

SECONDARY 4
2025 PRELIMINARY EXAMINATION

MATHEMATICS
Paper 1

4052/01

26 August 2025 (Tuesday)

2 hour 15 minutes

CANDIDATE
NAME

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CLASS

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INDEX NUMBER

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Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your full name, class and index number in the spaces above.
Write in dark blue or black pen in the space provided for each question.
You may use a HB pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** the questions.

The number of marks is given in brackets [] at the end of each question or part question.

If working is needed for any question, it must be shown in the space below the question.

Omission of essential working will result in loss of marks.

The total of the marks for this paper is 90.

The use of an approved scientific calculator is expected, where appropriate.

If the degree of accuracy is not specified in the question and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142.

For Examiner's Use		
Q1	2	
Q2	4	
Q3	4	
Q4	6	
Q5	2	
Q6	3	
Q7	4	
Q8	3	
Q9	3	
Q10	3	
Q11	2	
Q12	4	
Q13	4	
Q14	2	
Q15	4	
Q16	6	
Q17	5	
Q18	5	
Q19	4	
Q20	6	
Q21	2	
Q22	8	
Q23	4	
Total	90	

Mathematical Formulae

Compound Interest

$$\text{Total amount} = P \left(1 + \frac{r}{100} \right)^n$$

Mensuration

$$\text{Curved surface area of a cone} = \pi r l$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

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

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

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

$$\text{Arc length} = r\theta, \text{ where } \theta \text{ is in radians}$$

$$\text{Sector area} = \frac{1}{2} r^2 \theta, \text{ where } \theta \text{ is in radians}$$

Trigonometry

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

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

Statistics

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

$$\text{Standard deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f} \right)^2}$$

Answer all the questions.

1. $\xi = \{ \text{integers } x : 3 < x < 18 \}$

$P = \{ \text{multiples of 5} \}$

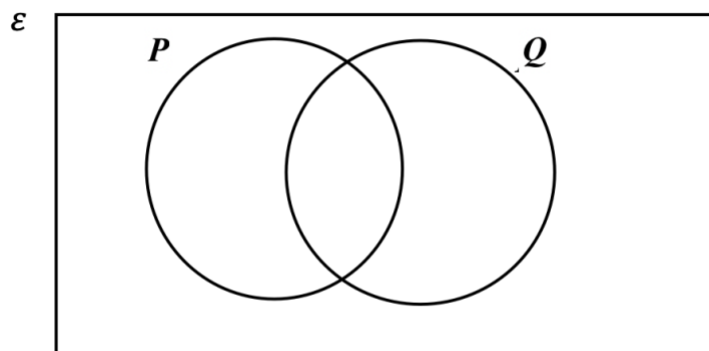
$Q = \{ \text{perfect squares} \}$

(a) List the elements in $(P \cup Q)'$.

Answer _____ [1]

(b) On the Venn diagram, shade the region which represents $(P \cap Q) \cup (P \cap Q')$.

Answer



[1]

2. (a) Use prime factors to explain why 18×63 is not a perfect square.

Answer

[2]

- (b) The number $18p$ is a perfect cube.
Find the smallest positive integer value of p .

Answer $p = \dots\dots\dots$ [2]

3. (a) Given that $2^{m-1} \times 3^m = 1$, find the value of 36^m .

Answer $36^m =$ _____ [2]

- (b) Simplify $\frac{(2xy)^{-2}}{12} \div \frac{x^3}{4y^2}$.

Answer _____ [2]

4. (a) Solve the equation $x^2 - 4x - 11 = 0$ by completing the square.
Give your answer correct to 2 decimal places.

Answer $x = \underline{\hspace{2cm}}$ or $x = \underline{\hspace{2cm}}$ [3]

- (b) (i) Factorise completely $4x^2 + 5x - 6$.

Answer $\underline{\hspace{4cm}}$ [1]

- (ii) Hence, factorise completely $4(2t + 2)^2 + 5(2t + 2) - 6$.

Write your answer as simply as possible.

Answer $\underline{\hspace{4cm}}$ [2]

5. It is given that y is directly proportional to x^2 .

Find the percentage increase in y if x is increased by 25% of its original value.

Answer _____ % [2]

6. Express as a single fraction in its simplest form

$$\frac{4(x-2)}{x^2-4} - \frac{2(3x-1)}{3x^2+5x-2} .$$

Answer _____ [3]

7. In the sequence, the difference between any two consecutive terms is the same number.

17 x y z 9 ...

