

- 1 (a) Write 468 000 in standard form.

$$4.68 \times 10^5$$

(1)

- (b) Write 5.037×10^{-4} as an ordinary number.

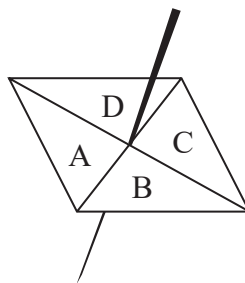
$$0.0005037$$

(1)

(Total for Question 1 is 2 marks)



2 Here is a biased spinner.



The table shows the probabilities that when the spinner is spun it will land on A, on B, on C and on D.

Letter	A	B	C	D
Probability	0.4	0.21	0.32	0.07

Luka will spin the spinner 200 times.

Work out an estimate for the number of times the spinner will land on A.

$$0.4 \times 200 = 80$$

80

(Total for Question 2 is 2 marks)

- 3 Seija works at a weather station.
The table gives information about the temperature, $T^{\circ}\text{C}$, at midday for each of 50 cities in the UK on Tuesday.

Temperature ($T^{\circ}\text{C}$)	Frequency
$10 < T \leq 15$ 12.5 x 2	25
$15 < T \leq 20$ 17.5 x 8	140
$20 < T \leq 25$ 22.5 x 13	292.5
$25 < T \leq 30$ 27.5 x 21	577.5
$30 < T \leq 35$ 32.5 x 6	195
	50 1230

- (a) Calculate an estimate for the mean temperature.

1230 ÷ 50 = 24.6

24.6 °C
(3)

Seija says,

“The median temperature is 22.5°C because 22.5 is the middle number in the middle group.”

- (b) Is Seija correct?
Give a reason for your answer.

No, the median is in the interval $25 < T \leq 30$

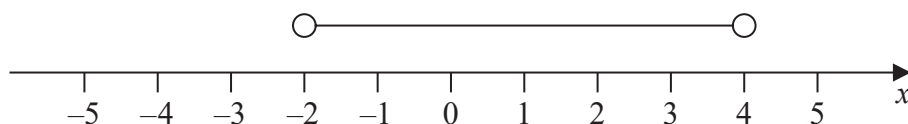
(1)

(Total for Question 3 is 4 marks)



- 4 Jenna is asked to show the inequality $-3 < x \leq 4$ on a number line.

Here is her answer.



- (a) Write down two mistakes Jenna has made.

1 She should have drawn an open circle at -3 , not -2

2 The circle at 4 should be coloured in

(2)

- (b) Work out the greatest integer that satisfies the inequality

$$\begin{array}{rcl}
 5y - 7 & < & 16 \\
 +7 & & +7 \\
 \hline
 5y & < & 25 \\
 \div 5 & & \div 5 \\
 \hline
 y & < & 5
 \end{array}$$

$$y < 5$$

(2)

(Total for Question 4 is 4 marks)



5 Ali buys packs of balloons and boxes of pencils.

There are 30 balloons in each pack.

There are 24 pencils in each box.

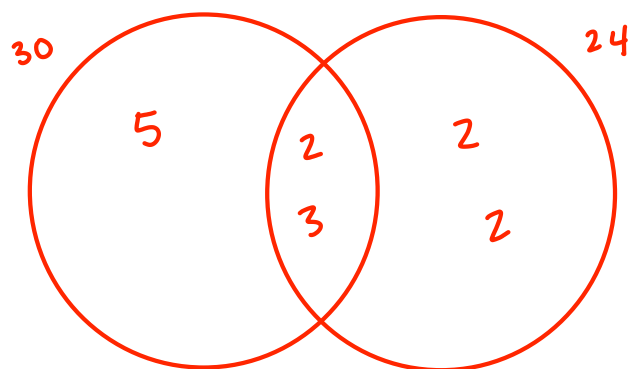
Ali buys exactly the same number of balloons and pencils.

Work out how many packs of balloons and how many boxes of pencils she could have bought.

You must show all your working.

$$30 = 2 \times 3 \times 5$$

$$24 = 2^3 \times 3$$



$$\begin{aligned} \text{LCM} &= 2^3 \times 3 \times 5 \\ &= 120 \end{aligned}$$

$$120 \div 30 = 4$$

$$120 \div 24 = 5$$

4 packs of balloons

5 boxes of pencils

(Total for Question 5 is 3 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

6 A company orders a large number of plates from a factory.

It would take 30 hours to make all the plates using 4 machines.

