Higher level Questions based on old exam papers

(Including 2016 questions)

ACKNOWLEDGEMENT IS GIVEN TO:
MINISTRY OF EDCATION OF THE REPUBLIC OF NAMIBIA
THROUGH DNEA
FOR AVAILING THE QUESTIONS FROM OLD EXAMPAPERS.

The Rössing Foundation

Sample questions for NSSH exam paper 1 type of questions, based on the syllabus part 1

Note for the user: the question are selected from past examination papers and divided in 20 sections.
Answers to these questions are also available on the website.

Questions are selected by T Hanemaaijer. thanem123@gmail.com

Content:

Section 1 Time lapses; speed time graph

1. [Specimen paper PI 2006 Q 1]

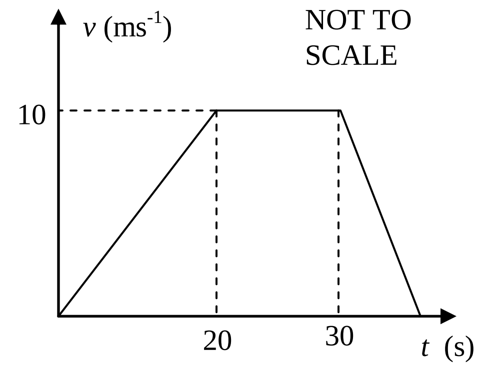
A train leaves Windhoek at 18:40 on Monday evening and arrives at Swakopmund at 05:37 on Tuesday.

(a) Find the train journey in hours and minutes. [1]

(b) The distance between Windhoek and Swakopmund is 380 km.
Calculate the average speed of the train in km/h. [2]

2. [Specimen paper PI 2006 Q 8]

The diagram shows the speed-time graph of a cyclist for a journey. The magnitude of the deceleration of the cyclist is twice that of the acceleration. The maximum velocity of $10ms^{-1}$ is reached after 20 seconds.



(a) Find the acceleration of the cyclist in the first 20 seconds. [2]

(b) Find the total time taken by the cyclist for the journey. [2]

(c) Find the total distance travelled by the cyclist for the journey. [2]

3. [Paper 1 2011 Q 4 (a)]

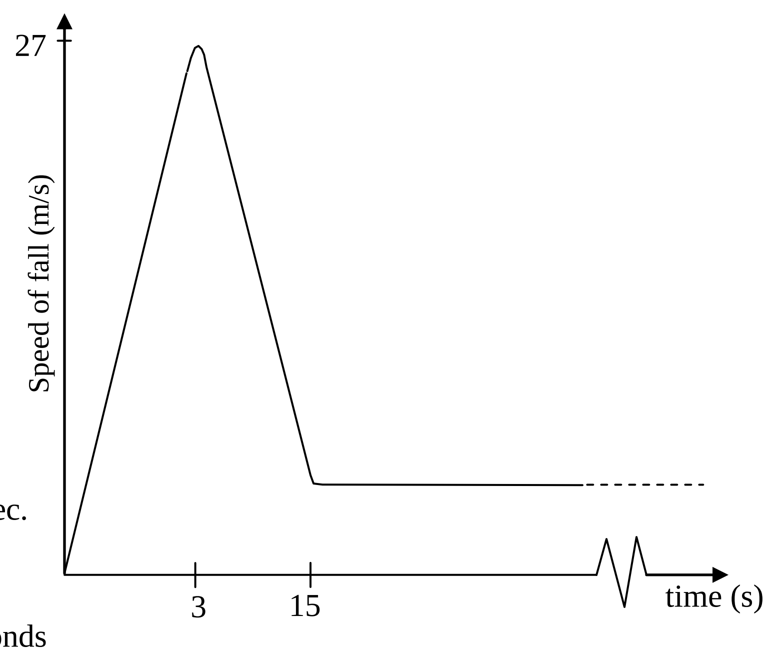
At an athletic meeting, John's time for the 10 000 metres race was exactly 34 minutes and he finished the race at 15 16.

(a) At what time did the race start? [1]

(b) The winner finished 50.3 seconds ahead of John. How long did the winner take to run the 10 000 m? [1]

4. [Paper 1 2011 Q1]

The diagram above is the speed-time graph which illustrates Peter's parachute jump from an aeroplane. During the first 3 seconds, he accelerates at a constant rate until he reaches a speed of 27 m/s. After 3 seconds he opens his parachute. His speed decreases for the next 12 seconds and then remains constant until he lands on the ground.



(a) Calculate\

(i) his acceleration, during the first 3 sec. [1]

(ii) the distance he falls during the first 3 sec. [2]

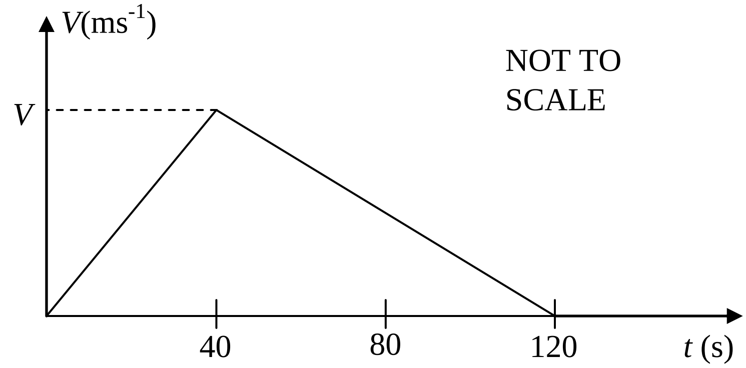
(b) The total distance Peter falls in the first 15 seconds is 124 m. His constant speed after that is 2 m/s. Calculate in minutes and seconds the **total** time for his jump if the aeroplane was 1200 m above the ground. [3]

5. [Paper 1 2008 Q 10]

The diagram shows the velocity-time graph of a car. The car starts from rest and reaches a top speed of V ms^{-1} after 40 s. It comes to rest after 120 s, having travelled a total distance of 1800 m. Find

(a) the value of the constant V,

(b) the distance travelled during the first 80 s.



6. [Paper 1 2013 Q 6]

A car travels 60 km at an average speed of 30km/h and then 40 km at an average speed of x km/h.

(a) Find the time taken for **(i)** the first 60 km. [1]

(ii) the next 40 kmin terms of x [1]

(b) Show that the average speed for the whole journey, S km/h is given by $S = \frac{50x}{x+20}$ [3]

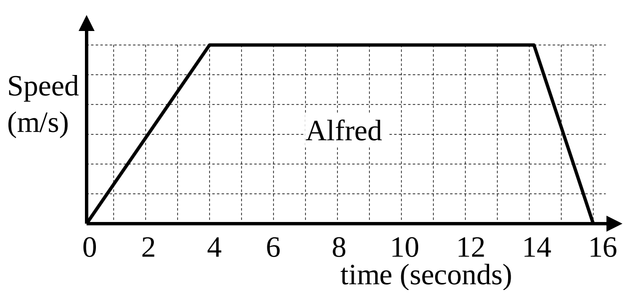
(c) Find x in terms of S. [2]

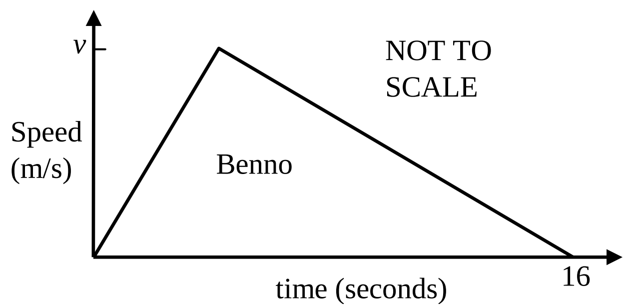
7. [Paper 1 2016 Q5]

A person in a car, travelling at 126 km/h, takes 1 second to go past a building on the side of the road. Calculate the length of the building in metres. [3]

8. [Paper 1 2016 Q11]

The two graphs show the speed-time graphs of two cyclists, Alfred and Benno. Alfred accelerated to 10 m/s, travelled at a steady speed and then slowed to a stop.





Given that both cyclists travel the same distance in 16 seconds, find the maximum speed of Benno. [4]

<u>Section 2 Inequalities and number properties.</u>

1. [Specimen paper PI 2006 Q 2]

(a) Solve the inequality: $10 - 6.5x < 23$ [2]

(b) Write down the smallest integer that satisfies the inequality. [1]

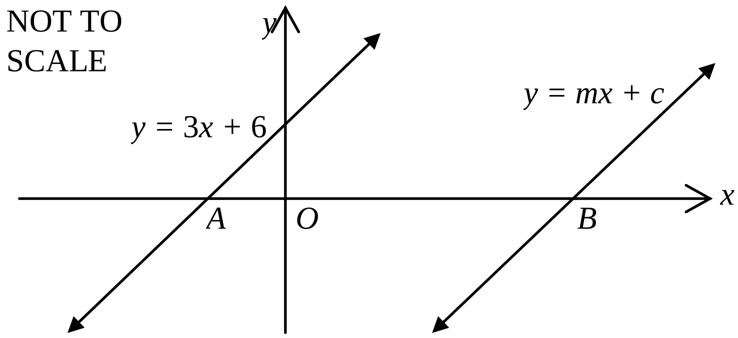
2. [Paper 1 2011 Q1]

$\frac{1}{\sqrt{3}}$ $\frac{1}{(\sqrt{3})^2}$ $\frac{1}{(\sqrt{3})^3}$ $\frac{1}{(\sqrt{3})^4}$ Four terms are given, write down those terms which are irrational. [1]

3. [Paper 1 2012 Q 8]

(a) The line $y = mx + c$ is parallel to the line $y = 3x + 6$.
The distance AB is 6 units.
Find the value of m and c. [4]

(b) Write down two inequalities which define the region between the two given parallel lines. [1]



4. [Paper 1 2013 Q 1]

Jens and Steven have their birthday on January 1st. In 2013 Jens is 13 and Steven is 17 years old.

(a) Which is the **next** year after 2013 when both their ages will be prime number? [1]

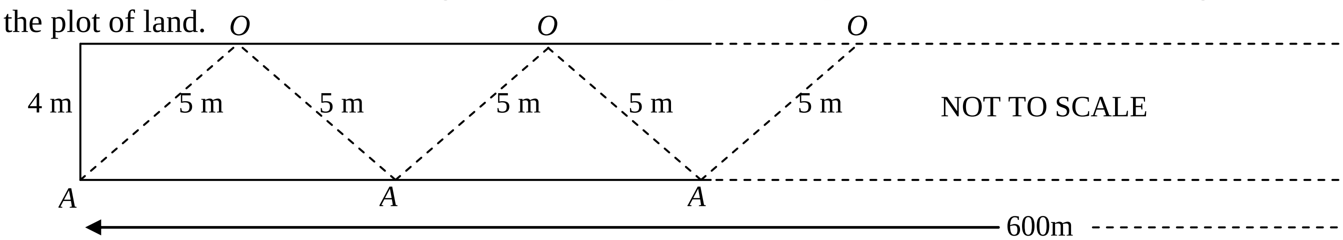
(b) In which year was Steven twice a sold as Jens? [1]

5. [Paper 1 2013 Q 3]

Write y^{-1} , y^0, y^2 and y^3 in increasing order of size when $y < -2$. [2]

6. [Paper 1 2014 Q 3]

To celebrate its centenary, a city planted apple trees, A, and orange trees, O, on a rectangular strip of land 4 metres wide and 600 m long. The trees were planted in a pattern shown for the full length of the plot of land.



Calculate the number of

(a) Apple trees [3]

(b) Orange trees [1]

7. [Paper 1 2014 Q 8(a)]

(a) Given that x is a positive integer, solve the inequality: $5 - \frac{2x}{3} > \frac{1}{2} + \frac{x}{4}$ [4]

8. [Paper 1 2015 Q 1]

Given that $-3 < x \leq 3\frac{1}{3}$

(a) the largest integer value of x, [1]

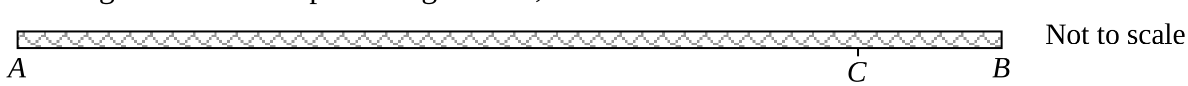
(b) the smallest prime number values of x, [1]

(c) the largest rational value of x. [1]

<u>Section 3 Accuracy of measurements, standard notation and significant figures.</u>

1. [Specimen paper PI 2006 Q 3]

The diagram shows a rope of length 20 m, correct to the nearest meter.



A piece, CB, is cut from the rope.

Given that the length CB is 2.5 meters, correct to 1 decimal place, find the maximum possible length of the remaining piece, AC. [3]

2. [Paper 1 2011 Q 5]

Mary's height is 1.51 m, measured correct to 3 significant figures.
David's height is 1.83 m, measured correct to 3 significant figures.

Find **(a)** the least possible value of Mary's height, [1]

(b) the greatest possible difference in their heights **(i)** in metres [2]

(ii) in centimeters [1]

3. [Paper 1 2008 Q4]

A motorist leaves Windhoek at 05:55 on his way to Tsumeb. The trip takes him 4 hours 10 minutes, correct to the nearest 10 minutes. He drives at an average speed of 100 km/h, correct to the nearest 5 km/h. Using this information, find

(a) his latest possible time of arrival in Tsumeb, [1]

(b) the maximum possible distance between Windhoek and Tsumeb. [2]

4. [Paper 1 2009 Q 4]

A light year is the distance travelled by light in 365 days. The speed of light is 3×10^8 km/h.
The distance to the star system Krul is 7×10^{23} km.
How many light years is it to the system of Krul?
Give your answer in standard form correct to 2 significant figures. [3]

5. [Paper 1 2007 Q5]

A truck driver takes freight by road from Walvis Bay to Johannesburg, a journey of 1900 km, to the nearest 50 km. The average speed of the truck for this journey is 100 km/h, to the nearest 10 km/h. Find the minimum time that this journey could take. Give your answer in hours and minutes, to the nearest minute. [3]

6. [Paper 1 2012 Q2]

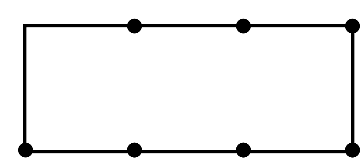
It takes the computer 250 millionth of a second to perform a particular operation.

(a) Express 250 millionth of a second in standard form. [1]

(b) Find the number of operations that can be performed in one minute. [2]

7. [Paper 1 2013 Q5]

Marc has eight rods of length 12 cm, correct to the nearest centimeter.
Each rod has a round head.
He places them in the shape of a rectangle, three rods long and one rod wide.



(a) Calculate the minimum length of his rectangle [1]

(b) Calculate the minimum perimeter of his rectangle [1]

8. [Paper 1 2014 Q4]

The length of a pendulum is measured as 1.63 m, to the nearest centimeter. The pendulum swings through an angel which is measured as 22º to the nearest degree.
Calculate the lower limit of the distance through which the end of the pendulum swings. [4]

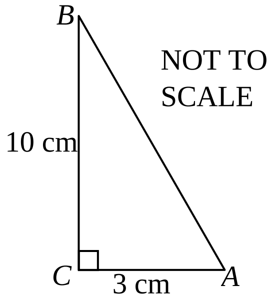
9. [Paper 1 2015 Q3]

Car tires need replacement after 7.5×10^6 revolutions. Given that the radius of the wheel of a car is 0.30 m, calculate the distance, in km, the car can travel before its tires need to be replaced. [2]

10. [Paper 1 2015 Q5]

The mass of the earth is $\frac{1}{95}$ of the mass of the planet Saturn. The mass of the earth is 5.97×10^{24} kg.
Calculate the mass of the planet Saturn, giving your answer, in standard form, correct to 2 significant fig. [2]

11. [Paper 1 2015 Q10]



The diagram shows a right-angled triangle *ABC* in which *AC* = 3 cm and *BC* = 10 cmeach measured to the nearest centimetre.

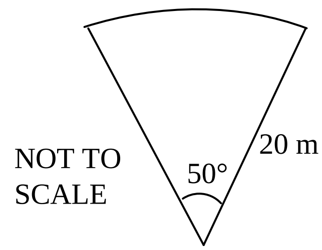
(a) Write down the smallest possible value of *AC*. [1]

(b) Calculate, correct to 1 decimal place, the largest possible size of angle *BAC*. [2]

12. [Paper 1 2016 Q2]

The diagram shows a plot of land in the shape of a sector of a circle. The radius is 20 m, correct to the nearest metre and the angle of the sector is 50°, correct to the nearest 5°. The perimeter of the plot of land is fenced.

Calculate the maximum length of fencing needed. [3]



Section 4 Variation

1. [Specimen paper PI 2006 Q 4]

The stored energy, *E* joules, in an elastic string is directly proportional to the square of the extension, *x*, in centimeters. The stored energy is 60 joules when the extension is 5 cm.

(**a**) Find the equation relating *E* to *x*. [2]

(**b**) Find the extension of the string when the stored energy is 135 joules. [1]

2. [Paper 1 2007 Q6]

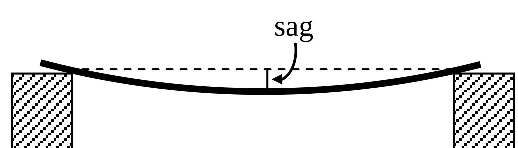
The magnetic force, *F* newtons, acting on a ball-bearing varies inversely as the square of the distance, *d* meters, of the ball-bearing from the magnet. Given that *F* = 12 newtons when *d* = 1.5 meters,

(a) find an equation relating *F* and *d*, [2]

(b) find the value of *F* when *d* = 0.6 m. [1]

3. [Paper 1 2010 Q 2]

An engineer carries out tests on copper rods.
He measures the amount of sag in different lengths of rods.
The results are shown in the table below.



Length of rod (*x*) in meters	0	1	2	3	4
sag (*y*) in millimeters	0	$\frac{1}{3}$	$2\frac{2}{3}$	9	$21\frac{1}{3}$

He knows that $y \propto x^n$ where *n* is a positive integer. Find the value of *n*. [4]

4. [Paper 1 2014 Q7]

Marc climbs a mountain. The temperature, *T* ºC, is directly proportional to the height, *h* metres, above base camp. When he is 750 m above base camp, the temperature is –6º C.