- (a) Find the values of x , y and z .

Answer $x =$ _____

$y =$ _____

$z =$ _____ [2]

- (b) Write down an expression for the n th term of the sequence.

Answer _____ [1]

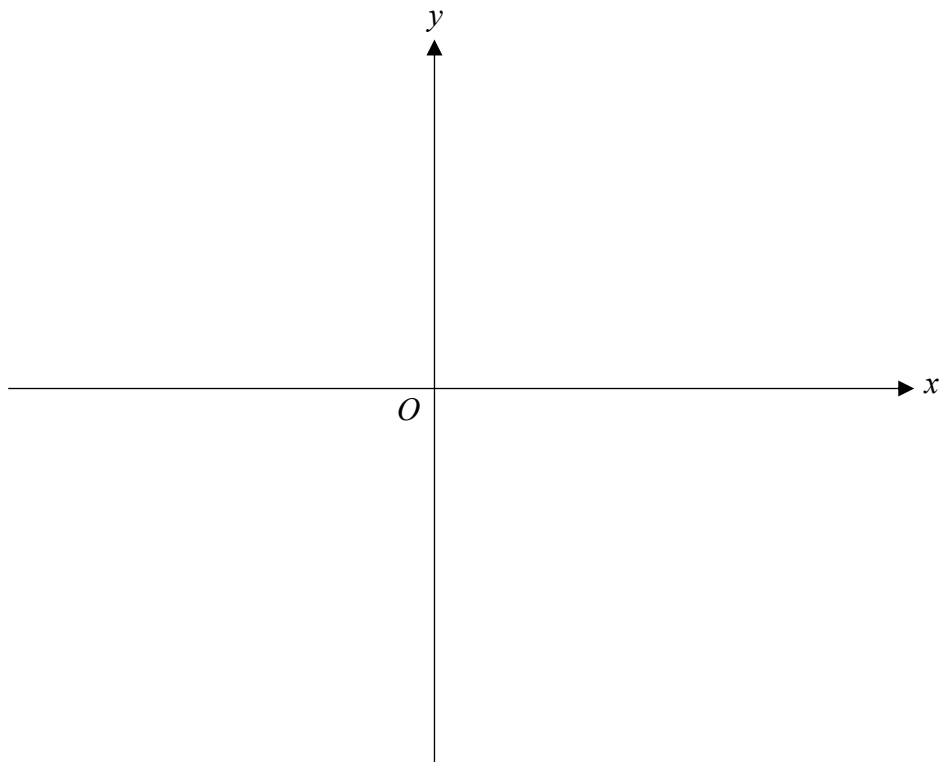
- (c) Explain why -317 is a term of this sequence.

Answer

[1]

8. Sketch the graph of $y = -(2x - 1)(x + 3)$ on the axes below.

Indicate clearly the coordinates of the turning point and where the graph crosses the axes.



[3]

9. Diana has two outlets that sell donuts of three flavours.

The number of donuts sold in the outlets over a two-hour period is given by the matrix $\mathbf{D}$.

$$\mathbf{D} = \begin{array}{ccc} \text{Blueberry} & \text{Chocolate} & \text{Apple} \\ \begin{pmatrix} 75 & 86 & 48 \\ 108 & 56 & 36 \end{pmatrix} & \begin{matrix} \text{Outlet 1} \\ \text{Outlet 2} \end{matrix} \end{array}$$

- (a) Each blueberry donut is sold at \$3.50.

Each chocolate donut is sold at \$4.50.

Each apple donut is sold at \$2.50.

Represent the selling price in a 3×1 column matrix $\mathbf{P}$.

Answer $\mathbf{P} =$ _____ [1]

- (b) Evaluate the matrix $\mathbf{M} = \mathbf{DP}$.

Answer $\mathbf{M} =$ _____ [1]

- (c) Explain what each element in matrix $\mathbf{M}$ represents.

Answer

[1]

- 10.** A bag contains some blue marbles, some green marbles and some red marbles.
The probability of choosing a green marble is 0.2 .
The probability of choosing a red marble is 0.35 .

(a) Find the probability of choosing a blue marble at random.

Answer _____ [1]

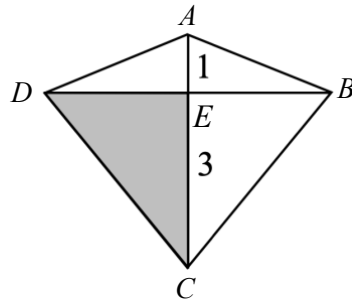
(b) In the bag, there are 9 more red marbles than green marbles.
Find the total number of marbles in the bag.