How many machines are needed to make all the plates in 6 hours?

$$\begin{array}{lcl} \div 5 & \swarrow & 30 \text{ hrs} = 4 \text{ machines} \\ & & \downarrow \\ & & 6 \text{ hrs} = 20 \text{ machines} \end{array} \quad \searrow \times 5$$

20

(Total for Question 6 is 2 marks)

7 Riley travelled by car and by aeroplane.

He travelled 143 miles by car at an average speed of 55 miles per hour.
Riley then travelled for 5 hours and 20 minutes by aeroplane.

Work out, in hours and minutes, Riley's total travelling time.



$$T = \frac{D}{S}$$

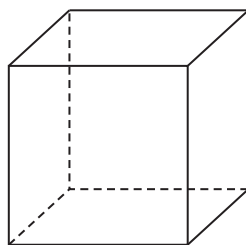
$$143 \div 55 = 2.6 = 2 \text{ hrs } 36 \text{ mins} \\ + 5 \text{ hrs } 20 \text{ mins}$$

..... 7 hours 56 minutes

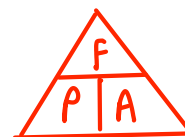
(Total for Question 7 is 3 marks)



- 8 The diagram shows a solid cube placed on a horizontal table.



$$\text{pressure} = \frac{\text{force}}{\text{area}}$$



The pressure on the table due to the cube is 3.5 newtons/cm^2

The force exerted by the cube on the table is 504 newtons.

Show that the total surface area of the cube is less than 900 cm^2

$$A = \frac{F}{P} = \frac{504}{3.5} = 144 \text{ cm}^2$$

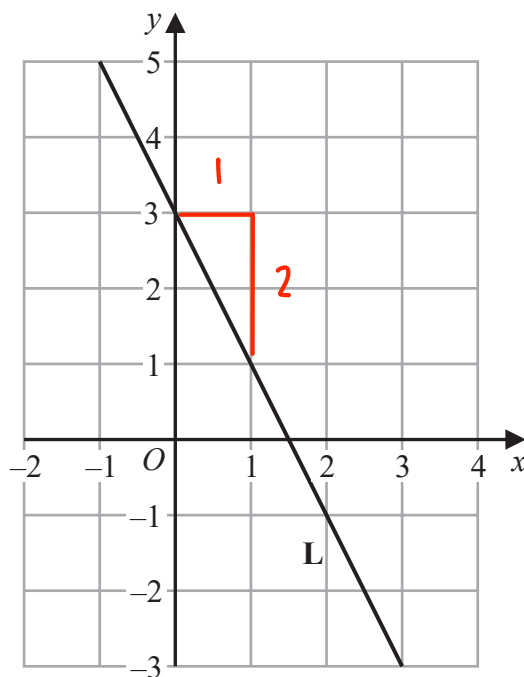
$$144 \times 6 = 864 \text{ cm}^2$$

$$864 < 900$$

(Total for Question 8 is 3 marks)



9 The line **L** is shown on the grid.



Find an equation for **L**.

$$\text{Gradient} = \frac{\text{rise}}{\text{run}} = \frac{-2}{1} = -2$$

$$y\text{-intercept} = 3$$

$$y = -2x + 3$$

(Total for Question 9 is 3 marks)



10 Make m the subject of $k = p + \frac{2m}{5}$

$$\begin{array}{rcl} & -p & -p \\ k - p & = & \frac{2m}{5} \\ & \times 5 & \times 5 \\ 5(k - p) & = & 2m \\ & \div 2 & \div 2 \\ \frac{5(k - p)}{2} & = & m \end{array}$$

(Total for Question 10 is 3 marks)

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DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



- 11 The floor plan of a house is drawn using a scale of 1 : 50
On the plan, a room in the house has a floor area of 48 cm^2

Work out the real area of the floor of this room.
Give your answer in m^2

$$\text{Length SF} = 50$$

$$\text{Area SF} = 50^2 = 2500$$

$$48 \text{ cm}^2 \times 2500 = 120000 \text{ cm}^2$$

$$\div 100^2 = 12 \text{ m}^2$$

12

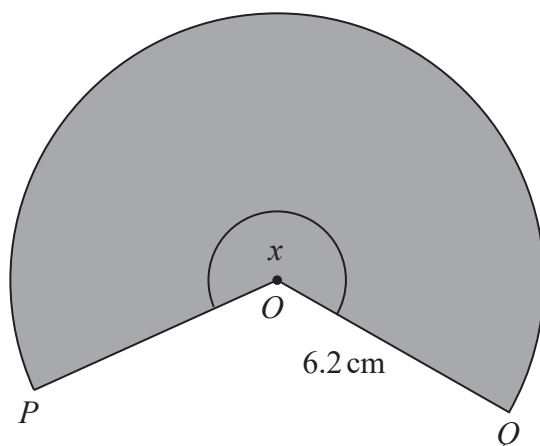
m^2

(Total for Question 11 is 3 marks)

m^2

(Total for Question 11 is 3 marks)

- 12 The diagram shows a shaded sector POQ of a circle with centre O and radius 6.2 cm.



