



International GCSE Mathematics

Formulae sheet – Higher Tier

**Arithmetic series**

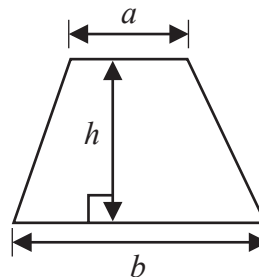
Sum to  $n$  terms,  $S_n = \frac{n}{2} [2a + (n - 1)d]$

**The quadratic equation**

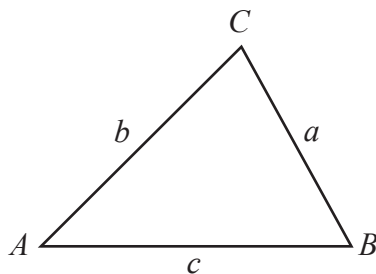
The solutions of  $ax^2 + bx + c = 0$  where  $a \neq 0$  are given by:

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

**Area of trapezium** =  $\frac{1}{2}(a + b)h$



**Trigonometry**



**In any triangle ABC**

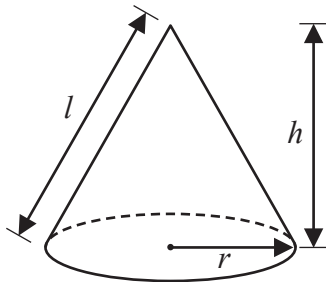
**Sine Rule**  $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

**Cosine Rule**  $a^2 = b^2 + c^2 - 2bc \cos A$

**Area of triangle** =  $\frac{1}{2} ab \sin C$

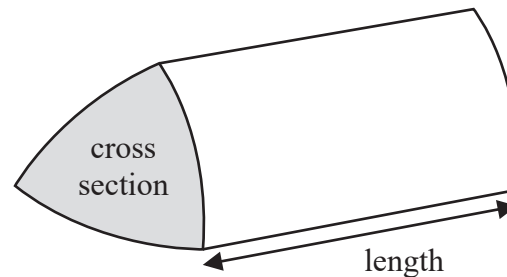
**Volume of cone** =  $\frac{1}{3} \pi r^2 h$

**Curved surface area of cone** =  $\pi r l$



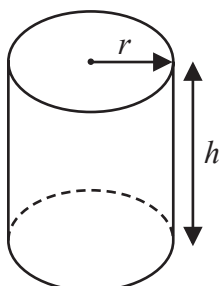
**Volume of prism**

= area of cross section  $\times$  length



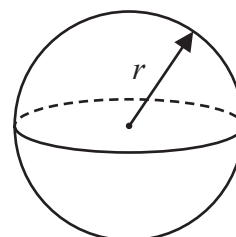
**Volume of cylinder** =  $\pi r^2 h$

**Curved surface area of cylinder** =  $2\pi r h$



**Volume of sphere** =  $\frac{4}{3} \pi r^3$

**Surface area of sphere** =  $4\pi r^2$



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**Answer ALL TWENTY SIX questions.**

**Write your answers in the spaces provided.**

**You must write down all the stages in your working.**

- 1** Write 1400 as a product of powers of its prime factors.  
Show your working clearly.