Answer _____ marbles [2]

11. The diagram shows a kite $ABCD$.

AC and DB are the diagonals of the kite.

E is a point on AC such that $AE : EC = 1 : 3$.



Not drawn to scale

Find the fraction of the kite that is shaded.

Answer _____ [2]

12. (a) Ben sold a painting to Carl at a profit of 20% and Carl then sold it to Don at a profit of 40%. If Don paid \$12800 for the painting, calculate how much Ben paid for the painting.

Answer \$_____ [2]

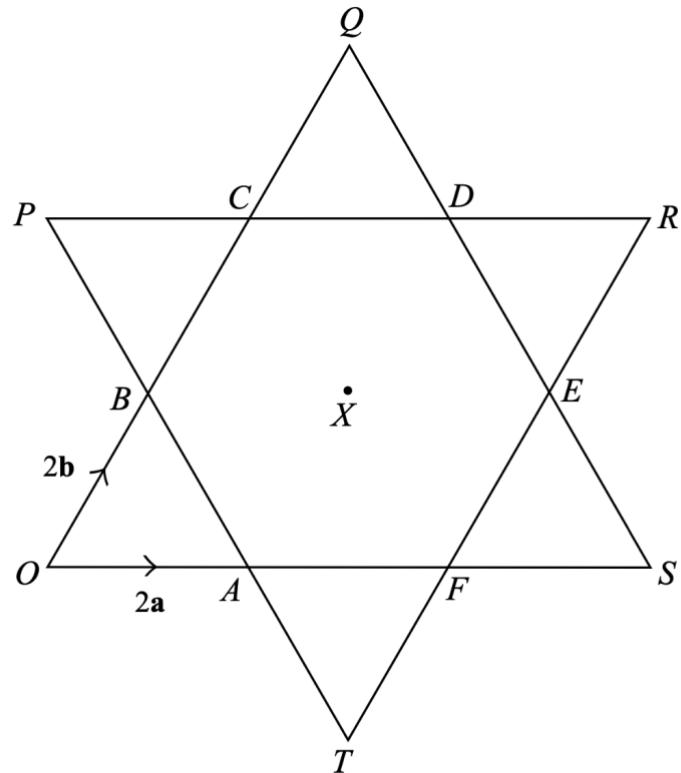
- (b) Some bacteria were introduced into a culture.

The number, N , of bacteria, t hours after being introduced is given by $N = 2 \times 5^t$.

Find the increase in the number of bacteria after 5 hours as a percentage of the number of bacteria originally introduced.

Answer _____% [2]

13.



A star is made up of a regular hexagon $ABCDEF$, centre X , surrounded by equilateral triangles.

$$\overrightarrow{OA} = 2\mathbf{a} \text{ and } \overrightarrow{OB} = 2\mathbf{b}.$$

- (a) Express the following vectors in terms of $\mathbf{a}$ and / or $\mathbf{b}$, giving your answers in the simplest form.

(i) $\overrightarrow{OR}$

Answer _____ [1]

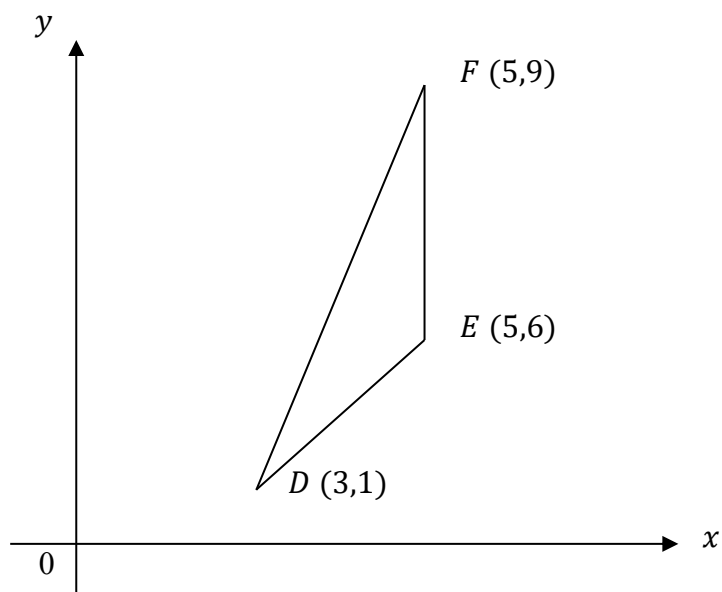
(ii) $\overrightarrow{FC}$

Answer _____ [1]

- (b) When $|\mathbf{a}| = 6$ units, find the perimeter of the star $OATFSERDQCPBO$.