The area of the shaded sector is 82.6 cm^2

Calculate the size of angle x .

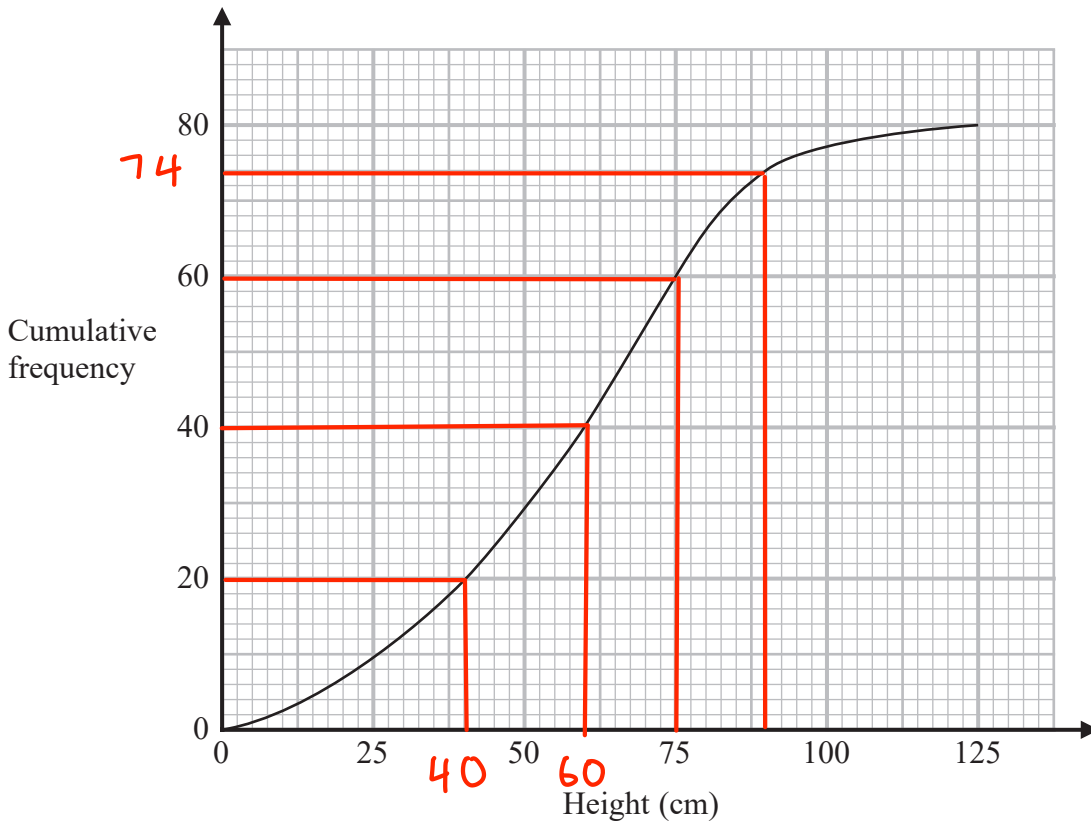
Give your answer correct to 3 significant figures.

$$\begin{aligned} \frac{x}{360} \times \pi \times 6.2^2 &= 82.6 \\ &\div 6.2^2 \\ \frac{x}{360} \times \pi &= 2.1488 \\ &\div \pi \\ \frac{x}{360} &= 0.683.. \\ \times 360 & \\ x &= 246.2 \end{aligned}$$

246

(Total for Question 12 is 2 marks)

- 13 Alan grew 80 plants of the same type outside.
The cumulative frequency graph shows information about the heights, in cm, of these plants.



- One of the plants is chosen at random.
- (a) Find an estimate for the probability that this plant will have a height greater than 90 cm.

$$\frac{6}{80}$$

(2)

- (b) Use the graph to find an estimate for the median height.

$$\frac{60}{58.5 \text{ to } 61.5}$$

(1) cm



- (c) Use the graph to find an estimate for the interquartile range of the heights.

$$75 - 40 = 35$$

35

..... cm

(2)

Alan also grew plants of the same type inside.

The interquartile range of the heights of these plants is 30 cm.

- (d) Give one comparison between the distribution of the heights of the plants grown inside with the distribution of the heights of the plants grown outside.

