

- 1 A sprinter runs a distance of 200 metres in 25 seconds.
Work out the average speed of the sprinter.

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$= \frac{200}{25} = 8 \text{ m/s}$$

..... 8 m/s

(Total for question 1 is 1 mark)

- 2 A block exerts a force of 120 Newtons on the ground.
The block has an area of 2 m².

Work out the pressure on the ground.

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

$$\text{pressure} = \frac{120}{2} = 60 \text{ N/m}^2$$

..... 60 N/m²

(Total for question 2 is 1 mark)

- 3 A piece of gold has a mass of 760 grams and a volume of 40 cm³.
Work out the density of the piece of gold.

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

$$= \frac{760}{40} = 19 \text{ g/cm}^3$$

..... 19 g/cm³

(Total for question 3 is 1 mark)

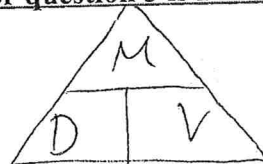
- 4 A rock has a mass of 56 grams and a density of 3.5 grams/cm³.
Work out the volume of the rock.

$$\text{volume} = \frac{\text{mass}}{\text{density}}$$

$$= \frac{56}{3.5} = \frac{112}{7} = 16 \text{ cm}^3$$

..... 16 cm³

(Total for question 4 is 1 mark)



5

A car travels a distance of 230 miles in 4 hours and 15 minutes.
Work out the average speed of the car, in miles per hour.
Give your answer to 1 decimal place.

4.25 hours

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$= \frac{230}{4.25}$$

$$= 54.1 \text{ mph}$$

..... 54.1 miles/hour

(Total for question 5 is 2 marks)

6

A block exerts a force of 84 Newtons on a table.
The pressure on the table is 30 N/m^2 .

Work out the area of the box that is in contact with the table.

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

$$= \frac{84}{30} = 2.8 \text{ m}^2$$

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

..... 2.8 m^2

(Total for question 6 is 2 marks)

7

A liquid has a density of 1.3 grams per ml.
Find the mass of 250 ml of the liquid.

$$\begin{aligned} \text{mass} &= \text{density} \times \text{volume} \\ &= 1.3 \times 250 \\ &= 325 \text{ g} \end{aligned}$$

..... 325 g

(Total for question 7 is 1 mark)

8

Dani leaves her house at 08 00.
She drives 63 miles to work.
She drives at an average speed of 27 miles per hour.
At what time does Dani arrive at work?



$$\text{time} = \frac{\text{distance}}{\text{speed}}$$

$$= \frac{63}{27}$$

$$= 2.3 \text{ hours}$$

$$= 2 \text{ hours } 20 \text{ mins}$$

..... 10:20

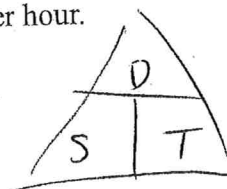
(Total for question 8 is 2 marks)

9

Anthony travels from Newcastle to Manchester at an average speed of 65 miles per hour. The journey takes him 2 hours and 15 minutes. 2.25 hours

Declan makes the same journey in 2 hours and 35 minutes.

(a) Work out Declan's average speed for the journey.



Anthony:
$$\begin{aligned} \text{distance} &= \text{speed} \times \text{time} \\ &= 65 \times 2.25 \\ &= \underline{146.25 \text{ miles}} \end{aligned}$$

Declan:
$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$= \frac{146.25}{2.58\dot{3}}$$

$$= 56.6 \text{ miles/hour (1dp)}$$

2hrs 35 mins

$$\frac{35}{60} = 0.58\dot{3} \text{ or } \frac{7}{12}$$

56.6 mph

(4)

took a different route for could
(b) If Declan stopped for a break during his journey, how would this affect your answer to part (a)?

The ans. If the distance was increased
the speed would be higher.

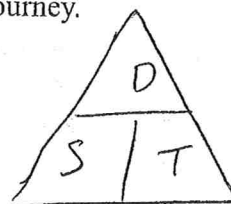
(If the distance decreased the speed would be lower) (1)

(Total for question 9 is 5 marks)

10

Rachel drives 300 miles from London to Newcastle.
 She drives the first 165 miles at an average speed of 60 mph.
 From this point it takes Rachel 3 hours and 15 minutes to complete her journey.

What was Rachel's average speed for the whole journey?



FIRST 165 MILES

$$\text{time} = \frac{\text{distance}}{\text{speed}}$$

$$= \frac{165}{60} = 2.75 \text{ hours}$$

$$= 2 \text{ hours } 45 \text{ mins}$$

$$2 \text{ hours } 45 + 3 \text{ hours } 15 = 6 \text{ hours}$$

~~135 MILES LEFT~~

$$\text{average speed} = \frac{\text{total distance}}{\text{total time}}$$

$$= \frac{300}{6}$$

$$= 50 \text{ mph}$$

50

..... mph

(Total for question 10 is 4 marks)

11 Andrew ran 3.1 miles in 14 minutes and 35 seconds.

He assumes he can run 8 miles at the same speed.

(a) Work out how long it would take Andrew to run 8 miles.

Give your answer in minutes and seconds to the nearest second.

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$= \frac{3.1}{14.58\dot{3}}$$

$$= 0.21257... \text{ miles/min}$$

$$14 \text{ mins } 35 \text{ secs} \\ = 14.58\dot{3} \text{ mins}$$

~~$$\text{distance} = \text{speed} \times \text{time}$$~~

$$\text{time} = \frac{\text{distance}}{\text{speed}}$$

$$= \frac{8}{0.21257} = 37 \text{ mins } 38 \text{ sec}$$

$$\dots\dots\dots 37 \dots\dots\dots \text{ mins } \dots\dots\dots 38 \dots\dots\dots \text{ secs} \\ (4)$$

Andrew's speed actually decreases the further he goes.

(b) How does this affect your answer to part (a)?

It would take longer to run 8 miles
(the answer would be higher.) (1)

(Total for question 11 is 5 marks)

12 Liquid A has a density of 1.2 g/cm^3

150 cm^3 of Liquid A is mixed with some of Liquid B to make Liquid C.

Liquid C has a mass of 210 g and a density of 1.12 g/cm^3

Find the density of Liquid B.



$$\begin{aligned}\text{Liquid A: mass} &= \text{density} \times \text{volume} \\ &= 1.2 \times 150 \\ &= 180 \text{ g}\end{aligned}$$

$$\begin{aligned}\text{Liquid C volume} &= \frac{\text{mass}}{\text{density}} \\ &= \frac{210}{1.12} \\ &= 187.5 \text{ cm}^3\end{aligned}$$

$$\begin{aligned}\text{Liquid B volume} &= \text{Liquid C} - \text{Liquid A} \\ &= 187.5 - 150 \\ &= 37.5 \text{ cm}^3\end{aligned}$$

$$\begin{aligned}\text{Liquid B mass} &= \text{Liquid C} - \text{Liquid A} \\ &= 210 - \cancel{150} - 180 \\ &= 30 \text{ g}\end{aligned}$$

$$\text{Liquid B density} = \frac{\text{mass}}{\text{volume}} = \frac{30}{37.5} = 0.8$$

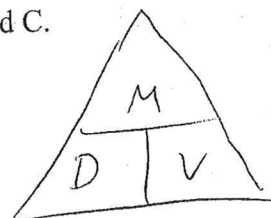
..... 0.8 g/cm^3

(Total for question 12 is 3 marks)

13

100ml of liquid A and 200ml of liquid B are mixed together to make liquid C.
 Liquid A has a density of 0.7g/ml.
 Liquid B has a density of 1.1 g/ml.

Work the density of liquid C.



$$\begin{aligned} \text{Liquid A: } \text{mass} &= \text{density} \times \text{volume} \\ &= 0.7 \times 100 \\ &= 70 \text{ g} \end{aligned}$$

$$\begin{aligned} \text{Liquid B: } \text{mass} &= 1.1 \times 200 \\ &= 220 \text{ g} \end{aligned}$$

$$\begin{aligned} \text{Liquid C density} &= \frac{\text{total mass}}{\text{total volume}} \\ &= \frac{70 + 220}{100 + 200} \\ &= \frac{290}{300} \\ &= 0.96 \text{ g/ml} \end{aligned}$$

..... 0.96 g/ml

(Total for question 13 is 4 marks)

$$\left[\frac{29}{30} \right]$$

- 1 The number of rabbits in a field t days from now is P_t where

$$P_0 = 220$$

$$P_{t+1} = 1.15(P_t - 20)$$

Work out the number of rabbits in the garden 3 days from now.

$$P_1 = 1.15(220 - 20) = 230$$

$$P_2 = 1.15(\text{Ans} - 20) = 242$$

$$P_3 = 1.15(\text{Ans} - 20) = 255$$

nearest
integer

255

(Total for question 1 is 3 marks)

- 2 The number of people living in a town t years from now is P_t where

$$P_0 = 55000$$

$$P_{t+1} = 1.03(P_t - 800)$$

Work out the number of people in the town 3 years from now.

$$P_1 = 1.03(55000 - 800) = 55826$$

$$P_2 = 1.03(\text{Ans} - 800) = 56677$$

$$P_3 = 1.03(\text{Ans} - 800) = 57553$$

(nearest integer)

57553

(Total for question 2 is 3 marks)

3 Using $x_{n+1} = 3 + \frac{9}{x_n^2}$

With $x_0 = 3$

Find the values of x_1, x_2 and x_3 .

$$x_1 = 3 + \frac{9}{(3)^2} = 4$$

$$x_2 = 3 + \frac{9}{(\text{Ans})^2} = 3.5625$$

$$x_3 = 3 + \frac{9}{(\text{Ans})^2} = 3.709141274$$

$$x_1 = \underline{\underline{4}}$$

$$x_2 = \underline{\underline{3.5625}}$$

$$x_3 = \underline{\underline{3.709141274}}$$

(Total for question 3 is 3 marks)

4 Using $x_{n+1} = \frac{5}{x_n^2 + 3}$

With $x_0 = 1$

Find the values of x_1, x_2 and x_3 .

$$x_1 = \frac{5}{(1)^2 + 3} = 1.25$$

$$x_2 = \frac{5}{(\text{Ans})^2 + 3} = 1.095890411$$

$$x_3 = \frac{5}{(\text{Ans})^2 + 3} = 1.190199669$$

$$x_1 = \underline{\underline{1.25}}$$

$$x_2 = \underline{\underline{1.095890411}}$$

$$x_3 = \underline{\underline{1.190199669}}$$

(Total for question 4 is 3 marks)

- 5 Starting with $x_0 = 3$, use the iteration formula $x_{n+1} = \frac{7}{x_n^2} + 2$ three times to find an estimate for the solution to $x^3 - 2x^2 = 7$

$$x_1 = \frac{7}{(3)^2} + 2 = \frac{25}{9}$$

$$x_2 = \frac{7}{(\text{Ans})^2} + 2 = 2.9072$$

$$x_3 = \frac{7}{(\text{Ans})^2} + 2 = 2.82822478$$

2.82822478

(Total for question 5 is 3 marks)

- 6 Starting with $x_0 = 0$, use the iteration formula $x_{n+1} = \frac{2}{x_n^2 + 3}$ three times to find an estimate for the solution to $x^3 + 3x = 2$

$$x_1 = \frac{2}{(0)^2 + 3} = \frac{2}{3}$$

$$x_2 = \frac{2}{(\text{Ans})^2 + 3} = \frac{18}{31}$$

$$x_3 = \frac{2}{(\text{Ans})^2 + 3} = 0.5993140006$$

0.5993140006

(Total for question 6 is 3 marks)

7 Using $x_{n+1} = \frac{5}{x_n^2} + 2$

With $x_0 = 2.5$

(a) Find the values of x_1 , x_2 and x_3 .

$$x_1 = \frac{5}{(2.5)^2} + 2 = 2.8$$

$$x_2 = \frac{5}{(\text{Ans})^2} + 2 = 2.637755102$$

$$x_3 = \frac{5}{(\text{Ans})^2} + 2 = 2.718622914$$

$$x_1 = \underline{2.8}$$

$$x_2 = \underline{2.637755102}$$

$$x_3 = \underline{2.718622914}$$

(3)

(b) Explain the relationship between the values of x_1 , x_2 and x_3 and the equation $x^3 - 2x^2 - 5 = 0$

$$x^2(x - 2) - 5 = 0$$

$$x^2(x - 2) = 5$$

$$x - 2 = \frac{5}{x^2}$$

$$x = \frac{5}{x^2} + 2$$

$x = \frac{5}{x^2} + 2$ is a rearrangement of $x^3 - 2x^2 - 5 = 0$

x_1 , x_2 and x_3 are estimates of the solution to $x^3 - 2x^2 - 5 = 0$

(2)

(Total for question 7 is 5 marks)

- 8 (a) Show that the equation $2x^3 - x^2 - 3 = 0$ has a solution between $x = 1$ and $x = 2$.

$$\text{when } x = 1 \quad 2(1)^3 - (1)^2 - 3 = -2$$

$$\text{when } x = 2 \quad 2(2)^3 - (2)^2 - 3 = 9$$

one positive and one negative \therefore solution between 1 and 2.

(2)

- (b) Show that the equation $2x^3 - x^2 - 3 = 0$ can be rearranged to give: $x = \sqrt{\frac{3}{2x-1}}$

$$x^2(2x-1) - 3 = 0$$

$$x^2(2x-1) = 3$$

$$x^2 = \frac{3}{2x-1}$$

$$x = \sqrt{\frac{3}{2x-1}}$$

(1)

- (c) Starting with $x_0 = 1$, use the iteration formula $x_{n+1} = \sqrt{\frac{3}{2x_n-1}}$ twice to find an estimate for the solution to $2x^3 - x^2 - 3 = 0$

$$x_1 = \sqrt{\frac{3}{2(1)-1}} = \sqrt{3}$$

$$x_2 = \sqrt{\frac{3}{2(\text{Ans})-1}} = 1.103395785$$

1.103395785

(3)

(Total for question 8 is 6 marks)

9 Using $x_{n+1} = 1 + \frac{1}{x_n^2}$

With $x_0 = 2$

(a) Find the values of x_1 , x_2 and x_3 .

$$x_1 = 1 + \frac{1}{(2)^2} = 1.25$$

$$x_2 = 1 + \frac{1}{(\text{Ans})^2} = 1.64$$

$$x_3 = 1 + \frac{1}{(\text{Ans})^2} = 1.371802499$$

$$x_1 = 1.25$$

$$x_2 = 1.64$$

$$x_3 = 1.371802499$$

(3)

(b) Explain the relationship between the values of x_1 , x_2 and x_3 and the equation $x^3 - x^2 - 1 = 0$

$$x^2(x-1) - 1 = 0$$

$$x^2(x-1) = 1$$

$$x-1 = \frac{1}{x^2}$$

$$x = 1 + \frac{1}{x^2}$$

$x = 1 + \frac{1}{x^2}$ is a rearrangement of $x^3 - x^2 - 1 = 0$.
 x_1 , x_2 and x_3 are estimates of a solution
to $x^3 - x^2 - 1 = 0$.

(2)

(Total for question 9 is 5 marks)

- 10 (a) Show that the equation $x^3 + 4x = 1$ has a solution between $x = 0$ and $x = 1$.

$$x^3 + 4x - 1 = 0$$

$$\text{when } x = 0 \quad (0)^3 + 4(0) - 1 = -1$$

$$x = 1 \quad (1)^3 + 4(1) - 1 = 4$$

one positive, one negative \therefore solution between 0 and 1

(2)

- (b) Show that the equation $x^3 + 4x = 1$ can be rearranged to give: $x = \frac{1}{4} - \frac{x^3}{4}$

$$4x = 1 - x^3$$

$$x = \frac{1}{4} - \frac{x^3}{4}$$

(1)

- (c) Starting with $x_0 = 0$, use the iteration formula $x_{n+1} = \frac{1}{4} - \frac{x_n^3}{4}$ twice to find an estimate for the solution to $x^3 + 4x = 1$

$$x_1 = \frac{1}{4} - \frac{(0)^3}{4} = 0.25$$

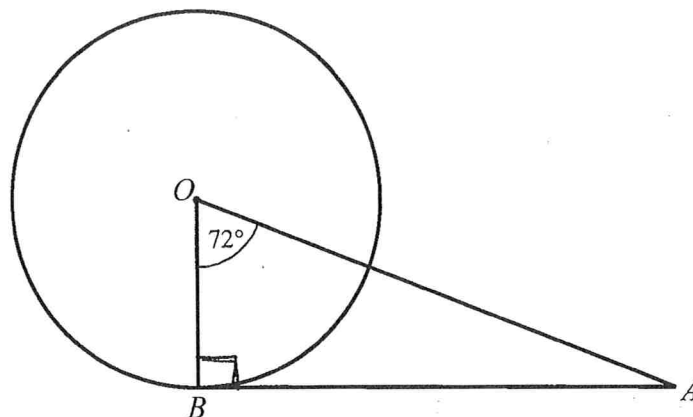
$$x_2 = \frac{1}{4} - \frac{(\text{Ans})^3}{4} = 0.24609375$$

$$\underline{0.24609375}$$

(3)

(Total for question 10 is 6 marks)

1



B is a point on the circumference of a circle, centre O .
 AB is a tangent to the circle.

Angle $BOA = 72^\circ$

Work out the size of angle BAO .
 You must show all your working.

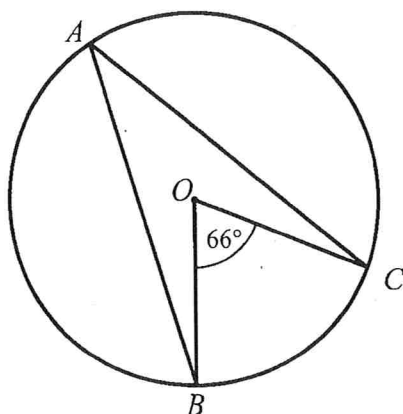
$$OBA = 90^\circ \quad \text{Tangent meets radius at } 90^\circ$$

$$BAO = 180 - 90 - 72 \quad \text{Angles in a triangle add to } 180^\circ$$

$$= \underline{\underline{18^\circ}} \quad 18^\circ$$

(Total for Question 1 is 2 marks)

2



A , B , C and D are points on the circumference of a circle.

Angle $BOC = 66^\circ$

(i) Find the size of angle BAC .

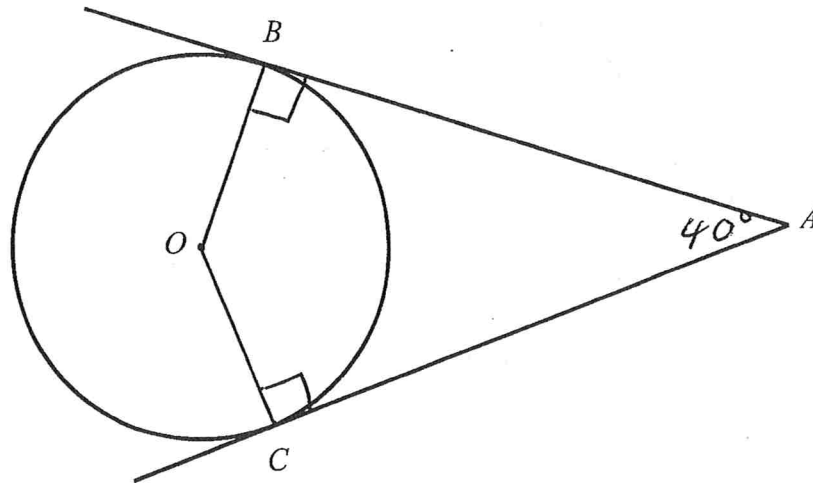
(ii) Give a reason for your answer.

33°

The angle at the circumference is half the angle at the centre

(Total for Question 2 is 2 marks)

3



B and C are points on a circle, centre O .
 AB and AC are tangents to the circle.

Angle $BAC = 40^\circ$

OBA and $OCA = 90^\circ$
 Tangent meets radius at 90°

Work out the size of angle BOC .
 You must show all your working.

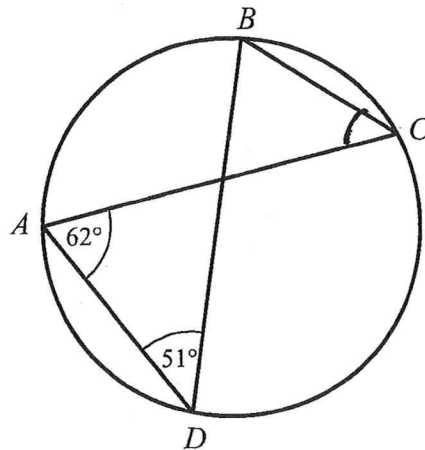
$$360 - 90 - 90 - 40 = 140^\circ$$

Angles in a quadrilateral
 add to 360°

140

(Total for Question 3 is 3 marks)

4



A , B , C and D are points on the circumference of a circle.

Angle $CAD = 62^\circ$

Angle $ADB = 51^\circ$

(i) Find the size of angle ACB .

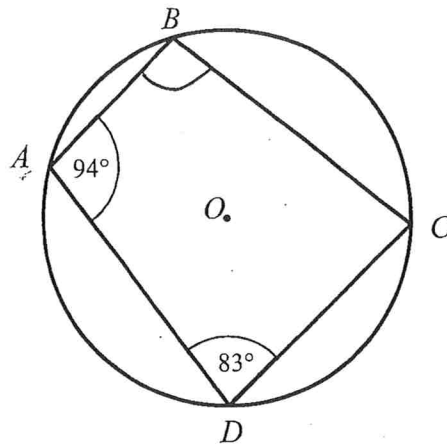
51

(ii) Give a reason for your answer.

Angles from the same points (to the circumference) are equal

(Total for Question 4 is 2 marks)

5



A, B, C and D are points on the circumference of a circle.

Angle $BAD = 94^\circ$

Angle $ADC = 83^\circ$

$$180 - 83$$

(i) Find the size of angle ABC .

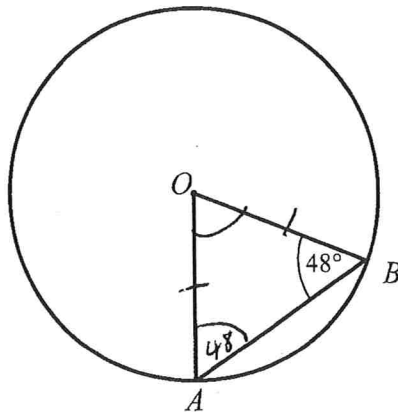
97°

(ii) Give a reason for your answer.

opposite angles in a cyclic quadrilateral add to 180°

(Total for Question 5 is 2 marks)

6



A and B are points on the circumference of a circle, centre O .

Angle $ABO = 48^\circ$

$OAB = 48^\circ$
Angles at base of isosceles are equal

(i) Find the size of angle AOB .