Answer _____units [2]

14. The diagram shows the points $D (3, 1)$, $E (5, 6)$ and $F (5, 9)$.



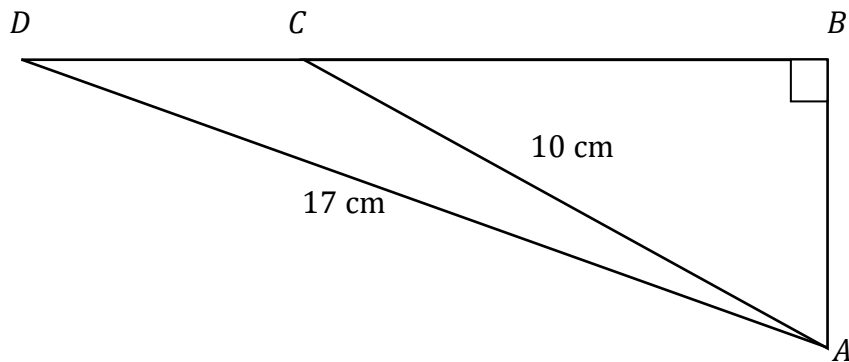
- (a) Find the coordinates of G such that $DEFG$ is a parallelogram.

Answer $G (\dots\dots\dots , \dots\dots\dots)$ [1]

- (b) Find the length of the line DF .

Answer $DF = \dots\dots\dots$ units [1]

15. In the triangle ABD , $AD = 17$ cm, $AC = 10$ cm and $\angle ABC = 90^\circ$.



- (a) Given that $\sin \angle ACD = \frac{3}{5}$, find the exact value of
 (i) AB

Answer _____ [1]

- (ii) $\tan \angle ACB$

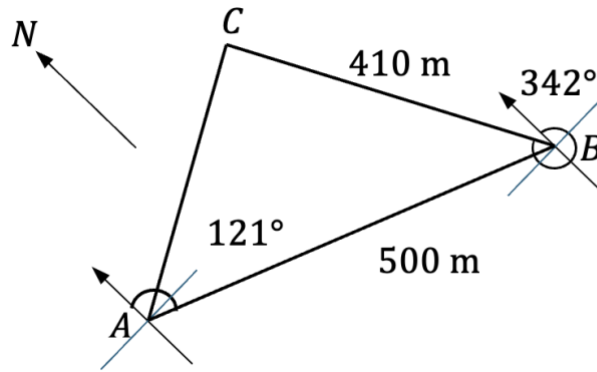
Answer _____ [2]

- (b) A circle Q_1 is drawn such that it passes through A , B and C .
 A second circle Q_2 is drawn such that it passes through A , B and D .
 Find the ratio of the circumference of Q_1 to circumference of Q_2 .

Answer _____ : _____ [1]

16. Aris cycled from his house at Alley Way, point A , to meet Meng at point B , which is 500 m away on a bearing of 121° .

on a bearing of 342° , which is 410 m from B .



- (a) Show that angle ABC is 41° .
Answer

[2]

- (b) Calculate the distance AC .

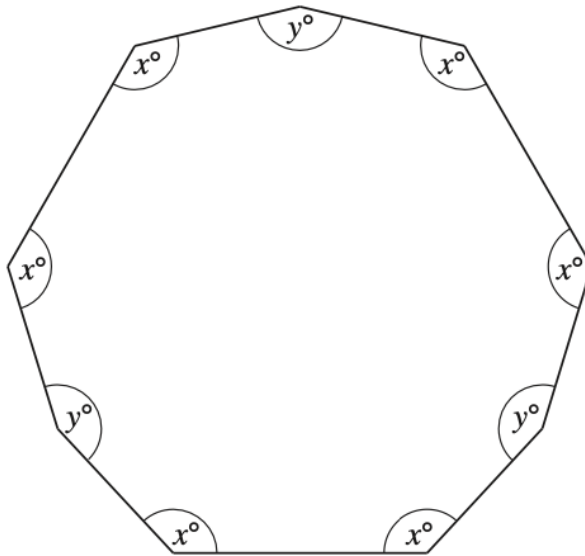
Answer _____ m [2]

- (c) Calculate the shortest distance from A to BC .