(a) Find an equation connecting *T* and *h*. [2]

(b) The base camp is 2500 m above sea level. The temperature at the top of the mountain is –18º C. Assuming that the same formula connecting *T* and *h* applies to the height above sea level.

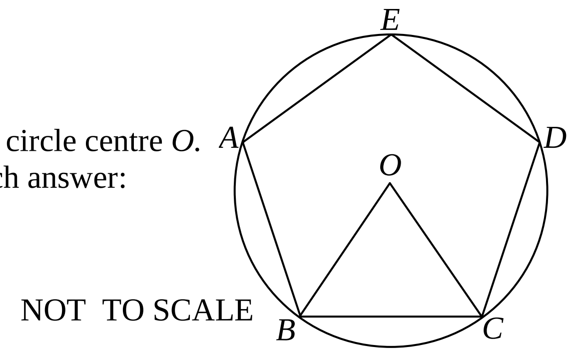
Find: **(i)** The height of the mountain above sea level. [3]

(ii) the temperature at sea level. [2]

Section 5 Polygons

1. [Specimen paper PI 2006 Q 5]

The diagram shows a regular pentagon *ABCDE* inscribed in a circle centre *O*.
Find the value of the following angles, giving a reason for each answer:



(a) angle *BOC* [2]

(b) angle *BEC* [2]

(c) angle *BDC* [2]

2. [Paper 1 2011 Q 2]

The following statements refer to types of quadrilateral. Write down the word which is missing from each statement.

(a) A …………………….. has rotational symmetry of order 4. [1]

(b) A …………………….. has 4 right angles but only two lines of symmetry. [1]

(c) A …………………….. has exactly one line of symmetry. [1]

3.[Paper 1 2011 Q 3 (b)]

A polygon has 3 angles of 140º, 2 angles of 130º and *x* angles of 160º. Find the value of *x*. [2]

4. [Paper 1 2015 Q 2]

Given that *ABCDE* is a regular polygon, calculate

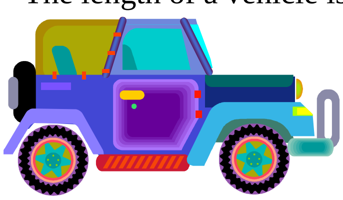
(a) angle *ABC* [1]

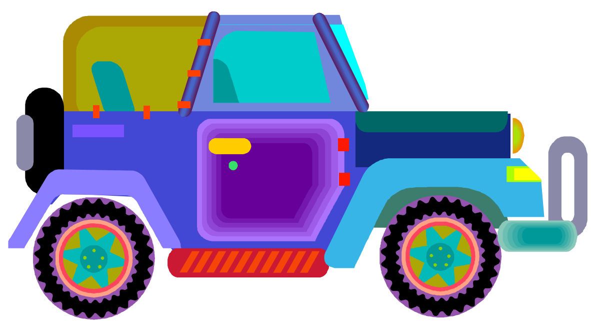
(b) angle *BCE* [1]

Section 6 Similar shapes

1. [Specimen paper PI 2006 Q 6]

The length of a vehicle is 4.5 meters. A model of the vehicle is made to the scale of 1 : 20.





(a) Find the length of the model in centimeters [1]

(b) The volume of the interior of the model is 600 cm^3. Find the volume of the interior of the vehicle in cubic meters. [3]

2. [Paper 1 2008 Q3]

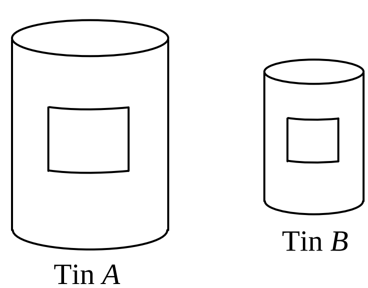
A shop sells two different sized copies of a famous painting:
'Poster' size measuring 90 cm by 60 cm and 'Postcard' size measuring 15 cm by 10 cm.

(a) Given that the height of a church in the 'Postcard' is 7.5 cm, find the height of the same church in the 'Poster'. [2]

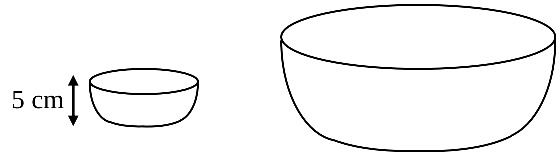
(b) Given that the area of the sky in the 'Poster' is 936 cm^2, find the area of the sky in the 'Postcard'. [2]

3. [Paper 1 2009 Q 6]

The diagram to the right shows to similarly shaped soup tins.
The capacities of tins *A* and *B* are 1080 cm^3 and 320 cm^3 respectively.
The area of the label on tin *B* is 40 cm^2.
What is the area of the label on tin *A*? [3]



4. [Paper 1 2010 Q 1]
The diagram shows similarly shaped bowls with capacity $100\ cm^3$ and $800\ cm^3$. The height of the smaller bowl is 5 cm. Find the height of the larger bowl. [2]

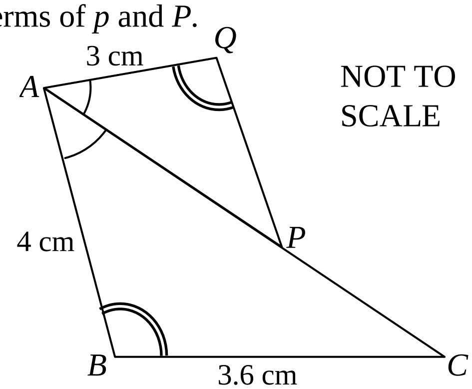


NOT TO SCALE

5. [Paper 1 2012 Q 4]
Jonas made a model of a building using a scale of 1 : 20. The roof of the building has an area of $300\ m^2$. Calculate the area of the roof of the model in square metres. [2]

6. [Paper 1 2015 Q 12]
(a) The scale model of a building is 1 : 500. The length of the base of the model is 9 cm long. Calculate the length of the base of the building in meters. [1]
(b) The scale of a model of a second building is 1 : m. The area of the base of the model is $p\ cm^2$. The area of base of the second building is $P\ cm^2$. Express m in terms of p and P. [2]

7. [Paper 1 2016 Q14]
The diagram shows two triangles ABC and APQ.
Angle PAQ = angle BAC and angle AQP = angle ABC.
AB = 4 cm, BC = 3.6 cm and AQ = 3 cm.
(a) Calculate the length of PQ. [2]
(b) The area of triangle $ABC = 5.6\ cm^2$.
Calculate the area of triangle APQ. [2]



NOT TO SCALE

Section 7 Finance & percentages (including reverse percentages), direct proportion and ratio.

1. [Specimen paper PI 2006 Q7]
Aune has been invited to spend her 2013 Christmas in Britain. Her uncle gives her N$2400 to take as pocket money. The exchange rate in 2013 is £1 = N$11.50.
(a) Convert N$ 2400 to £. Giving your answer to the nearest £. [1]
(b) The number of N$ obtained for £1 in 2012 is 30% less than the number of N$ obtained for £1 in 2009. Find the exchange rate in 2009. [2]

2. [Paper 1 2011 Q 4b]
Mandy won the long jump competition by jumping a distance of 6.16 metres. She jumped 10% further than Susan did. How far did Susan jump? [2]

3. [Paper 1 2008 Q1]
The annual rainfall in 2003 for Rundu was 470 mm
(a) Given that the rainfall in in 2004 was 16% more than in 2003, find the annual rainfall in 2004 [2]
(b) Given that the rainfall of 470 mm in 2003 was 29% more than in 2002, find the annual rainfall in 2002. [2]

4. [Paper 1 2009 Q 1] The retail price of a car in a showroom is N$225000.
(a) A profit of 50% on the cost price is included in this retail price. Calculate the cost price of the car. [2]
(b) A buyer must pay 15% tax on the retail price. How much tax does the buyer pay? [1]

5. Paper 1 2010 Q 3]
Gottlieb invested N$2 000 at a rate of 12% compound interest per year for 5 years.
(a) Calculate the value of the investment after 5 years. Give your answer correct to the nearest N$. [2]
(b) Express the total investment he received over the 5 year period as a percentage of the original investment of N$2 000. [2]

6. [Paper 1 2012 Q 1]

(a) A baker uses 325 g of flour to bake one loaf of bread.
How many kilograms of flour are needed for 120 loaves? [1]

(b) When mixing the ingredients for 800 loaves, he uses 300 litres of water. How many millitres of water are required for one loaf? [2]

(c) For fruit loaves the ratio (by mass) of flour : fruit : other ingredients is 8 : 7 : 5.
What mass of fruit is required for a mixture with a total mass of 160 kg? [2]

(d) In 2011, 45% of the baker's total expenses of N$70 000 was for the cost of fuel and the remainder was for the cost of materials.
In 2012, the cost of fuel increased by 4% and the cost of materials increased by 10%.
Calculate the percentage increase in his total expenses. [4]

7. [Paper 1 2013 Q 2]

(a) A bank charges N8.10 simpleinterest when N$360 is borrowed for **3 months**.
Calculate the annual percentage interest rate. [2]

(b) N$20 000 is invested for 3 years at 5% compound interest.
What will the investment be worth after 3 years. [2]

8. [Paper 1 2013 Q 1]

The bill for a meal in a restaurant is N$483.00.

(a) A tip of 8% of the bill is given to the waiter. How much is the tip rounded off to the nearest ten dollars? [1]

(b) The bill of N$483.00 is made up of the cost of the meal plus tax at 15% of the cost of the meal. What is the cost of the meal? [2]

9. Three friends, Alfredo, Bianca and Carlos decide to buy a second-hand car. Alfredo pays $\frac{1}{4}$ of the cost, Bianca pays $\frac{1}{3}$ of the cost and Carlos pays the rest. Bianca pays N$5000 more than Alfredo.
Calculate the cost of the car. [2]

10. [Paper 1 2016 Q1]

A school has 280 boys and 220 girls.

(a) The ratio of students to teachers is 10 : 1. Find the number of teachers. [2]

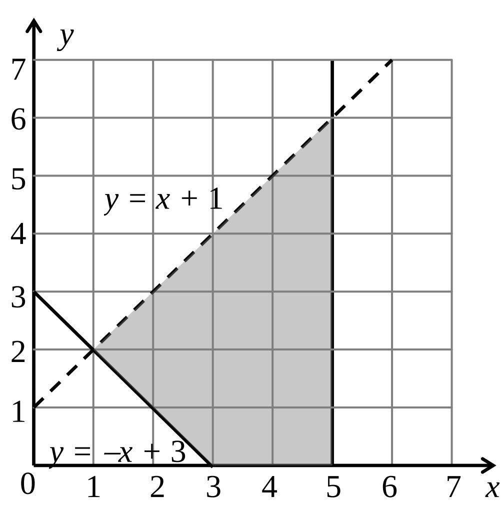
(b) There are 21 students on the school's committee. The ratio of girls to boys is 3 : 4.
Find the number of boys on the committee. [1]

(c) The cost of running a disco is N$2 640. This is an increase of 10% on the cost of running last year's disco. Find the cost of running last year's disco. [2]

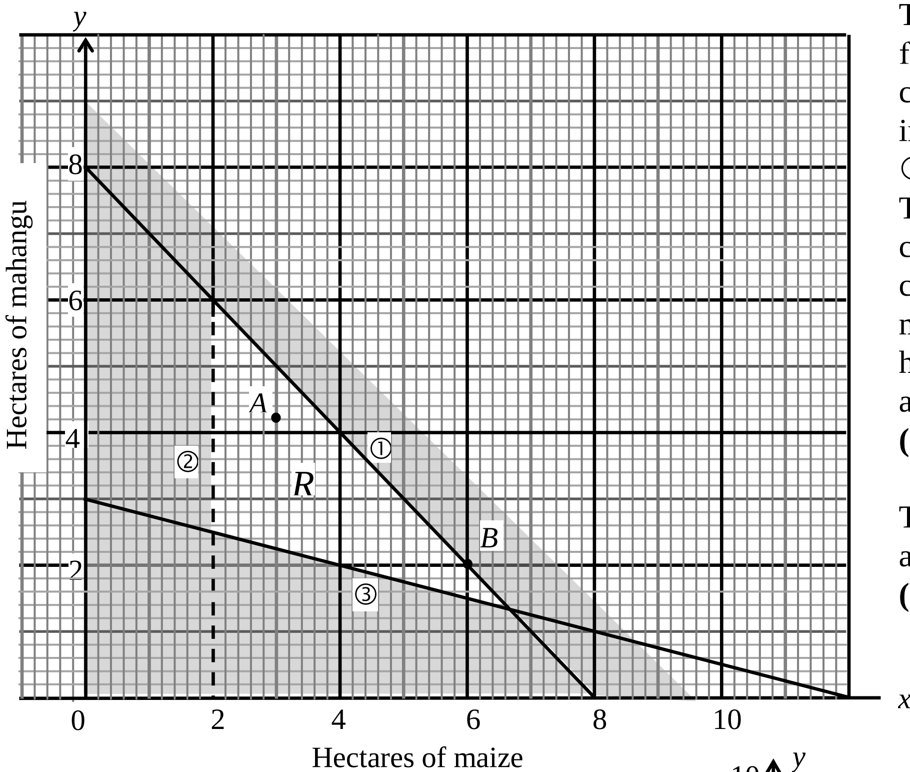
(d) The committee had an amount of N$15 000.00 which they invested for 3 years at a rate of 6.5% per year compound interest. Calculate the final amount the committee will have after 3 years giving your answer to the nearest N$100. [2]

Section 8 Linear programming

1. [Specimen paper PI 2006 Q9]
Write down the four inequalities which define the shaded region in the diagram to the right.



2. [Paper 1 2009 Q 12]



The constraints surrounding a particular farmer's of 2 crops, maize and mahangu, can be expressed as a set of 3 linear inequalities shown on the graph to the left as ①, ② and ③.

The region R shows the different combinations of numbers of hectares that he could plant. The number of hectares of maize is denoted by x and the number of hectares of mahangu by y. Points A and B are two labeled points in the region R.

(a) Find the three inequalities which define the region R in the graph. [4]

The profit on Maize is N$1000 per hectare, and the profit on mahangu is N$500 per ha.

(b) By showing the necessary working, decide which combination of crops, A or B, he should plant in order to make the greater profit [2]

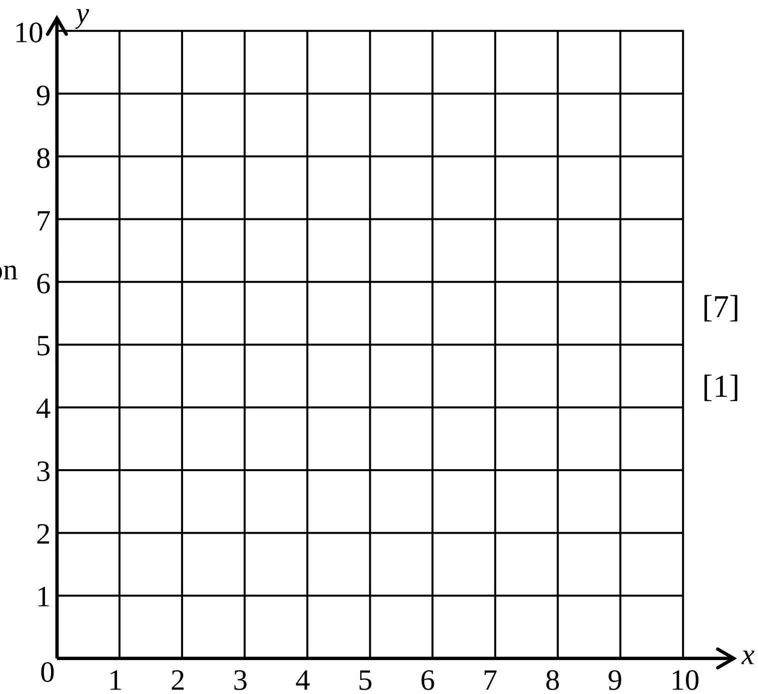
3. [Paper 1 2013 Q 14]

The set of points with coordinates (x, y) satisfies the five inequalities

$x \geq 0$, $y \geq 0$, $y + 2x \geq 8$, $4y + 3x \leq 24$ and $3y \geq 2x$.

