

Answer **all** the questions.

- 1 Expand and simplify $(2p + 5q)(3p^2 - q + 5r)$.

$$6p^3 - 2pq + 10pr + 15p^2q - 5q^2 + 25qr$$

B2 if all terms are correct
B1 if at least 3 terms are right

Answer [2]

- 2 Lee has two pieces of string.
Their lengths are in the ratio 5 : 3 and the total length of the two pieces of string is 8x cm.
Lee cuts 6 cm from each piece of string.
The ratio of their lengths is now 9 : 5.
Find the value of x. the first piece of string be 5x cm.

The first piece of string is 5x cm.

The second piece of string is 3x cm.

$$\frac{5x - 6}{3x - 6} = \frac{9}{5}$$

$$25x - 30 = 27x - 54$$

$$24 = 2x$$

$$x = 12$$

M1 for setting up the right equation

M1 for manipulation of algebraic terms

A1

Answer $x =$ [3]

- 3 A salesperson earns a fixed weekly salary of \$1000 plus 8% commission on the total value of items he sells.

- (a) In one week, he sold items worth \$1750.
Calculate the total amount the salesperson earned that week.

$$\begin{aligned} \text{Total amount} &= \$1000 + \frac{8}{100} \times 1750 \\ &= \$1140 \end{aligned}$$

B1

Answer \$..... [1]

- (b) The following week, the salesperson earned a total of \$1450.
Calculate the total value of items he sold that week.

$$\begin{aligned}\text{Commission} &= \$1450 - \$1000 \\ &= \$450\end{aligned}$$

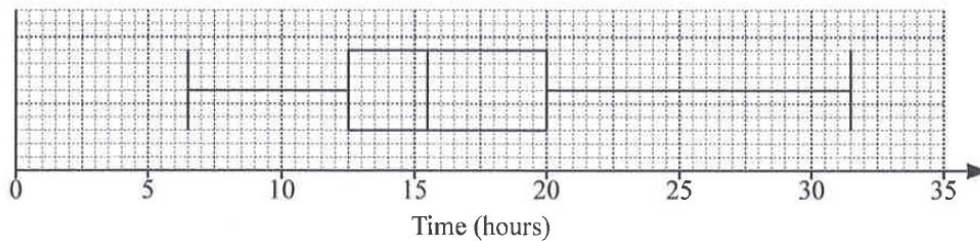
8% represents \$450

M1 for recognising that 8% rep \$450

$$\begin{aligned}100\% \text{ represents } & \$ \frac{450}{8} \times 100 \\ & = \$5625\end{aligned}$$

A1

- 4 The box-and-whisker-plot gives information about the time, in hours, that 120 adults spent on social media in one week.



- (a) State the median time.

15.5 hours

B1

Answerhours [1]

- (b) State the range.

$$\begin{aligned}\text{Range} &= 31.5 - 6.5 \\ &= 25\end{aligned}$$

B1

Answer hours [1]

- (c) There was an error in the collection of data.

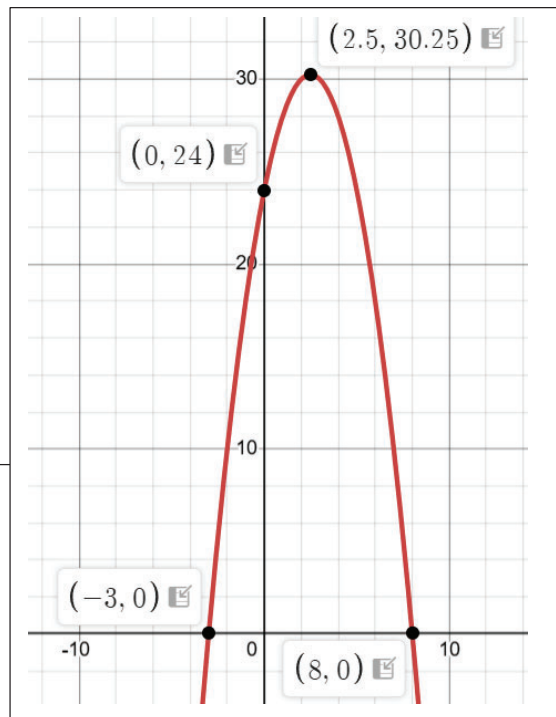
Every adult spent 2 hours less on social media in one week.