Answer _____ m [2]

17. The diagram shows a nonagon.

Six interior angles are each x° . The remaining three interior angles are each y° .



- (a) State the number of lines of symmetry if $x^\circ \neq y^\circ$.

Answer _____ [1]

- (b) Find the sum of the interior angles of the nonagon.

Answer _____[°] [1]

- (c) Hence, show that $y = -2x + 420$.

Answer

[1]

- (d) Given that $x : y = 13 : 16$, find x .

Answer $x =$ _____ [2]

- 18. (a)** Ellie went for a school exchange in the United Kingdom.
 She changed 250 Singapore dollars (\$) to UK pounds (£).
 She spent £100 during her trip and converted the remaining pounds back to Singapore dollars.

Exchange Rate	Buying Rate for One Singapore Dollar (\$)	Selling Rate for One Singapore Dollar (\$)
UK Pounds (£)	0.5746	0.5830

Using the exchange rate given, calculate how much Singapore dollars she had left.
 Give your answer to the nearest dollar.

Answer \$_____ [2]

- (b)** Jane intends to borrow \$88000 for her business venture and is considering the loan schemes by Bank *A* and Bank *B*.

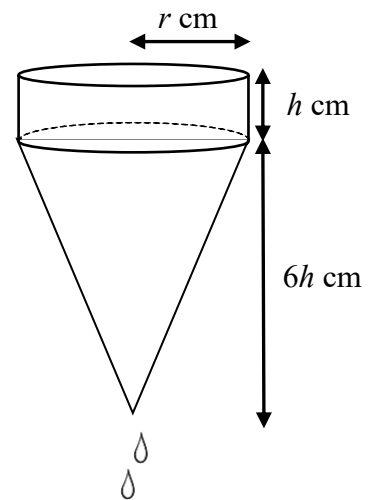
Bank <i>A</i>	Bank <i>B</i>
Interest rate of 2.38% per annum compound interest compounded half-yearly	Interest rate of 3.28% per annum simple interest

If Jane wishes to take a loan for a period of 5 years, determine which bank should she borrow from.
 Explain your answer with mathematical calculations.

Answer

[3]

19. A water tank is formed from a cylinder and a cone.
 The cylinder has radius r cm and height h cm.
 The cone has a base radius of r cm and height $6h$ cm.



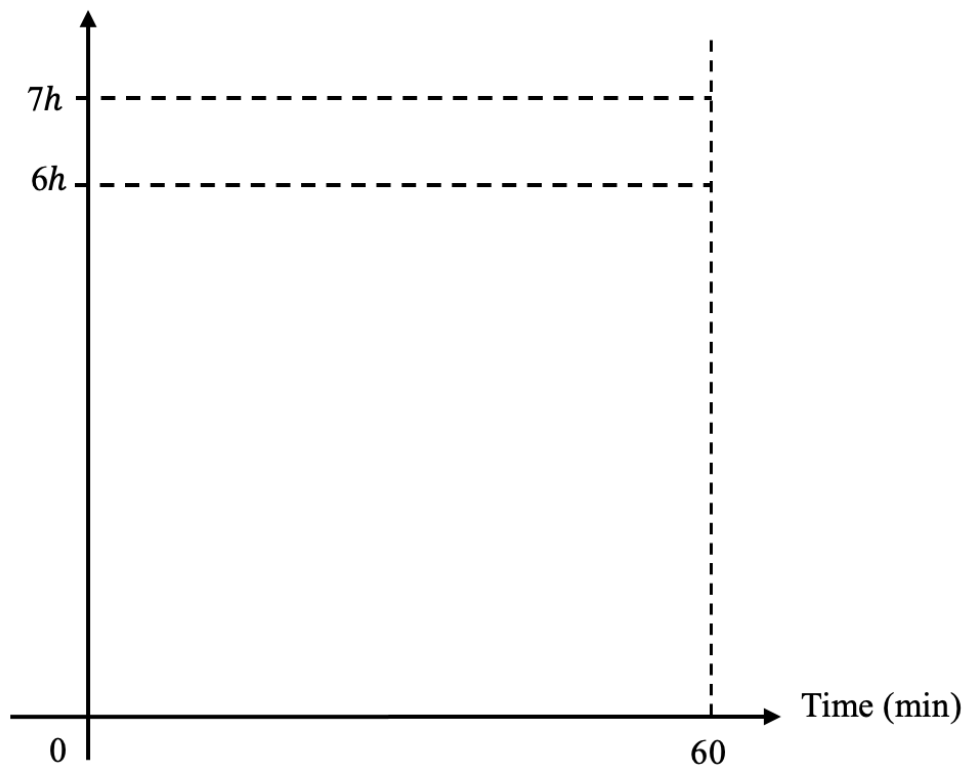
The water tank is filled with water to the brim of the tank.
 Water is leaked out at a constant rate and the tank is completely emptied in 60 minutes.