(a) On the grid below, construct accurately and clearly indicate by shading the unwanted regions, the region in which the set of points (x, y) must lie. [7]

(b) Using your graph, find the least integer value of $(y - x)$ for points in the region. [1]



4. [Paper 1 2015 Q 16]

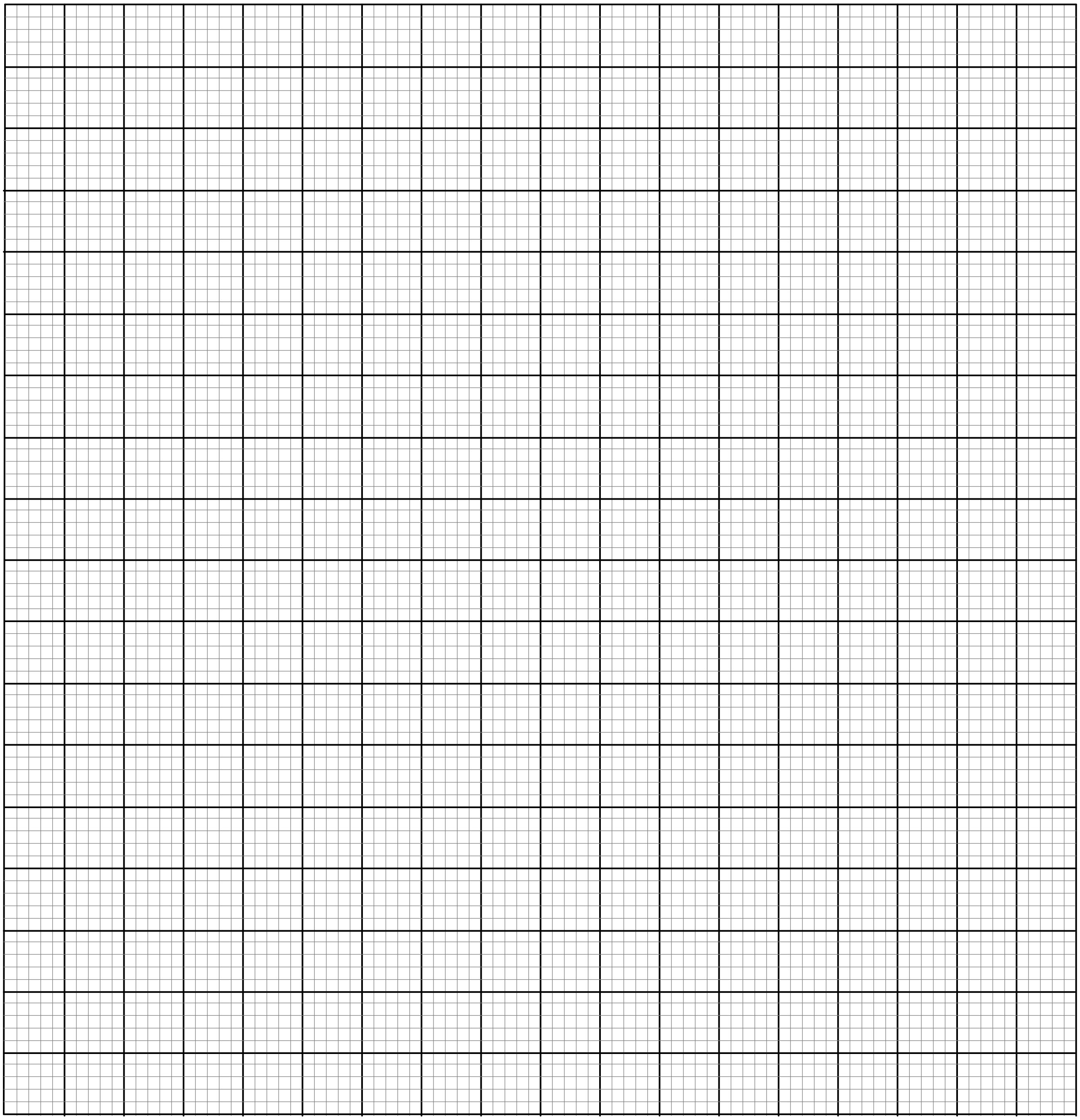
In a school gardening project, teachers and students carry soil to a vegetable plot. A teacher can carry 24 kg of soil and a student can carry 20 kg of soil. Each person makes one trip. Altogether at least 240 kg of soil must be carried. There are x teachers and y students.

(a) Show that this information leads to the inequality $6x + 5y \geqslant 60$. [1]

(b) There must not be more than 13 people carrying soil. Write down another inequality for this info. [1]

(c) There must be at least 4 teachers and at least 3 students carrying soil.
Write down another **two** inequalities. [2]

(d) On the grid below, draw all **four** inequalities on graph paper, using a scale of 1 cm to represent 1 unit on both axes. Shade the unwanted region. [5]



(e) From your graph, find **(i)** the least number of people required, [1]

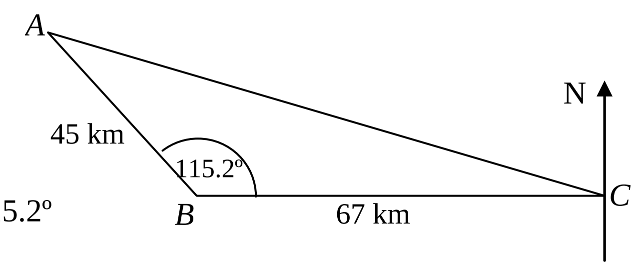
(ii) the greatest amount of soil which can be carried. [2]

Section 9 Trigonometry and bearings

1. [Specimen paper PI 2006 Q10]

The diagram shows three waterholes A, B and C in Etosha game National Park.

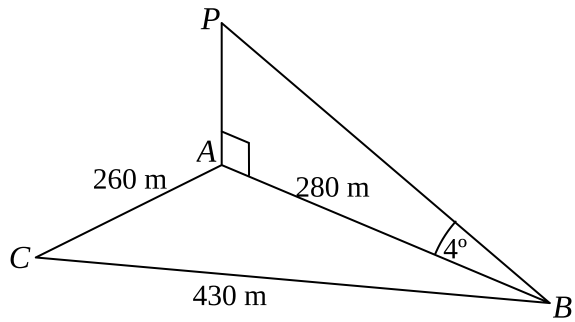
The distance between A and B is 45 km and the distance between B and C is 67 km. Angle $ABC = 115.2^{\circ}$



(a) Calculate the distance AC. [3]

(b) Given that B is due west of C, find the bearing of A from C. [3]

2. [Paper 1 2008 Q 13]



The diagram shows a triangular maize field *ABC* in a horizontal plane. The length of *AB* is 280 m, *AC* is 260 m and of *BC* is 430 m. A vertical radio mast *AP* is positioned at *A* and the angle of elevation of *P* is 4º.

(a) Find the height of the radio mast. [2]

(b) Show that the angle *CAB* = 105.5º [2]

(c) Find the area, in hectares, of the field *ABC*.
[1 hectare = 10^4 m^2] [2]

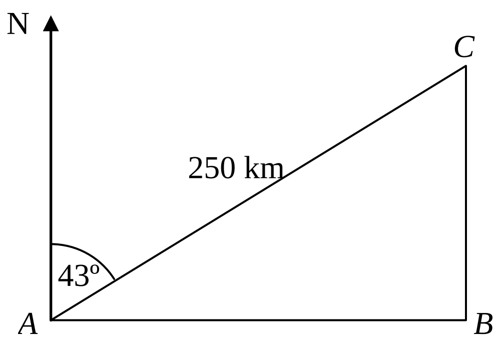
3. [Paper 1 2007 Q 2]

The diagram shows three towns *A, B* and *C*. The bearing of *C* from *A* is 043º. Town *B* is due east of *A* and *C* is due north of *B*. The distance *AC* is 250 km.

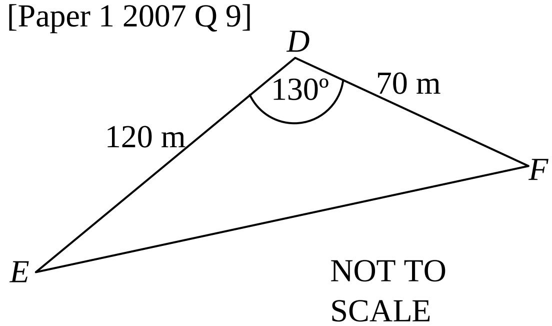
Calculate

(a) The bearing of *A* from *C*, [1]

(b) The distance *AB*. [2]



4. [Paper 1 2007 Q 9]



The diagram shows triangle *DEF* in which angle *EDF* = 130º, *DE* = 120 m and *DF* = 70 m.

(a) Calculate the area of triangle *DEF*, giving your answer in standard form. [2]

(b) Show that *EF* = 173 m, correct to 3 significant figures. [2]

(c) Hence calculate angle *DEF*. [2]

5. [Paper 1 2013 Q ?]

You are given the triangle. The vertices of all three triangles are labeled *A*, *O* and *P*. In each of the triangles, *OP* = 10 cm and *OA* = 8 cm.

(a) If angle *POA* = 90º, calculate the length of *AP*. [2]

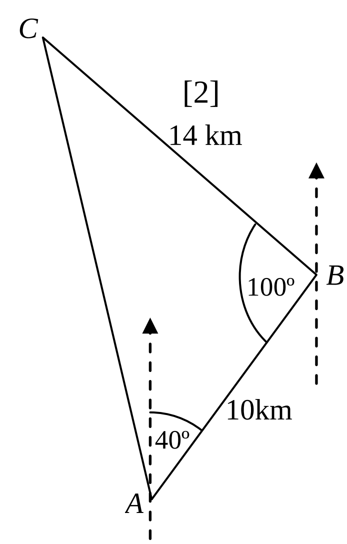
(b) If angle *OAP* = 90º, calculate the angle of *APO*. [2]

(c) If angle *POA* = 120º , calculate the length of *AP*. [2]

6. [Paper 1 2014 Q 11]

In triangle *ABC*, *AB* = 10 km, *BC* = 14 km and angle *ABC* = 100º.

The bearing of *B* from *A* is 040º.



(a) Calculate the bearing of *C* from *B*. [1]

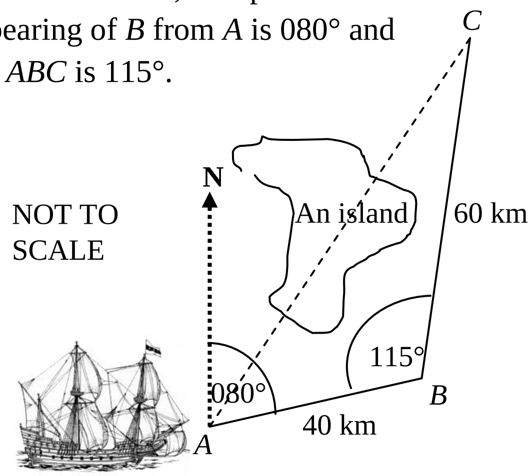
(b) Calculate the distance *AC*. [2]

(c) Jens and Sven set off from *A* together.
Jens ran from *A* to *B* to *C* at an average speed of 18 km/h.
Sven ran directly from *A* to *C* arriving at *C* at the same time as Jens. Find Sven’s average speed in km/h [3]

7. [Paper 1 2016 Q 15]

To avoid an island, a ship travels 40 km from A to B and then 60 km from B to C.

The bearing of B from A is 080° and angle ABC is 115°.



(a) Find the bearing of A from B. [1]

(b) Calculate the straight distance AC [3]

(c) Calculate angle BAC. [3]

(d) Calculate how far C is east of A. [3]

Section 10 Transformations

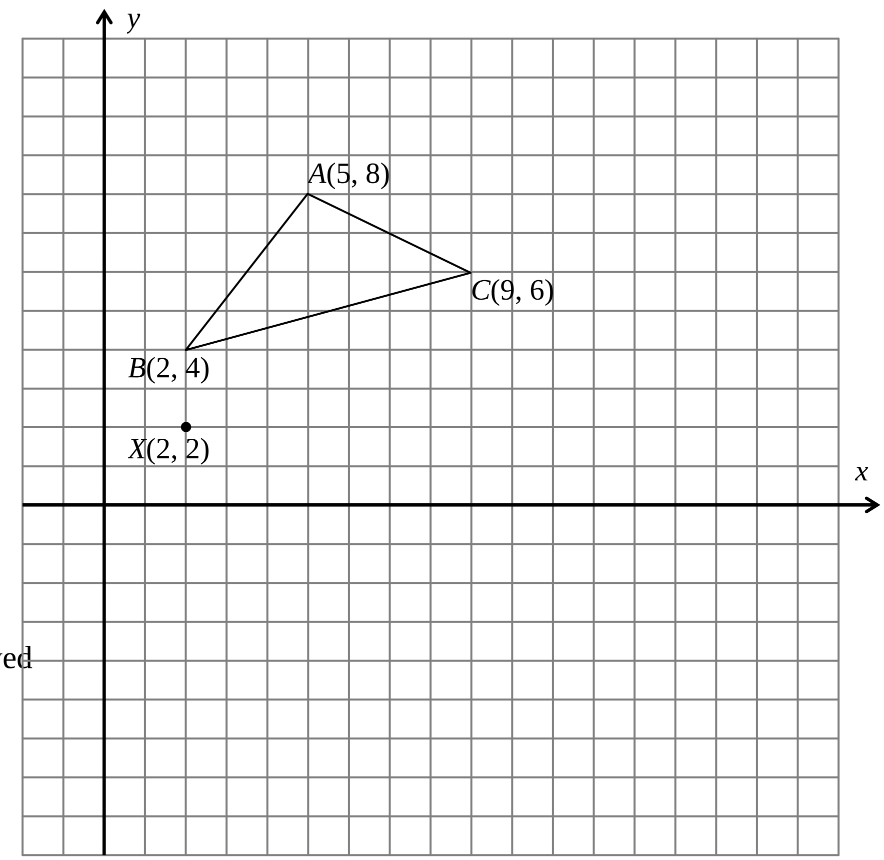
1. [Specimen paper PI 2006 Q11]

The diagram to the right shows $\triangle ABC$ in which $A(5, 8)$, $B(2, 4)$ and $C(9, 6)$.
The point X is (2, 2).
The following transformations can be applied to triangle ABC.

P the reflection in the line $y = x$

Q translation by the vector $\begin{pmatrix} -3 \\ 7 \end{pmatrix}$

R rotation clockwise through 90° about $X(2, 2)$.

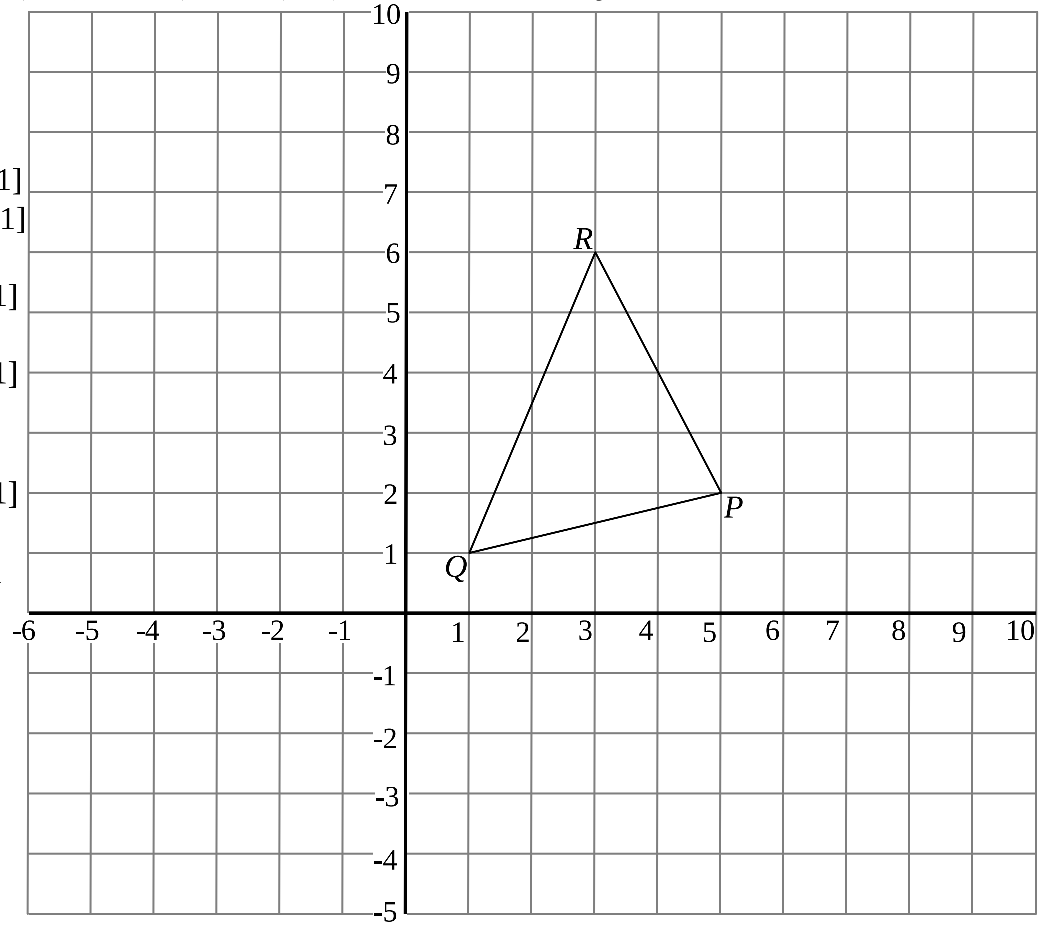


(a) Find the image of point A when transformation Q is applied, followed transformation P. [2]

(b) Find the image of point C when transformation R is applied to triangle ABC. [2]

2. [Paper 1 2011 Q 11]

The triangle PQR with vertices $P(5, 2)$, $Q(1, 1)$ and $R(3, 6)$ is shown in the diagram.



(a) An enlargement maps $\triangle PQR$ onto $\triangle PAB$. Given that the coordinates of A are $(m, 0)$, find

(i) the centre of enlargement, [1]

(ii) the value of m, [1]

(iii) the scale factor of the enlargement, [1]

(iv) the coordinates of the point B, [1]

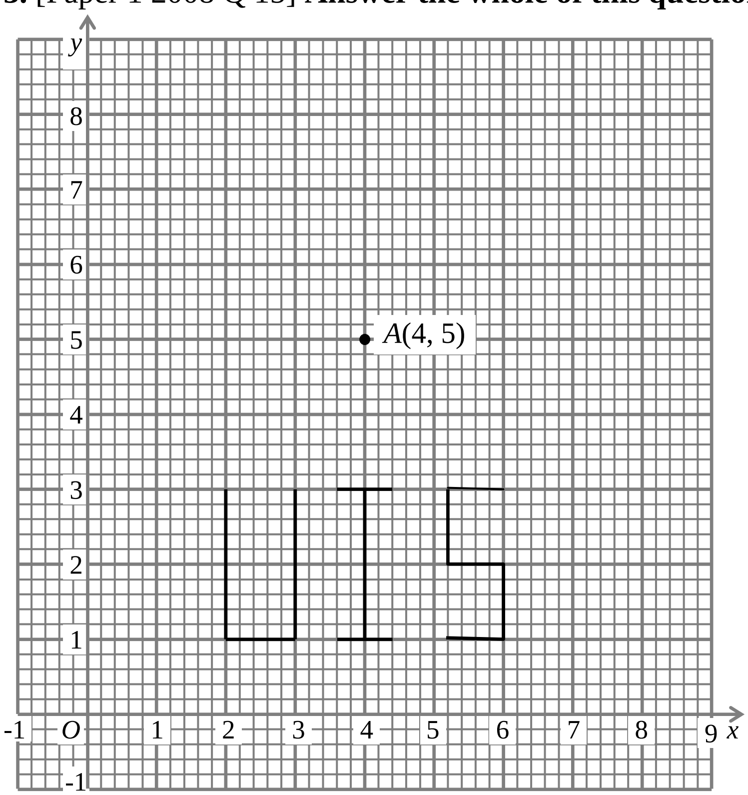
(v) the ratio of the area of $\triangle PAB$ to the area of $\triangle PQR$. [1]

(b) It is given that S is a point on the same diagram, and that $PQRS$ is a parallelogram.