The plants grown inside had a small IQR, suggesting that their heights varied less

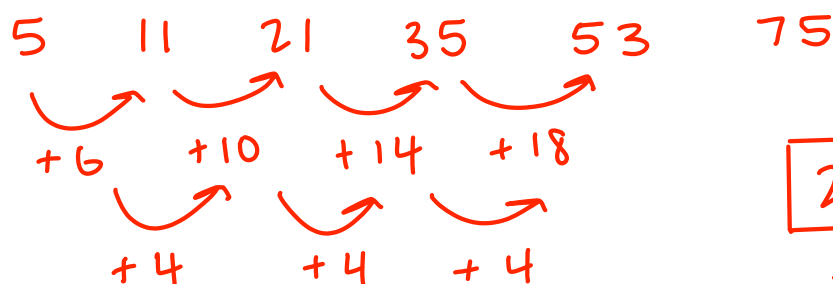
(1)

(Total for Question 13 is 6 marks)

14 Here are the first six terms of a quadratic sequence.

5 11 21 35 53 75

Find an expression, in terms of n , for the n th term of this sequence.



$$2n^2$$

$$\begin{array}{cccc} n^2 & 1 & 4 & 9 \\ 2n^2 & 2 & 8 & 18 \end{array}$$

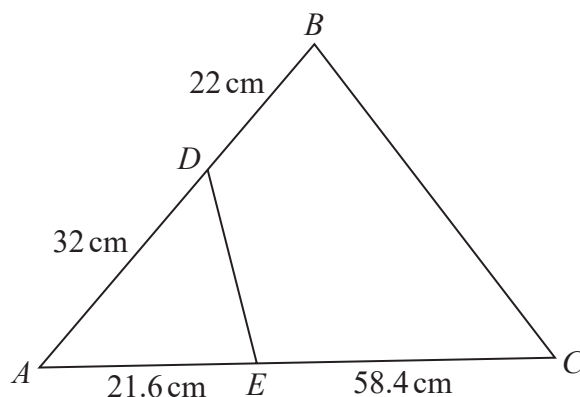
$$2n^2 + 3$$

terms	5	11	21
$- 2n^2$	2	8	18
	3	3	3

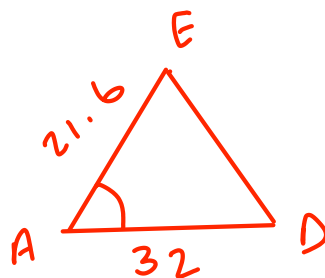
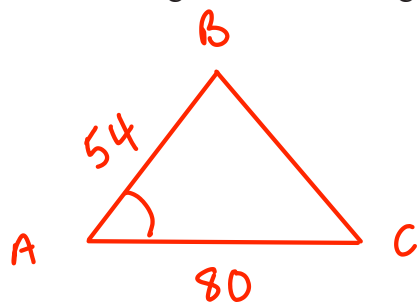
(Total for Question 14 is 2 marks)



15 The diagram shows triangle ABC and triangle AED .



Show that triangle ABC and triangle AED are similar.



$$54 \div 21.6 = 2.5$$

$$80 \div 32 = 2.5$$

The triangles are similar, triangle ABC is 2.5 times bigger than triangle AED

(Total for Question 15 is 2 marks)

16 Zia has to set a 4-digit security passcode on her phone.

Each digit of the passcode is a number from 1 to 9
She can use each number more than once.

Zia tells her friend Amber that

- the first digit is a cube number
- the second digit is a prime number
- the third digit is greater than 6
- the fourth digit is an odd number.

The diagram shows one possible 4-digit passcode.



Amber is going to have one attempt at guessing Zia's passcode.

Work out the probability that Amber guesses Zia's passcode on the first attempt.

$$\begin{array}{cccc} \underline{1, 8} & \underline{2, 3,} & \underline{7, 8,} & \underline{1, 3, 5,} \\ & \underline{5, 7} & \underline{9} & \underline{7, 9} \end{array}$$

$$2 \times 4 \times 3 \times 5 = 120 \text{ options}$$

$$\begin{array}{r} 1 \\ \hline 120 \end{array}$$

(Total for Question 16 is 3 marks)

- 17 (a) (i) Write $x^2 - 8x + 3$ in the form $(x - a)^2 - b$ where a and b are integers.

$$\begin{aligned} & (x - 4)^2 - 16 + 3 \\ & = (x - 4)^2 - 13 \end{aligned}$$

(2)

- (ii) Hence, write down the coordinates of the turning point on the graph of $y = x^2 - 8x + 3$

$$\left(\begin{array}{c} 4 \\ \hline \end{array} , \begin{array}{c} -13 \\ \hline \end{array} \right)$$

(1)

- (b) Solve $7x^2 + 8x - 5 = 0$
Give your solutions correct to 3 significant figures.

