

International GCSE Mathematics

Formulae sheet – Higher Tier

Arithmetic series

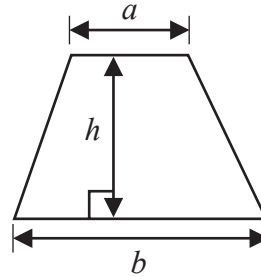
Sum to n terms, $S_n = \frac{n}{2} [2a + (n - 1)d]$

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

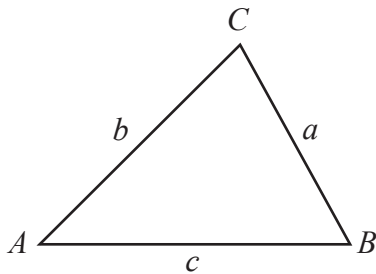
The quadratic equation

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

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



Trigonometry



In any triangle ABC

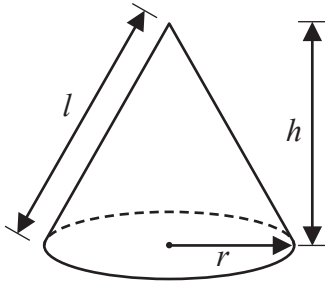
Sine Rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

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

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

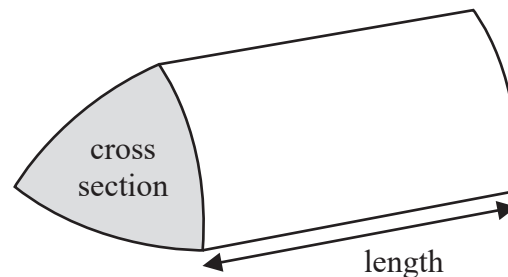
Volume of cone = $\frac{1}{3} \pi r^2 h$

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



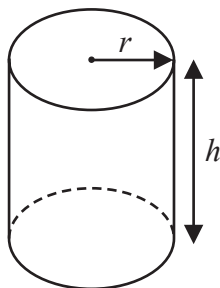
Volume of prism

= area of cross section \times length



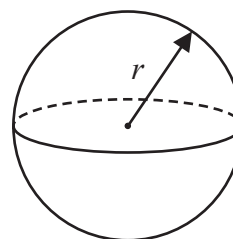
Volume of cylinder = $\pi r^2 h$

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 FOUR questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 The table shows information about the lengths, in minutes, of 50 telephone calls.

Length of telephone call (m minutes)	Frequency
$0 < m \leq 5$	8
$5 < m \leq 10$	2
$10 < m \leq 15$	6
$15 < m \leq 20$	4
$20 < m \leq 25$	12
$25 < m \leq 30$	18

(a) Write down the modal class.

.....
(1)

(b) Work out an estimate for the total length, in minutes, of these telephone calls.

..... minutes
(3)

(Total for Question 1 is 4 marks)



P 7 3 4 6 9 A 0 3 2 4

2 The diagram shows triangle ABC and triangle ECD

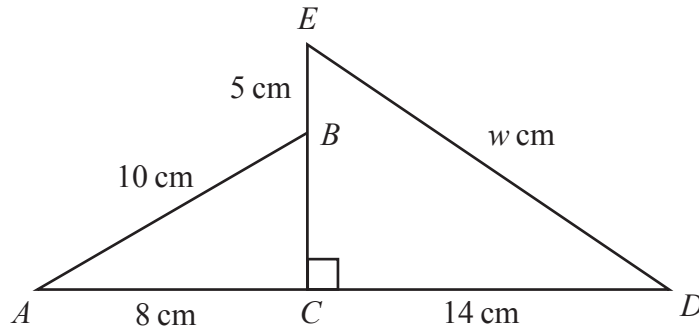


Diagram **NOT** accurately drawn

ACD and EBC are straight lines.

$$AB = 10 \text{ cm} \quad AC = 8 \text{ cm} \quad EB = 5 \text{ cm} \quad CD = 14 \text{ cm} \quad ED = w \text{ cm}$$