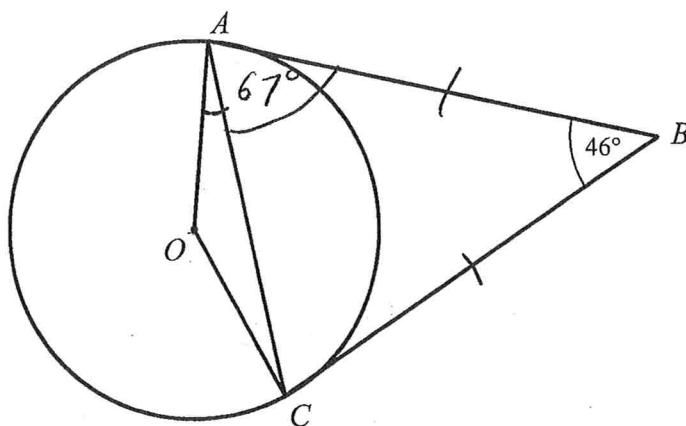
$$180 - 48 - 48$$

(ii) Give a reason for your answer.

84°

Angles at the base of an isosceles triangle are equal + angles in a triangle add to 180°

(Total for Question 6 is 2 marks)



A and C are points on the circumference of a circle, centre O .
 AB and BC are tangents to the circle.

Angle $ABC = 46^\circ$

Find the size of angle OAC .

Give reasons for each stage of your working.

ABC is an isosceles triangle, 2 tangents
 from the same point are equal

$$\angle CAB = \frac{180 - 46}{2} = \frac{134}{2} = 67^\circ$$

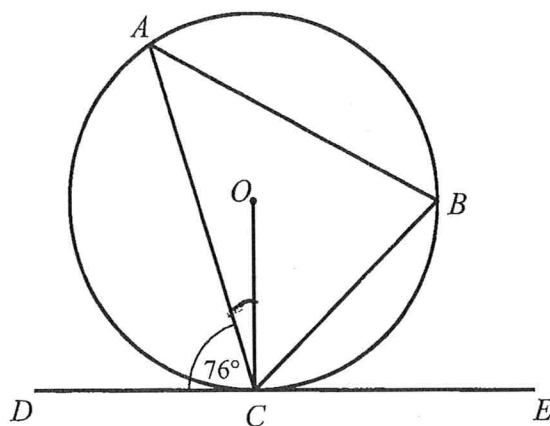
Angles at the base of an isosceles
 triangle are equal

$OAB = 90^\circ$ Tangent meets radius at 90°

$$\angle OAC = 90 - 67 = \underline{\underline{23^\circ}}$$

23°

(Total for Question 7 is 4 marks)



A and B are points on the circumference of a circle, centre O .
 DCE is a tangent to the circle.

Angle $ACD = 76^\circ$

- (a) Find the size of angle ACO .
 You must ~~show~~ all your working.
 Give reasons for

$$OCD = 90^\circ \quad \text{Tangent meets radius at } 90^\circ$$

$$90 - 76 = 14^\circ$$

14

 (2)

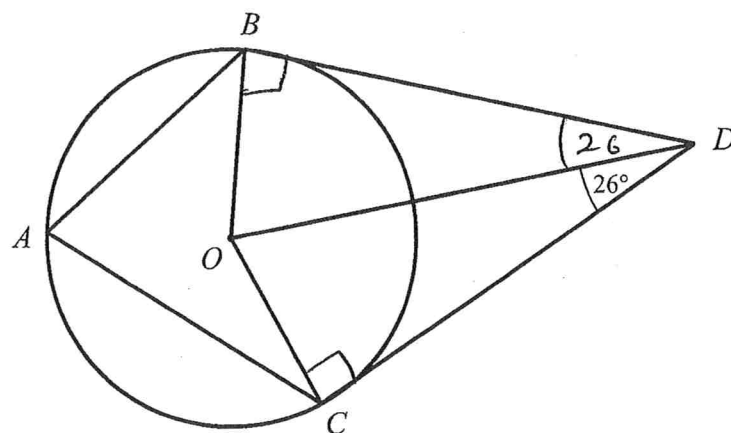
- (b) Find the size of angle ABC .
 You must ~~show~~ all your working.
 Give reasons for

$$ABC = 76^\circ \quad \text{Alternate segment theorem}$$

76

 (2)

(Total for Question 8 is 4 marks)



A , B and C are points on the circumference of a circle, centre O .
 BD and CD are tangents to the circle.

Angle $ODC = 26^\circ$

Find the size of angle BAC .

Give reasons for each stage of your working.

Triangle $BOD = \text{Triangle } DOC$ all sides are equal

OBD and $OCD = 90^\circ$ Tangent meets radius at 90°

$$BOD \text{ and } COD = 180 - 90 - 26 \\ = 64^\circ$$

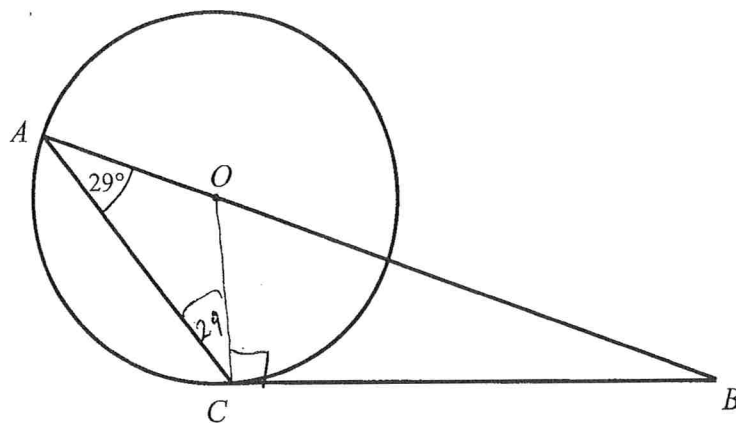
$$BOC = 2 \times 64 = 128^\circ$$

$$BAC = \frac{128}{2} = 64^\circ$$

Angle at circumference is half the angle at the centre

64°

(Total for Question 9 is 4 marks)



A and C are points on the circumference of a circle, centre O .
 BC is a tangent to the circle.

Angle $CAB = 29^\circ$

Find the size of angle ABC .
 You must show all your working.

$$OCA = 29^\circ$$

Angles at the base of
 an isosceles triangle
 are equal

$$OCB = 90^\circ$$

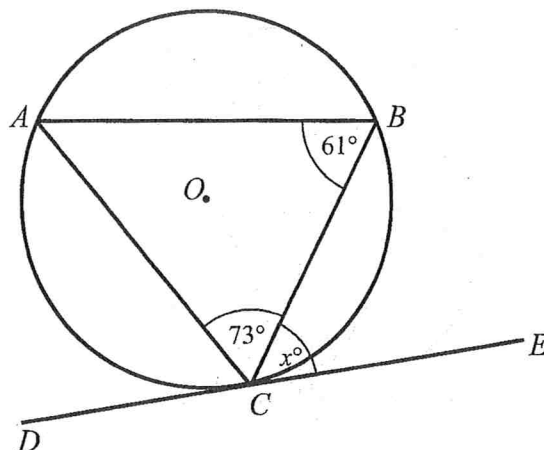
Tangent meets radius
 at 90°

$$\begin{aligned} ABC &= 180 - 90 - 29 - 29 \\ &= 32^\circ \end{aligned}$$

Angles in a triangle
 add to 180°

32

(Total for Question 10 is 4 marks)



A , B and C are points on the circumference of a circle, centre O .
 DCE is a tangent to the circle.

Angle $ABC = 61^\circ$

Angle $ACB = 73^\circ$

Angle $BCE = x^\circ$

Find the value of x .

You must show all your working.

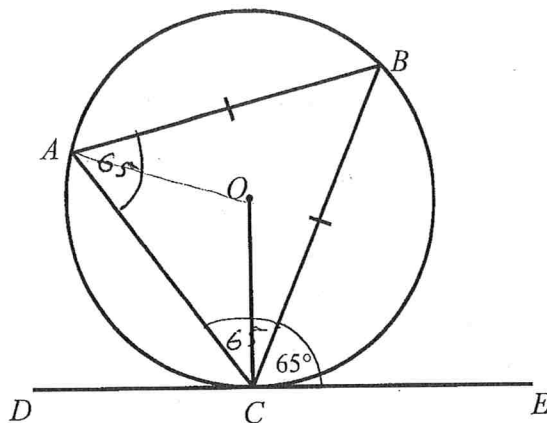
$$BAC = 180 - 73 - 61$$

$$= 46^\circ \quad \text{Angles in a triangle add to } 180^\circ$$

$$x = 46^\circ \quad \text{Alternate segment theorem}$$

46

(Total for Question 11 is 3 marks)



A , B and C are points on the circumference of a circle, centre O .
 DCE is a tangent to the circle.

$AB = BC$
 Angle $BCE = 65^\circ$

Find the size of angle AOC .
 You must show all your working.

$BAC = 65^\circ$ Alternate segment theorem

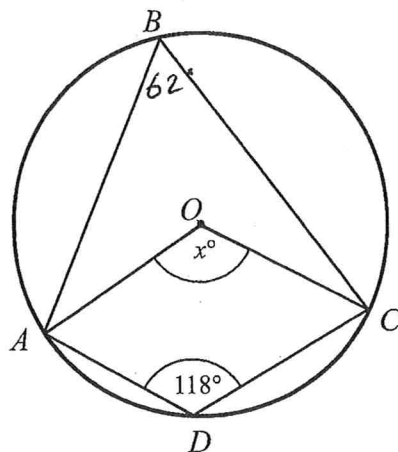
$ACB = 65^\circ$ Angles at the base of an isosceles triangle are equal

$ABC = 180 - 65 - 65$
 $= 50^\circ$ Angles in a triangle add to 180°

$AOC = 2 \times 50$
 $= 100^\circ$ Angle at centre is twice angle at circumference

100°

(Total for Question 12 is 4 marks)



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

Angle $ADC = 118^\circ$

Angle $AOC = x^\circ$

Work out the value of x .

You must show all your working.

$$\begin{aligned} \angle ABC &= 180 - 118 \\ &= 62^\circ \end{aligned}$$

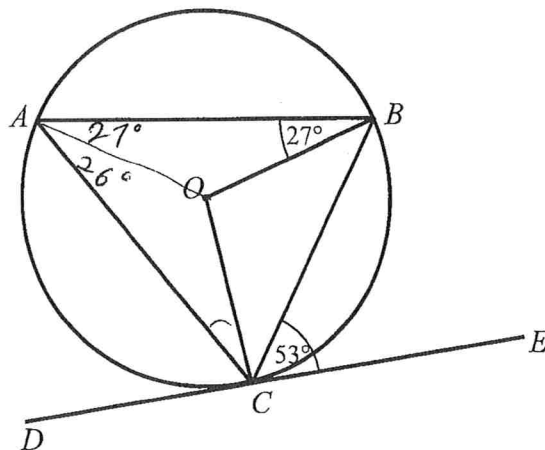
opposite angles in a cyclic quadrilateral add to 180°

$$\begin{aligned} \angle AOC &= 2 \times 62 \\ &= 124^\circ \end{aligned}$$

Angle at centre is twice angle at circumference

124

(Total for Question 13 is 3 marks)



A , B and C are points on the circumference of a circle, centre O .
 DCE is a tangent to the circle.

Angle $ABO = 27^\circ$

Angle $BCE = 53^\circ$

Find the size of angle ACO .

~~You must show all your working.~~

~~Give reasons for each stage of your working.~~

$BAO = 27^\circ$ Angles at base of isosceles triangle are equal

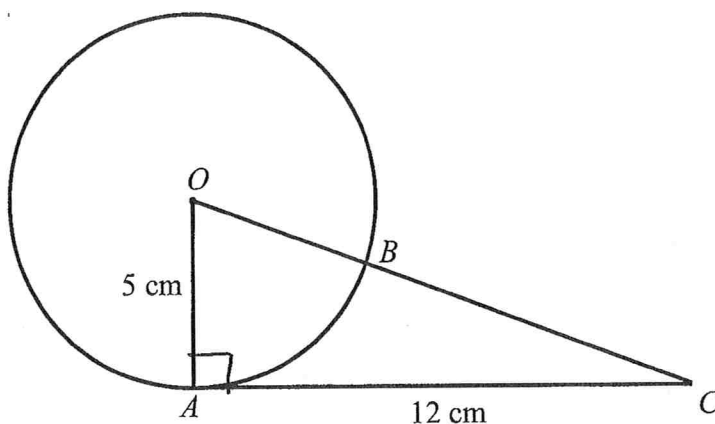
$BAC = 53^\circ$ Alternate segment theorem

$$OAC = 53 - 27 = 26^\circ$$

$ACO = 26^\circ$ Angles at base of isosceles triangle are equal

26

(Total for Question 14 is 2 marks)



A and B is a point on the circumference of a circle, centre O .

AC is a tangent to the circle.

OBC is a straight line.

$OA = 5$ cm

$AC = 12$ cm

Find the length of BC .

You must show all your working.

$OAC = 90^\circ$ Tangent meets radius at 90°

$$5^2 + 12^2 = OC^2$$

$$169 = OC^2$$

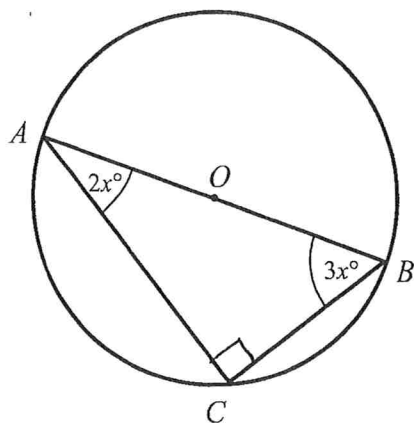
$$OC = \sqrt{169}$$

$$= 13 \text{ cm}$$

$$BC = 13 - 5 = 8 \text{ cm} \quad (\text{radius} = 5 \text{ cm})$$

8 cm

(Total for Question 15 is 4 marks)



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

Angle $CAB = 2x^\circ$

Angle $ABC = 3x^\circ$

Find the value of x .

You must show all your working.

$ACB = 90^\circ$ Angle in a semi circle
is 90°

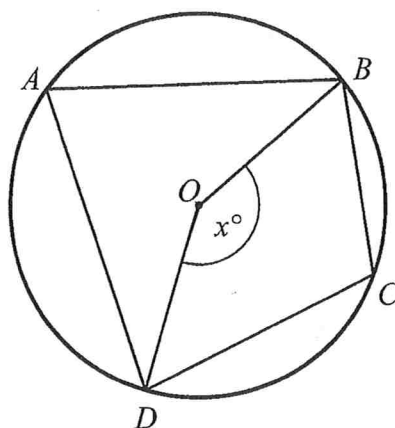
$$2x + 3x + 90 = 180$$

$$5x = 90$$

$$x = 18^\circ$$

$$x = 18$$

(Total for Question 16 is 3 marks)



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

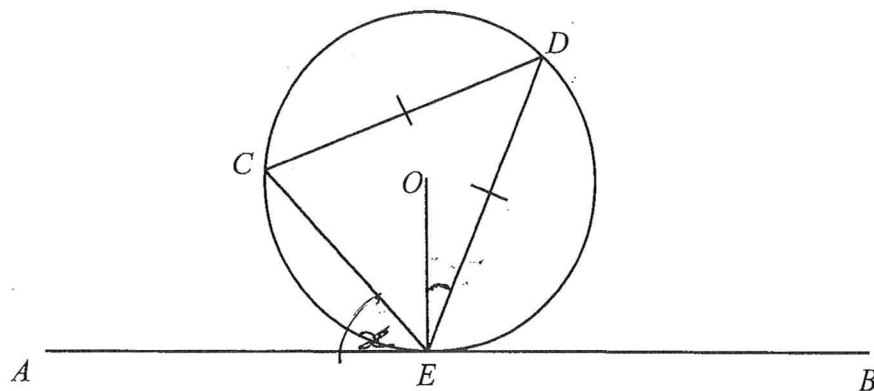
Angle $BOD = x^\circ$

Find the size of angle BCD , in terms of x .
Give reasons for each stage of your working.

$$BAD = \frac{1}{2}x \quad \begin{array}{l} \text{Angle at circumference} \\ \text{is half angle at centre} \end{array}$$

$$BCD = \underline{\underline{180 - \frac{1}{2}x}} \quad \begin{array}{l} \text{opposite angles in} \\ \text{a cyclic quadrilateral} \\ \text{add to } 180^\circ \end{array}$$

(Total for Question 17 is 3 marks)



C, D and E are points on a circle, centre O .
 AEB is a tangent to the circle at E .

$CD = DE$
 Angle $AEC = x^\circ$

Find the size of angle OED , in terms of x .
 Give reasons for each stage of your working.

$$CDE = x \quad \text{Alternate segment theorem}$$

$$CED = \frac{180 - x}{2} \quad \begin{array}{l} \text{Angles at the base} \\ \text{of an isosceles triangle} \\ \text{are equal} \end{array}$$

$$OEC = 90 - x \quad OEA = 90^\circ \quad \begin{array}{l} \text{Tangent meets} \\ \text{radius at } 90^\circ \end{array}$$

$$\begin{aligned} OED &= \frac{180 - x}{2} - (90 - x) \\ &= 90 - \frac{1}{2}x - 90 + x \\ &= \frac{1}{2}x \end{aligned}$$

(Total for Question 18 is 5 marks)

1.

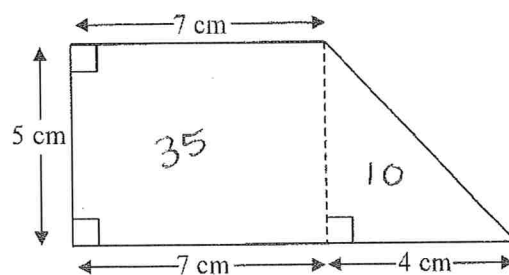


Diagram NOT accurately drawn

Work out the area of the shape.

$$5 \times 7 = 35$$

$$\frac{1}{2} \times 4 \times 5 = 10$$

..... 45 cm^2
(Total 3 marks)

2.

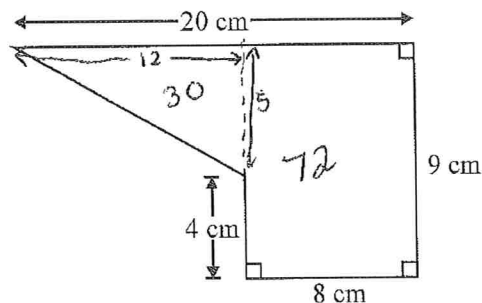


Diagram NOT accurately drawn

The diagram shows a shape.
Work out the area of the shape.

$$8 \times 9 = 72$$

$$\frac{1}{2} \times 12 \times 5 = 30$$

..... 102 cm^2
(Total 4 marks)

3. Here is a trapezium.

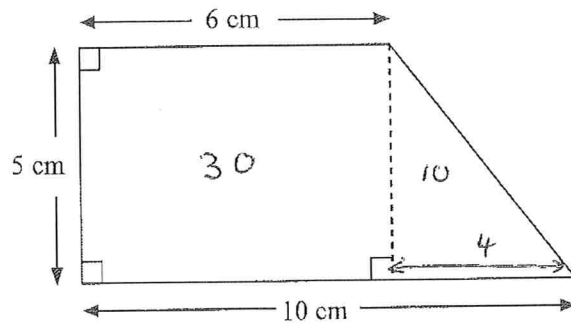


Diagram NOT accurately drawn

Work out the area of the trapezium.

$$5 \times 6 = 30$$

$$\frac{1}{2} \times 4 \times 5 = 10$$

.....40..... cm^2
(Total 2 marks)

4. The diagram shows a wall with a door in it.

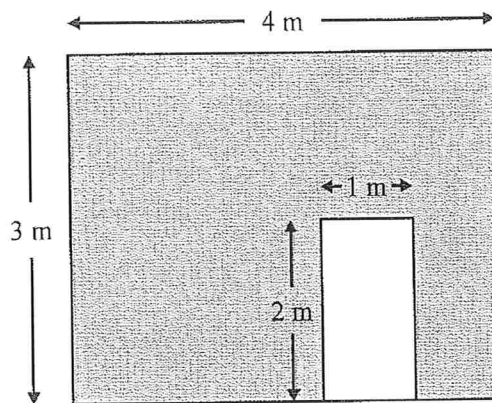


Diagram NOT
accurately drawn

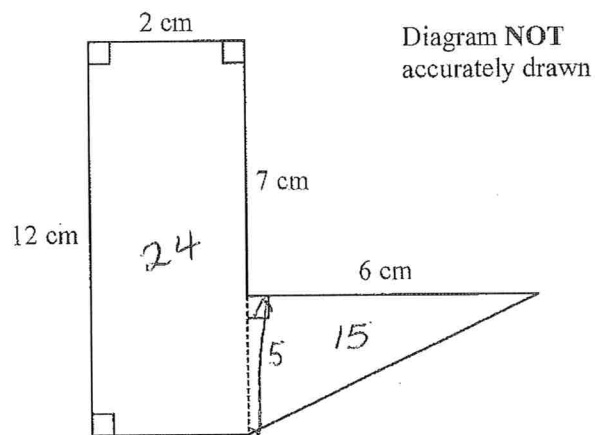
Work out the shaded area.

$$3 \times 4 = 12$$

$$1 \times 2 = 2$$

.....10..... m^2
(3)
(Total 3 marks)

5. The diagram shows a 6-sided shape made from a rectangle and a right-angled triangle.



Work out the total area of the 6-sided shape.

$$2 \times 12 = 24$$

$$\frac{1}{2} \times 6 \times 5 = 15$$

39 cm²
(Total 3 marks)

6.

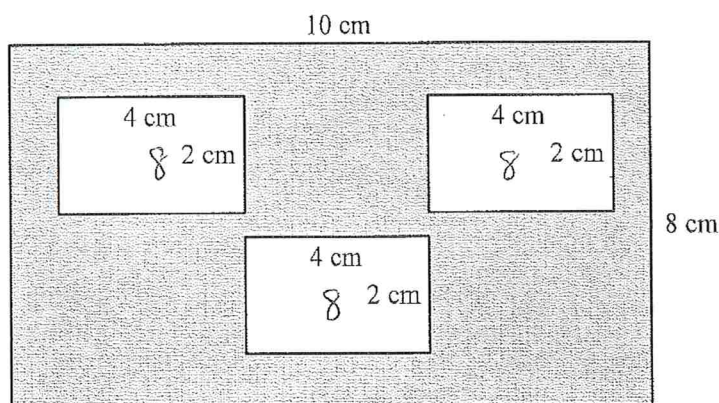


Diagram **NOT**
accurately drawn

The diagram shows 3 small rectangles inside a large rectangle.
The large rectangle is 10 cm by 8 cm.
Each of the 3 small rectangles is 4 cm by 2 cm.

Work out the area of the region shown shaded in the diagram.

$$10 \times 8 = 80$$

$$4 \times 2 = 8$$

$$80 - (3 \times 8)$$

$$80 - 24 = 56$$

.....56.....cm²
(Total 3 marks)

7.