$$a = 7 \quad b = 8 \quad c = -5$$

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

$$\frac{-(-8) \pm \sqrt{(-8)^2 - 4(7)(-5)}}{2(7)}$$

$$x = 0.449$$

$$x = -1.59$$

(3)

Alex has to find the solutions of the quadratic equation $3k^2 + 10k - 8 = 0$
Here is his working and answer.

$$(3k - 2)(k + 4) = 0$$

$$k = 2 \text{ or } k = -4$$

- (c) What mistake has Alex made?

$$3k - 2 = 0$$

$$3k = 2$$

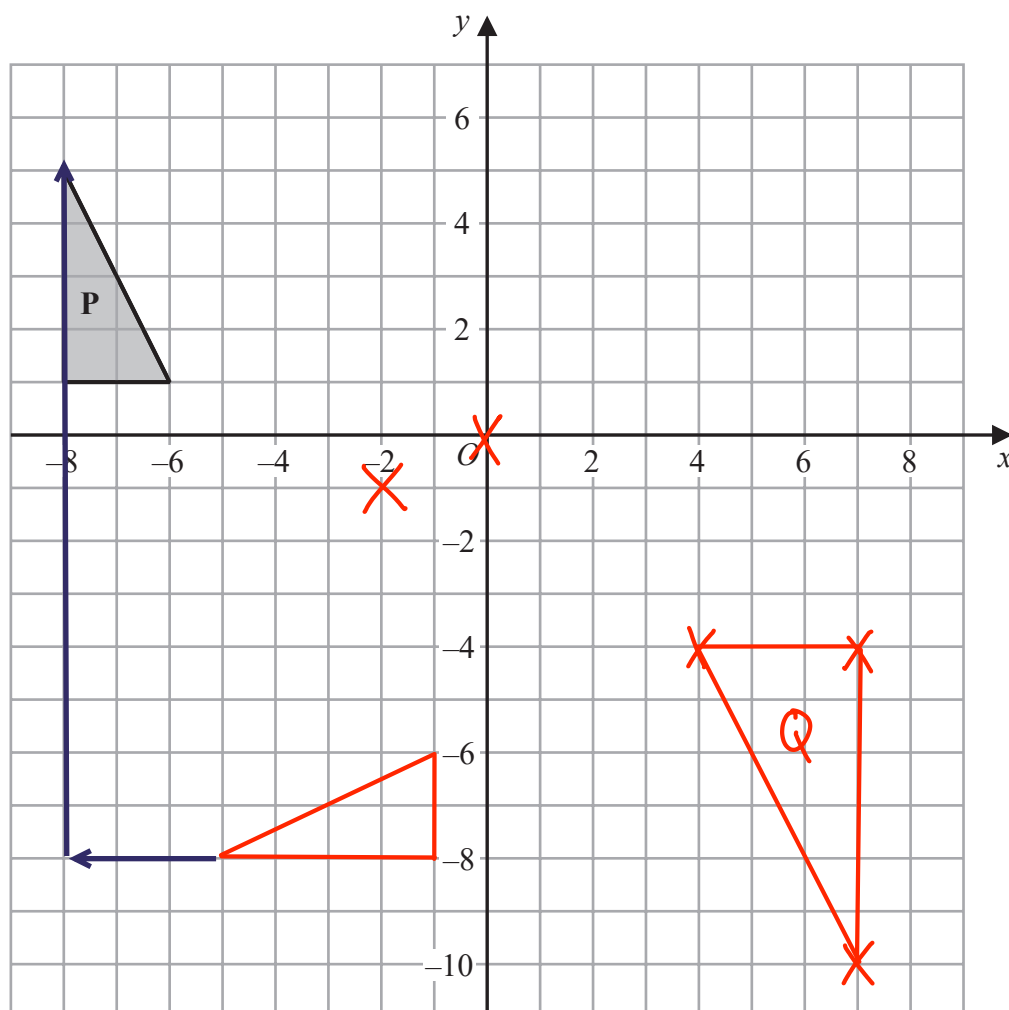
$$k = \frac{2}{3}$$

$$k = \frac{2}{3} \text{ or } k = -4$$

(1)

(Total for Question 17 is 7 marks)

18



- (a) Enlarge triangle **P** by scale factor $-1\frac{1}{2}$ with centre of enlargement $(-2, -1)$

Label your image **Q**.

(2)

Triangle **P** is transformed by a combined transformation of a rotation of 90° anticlockwise about the origin followed by a translation to give triangle **R**.

Exactly one vertex of triangle **P** is invariant under the combined transformation.

- (b) Find one possible column vector for the translation.