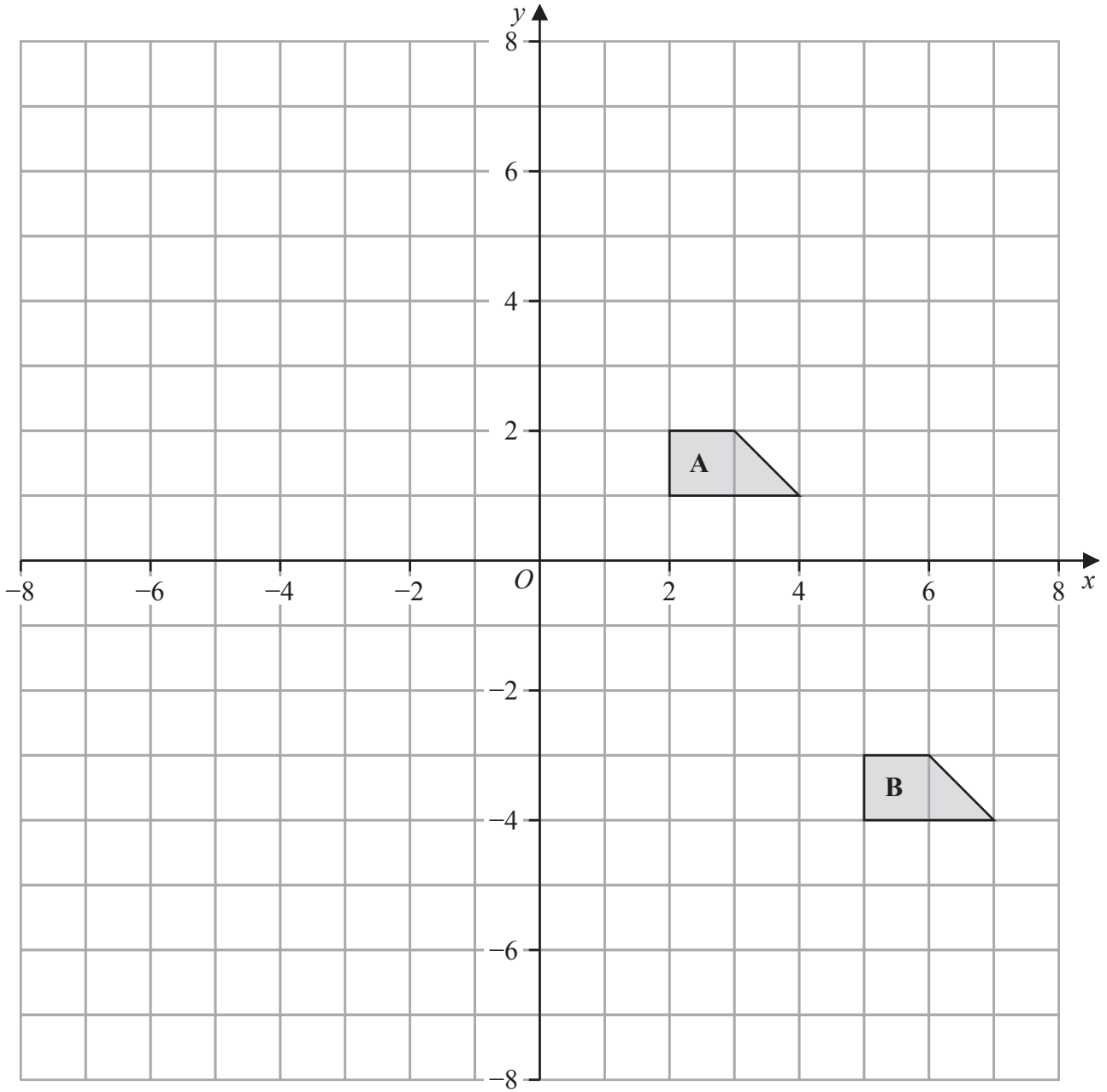
.....  
**(Total for Question 1 is 3 marks)**

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(a) Describe fully the single transformation that maps shape A onto shape B

(2)

(b) On the grid above, rotate shape A  $180^\circ$  about  $(-1, 0)$   
Label your shape C

(2)

(Total for Question 2 is 4 marks)

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3 Here is a list of four numbers written in ascending order of size

$x$        $x$        $y$       15

where  $x$  and  $y$  are integers.

The numbers have

a median of 12.5

a range of 4

Find the value of  $x$  and the value of  $y$

$x =$  .....

$y =$  .....

(Total for Question 3 is 2 marks)



4  $\mathcal{E} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$   
 $A = \{\text{factors of } 6\}$   
 $B = \{\text{prime numbers}\}$

(a) List the members of the set

(i)  $A \cup B$

.....  
(1)

(ii)  $A'$

.....  
(1)

Harpreet states that  $A \cap B = \emptyset$

Harpreet is incorrect.

(b) Explain why.

.....  
 .....  
 (1)

$C$  is a set with 4 members such that

the set  $A \cap C$  has 2 members

the set  $B \cap C$  has 2 members

Set  $A \cap C$  and set  $B \cap C$  have no members in common.