Describe the effect this change would have on the box-and-whisker plot.

The whole box-and-whisker plot will move to the **left** by **4 square units**.

B1 all key words must be present

- 5 Sketch the graph of $y = -(x+8)(x-3)$ on the axes below.
Indicate clearly the values where the graph crosses the x - and y - axes.



[3]

Coor of turning point (2.5, 30.25)

B1 correct shape and y -intercept
B1 correct turning point
B1 correct x -intercepts

- 6 Express as a single fraction in its simplest form $\frac{4}{3-2y} - \frac{5}{y+3}$.

$$\begin{aligned} & \frac{4}{3-2y} - \frac{5}{y+3} \\ &= \frac{4y+12-15+10y}{(3-2y)(y+3)} \\ &= \frac{14y-3}{(3-2y)(y+3)} \end{aligned}$$

M1 for combining to a single fraction

A1

Answer [2]

- 7 (a) A map has a scale of 1 : 2 500 000.

The distance between Singapore and Phuket is 1314 km.
Calculate the distance, in centimetres, between Singapore and Phuket on the map.

25 km represents 1 cm
1314 km represents **52.56 cm**

M1 for correctly converting from cm to km

A1, exact answer only

Answercm [2]

- (b) When a ball is dropped, the distance, d metres, it falls is directly proportional to the square of the time, t seconds, from when the ball is released.
The distance from which the ball is dropped is increased by 44%.
Calculate the percentage change in the time taken for the ball to reach the ground.

d	t^2
$1.44 d$	$(1.2t)^2 = 1.44 t^2$

M1 for getting $1.2^2 t^2$ or $1.2t$ as t

$$\begin{aligned}\text{Percentage change} &= \frac{1.2t - t}{t} \times 100\% \\ &= 20\%\end{aligned}$$

A1

Answer% [2]

- 8 Simplify $\frac{x^2 - 9}{3x^2 - 9x}$

$$\begin{aligned}\frac{x^2 - 9}{3x^2 - 9x} \\ &= \frac{(x-3)(x+3)}{3x(x-3)} \\ &= \frac{x+3}{3x}\end{aligned}$$

B2, factorising numerator and denominator correctly

A1

Answer [3]

- 9 Factorise $6x^2y^2 + xy - 3x^2y - 2xy^2$.

$$\begin{aligned}
 &6x^2y^2 + xy - 3x^2y - 2xy^2 \\
 &= xy(6xy + 1 - 3x - 2y) \\
 &= xy(6xy - 3x + 1 - 2y) \\
 &= xy[3x(2y - 1) - (2y - 1)] \\
 &= xy(3x - 1)(2y - 1)
 \end{aligned}$$

M1 for extracting common term

M1 for factorising by grouping

A1

Answer [3]

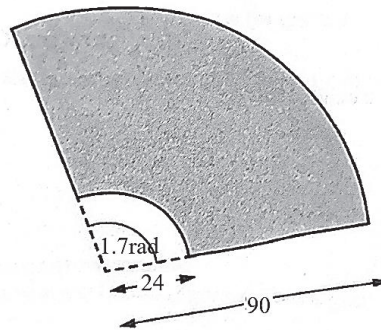
- 10 Five positive integers have a mean of 6, a median of 7 and a mode of 10. Find the five numbers.