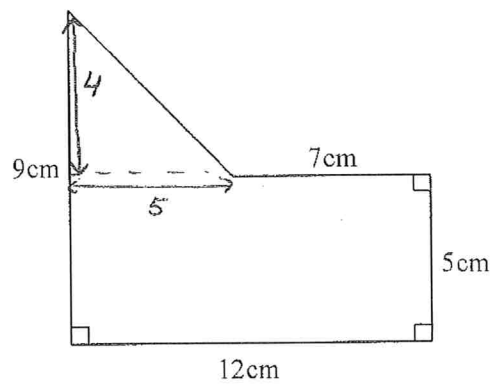


Diagram NOT accurately drawn

Work out the area of the shape.

$$12 \times 5 = 60$$

$$\frac{1}{2} \times 4 \times 5 = 10$$

.....70..... cm²
(Total 4 marks)

8.

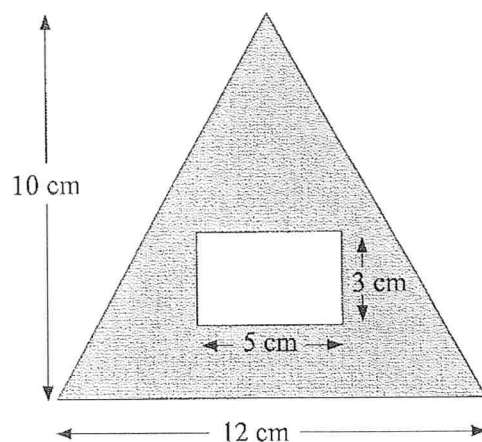


Diagram NOT accurately drawn

The diagram shows a rectangle inside a triangle.

The triangle has a base of 12 cm and a height of 10 cm.

The rectangle is 5 cm by 3 cm.

Work out the area of the region shown shaded in the diagram.

$$\frac{1}{2} \times 12 \times 10 = 60$$

$$3 \times 5 = 15$$

..... 45 cm²
(Total 3 marks)

9.

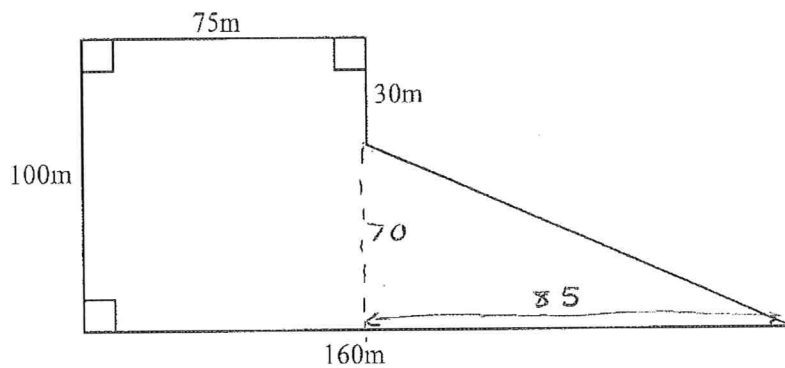


Diagram **NOT** accurately drawn

The diagram shows the plan of a field.
The farmer sells the field for £3 per square metre.

Work out the total amount of money the farmer should get.

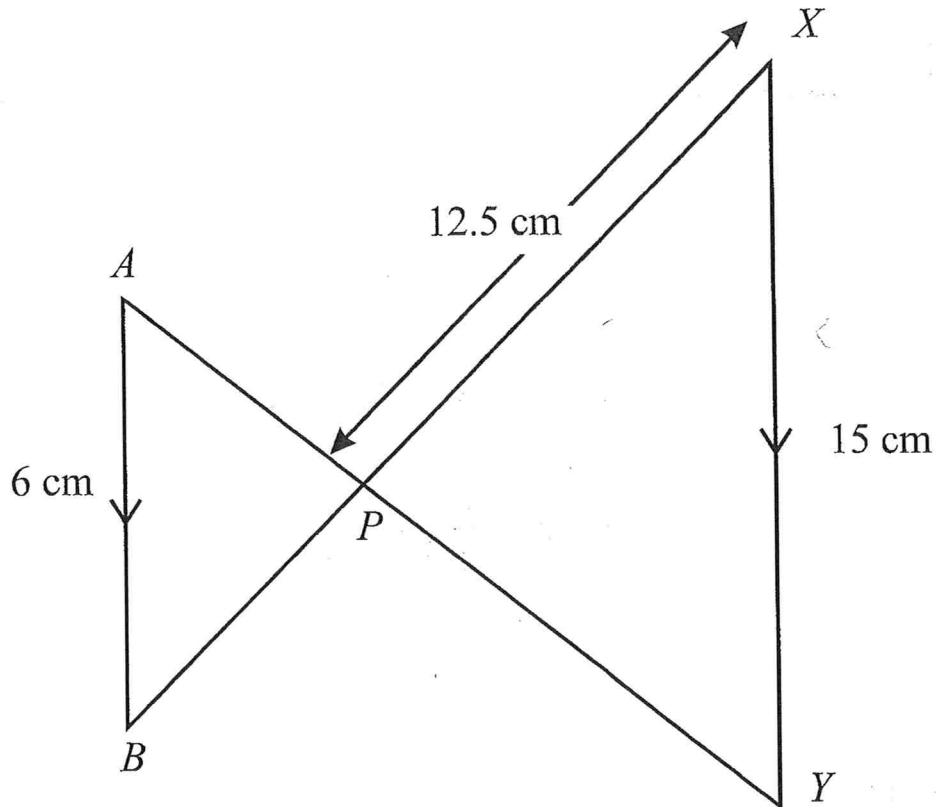
$$\begin{array}{rcl}
 75 \times 100 & = & 7500 \\
 \frac{1}{2} \times 70 \times 85 & = & 2975 \\
 & & \hline
 & & 10475
 \end{array}$$

$$10475 \times 3$$

£ 31425

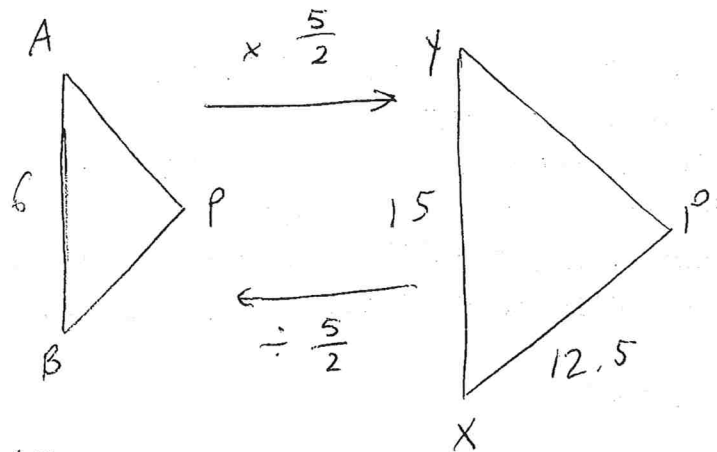
(Total 5 marks)

1



AB is parallel to XY .
 The lines AY and BX intersect at P .
 $AB = 6$ cm.
 $XP = 12.5$ cm.
 $XY = 15$ cm.

Work out the length of BP .

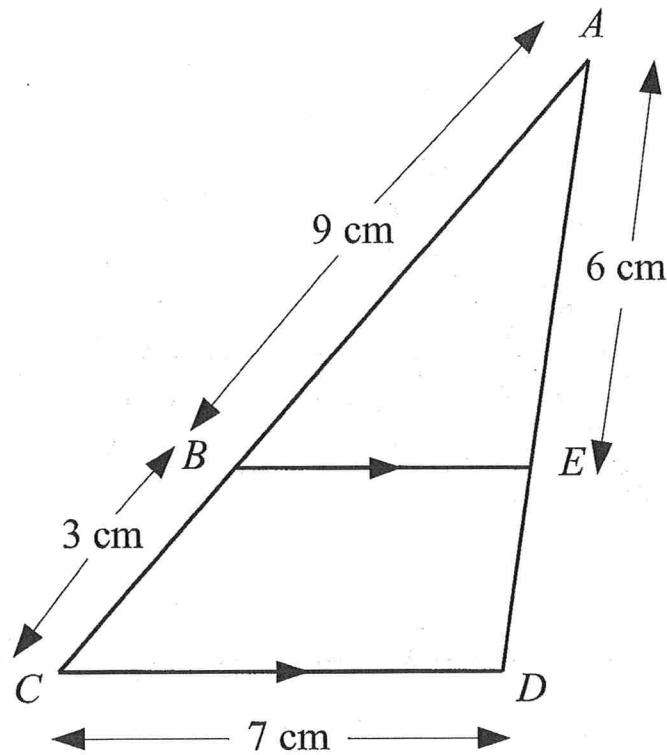


$$\text{Scale factor} = \frac{15}{6} = \frac{5}{2}$$

$$12.5 \div \frac{5}{2} = \underline{\underline{5}}$$

5 cm

(Total for Question 1 is 3 marks)



BE is parallel to CD .

$AB = 9$ cm, $BC = 3$ cm, $CD = 7$ cm, $AE = 6$ cm.

- (a) Calculate the length of ED .

$$\text{Scale factor} = \frac{12}{9} = \frac{4}{3}$$

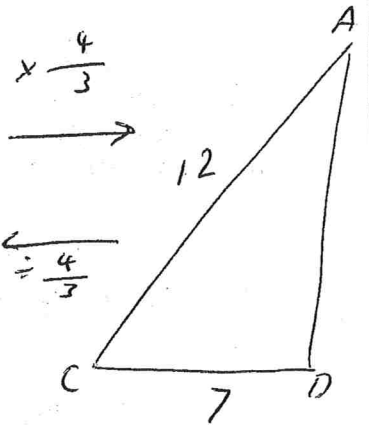
$$AD = 6 \times \frac{4}{3} = 8 \text{ cm}$$

$$ED = 8 - 6 = \underline{\underline{2 \text{ cm}}}$$

- (b) Calculate the length of BE .

$$7 \div \frac{4}{3}$$

$$7 \times \frac{3}{4} = \frac{21}{4} \text{ or } \underline{\underline{5.25}}$$

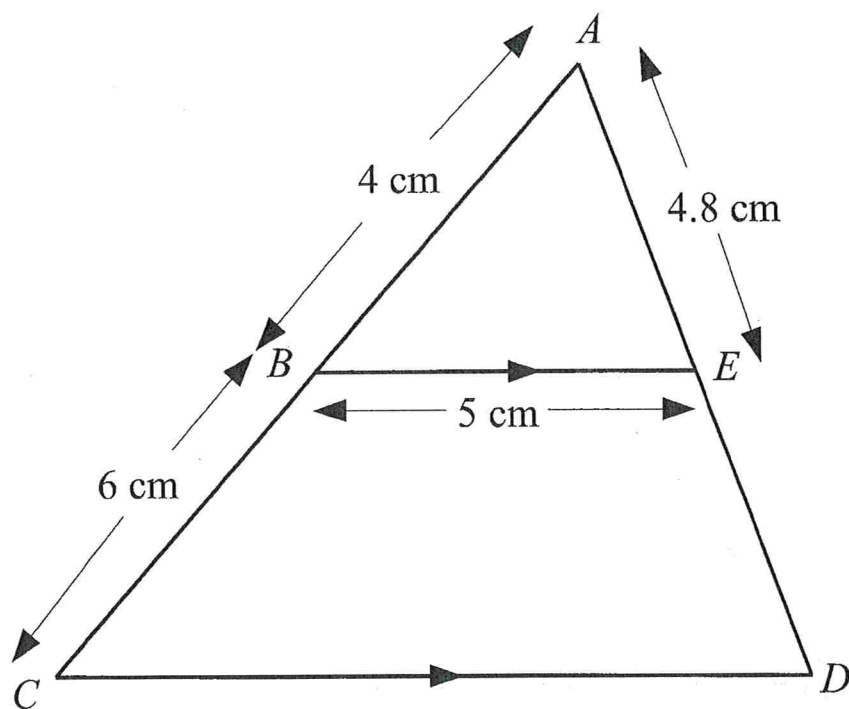


2 cm
(2)

$\frac{21}{4}$ cm
(2)

(Total for Question 2 is 4 marks)

3

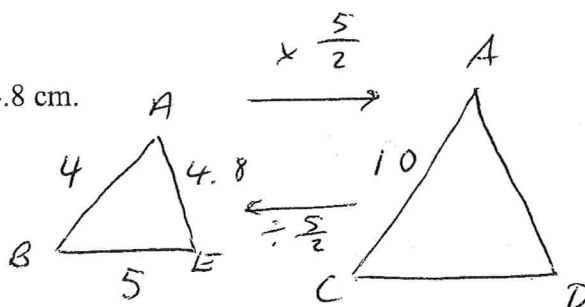


BE is parallel to CD .

ABC and AED are straight lines.

$AB = 4$ cm, $BC = 6$ cm, $BE = 5$ cm, $AE = 4.8$ cm.

- (a) Calculate the length of CD .



$$\text{Scale factor} = \frac{10}{4} = \frac{5}{2}$$

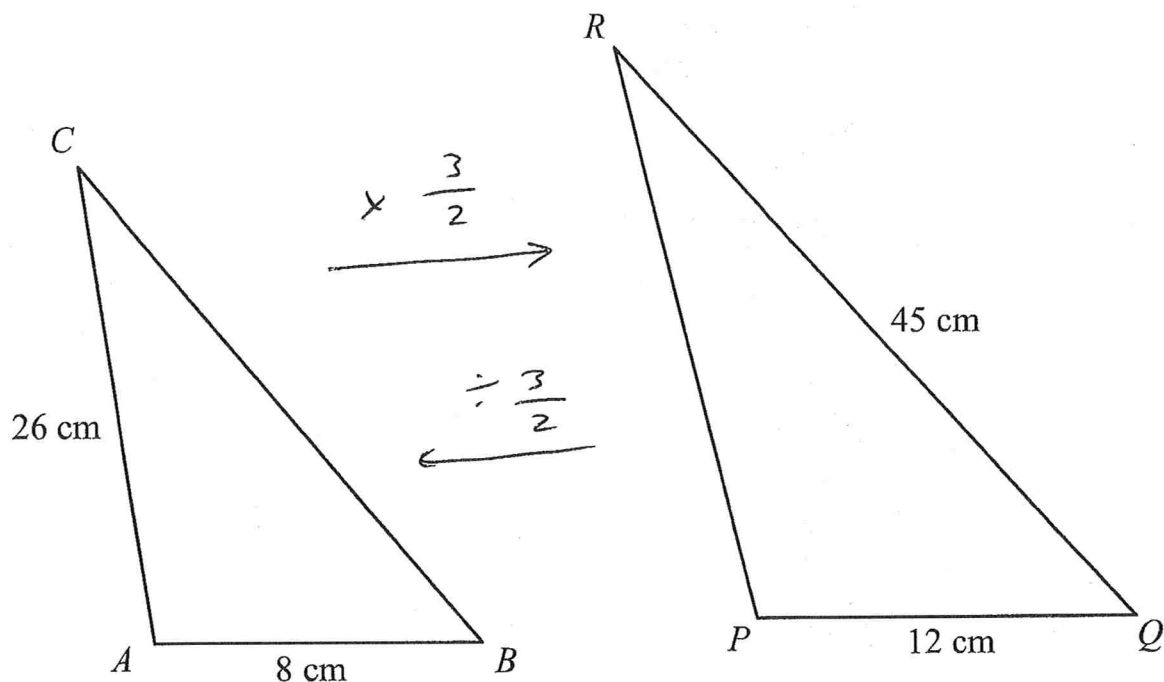
$$5 \times \frac{5}{2} = \frac{25}{2} \text{ or } 12.5 \quad \frac{25}{2} \text{ cm} \quad (2)$$

- (b) Calculate the length of ED .

$$AD = 4.8 \times \frac{5}{2} = 12 \text{ cm}$$

$$12 - 4.8 = 7.2 \text{ cm} \quad 7.2 \text{ cm} \quad (2)$$

(Total for Question 3 is 4 marks)



The two triangles ABC and PQR are mathematically similar.

Angle $A =$ angle P .

Angle $B =$ angle Q .

$AB = 8$ cm.

$AC = 26$ cm.

$PQ = 12$ cm.

$QR = 45$ cm.

$$\text{scale factor} = \frac{12}{8} = \frac{3}{2}$$

- (a) Calculate the length of PR .

$$26 \times \frac{3}{2} = \underline{\underline{39}}$$

39 cm
(2)

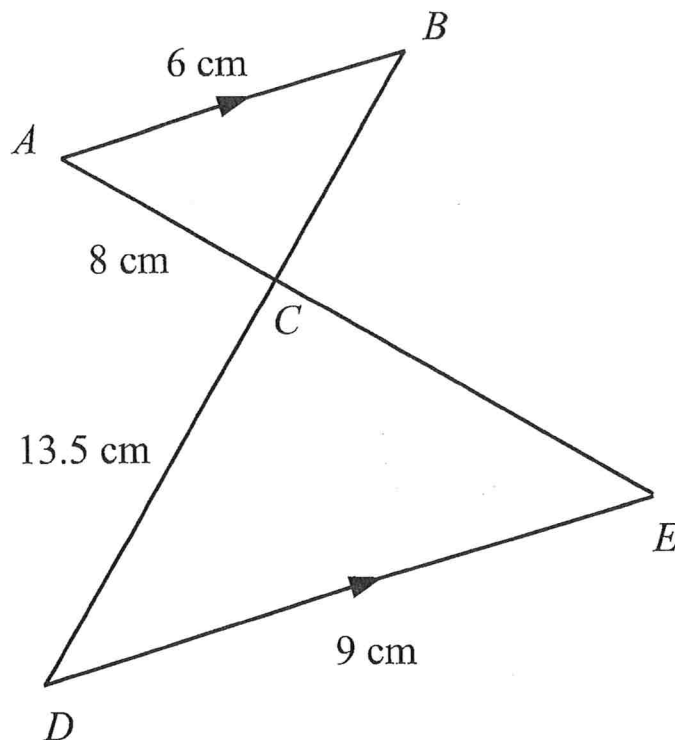
- (b) Calculate the length of BC .

$$45 \div \frac{3}{2}$$

$$45 \times \frac{2}{3} = \underline{\underline{30}}$$

30 cm
(2)

(Total for Question 4 is 4 marks)

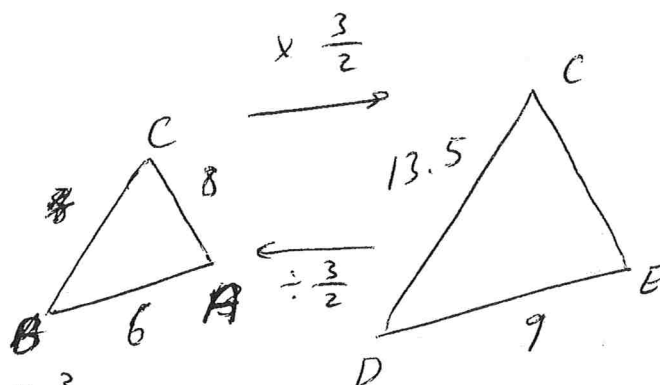


AB is parallel to DE .
 ACE and BCD are straight lines.
 $AB = 6$ cm,
 $AC = 8$ cm,
 $CD = 13.5$ cm,
 $DE = 9$ cm.

- (a) Calculate the length of CE .

$$\text{Scale factor} = \frac{9}{6} = \frac{3}{2}$$

$$8 \times \frac{3}{2} = \underline{\underline{12}}$$



$$\underline{\hspace{2cm} 12 \hspace{2cm}} \text{ cm} \quad (2)$$

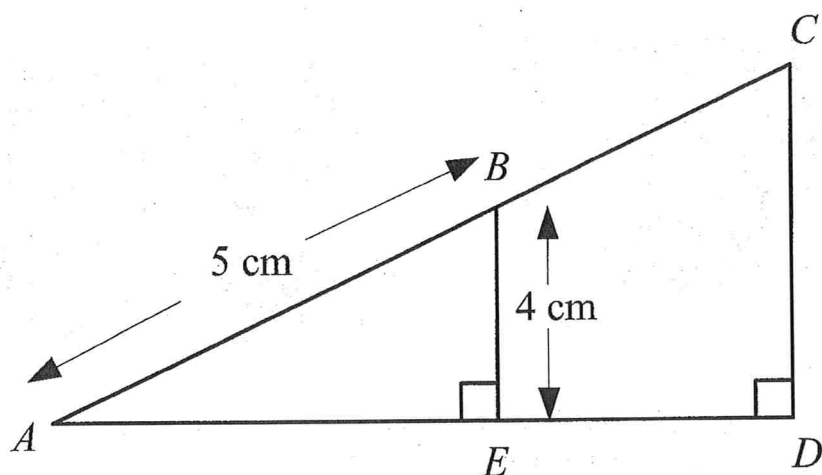
- (b) Calculate the length of BC .

$$13.5 \div \frac{3}{2}$$

$$13.5 \times \frac{2}{3} = \underline{\underline{9}}$$

$$\underline{\hspace{2cm} 9 \hspace{2cm}} \text{ cm} \quad (2)$$

(Total for Question 5 is 4 marks)

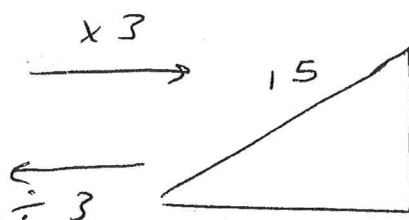
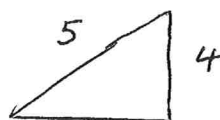


$$AC = 5 \times 3$$

$$AB:AC = 1:3$$

$$AC = 15 \text{ cm}$$

- (a) Calculate the length of CD .



$$\text{Scale factor} = \frac{15}{5} = 3$$

$$4 \times 3 = \underline{\underline{12}}$$

- (b) Calculate the length of BC .

$$15 - 5 = \underline{\underline{10}}$$

$$\underline{\hspace{2cm}} 12 \text{ cm} \quad (2)$$

$$\underline{\hspace{2cm}} 10 \text{ cm} \quad (2)$$

(Total for Question 6 is 4 marks)



A 20 Euro note is a rectangle 133 mm long and 72 mm wide.
 A 500 Euro Note is a rectangle 160 mm long and 82 mm wide.

Show that the two rectangles are not mathematically similar.

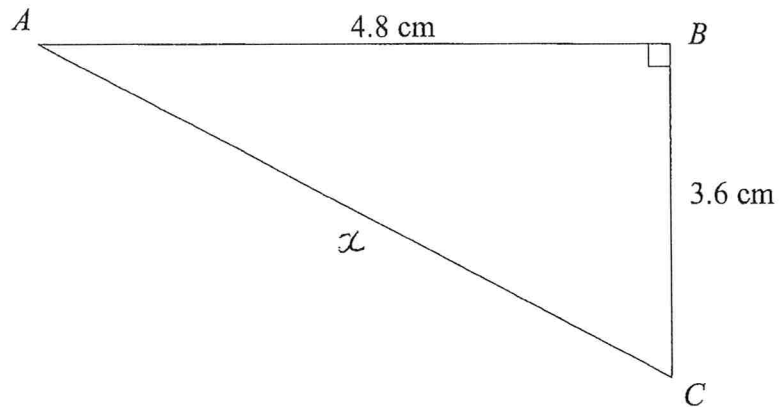
$$\text{scale factor for length} = \frac{160}{133}$$

$$\text{scale factor for width} = \frac{82}{72} = \frac{41}{36}$$

The scale factor for length is not
 equal to the scale factor for
 width \therefore they are not similar.