- (a) Find the time taken, in minutes, for the water in the cylinder to drain completely.

Answer _____ mins [2]

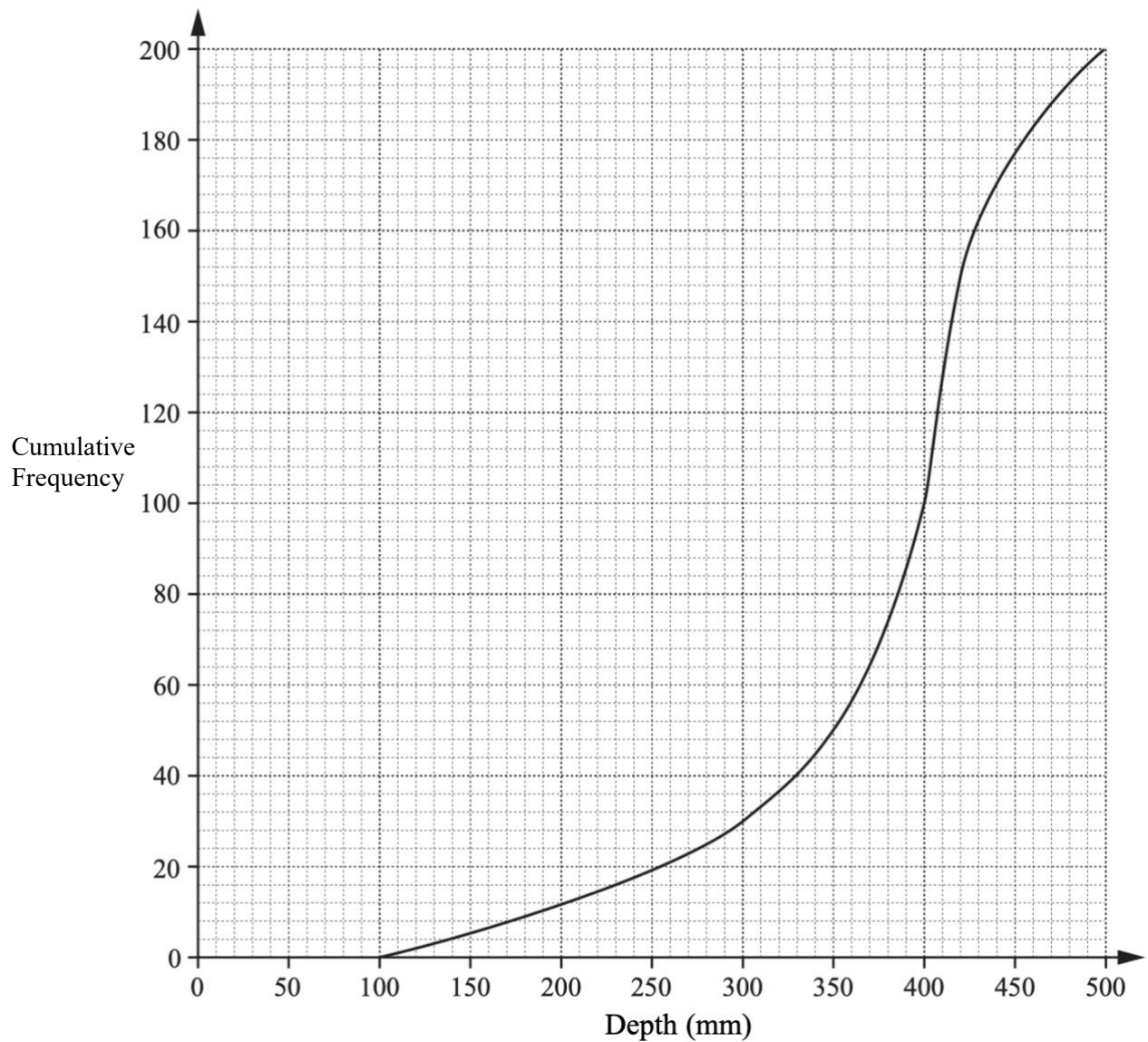
- (b) On the grid provided, sketch the graph of the height of the water level in the tank against the time taken (in min).