1, 2, 7, 10, 10

B2 for getting all the numbers correct
right
B1 if for getting 7, 10, 10

Answer,,,, [2]

11



Calculate the perimeter of the shaded area.
All lengths are in centimetres.

$$\text{Perimeter of shaded area} = 1.7 \times 24 + 1.7 \times 90 + 2(66)$$

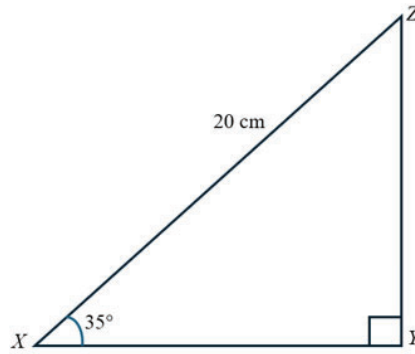
M1 for setting up the equation correctly

$$= 325.8 \text{ cm}$$

A1, exact so do not accept 3 s.f ans

..... cm [2]

12



- (a) Calculate the distance YZ .

$$\sin 35^\circ = \frac{YZ}{20}$$

M1 for setting up the correct equation

$$YZ = 20 \sin 35^\circ$$

$$= 11.472 \text{ cm}$$

$$= 11.5 \text{ cm (3 s.f.)}$$

A1

Answer $YZ = \dots\dots\dots \text{cm}$ [2]

- (b) Calculate the area of triangle XYZ .

$$\cos 35^\circ = \frac{XY}{20}$$

$$XY = 20 \cos 35^\circ$$

$$= 16.383 \text{ cm}$$

$$= 16.4 \text{ cm (3 s.f.)}$$

M1 for finding XY

$$\begin{aligned} \text{Area of triangle } XYZ &= \\ &= 94.0 \text{ cm}^2 \end{aligned}$$

A1

Alternative solution

$$\angle XZY = 55^\circ$$

M1 for finding
angle XZY

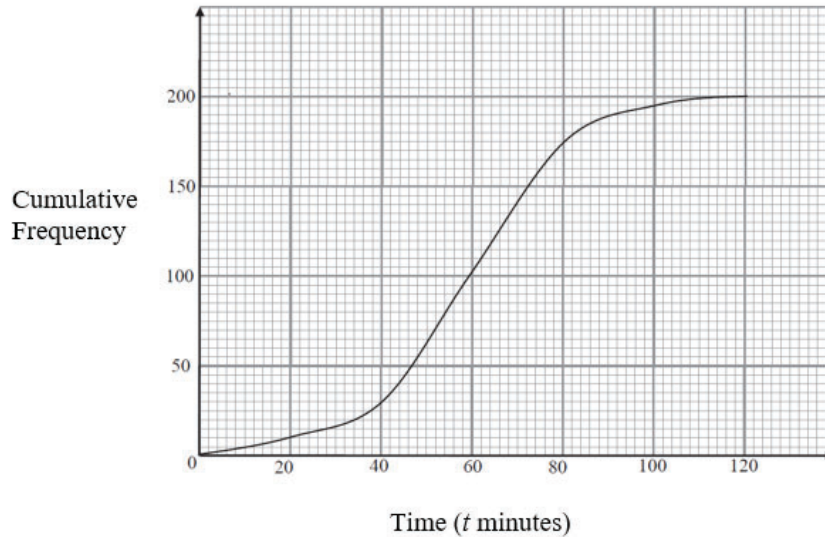
$$\text{Area of triangle} = \frac{1}{2} \times (20)(11.472) \sin 55^\circ$$

$$= 94.0 \text{ cm}^2$$

A1

Answer $\dots\dots\dots \text{cm}^2$ [2]

- 13 A group of 200 people estimated the time, t minutes, they spent at an exhibition. The cumulative frequency diagram represents their estimates.



- (a) Use the diagram to find the estimated interquartile range of the estimated times.

$$\text{Interquartile range} = 72 - 47$$

$$= 25 \text{ minutes}$$

M1 for finding the UQ and LQ

A1

Answerminutes [2]

- (b) One of these people is chosen at random.