(Total for Question 7 is 3 marks)

1



Calculate the length of AC.

$$3.6^2 + 4.8^2 = x^2$$

$$36 = x^2$$

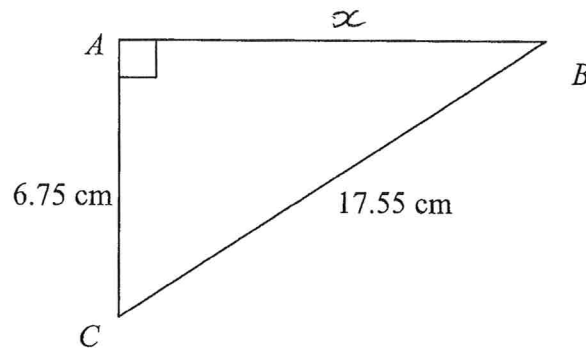
$$x = \sqrt{36}$$

$$= 6$$

.....6.....cm

(Total for question 1 is 3 marks)

2



Calculate the length of ~~BC~~
AB

$$x^2 + 6.75^2 = 17.55^2$$

$$x^2 = 17.55^2 - 6.75^2$$

$$x^2 = 262.44$$

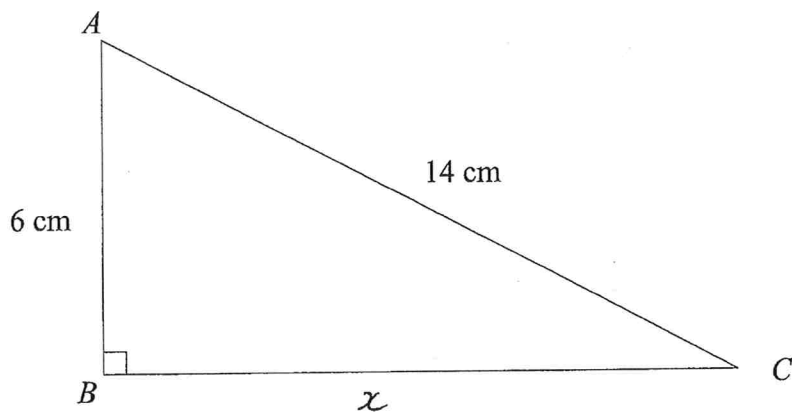
$$x = \sqrt{262.44}$$

$$= 16.2$$

.....16.2.....cm

(Total for question 2 is 3 marks)

3



Calculate the length of BC .
Give your answer to 1 decimal place.

$$x^2 + 6^2 = 14^2$$

$$x^2 = 14^2 - 6^2$$

$$x^2 = 160$$

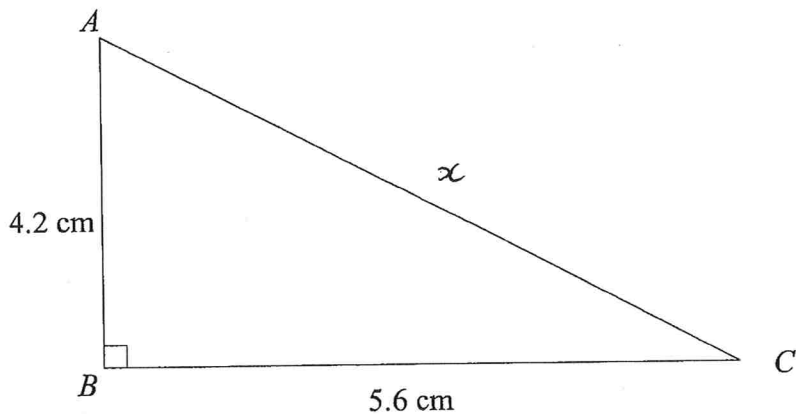
$$x = \sqrt{160}$$

$$= 12.6 \text{ (1dp)}$$

$$\dots\dots\dots 12.6 \text{ cm}$$

(Total for question 3 is 3 marks)

4



Calculate the length of AC .

$$4.2^2 + 5.6^2 = x^2$$

$$49 = x^2$$

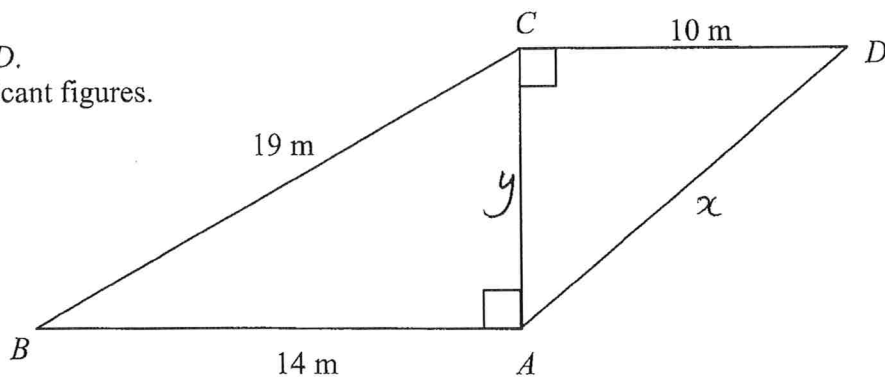
$$x = \sqrt{49}$$

$$= 7$$

$$\dots\dots\dots 7 \text{ cm}$$

(Total for question 4 is 3 marks)

- 5 Calculate the length of the AD .
Give your answer to 3 significant figures.



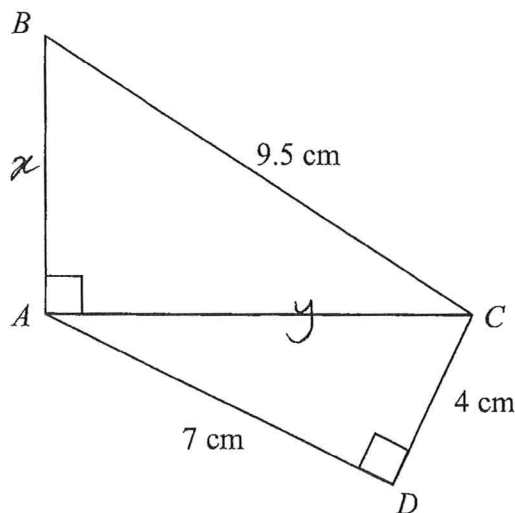
$$\begin{aligned} 14^2 + y^2 &= 19^2 \\ y^2 &= 19^2 - 14^2 \\ y^2 &= 165 \\ y &= \sqrt{165} \\ &= 12.84523... \end{aligned}$$

$$\begin{aligned} 10^2 + 12.84523^2 &= x^2 \\ 265 &= x^2 \\ x &= \sqrt{265} \\ &= 16.3 \text{ (3sf)} \end{aligned}$$

.....16.3.....m

(Total for question 5 is 4 marks)

- 6 Calculate the length of the AB .
Give your answer to 3 significant figures.



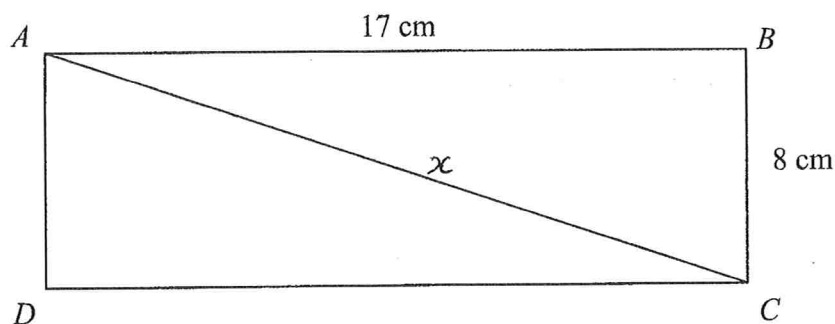
$$\begin{aligned} 4^2 + 7^2 &= y^2 \\ 65 &= y^2 \end{aligned}$$

$$\begin{aligned} x^2 + y^2 &= 9.5^2 \\ x^2 + 65 &= 9.5^2 \\ x^2 &= 9.5^2 - 65 \\ x^2 &= 25.25 \\ x &= \sqrt{25.25} \\ &= 5.02 \text{ (3sf)} \end{aligned}$$

.....5.02.....cm

(Total for question 5 is 4 marks)

7



$ABCD$ is a rectangle.

Calculate the length of the diagonal AC .

Give your answer correct to 1 decimal place.

$$\begin{aligned} 8^2 + 17^2 &= x^2 \\ 353 &= x^2 \\ x &= \sqrt{353} \\ x &= 18.8 \text{ (1dp)} \end{aligned}$$

.....18.8.....cm

(Total for question 7 is 3 marks)

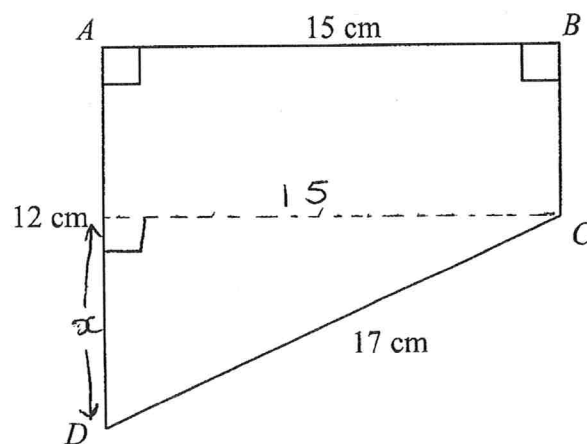
8

$ABCD$ is a trapezium.

Calculate the length of BC .

$$\begin{aligned} x^2 + 15^2 &= 17^2 \\ x^2 &= 17^2 - 15^2 \\ x^2 &= 64 \\ x &= \sqrt{64} \\ &= 8 \end{aligned}$$

$$BC = 12 - 8 = 4$$



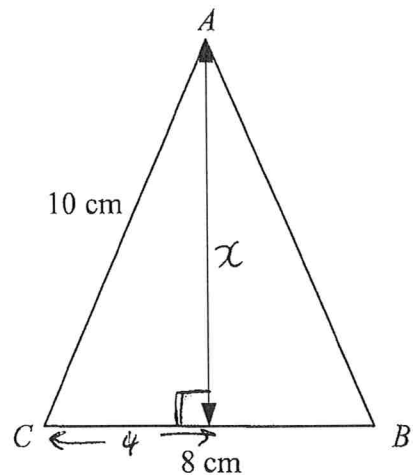
.....4.....cm

(Total for question 8 is 3 marks)

9 *ABC* is an isosceles triangle.

Calculate the perpendicular height of *ABC*.
Give your answer correct to 3 significant figures..

$$\begin{aligned}x^2 + 4^2 &= 10^2 \\x^2 &= 10^2 - 4^2 \\x^2 &= 84 \\x &= \sqrt{84} \\&= 9.17 \text{ (3sf)}\end{aligned}$$

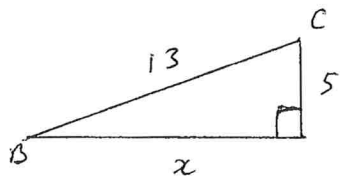


.....9.17.....cm

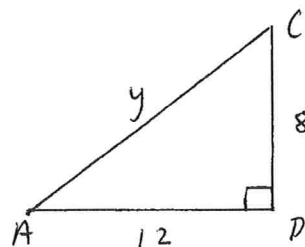
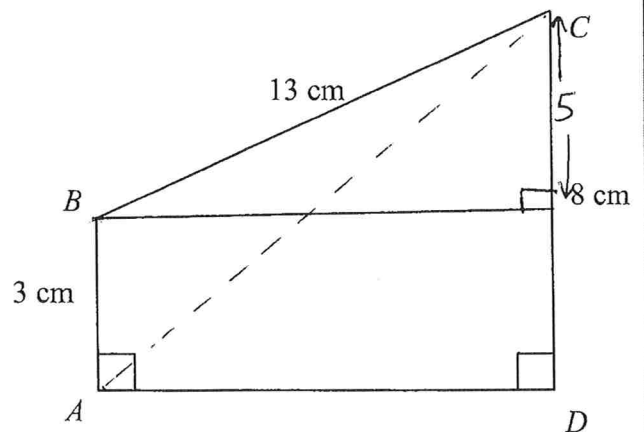
(Total for question 9 is 3 marks)

10 *ABCD* is a trapezium.

Calculate the length of *AC*.
Give your answer correct to 3 significant figures..



$$\begin{aligned}x^2 + 5^2 &= 13^2 \\x^2 &= 13^2 - 5^2 \\x^2 &= 144 \\x &= \sqrt{144} \\&= 12\end{aligned}$$



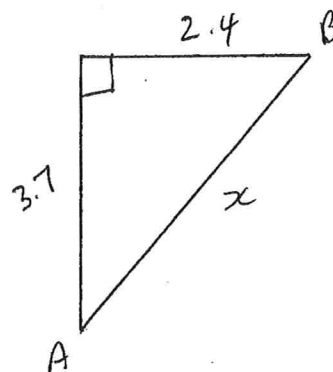
$$\begin{aligned}8^2 + 12^2 &= y^2 \\y^2 &= 208 \\y &= \sqrt{208} \\y &= 14.4 \text{ (3sf)}\end{aligned}$$

.....14.4.....cm

(Total for question 10 is 4 marks)

- 11 A ship leaves point A and sails for 3.7 km due North.
The ship then sails for 2.4 km due East to reach point B.

Calculate the the shortest distance between point A and point B.
Give your answer correct to 1 decimal place.



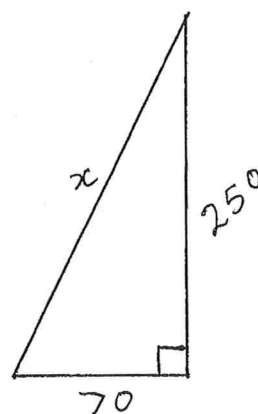
$$\begin{aligned}
 2.4^2 + 3.7^2 &= x^2 \\
 x^2 &= 19.45 \\
 x &= \sqrt{19.45} \\
 &= 4.4 \text{ km (1dp)}
 \end{aligned}$$

.....4.4.....km

(Total for question 11 is 3 marks)

- 12 A ladder reaches ^{250cm}2.5 m up a vertical wall.
The base of the ladder is 70 cm from the base of the wall on a horizontal ground.

Find the length of the ladder.



$$\begin{aligned}
 70^2 + 250^2 &= x^2 \\
 67400 &= x^2 \\
 x^2 &= 67400 \\
 x &= \sqrt{67400} \\
 &= 259.6150997 \text{ cm} \\
 &= 260 \text{ cm (nearest cm)}
 \end{aligned}$$

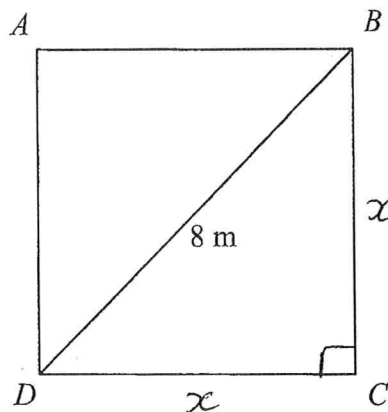
.....260 cm.....

(Total for question 12 is 4 marks)

OR 2.6m

- 13 $ABCD$ is a square.
The diagonal of the square is 8 m.

Calculate the perimeter of the square.
Give your answer correct to one decimal place.



$$x^2 + x^2 = 8^2$$

$$2x^2 = 64$$

$$x^2 = 32$$

$$x = \sqrt{32}$$

$$= 5.656854249 \text{ m}$$

$$4 \times 5.656... = 22.6 \text{ m (1dp)}$$

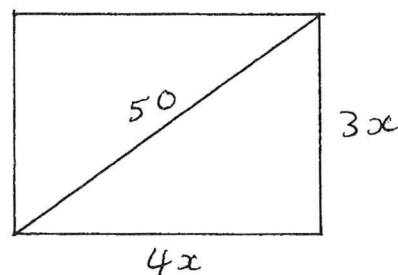
$$22.6 \text{ m}$$

(Total for question 13 is 3 marks)

- 14 A television has a diagonal length of 50 inches.

The ratio of the length of the television to the width of the television is 4:3

Calculate the length and the width of the television.
Give your answers correct to 1 decimal place.



$$(3x)^2 + (4x)^2 = 50^2$$

$$9x^2 + 16x^2 = 2500$$

$$25x^2 = 2500$$

$$x^2 = 100$$

$$x = 10$$

$$4 \times 10 = 40$$

$$3 \times 10 = 30$$

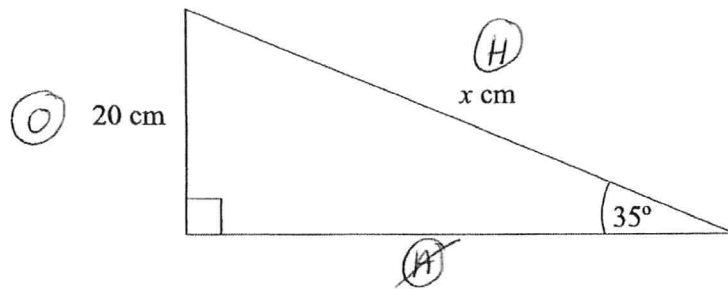
Length 40 inches

Width 30 inches

(Total for question 14 is 3 marks)

SOH CAH TOA

1



Work out the value of x.

$$\sin(35) = \frac{20}{x}$$

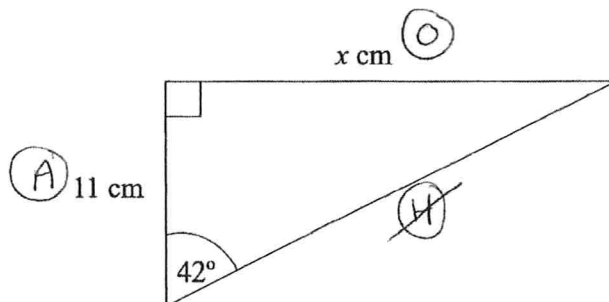
$$x = \frac{20}{\sin(35)}$$

$$= 34.9 \text{ (1dp)}$$

34.9

(Total for question 1 is 2 marks)

2



Work out the value of x.

$$\tan(42) = \frac{x}{11}$$

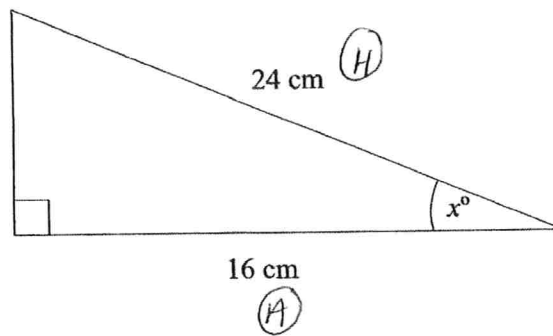
$$x = 11 \times \tan(42)$$

$$= 9.9 \text{ (1dp)}$$

9.9

(Total for question 2 is 2 marks)

3



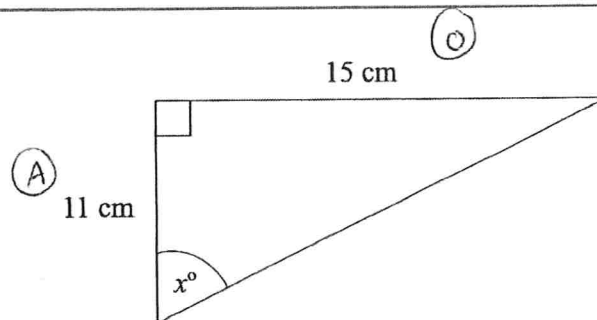
Work out the value of x .

$$\begin{aligned}\cos x &= \frac{16}{24} \\ x &= \cos^{-1}\left(\frac{16}{24}\right) \\ &= 48.2 \text{ (1dp)}\end{aligned}$$

.....48.2.....

(Total for question 3 is 2 marks)

4



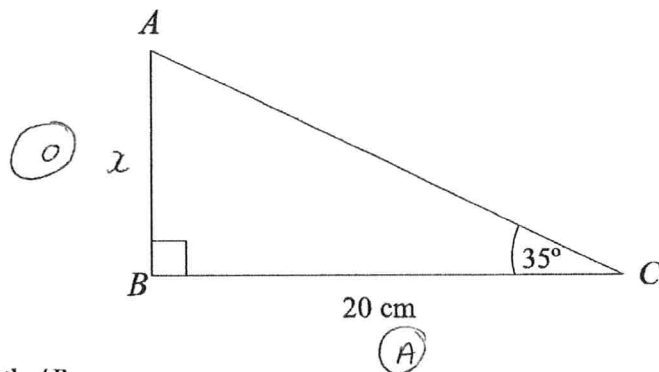
Work out the value of x .

$$\begin{aligned}\tan x &= \frac{15}{11} \\ x &= \tan^{-1}\left(\frac{15}{11}\right) \\ &= 53.7 \text{ (1dp)}\end{aligned}$$

.....53.7.....

(Total for question 4 is 2 marks)

5



Calculate the length AB .

$$\tan(35) = \frac{x}{20}$$

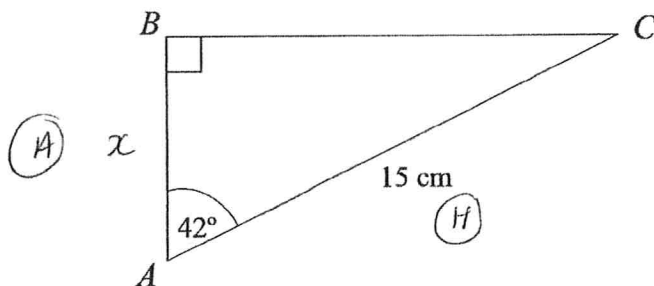
$$x = 20 \times \tan(35)$$

$$= 14.0 \text{ (1dp)}$$

.....14.0.....cm

(Total for question 5 is 2 marks)

6



Calculate the length AB .

$$\cos(42) = \frac{x}{15}$$

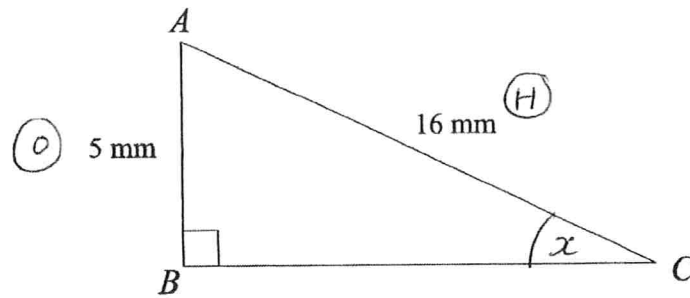
$$x = 15 \times \cos(42)$$

$$= 11.1 \text{ (1dp)}$$

.....11.1.....cm

(Total for question 6 is 2 marks)

7



Calculate the size of angle ACB .

$$\sin x = \frac{5}{16}$$

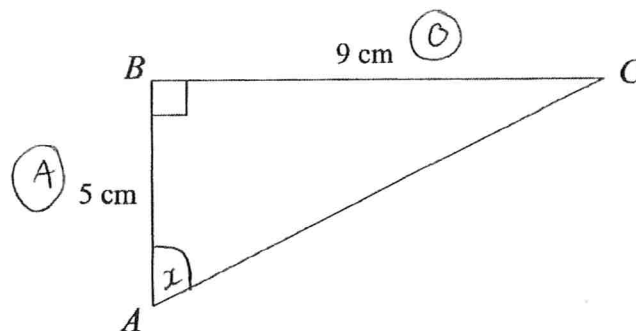
$$x = \sin^{-1}\left(\frac{5}{16}\right)$$

$$= 18.2 \text{ (1dp)}$$

..... 18.2 °

(Total for question 7 is 2 marks)

8



Calculate the size of angle BAC .