Work out the value of w

Give your answer correct to one decimal place.

$$w = \dots\dots\dots$$

(Total for Question 2 is 4 marks)

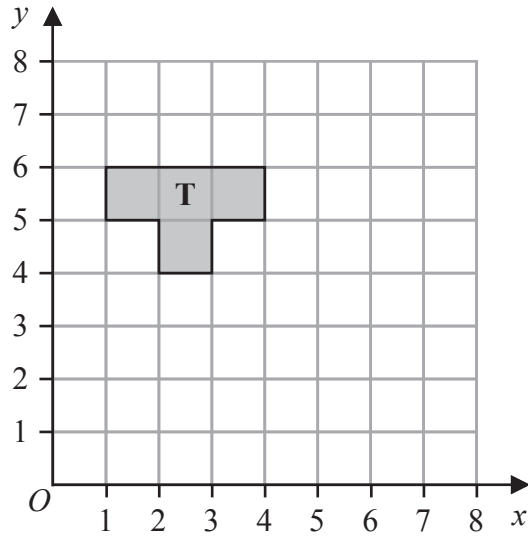
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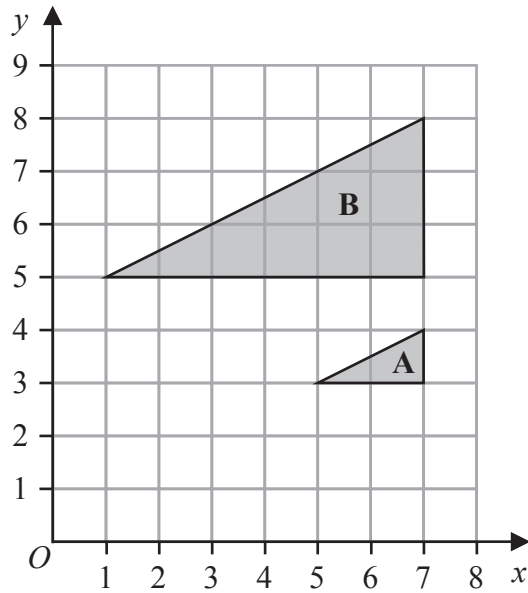


3



(a) Reflect shape **T** in the line $y = x$

(2)



(b) Describe fully the single transformation that maps triangle **A** onto triangle **B**

(3)

(Total for Question 3 is 5 marks)

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4 (a) Solve $\frac{2x+5}{6} = 2x-5$

Show clear algebraic working.

$x = \dots\dots\dots$
(3)

(b) Simplify $h^{15} \div h^3$

$\dots\dots\dots$
(1)

(c) Simplify fully $(2g^3k^5)^4$

$\dots\dots\dots$
(2)

(d) Given that $\frac{y^5 \times y^n}{y^7} = y^{12}$

work out the value of n

$n = \dots\dots\dots$
(2)

(Total for Question 4 is 8 marks)



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5 Avril bakes a cake.

She uses flour, butter and sugar such that

$$\text{weight of flour : weight of butter} = 6 : 5$$

$$\text{weight of butter : weight of sugar} = 3 : 2$$

Avril uses 120 grams of sugar.

Work out the weight of flour Avril uses.

..... grams

(Total for Question 5 is 3 marks)



6 Show that $3\frac{3}{7} \div 2\frac{2}{3} = 1\frac{2}{7}$

(Total for Question 6 is 3 marks)

- 7 Hermione buys a boat for \$26 800
The value of the boat depreciates by 8% each year.
Work out the value of the boat at the end of 3 years.
Give your answer correct to the nearest dollar.

\$.....

(Total for Question 7 is 3 marks)



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- 8 The mean number of goals scored by a hockey team in 8 matches is 6
The team plays 2 more matches and scores k goals in each match.
The mean number of goals scored by the hockey team in the 10 matches is 7

Work out the value of k

$k = \dots\dots\dots$

(Total for Question 8 is 3 marks)

- 9 A straight line passes through the points with coordinates $(0, -3)$ and $(2, 0)$
Find an equation of the line.