The probability that the person's estimate is greater than t minutes is $\frac{4}{5}$.

Find the value of t .

Probability of a person's estimate less than or equal to t minutes is $\frac{1}{5}$.

Number of people = 40

From graph, $t = 44$

M1 for 40

A1

Answer $t =$ [2]

14

$$n = \frac{m(x - y^2)}{p}, \text{ where } p \neq 0.$$

(a) Find n when $m = 14$, $p = 9$, $x = 2$ and $y = -3$.

$$\begin{aligned} n &= \frac{14(2 - 9)}{9} \\ n &= \frac{14(2 - 9)}{9} \\ &= -10\frac{8}{9} \text{ or } -\frac{98}{9} \end{aligned}$$

A1, exact value, hence do not accept answers corrected to 3 s.f

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

(b) Rearrange the formula to make y the subject.

$$n = \frac{m(x - y^2)}{p}$$

$$np = mx - my^2$$

$$my^2 = mx - np$$

$$y^2 = \frac{mx - np}{m}$$

$$y = \pm \sqrt{\frac{mx - np}{m}} \text{ or } \pm \sqrt{x - \frac{pn}{m}}$$

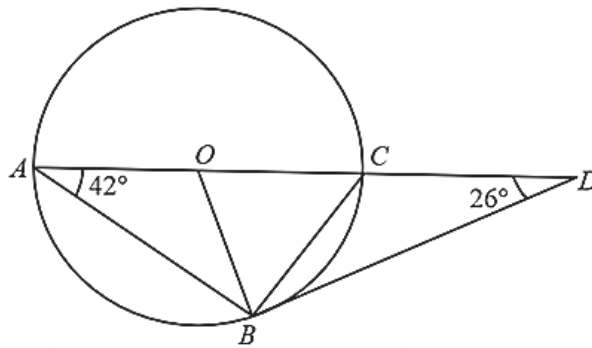
M1 for multiplying n by p

M1 for finding y^2

A1, no marks if $\pm$ is not seen

Answer $y = \dots\dots\dots$ [3]

15



A, B and C are points on a circle, centre O .
 ACD is a straight line, angle $BDC = 26^\circ$ and angle $BAO = 42^\circ$.

- (a) Find angle OBC .
 Give a reason for each step of your working.

Minus 1 mark if no
 mention of radii or
 radius of circle

$$\begin{aligned}
 OA &= OB \text{ (radii of a circle)} \\
 \angle OBA &= 42^\circ \text{ (base angle of isosceles triangle } OAB) \\
 \angle ABC &= 90^\circ \text{ (angle in a semicircle)} \\
 \angle OBC &= 90^\circ - 42^\circ \\
 &= 48^\circ
 \end{aligned}$$

A1

M1 for finding
 either finding
 angle OBA or
 angle ABC

- (b) Explain why BD is **not** a tangent to the circle.

$$\begin{aligned}
 \angle BOC &= 84^\circ \text{ (ext angle of isosceles triangle } OBC) \\
 \angle OBD &= 180^\circ - 84^\circ - 26^\circ \text{ (sum of angles in a triangle)} \\
 &= 70^\circ
 \end{aligned}$$

M1 for finding
 angle OBD

Since $\angle OBD \neq 90^\circ$, therefore by the converse of the
 radius perpendicular to tangent, BD is not a tangent to the circle.

A1 stating it's not 90° with (by converse) tangent
 $\perp$ radius

Alternative solution

$$\begin{aligned}
 \angle BOC &= 84^\circ \text{ (angle at centre} = 2 \text{ angle at circumference)} \\
 \angle OBD &= 180^\circ - 84^\circ - 26^\circ \text{ (sum of angles in a triangle)} \\
 &= 70^\circ
 \end{aligned}$$

M1 for finding
 angle OBD

Since $\angle OBD \neq 90^\circ$, therefore by the converse of the radius perpendicular to
 tangent, BD is not a tangent to the circle.