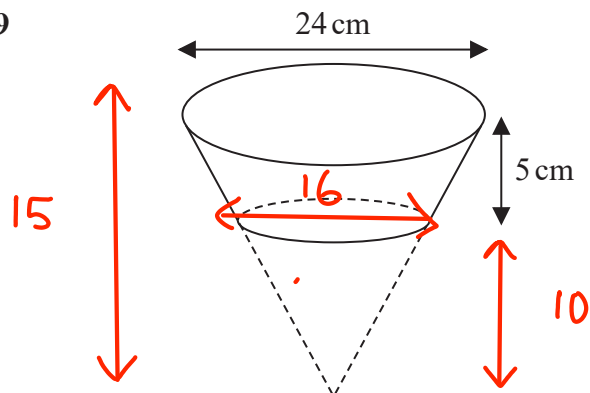
$$\begin{pmatrix} -3 \\ 13 \end{pmatrix}$$

(1)

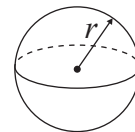
(Total for Question 18 is 3 marks)



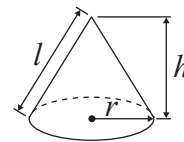
19



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



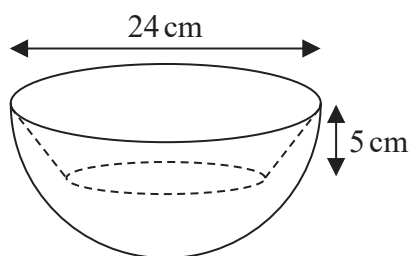
$$\text{Volume of cone} = \frac{1}{3} \pi r^2 h$$



The diagram above shows a frustum **F** of a cone.

The frustum is made by removing a cone with height 10 cm from a solid cone with height 15 cm and base diameter 24 cm.

The solid **S** is made by removing **F** from a solid hemisphere as shown in the diagram below.



The hemisphere has diameter 24 cm.

Calculate the volume of solid **S**.

Give your answer correct to 3 significant figures.

$$15 \div 10 = 1.5 \text{ (SF)}$$

$$24 \div 1.5 = 16$$

$$\begin{aligned} \text{Frustum} &= \frac{1}{3} \pi \times 12^2 \times 15 - \frac{1}{3} \pi \times 8^2 \times 10 \\ &= 1591.74 \end{aligned}$$

$$\begin{aligned} \text{Hemisphere} &= \frac{1}{2} \times \frac{4}{3} \times \pi \times 12^3 \\ &= 3619.11 \dots \end{aligned}$$

$$\begin{aligned} 3619.11 - 1591.74 &= 2027.37 \\ &= 2030 \text{ cm}^3 \end{aligned}$$

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DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

..... 2030 cm³

(Total for Question 19 is 4 marks)