(i) Write down the coordinates of the point S.

(ii) Describe fully the single transformation which maps $\triangle PQR$ onto $\triangle RSP$.

3. [Paper 1 2008 Q 15] **Answer the whole of this question on a sheet of graph paper.**



(a) Draw x-axes and y-axes from -8 to 8 using a scale of 1 cm to 1 unit.
Copy the word **UIS** onto the grid so that it is exactly as in the diagram to the left. [1]

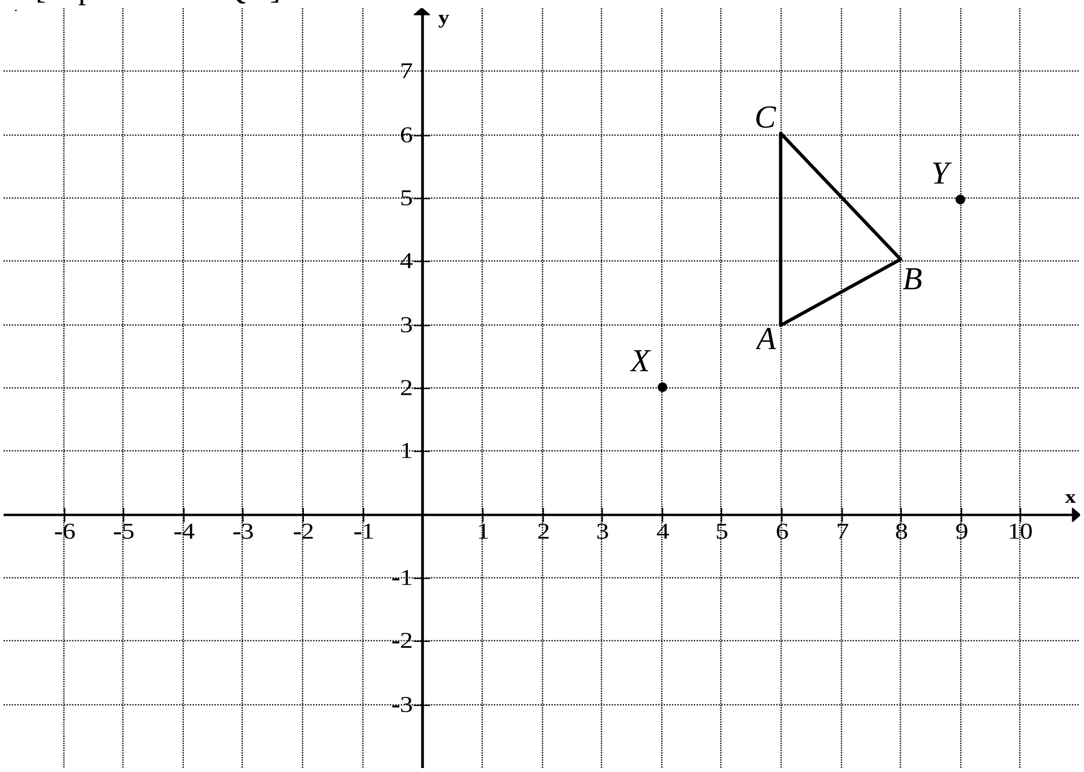
(b) Draw accurately the following transformations.

(i) Enlarge the letter **U** by a scale factor 3 with $A(4, 5)$ as the centre of enlargement. [2]

(ii) Rotate the letter **I** through 90º anticlockwise about origin O. [2]

(iii) Reflect the letter **S** in the line $y = -1$. [2]

4. [Paper 1 2010 Q 9]



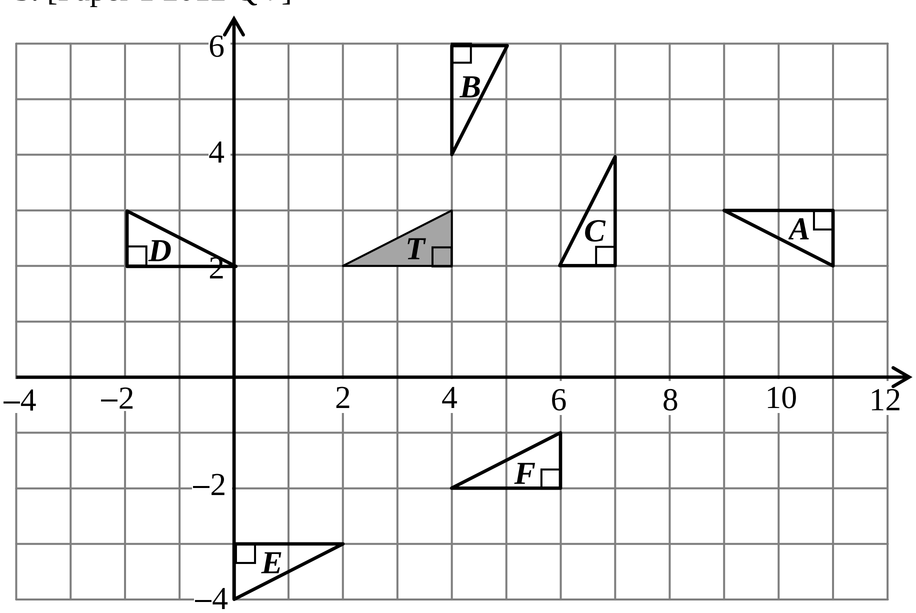
The diagram shows a triangle *ABC* in which *A* is (6, 3), *B* is (8, 4) and *C* is (6, 6). Point *X* is (4, 2) and *Y* is (9, 5)

(a) Triangle *ABC* is rotated through 90º anticlockwise about the point *X*. Write down the coordinates of the image of *A* after this rotation. [2]

(b) Triangle *ABC* is enlarged with the centre of enlargement at *Y* and with scale factor 3. Write down the coordinates of the image of *B* after this enlargement. [2]

(c) The point *C* is translated by the vector $\begin{pmatrix} -2 \\ -3 \end{pmatrix}$. Write down the coordinates of the image of *C* after this translation. [2]

5. [Paper 1 2012 Q 7]



Use one of the letter ***A, B, C, D, E or F*** To answer the following questions.

(a) Which triangle is ***T*** mapped onto by a **translation**? Write down the translation vector. [2]

(b) Which triangle is ***T*** mapped onto by a **reflection**? Write down the equation of the mirror line. [2]

(c) Which triangle is ***T*** mapped onto by a **rotation**? Write down the coordinates of the centre of the rotation. [2]

6. [Paper 1 2015 Q 13]

(a) Describe fully the single transformation which maps

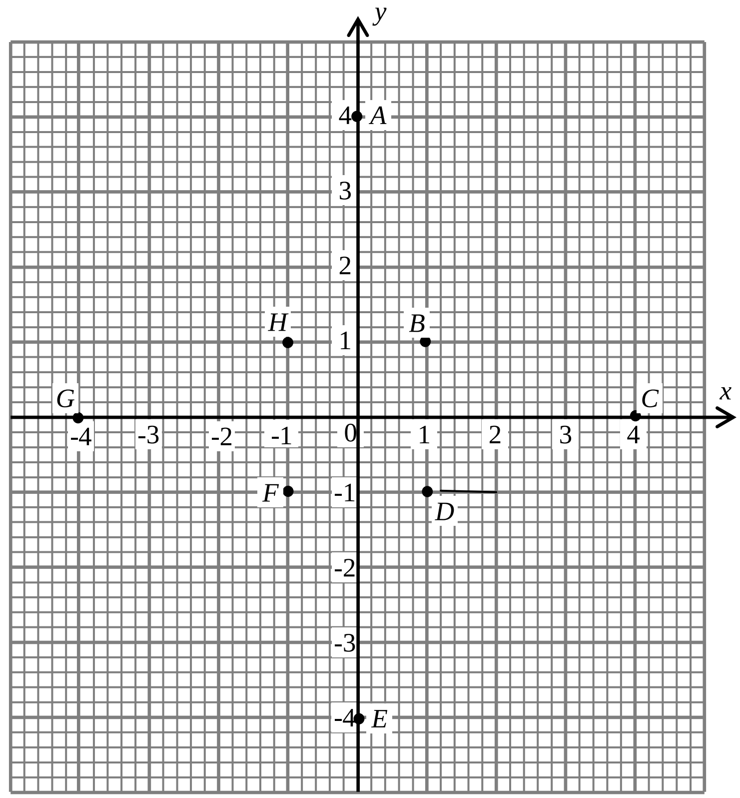
(i) both *G* onto *D* and *H* onto *C*, [2]

(ii) both *G* onto *C* and *H* onto *D* [2]

(b) Write down the position of the

(i) point *B* when it is translated by $\begin{pmatrix} -1 \\ 3 \end{pmatrix}$ [1]

(ii) point *F* when it is reflected in the line $y = -x$ [1]



7. [Paper 1 2016 Q6]

The point *A* has coordinates (3, −2). Find the image of *A* after

(a) a reflection in the *y*-axis, [1]

(b) a reflection in the line $y = x$, [1]

(c) a translation by the vector $\begin{pmatrix} -3 \\ 1 \end{pmatrix}$ [2]

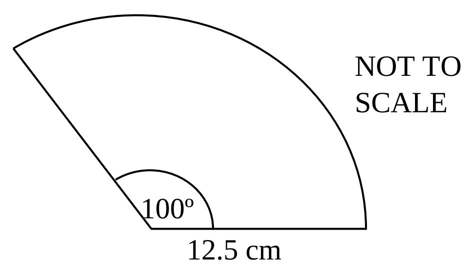
<u>Section 11 Mensuration</u>

1. [Specimen paper PI 2006 Q12]

The diagram shows a sector of a circle which Paulo is using to form a hollow cone without overlap.

The radius of the sector is 12.5 cm and the sector angle is 100º.

Find



(a) the arc length of the sector. [2]

(b) the radius of the cone. [2]

(c) the height of the cone. [2]

2. [Paper 1 2008 Q 9]

A cubic block of wax, of side 6 cm, is melted down and used to make a cylindrical candle of height 14 cm.

(a) Find the volume of the cube. [1]

(b) Find the radius of the cylinder. [2]

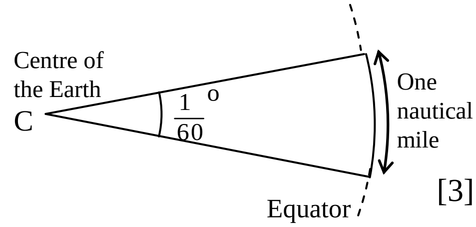
The cylindrical candle burns at an average rate of 2 cm/h.

(c) Express 2 cm/h in m/s, giving your answer in standard form. [2]

3. [Paper 1 2009 Q 5]

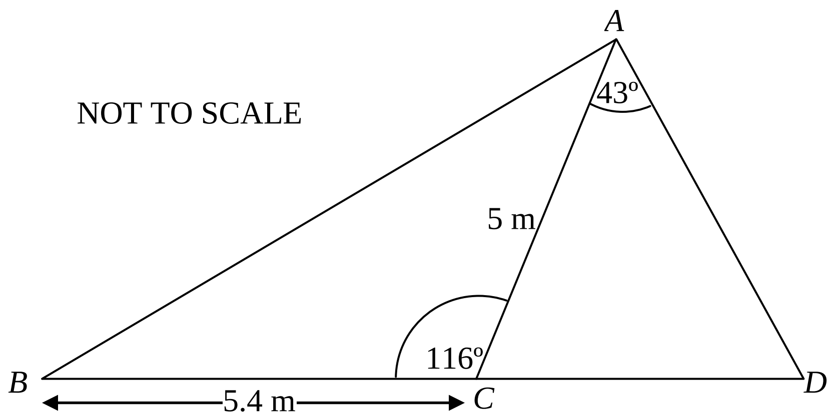
A nautical mile, or a mile at sea, is defined as 'the length of an arc along the equator subtended by an angle of $\frac{1}{60}$ of a degree at the centre of the earth'.

The diagram to the right shows a section through the earth at the equator. The centre of the earth is labeled *C*.
Given that the diameter of the earth is approximately 12 756 km, find the length of a nautical mile in metres. [3]



4. [Paper 1 2009 Q 14]

The diagram below represents some of the beams that support the roof of a house. It is given that *AC* = 5 m, *BC* = 5.4 m, angle *BCA* = 116º, angle *CAD* = 43º, and that *BCD* is a straight line.



(a) Find the length of

(i) *AB* [2]

(ii) *CD* [3]

An extra beam needs to be added to the structure. This beam must join the midpoint of *AC* to a point on *AD*. The beam will either be positioned so that it is parallel to *CD*, or so that it is perpendicular to *AD*.

(b) Find the length of this beam, if it is positioned so that it is

(i) Parallel to *CD*, [2]

(ii) Perpendicular to *AD*. [2]

5. [Paper 1 2009 Q 16]

The diagram shows the cross section through a rectangular tank, placed on a horizontal table *XY*. The tank is 12 cm high and has a square base of side 20 cm.

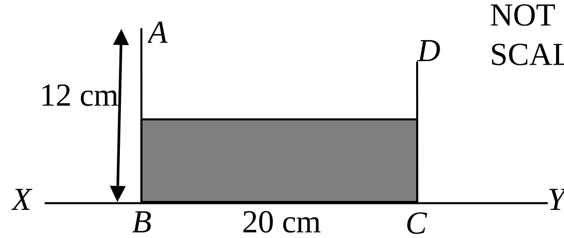
(a) (i) Calculate the total volume of the tank. [2]

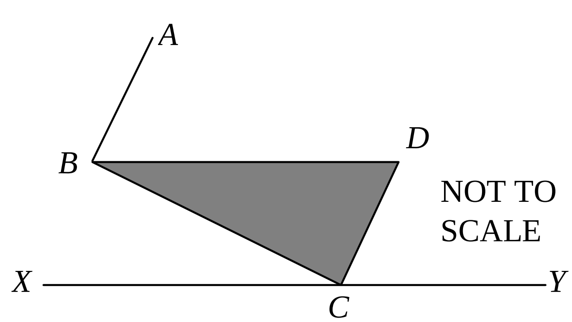
(ii) 3000 cm^3 of water is poured in the tank.
Calculate the height of the water in the tank. [2]

(b) The tank is then tilted and water is allowed to overflow at *D*, until *BD* becomes horizontal, as shown in the second diagram.
Calculate

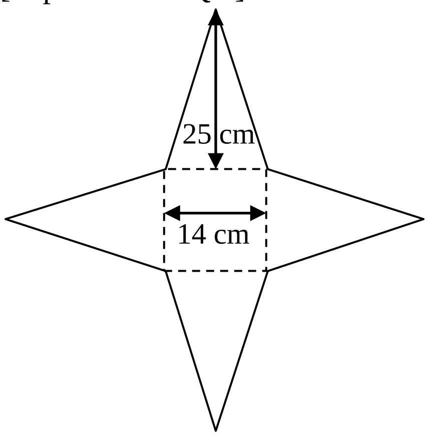
(i) The volume of water remaining in the tank, [1]

(ii) The vertical height of *B* above the table. [4]





6. [Paper 1 2007 Q 4]



The diagram shows the net of a pyramid with a square base of side 14 cm. Each side face of the pyramid is an isosceles triangle of perpendicular height 25 cm. The net is folded to make the pyramid.

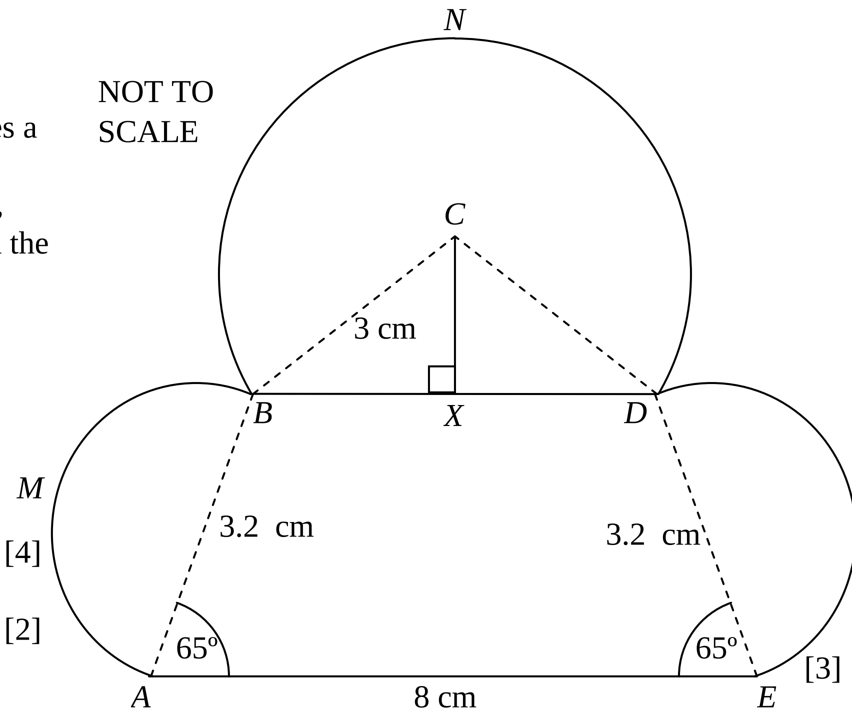
(a) Find the height of the pyramid above the base. [2]

(b) Find the volume of the pyramid. [1]

[The volume of a pyramid of base area A and height h is $\frac{1}{3}Ah$]

7. [Paper 1 2012 Q 12]

On the television, a weather forecaster uses a diagram of a cloud, as shown to the right.
Its perimeter consists of a straight line *AE*, two semicircular arcs *AMB* and *DPE* and the major arc *BND* of a circle centre *C*.
AE = 8 cm, *AB* = *DE* = 3.2 cm and
BC = *CD* = 3 cm.
Angle *BAE* = angle *DEA* = 65º and *X* is the midpoint of *BD*.