A1 stating it's not 90° with (by converse) tangent $\perp$ radius

16 Solve these simultaneous equations.

$$3x + 5y + 8 = 0$$

$$4x + 13y - 2 = 0$$

You must show your working.

$$3x + 5y + 8 = 0 \quad -(1)$$

$$4x + 13y - 2 = 0 \quad -(2)$$

$$(1) \times 4 \quad 12x + 20y + 32 = 0 \quad -(3)$$

$$(2) \times 3 \quad 12x + 39y - 6 = 0 \quad -(4)$$

$$(4) - (3) \quad 19y - 38 = 0$$

$$y = 2$$

Sub $y = 2$ into (1)

$$3x + 10 + 8 = 0$$

$$3x = -18$$

$$x = -6$$

$$\text{Ans : } x = -6 \text{ or } y = 2$$

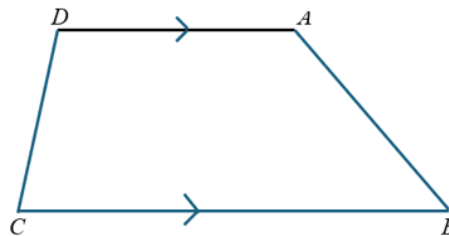
M1 for making coeff of x or y the same/ M1 for making x or y the subject of the equation

M1 for eliminating x or y / M1 for correct substitution

A1 for getting both x and y correct

Answer $x = \dots\dots\dots$
 $y = \dots\dots\dots$ [3]

17



$ABCD$ is a trapezium.

The ratio angle CDA : angle DCB : angle $CBA = 18 : 6 : 2$.

Find angle DAB .

24 units represent 180°

1 unit represents 7.5°

2 units represent 15°

$$\begin{aligned} \angle DAB &= 180^\circ - 15^\circ \text{ (int angles, } AB \parallel BC) \\ &= 165^\circ \end{aligned}$$

M1 for recognising that angle CDA and DCB are int angles.
 It is good practice to write the angle reasoning so that markers understand your work.

M1 for either applying int angles or sum of angles in quad correctly

A1

Note: Answer mark is deducted if there is no clear indication of the unit of measure used throughout the entire working.

Answer Angle $DAB = \dots\dots\dots$ [3]

- 18** Alice borrowed a sum of money from the bank which charges a compound interest of 3.5% per annum, compounded quarterly.
Given that Alice had to pay \$67.30 in interest at the end of the first year, find the original sum of money borrowed, giving your answer correct to the nearest dollar.

Let the original sum of money Alice borrowed be \$ P .

$$P + 67.30 = P \left(1 + \frac{0.875}{100} \right)^4$$

M1 for setting up the correct equation

$$67.30 = P \left(1 + \frac{0.875}{100} \right)^4 - P$$

$$67.30 = P \left[\left(1 + \frac{0.875}{100} \right)^4 - 1 \right]$$

M1 for factorising, only awarded if original set up has total = principal + interest.

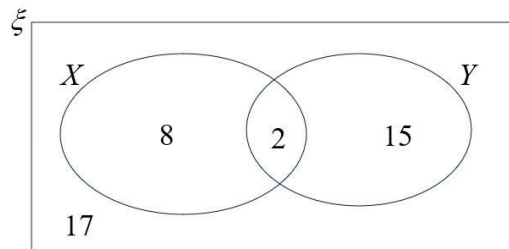
$$P = \frac{67.30}{\left[\left(1 + \frac{0.875}{100} \right)^4 - 1 \right]}$$

$$P = \$1898 \text{ (nearest dollar)}$$

A1

Answer \$ [3]

- 19** The Venn diagram shows the universal set and the number of elements in each of its subsets.



