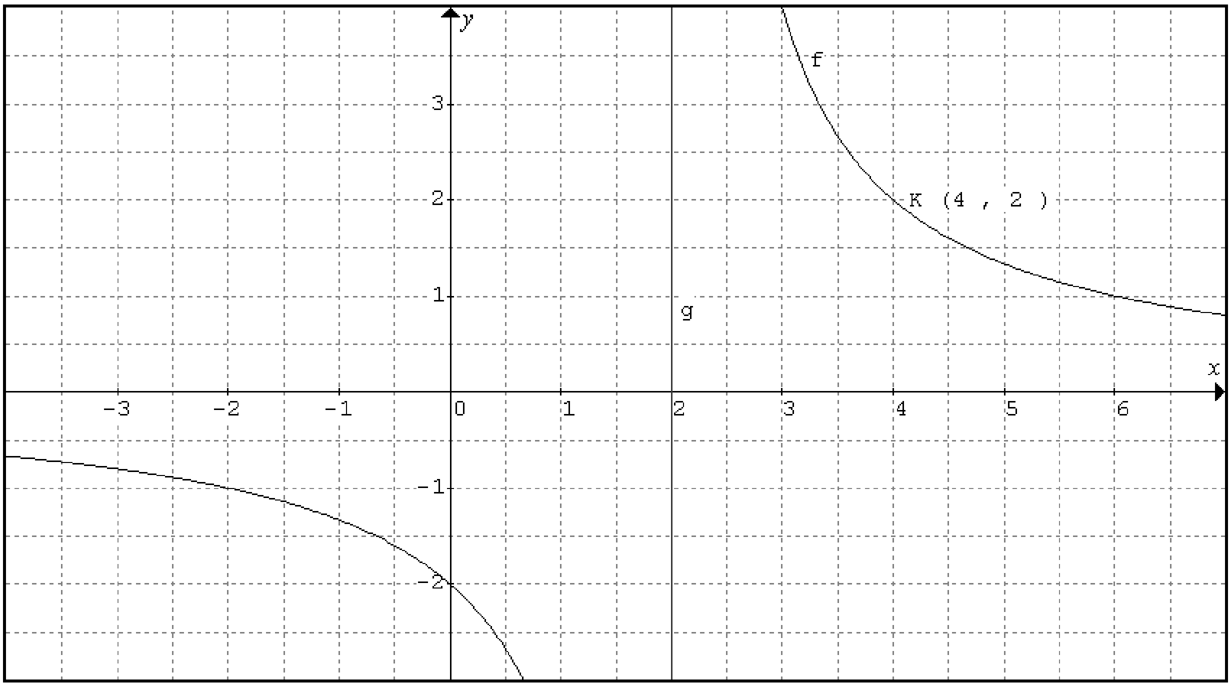
4.1 Write down the equation of the asymptote of $h$ (1)

4.2 Determine the coordinates of the intercepts of $h$ with the $x$ and $y$ axes (6)

4.3 Write down the equation of the reflection of $h(x)=\left(\frac{1}{4}\right)^{x-1}-2$ in the $y$ axis. (2)

**[9]**

**Question 5:** The sketch below represents the graph of $f(x)=\dfrac{a}{x+p}+q$



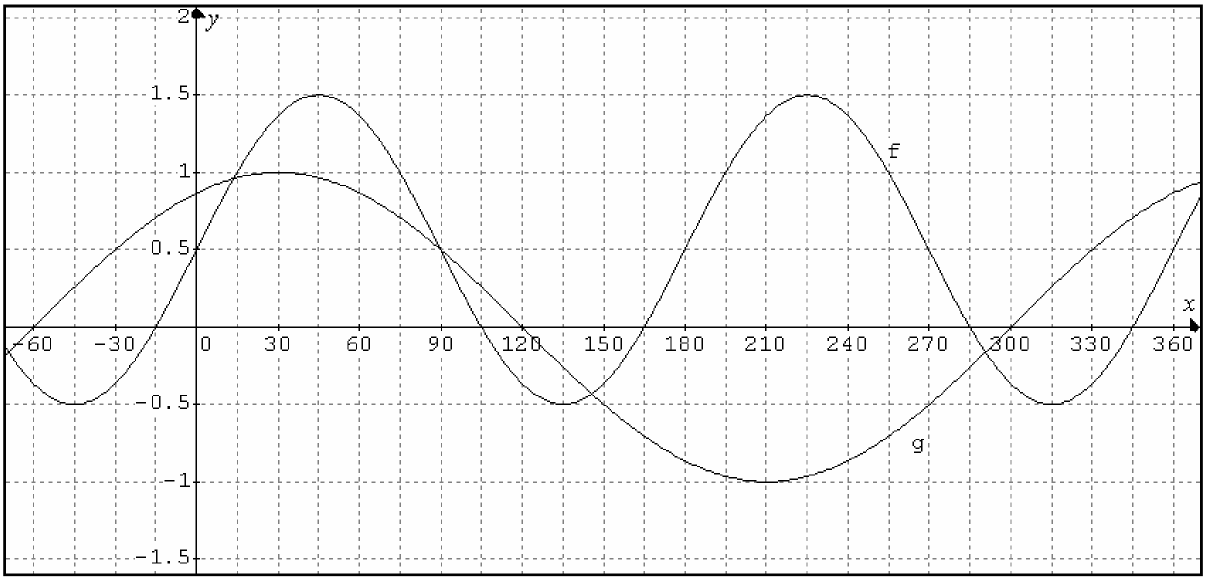

5.1 If the line of g is the vertical asymptote of the above function, determine the value of $a$, $p$ and $q$ and hence the equation of f. (5)

5.2 What is the equation of the horizontal asymptote? (1)

5.3 What is the equation of the axis of symmetry that has a positive gradient? (2)

**[8]**

**Question 6:** Given $f(x) = a\sin(bx + c)^\circ + d$ and $g(x) = p\cos(qx + r)^\circ + s$

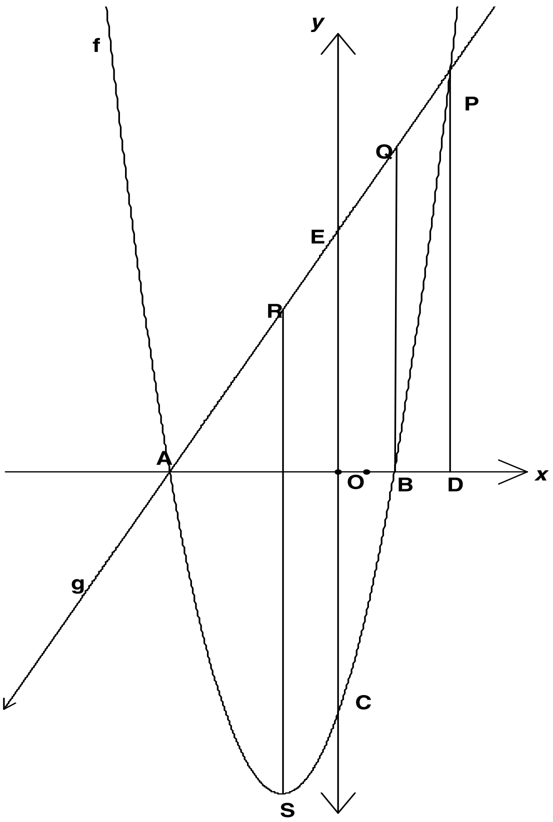



6.1 Determine the values of $a$, $b$, $c$, $d$, $p$, $q$, $r$ and $s$ and hence the equations of $f$ and $g$ (4)

6.2 Read from the sketch, the values of $x$ for which $f(x) = g(x)$ for $x \in [0^0; 180^0]$ (2)

**[6]**

**Question 7**




$f(x) = x^2 + 4x - 12$ $g(x) = 2x + 12$

7.1 Determine the lengths of OA; OB and OC. (4)

7.2 Determine the coordinates of P. (5)

7.3 Calculate the length of RS if S is the turning point. (5)

7.4 Determine the lengths of BD; QB and EC. (6)

7.5 Write down the equation of:

7.5.1 the reflection of $f(x)$ in the $y$ axis; (2)

7.5.2 the parabola with the same zeros as $f(x)$, which has been stretched through the $x$ axis by a factor of 2 (2)

7.6 Calculate the average gradient of $f(x)$ between S and B. (3)

**[27]**

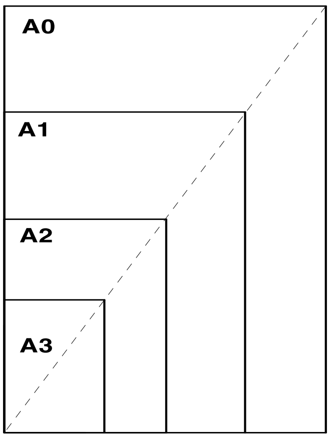
## Grade 11 Investigation: Ratios **Marks: 100**

1. Solve the following equation for *x* in terms of *y*: $x^2 - 3xy + 2y^2 = 0$ and hence show that the ratio *x* : *y* is 1 : 1 or 2 : 1.

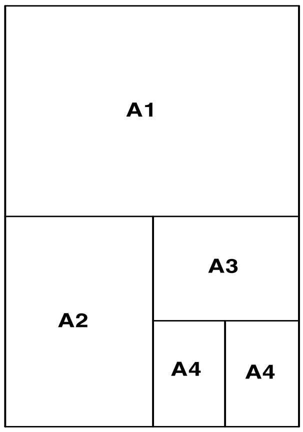
2. Most paper is cut to internationally agreed sizes: A0, A1, A2, …A7 with the property that the A1 sheet is half the size of the A0 sheet and has the same shape as the A0 sheet, the A2 sheet is half the size of the A1 sheet and has the same shape and so on.

   2.1 Explain what it means that the sheets all have the same shape.
   2.2 Find the ratio of the length to the breadth of each rectangular piece of paper.

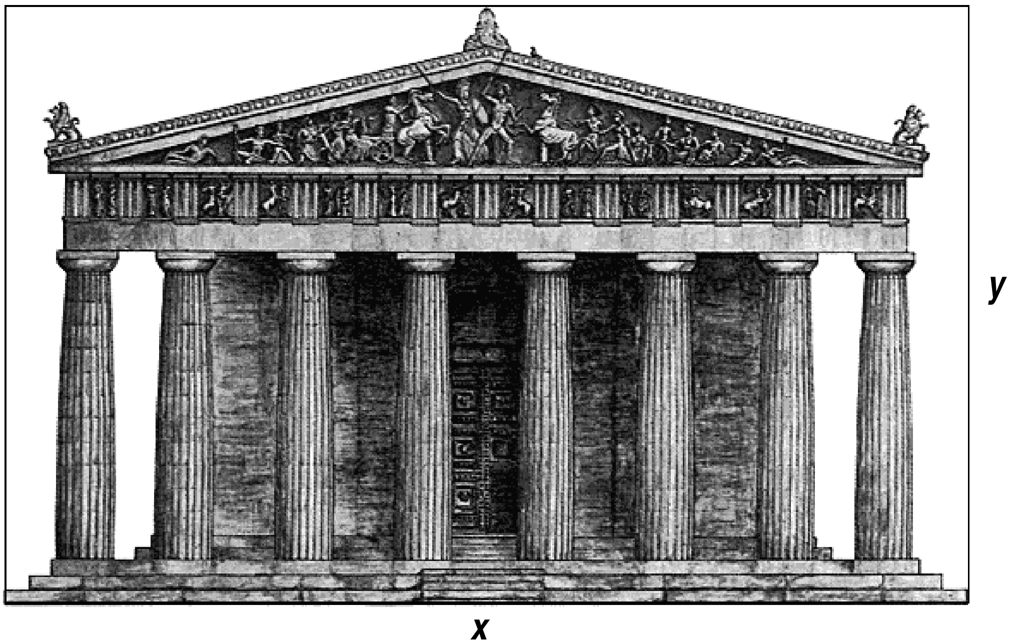
All sheets have the same shape




An A0 sheet folds into two A1 sheets

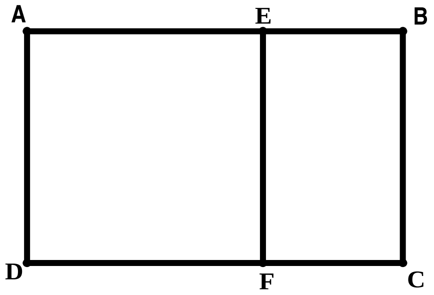



3 The golden rectangle has been recognised through the ages as being aesthetically pleasing. It can be seen in the architecture of the Greeks, in sculptures and in Renaissance paintings.



3.1 Measure *x* and *y* and hence estimate the golden ratio *x : y*

3.2 The golden rectangle has the property that when a square the length of the shorter side of the rectangle is cut from it, another rectangle with the same shape is left.

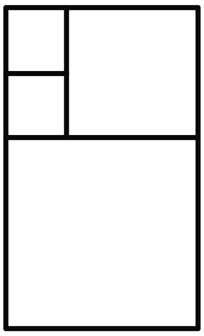



$$\frac{AB}{BC}=\frac{BC}{EB}$$

The process can be continued indefinitely, producing smaller and smaller rectangles. Using this information, calculate the ratio *x : y* in surd form.

3.3 Write the ratio (often called phi: $\phi$) correct to 3 decimal places.

4. A sequence of rectangles can be built up in the following way : start with a rectangle made by two identical squares placed next to each other. The next rectangle is formed by adding a square on to the longer side of this rectangle. The process can be continued indefinitely. Investigate the ratio of the length to the breadth of these rectangles. Let the first rectangle have dimensions 2 units by 1 unit.



5. A line segment, AB can be divided in the golden ratio at C in the following way:

5.1 At B, draw a perpendicular to AB and mark off BD equal to half AB.

5.2 Join AD.

5.3 On DA mark off DE equal to DB.

5.4 On AB mark off AC equal to AE.

5.5 Now prove that this construction divides AB so that AC:CB=$\phi$

# Control Test

## Grade 11 Test: Equations, Inequalities and Exponents

**Time: 1 hour** **Marks: 50**

### Question 1

Solve for x in each of the following;

1.1 $x(x-4)=21$ (4)

1.2 $7-5x=x^2$ (5)

1.3 $1+\dfrac{x+1}{x+2}+\dfrac{2}{x-1}=0$ (6)

1.4 $x^2-6<-5x$ (5)

1.5 $2^{3x-6}=\sqrt{8}$ (3)

**[23]**

### Question 2

Solve simultaneously for *x* and *y* in the following system of equations.

$2y+x=1$ and $y=3x^2-x-3$

**[7]**

### Question 3

The last nuclear test explosion was carried out by the French on an island in the south Pacific in 1996. Immediately after the explosion, the level of *Strontium-ninety* on the island was 64 times the level considered to be "safe" for human habitation. If the half-life of *Strontium-ninety* is 28 years, how long will it take for the island to once again be habitable? (Half-life is the amount of time it takes for half of the amount of a substance to decay.)

( Hint: Let the original amount of *Strontium-ninety* present be equal to $x$ and it then follows that the amount present after 28 years is $\dfrac{x}{2}$ )

**[8]**

**Question 4**

Computer A takes 12 minutes more to print the Grade 11 exam papers than does computer B. Used together the computers can print the papers in 8 minutes. Find the time that computer A, used alone, will require to print the papers.

**[6]**

**Question 5**

The two numbers 4 and 2 have the peculiar property that their difference equals their quotient. That is $4-2=2$ and $4 \div 2 = 2$. There are other numbers with this property: $4\frac{1}{2}$ and 3, $5\frac{1}{3}$ and 4 are two other pairs.

5.1 Find a fourth pair of numbers with this property. (2)

5.2 Explain how pairs of numbers with this property can be generated. (4)

**[6]**

## Grade 11 Project: Finance

**Marks: 50**

This project is designed to be done by groups of three. Where the number in the class is not divisible by 3, one or two groups must have 4 members and approach 4 companies when tackling the second task described below. It is suggested that each group member approach a different company, which also needs to be different from the companies approached by others in the group or by other groups. It is suggested that time be allocated to choosing companies so that enough different companies are identified. Your teacher will provide you with a letter which you can use to make contact with a company.

1. Two companies each bought machinery worth R1 000 000 at the same time.

   Company A valued the machinery as follows at the end of each of the next three years:

   Year 1: R850 000 ; Year 2: R722 500 ; Year 3: R614 125

   Company B valued their machinery at the year ends as follows:

   Year 1: R850 000 ; Year 2: R700 000 ; Year 3: R550 000

   Each claim that the machinery is depreciating at 15% p.a.