(c) List the 4 members of set  $C$

.....  
(2)

**(Total for Question 4 is 5 marks)**



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- 5 The diagram shows the design for a badge, which will be made using wire.  
The design is a circle inside a square  $ABCD$

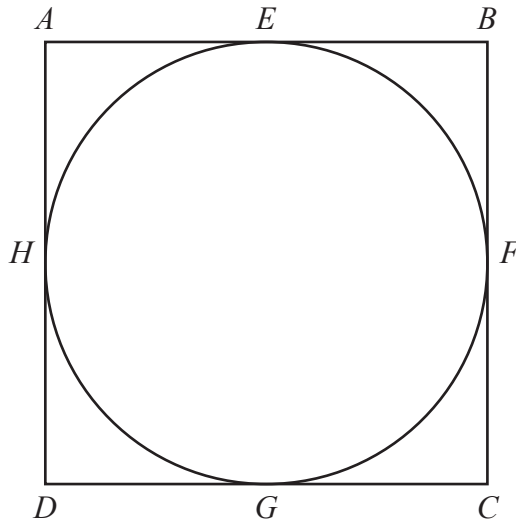


Diagram **NOT**  
accurately drawn

The circle touches the square at the points  $E, F, G$  and  $H$

The area of the square is  $81 \text{ cm}^2$

Calculate the total length of wire that will be needed to make the square and the circle.  
Give your answer correct to 3 significant figures.

..... cm

**(Total for Question 5 is 4 marks)**



6 (a) Solve  $\frac{2f}{3} = 4f - 17$

Show clear algebraic working.

$f = \dots\dots\dots$   
(3)

(b) Simplify  $(e + 12)^0$  where  $e > 0$

$\dots\dots\dots$   
(1)

(c) Simplify fully  $\frac{12a^4h^6}{4ah^2}$

$\dots\dots\dots$   
(2)

(d) Factorise fully  $20x^5y + 12x^3y^4$

$\dots\dots\dots$   
(2)

(Total for Question 6 is 8 marks)



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7  $\frac{3^{-2} \times 3^5}{3^{10}} = 3^n$

Find the value of  $n$

$n = \dots\dots\dots$

**(Total for Question 7 is 2 marks)**

8 In a sale, all normal prices are reduced by 17%

The sale price of a fridge is 6225 rupees.

Work out the normal price of the fridge.

$\dots\dots\dots$  rupees

**(Total for Question 8 is 3 marks)**



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9 (a) Write  $6.04 \times 10^5$  as an ordinary number.

.....  
(1)

(b) Write 0.00007 in standard form.

.....  
(1)

(c) Work out  $\frac{7.6 \times 10^{10}}{4 \times 10^5 - 2 \times 10^4}$

Give your answer in standard form.

.....  
(2)

**(Total for Question 9 is 4 marks)**



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10 The diagram shows a hexagon  $ABCDEF$

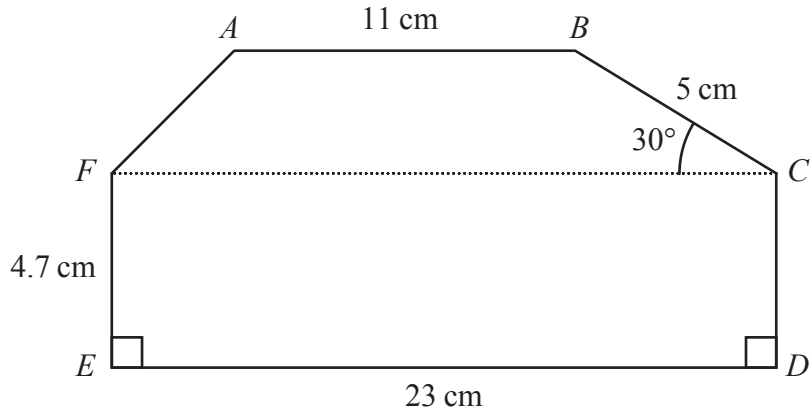


Diagram **NOT** accurately drawn

Angle  $BCF = 30^\circ$   
 $AB, FC$  and  $ED$  are parallel.

Calculate the area of  $ABCDEF$   
Show your working clearly.