Find the value of

(a) $n(X' \cap Y)'$,

$$= 17 + 8 + 2 = 27$$

B1

Answer [1]

(b) $n((X' \cup Y) \cap (X \cup Y)')$.

$$= 17$$

B1

Answer [1]

- 20 (a) Write 0.0000000357 in standard form.

$$3.57 \times 10^{-8}$$

B1

Answer [1]

- (b) (i) Write 5.7×10^{97} in the form $A \times 10^{98}$.

$$= 0.57 \times 10^{98}$$

B1

Answer [1]

- (ii) Hence work out $((100.2 \times 10^{98}) - (5.7 \times 10^{97}))$.

Give your answer in standard form.

$$(100.2 \times 10^{98}) - (0.57 \times 10^{98})$$

$$= 99.63 \times 10^{98}$$

$$= 9.963 \times 10^{99}$$

B1

Answer [1]

- 21 x is a number between 200 and 300.

The highest common factor of x and 126 is 21.

Find the smallest possible value of x .

$$126 = 2 \times 3^2 \times 7$$

$$\text{HCF} = 3 \times 7$$

$$x = 3 \times 7 \times 11$$

$$= 231$$

M1 for writing 126 in terms of its prime factors

A1

Answer $x =$ [2]

22

$$\sin\left(\frac{1}{2}x^\circ\right) = 0.961$$

Find two possible values of x in the range $0 \leq x \leq 360$.

$$\sin\left(\frac{1}{2}x^\circ\right) = 0.961$$

$$\frac{1}{2}x^\circ = 73.946^\circ, 180^\circ - 73.946^\circ$$

$$x^\circ = 147.9^\circ \text{ or } 212.1^\circ$$

B1, B1

Note: 1 mark is deducted if both answers are left to 3 significant figures. Students are to follow instructions on cover page.

23

12 24 8 21 28 17 $2p$ $4p^2$

The list shows information about the number of text messages Mei received each day for 8 days.

The total number of text messages is 140.

(a) Show that $p = 2.5$.

Answer

$$12 + 24 + 8 + 21 + 28 + 17 + 2p + 4p^2 = 0$$

$$4p^2 + 2p + 110 = 140$$

$$2p^2 + p - 15 = 0$$

$$(p+3)(2p-5) = 0$$

$$p+3 = 0 \text{ or } 2p-5 = 0$$

$$p = -3 \text{ (rej bec } p > 0) \text{ or } p = 2.5 \text{ (shown)}$$

M1 for showing the correct set up of equation

M1 for correct factorisation or correct application of quadratic formula

M1 for applying zero product rule and sound rejection reason.

[3]

(b) The standard deviation for Mei's data is 7.89.

For the same 8 days, Mei's brother also received some text messages.

For his data, the mean is 19 and the standard deviation 8.51.

Make two comparisons between the distributions for the number of text messages received by Mei and her brother.

1. Mei's brother received **more text messages** on average because the **mean is higher** at 19 compared to Mei's mean which is 17.5.

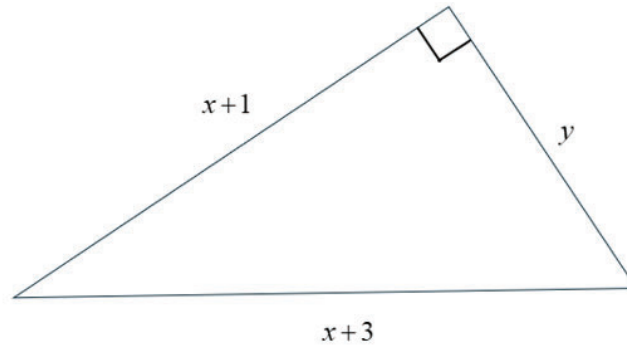
B1

2. The **number of text messages** Mei's brother received **is less consistent** since the **standard deviation is higher** at 8.51 compared to Mei's which is 7.89.