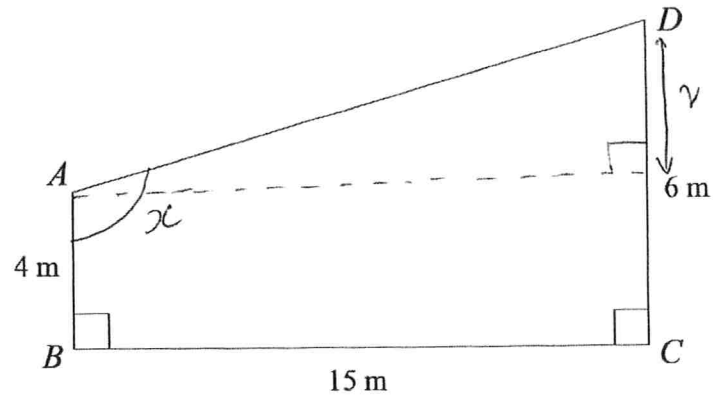
$$\tan x = \frac{9}{5}$$

$$x = \tan^{-1}\left(\frac{9}{5}\right)$$

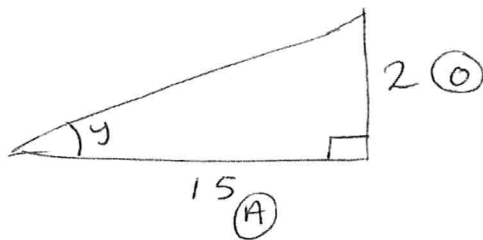
$$= 60.9 \text{ (1dp)}$$

..... 60.9 °

(Total for question 8 is 2 marks)



Work out the size of angle BAD .
Give your answer to 1 decimal place.



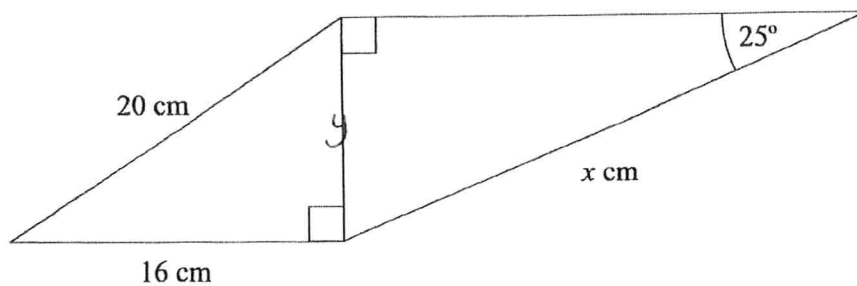
$$\begin{aligned}\tan y &= \frac{2}{15} \\ y &= \tan^{-1}\left(\frac{2}{15}\right) \\ &= \underline{\underline{7.6^\circ}} \quad (1 \text{ dp})\end{aligned}$$

$$\begin{aligned}BAD &= 90 + 7.6 \\ &= \underline{\underline{97.6^\circ}}\end{aligned}$$

97.6°

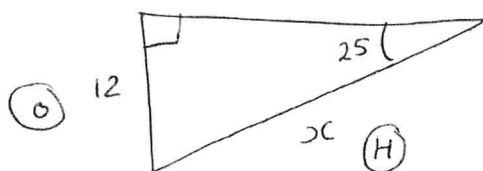
(Total for question 9 is 3 marks)

10



Work out the value of x .
Give your answer to 1 decimal place.

$$\begin{aligned}
 y^2 + 16^2 &= 20^2 \\
 y^2 &= 20^2 - 16^2 \\
 y^2 &= 144 \\
 y &= 12
 \end{aligned}$$

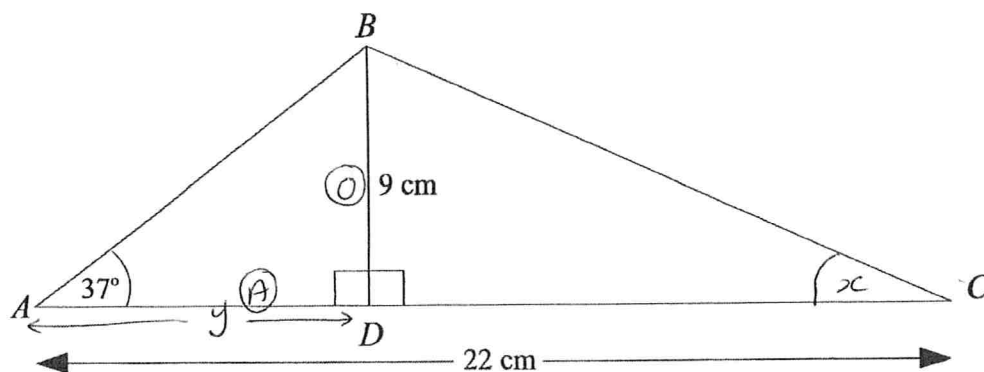


$$\begin{aligned}
 \sin(25) &= \frac{12}{x} \\
 x &= \frac{12}{\sin(25)} \\
 &= 28.4 \text{ (1 dp)}
 \end{aligned}$$

28.4

(Total for question 10 is 4 marks)

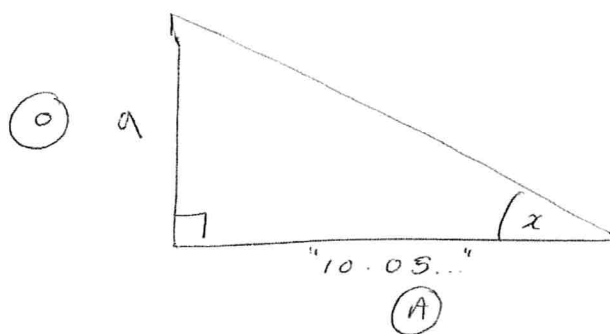
11



Work out the size of angle BCD .
Give your answer to 1 decimal place.

$$\begin{aligned}\tan(37) &= \frac{9}{y} \\ y &= \frac{9}{\tan(37)} \\ &= 11.9434\dots\end{aligned}$$

$$\begin{aligned}CD &= 22 - 11.9434 \\ &= 10.05659\dots\end{aligned}$$



$$\begin{aligned}\tan x &= \frac{9}{10.05\dots} \\ x &= \tan^{-1}\left(\frac{9}{10.05\dots}\right) \\ &= 41.8 \text{ 1dp}\end{aligned}$$

.....41.8°

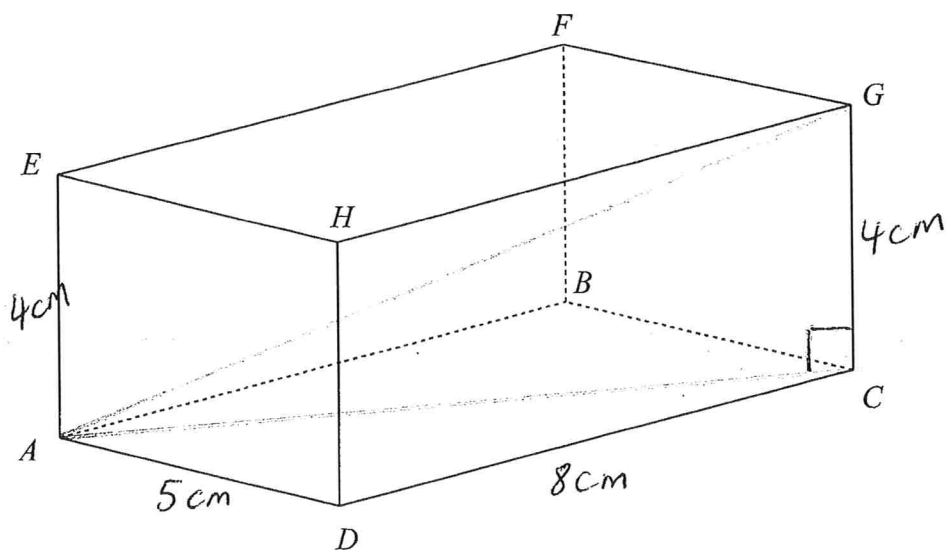
(Total for question 11 is 4 marks)

- 1 The diagram shows a cuboid $ABCDEFGH$.

$$AE = 4 \text{ cm}$$

$$AD = 5 \text{ cm}$$

$$DC = 8 \text{ cm}$$



Calculate the length of AG .
Give your answer correct to 3 significant figures.

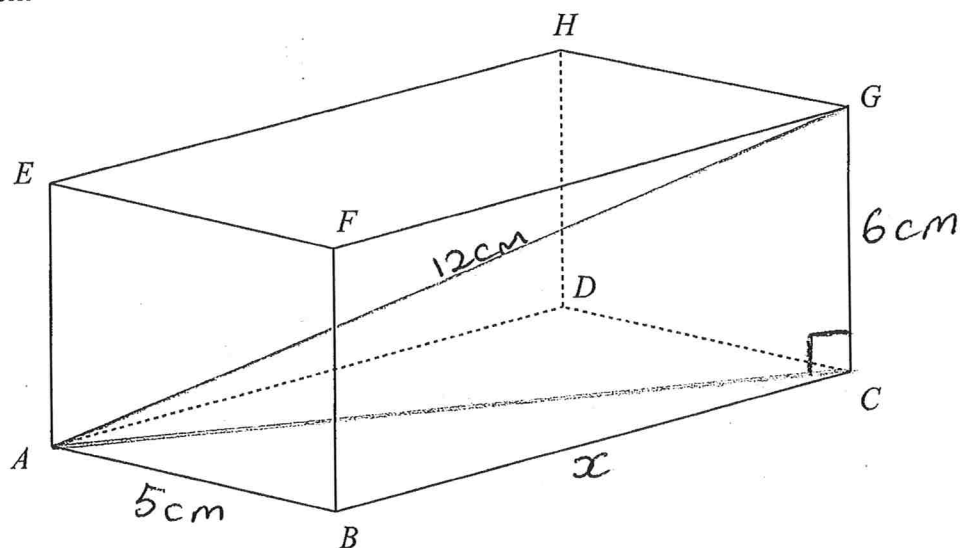
$$\begin{aligned} AG^2 &= 5^2 + 8^2 + 4^2 \\ &= \sqrt{5^2 + 8^2 + 4^2} \\ &= \underline{\underline{10.2 \text{ cm}}} \end{aligned}$$

10.2 cm

(Total for Question 1 is 3 marks)

- 2 The diagram shows a cuboid $ABCDEFGH$.

$AB = 5 \text{ cm}$
 $AE = 6 \text{ cm}$
 $AG = 12 \text{ cm}$



Calculate the length of AD .
 Give your answer correct to 3 significant figures.

$$\begin{aligned} AC^2 + 6^2 &= 12^2 \\ AC^2 &= 12^2 - 6^2 \\ AC &= \sqrt{12^2 - 6^2} \\ &= 6\sqrt{3} \text{ cm} \end{aligned}$$

$$\begin{aligned} 5^2 + x^2 &= (6\sqrt{3})^2 \\ x^2 &= (6\sqrt{3})^2 - 5^2 \\ &= 108 - 25 \\ x &= \sqrt{83} \\ &= 9.11 \end{aligned}$$

9.11 cm

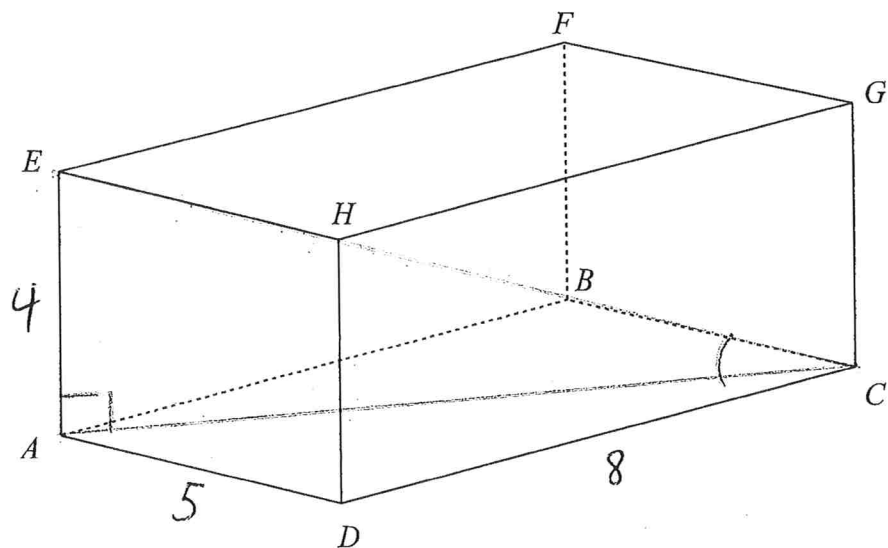
(Total for Question 2 is 4 marks)

3 The diagram shows a cuboid $ABCDEFGH$.

$$AE = 4 \text{ cm}$$

$$AD = 5 \text{ cm}$$

$$DC = 8 \text{ cm}$$

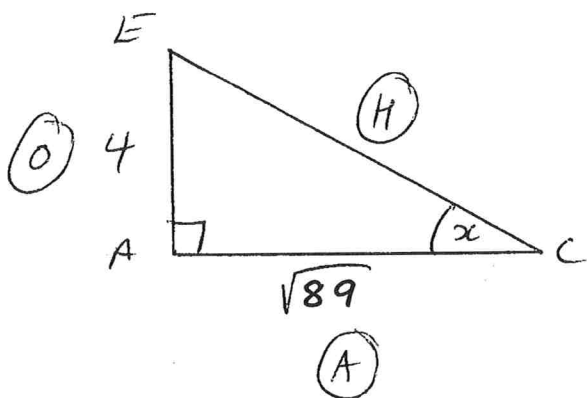


Calculate the size of angle ECA .
Give your answer correct to 3 significant figures.

$$AC^2 = 5^2 + 8^2$$

$$AC = \sqrt{5^2 + 8^2}$$

$$= \sqrt{89}$$



$$\tan x = \frac{O}{A}$$

$$= \frac{4}{\sqrt{89}}$$

$$x = \tan^{-1}\left(\frac{4}{\sqrt{89}}\right)$$

$$= 23.0^\circ$$

$$23.0^\circ$$

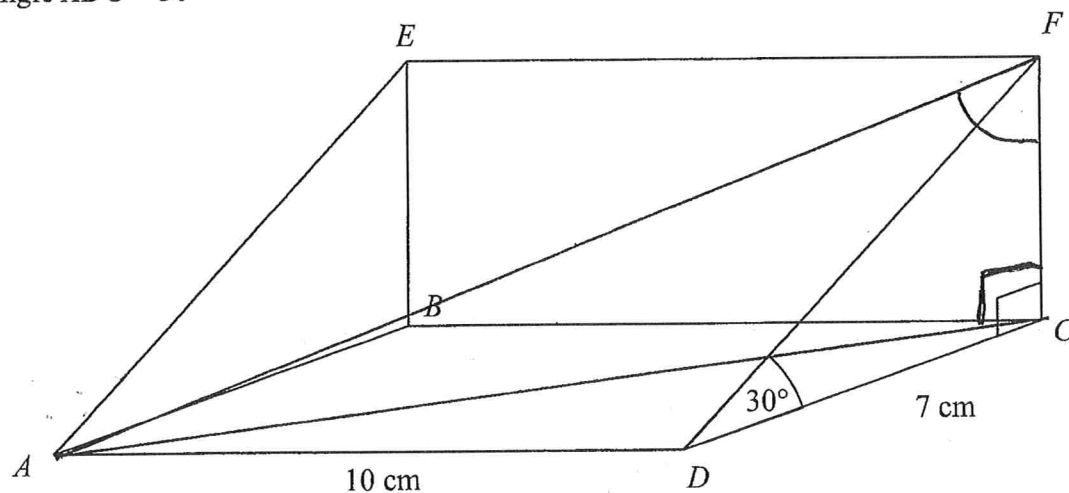
(Total for Question 3 is 4 marks)

- 4 The diagram shows a triangular prism.

$$CD = 7 \text{ cm}$$

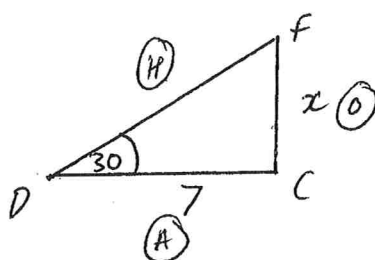
$$AD = 10 \text{ cm}$$

$$\text{Angle } ADC = 30^\circ$$



Calculate the size of angle AFC .

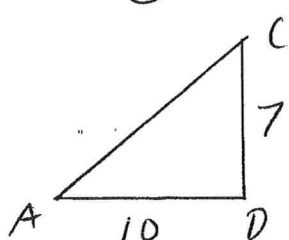
Give your answer correct to 1 decimal place.



$$\tan 30 = \frac{x}{7}$$

$$x = 7 \tan 30$$

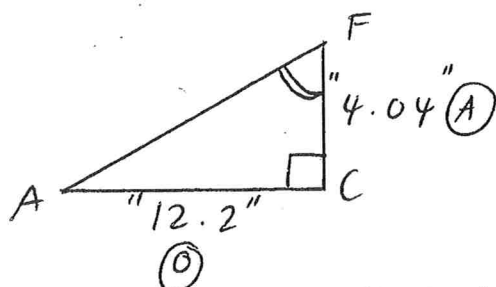
$$= 4.04145\dots$$



$$AC^2 = 10^2 + 7^2$$

$$AC = \sqrt{10^2 + 7^2}$$

$$= 12.2065\dots$$



$$\tan \theta = \frac{12.2}{4.04}$$

$$\theta = \tan^{-1}\left(\frac{12.2}{4.04}\right)$$

$$= 71.7$$

$$71.7^\circ$$

(Total for Question 4 is 4 marks)

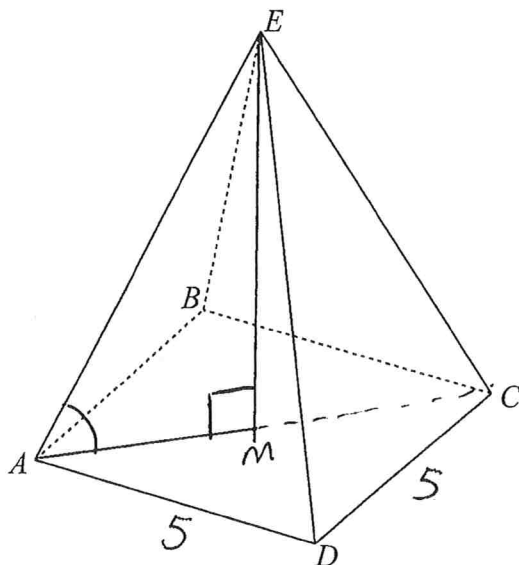
5

The diagram shows a pyramid.

The base of the pyramid $ABCD$ is a square.

$AB = 5$ cm

The point E is 10 cm vertically above the base.



Calculate the size of angle EAC .

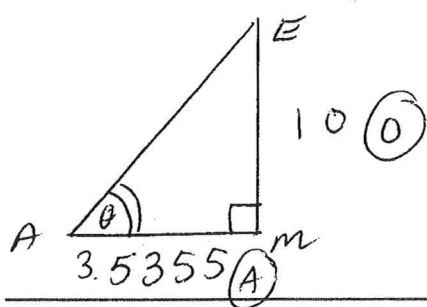
$$AC^2 = 5^2 + 5^2$$

$$AC = \sqrt{5^2 + 5^2}$$

$$= 7.07106...$$

$$AM = \frac{7.07106}{2}$$

$$= 3.5355$$



$$\tan \theta = \frac{10}{3.5355}$$

$$\theta = \tan^{-1}\left(\frac{10}{3.5355}\right)$$

$$= 70.5$$

$$70.5^\circ$$

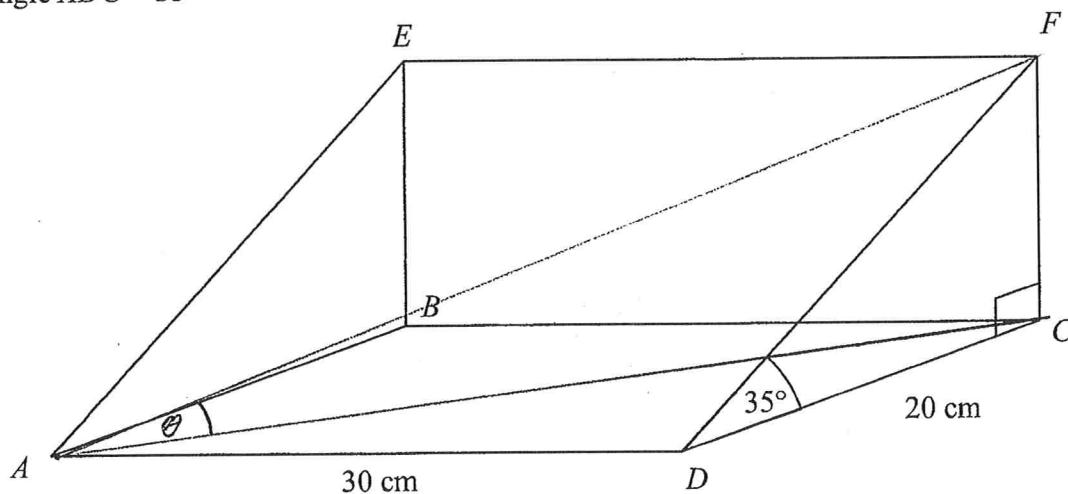
(Total for Question 5 is 4 marks)

- 6 The diagram shows a triangular prism.