.....  $\text{cm}^2$

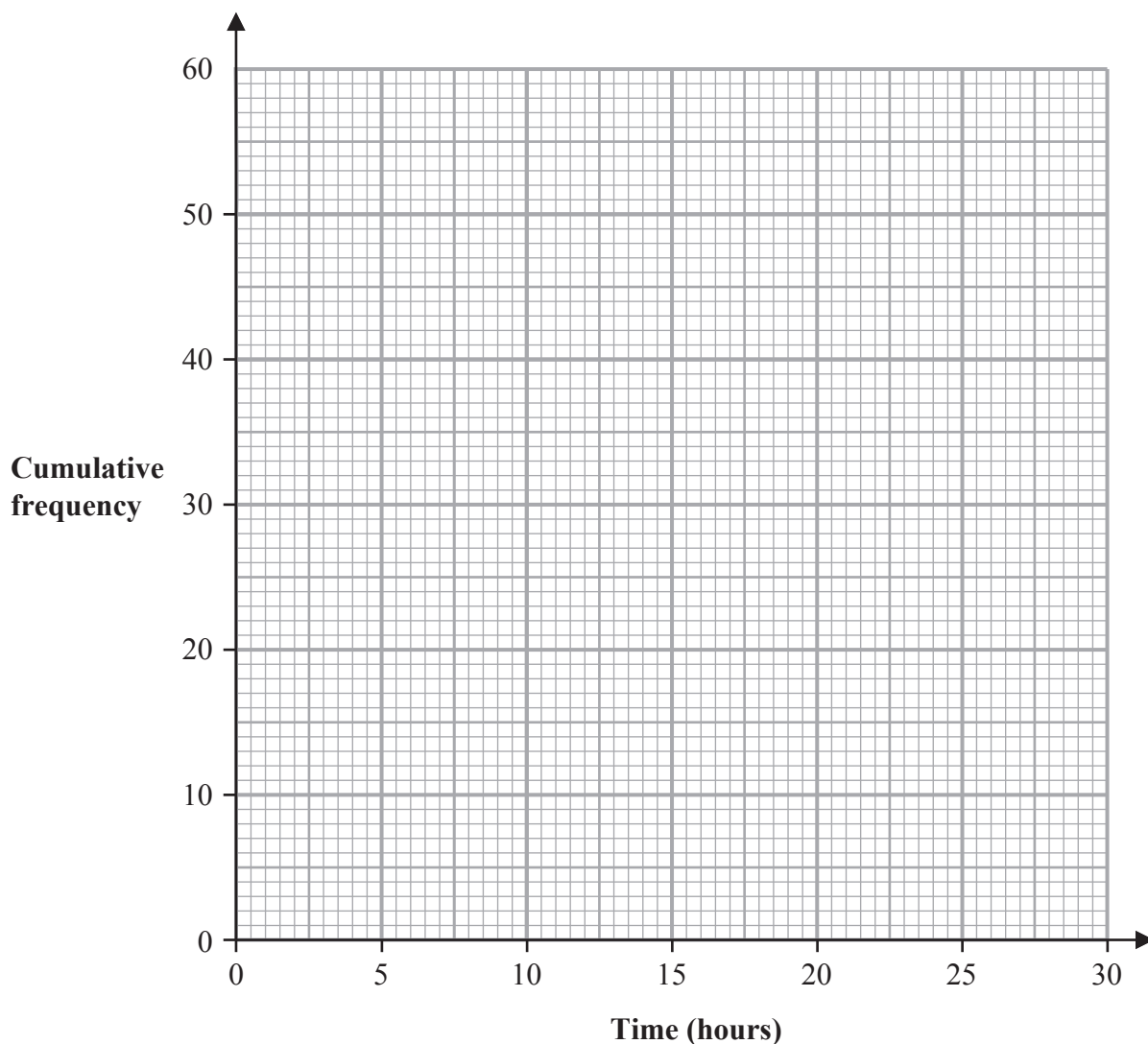
(Total for Question 10 is 5 marks)



- 11 The cumulative frequency table gives information about the time, in hours, that each of 60 workers spent working from home in one week.

| Time ( $t$ hours) | Cumulative frequency |
|-------------------|----------------------|
| $0 < t \leq 5$    | 6                    |
| $0 < t \leq 10$   | 17                   |
| $0 < t \leq 15$   | 27                   |
| $0 < t \leq 20$   | 42                   |
| $0 < t \leq 25$   | 53                   |
| $0 < t \leq 30$   | 60                   |

- (a) On the grid below, draw a cumulative frequency graph for the information in the table.



(2)



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(b) Use your graph to find an estimate for the interquartile range of the times.

..... hours  
(2)

25 workers spent more than  $W$  hours working from home.