   1.1 Investigate and comment on the claim by each company.
   1.2 Write down the value of the machinery for each company after *n* years.

2. Write a paragraph on the methods used by three different companies to value depreciating equipment each year. Compare methods used and suggest reasons for any differences found. Give the name of the company, the nature of the equipment which is depreciating and the formulae used by each company to determine the current value of their equipment. Also indicate when the company plans to replace their depreciating equipment and how they calculate the expected cost to the company for replacement.

**Assessment**

Marks will be awarded as follows:

1.1 4 marks
1.2 6 marks

2. 25 marks for calculations
   15 marks for explanation

The group members can then all take this mark, or the mark can be multiplied by 3 (or 4 if there are 4 in the group) and different marks can be awarded according to the contribution of each member. The average of the marks in the group must be the mark allocated by your teacher.

Exam A

## Grade 11 Mathematics Exam — Paper 1

**Time: 3 hours** **Marks: 150**

### Question 1

1.1 Solve for x in each of the following;

1.1.1 $(2x-1)(x+3)=12x+1$ (5)

1.1.2 $2x^2-7x-4>0$ (4)

1.1.3 $x^2-1=x$ (5)

1.2 Solve for both x and y in the system of equations below.

$2y+x=1$ and $y=3x^2-x-3$ (7)

**[21]**

### Question 2

Simplify the following;

2.1 $\dfrac{(3x)^{-2}}{3x^{-3}}$ (3)

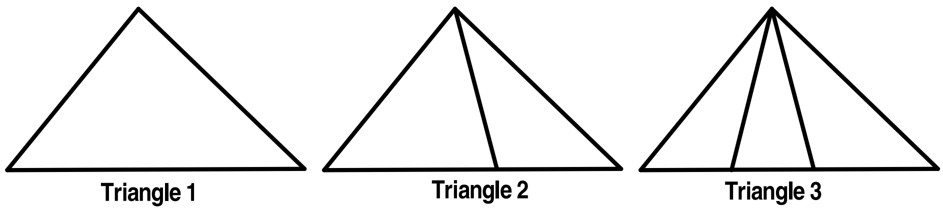
2.2 $\sqrt{108x^{12}}+\sqrt{243x^{12}}$ (3)

2.3 $\dfrac{x^{-1}+y^{-1}}{x^{-1}y-y^{-1}x}$ (5)

**[11]**

### Question 3

In the sketch below, a new line is drawn each time, from the same vertex to the side opposite. This leads to more and more triangles being formed each time.



3.1 Fill in the table on your diagram sheet

| **Sketch number** | **1** | **2** | **3** | **4** |
|---|---|---|---|---|
| **No of internal lines** | 0 | 1 | 2 | |
| **Total number of triangles** | 1 | 3 | 6 | |

(4)

3.2 How many internal lines would be added in the *n-th* sketch? (1)

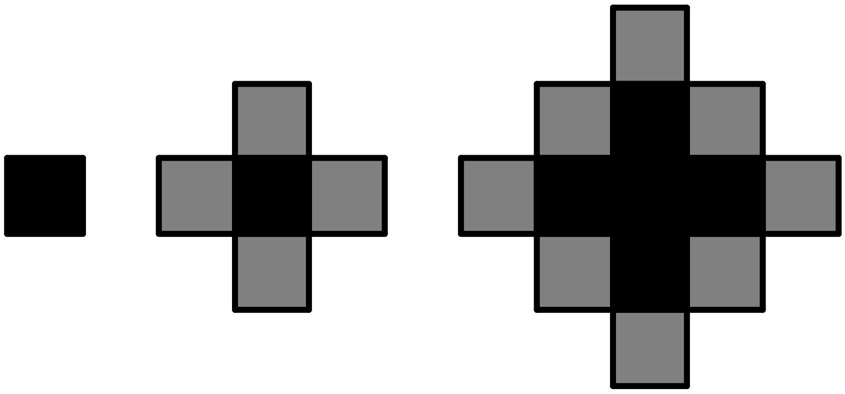
3.3 Determine how many triangles would there be in the *n-th* sketch? (5)

3.4 Which sketch would have 153 triangles? (4)

**[14]**

**Question 4**

The diagram shows a sequence of patterns. Each one is made by surrounding the previous pattern (shade black) by squares that are shaded grey.



4.1 On the square grid on your diagram sheet, draw the next pattern (2)

4.2 There are two sequences formed. The first, is the number of squares added to each new pattern (the grey squares), the second is the total number of squares making up the pattern. Write down the first six terms of each sequence (6)

4.3 Find a formula for the $n-th$ term in each sequence. (4)

**[12]**

## Question 5

5.1 After just 2 years, a laptop computer is one third it's original value. Assuming reducing balance depreciation, what was the annual rate of depreciation? (5)

5.2 Sindiswa is investing her money with a local investment company that is offering her an interest rate of 14% p.a compounded quarterly. Her colleague, Linda, is investing hers with a professional bank that is offering her 12,5% p.a compounded monthly. Calculate who will receive a better return. (6)

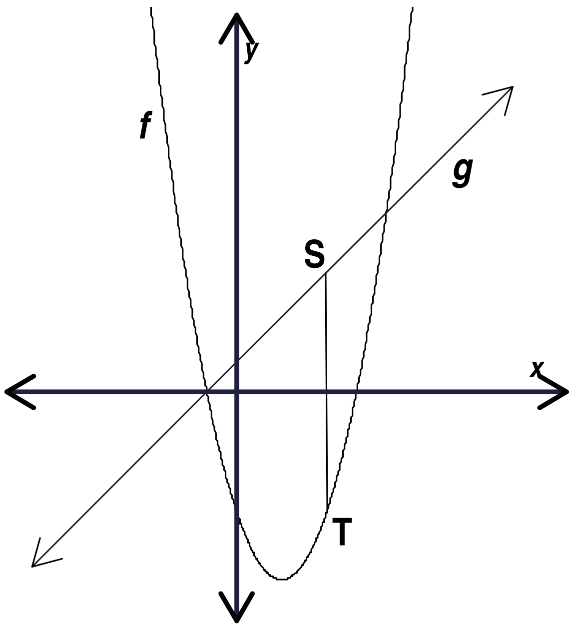
5.3 Byron deposits R2500 into a bank account and makes no withdrawals for 8 years. At the end of the fifth year he deposits an additional R1200. If the interest rate for the first 4 years is 8% p.a compounded quarterly and 9,5% p.a compounded semi-annually for the remaining four years, what will have accrued in the account at the end of the eighth year.

(7)

**[18]**

## Question 6

Below, the following two functions are sketched; $f(x) = 2x^2 - 3x - 2$ and $g(x) = x + \frac{1}{2}$




6.1 Find the zeroes of both functions. (5)

6.2 Determine, using any method, the coordinates of the minimum value of $f$ (4)

6.3 ST is drawn such that it is perpendicular to the x axis. If the length of ST = 4, find the coordinates of S. (4)

6.4 Find the average gradient of the curve $f$ between $x = 0$ and $x = -3$ (3)

6.5 Give the equation of $k$ if $k(x)$ results from shifting $f(x)$ a $\frac{3}{4}$ unit to the left. (2)

6.6 Give the equation of $j$ if $j(x)$ results from shifting $g(x)$ 1 unit up. (2)

**[20]**

**Question 7**

Consider the equation $h(x) = -\frac{4}{x+2} + 4$

7.1 Determine the root of $h(x) = 0$ (3)

7.2 What is the value of $h(0)$? (3)

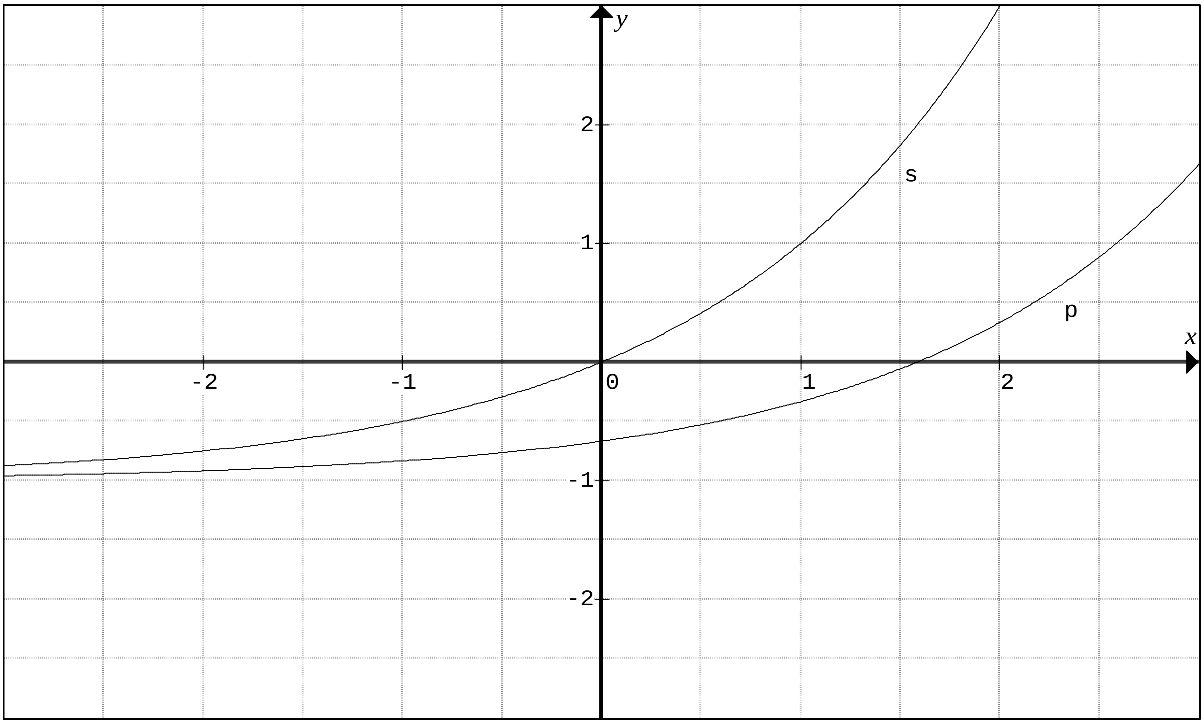
7.3 Write down the equation/s representing the asymptote/s of this function (2)

7.4 Draw a sketch of $h(x)$ showing clearly all intercepts with axes and any asymptotes that may exist. If there are any lines of symmetry, indicate these on the sketch. (6)

**[14]**

**Question 8**

The graphs below are the functions $p(x) = a.b^x - c$ and $s(x) = b^x - c$




8.1 What is the value of c (2)

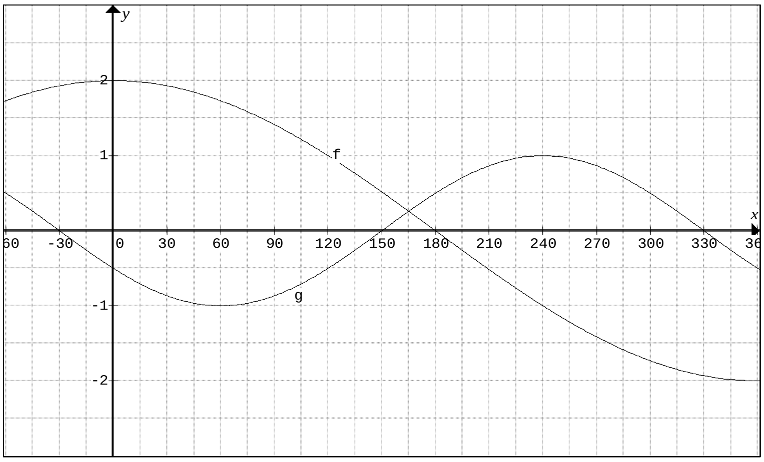
8.2 If the curve of $s(x)$ passes through the point $(1;1)$, find the value of b. (3)

8.3 If $p(x)$ cuts the $y-axis$ at $y = -\frac{2}{3}$, find the value of a. (3)

8.4 Determine the equation of $r$ if $p(x)$ is shifted 2 units to the right to create $r(x)$ (2)

**[10]**

## Question 9




The sketch represents the functions

$f(x) = a\cos bx$ and
$g(x) = c\sin(x + d)$

for the interval $x \in [-60;360]$

9.1 Determine the values of a, b, c and d (6)

9.2 Read off the graph the value of x for which $f(x) = g(x)$ (1)

9.3 Write down the equation of $h$ if $h(x) = g(x - 10)^\circ$ (2)

9.4 What is the equation of $p$ if $p(x)$ is the reflection of $f(x)$ in the line $y = 0$ (1)

**[10]**

## Question 10

A chocolate factory produces both chocolate coated raisons as well as chocolate coated peanuts. In a day, they can produce a maximum of 100kg's of raisons and 125kg's of peanuts. They are mixed together and sold in two different packets. The 'Nuts about Nuts' packet has one third raisons and two thirds peanuts. The other packet, 'Half-n-Half', has equal quantities of both.Packets of 'Nuts about Nuts' sell at a profit of R4 per kilogram while the 'Half-n-Half' sells at a profit of R5 per kilogram.

Let there be x kg's of 'Half-n-Half' produced in a day and y kg's of 'Nuts about Nuts'.

10.1 Give, in terms of x and y, the mathematical constraints that must be satisfied each day. (4)

10.2 Write down a function for the Profit (P) to be made (2)

10.3 Illustrate the constraints graphically, on the grid paper provided. Clearly indicate the feasible region. (8)

10.4 Use your graph to determine;

10.4.1 the values of x and y that will ensure maximum profit. (4)

10.4.2 the profit earned according to the values found in 10.4.1 (2)

**[20]**

## Diagram Sheet

**Question 3**

| Sketch number | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| No of internal lines | 0 | 1 | 2 | |
| Total number of triangles | 1 | 3 | 6 | |

**Question 4**

**Question 10**

Exam B

## Grade 11 Mathematics Exam — Paper 1

**Time: 3 hours** — **Marks: 150**

### Question 1

1.1 Solve for x in each of the following (in simplest surd form where applicable):

1.1.1 $x^2 + 2x = 1$ (4)

1.1.2 $2x^2 - x - 6 \leq 0$ (4)

1.1.3 $\frac{1}{x+3} + \frac{2x}{x-3} = 1$ (5)

1.2 Solve for both x and y in the system of equations below.

$xy + 6 = 0$ and $x + 3y + 3 = 0$ (7)

**[20]**

### Question 2

Simplify the following;

2.1 $\sqrt{3}\left(\sqrt{3} + \sqrt{6}\right) + \sqrt{2}$ (Answer in simplest surd form) (3)

2.2 Solve for $x : 3.2^{-x} = 0{,}375$ (3)

2.3 The mass of a certain microorganism is $\left(5 \times 10^{-8}\right)g$ . How many organisms are there in a population with a total mass of 0,25 $g$ ? (4)

**[10]**

### Question 3

3.1 Nthabi is running a small business. She has just bought equipment for R 500 000

3.1.1 She decides to depreciate the equipment at 20% p.a. on the straight line basis. When will she write the equipment off? (2)

3.1.2 Nthabi changes her mind and depreciates the equipment at 25% p.a. on the reducing balance. Calculate the value of the equipment after 5 years. Give your answer correct to the nearest Rand. (4)

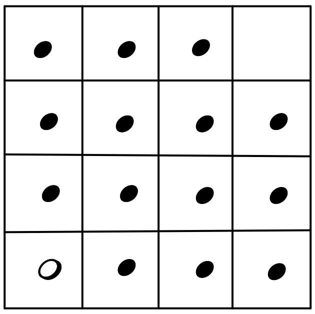
3.2 Which is the better investment offer: 10,28% p.a. compounded daily (use 365 days in a year) or 10,3% p.a. compounded monthly? (6)

3.3 John inherits R 80 000 and decides to invest the money so that he can finance weddings for his two daughters. The one gets married exactly one year later and he withdraws R50 000 to pay for this event. If interest of 10% p.a. compounded quarterly is applicable for two years and this rate then changes to 9,5% p.a. compounded monthly, calculate how much he will have available when his other daughter gets married after five years (four years after the first daughter). (8)

**[20]**

**Question 4**

- In the sketch below a 4 by 4 game board is illustrated. The aim of the game is to move the disc in the bottom left hand block into the top right hand block in the smallest number of moves.
- It was found that for this board, the smallest number of moves is 21.