(a) (i) Use the trapezium *ABDE* to show that *BX* = 2.648 cm, correct to 4 significant figures. [4]

(ii) Show that angle *BCX* = 62.0º, correct to 3 significant figures. [2]

(b) Calculate the length of *BE*. [3]

(c) Calculate

(i) the area of triangle *BCD*, [3]

(ii) the area of trapezium *ABDE*, [3]

(iii) the area of major sector *BND*, [2]

(iv) the total area of the cloud diagram. [3]

8. [Paper 1 2013 Q11]

(a) Calculate the area of an equilateral triangle with sides of 8 cm. [2]

(b) Calculate the radius of a circle with a circumference of 8 cm. [2]

(c) The diagrams represents the nets of 3 solids. Each straight line is 8 cm long. Each circle has a Circumference of 8 cm. The arc length in Diagram 3 is 8 cm.

(i) Name the solid whose net is Diagram 1.
Calculate its surface area. [2]

(ii) Name the solid whose net is Diagram 2.
Calculate its volume. [3]

(iii) Name the solid whose net is Diagram 3.
Calculate its perpendicular height. [3]

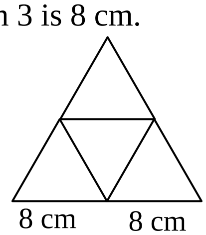


Diagram 1

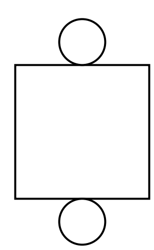


Diagram 2

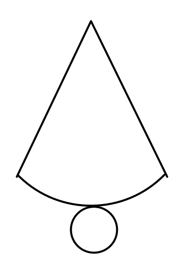
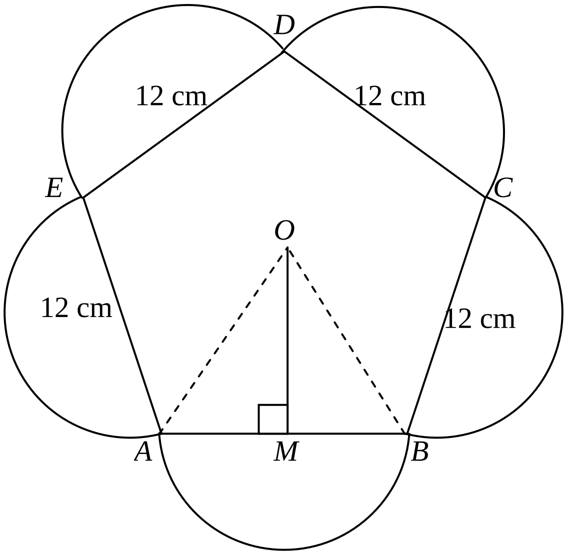


Diagram 3

9. [Paper 1 2014 Q10]

NOT TO SCALE



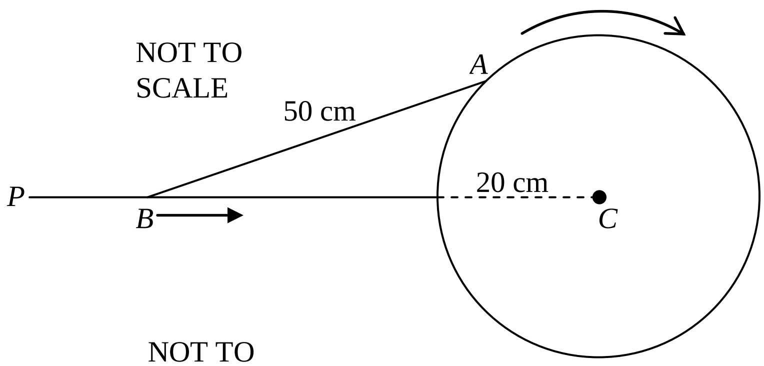
A flower design is based on a regular pentagon *ABCDE* with centre of symmetry *O* and sides of length 12 cm. Each side of the pentagon is the diameter of a semicircle .
OM is perpendicular to *AB.*
Calculate

(a) the size of angle *OAB*, [2]
(b) the length of *OM*, [2]
(c) the area of the pentagon *ABCDE*, [2]
(d) the area of the whole design, consisting of the pentagon and the five semicircles. [2]

10. [Paper 1 2015 Q13]

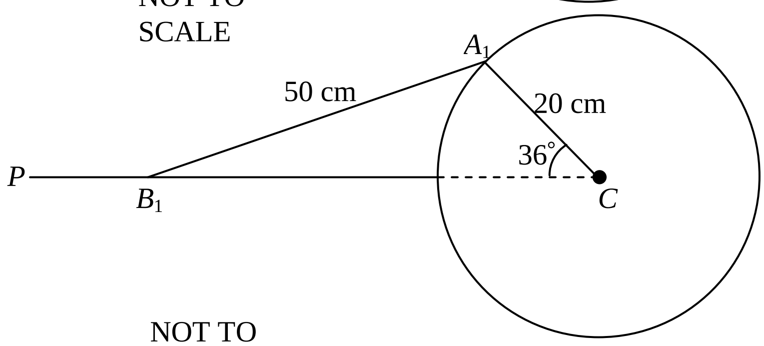
A thin string of length 50 cm has one side fastened to a point *A*, on the rim of a circular wheel of radius 20 cm and centre *C*. The other end is fastened to a small bead, *B*, which is threaded on a thin fixed rod *PC*. The wheel is slowly rotated clockwise, thus pulling the bead along the wire.

NOT TO SCALE



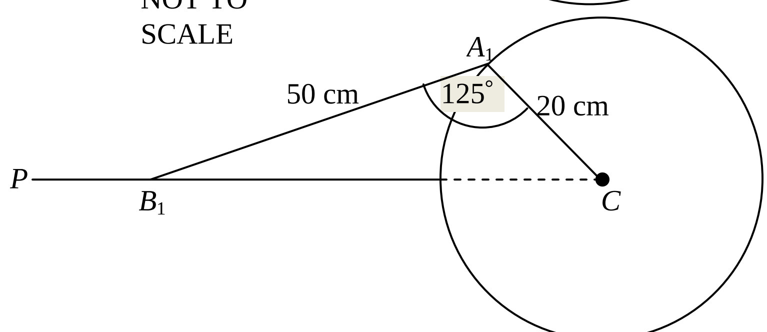
(a) When *A* is at the position A_1 , the bead is at position B_1 and angle $A_1CB_1 = 36^\circ$.
Find angle A_1B_1C, the angle between the string and the wire. [2]

NOT TO SCALE



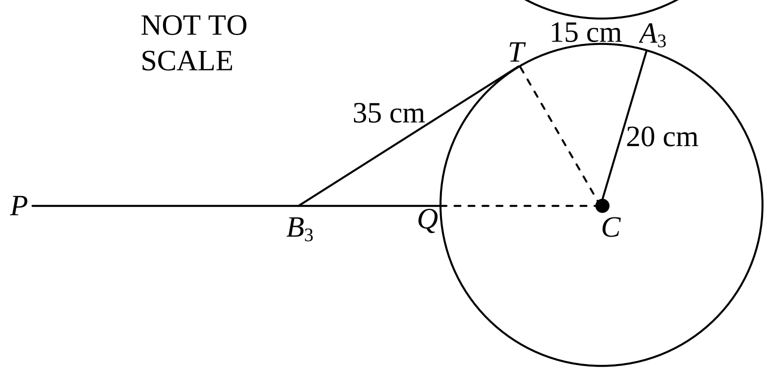
(b) When *A* is at the position A_2, the bead is at position B_2 and angle $B_2A_2C = 125^\circ$.
Find B_2C, the distance of the bead from the centre of the wheel. [2]

NOT TO SCALE



(c) When *A* is at the position A_3, the bead is at the position B_3, and part of the string, B_3T, is a tangent to the circle. The length of the string around the arc TA_3 is 15 cm.
(i) Find the size of angle A_3CT. [2]
(ii) Find B_3Q, the distance of the bead from the wheel, where *Q* is on the rod *PC*, touching the wheel. [3]

NOT TO SCALE



Section 12 Statistics

1. [Specimen paper PI 2006 Q13]

A café owner in Oshakati sells take-away meals at lunch times. He kept a records of the number of meals, M, that were sold per Week over a period of 50 weeks and summarized the information in the table to the right.

Number of meals (M) served per week.	**Number of weeks**
$0 < M \leq 100$	2
$100 < M \leq 200$	7
$200 < M \leq 300$	11
$300 < M \leq 400$	17
$400 < M \leq 500$	7
$500 < M \leq 600$	4
$600 < M \leq 700$	1
$700 < M \leq 800$	1

(a) Draw, **on a graph paper,** a cumulative frequency curve for the the data. [3]

(b) Use your graphs to estimate the median number of meals served over the period of 50 weeks. [2]

(c) Calculate an estimate of the mean number of meals served per week. [2]

2. [Paper 1 2011 Q8]

Mass (m) (kg)	$5 \leq m < 10$	$10 \leq m < 15$	$15 \leq m < 25$	$25 \leq m < 40$
Frequency	36	24	25	48

The grouped frequency table shows the masses of 132 children.

(a) Anna represents this information in a histogram.
The height of the bar which represents the 36 children with mass $5 \leq m < 10$, is 14.4 cm.
Calculate the height of the bar for the interval of $15 \leq m < 25$. [2]

(b) Estimate the mean mass of the 132 children. [3]

3. [Paper 1 2009 Q 8]

A group of high school girls took part in a sponsored fun run in their town. The table below shows the distances that the girls ran.

Distance (km)	2	3	4	5	6
Frequency	x	1	3	7	2

(a) Given that the median distance run was 3 km, find the value of x. [1]

(b) Calculate the mean distance that the group of girls ran. [2]

4. [Paper 1 2009 Q 9]

A survey is made of the lengths of 300 streams. The lower quartile, the median and the 70th percentile of the distribution are 15 km, 19 km and 24 km respectively.

(a) Copy and complete the table below. [3]

Length (x km)	Frequency
$0 < x \leq 15$	
$15 < x \leq 19$	
$19 < x \leq 24$	
$24 < x \leq 30$	

(b) On the graph paper provided, using 2 cm to represent 5 units on both axes, draw a histogram to represent the data in the table. [3]

5. [Paper 1 2008 Q 12]

The cumulative frequency curve shows the time taken by 120 students to write an essay in an examination.

(a) Use the graph to estimate

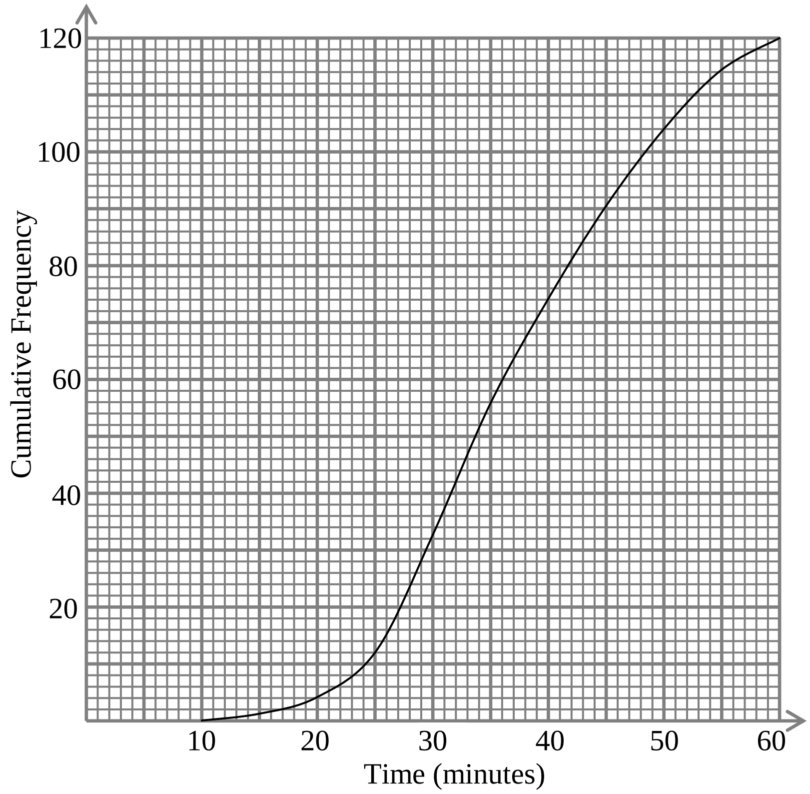
(i) the median time [1]

(ii) the percentage of students who took more than 42 minutes to write the essay. [3]

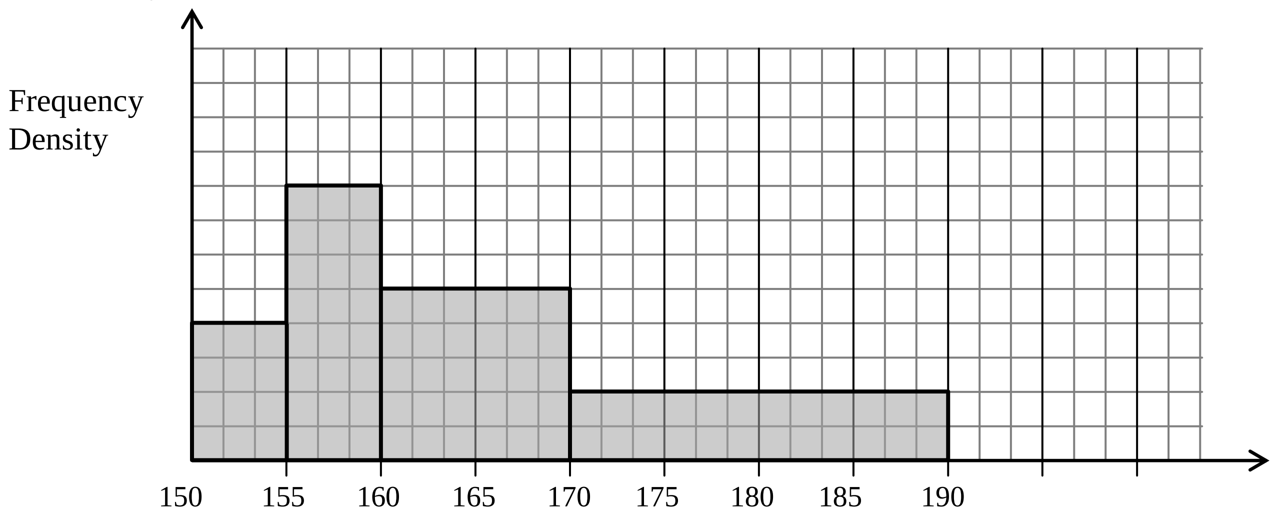
This information is also shown in the frequency table below.

Time T in minutes	Frequency
$10 \le T < 20$	4
$20 \le T < 30$	a
$30 \le T < 40$	41
$40 \le T < 50$	31
$50 \le T < 60$	b

(b) Find the value of a and b. [2]



6. [Paper 1 2007 Q 11]



The histogram above shows the heights of 300 girls recorded from a survey in Windhoek.
This information is also shown in the frequency table below.

Height (cm)	Frequency
$150 < h \le 155$	40
$155 < h \le 160$	80
$160 < h \le 170$	p
$170 < h \le 190$	q

(a) Use the information above to find the value of p and q. [2]

(b) Calculate an estimate of the mean height of the 300 girls. [3]

(c) State the interval in which the median height falls. [1]

7. [Paper 1 2013 Q4]

The ages, to the nearest month, of a group of seven toddlers are :

3 years 5 months,
3 years 9 months,
2 years 11 months,
3 years 4 months,
4 years 4 months.
3 years 10 months and
2 years 11 months.

Find in years and months:

(a) the mode, [1]

(b) the median, [1]

(c) the mean [3]

8. [Paper 1 2014 Q9]

Answer the whole of this question on a sheet of graph paper.

152 passengers on an aircraft had their baggage weighed. The results are shown in the table.

Mass of baggage, M (kg)	$0 < M \leq 10$	$10 < M \leq 15$	$15 < M \leq 20$	$20 < M \leq 35$
Number of passengers	20	36	48	48

Using a scale of 2 cm to represents 5 kg draw a horizontal axis for $0 < M \leq 40$.

Using an area scale of 1 cm^2 to represent 2 passengers, draw a histogram for this data. [5]

9. [Paper 1 2015 Q6]

A six-faced die was thrown 28 times.

The table shows the number of times that each possible score occurred.

Score	1	2	3	4	5	6
Frequency	8	6	6	2	4	2

(a) Write down the modal score. [1]

(b) After the 27^{th} throw the median score was 2.What was the least possible score on the 28^{th} throw? [2]

(c) The die was then thrown twice more. The mean score of all 30 throws was exactly 3.
What were the scores on the extra two throws? [2]

10. [Paper 1 2015 Q7]

The lengths of 50 rods are shown in the table.
Calculate the mean length of the rods, giving your answer to the nearest centimeter. [3]

Lenghts (l) (in cm)	**Frequency**
$68 \leq l < 70$	3
$70 \leq l < 74$	7
$74 \leq l < 78$	10
$78 \leq l < 81$	16
$81 \leq l < 83$	14

11. [Paper 1 2016 Q8]

The mass of each of 60 potatoes is measured. The table shows the result.

Mass (m) in grams	$10 < m \leq 20$	$20 < m \leq 40$	$40 < m \leq 50$
Frequency	10	30	20

(a) On a histogram the height of the bar of the “$20 < m \leq 40$ interval is 3 cm. Find the height of the bar of the $40 < m \leq 50$ interval on the histogram. [3]

(b) Write down the modal interval. [1]

Section 13 Probability

1. [Specimen paper PI 2006 Q14]

A lady golfer from Walvis Bay plays a particular hole many times in a year. On 30% of all days, there is a wind blowing across the course. If the wind is blowing, the probability that she hits a straight drive is 0.4, but if the wind is not blowing, the probability that she hits a straight drive, is 0.8.

Find the probability that on a particular day

(a) the wind is not blowing and she hits a straight drive. [2]

(b) she hits a straight drive. [2]

She plays the whole on the two successive days, find the probability that

(c) she does not hit a straight drive on either of the two days. [2]

2. [Paper 1 2011 Q6]

Two bags contain coloured balls. Bag A contains 5 red balls and 2 white balls.
Bag B contains 2 red balls and 4 white balls. One ball is taken from each bag at random.