(c) Use your graph to find an estimate for the value of  $W$

$W =$  .....  
(2)

One of the 60 workers is chosen at random.  
This worker spent  $H$  hours working from home.

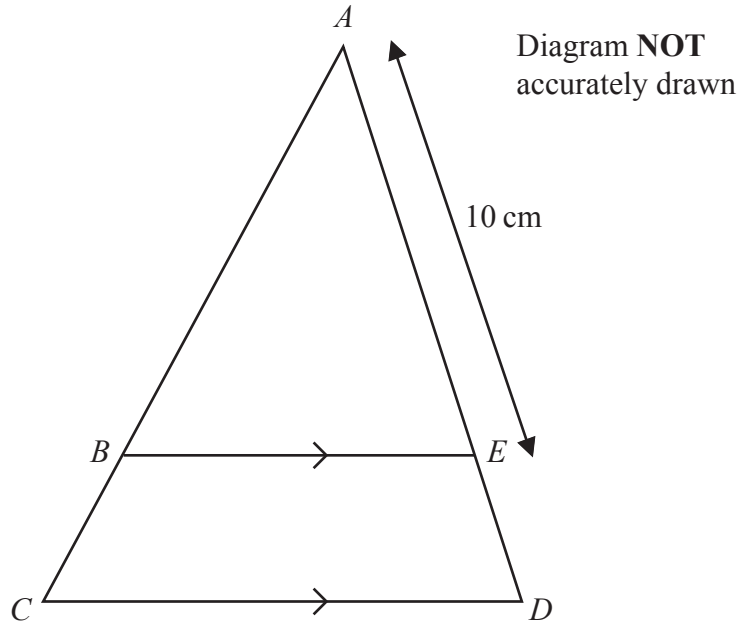
(d) Find the probability that  $5 < H \leq 10$

.....  
(1)

**(Total for Question 11 is 7 marks)**



P 7 3 4 7 0 A 0 1 3 3 2



In the diagram,  $ABC$  and  $AED$  are straight lines.  
 $BE$  is parallel to  $CD$

$$AE = 10 \text{ cm} \quad \text{and} \quad CD = 1.5 \times BE$$

(a) Work out the length of  $ED$

..... cm  
 (2)

$$AB = (2x + 5) \text{ cm} \text{ and } BC = (3x - 5) \text{ cm}$$

(b) Work out the value of  $x$

$x =$  .....  
 (2)

(Total for Question 12 is 4 marks)



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13  $OAB$  is a sector of a circle with centre  $O$  and radius  $r$  cm.

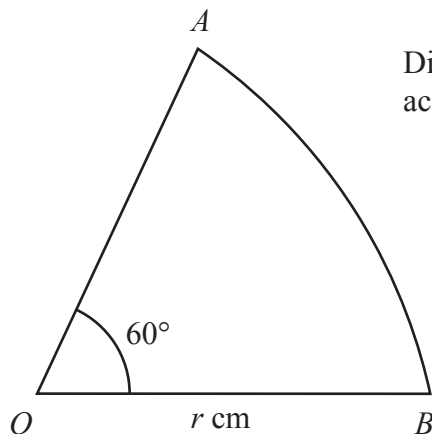


Diagram **NOT** accurately drawn

Angle  $AOB = 60^\circ$

The perimeter of the sector is  $P$  cm.

Find a formula for  $P$  in terms of  $r$

Give your answer in the form  $P = r(c\pi + k)$  where  $c$  and  $k$  are values to be found.

.....  
(Total for Question 13 is 3 marks)



P 7 3 4 7 0 A 0 1 5 3 2

14 Adriana is going to roll a biased dice and spin a biased coin.

The probability that the coin will land on Heads is 0.8

The probability that the dice will land on 6 and the coin will land on Heads is 0.24

Work out the probability that the dice will land on 6 and the coin will land on Tails.