Height of water level (cm)



[2]

20. The cumulative frequency curve shows the distribution of the depth, d mm, of a canal measured daily for a period of 200 days.



(a) Use the curve to estimate

(i) the median depth of the canal,

Answer _____ mm [1]

(ii) the interquartile range of the depth,

Answer _____ mm [1]

(iii) the depth at the 30th percentile,

Answer _____ mm [1]

(iv) the number of days when the depth of the canal was at least 450 mm.

Answer _____ days [1]

(b) The information on the cumulative frequency curve is shown in this table.

Depth (mm)	$100 < d \leq 200$	$200 < d \leq 300$	$300 < d \leq 400$	$400 < d \leq 500$
No. of days	12	m	n	100

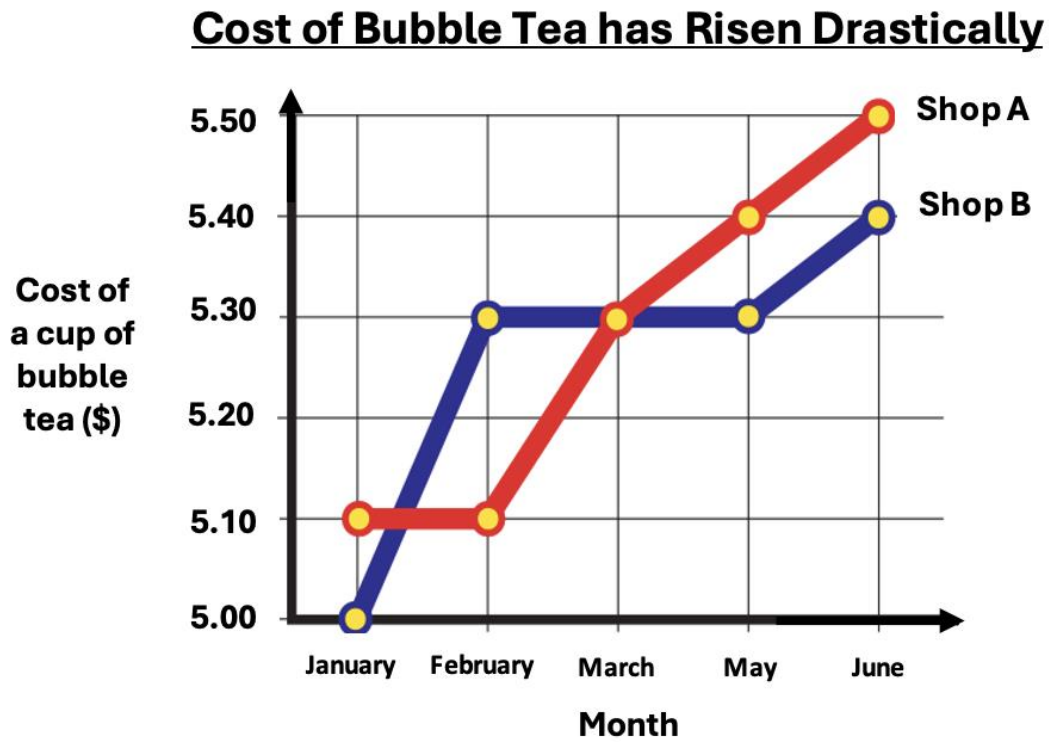
(i) Find the values of m and n .

Answer $m = \dots\dots\dots n = \dots\dots\dots$ [1]

(ii) Calculate an estimate of the mean depth of the canal.

Answer _____ mm [1]

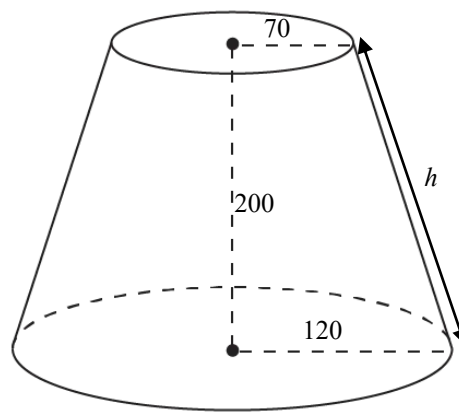
21.