.....

(Total for Question 9 is 2 marks)



10 The diagram shows a hexagon $ABCDEF$

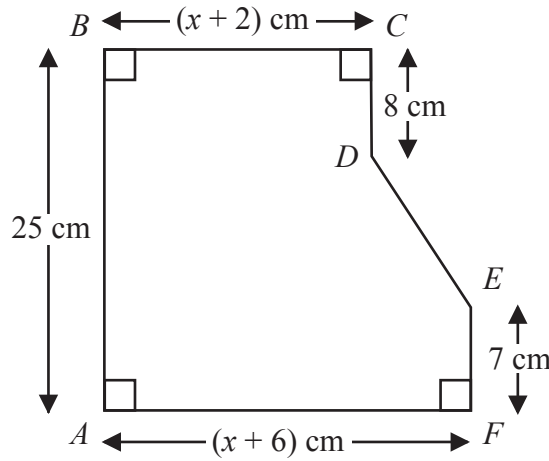


Diagram **NOT** accurately drawn

$AB = 25 \text{ cm}$ $BC = (x + 2) \text{ cm}$ $CD = 8 \text{ cm}$ $EF = 7 \text{ cm}$ $AF = (x + 6) \text{ cm}$

The area of hexagon $ABCDEF$ is 258 cm^2

Work out the value of x

$x = \dots\dots\dots$

(Total for Question 10 is 5 marks)

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12 $2^7 \times 4^5 = 4^x$

(a) Calculate the value of x

$x = \dots\dots\dots$
(2)

(b) Simplify fully $(125p^6y^{24})^{\frac{2}{3}}$

$\dots\dots\dots$
(2)

(Total for Question 12 is 4 marks)

13 Robert asked 11 people how many meetings they attended last week.

Here are the results in numerical order.

1 2 4 6 6 8 11 12 13 14 17

Find the interquartile range of the number of meetings.

$\dots\dots\dots$

(Total for Question 13 is 2 marks)

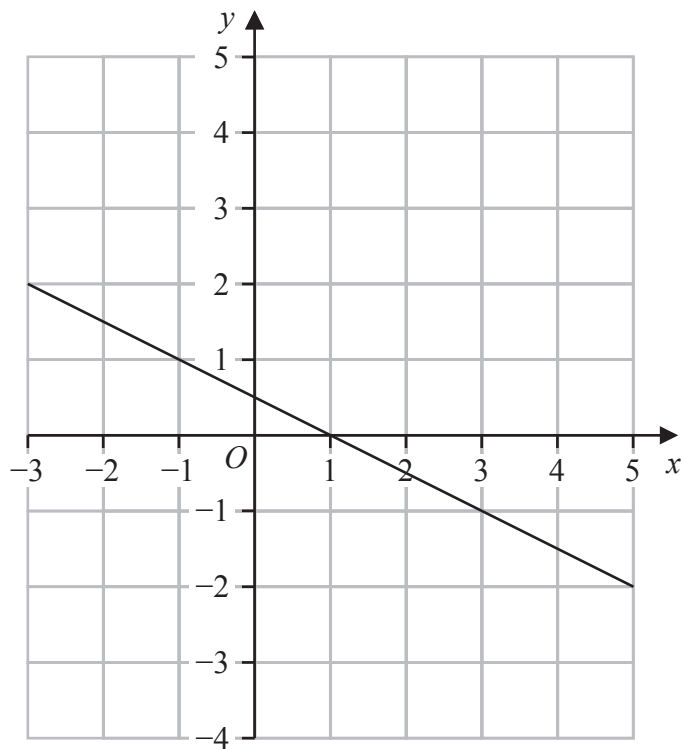


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14 Here is the graph of the equation $2y + x = 1$ drawn on a grid.