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(Total for Question 14 is 3 marks)



15

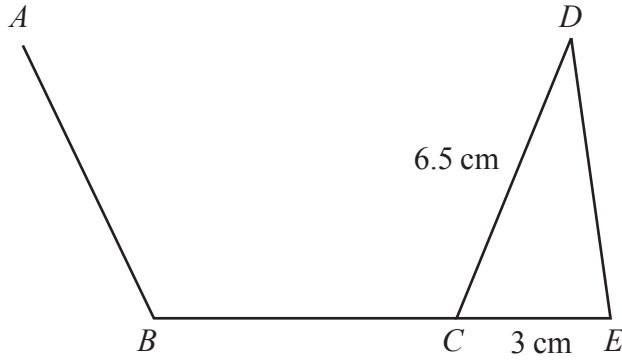


Diagram **NOT** accurately drawn

$AB$ ,  $BC$  and  $CD$  are three sides of a regular pentagon and  $CDE$  is a triangle.  
 $BCE$  is a straight line.

$$CD = 6.5 \text{ cm} \quad CE = 3 \text{ cm}$$

Work out the area of triangle  $CDE$   
Give your answer correct to 3 significant figures.

.....  $\text{cm}^2$

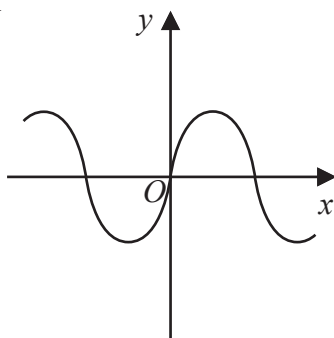
(Total for Question 15 is 3 marks)

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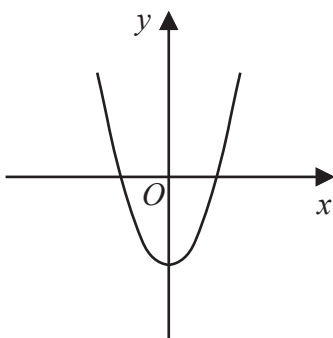


16 Here are six graphs.

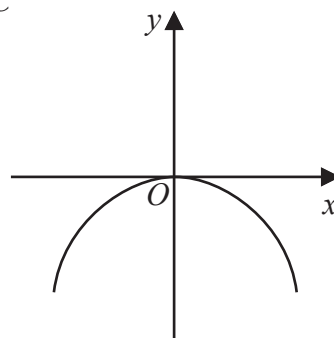
A



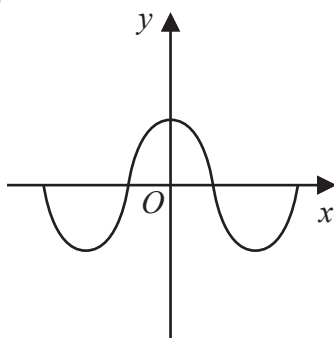
B



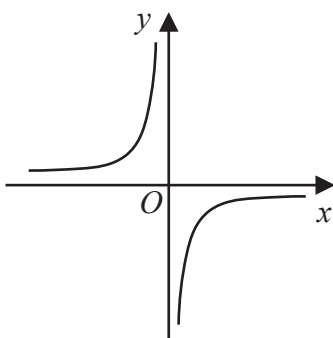
C



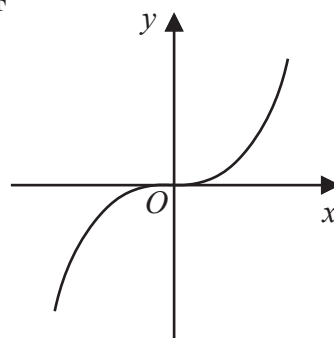
D



E



F



Write down the letter of the graph that could have the equation

(i)  $y = -\frac{1}{x}$

.....  
(1)

(ii)  $y = \sin x^\circ$

.....  
(1)

(Total for Question 16 is 2 marks)



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17  $f(x) = \frac{x}{2x - 4}$      $g(x) = 3x + 1$

Given that  $fg(k) = 2$

work out the value of  $k$

$k = \dots\dots\dots$

(Total for Question 17 is 3 marks)



18 Use algebra to show that  $0.\dot{3}0\dot{6} = \frac{34}{111}$

(Total for Question 18 is 2 marks)

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19 Aviv goes on a cycle journey.

For the cycle journey

average speed = 19 km/h correct to the nearest whole number

time = 1.5 hours correct to one decimal place

Work out the upper bound for the distance Aviv travels.

Give your answer correct to 3 significant figures.

..... km

(Total for Question 19 is 3 marks)



P 7 3 4 7 0 A 0 2 1 3 2

20 Solve  $6x^2 - 7x - 20 > 0$   
Show clear algebraic working.

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.....  
(Total for Question 20 is 4 marks)



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21  $ABCD$  is a square.