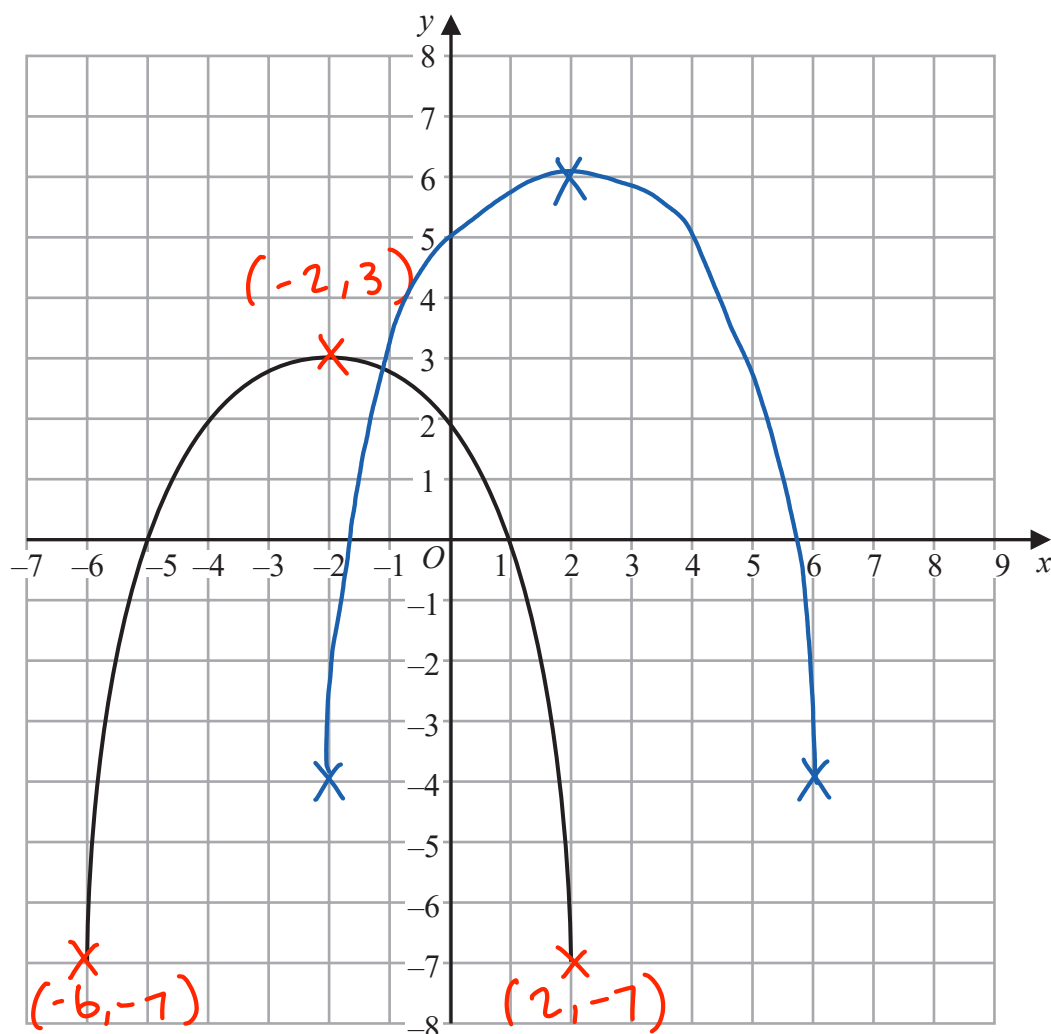


20 The turning point on the graph of $y = g(x)$ has coordinates $(-3, 6)$

(a) Write down the coordinates of the turning point on the graph of $y = g(x - 7)$

(4 , 6)
(1)

The graph of $y = f(x)$ is shown on the grid.



(b) On the grid, sketch the graph of $y = f(-x) + 3$

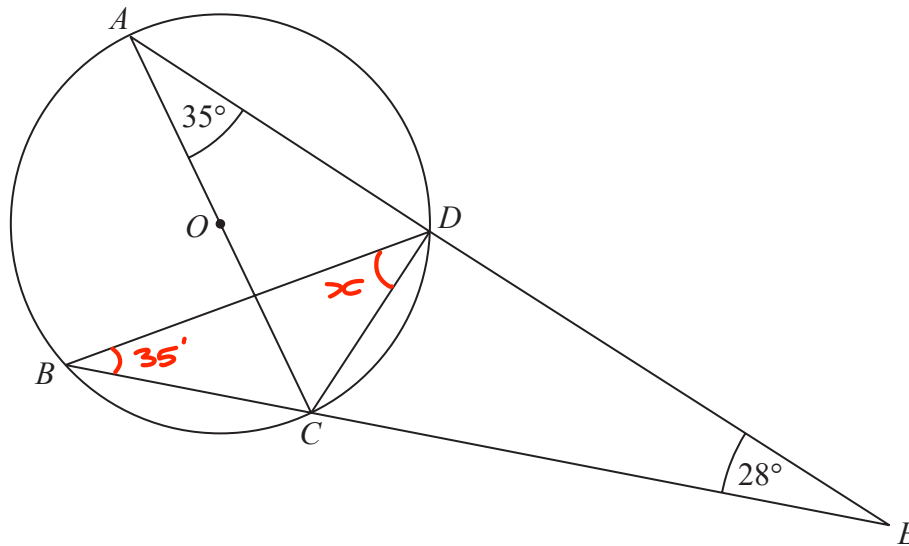
(2)

(Total for Question 20 is 3 marks)

Tip: you need to change the sign of the x coordinate, and add 3 to the y coordinate



21



A , B , C and D are points on the circumference of a circle, centre O .
 AC is a diameter of the circle.

ADE and BCE are straight lines.

Work out the size of angle BDC .

Write down any circle theorems that you use.

$$\angle CBD = 35^\circ \quad \text{Angles in the same segment are equal}$$

$$\angle ADC = 90^\circ \quad \text{The angle in a semicircle is } 90^\circ$$

$$\angle BDE = 117^\circ \quad \text{Angles in a triangle add to } 180^\circ$$

$$90 + 117 = 207$$

$$207 - 180 = 27^\circ$$

Tip: by adding 90 and 117 together we have found how much over 180° (a straight line) these angles have added to when angle x has been used twice, by taking away 180° we are able to find the size of angle x .