The same game can be played on bigger or on smaller boards. The following are the smallest number of moves on the given sized boards:

| | 2 by 2 | 3 by 3 | 4 by 4 | 5 by 5 |
|---|---|---|---|---|
| Smallest number of moves | 5 | 13 | 21 | 29 |

4.1 What is the smallest number of moves on a 6 by 6 board? (2)

4.2 What is the smallest number of moves on an $n$ by $n$ board? (4)

4.3 Lindiwe says the smallest number of moves for an $n$ by $n$ board is $an+b$ where $a$ and $b$ can be determined from the equations: $5=2a+b$ and $13=3a+b$
Is she correct? Justify your answer fully. (6)

**[10]**

**Question 5**

Consider the following patterns of diamond shapes:

♦ ♦ ♦

♦ ♦ ♦ ♦
♦ ♦ ♦ ♦

♦ ♦ ♦ ♦ ♦
♦ ♦ ♦ ♦ ♦
♦ ♦ ♦ ♦ ♦

5.1 How many diamonds(♦) are there in the next pattern? (2)

5.2 How many diamonds are there in the *n*th pattern? (4)

5.3 Which pattern has 960 diamonds? (4)

**[10]**

## Question 6

Given the functions $y = f(x) = -\frac{1}{2}(x+1)^2 + 2$ and $y = g(x) = -2x - 6$:

6.1 Write down the co-ordinates of the turning point of $f$ (2)

6.2 Calculate the roots of the equation $f(x) = 0$ (4)

6.3 Write down the equation of the axis of symmetry of $f$ . (1)

6.4 Sketch the graphs of $y = f(x)$ and $y = g(x)$ on the same system of axes (4)

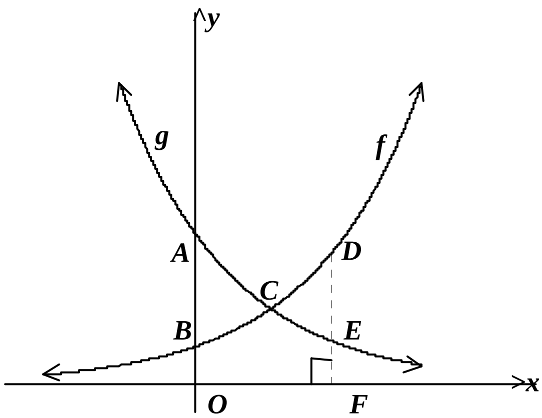
6.5 Determine the values of $x$ for which $f(x) \geq g(x)$ (4)

6.6 Describe in words the difference between shape of $y = f(x)$ and $y = 2f(x)$ (2)

**[17]**

## Question 7

Sketched below are the functions $y = f(x) = 2^{x-2}$ and $y = g(x) = 2^{1-x}$ .. A and B are intercepts of the two graphs with the $y$ -axis and C is the point of intersection of the two graphs. DEF is parallel to the $y$ -axis with D and E on the two graphs.




7.1 Determine the distance AB. (3)

7.2 Given that OF = 3 units, determine the average gradient between the points

7.2.1 A and E and (2)

7.2.2 B and D and hence (1)

7.2.3 determine which curve is steeper between $x = 0$ and $x = 3$ (1)

7.3 Determine the co-ordinates of C (2)

7.4 Write down the equation that results if $y = 2^{1-x}$ is shifted 1 unit to the right. (2)

7.5 Write down the equation if $y = 2^{x-1}$ is shifted 1 unit down. (2)

**[13]**

## Question 8

Sketched below are the graphs of $p(x)=\dfrac{3}{x-1}-2$ and $q(x)=x-1$

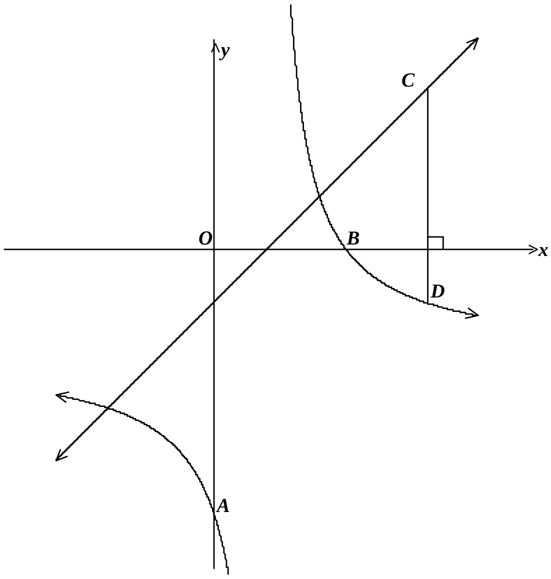
8.1 Calculate the co-ordinates of A and B. (4)

8.2 Write down the equation of the horizontal asymptote of $p(x)$ (2)

8.3 Write down the domain of $p(x)$ (2)

8.4 Show that $p(-2)=q(-2)$ and state the significance of this fact to the sketch. (3)

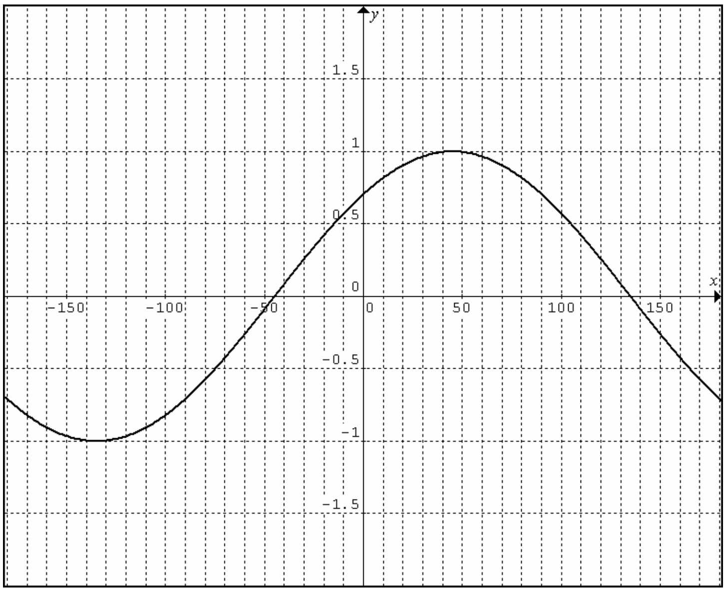
8.5 Determine the co-ordinates of D if $CD = 4$ where $CD$ is perpendicular to the $x$-axis. (5)




**[16]**

## Question 9

The sketch below represents the function $f(x)=a\cos(bx+c)$ for the interval $x\in[-180^0;180^0]$




9.1 Determine the values of a, b and c (4)

9.2 On the diagram sheet, plot the graph of $g(x)=\sin 2x$ (4)

9.3 Write down the equation of the reflection of $f(x)$ about the $y$ axis. (2)

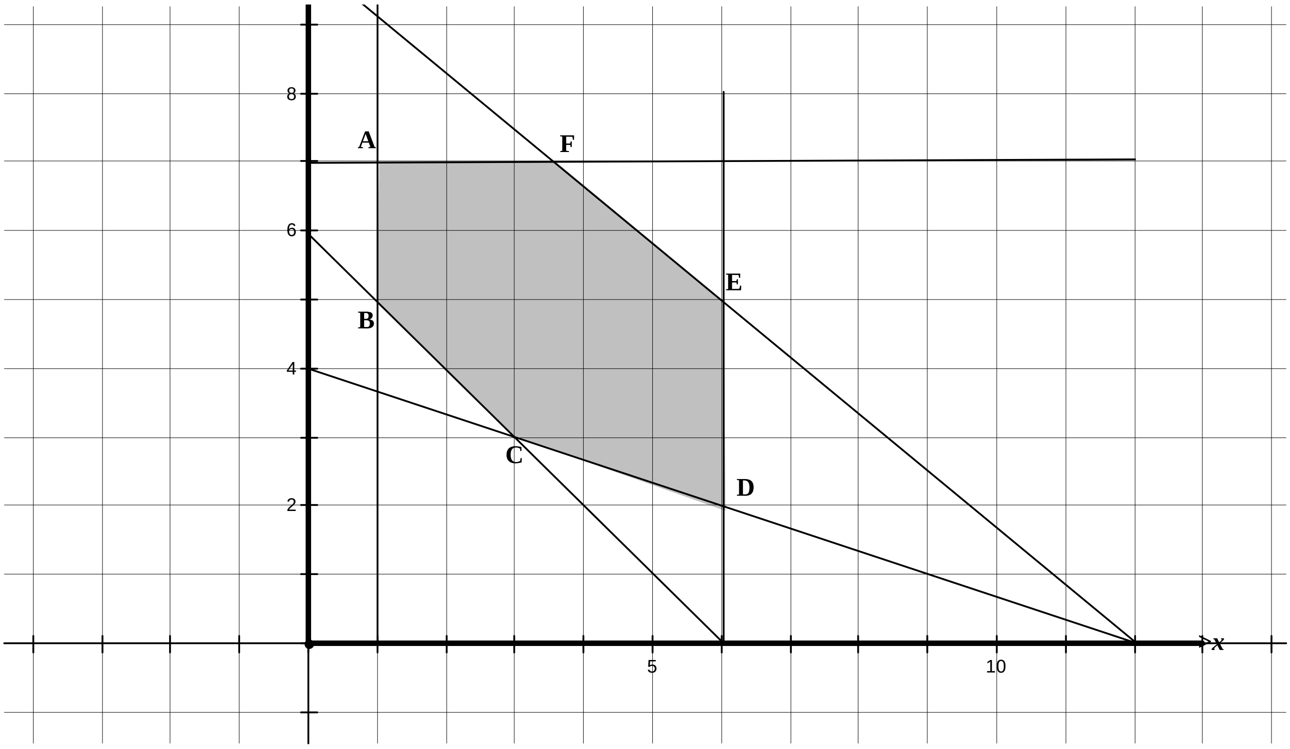
9.4 Write down the equation of the reflection of $g(x)$ about the $x$ axis. (2)

9.5 Read from your graph the values of $x\in[-180^0;180^0]$ for which $f(x)=g(x)$ (3)

**[15]**

## Question 10

The sketch below represents the feasible region ABCDEF of a linear programming problem.




10.1 Two of the constraints are $1 \leq x \leq 6$ and $6y + 5x \leq 60$. Write down the inequalities that represent the other constraints. (5)

10.2 The point $P(5; p)$ lies in the feasible region and the point $Q(q;3)$ is not in the feasible region. Write down one possible value of $p$ and one possible value of $q$. (2)

10.3 Find the values of $x$ and $y$ for which the objective function $O_1 = 8x + 4y$ has a minimum value. (2)

10.4 Write down the minimum value of $O_1$ (1)

10.5 Find the values of $x$ and $y$ for which $O_2 = 3y + 4x$ is maximised. (2)

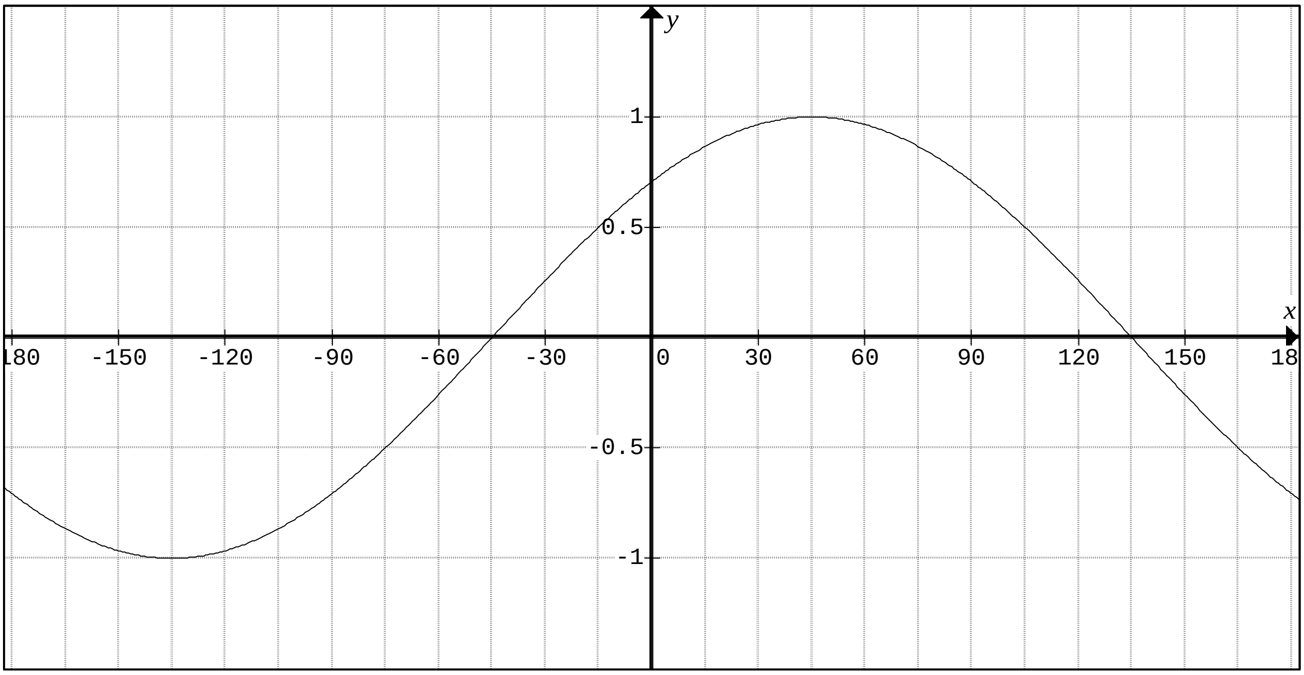
10.6 Write down the maximum value of $O_2$ (1)

10.7 Marlene says that $O_3 = 6y + 5x$ maximises at more than one point. Is she right? Explain. (4)

**[17]**

**Diagram Sheet** **Name: ________________________________**

**Question 9**



## Grade 11 Assignment: Analytical and Transformation Geometry  Marks: 50

A metacog may be seen as something between a mind map and a summary. It is the way you choose to order your knowledge and understanding of a particular topic. Using your notes, text book and any other reference source, develop a metacog that you can use as a learning and revision aid for analytical and transformation geometry.

Use the rubric provided as a guide to what you should include. Once you have developed your metacog, you will be required to use it to answer a series of questions.

RUBRIC **[35]**

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| **INCLUSION OF IMPORTANT CONTENT** | Substantial amounts of important content have been omitted. | Key aspects of content have been omitted. | Most important content has been included. | Almost all important content has been included. | All important content has been included. |
| **ARRANGEMENT OF CONTENT** | No attempt made to group and sequence content. | Little attempt made to group and sequence content. | Either the sequencing or grouping of content is not logical. | Most content is both logically grouped and sequenced. | Content has been both logically grouped and sequenced. |
| **INCLUSION OF FORMULAS** | Formulas have not been included. | Fewer than half the necessary formulas have been included. | Most of the necessary formulas have been included. | One or two necessary formulas have been omitted. | All necessary formulas have been included. |
| **EXPLANATION OF FORMULAS** | Formulas have not been included. | Elements of formulas seldom explained. | Explanation of elements of formulas omitted in several instances. | One or two omissions in explanation of elements of formulas. | The elements of all formulas have been clearly explained. |
| **DERIVATION OF FORMULAS** | Formulas have not been included. | Derivation of formulas seldom noted. | Derivation of formulas not noted in several instances. | One or two omissions in noting derivation of formulas. | Derivation of all formulas has been clearly noted. |
| **USE OF DIAGRAMS** | No attempt made to include diagrams. | Inadequate attempt made to include diagrams. | Diagrams not always included resulting in confusion about content. | Diagrams included, but on occasions, either unclear or not relevant. | Diagrams included. Clearly drawn and relevant. |
| **APPLICATION OF KNOWLEDGE** | No attempt made to include applications of knowledge. | Inclusion of applications of knowledge mostly inadequate. | Applications of knowledge are mostly sufficient. | Applications of knowledge are included but either contain repetition or are not sufficient in one or two instances. | Key and different applications of knowledge are included. |

USING YOUR RUBRIC, ANSWER THE FOLLOWING QUESTIONS:
(No assistance may be given or any other source used in order to answer the questions.)

1. Write down the formula for calculating the distance between two points.

2. Which theorem is used to derive this formula?

3. Explain how you would use the distance formula to prove that two triangles are congruent.

4. Write down the formula for calculating the midpoint of a line joining two points.

5. Explain how you would use the midpoint formula to prove that a quadrilateral is a parallelogram.

6. What is the difference between gradient and inclination?

7. Explain how you would use gradient to determine whether or not three points were collinear.

8. If two lines are perpendicular, what is the relationship between their gradients?

9. When you try to calculate the gradient of a line using the inclination, your calculator shows an error message. How do you interpret this?