B1

[2]

24



The right-angled triangle has sides $(x+1)$, $(x+3)$ and y where x and y are integers.

- (a) Show that y is an even number.

Answer

$$\begin{aligned} y^2 &= (x+3)^2 - (x+1)^2 \\ &= x^2 + 6x + 9 - (x^2 + 2x + 1) \\ &= 4x + 8 \\ &= 4(x+2) \end{aligned}$$

M1 for setting up the correct equation

M1 for correct expansion/applying difference of squares to reach $4x+8$

Since 4 is even, multiplying it by $(x+2)$, an integer, will make y^2 even.

Taking square root of an even number gives an even number.

Therefore y even. (shown)

M1 for convincingly establishing y^2 is even.

A1 for stating that the square root of an even number must be even and concluding for y .

OR

$$\begin{aligned} y^2 &= 4(x+2) \\ y &= 2\sqrt{x+2} \end{aligned}$$

Since y is an integer, $\sqrt{x+2}$ must be an integer.
As such, 2 is a factor of y , therefore y is even.

M1 correct y .

A1 for stating that $\sqrt{x+2}$ is an integer and therefore 2 is a factor. Proper conclusion for y .

[4]

- (b) Find a possible value of y and the corresponding value of x .

$$\begin{aligned} \text{Let } y^2 &= 16^2 \\ \therefore y &= 4 \\ \text{Hence } 4x + 8 &= 16 \\ x &= 2 \end{aligned}$$

B1: accept any logical y , where y^2 is a multiple of 4

B1

Answer $x = \dots\dots\dots y = \dots\dots\dots$ [2]

-
- 25** Solve the equation $a^2 + 17a - 30 = 0$ by completing the square.
Give your solutions correct to 2 decimal places.

$$a^2 + 17a - 30 = 0$$

$$\left(a + \frac{17}{2}\right)^2 - \left(\frac{17}{2}\right)^2 - 30 = 0$$

M1 for completing the square correctly
--

$$\left(a + \frac{17}{2}\right)^2 = \left(\frac{17}{2}\right)^2 + 30$$

$$\left(a + \frac{17}{2}\right)^2 = 102.25$$

$$a + \frac{17}{2} = \pm\sqrt{102.25}$$

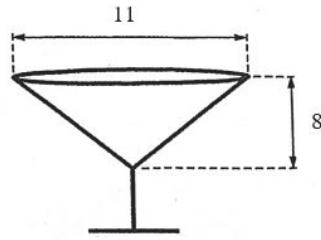
M1 for taking square root

$$a = 1.61 \text{ or } -18.61 \text{ (2 d.p.)}$$

A1 for both correct answers

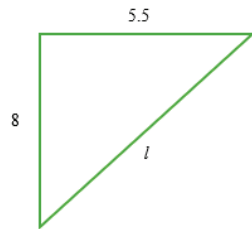
Answer $a = \dots\dots\dots$ or $a = \dots\dots\dots$ [3]

26



A glass is in the shape of a cone on a stem is filled to the brim with water.
 The diameter of the top of the glass is 11 cm.
 The height of the cone is 8 cm.
 The thickness of the glass is negligible.

(a) Calculate the curved surface area of the inside of the glass.



$$\begin{aligned} l^2 &= 5.5^2 + 8^2 \\ &= 94.25 \\ l &= \sqrt{94.25} \end{aligned}$$

M1 for finding the slant height of the cone

$$\begin{aligned} \text{Curved surface area of the inside of the glass} &= \pi(5.5)(\sqrt{94.25}) \\ &= 168 \text{ cm}^2 \text{ (3s.f.)} \end{aligned}$$

A1

Answer cm² [2]

- (b) Ethan pours 40% of the water in this glass into a second glass.
 The second glass is in the shape of a cylinder.
 The depth of water in the cylindrical glass is 2.5 cm.
 Calculate the diameter of the cylindrical glass.