Find the probability that

(a) both balls are red, [2]

(b) the balls are of different colours. [3]

3. [Paper 1 2008 Q 8]

Eight children want to go to a concert but only three tickets are available. The three tickets are placed in three of eight identical envelops which are sealed. The children pick an envelop each, at random, one after the other.

(a) State the probability that the first child picks an envelop with a ticket. [1]

(b) Find the probability that the second child picks an envelop with a ticket. [3]

4. [Paper 1 2009 Q 7]

A group of 10 businessmen visit southern Africa. Of these, only 4 have previously visited Namibia.

(a) If one member of this group is chosen at random, what is the probability that he has never been to Namibia before? [1]

(b) If two members of this group are chosen at random what is the probability that at least one of the two has visited Namibia before? [2]

5. [Paper 1 2007 Q 12]

A grade 12 learner from Keetmanshoop is attempting to pass his driver's test. The probability that he Passes on his first attempt is $\frac{3}{5}$. At any further attempt the probability that he passes is $\frac{9}{10}$.

(a) Draw a tree diagram that illustrates the probabilities of passing at the first, second or third attempt. [2]

(b) Find the probability that he needs no more than two attempts to pass the test. [2]

(c) It takes him n attempts (where $n \geq 2$) to pass. Write down an expression, in terms of n, for the probability that he passes on the n^{th} attempt. [2]

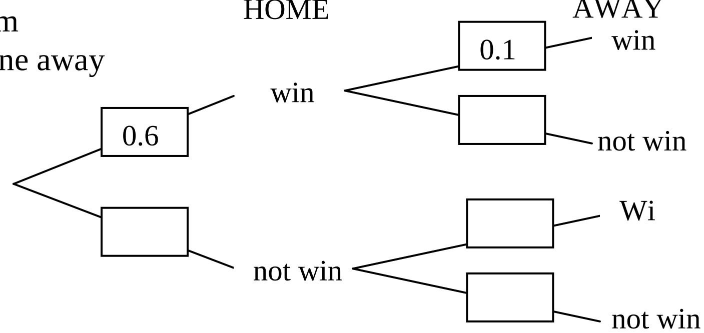
6. [Paper 1 2012 Q 6]

The probability that Rangers win a hockey match at home is 0.6 but only 0.1 for a match away.

(a) Copy and complete the following tree diagram for two consecutive matches, one home and one away [2]

(b) What is the probability that Rangers wins both matches? [1]

(c) What is the probability that Rangers wins at least one of the matches? [2]



7. [Paper 1 2013 Q 10]

In a group of 16 boys and 14 girls, 7 of the boys and 4 of the girls were raised in Oshakati.

(a) One child from the group of 30 was chosen at random. Find the probability that the child

(i) was not a boy raised in Oshakati [1]

(ii) was raised in Oshakati. [1]

(b) Two children (irrespective of the gender) were chosen at random. Calculate the probability that **neither** was raised in Oshakati, leaving your answer as a fraction in its simplest form. [3]

8. [Paper 1 2014 Q 5]

During a week in November, on any one day, the probability that Magda will swim is 0.7 and the probability that she will wear a bikini is 0.18.

(a) Find the probability that on the first day of the week

(i) she will swim and will not wear a bikini, [1]

(ii) she will swim, or wear a bikini, but not both. [3]

(b) Find the probability that the first time she will wear a bikini is on the fourth day of the week. [2]

9. [Paper 1 2015 Q 8]

Johanna has three 50 cents coins and two 10 cents coins in her pocket. She takes two coins of her pocket, at random, one after the other. The coins are not replaced.

(a) Find the probability that the total value of the two coins is **(i)** 20 cents [1]

(ii) 60 cents [2]

(b) Johanna then takes out a third coin. Find the probability that the total value of the three coins taken out is 70 cents. [3]

10. [Paper 1 2016 Q 7]

On her way to school, Alice passes through three sets of traffic lights. The probability that the lights are at green are $\frac{3}{4}$, $\frac{1}{5}$, and $\frac{2}{3}$ respectively. She has to stop when the traffic lights are not at green.

(a) Find the probability that she will find all three traffic lights ate green. [1]

(b) Find the probability that she has to stop at least once. [2]

(c) Find the probability that she has to stop at exactly two sets of traffic lights. [3]

Section 14 Algebra & Functions

1. [Specimen paper PI 2006 Q15]

The functions f and g are defined by $f : x \mapsto \dfrac{6}{2x+3}$, $x \in \mathbb{R}$, $x \neq -1.5$ $\quad$ $g : x \mapsto 2 - 4x$, $x \in \mathbb{R}$

(a) Express fg(x) in terms of x. [2]

(b) Hence, solve fg(x) = 3. [1]

2. [Paper 1 2011 Q 7]

A teacher asks her students to write down an expression, using each of the four integers 1, 2, 3 and n exactly once. Alice's expressions is $(2n)^{3+1}$ Bernhard's expression is $(3 + 1)^{2n}$

(a) Alice's expression can be written as an^b and Bernhard's expression can be written as c^n. Find the values of a, b and c. [3]

(b) Write down an expression, using each of the integers 1, 2, 3 and n exactly once, which will always be greater than 1 for any integral value of n. [1]

3. [Paper 1 2008 Q2]

Maria buys 4 books at N\$ x each,
p books at N\$ 20 each,
3 books at N\$ $3x$ each.

Simplifying each answer, find an expression in terms of x and/or p, for

(a) the total number of books bought, [1]

(b) the total cost, in N\$, of the books bought, [2]

(c) the mean cost in N\$ of the books bought. [1]

4. [Paper 1 2008 Q 11]

The function f is defined by f: $\mapsto \frac{1}{2}x + 3$.

(a) Sketch and label, on a single diagram, the graphs of $y = \mathrm{f}(x)$ and $y = \mathrm{f}^{-1}(x)$, making clear the relationship between these two graphs. [3]

(b) On your diagram, shade the region defined by the inequalities $x \geq 0$, $y \geq 0$, $y \leq \mathrm{f}(x)$ and $y \geq \mathrm{f}^{-1}(x)$. [2]

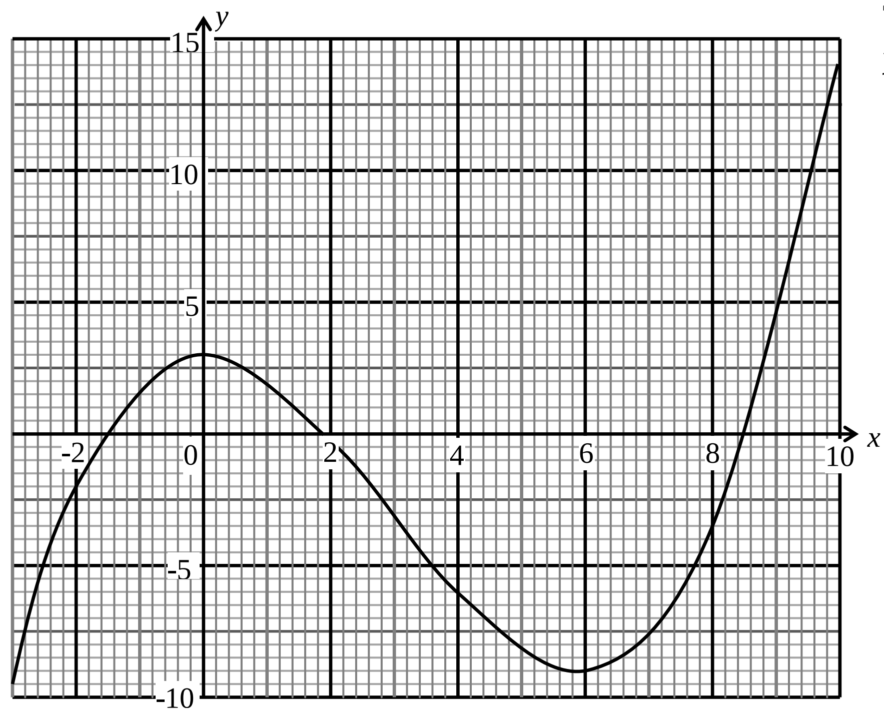
5. [Paper 1 2007 Q 7]

The volume of a cuboid is given by the expression $x^3 - 2x^2 - 5x + 6$.

(a) Given that the length of the cuboid is $(x - 3)$, find the area of the base in terms of x. [2]

(b) Given that the length of the base is $(x + k)$ and the width is $(x + h)$, where k and h are integers, find the possible values of k and h. [2]

6. [Paper 1 2009 Q 11]



The diagram shows the accurate graph of $y = \mathrm{f}(x)$, for $-3 \leq x \leq 10$.

23

(a) Use the graph to find $\mathrm{f}^{-1}(5)$. [1]

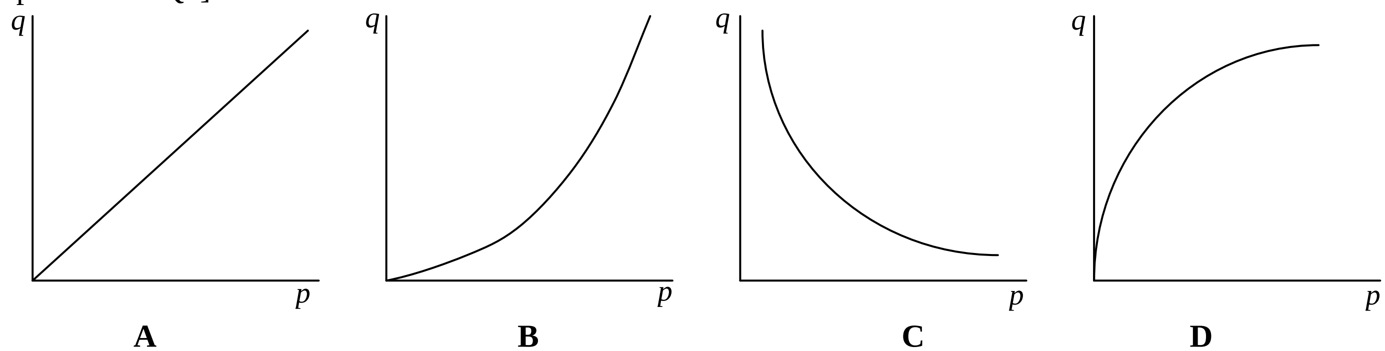
(b) It is given that k is an integer for which the equation $\mathrm{f}(x) = k$ has exactly two different solutions. Use the graph to find the two values of k. [2]

(c) The equation $\mathrm{f}(x) + x - 1 = 0$ can be solved by drawing a line on the grid.

(i) Write down the equation of this line. [1]

(ii) How many solutions are there for $\mathrm{f}(x) + x - 1 = 0$? [1]

7. [Paper 1 2014 Q6]



Given that k is a constant, suggest which of the graphs corresponds to each of the equations. [4]

(a) $q = k/p$ **(b)** $q = k\,p^2$ **(c)** $q = k\sqrt{p}$ **(d)** $q = k\,p$

8. [Paper 1 2015 Q11]

(a) Simplify $\dfrac{3a^2 - 3}{3a^2} \times \dfrac{a^3 - a^2}{a^2 + a}$ [4]

(b) Given that $(x + 2)$ books cost N$$(x^3 - 7x - 6)$, find, in its simplest form, the cost of one book. [3]

9. [Paper 1 2016 Q4]

Find the value of $a^2 + b^2$ when $a + b = 6$ and $ab = 7$. [3]

Section 15 Coordinate geometry

1. [Specimen paper PI 2006 Q16]

The points A and B have the coordinates (–3, 6) and (9, –4) respectively.

(a) Find the equation of the line AB. [3]

(b) Find equation of the locus of all points equidistant to A and B [3]

(c) Verify that point C(13, 13) lies on this locus [1]

(d) Find the distance AC. [2]

2. The graph of the curve $x^2 + y^2 = 9$ meets the graph of $x - y + 1 = 0$ at two points.

Find the coordinates of these points, giving your answer correct to one decimal place. [5]

3. [Paper 1 2011 Q12]

In the diagram $KLMN$ is a square.

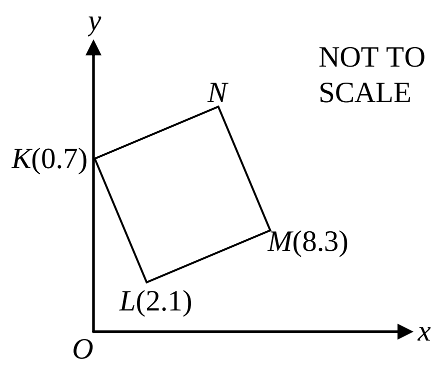
K is the point (0, 7), L is the point (2, 1) and M is the point (8, 3).

(a) Find the equation of

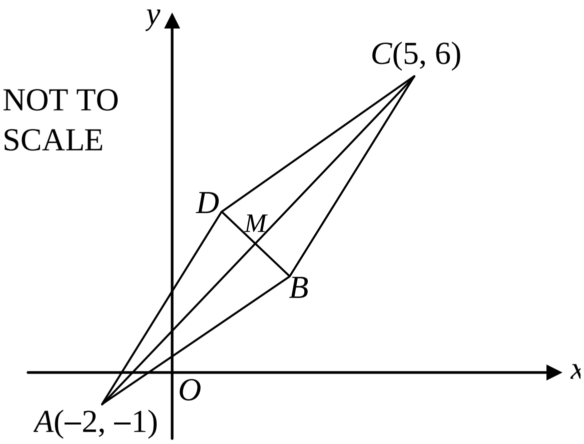
(i) KL, [2]

(ii) the perpendicular bisector of LM. [2]

(b) Calculate the area of the square. [2]



4. [Paper 1 2008 Q 14]



The diagrams shows a rhombus *ABCD*. The coordinates of *A* and *C* are (–2, –1) and (5, 6) respectively. The diagonals
AC and *BD* intersect at *M*.

(a) Find the equation of the line *AC*. [2]

(b) Show that the coordinates of *M* are (1.5, 2.5) [1]

(c) Find the equation of the line *BD*. [2]

The coordinates of *B* are (2, 2)

(d) Find the coordinates of D. [2]

(e) Calculate the perimeter of the rhombus. [2]

5. [Paper 1 2009 Q 13]

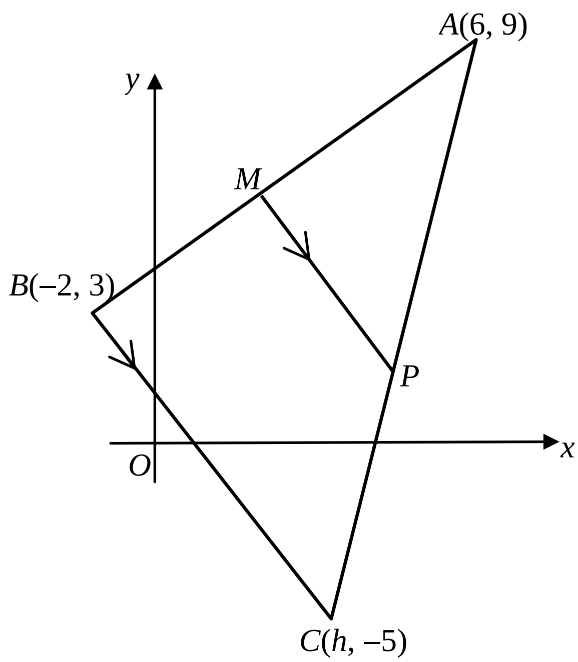
The diagram to the right shows a triangle *ABC*. The coordinates of its vertices *A*, *B* and *C* are (6, 9), (–2, 3) and (*h* , –5) respectively. It is also given that *BA* = *BC* and that *h* is a positive constant.

(a) Find the value of *h*. [3]

(b) Show that the angle *ABC* = 90º [2]

The midpoint of *AB* is the point *M*. The line through *M*, is parallel to *BC*, intersects *AC* at *P*.

(c) Find the equation of the line *MP*. [3]



6. [Paper 1 2013 Q 7]

The straight line $4x - y = 9$ intersects the curve $y = 3 + 13x - 3x^2$ at points *P* and *Q* respectively.

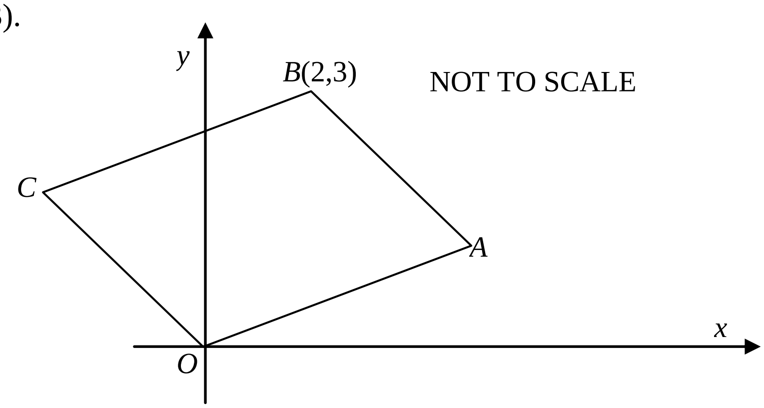
(a) Show that the *x*-coordinates of points *P* and *Q* are −1 and 4 respectively. [3]

(b) Hence find the length of line *PQ*. [2]

(c) Find the equation of the perpendicular bisector of line *PQ*. [4]

7. [Paper 1 2014 Q 13]

In the diagram, *OABC* is a parallelogram. The equation of *OA* is $y = \frac{1}{4}x$, the gradient of *OC* is −1 and *B* is the point (2, 3).



Determine

(a) the equation of the line *AB*, [2]

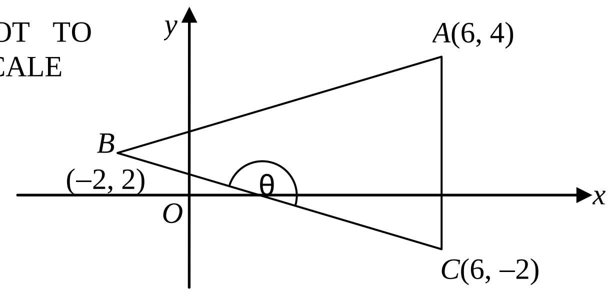
(b) the coordinates of point *A*, [3]

(c) the midpoint of *OB*, [1]

(d) the equation of the perpendicular bisector of *OB*. [3]

15. [Paper 1 2015 Q 15]

NOT TO SCALE



In the diagram, triangle *ABC* has vertices *A*(6, 4), *B*(–2, 2) and *C*(6, –2) in the Cartesian plane. The line *BC* is inclined at an obtuse angle θ to the positive *x*-axis.