State one aspect of the graph that may be misleading and explain how this may lead to a misinterpretation of the graph.

Answer

22.



The diagram shows a lampshade in the shape of a frustum.

The bottom radius of the frustum is 120 mm.

The top radius of the frustum is 70 mm.

The vertical height of the frustum is 200 mm.

(a) Find the slant height, h , of the frustum.

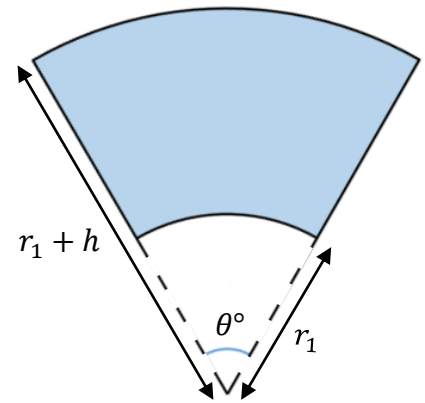
Answer _____ mm [2]

- (b) The shaded area represents the net of the lampshade.

The radius of the inner arc is r_1 mm.

The radius of the outer arc is $(r_1 + h)$ mm.

Show that the radius of the inner arc is 288.6 mm.



Answer

[3]

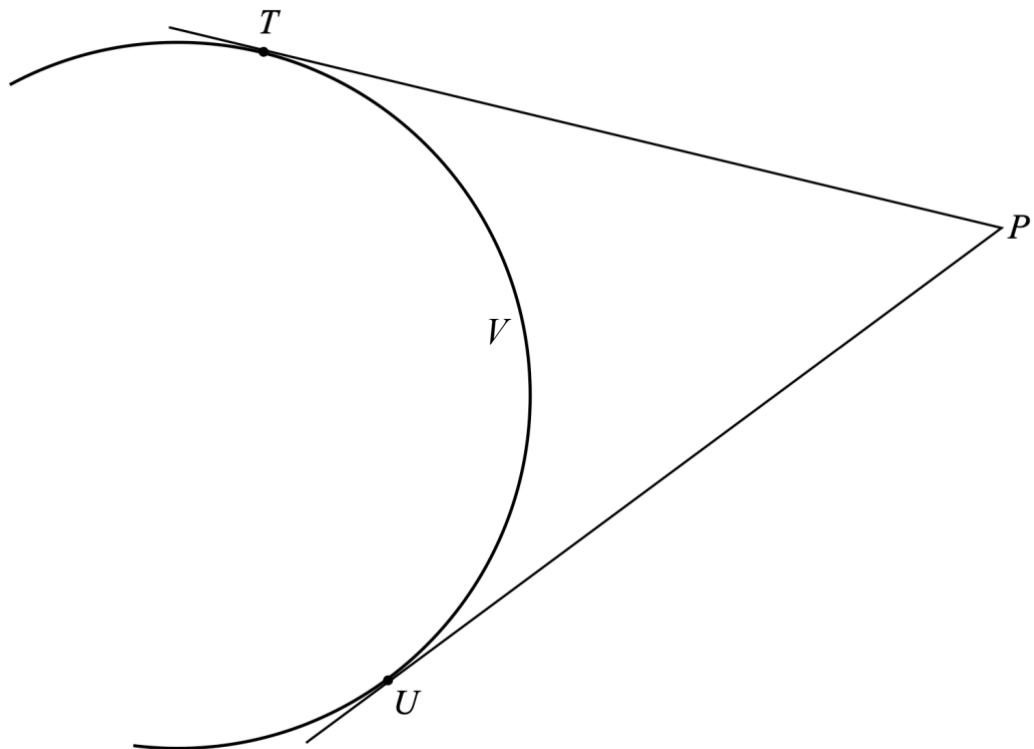
- (c) Hence, find angle θ .

Answer $\theta^\circ = \dots\dots\dots^\circ$ [1]

- (d) Calculate the amount of material required to make the lampshade, leaving your answer in square centimeters.

Answer _____ cm^2 [2]

23. The diagram shows a plot of land, $PTVU$, on a campsite.
 PT and PU are tangents of an arc of a circle at T and U .



- (a) Find the center of the circle and label it X . [1]
- (b) Construct the perpendicular bisector of TP . [1]
- (c) Construct the angle bisector of angle TPU . [1]
- (d) A lookout tower is to be built on the campsite $PTVU$, nearer to T than P and nearer to PT than PU .
 Shade the region where the lookout tower is to be built. [1]

----- End of Paper -----