$$\begin{aligned}\text{Volume of water in the glass} &= \frac{1}{3} \times \pi \times 5.5^2 \times 8 \\ &= 80\frac{2}{3}\pi\text{cm}^3\end{aligned}$$

M1 for finding the vol of water in the glass

$$\pi r^2 (2.5) = 80\frac{2}{3}\pi \times 0.4$$

M1 for correct formula of volume of cylinder and taking 40% of their volume of cone.

$$r^2 = \frac{80\frac{2}{3} \times 0.4}{2.5}$$

$$r = \sqrt{\frac{80\frac{2}{3} \times 0.4}{2.5}}$$

M1 for correct r

$$\text{diameter} = 2r$$

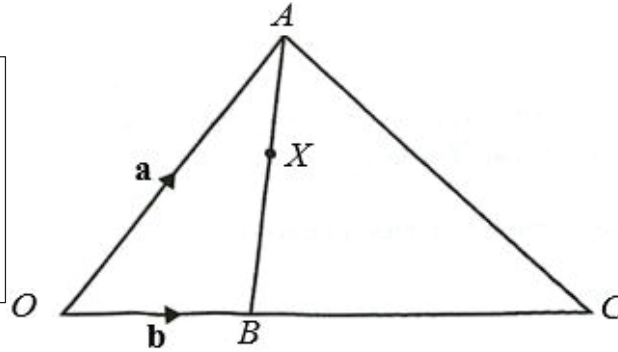
$$\begin{aligned}&= 2 \times \sqrt{\frac{80\frac{2}{3} \times 0.4}{2.5}} \\ &= 7.19 \text{ cm (3 s.f.)}\end{aligned}$$

A1

Answer cm [4]

27

Note: 1 mark is deducted from overall of this question if students did not use proper vector notations.



OAC is a triangle and B is a point on OC .

$\overrightarrow{OA} = \mathbf{a}$, $\overrightarrow{OB} = \mathbf{b}$ and $OB:BC = 2:3$.

X is the point on AB such that $AX:XB = 1:2$.

- (a) Express $\overrightarrow{AC}$ in terms of $\mathbf{a}$ and $\mathbf{b}$, as simply as possible.

$$\overrightarrow{OC} = 2.5\mathbf{b}$$

$$\overrightarrow{AC} = 2.5\mathbf{b} - \mathbf{a}$$

M1 for correct $\overrightarrow{OC}$ in terms of $\mathbf{b}$

A1

Answer $\overrightarrow{AC} = \dots\dots\dots$ [2]

- (b) Express $\overrightarrow{XB}$ in terms of $\mathbf{a}$ and $\mathbf{b}$, as simply as possible.

$$\overrightarrow{AB} = \mathbf{b} - \mathbf{a}$$

$$\overrightarrow{XB} = \frac{2}{3}(\mathbf{b} - \mathbf{a})$$

M1 for correct $\overrightarrow{AB}$ in terms of $\mathbf{a}$ and $\mathbf{b}$

A1

Answer $\overrightarrow{XB} = \dots\dots\dots$ [2]

- (c) Y is the point on OC such that $AXYC$ is a trapezium.

Find, in terms of $\mathbf{a}$ and $\mathbf{b}$, $\overrightarrow{XY}$.

For $AXYC$ to be a trapezium, triangle BXY is similar to triangle BAC .

$$\frac{XY}{AC} = \frac{BX}{BA} = \frac{2}{3}$$

$$\overrightarrow{XY} = \frac{2}{3}\overrightarrow{AC}$$

$$= \frac{2}{3}\left(\frac{5}{2}\mathbf{b} - \mathbf{a}\right)$$

$$= \frac{5}{3}\mathbf{b} - \frac{2}{3}\mathbf{a}$$

M1 for identifying triangle BXY to be similar to triangle BAC

A1

$\overrightarrow{XY} = \dots\dots\dots$ [2]

END OF PAPER

Setter: Low SG