By drawing another straight line on the grid, solve the simultaneous equations

$$\begin{aligned}y - x - 2 &= 0 \\ 2y + x &= 1\end{aligned}$$

$x =$

$y =$

(Total for Question 14 is 3 marks)



P 7 3 4 6 9 A 0 1 3 2 4

15 (a) Use algebra to show that $0.\dot{3}\dot{7}\dot{2} = \frac{41}{110}$

(2)

(b) Express $\frac{\sqrt{125} + \sqrt{80}}{\sqrt{3}}$ in the form \sqrt{n} where n is an integer.

Show your working clearly.

(3)

(Total for Question 15 is 5 marks)



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16 Expand and simplify $(2x + 3)(x - 5)(x + 4)$

.....
(Total for Question 16 is 3 marks)

17 $P = a(c + y)$

$a = 8.3$ correct to 2 significant figures

$c = 2$ correct to 1 significant figure

$y = 15$ correct to the nearest 5

Work out the upper bound for the value of P
Show your working clearly.

.....
(Total for Question 17 is 3 marks)



- 18 A particle is moving along a straight line that passes through the fixed point O
The displacement, s metres, of the particle from O at time t seconds is given by

$$s = 2t^3 - 5t^2 + 6t - 5$$

Find the value of t when the acceleration of the particle is 5 m/s^2

$t = \dots\dots\dots$

(Total for Question 18 is 4 marks)

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19 The functions f and g are such that

$$f : x \mapsto 5x + 7$$

$$g : x \mapsto \frac{5}{2x - 9}$$

(a) State which value of x cannot be included in any domain of g

.....
(1)

(b) Find $fg(4)$

.....
(2)

The function h is such that

$$h : x \mapsto 3x^2 - 12x + 8 \quad \text{where } x > 2$$

(c) Express the inverse function h^{-1} in the form $h^{-1} : x \mapsto \dots$

$h^{-1} : x \mapsto$
(4)

(Total for Question 19 is 7 marks)



- 20 The diagram shows equilateral triangle ABC with sides of length 10 cm. A circle is drawn inside the triangle.

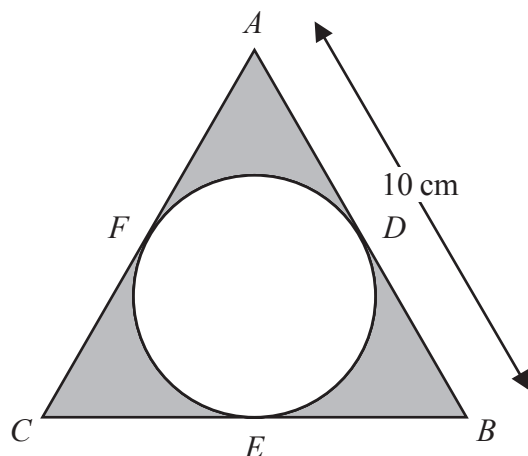


Diagram **NOT** accurately drawn

D , E and F are points on the circle.

ADB , BEC and CFA are tangents to the circle.

Calculate the total area of the regions shown shaded in the diagram. Give your answer correct to 3 significant figures.

..... cm²

(Total for Question 20 is 4 marks)

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21 The line with equation $x + 2y = 5$ intersects the curve with equation $x^2 + 3y^2 = 13$ at the points A and B

Find the coordinates of A and the coordinates of B
Show clear algebraic working.