The point  $A$  has coordinates  $(-5, 2)$

The point  $B$  has coordinates  $(3, 5)$

Find an equation of the line that passes through  $B$  and  $C$

Give your answer in the form  $ax + by + c = 0$  where  $a$ ,  $b$  and  $c$  are integers.

.....  
(Total for Question 21 is 4 marks)



22 Solve the simultaneous equations

$$x^2 + y^2 = y + 11$$

$$y = 3x - 1$$

Show clear algebraic working.

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(Total for Question 22 is 5 marks)

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23 A curve has equation  $y = f(x)$

The coordinates of the minimum point on this curve are  $(6, -3)$

Write down the coordinates of the minimum point on the curve with equation

(i)  $y = f(x) + 10$

(....., .....)  
(1)

(ii)  $y = f(3x)$

(....., .....)  
(1)

(Total for Question 23 is 2 marks)



P 7 3 4 7 0 A 0 2 5 3 2

24 The diagram shows a solid, **S**, made from a cone and a hemisphere.

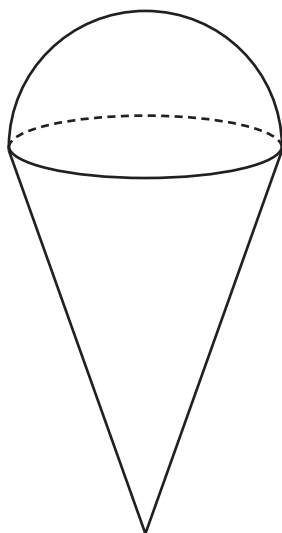


Diagram **NOT**  
accurately drawn

The centre of the circular face of the cone coincides with the centre of the flat surface of the hemisphere.

The radius of the circular face of the cone,  $x$  cm, is equal to the radius of the hemisphere.

The total height of **S** is  $4 \times$  the radius of the hemisphere.

A separate sphere has radius  $kx$  cm.

The volume of this sphere is  $12.5 \times$  the volume of **S**

(a) Work out the value of  $k$

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$$k = \dots\dots\dots (4)$$

A solid, **T**, is similar to solid **S**

The volume of **T** is  $512 \times$  the volume of **S**

The total surface area of **T** is  $d \times$  the total surface area of **S**

(b) Find the value of  $d$

$$d = \dots\dots\dots (1)$$

(Total for Question 24 is 5 marks)

Turn over for Question 25



25  $OPQR$  is a parallelogram.

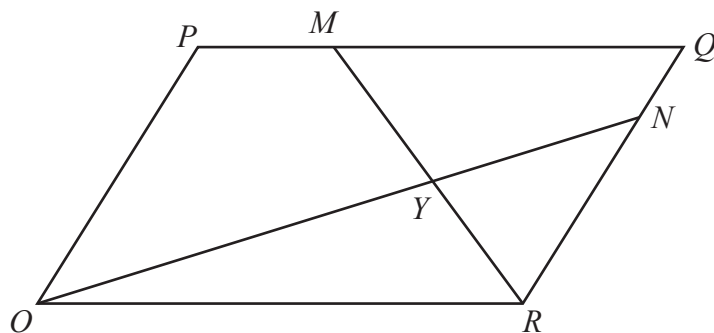


Diagram **NOT** accurately drawn

$\vec{OP} = 2\mathbf{a}$  and  $\vec{OR} = 3\mathbf{b}$

The point  $M$  lies on  $PQ$  such that  $PM = \frac{1}{4}PQ$

The point  $N$  lies on  $RQ$  such that  $RN = \frac{4}{5}RQ$

(a) Find, in terms of  $\mathbf{a}$  and  $\mathbf{b}$ , giving your answers in simplest form

(i)  $\vec{ON}$

.....  
(1)

(ii)  $\vec{MR}$

.....  
(1)

$MR$  and  $ON$  intersect at the point  $Y$

Given that

$$OY = k \times ON$$

(b) use a vector method to find the value of  $k$

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$$k = \dots\dots\dots (4)$$

**(Total for Question 25 is 6 marks)**

**Turn over for Question 26**



26 Write  $4 - \left[ (3x - 5) \div \frac{3x^2 + x - 10}{4x - 1} \right]$  as a single fraction in its simplest form.

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(Total for Question 26 is 4 marks)

TOTAL FOR PAPER IS 100 MARKS



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