(a) Calculate the coordinates of the midpoint of *AC*. [1]

(b) Calculate the area of Δ*ABC*. [2]

(c) Find the equation of the line *BC*. [2]

(d) Calculate the size of angle θ. [3]

(e) Find the equation of the line which is parallel to $y + 2x = 8$ and which passes through point *A*. [2]

16. [Paper 1 2016 Q16]

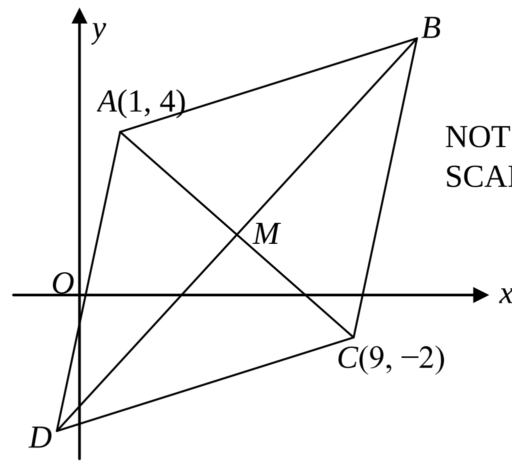
The diagram shows a rhombus *ABCD* in which the diagonals *AC* and *BD* intersect at *M*. The coordinates of *A* and *C* are (1, 4) and (9, −2) respectively.

(a) Determine, in the form $ax + by + c = 0$ the equation of

(i) *AC*

(ii) *BD*

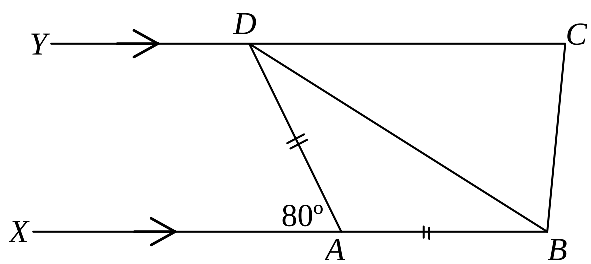
(b) Calculate the length of AC.



<u>Section 16 Geometry including circle geometry</u>

1. [Paper 1 2011 Q 3(a)]

In the diagram, *XB* and *YC* are parallel. Given AD = AB and angle *XAD* = 80º, find

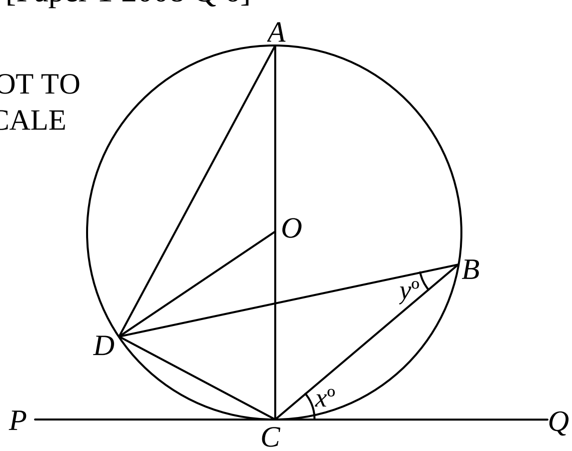


(a) ∠*ABD*, [1]

(b) ∠*BDY*. [1]

2. [Paper 1 2008 Q 6]

NOT TO SCALE



In the diagram, *ABCD* is a cyclic quadrilateral in a circle with centre *O* and *AC* is a diameter. The line *PCQ* is a tangent to the circle at *C*. Given that angle *BCQ* = xº and angle *CBD* = yº, find in terms of *x* and/or *y*,

(a) angle *OCB*, [1]

(b) angle *CAB*, [1]

(c) angle *DOC*, [1]

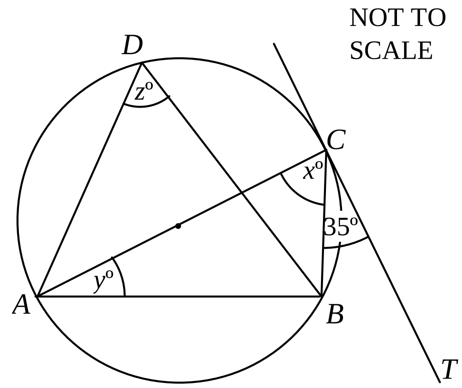
(d) angle *ODC*. [1]

3. [Paper 1 2009 Q 3]

In the given diagram, a circle with diameter *AC* passes through the points *A*, *B*, *C* and *D*.

A tangent *TC* to the circle touches the circle at *C*.

Angle *BCT* = 35°.



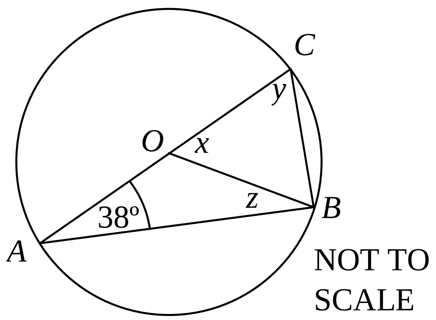
(a) Give a reason for each of the following:

(i) $x = 55^\circ$, [1]

(ii) $y = 35^\circ$. [1]

(b) Find the value of angle *z*. [1]

4. [Paper 1 2007 Q 1]



The diagram shows three points *A*, *B* and *C* on a circle, centre *O*.
Given that angle *CAB* = 38°, find the value of the angle denoted by

(a) *x*, [1]

(b) *y*, [1]

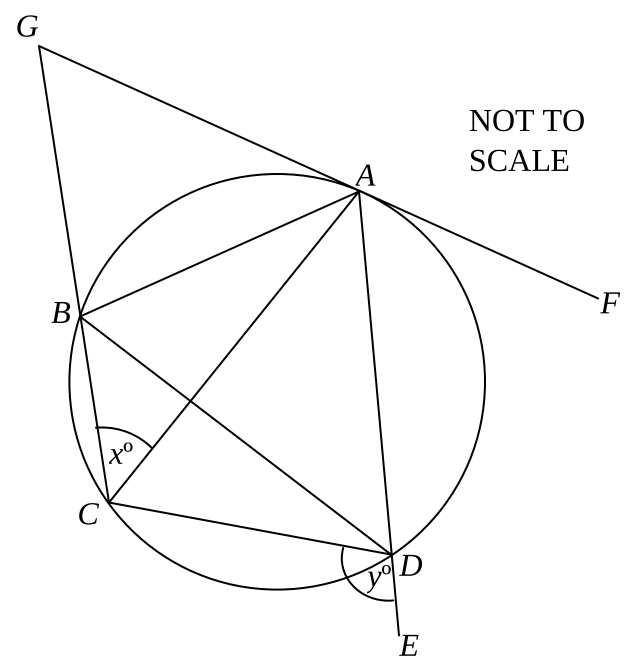
(c) *z* [1]

5. [Paper 1 2010 Q 7]

The diagram shows a cyclic quadrilateral *ABCD* with *GAF*, a tangent to the circle at *A*.

The tangent meets *CB* produced at *G*.

The line *AD* is produced to *E*, angle *CDE* = *y*° and angle *ACB* = *x*°.



(a) Find another angle which equals *x*°. Give reasons for your answer. [2]

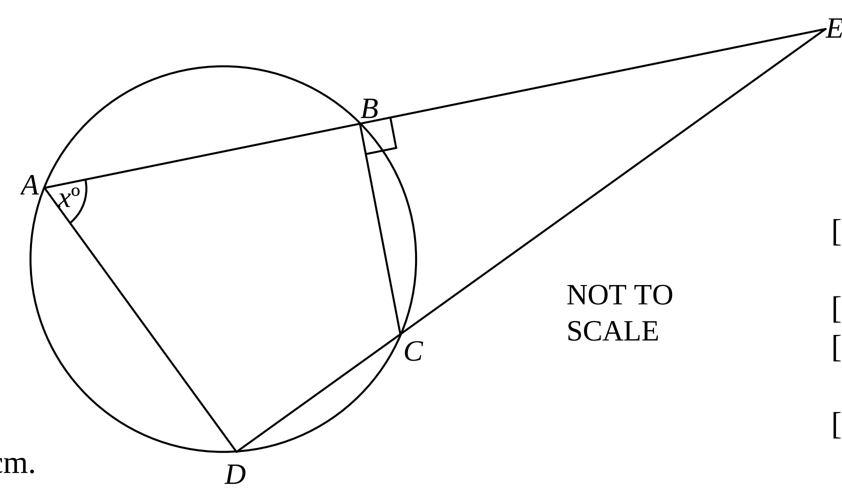
(b) Explain why angle *ABC* = *y*° [1]

(c) Express angle *BAC* in terms of *x* and *y*. [1]

(d) Express angle *AGB* in terms of *x* and *y*. [2]

6. [Paper 1 2013 Q 13]

In the diagram, *A*, *B*, *C* and *D* lie on a circle and *AB* and *DC*, when produced, meet at *E*. The line *CB* is perpendicular to the line *AE*. The angle *BAD* = *x*°.



(a) Give a reason why *AC* is a diameter of the circle. [1]

(b) Express in terms of *x*,

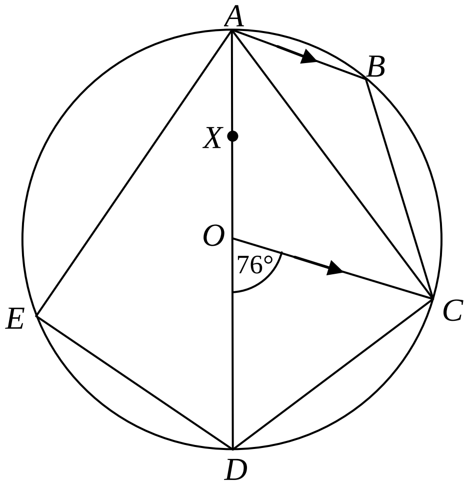
(i) angle *BCD* [1]

(ii) angle *BEC* [1]

(c) Show that triangles *ADE* and *CBE* are Similar. [2]

(d) It is given that *BC* = 3 cm and *AD* = 4 cm.
Write down the ratio of the area of triangle *ADE* to the area triangle *CBE*. [2]

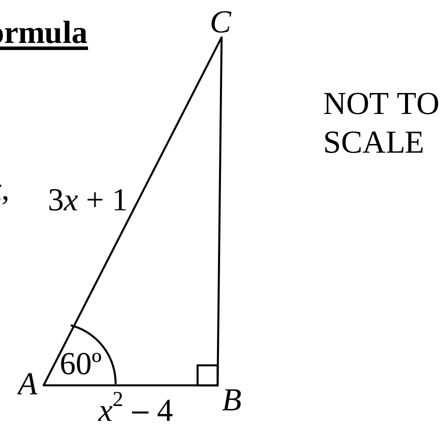
7. [Paper1 Q13 2016]
The diagram shows a circle, centre *O*, with points *A*, *B*, *C*, *D* and *E* on the circumference.
AD is the diameter of the circle, angle *COD* = 76° and *AB* is parallel to *OC*.



(a) Find
(i) angle *ODC* [1]
(ii) angle *ABC* [1]
(iii) angle *ACB* [1]
(b) *X* is a point on *AD* such that *AX* : *XD* is 1 : 3
Given that the area of triangle *EAD* = 96 cm^2,
calculate the area of triangle *EXD*. [2]

Section 17 Equations, substitutions & changing the subject of a formula

1. [Paper 1 2011 Q 9]
The diagram shows a triangle *ABC* with angle *CAB* = 60º, and
angle *ABC* = 90º , *AC* = $3x + 1$ and *AB* = $x^2 - 4$.



(a) Use the diagram above to write down an equation in terms of *x*, and show that the equation simplifies to $2x^2 - 3x = 9$. [3]
(b) Solve the equation by the method of completing the square. [4]
(c) Write down the length of side *AB*. [1]

2. [Paper 1 2009 Q 2]
Given that $x = \dfrac{3y+5}{2y}$,
(a) Calculate the exact value of *x* when *y* = 9. [1]
(b) Find *y* in terms of *x*. [3]

3. [Paper 1 2007 Q 8]
(a) Express $\dfrac{3}{(x+1)(x+3)} - \dfrac{2}{(x+3)}$ as a single fraction, giving your answer in its simplest form. [3]

(b) Hence solve the equation $\dfrac{3}{(x+1)(x+3)} - \dfrac{2}{(x+3)} = 0$ [1]

4. [Paper 1 2010 Q 4]
It is given that $y = \dfrac{7}{\sqrt{x}} - 70$
(a) Find the value of *y* when $x = 2.53 \times 10^{-8}$, giving your answer in standard form. [2]
(b) Find *x* in terms of *y*. [2]

5. [Paper 1 2012 Q 11]

(a) A quadratic function has the equation $y = px^2 + qx + r$.

(i) Sketch a possible graph of the function if $p < 0$. [1]

(ii) Sketch the graph of the function in the case where $p = 1$, $q = r = 0$. [2]

(b) (i) Express $2x^2 - 3x - 4$ in the form $2(x + a)^2 + b$. [3]

(ii) Hence, or otherwise, find the coordinates of the stationary point of the curve $y = 2x^2 - 3x - 4$ [1]

6. [Paper 1 2013 Q 8]

Solve the equation $\frac{x+1}{x-1} - \frac{x+2}{x} = 2$, giving your answers correct to 2 decimal places. [4]

7. [Paper 1 2014 Q 8(b)]

(b) Make V the subject of the formula $T = \frac{5}{V^2 + 4}$ [3]

8. [Paper 1 2016 Q 9]

(a) Make b subject of the formula in $T - 2 = \frac{4a}{3 + 4b^2}$ [3]

(b) Express $y = -\frac{1}{3}x^2 - 4x + 2$ in the form $y = a(x + p)^2 + q$. [3]

Section 18 Construction; locus and symmetry.

1 . [Paper 1 2011 Q 10]

In each of the diagrams below, triangle ABC is an isosceles right-angled triangle, and $AB = AC = 6$ cm.
A straight line or a circular arc divides each triangle into two parts, one of which is shaded.

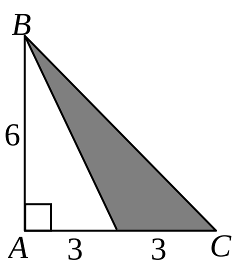


diagram 1

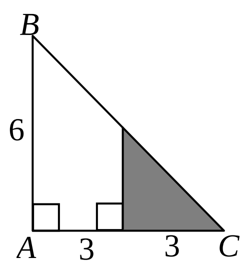


diagram 2

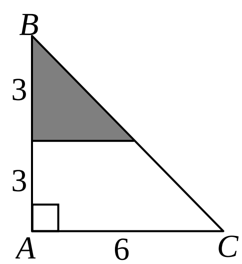


diagram 3

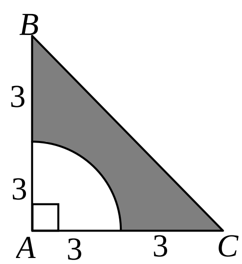


diagram 4

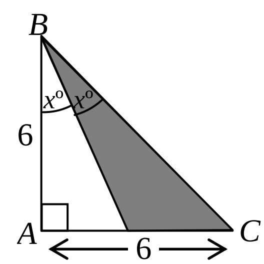


diagram 5

(a) Which diagram has a shaded region showing **all** the points in the triangle which are

(i) closer to BC than to BA, [1]

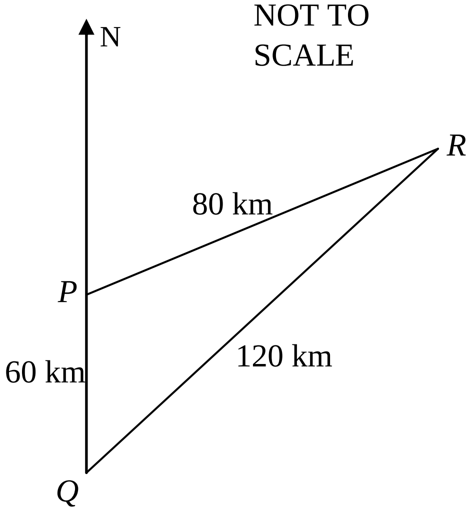
(ii) more than 3 cm from A, [1]

(iii) closer to C than to A? [1]

(b) Write down the value of x. [1]

(c) Calculate the **shaded** area of **(i)** diagram 1 [1] **(ii)** diagram 2 [2] **(iii)** diagram 5 [3]

2. [Paper 1 2008 Q16] **This question should be answered on a new page.**



The diagram shows three lodges *P*, *Q* and *R* which are situated in northern Namibia.
Lodge *Q* is 60 km to the south of lodge *P*. Lodge *R* is 80 km from lodge *P* and 120 km from lodge *Q*.

(a) Construct triangle *PQR* using a scale of 1 cm to represent 10 km [2]

The owners of the three lodges are investigating the possibility of fly-in safaris. In order to do so they need to build a small airport. A gravel road joins *P* and *R*.
The airport must be more than 10 km from this road. Furthermore, the airport must be nearer to *P* than to *Q*, but at least 50 km from *R*.

(b) **Construct** the locus of points , within triangle PQR,

(i) which are 10 km from PR, [1]

(ii) which are equidistant from P and Q, [2]

(iii) which are 50 km from R. [1]

(c) Hence shade the area in which the airport can be built. [1]

3. [Paper 1 2007 Q13]

In the Omaheke region, two radio stations *A* and *B* are 180 km apart. Signals from *A* can be received up to a distance of 105 km and signals from *B* can be received up to a distance of 135 km.