10. Write down the general equation of a straight line passing through two points.

11. If you know the equation of one side of a parallelogram, what additional information do you require in order to calculate the equation of the opposite side?

12. The point A(4;1) is mapped onto A' using the rule $(x;y) \rightarrow (x+1;y-2)$. Where is the point A' in relation to A?

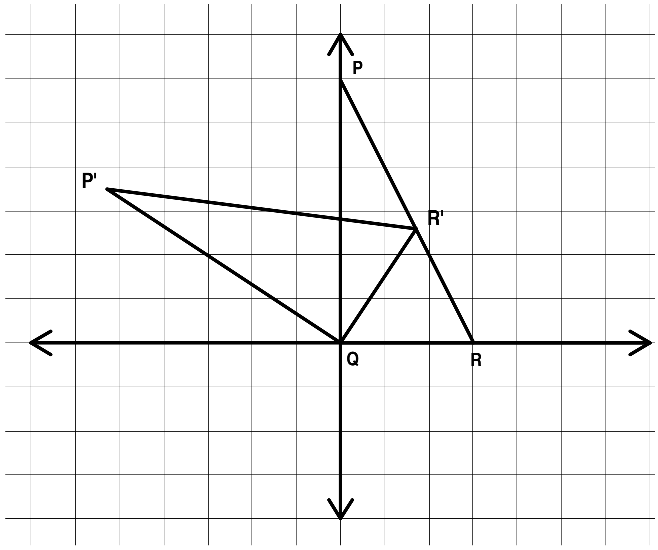
13. The point B' is the reflection of B(0:-2) about the line $y = x$. What are the coordinates of B'?

14. Explain the transformation that is being used if $(x;y) \rightarrow (-x;-y)$.

15. Polygon A'B'C'D' is an enlargment through the origin by a factor of 2 of polygon ABCD. Describe the relationship between AB and A'B'.

**[15]**

**Grade 11 Investigation:** **Marks: 50**




Refer to the figure above. $\Delta PQR$ is a right-angled triangle, with the right-angle lying on the origin and coordinates P(0;6), Q(0;0), R(3;0). $\Delta PQR$ has been rotated about the origin so that R' lies on the hypotenuse $PR$ .

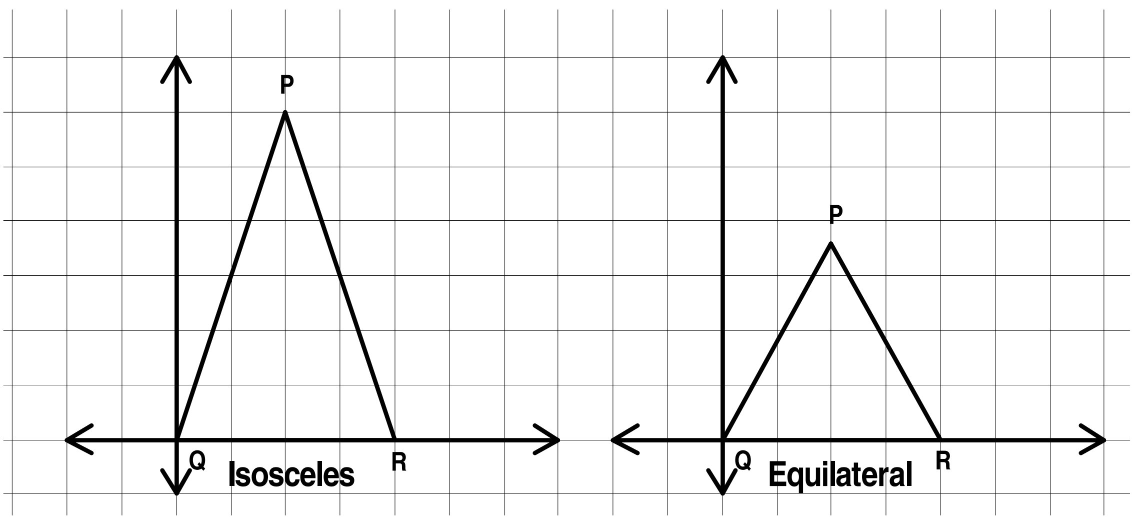
1 Use any method to determine the angles of $\Delta PQR$ and $\Delta P'QR'$, and the angle of rotation of $\Delta PQR$ . Show all calculations. (6)

2 Develop a conjecture about the relationship between the angle of rotation and $\angle P$ . (2)

3 Prove your conjecture. (4)

4 Investigate the conditions under which the conjecture is true and under which conditions it is no longer true. Write up your conclusions, with proofs where possible.

5 Expand the investigation to include the following situations and write up your results:




6 What happens when $\Delta PQR$ is scalene?

**Assessment Guidelines**

Questions 1, 2 and 3 will be marked according to a memorandum, with marks as indicated.

The remainder of the investigation will be marked using the grid below:

<table>
<tr><td></td><td colspan="4">How well have you communicated your ideas and discoveries? You should assume that the person marking your work has not seen the problem before. You should include diagrams, 2-D models, accurate constructions (as appropriate) to clarify your communication.</td><td colspan="4">How well you have thought about the problem. Is there evidence that you have investigated the problem? Have you considered different possibilities? Have you made an attempt to extend your thoughts and ideas beyond the obvious?</td><td colspan="4">Has your investigation led you to make any conjectures about the problem? Have you attempted to prove or disprove these conjectures? Have you successfully proved or disproved the conjectures?</td></tr>
<tr><td>Q4</td><td>0</td><td>1</td><td>2</td><td>3</td><td>0</td><td>1</td><td>2</td><td>3</td><td>0</td><td>1</td><td>2</td><td>3</td></tr>
<tr><td>Q5</td><td>0</td><td>2</td><td>4</td><td>6</td><td>0</td><td>2</td><td>4</td><td>6</td><td>0</td><td>2</td><td>4</td><td>6</td></tr>
<tr><td>Q6</td><td>0</td><td>1</td><td>2</td><td>3</td><td>0</td><td>1</td><td>2</td><td>3</td><td>0</td><td>1</td><td>2</td><td>3</td></tr>
<tr><td colspan="2">PRESENTATION</td><td>0</td><td>1</td><td>2</td></tr>
</table>

# Control Test

## Grade 11 Test: Trigonometry and Mensuration

**Time: 1 hour** **Marks: 50**

### Question 1

1.1 Simplify the following expressions without the use of a calculator and show ALL the calculations:

1.1.1 $\dfrac{\cos 38^\circ \sin 315^\circ}{\cos 225^\circ \sin 128^\circ}$ (3)

1.1.2 $\dfrac{\sin(180^\circ + x)\ .\ \sin(90^\circ + x)}{\tan(-x)} + \sin x\ .\ \cos(90^\circ - x)$ (5)

1.2 If $\sin\alpha = -\dfrac{3}{5}$ and 180° < α < 270°, determine the value of:

1.2.1 tan α sin α. (2)

1.2.2 sin α + cos α (2)

1.2.3 Determine the numerical value of α. (1)

1.3 Show that: $\dfrac{1}{1-\cos x} - \dfrac{1}{1+\cos x} = \dfrac{2}{\sin x \tan x}$ (5)

**[18]**

### Question 2

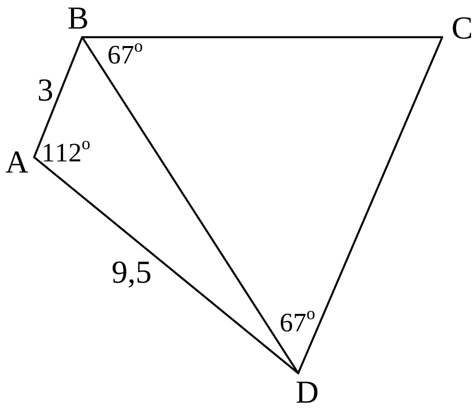
2.1 If 3 sin θ = 1,347, calculate cos (2θ - 15°) for θ ∈ (0°; 180°) (4)

2.2 Determine the general solution for : $\sin x\ .\ (2\cos x - 1) = 0$ (6)

**[10]**

**Question 3**

In the diagram below : AB = 3 units ; AD = 9,5 units ; $\hat{A} = 112^\circ$ ; $C\hat{B}D = B\hat{D}C = 67^\circ$




3.1 Show, by calculation, that BD = 10,98 units (2)

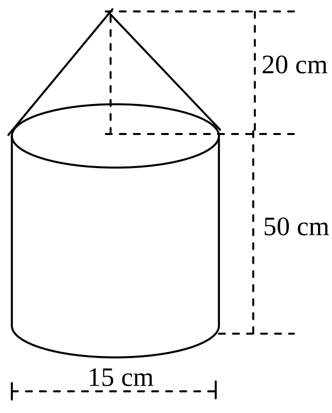
3.2 Hence calculate the perimeter of ABCD. (6)

3.3 Calculate the area ABCD (4)

**[12]**

**Question 4**

A time-capsule is made of a cone and a cylinder and is filled with goods for remembrance.
Its dimensions are as given in the sketch.




4.1 Calculate the volume of the capsule. (5)

4.2 Calculate the total surface area of the capsule. (5)

**[10]**

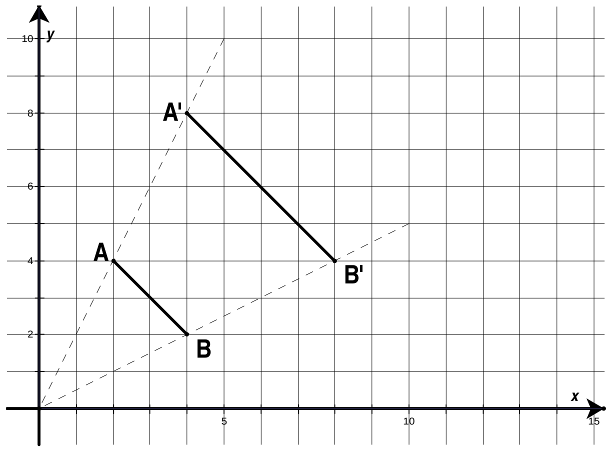
## Grade 11 Project: Enlargements **Marks:**

### Section A

| |
|---|
| The **centre of enlargement** is the origin for all these examples.<br>*Definition*: **Scale Factor** - is the number you multiply the original lengths by to get the lengths on the enlargement. |

Each grid has an $x$-axis from –1 to 15, and a $y$-axis from – 2 to 15.

### Question 1




1.1 Use the grid and complete:
A ( ; ) B ( ; ) A' ( ; ) B' ( ; )

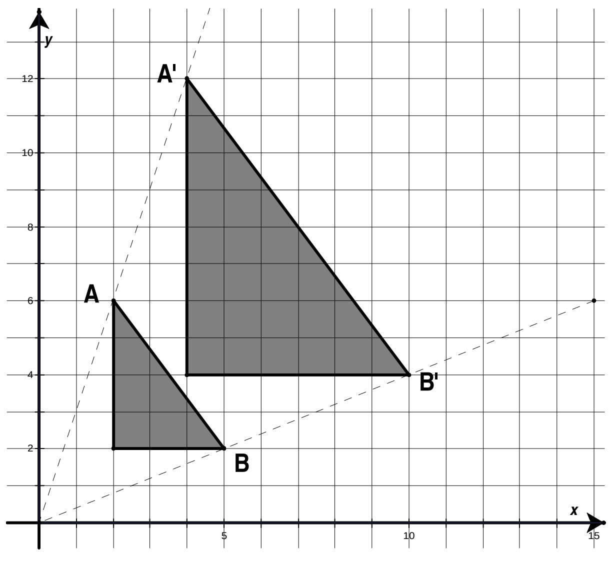
1.2 What do you notice about the co-ordinates of the images A' and B' ?

1.3 Calculate the length of AB and A'B'.

1.4 What do you notice?

1.5 What is the scale factor for this enlargement?

### Question 2




2.1 Use the grid and complete:
A ( ; ) B ( ; ) A' ( ; ) B' ( ; )

2.2 What do you notice about the co-ordinates of the images A' and B' ?

2.3 Calculate the length of AB and A'B'.

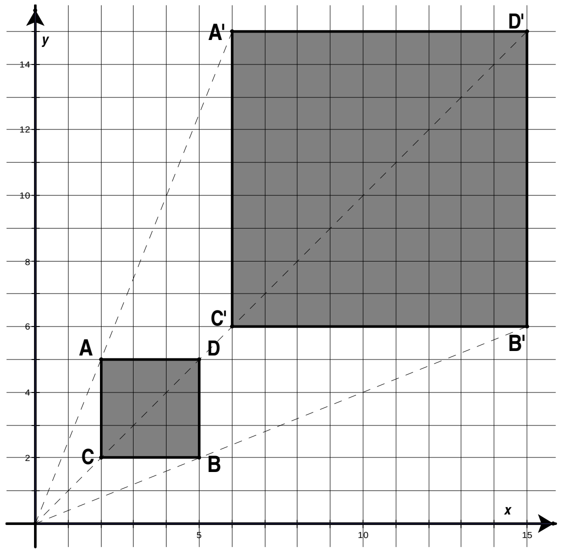
2.4 What do you notice?

2.5 What is the scale factor for this enlargement?

2.6 Calculate the area for each triangle.

2.7 What is the area scale factor?

**Question 3**




3.1 Use the grid and complete:
A ( ; ) B ( ; ) A' ( ; ) B' ( ; )

3.2 What do you notice about the co-ordinates?

3.3 Calculate the length of CB and AC.

3.4 Calculate the length of C'B' and A'C'

3.5 What do you notice?

3.6 What is the scale factor for this enlargement?

3.7 Calculate the area of both rectangles.

3.8 What is the area scale factor?

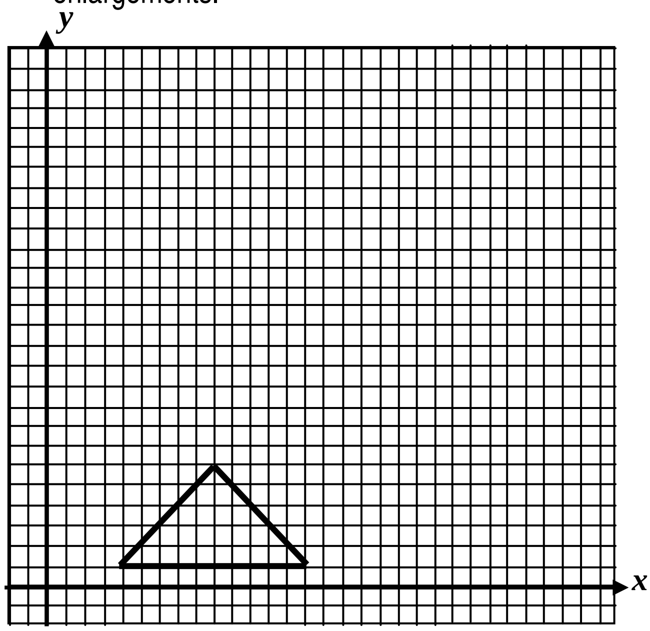
**Question 4**

4.1 Write down conjectures about the coordinates, lengths of sides and area of A' B' C' D' in question 3.

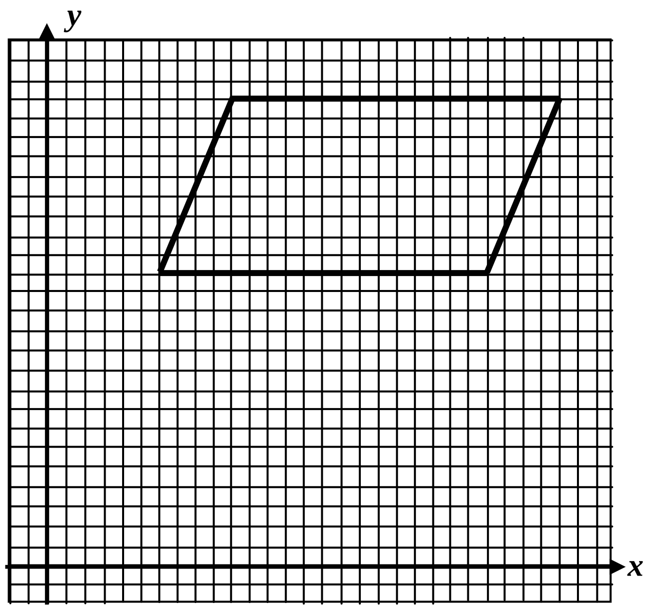
4.2 Do you think this will always be true for any enlargement through the origin?

**Question 5**

5.1 Put each shape below through the enlargement described.
All enlargements are through the origin.
Draw the enlargements on the grids provided. Use your conjecture to determine the co- ordinates of the enlargements.