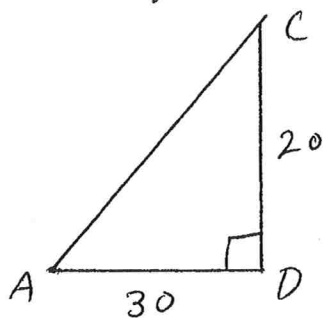
$$CD = 20 \text{ cm}$$

$$AD = 30 \text{ cm}$$

$$\text{Angle } ADC = 35^\circ$$



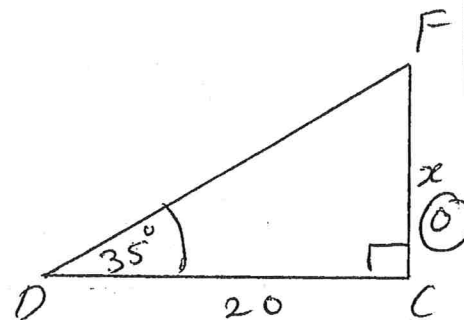
Calculate the size of angle the line AF makes with the plane $ABCD$.
Give your answer correct to 3 significant figures.



$$AC^2 = 30^2 + 20^2$$

$$AC = \sqrt{30^2 + 20^2}$$

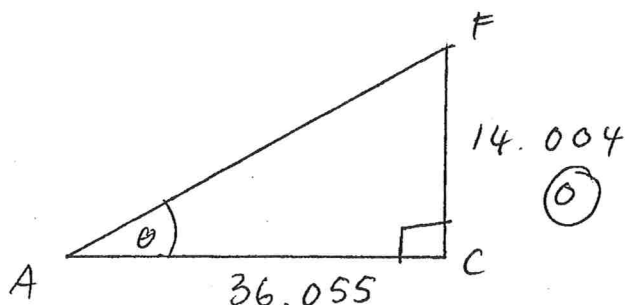
$$= 36.0555 \text{ cm}$$



$$\tan 35 = \frac{x}{20}$$

$$x = 20 \tan 35$$

$$= 14.004$$



$$\tan \theta = \frac{14.004}{36.055}$$

$$= 21.2^\circ$$

$$21.2^\circ$$

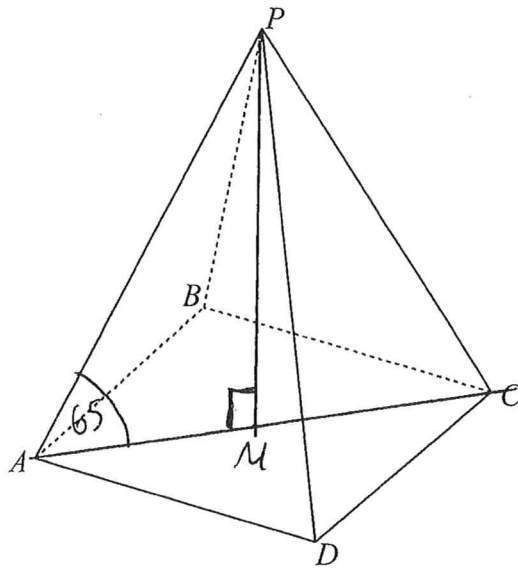
(Total for Question 6 is 4 marks)

7

The diagram shows a pyramid.
The base of the pyramid $ABCD$ is a square.

$$AB = 15 \text{ cm}$$

$$\text{Angle } PAC = 65^\circ$$



Calculate the volume of the pyramid.

$$\text{volume} = \frac{1}{3} (\text{base area}) \times \text{height}$$

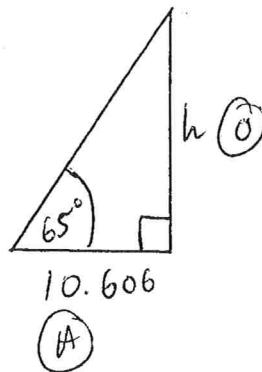
$$AC^2 = 15^2 + 15^2$$

$$AC = \sqrt{15^2 + 15^2}$$

$$= 15\sqrt{2} \text{ cm}$$

$$AM = \frac{15\sqrt{2}}{2}$$

$$= \underline{10.606 \text{ cm}}$$



$$\tan 65 = \frac{h}{10.606}$$

$$h = 10.6 \tan 65$$

$$= 22.7459 \dots \text{ cm}$$

$$\text{Area of base} = 15 \times 15$$

$$= 225 \text{ cm}^2$$

$$\text{Volume} = \frac{1}{3} (225) (22.7)$$

$$= 1706$$

$$\underline{1706} \text{ cm}^3$$

(Total for Question 7 is 5 marks)

1

$$a = \begin{pmatrix} 2 \\ 3 \end{pmatrix} \text{ and } b = \begin{pmatrix} 1 \\ 5 \end{pmatrix}$$

(a) Write down as a column vector

(i) $a + b$ $\begin{pmatrix} 2 \\ 3 \end{pmatrix} + \begin{pmatrix} 1 \\ 5 \end{pmatrix}$

$$\begin{pmatrix} 3 \\ 8 \end{pmatrix}$$

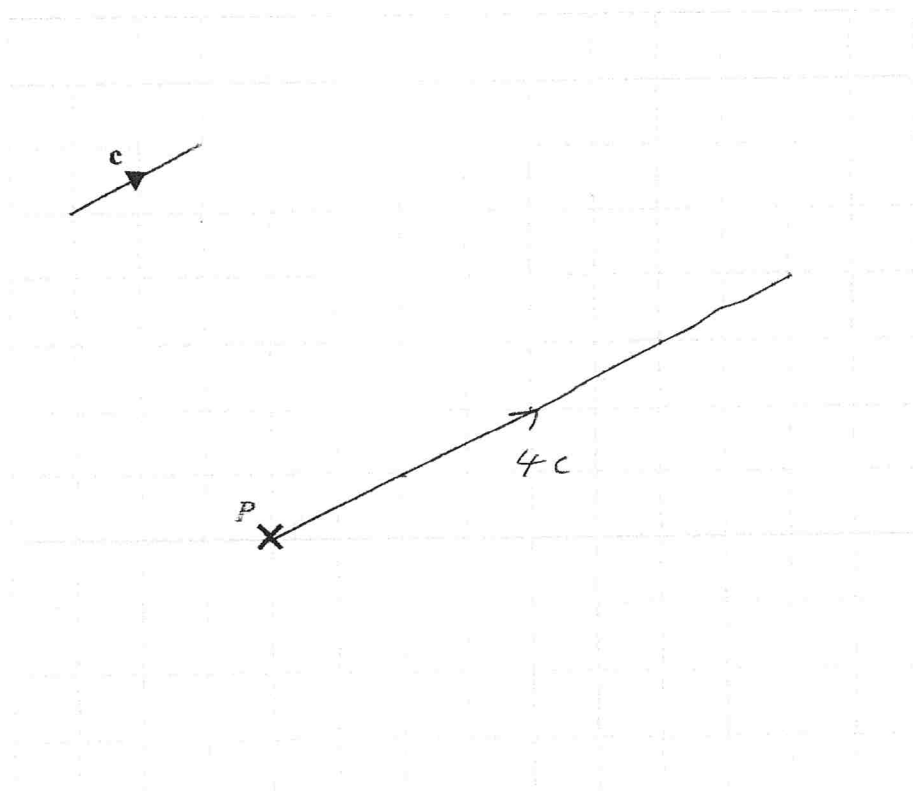
(1)

(ii) $2a + 3b$ $2\begin{pmatrix} 2 \\ 3 \end{pmatrix} + 3\begin{pmatrix} 1 \\ 5 \end{pmatrix}$

$$\begin{pmatrix} 4 \\ 6 \end{pmatrix} + \begin{pmatrix} 3 \\ 15 \end{pmatrix}$$

$$\begin{pmatrix} 7 \\ 21 \end{pmatrix}$$

(2)

The vector c is drawn on the grid.(b) From the point P , draw the vector $4c$ 

(1)

(Total for question 1 is 4 marks)

2

$$a = \begin{pmatrix} 4 \\ 1 \end{pmatrix} \text{ and } b = \begin{pmatrix} 3 \\ 2 \end{pmatrix}$$

(a) Write down as a column vector

$$(i) \ a + b \quad \begin{pmatrix} 4 \\ 1 \end{pmatrix} + \begin{pmatrix} 3 \\ 2 \end{pmatrix}$$

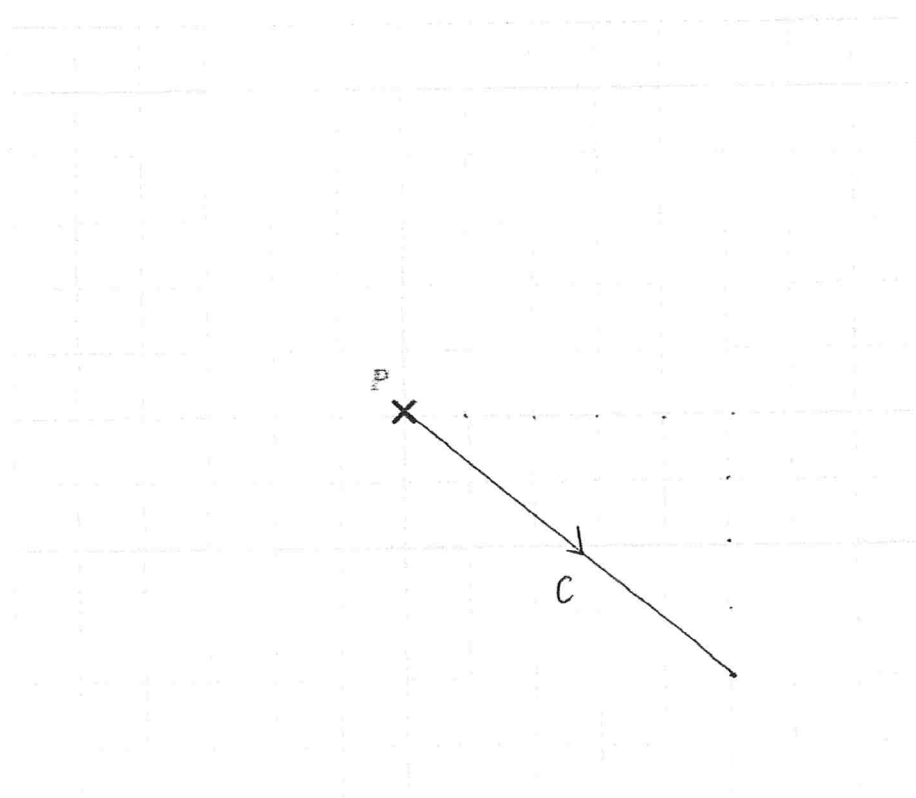
$$\begin{array}{r} \begin{pmatrix} 7 \\ 3 \end{pmatrix} \\ \hline (1) \end{array}$$

$$(ii) \ 2a - b \quad 2 \begin{pmatrix} 4 \\ 1 \end{pmatrix} - \begin{pmatrix} 3 \\ 2 \end{pmatrix}$$

$$\begin{pmatrix} 8 \\ 2 \end{pmatrix} - \begin{pmatrix} 3 \\ 2 \end{pmatrix}$$

$$\begin{array}{r} \begin{pmatrix} 5 \\ 0 \end{pmatrix} \\ \hline (2) \end{array}$$

$$c = \begin{pmatrix} 5 \\ -4 \end{pmatrix}$$

(b) From the point P , draw the vector c 

(1)

(Total for question 2 is 4 marks)

3

$$a = \begin{pmatrix} -2 \\ 3 \end{pmatrix} \text{ and } b = \begin{pmatrix} 5 \\ -1 \end{pmatrix}$$

(a) Write down as a column vector

(i) $a + b$

$$\begin{pmatrix} -2 \\ 3 \end{pmatrix} + \begin{pmatrix} 5 \\ -1 \end{pmatrix}$$

$$\begin{pmatrix} 3 \\ 2 \end{pmatrix}$$

(1)

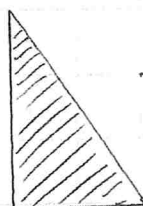
(ii) $2a - b$

$$2 \begin{pmatrix} -2 \\ 3 \end{pmatrix} - \begin{pmatrix} 5 \\ -1 \end{pmatrix}$$

$$\begin{pmatrix} -4 \\ 6 \end{pmatrix} - \begin{pmatrix} 5 \\ -1 \end{pmatrix}$$

$$\begin{pmatrix} -9 \\ 7 \end{pmatrix}$$

(2)

(b) Translate the triangle by the vector $\begin{pmatrix} 3 \\ -2 \end{pmatrix}$ 

(1)

(Total for question 3 is 4 marks)

4 A is the point $(3, 2)$ and B is the point $(4, -1)$.

(a) Write down as a column vector \overrightarrow{AB}

$$\begin{pmatrix} 4 \\ -1 \end{pmatrix} - \begin{pmatrix} 3 \\ 2 \end{pmatrix}$$

$$\begin{pmatrix} 1 \\ -3 \end{pmatrix}$$

(1)

C is the point $(5, -2)$ and D is the point $(2, 1)$.

(b) Write down as a column vector \overrightarrow{CD}

$$\begin{pmatrix} 2 \\ 1 \end{pmatrix} - \begin{pmatrix} 5 \\ -2 \end{pmatrix}$$

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

(1)

(Total for question 4 is 2 marks)

5 A is the point $(5, -1)$ and B is the point $(4, -3)$.

(a) Write down as a column vector \overrightarrow{AB}

$$\begin{pmatrix} 4 \\ -3 \end{pmatrix} - \begin{pmatrix} 5 \\ -1 \end{pmatrix}$$

$$\begin{pmatrix} -1 \\ -2 \end{pmatrix}$$

(1)

C is the point $(1, 6)$ and D is the point $(-3, 9)$.

(b) Write down as a column vector \overrightarrow{CD}

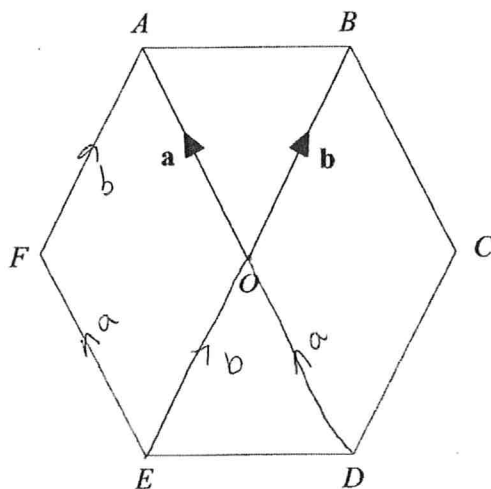
$$\begin{pmatrix} -3 \\ 9 \end{pmatrix} - \begin{pmatrix} 1 \\ 6 \end{pmatrix}$$

$$\begin{pmatrix} -4 \\ 3 \end{pmatrix}$$

(1)

(Total for question 5 is 2 marks)

- 6 $ABCDEF$ is a regular hexagon with centre O .



$$\vec{OA} = a$$

$$\vec{OB} = b$$

- (a) Find, in terms of a , the vector \vec{AD}

$$\frac{-2a}{(1)}$$

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

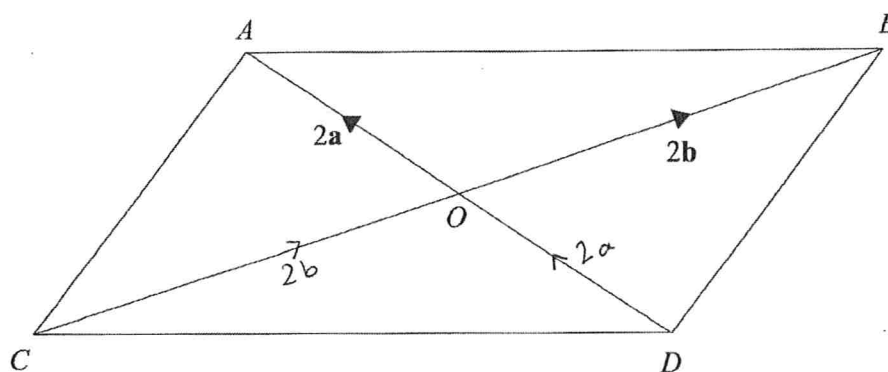
$$\frac{-a + b}{(1)}$$

- (c) Find, in terms of a and b , the vector \vec{AF}

$$\frac{-b}{(1)}$$

(Total for question 6 is 3 marks)

- 7 The diagram shows a parallelogram.



$$\vec{OA} = 2a$$

$$\vec{OB} = 2b$$

- (a) Find, in terms of a , the vector \vec{DA}

$$\frac{4a}{(1)}$$

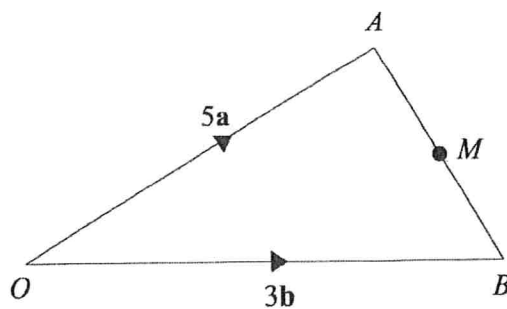
- (b) Find, in terms of a and b , the vector \vec{AB}

$$\frac{-2a + 2b}{(1)}$$

- (c) Find, in terms of a and b , the vector \vec{AC}

$$\frac{-2a - 2b}{(1)}$$

(Total for question 7 is 3 marks)



$$\vec{OA} = 5a$$

$$\vec{OB} = 3b$$

M is the midpoint of AB

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

$$\frac{-5a + 3b}{(1)}$$

- (b) Find, in terms of a and b, the vector \vec{AM}

half of \vec{AB}

$$\frac{-\frac{5}{2}a + \frac{3}{2}b}{(1)}$$

- (c) Find, in terms of a and b, the vector \vec{OM}

$$5a - \frac{5}{2}a + \frac{3}{2}b$$

or $5a - 2.5a + 1.5b$

$$\frac{\frac{5}{2}a + \frac{3}{2}b}{(1)}$$

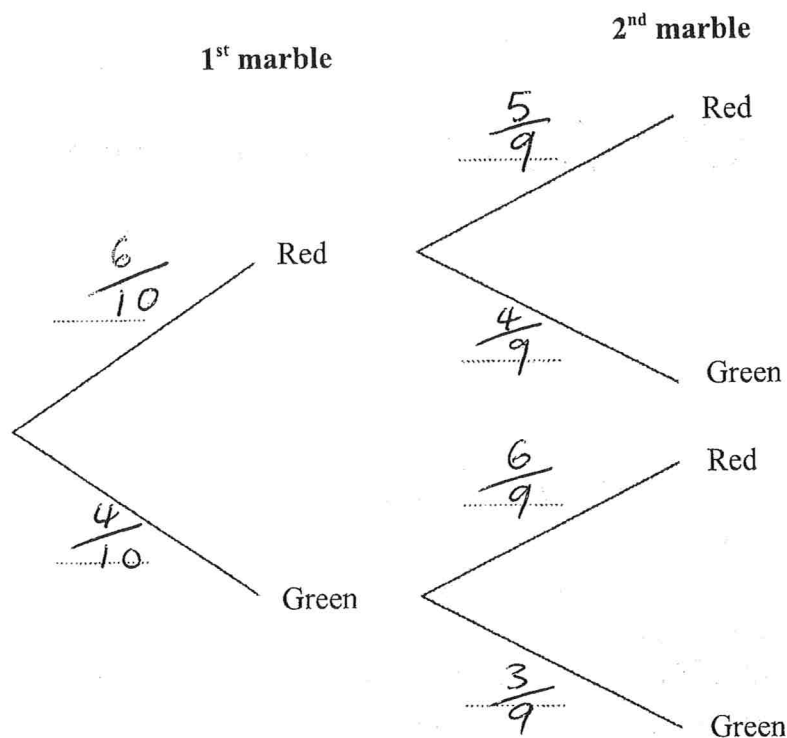
(Total for question 8 is 3 marks)

- 1 There are only red marbles and green marbles in a bag.
There are 6 red marbles and 4 green marbles.

Mason takes at random a marble from the bag.
He does not put the marble back in the bag.

Mason takes at random a second marble from the bag.

- (a) Complete the probability tree diagram.



(2)

- (b) Work out the probability that Mason takes two marbles the same colour.

$$P(\text{Red, Red}) = \frac{6}{10} \times \frac{5}{9} = \frac{30}{90}$$

$$\begin{matrix} \text{Green} & \text{Green} \\ P(\text{blue, blue}) \end{matrix} = \frac{4}{10} \times \frac{3}{9} = \frac{12}{90}$$

$$\frac{30}{90} + \frac{12}{90} = \frac{42}{90}$$

$$\frac{42}{90}$$

(2)

(Total for Question 1 is 4 marks)

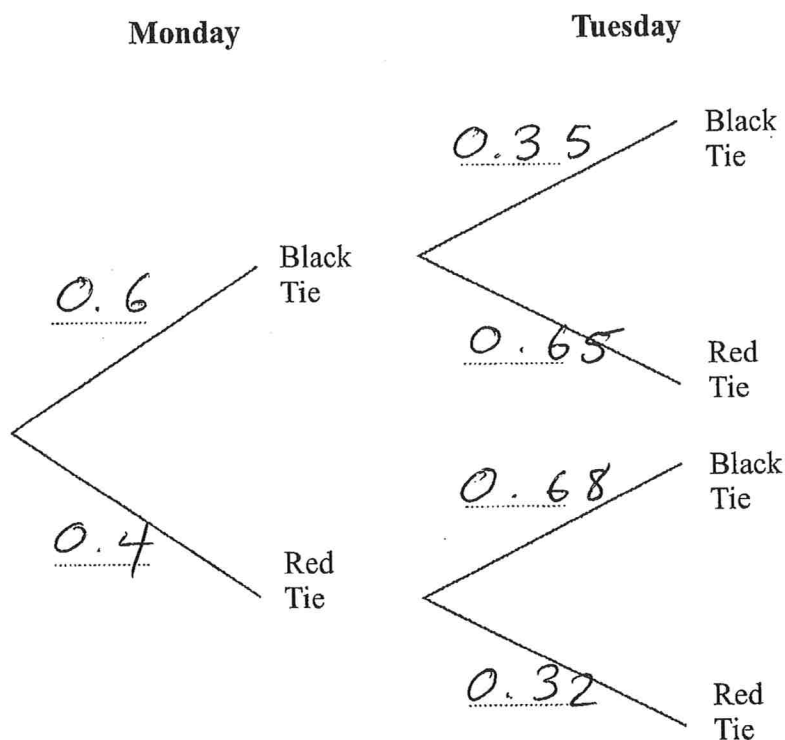
$$\left[\text{or } \frac{7}{15} \right]$$

- 2 Each day Paul wears either a black tie or a red tie to work.

On Monday the probability he wears a black tie is 0.6

If Paul wears a black tie on Monday, the probability that he will wear a black tie on Tuesday is 0.35
If he does **not** wear a black tie on Monday, the probability that he will wear a black tie on Tuesday is 0.68

- (a) Complete the probability tree diagram.