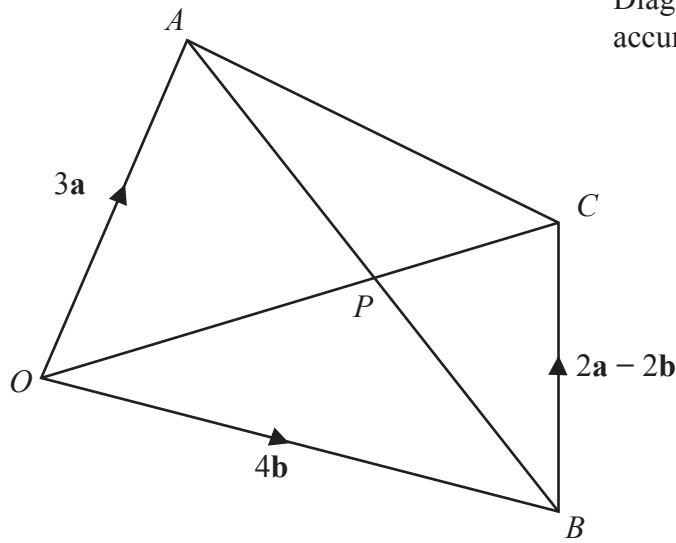
(..... ,)

(..... ,)

(Total for Question 21 is 5 marks)



Diagram NOT accurately drawn



$OACB$ is a quadrilateral.

$$\vec{OA} = 3\mathbf{a} \quad \vec{OB} = 4\mathbf{b} \quad \vec{BC} = 2\mathbf{a} - 2\mathbf{b}$$

- (a) (i) Find the vector \vec{OC} in terms of \mathbf{a} and \mathbf{b}
Simplify your answer.

$$\vec{OC} = \dots\dots\dots (1)$$

- (ii) Find the vector \vec{AB} in terms of \mathbf{a} and \mathbf{b}

$$\vec{AB} = \dots\dots\dots (1)$$

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The point P lies on AB and on OC

- (b) Using a vector method, find the ratio $AP : PB$
Show your working clearly.

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.....
(3)

(Total for Question 22 is 5 marks)



23 Here is a frustum of a cone.

The frustum is made by removing a small cone from a similar large cone.

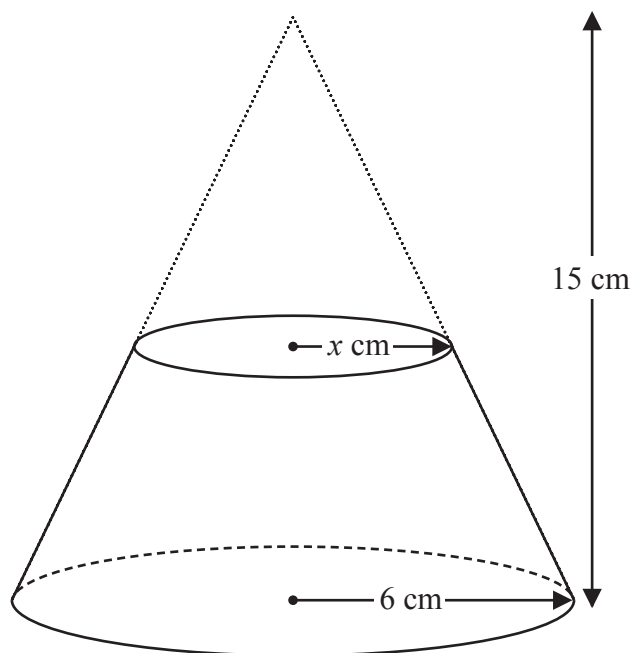


Diagram **NOT**
accurately drawn

The height of the large cone is 15 cm.

The radius of the base of the large cone is 6 cm.

The radius of the base of the small cone is x cm.

Given that the volume of the frustum is $\frac{4212}{25}\pi \text{ cm}^3$

work out the value of x

Show clear algebraic working.

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$$x = \dots\dots\dots$$

(Total for Question 23 is 5 marks)

Turn over for Question 24



24 Solve $\frac{45x^3 - 80x}{3x^2 + x - 4} \times \left(\frac{1}{3x - 4} + \frac{1}{x} \right) = \frac{4(x + 2)}{5x - 8}$

Show clear algebraic working.

$x = \dots\dots\dots$

(Total for Question 24 is 5 marks)

TOTAL FOR PAPER IS 100 MARKS

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