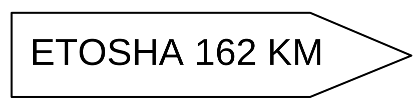
(a) Using a scale of 1 cm : 15 km, plot and label the positions of *A* and *B* on a diagram. [1]

(b) By means of suitable constructions, shade the region in which signals from both radio stations can be received. [3]

(c) The government wants to build a police station, **equidistant** from the two radio stations. It must be able to receive signals from both radio stations. Clearly show on your diagram the locus of points where this police station could be built. [2]

4. [Paper 1 2010 Q 6]

A road sign indicates a distance of 162 km to the gate of Etosha.



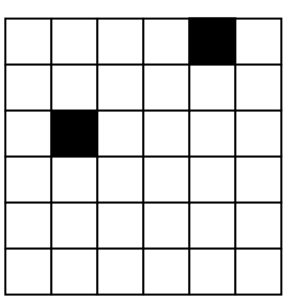
(a) Write down the letters in the name ETOSHA which have line symmetry. [2]

(b) Write down the letters in the name ETOSHA which have rotational symmetry. [1]

(c) Calculate the time it would take a motorist to travel to Etosha from that particular road sign, if he travelled at an average speed of 72 km/h. [2]

(d) Another motorist travels at an average speed of 85 km/h. Given that the distance of 162 km is correct to the nearest kilometer and the speed of 85 km/h is correct to the nearest 5 km/h
Calculate the shortest possible time that it could take this motorist to complete the journey. [3]

5. [Paper 1 2012 Q 3]



Copy this 6 $\times$ 6 grid and shade in the **minimum** number of squares so that this grid has **rotational** symmetry of the order 4. [2]

6. [Paper 1 2014 Q 14]

Answer the whole of this question on a sheet of graph paper.

(a) Using a scale of 1 cm to represent 1 unit on each axis, draw an x-axis for $-6 \le x \le 10$ and a y- axis for $-2 \le y \le 12$. Mark the point $A(-6,1)$, $B(-3,10)$ and $C(9,6)$. Draw the triangle ABC. [1]

(b) Construct the locus of points which are

(i) 7 cm from A and inside triangle ABC, [1]

(ii) equidistant from B and from C, [2]

(iii) equidistant from BC and from AC. [2]

(c) Shade the region inside triangle ABC which is

(i) more than 7 cm from A,

(ii) closer to B than to C and

(iii) closer to AC than to BC.

Label this region R. [2]

7. [Paper 1 2016 Q 3]

T R I G O N O M E T R Y

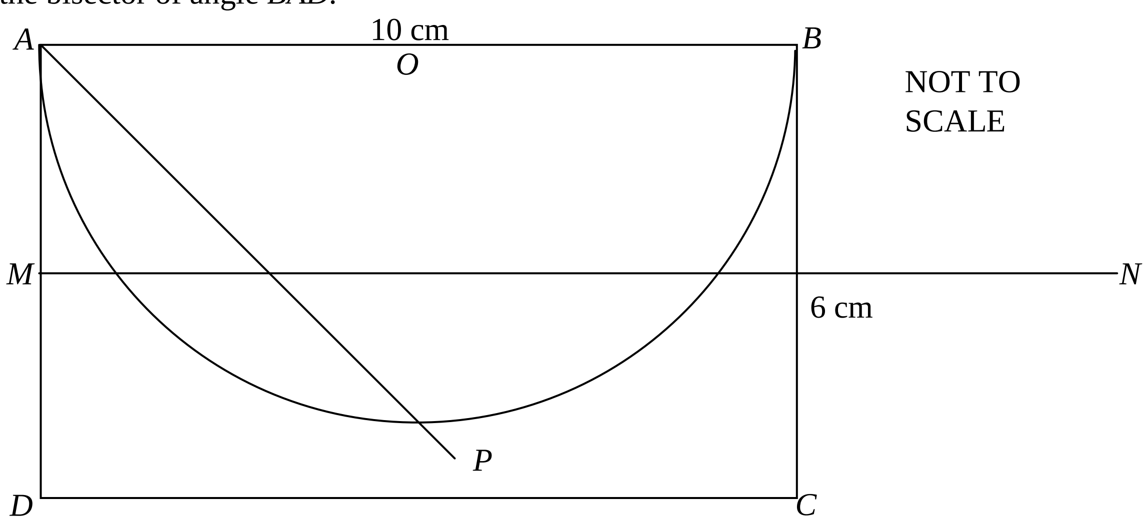
From the above word, write down the letters which have

(a) Exactly two lines of symmetry, [1]

(b) rotational symmetry of order 2.

8. [Paper 1 2016 Q 12]

ABCD is a rectangle with $AB = 10$ cm and $BC = 6$ cm. *MN* is the perpendicular bisector of *BC* and *AP* is the bisector of angle *BAD*.



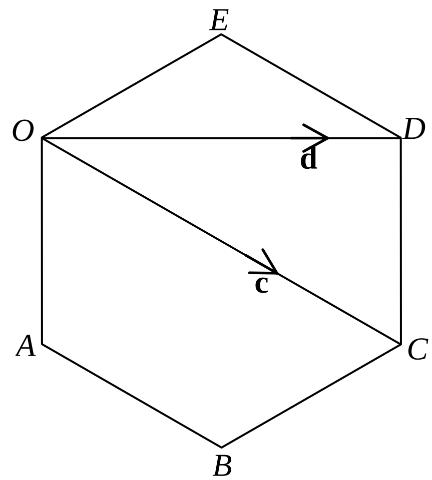
Write the letter R in the region which satisfies all three of the following conditions

- nearer to *AB* than to *AD*
- nearer to *C* than to *B*
- less than 5 cm from *O*. [3]

Section 19 2D vectors.

1. [Paper 1 2011 Q 13]

The diagram shows a regular hexagon *OABCDE* with *O* as origin.
The position vector of *C* is **c** and the position vector *D* is **d**.



(a) Find, in terms of **c** and **d**,

(i) *DC* [1]

(ii) *OE* [2]

(iii) the position vector of *B*. [2]

(b) The sides of the hexagon are 10 cm in length. Calculate

(i) the size of angle *ABC*, [1]

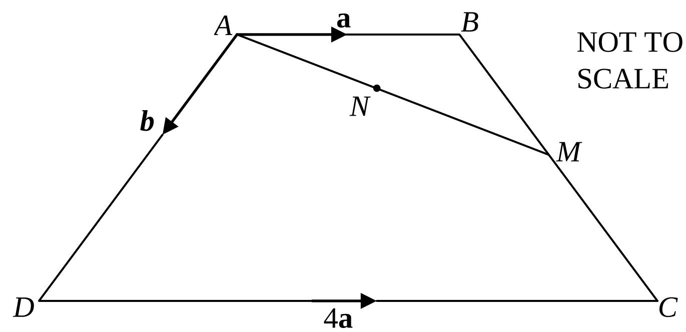
(ii) the area of ΔABC, correct to nearest cm^2, and [3]

(iii) the length of the straight line *AC*. [2]

2. [Paper 1 2008 Q 7]

In the diagram, the point *M* is the midpoint of *BC*.
The point *N* lies on *AM* and *AN* : *NM* is 3 : 4.

The vector $\overrightarrow{AB} = \mathbf{a}$, $\overrightarrow{AD} = \mathbf{b}$ and $\overrightarrow{DC} = 4\mathbf{a}$.
Find in terms of **a** and **b**,

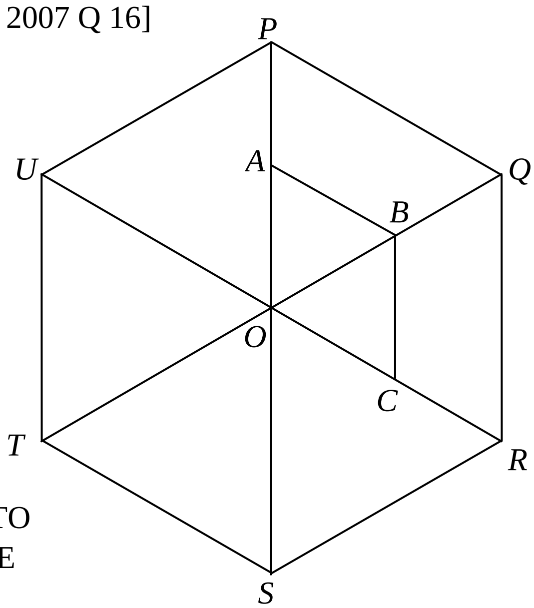


(a) $\overrightarrow{BC}$ [1]

(b) $\overrightarrow{BM}$ [1]

(c) $\overrightarrow{AN}$ [2]

3. [Paper 1 2007 Q 16]



The diagram shows a regular hexagon *PQRSTU* with centre *O*. The midpoints of *OP*, *OQ* and *OR* are *A*, *B* and *C* respectively. Lines *AB* and *BC* are drawn.

(a) Describe fully the single transformation which maps

(i) the triangle *OAB* onto triangle *OCB*. [2]

(ii) the triangle *OPQ* onto triangle *OST*. [2]

(b) Write down the scale factor of the enlargement which maps triangle *OAB* onto triangle *OPQ*. [1]

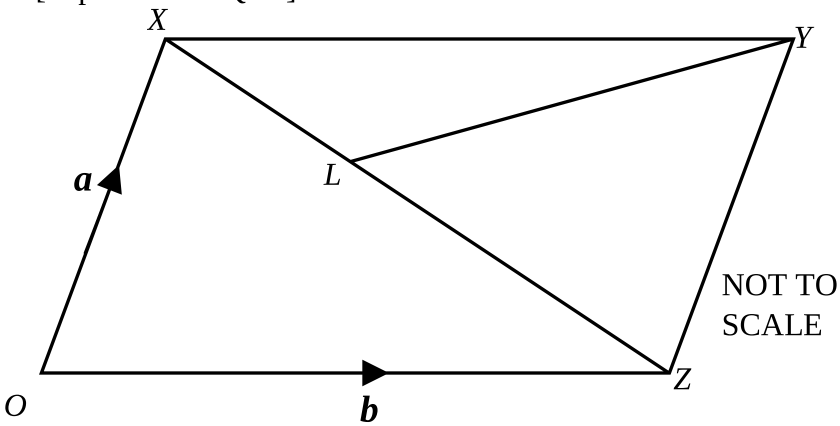
(c) The vector $\overrightarrow{ST} = \boldsymbol{a}$ and $\overrightarrow{SR} = \boldsymbol{b}$. Write in terms of $\boldsymbol{a}$ and or $\boldsymbol{b}$,

(i) the vector $\overrightarrow{TR}$ [1]

(ii) the vector $\overrightarrow{OQ}$ [1]

(iii) the vector $\overrightarrow{RQ}$ [1]

4. [Paper 1 2009 Q 15]



The diagram shows a parallelogram *OXYZ* where *O* is the origin. The point *L* lies on *XZ* such that $ZL : LX = 2 : 1$.

Given that $\overrightarrow{OX} = \boldsymbol{a}$ and $\overrightarrow{OZ} = \boldsymbol{b}$, find each Of the following vectors in terms of $\boldsymbol{a}$ and $\boldsymbol{b}$, Leaving each answer in its simplest form:

(a) $\overrightarrow{ZX}$, [1]

(b) $\overrightarrow{ZL}$, [1]

(c) $\overrightarrow{YL}$, [2]

(d) the position vector of point *L*. [2]

5. [Paper 1 2010 Q 5]

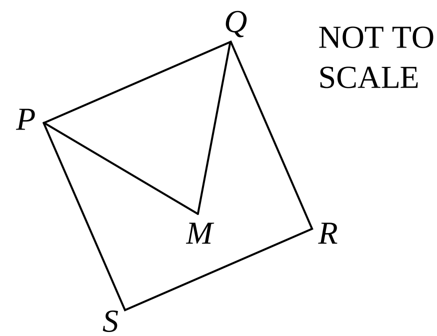
The diagram shows a point *M* inside a square *PQRS.*

It is given that $\overrightarrow{MP} = \begin{pmatrix} -4 \\ 3 \end{pmatrix}$ and $\overrightarrow{MQ} = \begin{pmatrix} 3 \\ 5 \end{pmatrix}$.

Express the following as column vectors:

(a) $\overrightarrow{PQ}$, [2]

(b) $\overrightarrow{QR}$. [2]



6. [Paper 1 2013 Q 12]

(a) Given that $\overrightarrow{AB} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}$, $\overrightarrow{BC} = \begin{pmatrix} 0 \\ 1 \end{pmatrix}$ and $\overrightarrow{CD} = \begin{pmatrix} -5 \\ 1 \end{pmatrix}$.

Find **(i)** $\overrightarrow{DB}$, [2]

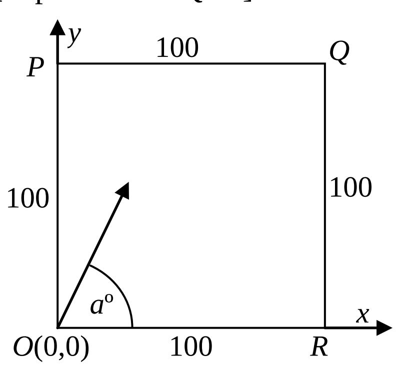
(ii) $|\overrightarrow{CD}|$ [2]

(b) The quadrilateral *ABCD*, is such that $\overrightarrow{AB} = 2\mathbf{p}$, $\overrightarrow{BC} = \mathbf{q}$ and $\overrightarrow{CD} = -3\mathbf{p}$.

(i) What is the special name given to *ABCD*? [1]

(ii) Express $\overrightarrow{DA}$ in terms of **p** and **q**, giving your answer in its simplest form. [2]

7. [Paper 1 2014 Q 12]



In a video game, the size of the screen is 100 units by units.
The player has to enter a direction in which the ball will travel.
This done by entering a vector.

John enters the vector $\begin{pmatrix} 1 \\ 2 \end{pmatrix}$ for a ball which starts from *O*(0,0).

The ball moves across the screen in a straight line, making an angle $a°$ with *OR* as shown in the diagram to the left.

(a) Find the value of $a°$, correct to 1 decimal place. [2]

(b) The position vector of the ball as it moves to the top of the screen PQ can be written as $k\begin{pmatrix}1\\2\end{pmatrix}$.

Find the value of k when the ball reaches PQ. [1]

(c) Write down the coordinates of the point where the ball hits PQ. [2]

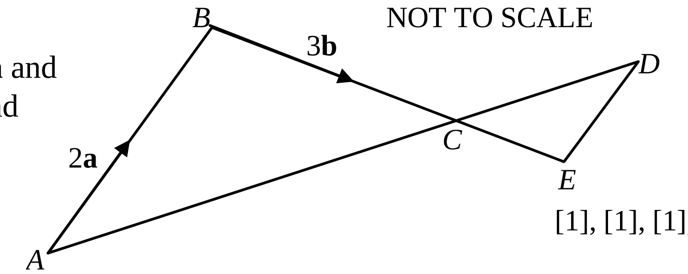
(d) When the ball hits PQ it rebounds so that its new path is at 90º to the previous path.
Determine the vector that describes the ball's direction after it rebounds from PQ. [2]

8. [Paper 1 2015 Q 9]

In the diagram BCE and ACD are straight lines. $\boldsymbol{AB} = 2\mathbf{a}$ and $\boldsymbol{BC} = 3\mathbf{b}$. The point C divides AD in the ratio 2 : 1 and divides BE in the ratio 3 : 1.

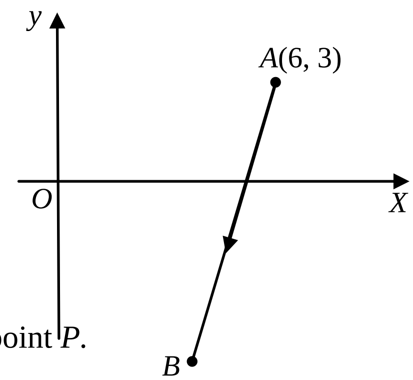
Express, in terms of **a** and/or **b**, the vectors

(a) ***AC*** **(b)** ***CD*** **(c)** ***CE*** **(d)** ***ED*** [1], [1], [1], [2]



9. [Paper 1 2016 Q10]

The diagram shows two points A and B. The point A has coordinates (6, 3) and $\overrightarrow{AB} = \begin{pmatrix}-3\\-9\end{pmatrix}$



(a) Express $\overrightarrow{OB}$ as a column vector. [2]

(b) Show that $\overrightarrow{OB}$ is perpendicular to $\overrightarrow{OA}$. [2]

(c) Point P is such that $\overrightarrow{PA} = -\frac{2}{3}\overrightarrow{OA}$. Find the coordinate of the point P. [3]

Section 20 Logs and exponents.

1. [Paper 1 2009 Q 10]

It is given that: $5^a = 25(5^{3b})$ and $\log(3a + 6) - \log(b + 1) = 1$

(a) Show that these equations can be reduced to $a - 3b = 2$ and $3a - 10b = 4$ respectively. [4]

(b) Hence find the values of a and b. [2]

2. [Paper 1 2008 Q 5] Given that $\dfrac{8^{n+1}}{2^{n-2} \times 2^{n+4}} = 2^k$ find k in terms of n. [3]

3. [Paper 1 2007 Q 3] Solve the equation $3(2^x) = 5$ [3]

4. [Paper 1 2010 Q 10]

(a) It is given that $5^x = 4$ and $5^y = 6$. Find the exact value of 5^{x+y}. [1]

(b) In a laboratory experiment it is found that there are 2^{20} cells in a dish, at a particular moment in time. A fluid which destroys half of those cells, is added to the dish at that moment. Find the number of cells left, giving your answer in index notation. [2]

(c) Use the method of completing the square to solve the equation $x(x - 3) - 10 = 0$. [4]

5. [Paper 1 2012 Q5] Simplify completely:

(a) $\dfrac{6a^2-6}{6a} \times \dfrac{a^3-a^2}{a^2-2a+1}$ [4]

(b) $\dfrac{5^{2n+1} \times 3^{2n-3}}{15^{2n}}$ leaving your answer a s a common fraction. [3]

6. [Paper 1 2014 Q2]

In computing terms , a 'kilobyte' is 2^{10} bytes and each byte is 8 bits.

(a) 1kilobyte is 2^x bits. Find *x*. [1]

(b) 4 kilobytes is 2^y bits. Find *y*. [1]