27

(Total for Question 21 is 4 marks)



22 Ebony makes some bracelets to sell.

$$LB = 187.5 \quad UB = 192.5$$

The materials to make all the bracelets cost £190, correct to the nearest £5

Ebony sells all the bracelets for a total of £875, correct to the nearest £5

$$LB = 872.5 \quad UB = 877.5$$

The total time taken to make and sell all these bracelets was 72 hours, correct to the nearest hour.

$$LB = 71.5 \quad UB = 72.5$$

Ebony uses this method to calculate her hourly rate of pay

$\text{Hourly rate of pay} = \frac{\text{total selling price} - \text{total cost of materials}}{\text{total time taken}}$
$LB \qquad \qquad \qquad UB$

The minimum hourly rate of pay for someone of Ebony's age is £8.20

By considering bounds, determine if Ebony's hourly rate of pay was definitely more than £8.20

You must show all your working.

$$\text{Lower bound} = \frac{872.5 - 192.5}{72.5} = 9.38$$

Yes, the minimum she could make would be £9.38 per hour

(Total for Question 22 is 4 marks)



23 Given that $\frac{2x^2 + y^2}{4x^2 - y^2} = \frac{43}{11}$ where $x > 0$ and $y > 0$

find, in its simplest form, the ratio $x:y$

Tip: when you have two fractions equal to each other you can cross multiply to solve

$$11(2x^2 + y^2) = 43(4x^2 - y^2)$$

$$22x^2 + 11y^2 = 172x^2 - 43y^2$$

$$54y^2 = 150x^2$$

$$\div 54$$

$$\div 54$$

$$y^2 = \frac{25}{9}x^2$$

$$\sqrt{}$$

$$\sqrt{}$$

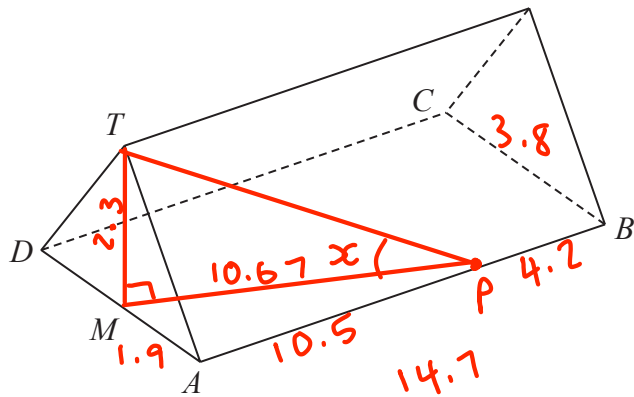
$$y = \frac{5}{3}x$$

$$\begin{array}{ccc} x & : & y \\ 1 & : & \frac{5}{3} \\ \times 3 & \swarrow & \searrow \times 3 \\ 3 & : & 5 \end{array}$$

$$3 : 5$$

(Total for Question 23 is 4 marks)

24 The diagram shows a triangular prism with a horizontal rectangular base $ABCD$.



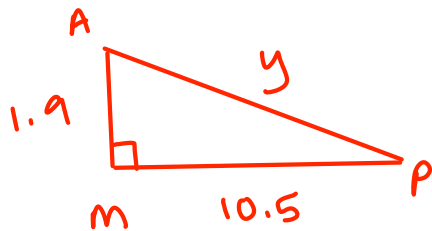
M is the midpoint of AD .
The vertex T of the prism is vertically above M .

$AB = 14.7\text{ cm}$ $BC = 3.8\text{ cm}$ $MT = 2.3\text{ cm}$

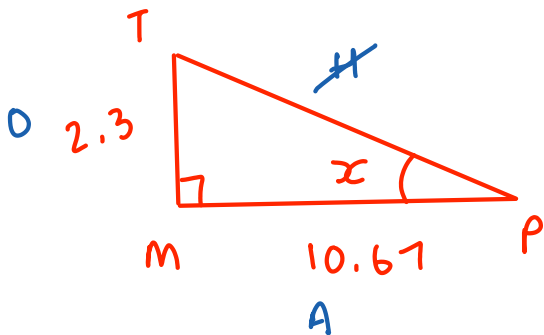
P is the point on AB such that

$AP:PB = 5:2$ $14.7 \div 7 = 2.1$
 $\rightarrow 2.1 \times 5 = 10.5$
 $2.1 \times 2 = 4.2$

Calculate the size of the angle between TP and the base $ABCD$ of the prism.
Give your answer correct to 1 decimal place.



$\sqrt{10.5^2 + 1.9^2} = 10.67$



$\tan^{-1}\left(\frac{2.3}{10.67}\right)$
 $= 12.16$

12.2

(Total for Question 24 is 4 marks)

TOTAL FOR PAPER IS 80 MARKS