Scale factor = 3



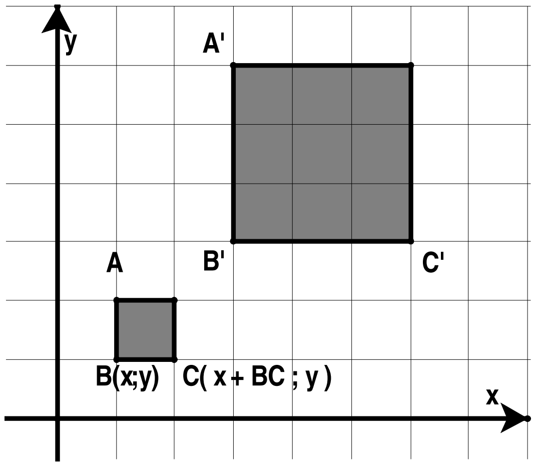

Scale factor = $\frac{1}{3}$

5.2 Did your conjecture give the correct answers? Explain.

**Question 6**

Let's try and prove this conjecture!
Use the grid provided.

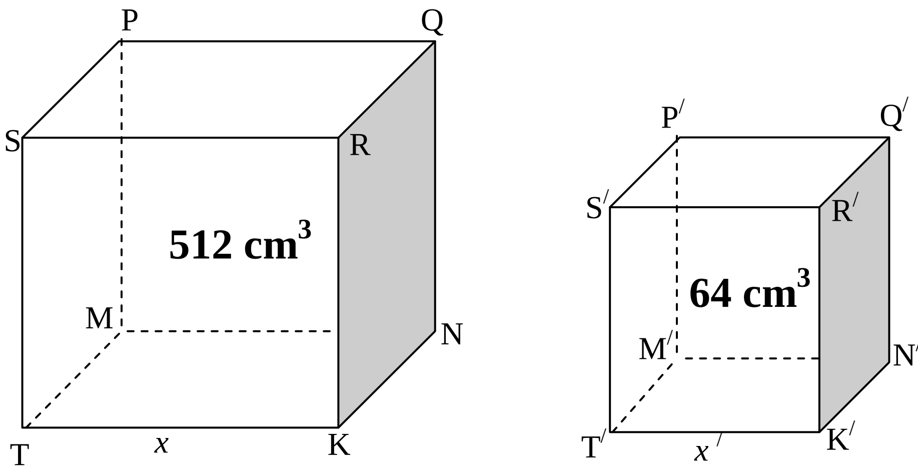
The scale factor is k.
(*Hint:* Prove that BC x k = B'C')



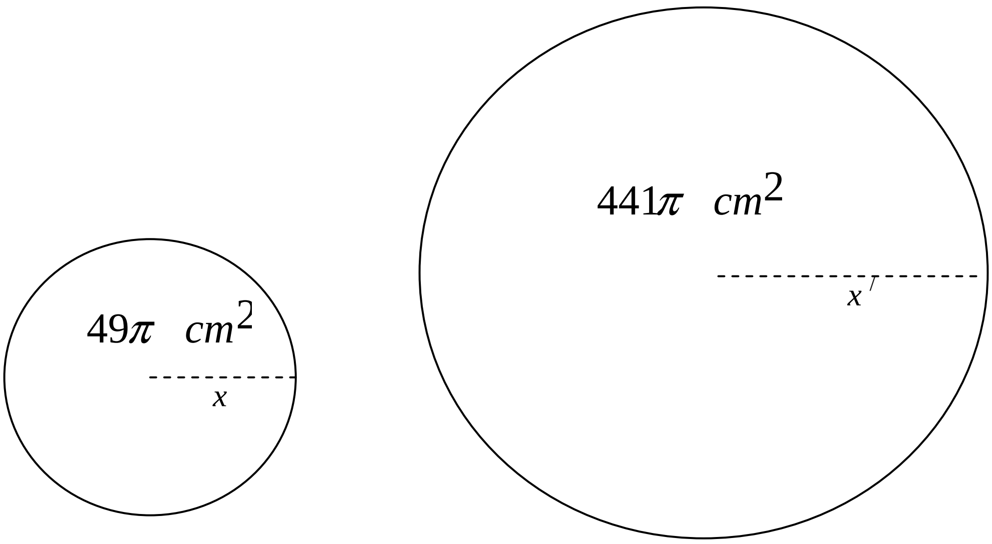

**Question 7**

The cube and the circle below show enlargements or reductions but have not been drawn to scale. In each case, write down the scale factor and calculate $x$. (The volumes of the cubes and the areas of the circles are given.)

7.1




7.2

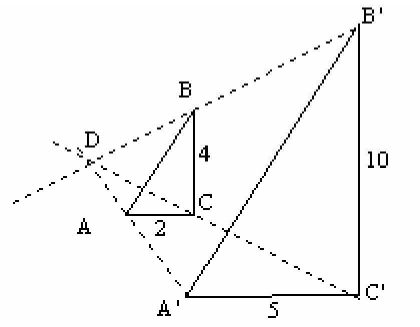



7.3 Write down any conjectures that you notice about the above enlargements.

**Section B**

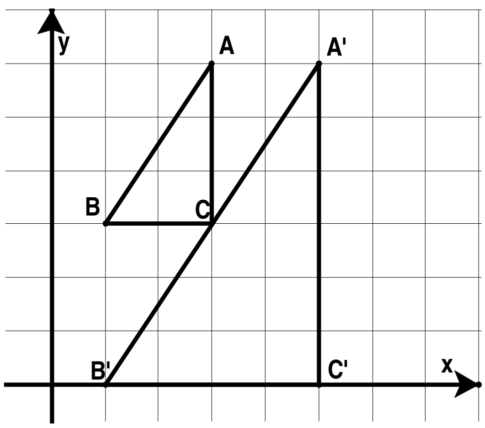
*Note:* Finding the **centre of Enlargement**

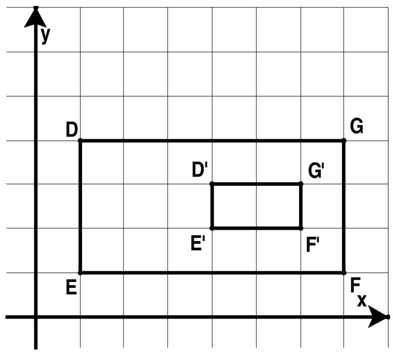
To find the centre of enlargement join A to A' , B to B' and C to C ' extending them if necessary. The point where these lines intersect is the centre of enlargement

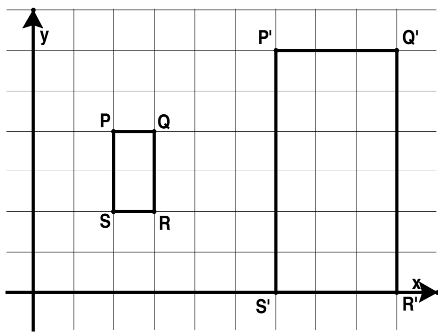


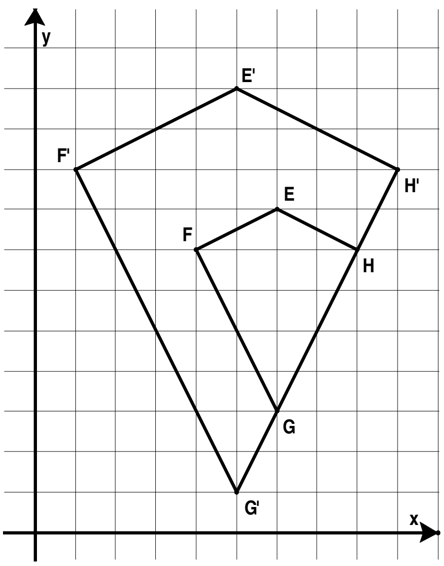

**Question 1**

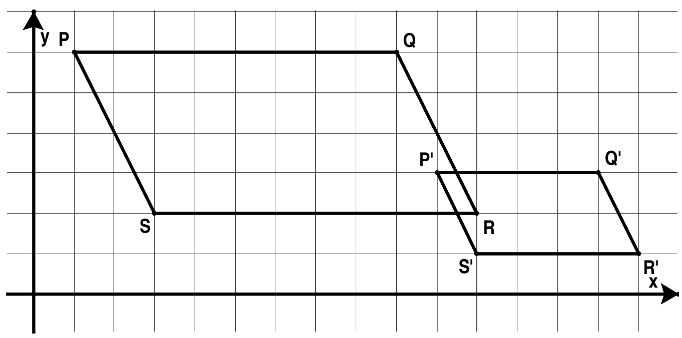
All the diagrams below show an enlargement or reduction. Find the position of the centre of enlargement or reduction and state the value of the scale factor




**Question 2**

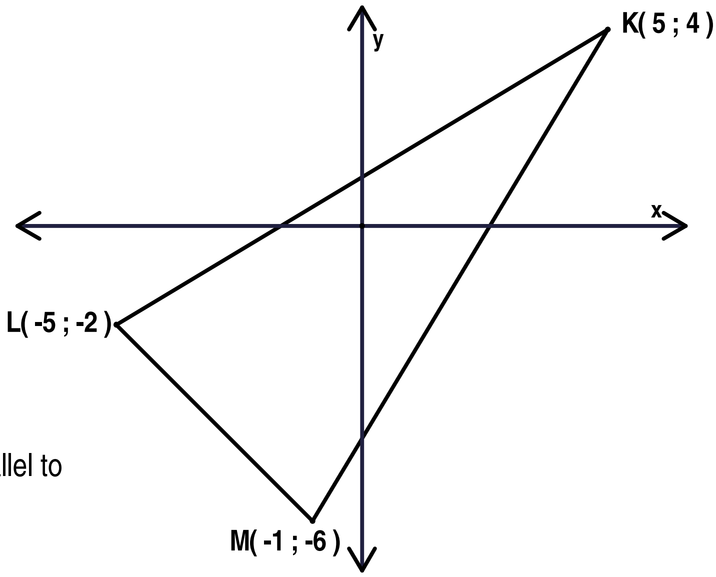
Determine a general formula for a scale factor *k* and centre of enlargement (*a* ; *b*)

## Grade 11 Mathematics Exam — Paper 2

**Time: 3 hours** — **Marks: 150**

### Question 1

In the diagram below, L(-5; -2), M(-1; -6) and K(5; 4) are the vertices of $\Delta KLM$ in a Cartesian plane.




Determine:

1.1 N, the midpoint of MK (3)

1.2 the gradient of LM (3)

1.3 the length of LM (leave the answer in simplest surd form) (3)

1.4 equation of the LM (4)

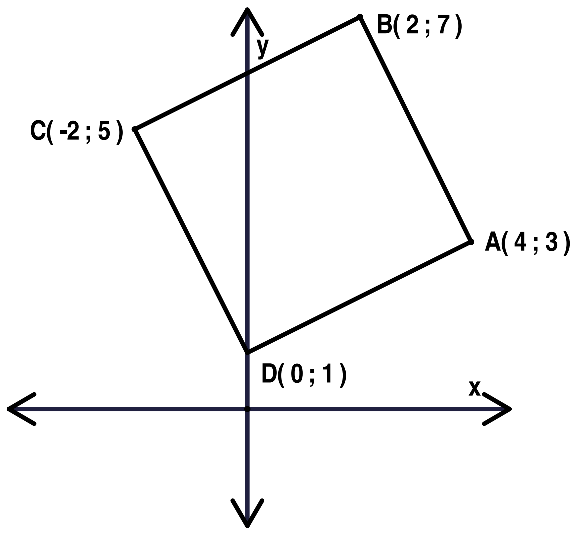
1.5 the equation of the line parallel to LM passing through N. (4)

1.6 the inclination of LM (3)

**[20]**

### Question 2

In the diagram below, A(4 ; 3), B (2 ; 7), C (-2 ; 5) and D (0 ; 1) are four points in a Cartesian plane.




2.1 Show that CA= BD (5)

2.2 Show that the coordinates of M, the midpoint of BD, are (1 ; 4) (3)

2.3 Prove that AM $\perp$ BD (5)

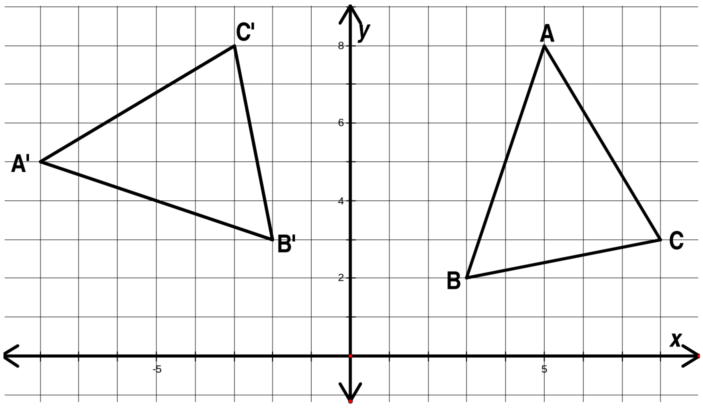
2.4 Prove that A, M and C are collinear (3)

2.5 State, giving a reason, which type of quadrilateral ABCD is. (2)

**[18]**

**Question 3**

The diagram alongside shows $\Delta ABC$ with its transformation $\Delta A^/ B^/ C^/$.




3.1 Write down the coordinates of A and $A^/$ (2)

3.2 Describe the above transformation. (2)

3.3 If $\Delta A^{//}B^{//}C^{//}$ is the rotation of $\Delta ABC$ through 180º, sketch $\Delta A^{//}B^{//}C^{//}$ using the diagram sheet provided. (3)

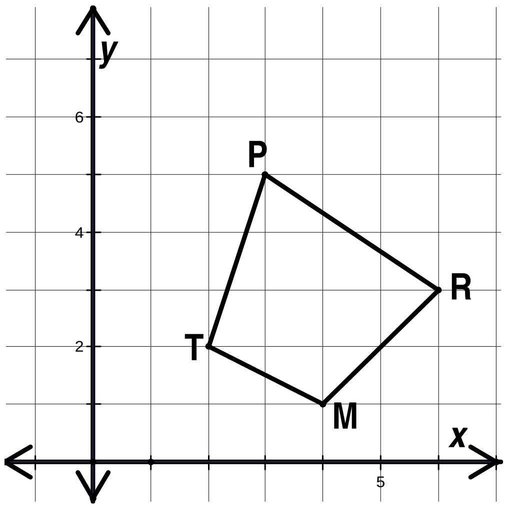
3.4 State the coordinates of vertex $C^{//}$. (2)

3.5 Write down the general coordinates of the transformation as described in question 3.3. (2)

**[11]**

**Question 4**

4.1 The diagram below shows quadrilateral PRMT with P(3 ; 5) on the Cartesian plane.




4.1.1 Sketch, using a scale factor of 4, the enlargement of PRMT through the origin using the grid on the diagram sheet. (4)

4.1.2 Write down the coordinates of $R^/$ and $T^/$ on the sketch. (2)

4.2 If K(3 ; 5) is rotated through the origin in a clockwise direction through an angle of 90º, write down the coordinates of $K^/$, the image of K. (2)

4.3 $\Delta ABC$ has coordinates A(2 ; 6), B(– 3 ; 4) and C(1 ; – 8 ) and its transformation $\Delta A^/B^/C^/$ has coordinates A(1 ; 3), B$\left(-\frac{3}{2};2\right)$ and C$\left(\frac{1}{2};-4\right)$. Describe the transformation. (3)

**[11]**

## Question 5

5.1 Simplify the following expressions and show ALL the calculations without using a calculator

5.1.1 $\dfrac{\cos(180^0 - x)\sin(x - 90^0) - 1}{\tan^2(540^0 + x)\sin(90^0 + x)\cos(-x)}$ (6)

5.1.2 $\dfrac{\sin 63°.\cos^2 135°.\tan 315°}{\sin 240°.\tan 150°.\cos 27°}$ (7)

5.2 Prove the following identity:

$$2 - \cos^2 x(2 + \tan^2 x) = \sin^2 x$$ (5)

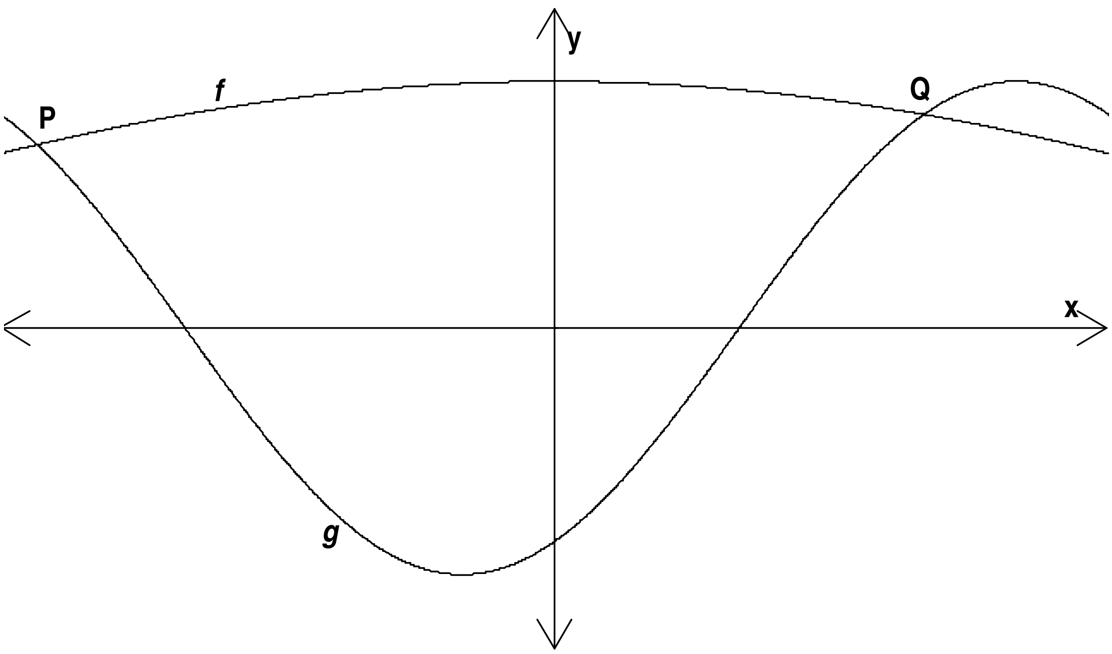
5.3 Solve for $x$ in the following equation: $\sqrt{2}\,\sin x - 1 = 0$ for $x \in [0° ; 360°]$ (4)

5.4 Determine the general solution of the equation: $4\sin^2 x - 3 = 0$. (6)

**[28]**

## Question 6

Sketched below are the graphs of functions $f(x) = \cos\dfrac{x}{4}$ and $g(x) = \sin(x - 60°)$ for $x \in [-180°; 180°]$. The curves intersect at points O and Q.