(2)

- (b) Work out the probability Paul wears different coloured ties on Monday and Tuesday .

$$P(\text{Black, Red}) = 0.6 \times 0.65 = 0.39$$

$$P(\text{Red, Black}) = 0.4 \times 0.68 = 0.272$$

$$0.39 + 0.272 = 0.662 \quad \underline{0.662} \quad (3)$$

(Total for Question 2 is 5 marks)

$$\left[\frac{331}{500} \right]$$

3 There are 8 counters in a bag.

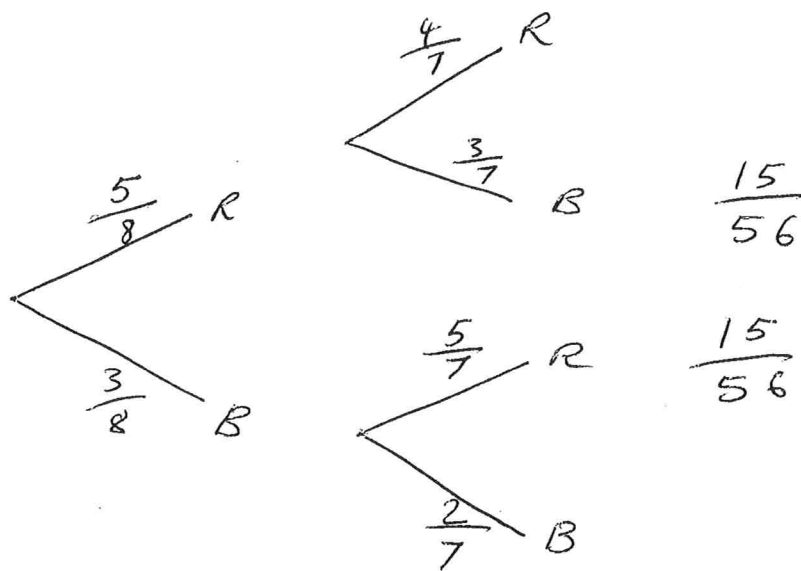
5 of the counters are red.

3 of the counters are blue.

Two counters are taken at random from the bag.

Work out the probability that one counter of each colour are taken.

You must show your working.



$$\frac{15}{56} + \frac{15}{56} = \frac{30}{56}$$

$$\frac{30}{56}$$

(Total for Question 3 is 4 marks)

$$\left[\text{OR } \frac{15}{28} \right]$$

4 There are 10 counters in a bag.

5 of the counters are red.

3 of the counters are blue.

2 of the counters are green.

Billie takes two counters are taken at random from the bag.

Work out the probability that both of the counters Billie takes are the same colour.

You must show your working.

$$P(\text{Red, Red}) = \frac{5}{10} \times \frac{4}{9} = \frac{20}{90}$$

$$P(\text{Blue, Blue}) = \frac{3}{10} \times \frac{2}{9} = \frac{6}{90}$$

$$P(\text{Green, Green}) = \frac{2}{10} \times \frac{1}{9} = \frac{2}{90}$$

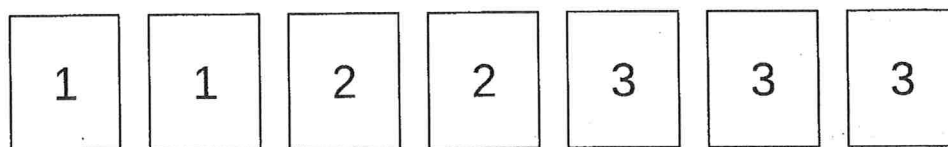
$$\frac{20}{90} + \frac{6}{90} + \frac{2}{90} = \frac{28}{90}$$

$$\frac{28}{90}$$

(Total for Question 4 is 4 marks)

$$\left(\text{or } \frac{14}{45} \right)$$

5 Here are seven number cards.



Helen takes a card at random.
She does not replace the card.

Helen then takes another card at random.

(a) Calculate the probability that both cards have the same number on them.

$$P(1, 1) = \frac{2}{7} \times \frac{1}{6} = \frac{2}{42}$$

$$P(2, 2) = \frac{2}{7} \times \frac{1}{6} = \frac{2}{42}$$

$$P(3, 3) = \frac{3}{7} \times \frac{2}{6} = \frac{6}{42}$$

$$\frac{2}{42} + \frac{2}{42} + \frac{6}{42} = \frac{10}{42}$$

$$\frac{10}{42}$$

(or $\frac{5}{21}$) (3)

(b) Calculate the probability that the number on the second card Helen takes is greater than the number on the first card she takes.

$$P(1, 2) = \frac{2}{7} \times \frac{2}{6} = \frac{4}{42}$$

$$P(1, 3) = \frac{2}{7} \times \frac{3}{6} = \frac{6}{42}$$

$$P(2, 3) = \frac{2}{7} \times \frac{3}{6} = \frac{6}{42}$$

$$\frac{4}{42} + \frac{6}{42} + \frac{6}{42} = \frac{16}{42}$$

$$\frac{16}{42}$$

(3)

(Total for Question 5 is 6 marks)

$$(or \frac{8}{21})$$

6 50 people were asked if they like tea, coffee and hot chocolate.

Every person liked at least one of the drinks.

17 of the people like all three drinks.

31 of the people like hot chocolate

34 of the people like tea.

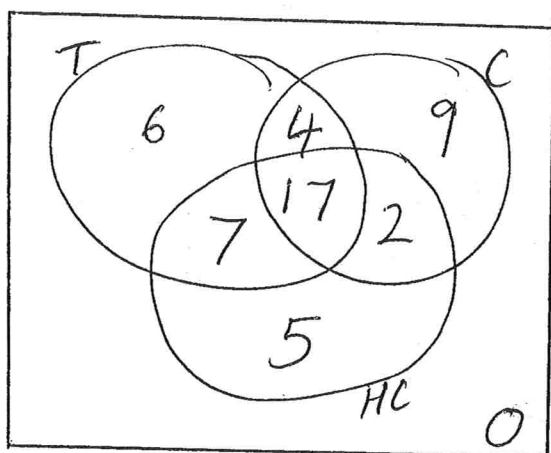
21 of the people like tea and coffee.

7 of the people like tea and hot chocolate but not coffee

2 of the people like coffee and hot chocolate but not tea

Two of the 50 people are chosen at random.

Work out the probability that they both like coffee.



32 like coffee

$$\frac{32}{50} \times \frac{31}{49} = \frac{496}{1225}$$

$$\frac{496}{1225}$$

(Total for Question 6 is 5 marks)

OR 0.405

$$\text{OR } \frac{992}{2450}$$

7

11 people like all three fruits.

33 people like apples.

6 like apples and bananas but not oranges.

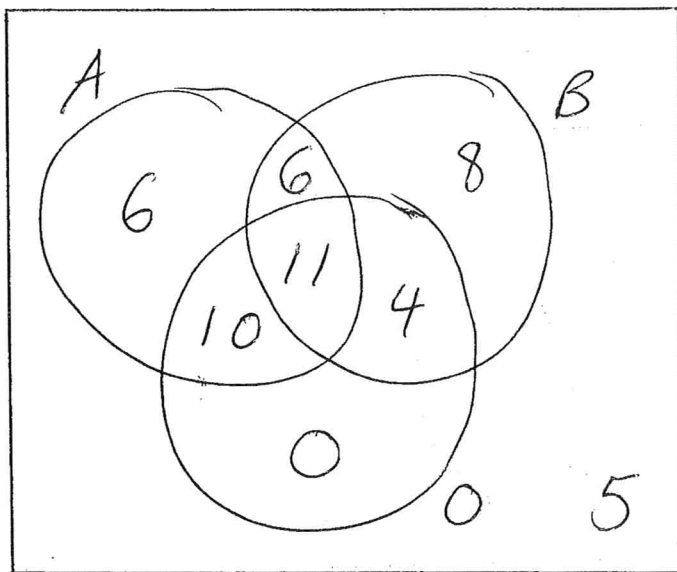
15 like bananas and oranges.

5 of the people do not like any of the fruits.

All 25 people who like oranges like at least one other fruit.

Two of the 50 people are chosen at random.

Work out the probability that they both like bananas.



29
34 like bananas

$$\begin{array}{r} 29 \\ 34 \\ \hline 50 \end{array} \times \begin{array}{r} 28 \\ 33 \\ \hline 49 \end{array} = \frac{561}{1225}$$

$$\begin{array}{r} 58 \\ \hline 56 \overline{) 175} \\ \underline{122} \\ 53 \end{array}$$

(Total for Question 7 is 5 marks)

OR

$$\begin{array}{r} 0.458 \\ 0.331 \\ \hline 1.122812 \\ \hline 2450 \end{array}$$

6 50 people were asked if they like tea, coffee and hot chocolate.

Every person liked at least one of the drinks.

17 of the people like all three drinks.

31 of the people like hot chocolate

34 of the people like tea.

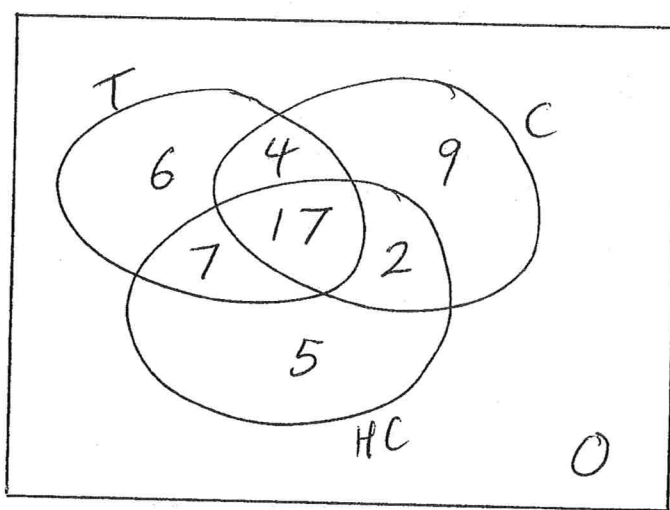
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Two of the 50 people are chosen at random.

Work out the probability that they both like coffee.



32 like coffee

$$\frac{32}{50} \times \frac{31}{49} = \frac{496}{1225}$$

$$\frac{496}{1225}$$

(Total for Question 6 is 5 marks)

OR $\frac{992}{2450}$

OR 0.405

7 50 people were asked which fruits they liked from apples, bananas and oranges.

11 people like all three fruits.

33 people like apples.

6 like apples and bananas but not oranges.

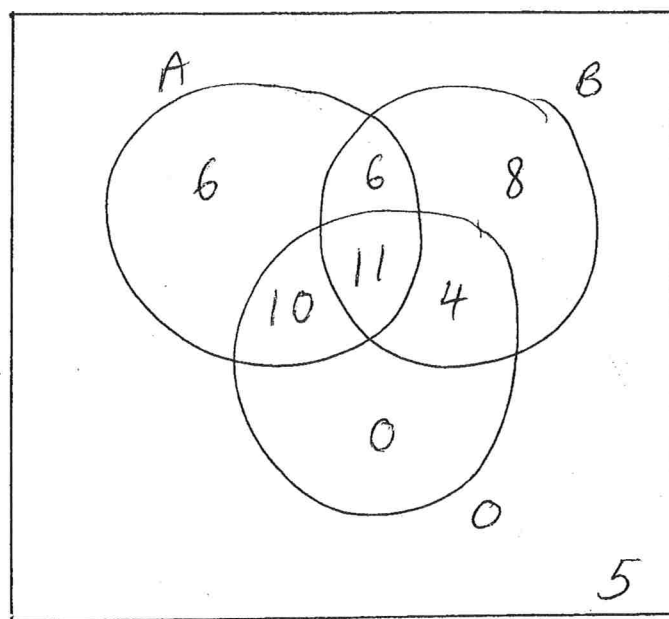
15 like bananas and oranges.

5 of the people do not like any of the fruits.

All 25 people who like oranges like at least one other fruit.

Two of the 50 people are chosen at random.

Work out the probability that they both like bananas.



29 like bananas

$$\frac{29}{50} \times \frac{28}{49} = \frac{561}{1225} = \frac{58}{175}$$

$$\frac{58}{175}$$

(Total for Question 7 is 5 marks)

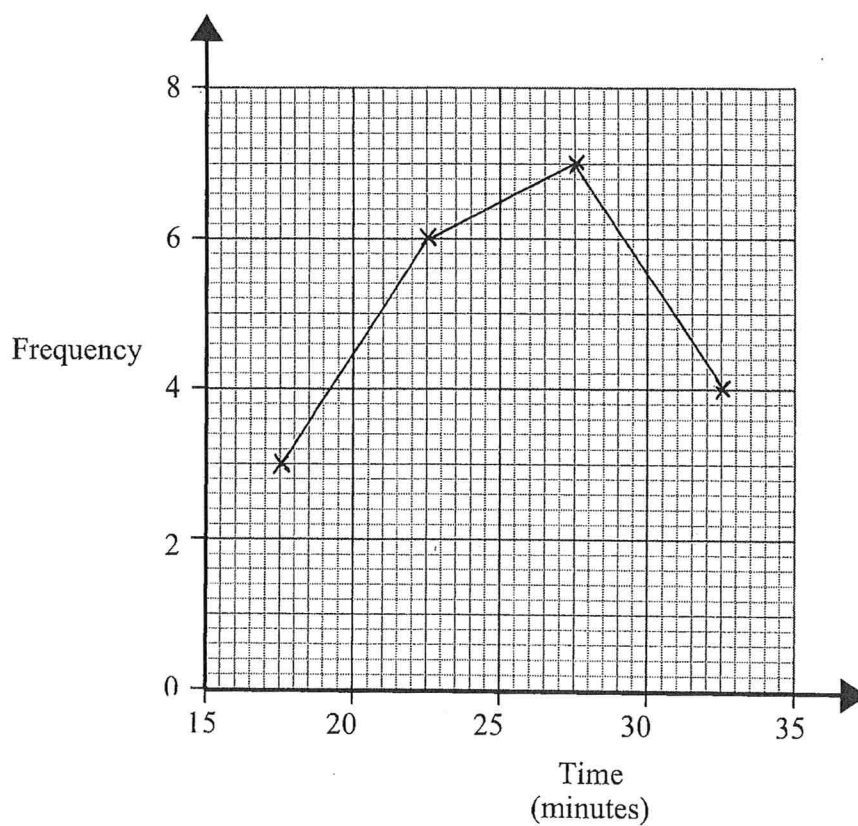
OR $\frac{812}{2450}$

OR 0.331

- 1 The table below gives information about the time taken for 20 people to run 5 km.

Time (minutes)	Frequency
$15 < t \leq 20$	3
$20 < t \leq 25$	6
$25 < t \leq 30$	7
$30 < t \leq 35$	4

Draw a frequency polygon to show this information.

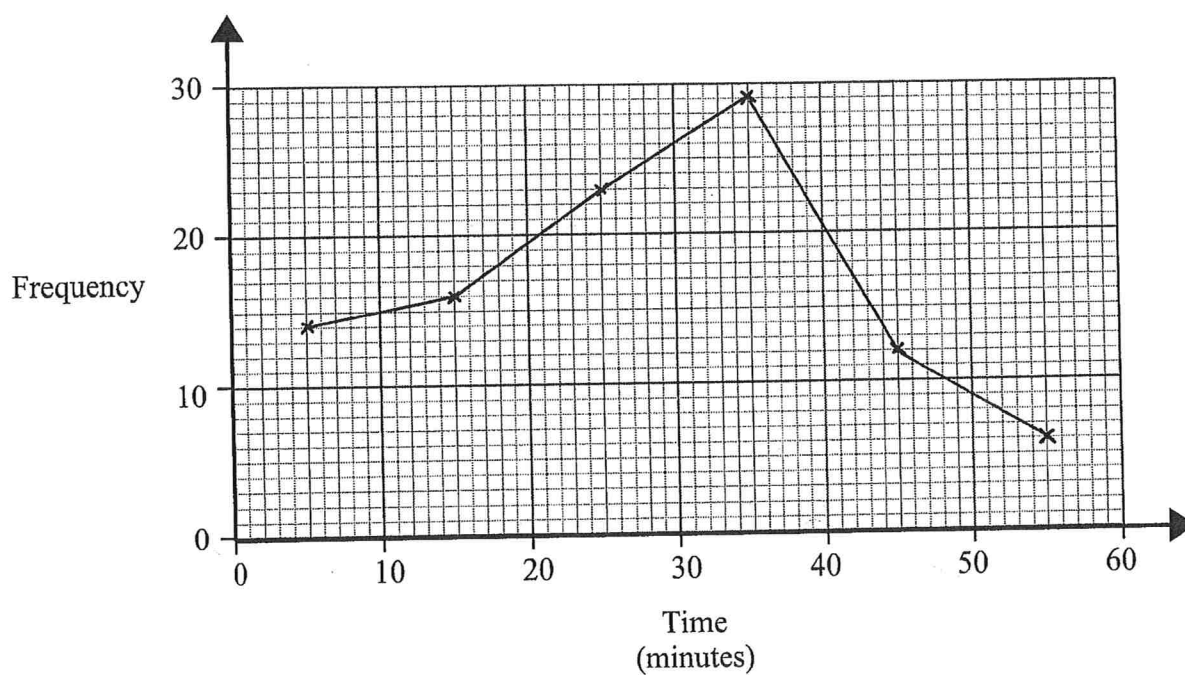


(Total for Question 1 is 2 marks)

- 2 The frequency table shows the time taken for 100 people to travel to an event.

Time (minutes)	Frequency
$0 < t \leq 10$	14
$10 < t \leq 20$	16
$20 < t \leq 30$	23
$30 < t \leq 40$	29
$40 < t \leq 50$	12
$50 < t \leq 60$	6

Draw a frequency polygon to show this information.

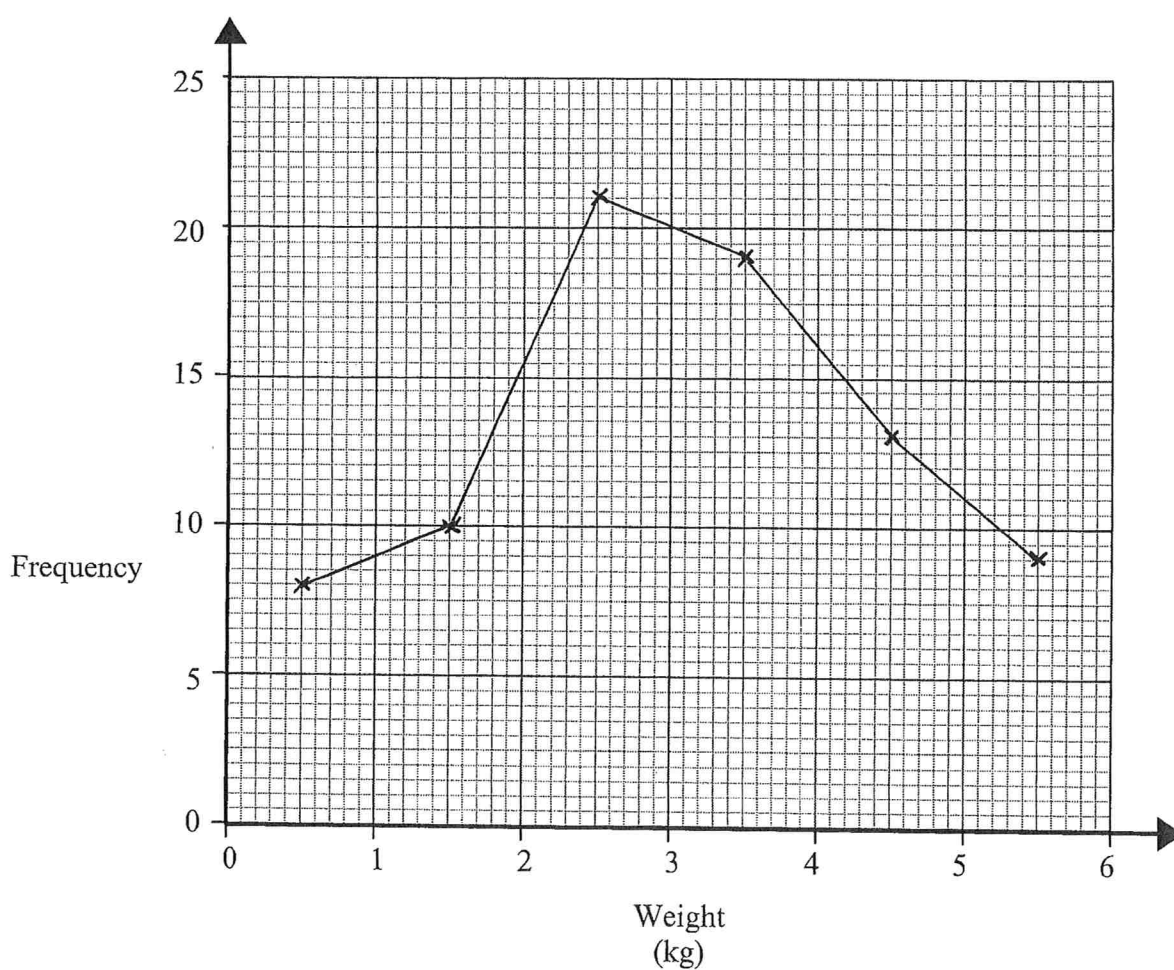


(Total for Question 2 is 2 marks)

- 3 The frequency table shows the weight, in kg, of some cats.

Weight (kg)	Frequency
$0 < w \leq 1$	8
$1 < w \leq 2$	10
$2 < w \leq 3$	21
$3 < w \leq 4$	19
$4 < w \leq 5$	13
$5 < w \leq 6$	9

Draw a frequency polygon to show this information.