6.1 Determine the co-ordinates of the point Q (6)

.

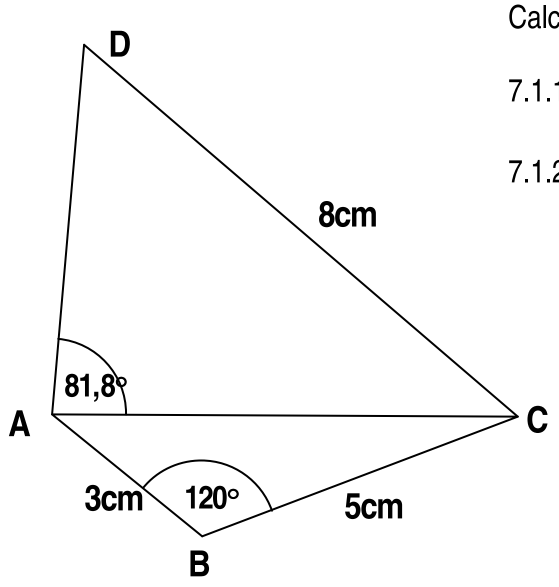
6.2 State the range of *g* if the graph of *g* undergoes a positive, vertical shift of 1 unit. (2)

6.3 Write down the new equation of *g* if it is shifted 60º horizontally to the left. (2)

**[10]**

## Question 7

7.1 In the accompanying figure ABCD is a quadrilateral with AB = 3cm, $\hat{B} = 120^\circ$, BC = 5cm, DC = 8cm and $D\hat{A}C = 81{,}8^\circ$.

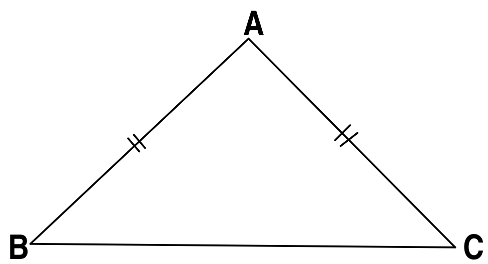



Calculate:

7.1.1 AC (4)

7.1.2 $\hat{D}$ correct to 1 decimal place. (4)

7.2 In the figure ABC is an isosceles triangle with b = c.



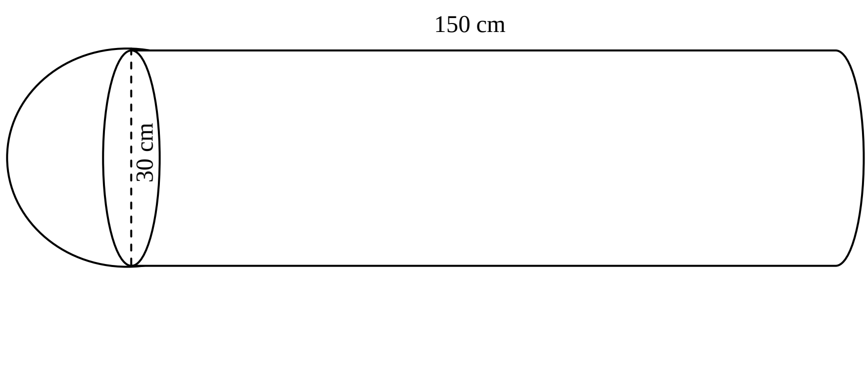

7.2.1 Use the figure to show that $b^2 = \dfrac{2(area\Delta ABC)}{\sin A}$ (2)

7.2.2 Now use the cosine rule to show that $b^2 = \dfrac{a^2}{2(1-\cos A)}$ (2)

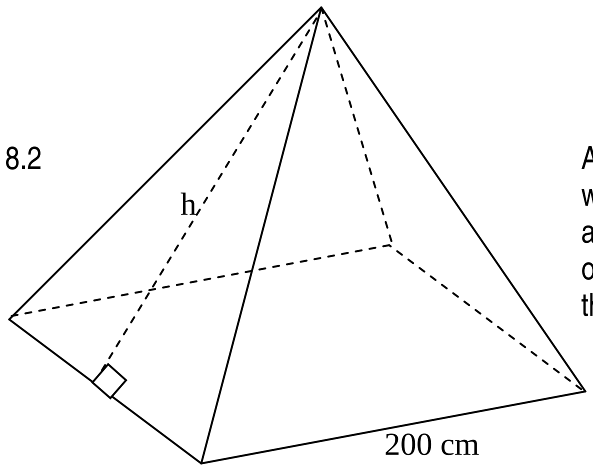
**[12]**

## Question 8

8.1 A time-capsule in which mementoes will be saved consists of a cylindrical body with a with a hemisphere on top. The diameter of the cylinder is 30 cm and the height of the cylinder is 150 cm. Calculate the total volume of the time-capsule.




(5)




8.2 A tent manufacturer makes a tent in the shape of a pyramid with a square base. The square ground sheet of the tent is attached to the tent. If slant height, h, is 350 cm and a side of the base is 200 cm , calculate the total surface area of the tent. (5)

**[10]**

**Question 9**

9.1 Below are the percentage scores that 15 learners obtained in a Physical Science Examination

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 72 | 57 | 63 | 81 | 60 | 51 | 96 | 66 |
| 78 | 54 | 39 | 69 | 90 | 30 | 39 | |

9.1.1 What is the median for the above data? (2)

9.1.2 Write down the upper and lower quartiles. (2)

9.1.3 Draw a box and whisker diagram for the data. (2)

9.2 The traffic department investigated where it would be most appropriate to in install speed cameras. As part of their investigation a survey was done of the different speeds of vehicles on a stretch of a national road. The following table shows the results of the survey:

| **SPEED (in km/h)** | **FREQUENCY (Of vehicles)** | **CUMULATIVE FREQUENCY** |
|---|---|---|
| $40 < d \leq 60$ | 49 | |
| $60 < d \leq 80$ | 92 | |
| $80 < d \leq 100$ | 134 | |
| $100 < d \leq 120$ | 158 | |
| $120 < d \leq 140$ | 49 | |
| $140 < d \leq 160$ | 17 | |
| $160 < d \leq 180$ | 1 | |

9.2.1 How many vehicles were observed in the survey? (1)

9.2.2 Complete the cumulative frequency column using the table on the diagram sheet. (2)

9.2.3 Represent the information in the table by drawing an ogive (cumulative frequency curve) on the grid provided on the diagram sheet. (4)

9.2.4 Use your graph to determine the median speed. Indicate on your graph using the letter T where you would read off your answer. (3)

**[16]**

**QUESTION 10**

The data below gives the number of homeruns scored by ten Western Province baseball players over 5 seasons.

| | | | | |
|---|---|---|---|---|
| 24 | 6 | 16 | 10 | 13 |
| 17 | 10 | 9 | 14 | 11 |

| **DATA** | $(x_i - \bar{x})$ | $(x_i - \bar{x})^2$ |
|---|---|---|
| 24 | | |
| 6 | | |
| 16 | | |
| 10 | | |
| 13 | | |
| 17 | | |
| 10 | | |
| 9 | | |
| 14 | | |
| 11 | | |
| $\sum_{i=1}^{n}(x_i - \bar{x})^2 =$ | | |

10.1 Calculate the mean number of homeruns. (2)

10.2 Complete the above table on the diagram sheet and use it to calculate the variance of the homeruns. (4)

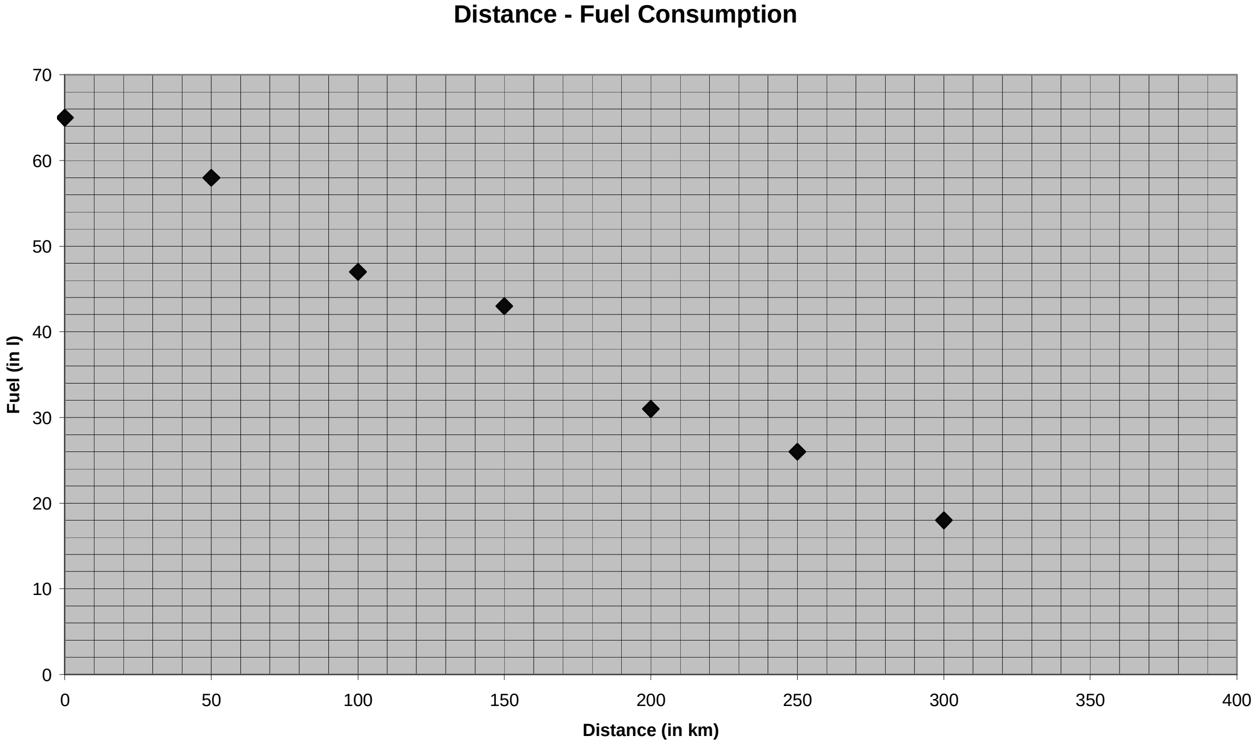
10.3 Now write down the standard deviation. (1)

10.4 What can you deduce from the standard deviation about the homeruns scored by the ten players? (2)

**[9]**

## QUESTION 11

A car with a 65 *l* fuel tank capacity used fuel over certain distances travelled as shown in the graph below:



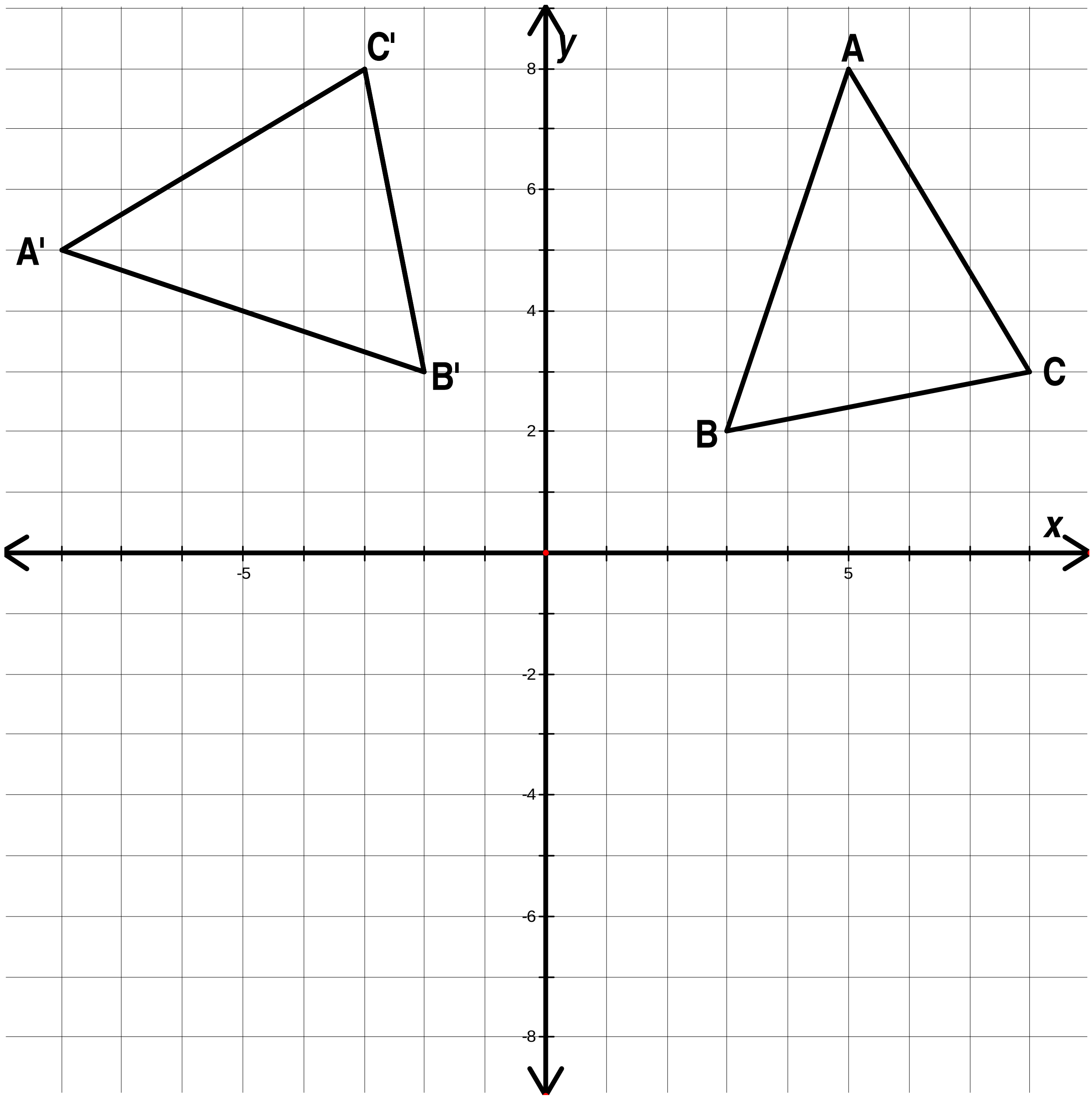

11.1 Draw an approximate line of best fit and find its equation. (4)

11.2 Use your equation to determine after how many kilometres the tank will be empty. (1)

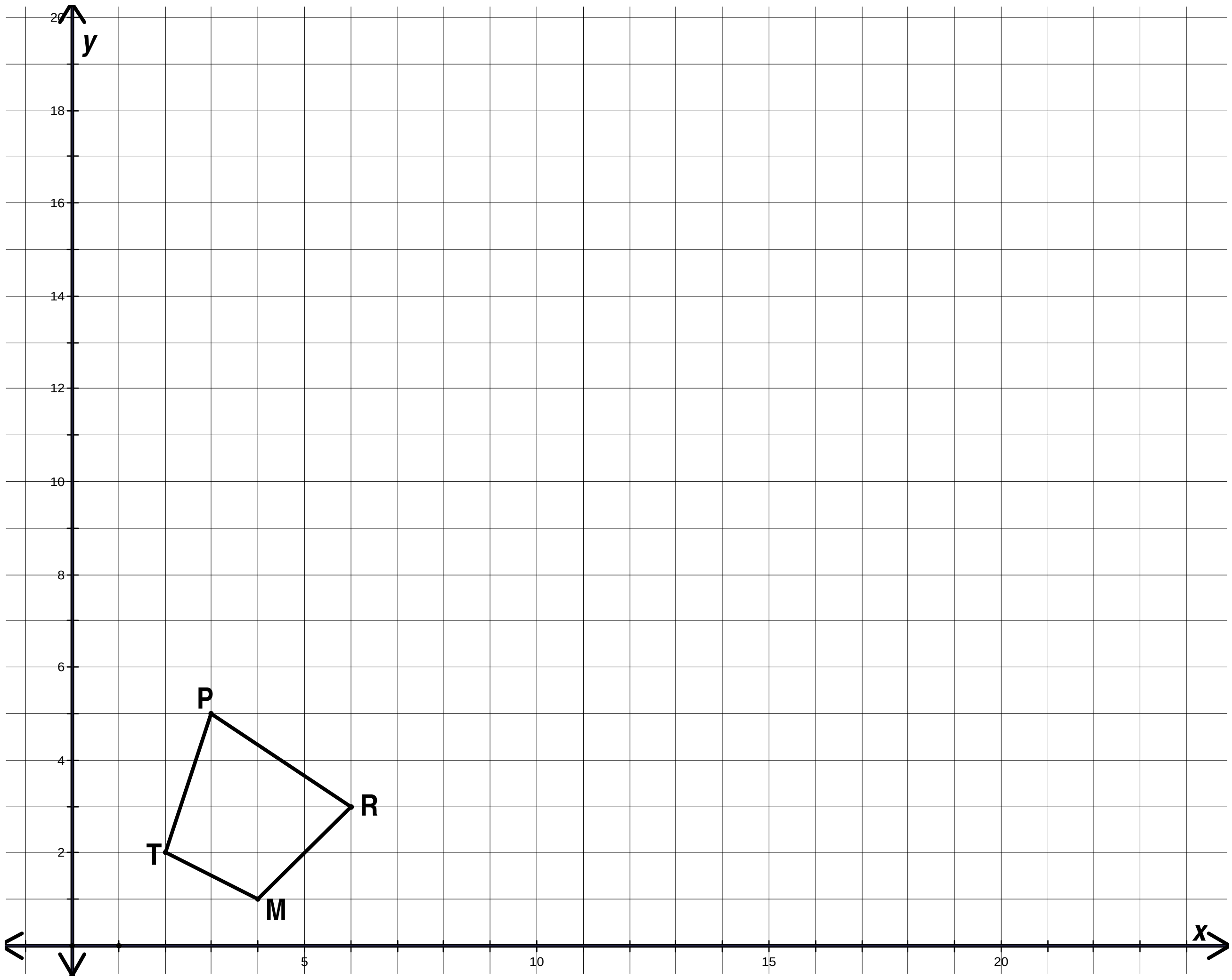
**[5]**

**Diagram Sheet**

**Question 3**



## Question 4




## Question 9

9.2.2

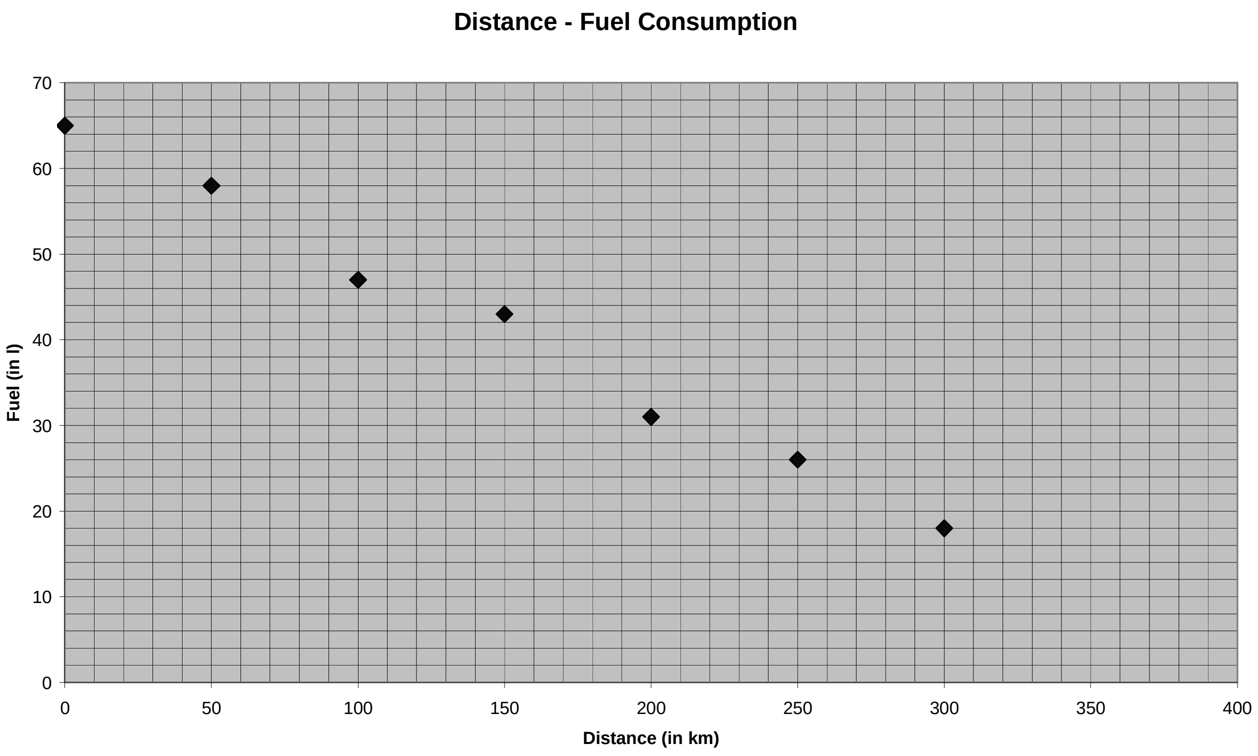
| SPEED (in km/h) | FREQUENCY (Of vehicles) | CUMULATIVE FREQUENCY |
|---|---|---|
| $40 < d \leq 60$ | 49 | |
| $60 < d \leq 80$ | 92 | |
| $80 < d \leq 100$ | 134 | |
| $100 < d \leq 120$ | 158 | |
| $120 < d \leq 140$ | 49 | |
| $140 < d \leq 160$ | 17 | |
| $180 < d \leq 200$ | 1 | |

9.2.3 and 9.2.4

## Question 10

| DATA | $(x_i - \bar{x})$ | $(x_i - \bar{x})^2$ |
|---|---|---|
| 22 | | |
| 5 | | |
| 16 | | |
| 10 | | |
| 20 | | |
| 17 | | |
| 12 | | |
| 9 | | |
| 14 | | |
| 11 | | |
| $\sum_{i=1}^{n}(x_i - \bar{x})^2 =$ | | |

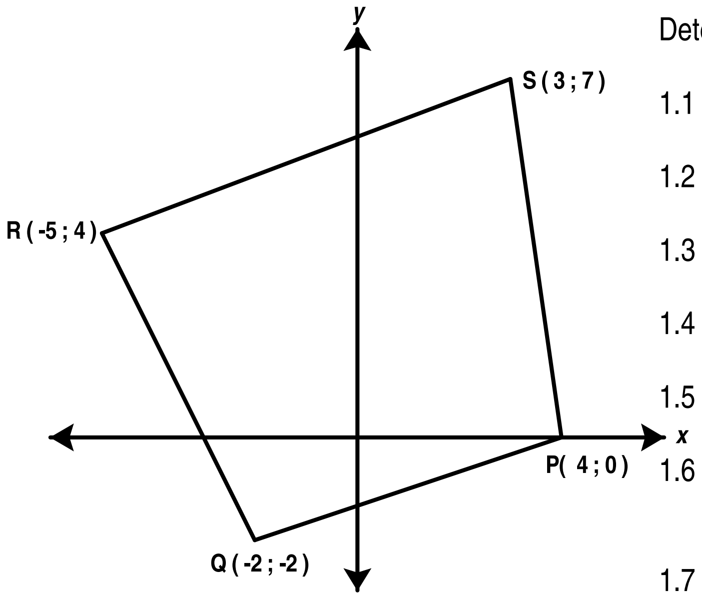
## Question 11



## Grade 11 Mathematics Exam — Paper 2
**Time: 3 hours** — **Marks: 150**

### Question 1

In the diagram, P(4;0) Q(-2;-2) R(-5;4) and S(3;7) are the vertices of quadrilateral PQRS which lies in the Cartesian plane.




Determine:

1.1 The gradient of RS. (3)

1.2 The equation of RS. (4)

1.3 The inclination of RQ. (3)

1.4 The measure of angle RQP. (4)

1.5 The midpoint of PS. (3)

1.6 The length of PQ (leave your answer in simplest surd form). (3)

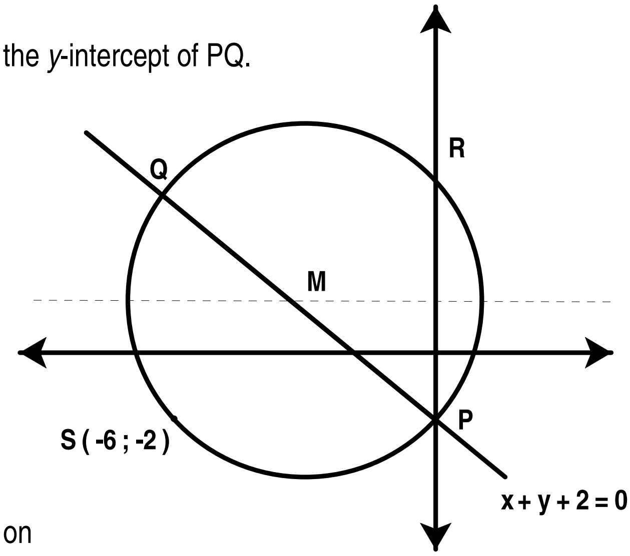
1.7 The equation of the line which is parallel to RQ and passes through P. (3)

**[23]**

### Question 2

In the diagram, PQ is the diameter of the circle. The equation of PQ is $x + y + 2 = 0$.

2.1 Determine the co-ordinates of P, the *y*-intercept of PQ. (2)




2.2 If Q , which lies on the circle and on PQ, is the point (*a;*4), calculate the value of *a*. (2)

2.3 Show that the co-ordinates of M, the centre of the circle are (-3;1). (2)

2.4 Calculate the length of the radius of the circle. Leave your answer in simplified surd form. (3)

2.5 A line, AB, is drawn through M, parallel to the *x*-axis. If R is the reflection of P about the line AB, determine the co-ordinates of R. (2)

2.6 The point S(-6;-2) lies on the circumference of the circle. Show that MS is perpendicular to MP. (4)

2.7 Calculate the area of $\Delta PQS$ . (4)

**[19]**

**Question 3**

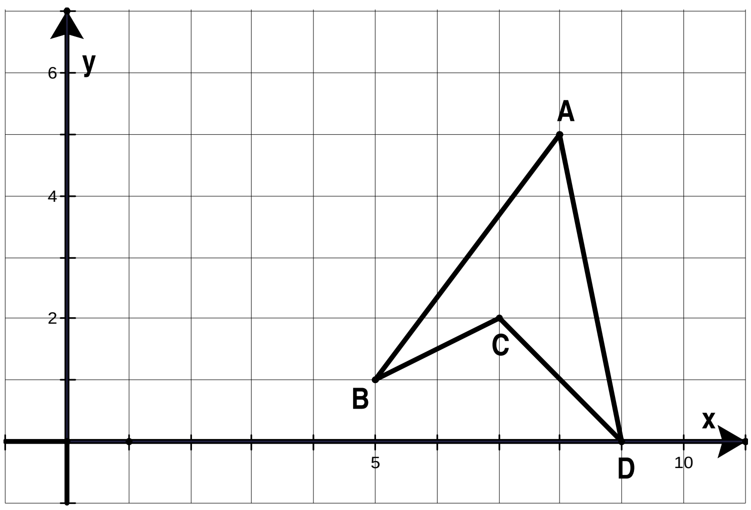
3.1 The point W(4;3) lies in the Cartesian plane. Determine the co-ordinates of the image of W under each of the following conditions:

3.1.1 W is reflected about the line *y* = *x* (2)

3.1.2 W has been rotated about the origin through 90º in a clockwise direction. (2)

3.1.3 $W(4;3) \rightarrow (x-2;\ 2y)$ (2)

3.2 In the diagram, polygon ABCD has vertices A(8;5) , B(5;1) , C(7; 2) and D(9; 0)




3.2.1 PQRS is a transformation of ABCD and has co-ordinates P(-8;5) Q(-5;1) R(-7;2) and S(-9;0). Describe the transformation. (2)

3.2.2 $A'B'C'D'$ is the image of ABCD under the following transformation $(x; y) \rightarrow (x-4; y+1)$. Draw $A'B'C'D'$ on the diagram sheet provided. (2)

3.2.3 Describe the above transformation. (2)

3.2.4 The transformation T of the Cartesian plane occurs as follows: A point is rotated about the origin 180° in the clockwise direction. After this, the point is reduced through the origin by a factor of 2. If KLMN is the image of $A'B'C'D'$ after applying the transformation T, sketch KLMN on the diagram. (4)

3.2.5 Describe the relationship between the perimeter of $A'B'C'D'$ and the perimeter of KLMN. (2)

**[18]**

**Question 4**

4.1 Evaluate: $\sin 35^\circ \cos 65^\circ + \tan 45^\circ$ (4)

4.2 Simplify without the use of a calculator:

$$\cos(-x)\tan(180^\circ - x)\left[\sin(-x) + \frac{\cos^2(180^\circ + x)}{\sin(360^\circ - x)}\right]$$ (8)

4.3 ABC is any triangle. Prove that $\sin(A + C) = \sin B$. (3)

4.4 Prove the following identity: $\dfrac{\sin x}{\cos^3 x + \cos x \sin^2 x} = \tan x$ (4)

4.5 Solve for *x* in the following equation: $\sqrt{3}\tan x - 3 = 0$ for $x \in [180^\circ; 360^\circ]$ (5)

4.6 Given the trigonometric equation $4\sin^2 x - 1 = 0$

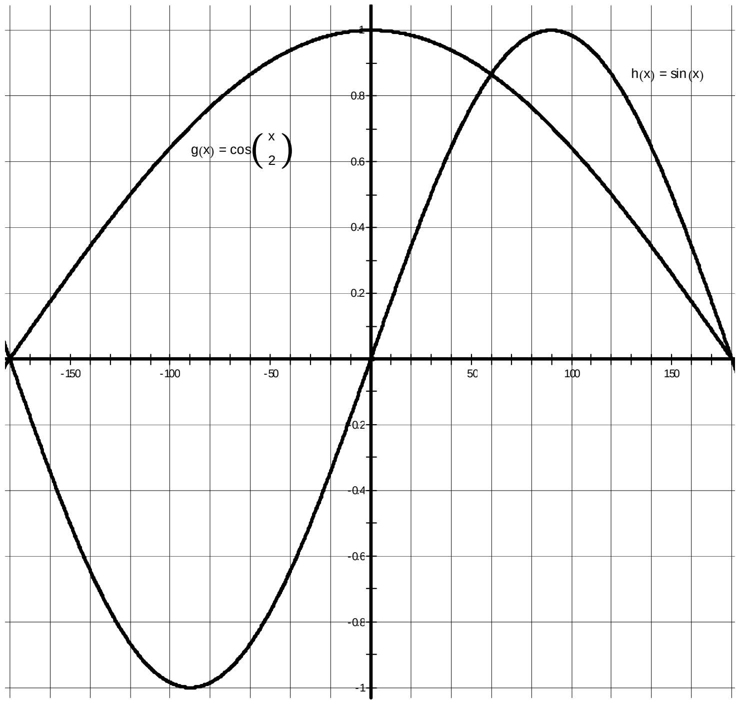
4.6.1 Factorise the expression $4\sin^2 x - 1$ (2)

4.6.2 Hence find the general solution of the equation: $4\sin^2 x - 1 = 0$ (4)

**[30]**

**Question 5**

The sketch below contains the graphs of $g(x) = \cos\frac{x}{2}$ and $h(x) = \sin x$ for $x \in [-180°;180°]$. The co-ordinates of I, a point of intersection of the two graphs are $\left(60°;\frac{\sqrt{3}}{2}\right)$




5.1 Use your graph to solve the following equation: $\cos\frac{x}{2} = \sin x$ for $x \in [-180°;180°]$ (3)

5.2 If *g* is shifted horizontally 30 degrees horizontally towards the right, what will the new equation of *g* be? (2)

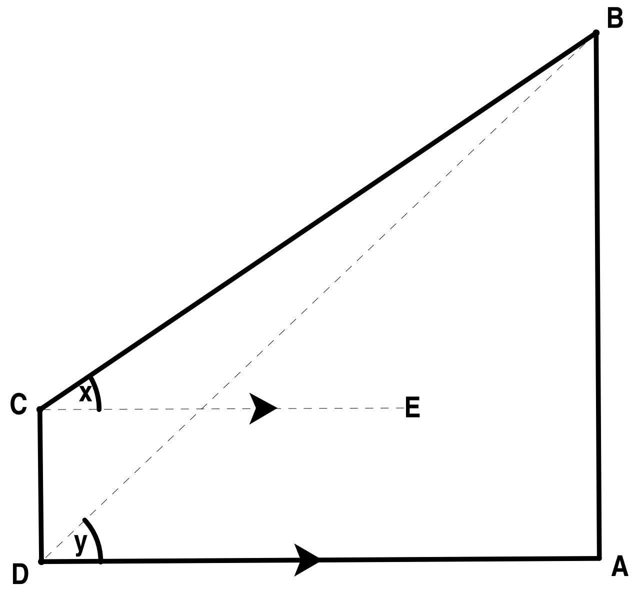
5.3 Determine the new co-ordinates of I after *g* has been shifted. (3)

5.4 If the equation of *h* is changed to $h(x) = 2\sin x + 1$, explain clearly how the graph of *g* will change. You must refer to range, amplitude and period. (3)

**[10]**

**Question 6**

Patrick has bought a plot of land which has an irregular shape as shown below. He has obtained an old diagram of the land and wishes to work out the length AB of the plot. DC is 11 metres, $A\hat{D}B$ is marked *y* and angle $B\hat{C}E$ is marked *x*. CE is parallel to DA.




6.1 Find the size of angle CBD in terms of *x* and *y*. (2)

6.2 Show that $DB = \dfrac{11\cos x}{\sin(y-x)}$ (3)

6.3 Now show that $AB = \dfrac{11\cos x \cdot \sin y}{\sin(y-x)}$ (2)

6.4 A key on the diagram indicates that $x = 37{,}3°$ and $y = 42°$. Use this information to calculate the length of AB. (2)

**[9]**

**Question 7**

In $\Delta ABC$, $AB = c$, $BC = a$, and $AC = \sqrt{a^2 + ac + c^2}$. Without using a calculator, find the size of angle $B$.

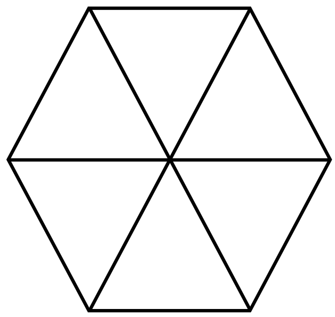
**[4]**

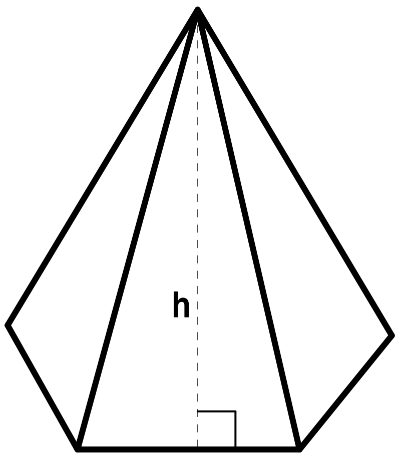
**Question 8**

8.1 The City Municipality has ordered special hexagonal pyramid cones to place in the road to warn drivers of unusual hazards. The cones have to be painted with a red reflective paint.

The base of the pyramid is a regular hexagon consisting of six equilateral triangles with side of 30cm as shown below:

8.1.1 Calculate the area of the base of the pyramid. (3)

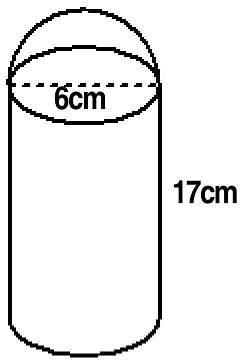





8.1.2 The hexagonal pyramid cones are shown in the diagram alongside. The slant height, h, is 65cm. Calculate the surface area of a cone.

(3)

8.2 A can of aerosol deodorant has a cylindrical shape with a hemisphere on top as shown in the diagram below. The diameter of the cylinder is 6cm and the height of the cylinder is 17cm. Calculate the total volume of the can of deodorant.

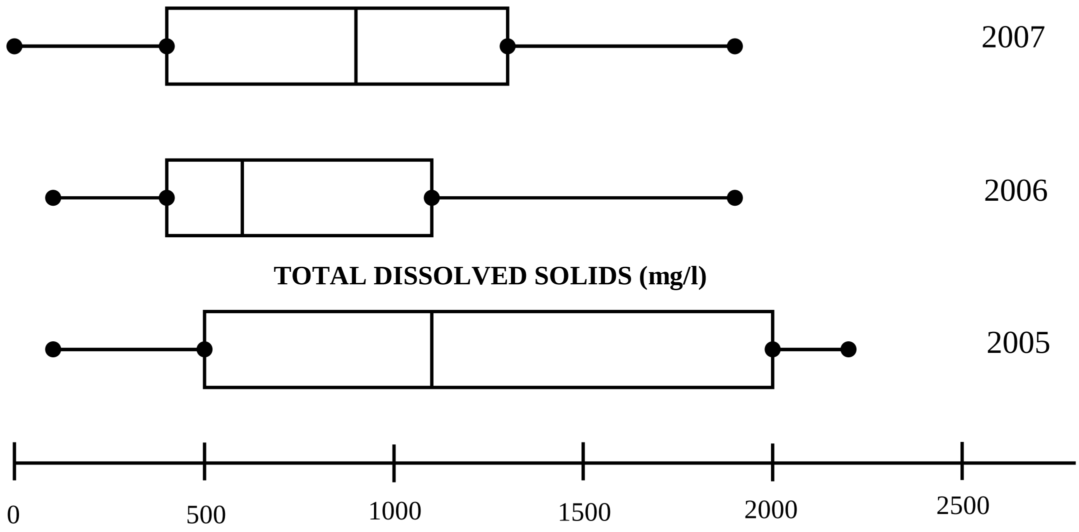



(5)

**[11]**

## Question 9

Below are box and whisker plots that depict the results of a pollution survey in a Western Cape River conducted from 2005 to 2007. The survey measured to pollution (total dissolved solids) in milligrams per litre of water.




9.1 Determine the five number summary for 2006. (2)

9.2 Which year had the greatest range of results? Explain your answer. (2)

9.3 Using the data, comment on the pollution levels in the river over the three years of monitoring. (3)

**[7]**

## Question 10

10.1 The heights of 10 primary school boys were measured. These heights are given in the table below:

| Height (cm) | $(x_i - \overline{x})$ | $(x_i - \overline{x})^2$ |
|---|---|---|
| 119 | | |
| 112 | | |
| 116 | | |
| 123 | | |
| 122 | | |
| 123 | | |
| 135 | | |
| 151 | | |
| 143 | | |
| 145 | | |
| $\sum_{i=1}^{n}(x_i - \overline{x})^2$ | | |

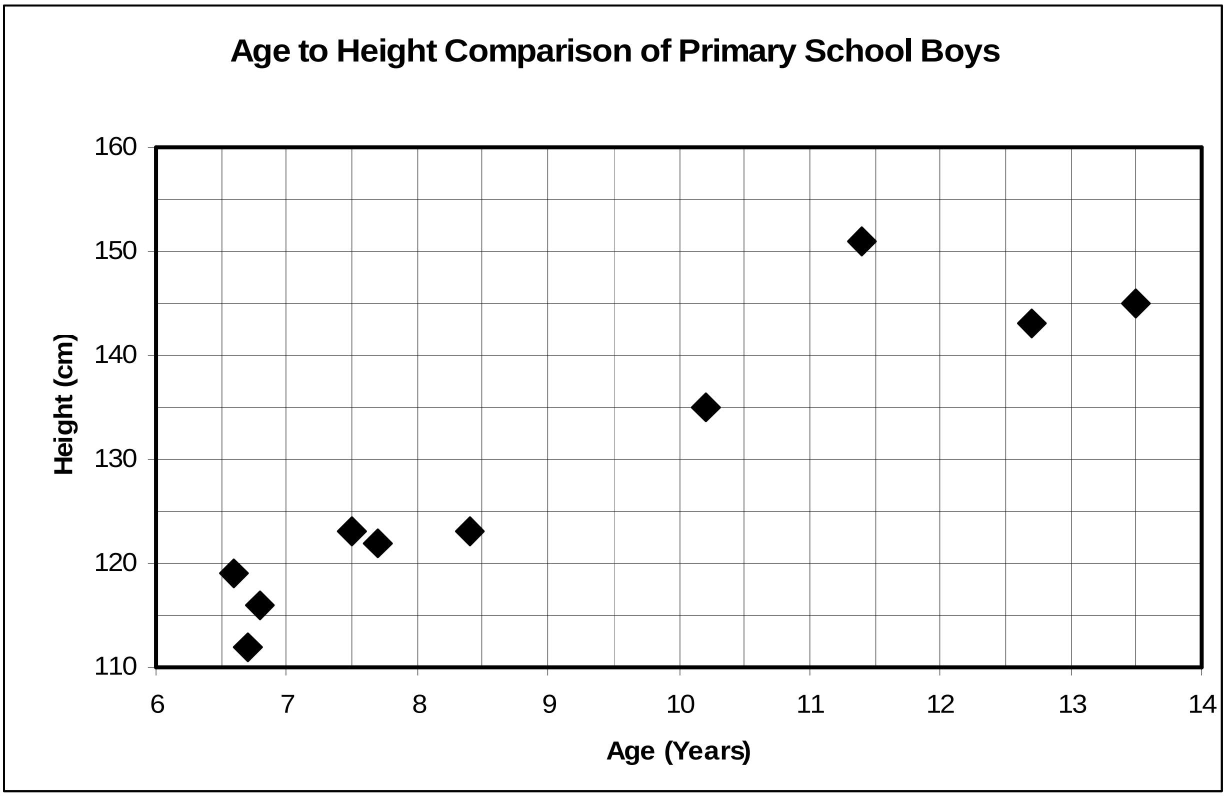
10.1.1 Calculate the mean height of the boys. (2)

10.1.2 Complete the table on the diagram sheet and use it to calculate the variance of the heights. (3)

10.1.3 Calculate the standard deviation. (1)

10.1.4 What conclusion can you draw about the height of the boys using the standard deviation? (1)

10.2 In addition to height, the age of the boys was also recorded and a scatter diagram of this data was produced. This diagram appears below:




10.2.1 On the diagram sheet, draw an approximate line of best fit. (1)

10.2.2 Use the line to estimate the height of a 9-year old boy. Indicate on the diagram where you made this estimate. (2)

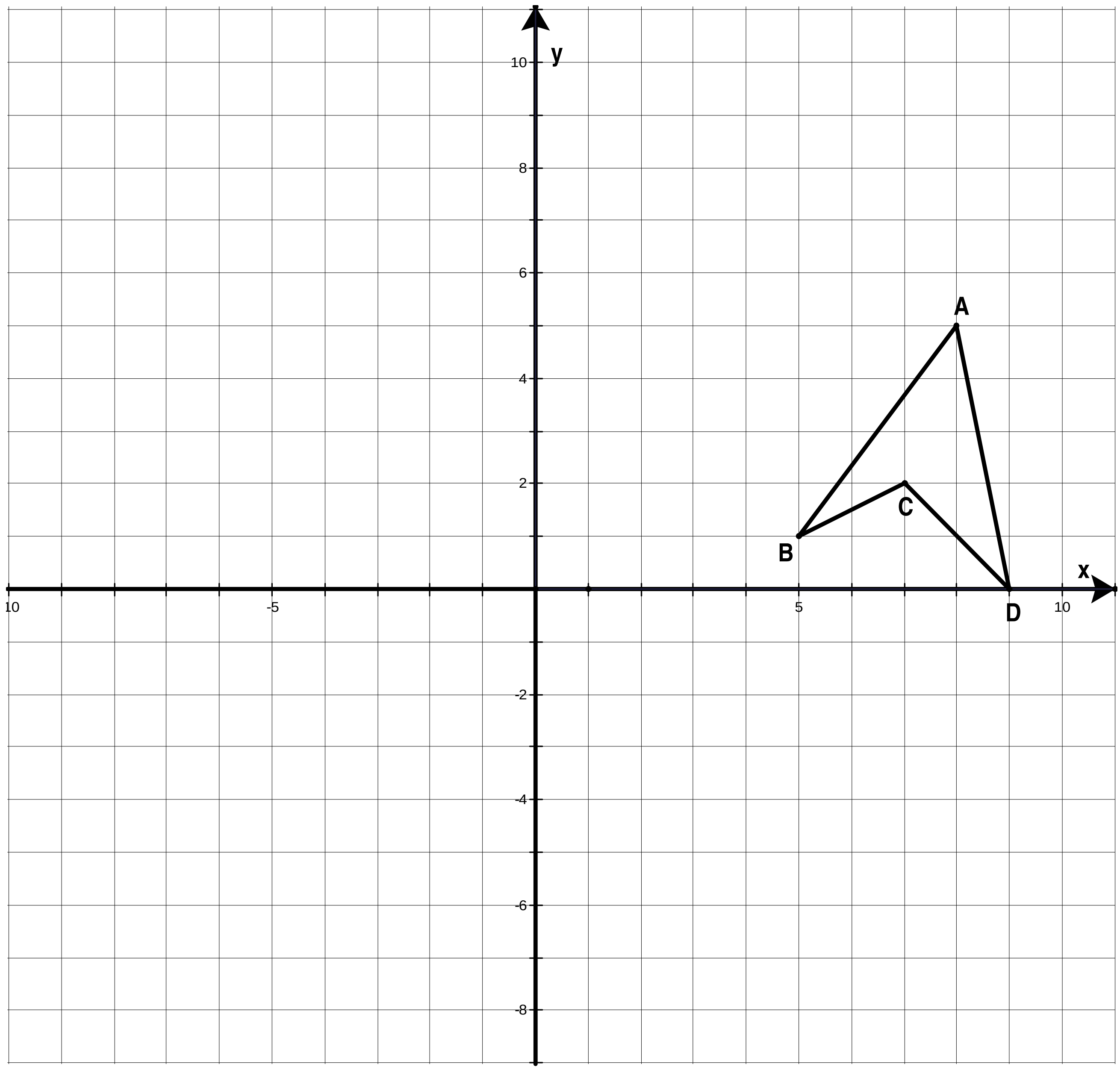
10.2.3 Find the equation of the line of best fit. (3)

10.2.4 Use your equation of the line of best fit to predict the height of a 16 year old boy. (1)

**[14]**

**Diagram Sheet**

**Question 3**



## Question 10

| Height (cm) | $(x_i - \bar{x})$ | $(x_i - \bar{x})^2$ |
|---|---|---|
| 119 | | |
| 112 | | |
| 116 | | |
| 123 | | |
| 122 | | |
| 123 | | |
| 135 | | |
| 151 | | |
| 143 | | |
| 145 | | |
| $\sum_{i=1}^{n}(x_i - \bar{x})^2$ | | |