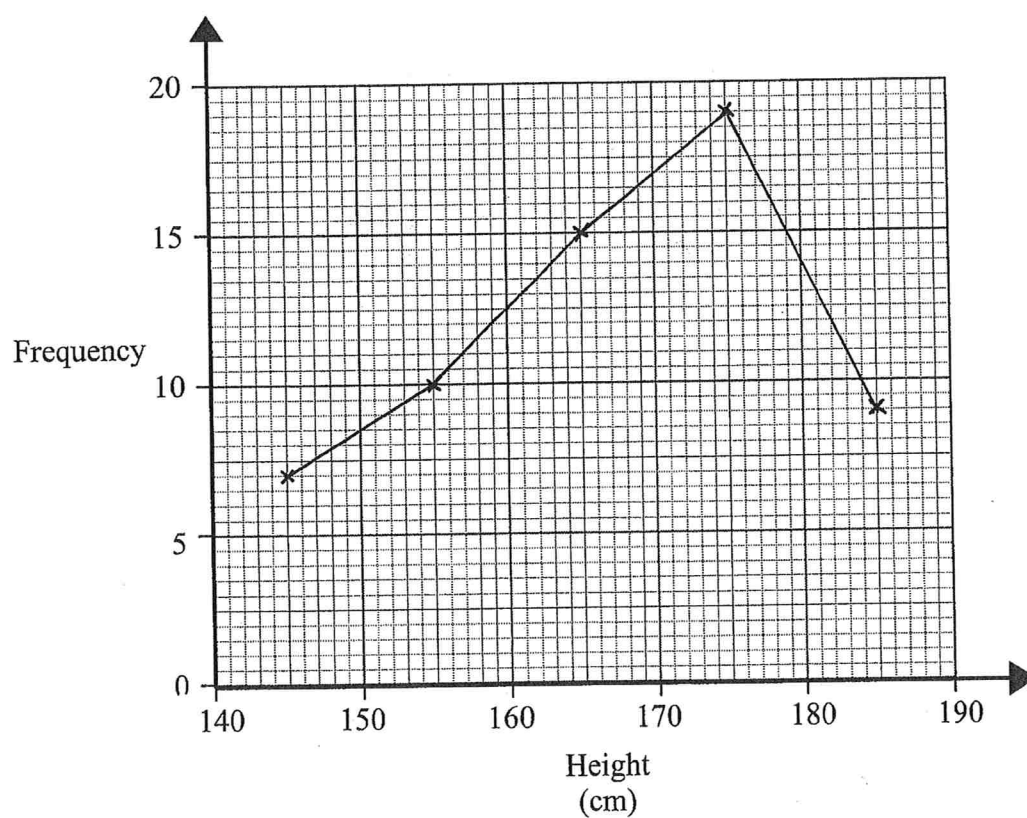
(Total for Question 3 is 2 marks)

4

The frequency table shows the heights, in cm, of some tomato plants.

Height (cm)	Frequency
$140 < h \leq 150$	7
$150 < h \leq 160$	10
$160 < h \leq 170$	15
$170 < h \leq 180$	19
$180 < h \leq 190$	9

Draw a frequency polygon to show this information.

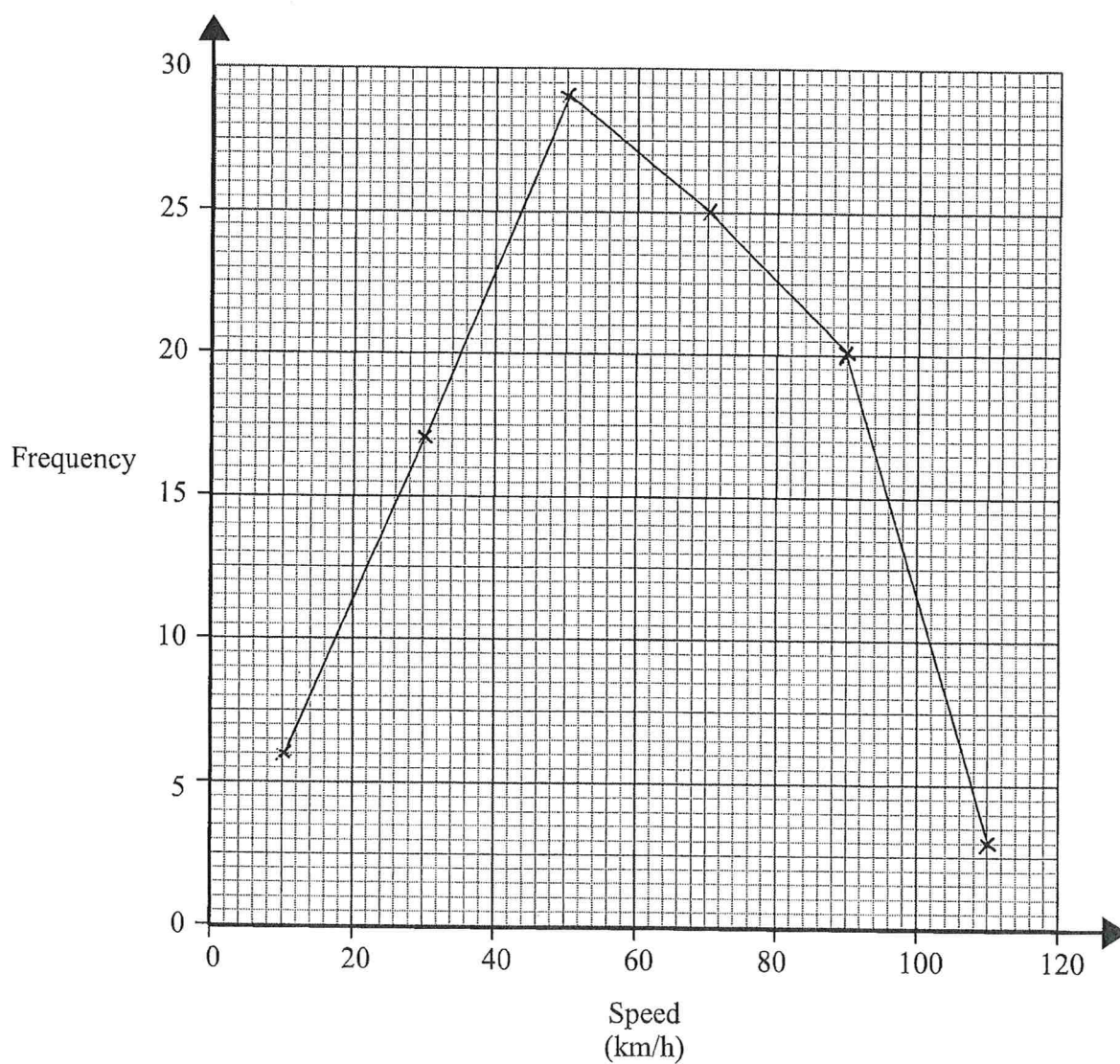


(Total for Question 4 is 2 marks)

- 5 The frequency table shows the speeds of 100 cars.

Speed (km/h)	Frequency
$0 < s \leq 20$	6
$20 < s \leq 40$	17
$40 < s \leq 60$	29
$60 < s \leq 80$	25
$80 < s \leq 100$	20
$100 < s \leq 120$	3

Draw a frequency polygon to show this information.

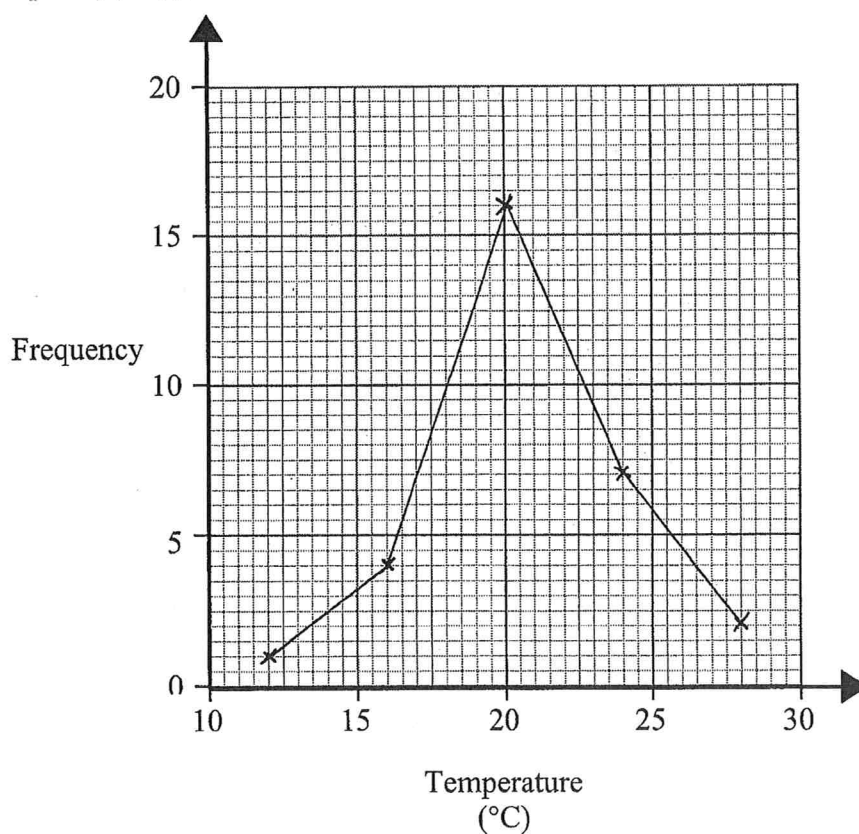


(Total for Question 5 is 2 marks)

- 6 The frequency table shows the temperature, in degrees, of 30 days.

Temperature ($^{\circ}\text{C}$)	Frequency
$10 < t \leq 14$	1
$14 < t \leq 18$	4
$18 < t \leq 22$	16
$22 < t \leq 26$	7
$26 < t \leq 30$	2

Draw a frequency polygon to show this information.

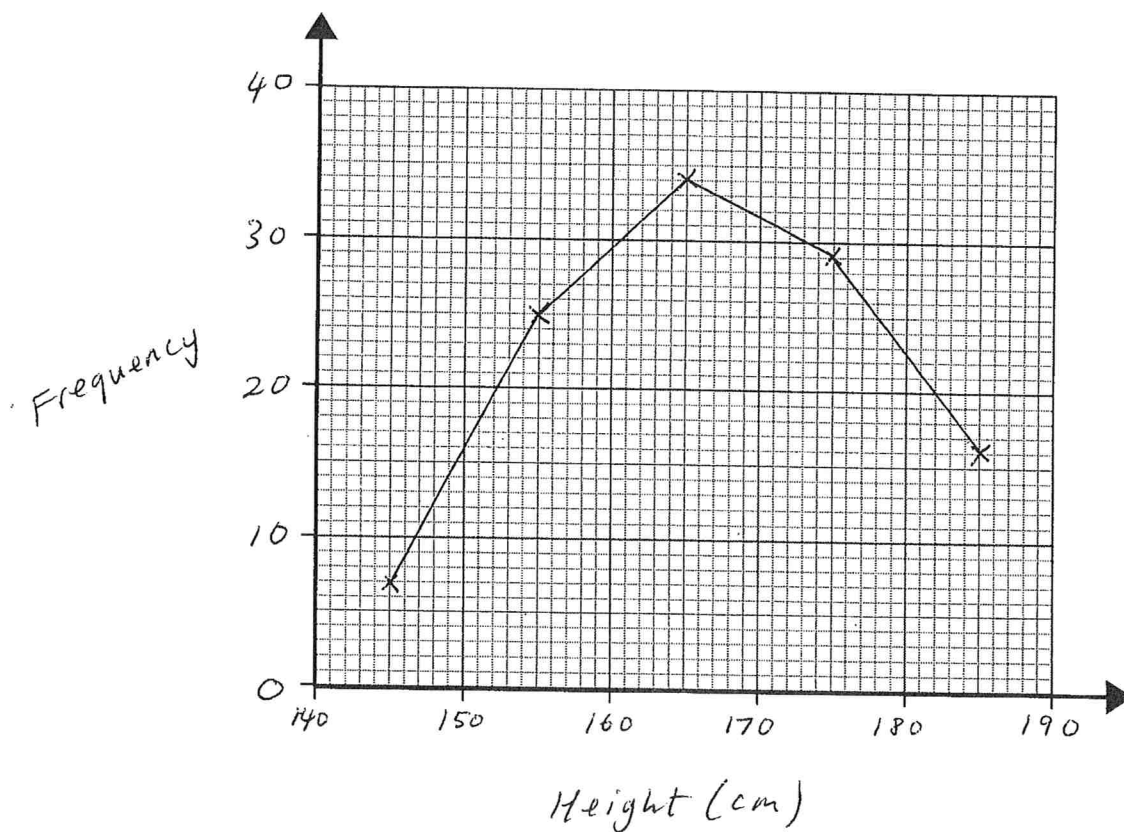


(Total for Question 6 is 2 marks)

- 7 The frequency table shows the heights, in cm, of some people.

Height (cm)	Frequency
$140 < h \leq 150$	7
$150 < h \leq 160$	25
$160 < h \leq 170$	34
$170 < h \leq 180$	29
$180 < h \leq 190$	16

Draw a frequency polygon to show this information.



(Total for Question 7 is 4 marks)

1 The table shows information about the age of 80 teachers.

$$F.d = \frac{\text{Freq}}{\text{width}}$$

Age (years)	Frequency
$20 < a \leq 30$ ¹⁰	20
$30 < a \leq 35$ ⁵	22
$35 < a \leq 40$ ⁵	16
$40 < a \leq 50$ ¹⁰	13
$50 < a \leq 65$ ¹⁵	9

F.d.

$$2 \quad [20 \div 10]$$

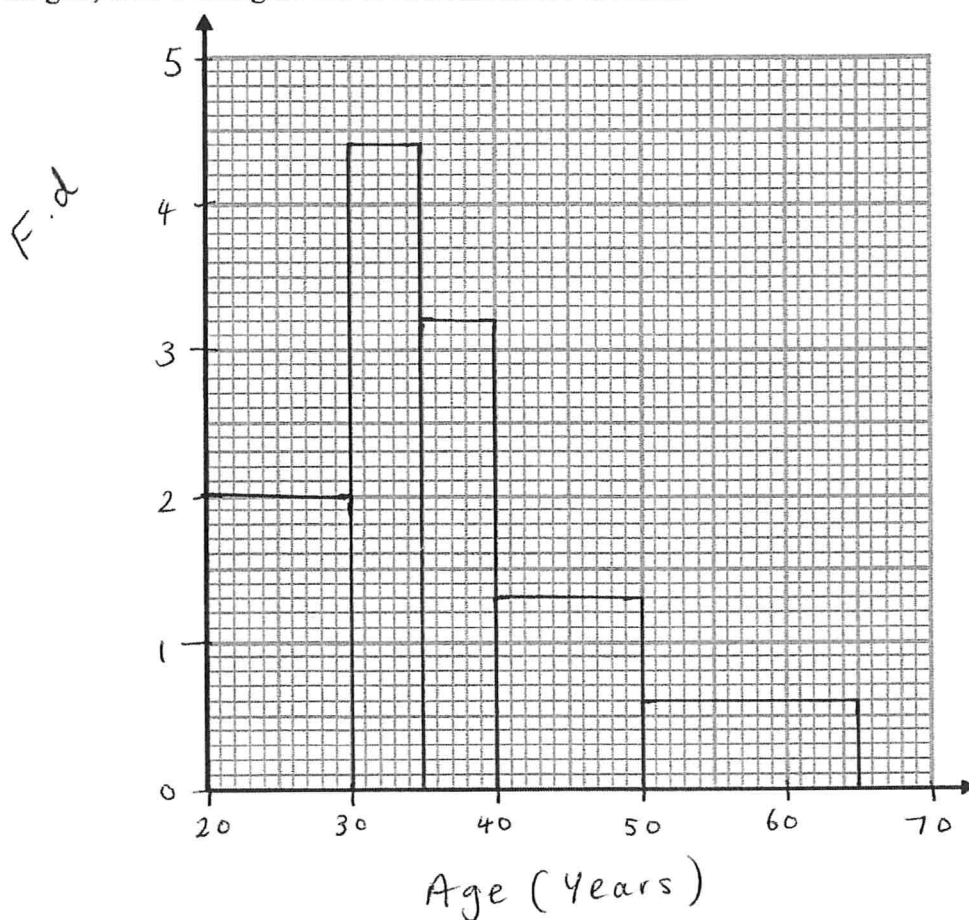
$$4.4 \quad [22 \div 5]$$

$$3.2 \quad [16 \div 5]$$

$$1.3 \quad [13 \div 10]$$

$$0.6 \quad [9 \div 15]$$

On the grid, draw a histogram for the information in the table.



(Total for question 1 is 3 marks)

- 2 The table shows information about the speed, in mph, of some cars.

Speed (mph)	Frequency
$40 < s \leq 55$ ¹⁵	6
$55 < s \leq 60$ ⁵	10
$60 < s \leq 65$ ⁵	46
$65 < s \leq 75$ ¹⁰	48
$75 < s \leq 90$ ¹⁵	6

F.d.

0.4

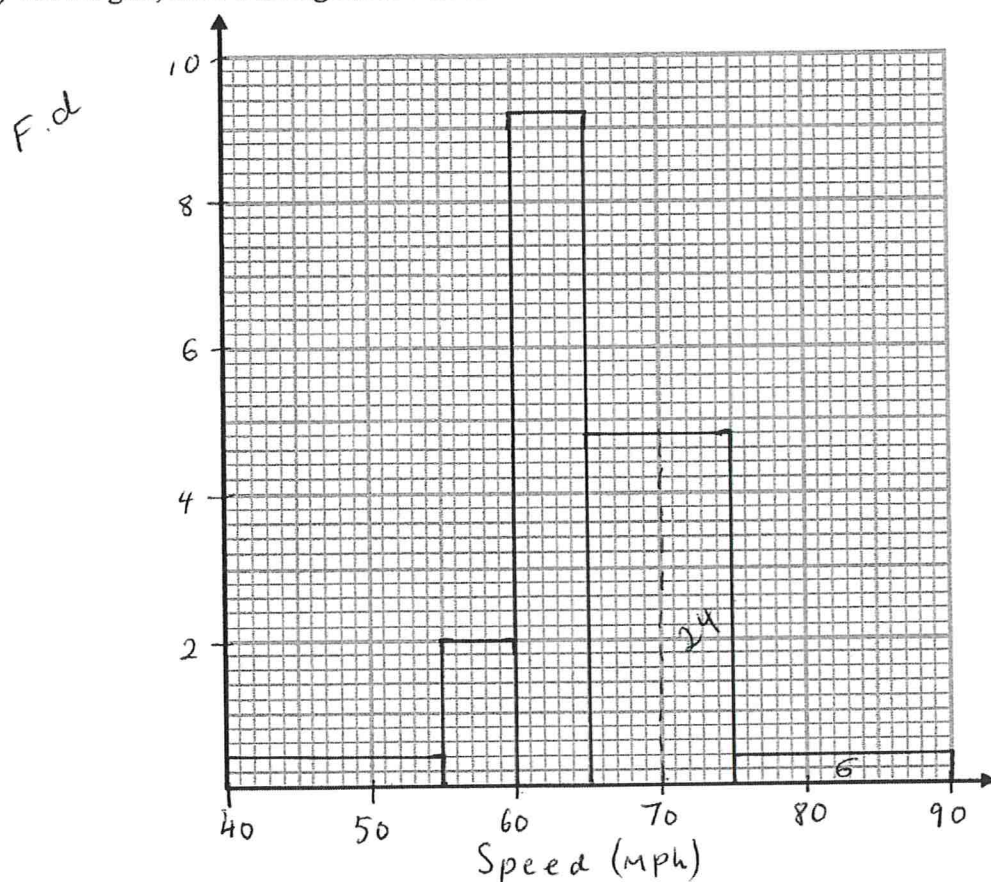
2

9.2

4.8

0.4

- (a) On the grid, draw a histogram for the information in the table.



(3)

- (b) Work out an estimate for the number of cars over 70mph.

30

(1)

(Total for question 2 is 4 marks)

3 The table shows information about the weight of 60 pigs.

Weight (kg)	Frequency
$60 < w \leq 75$ ¹⁵	9
$75 < w \leq 85$ ¹⁰	16
$85 < w \leq 90$ ⁵	25
$90 < w \leq 110$ ²⁰	10

F.d.

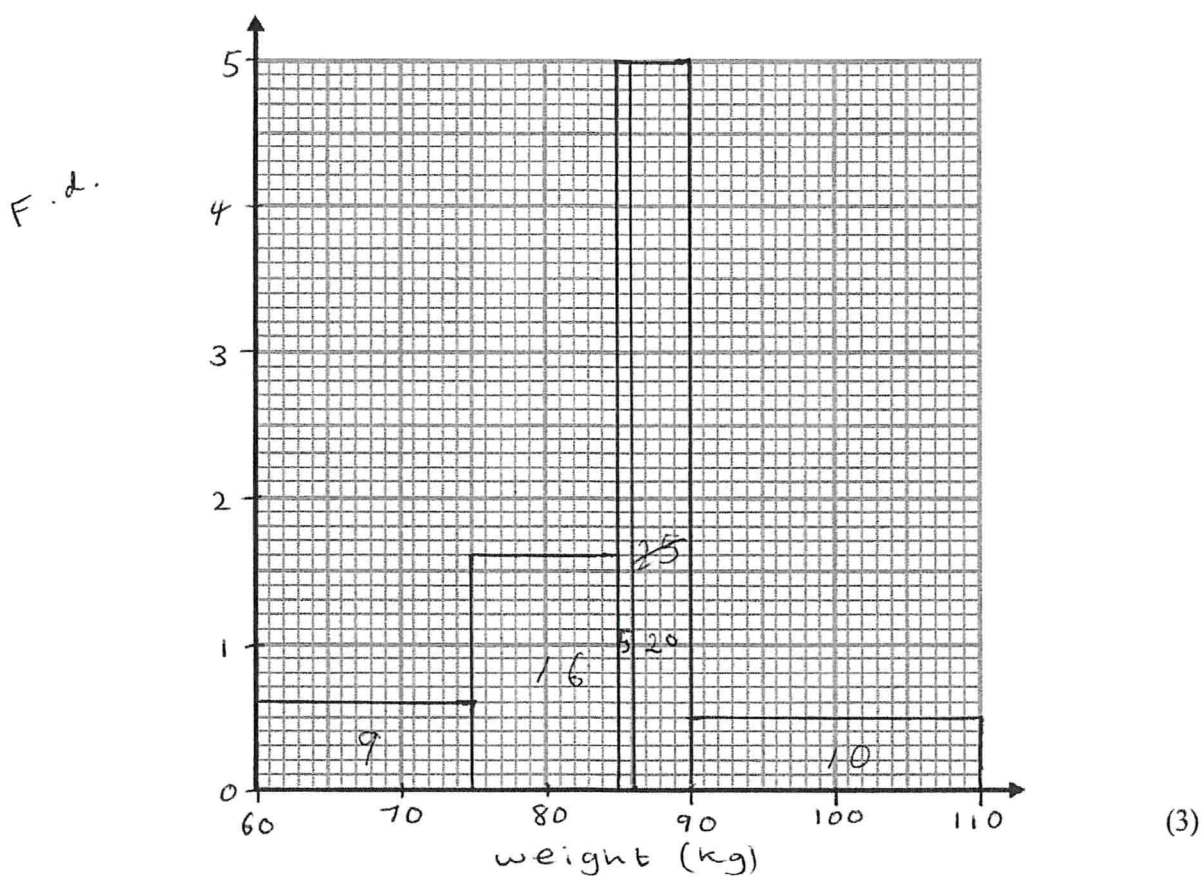
0.6

1.6

5

0.5

(a) On the grid, draw a histogram for the information in the table.



(b) Find an estimate for the median.

$$\frac{60}{2} = 30$$

30 on each side

86 kg
(2)

(Total for question 3 is 5 marks)

- 4 The table shows information about the time, in seconds, taken for some people to run a 100m race.

Time (s)	Frequency
$10 < t \leq 12$	6
$12 < t \leq 13$	21
$13 < t \leq 14$	23
$14 < t \leq 16$	42
$16 < t \leq 20$	8

$F = 2$

3

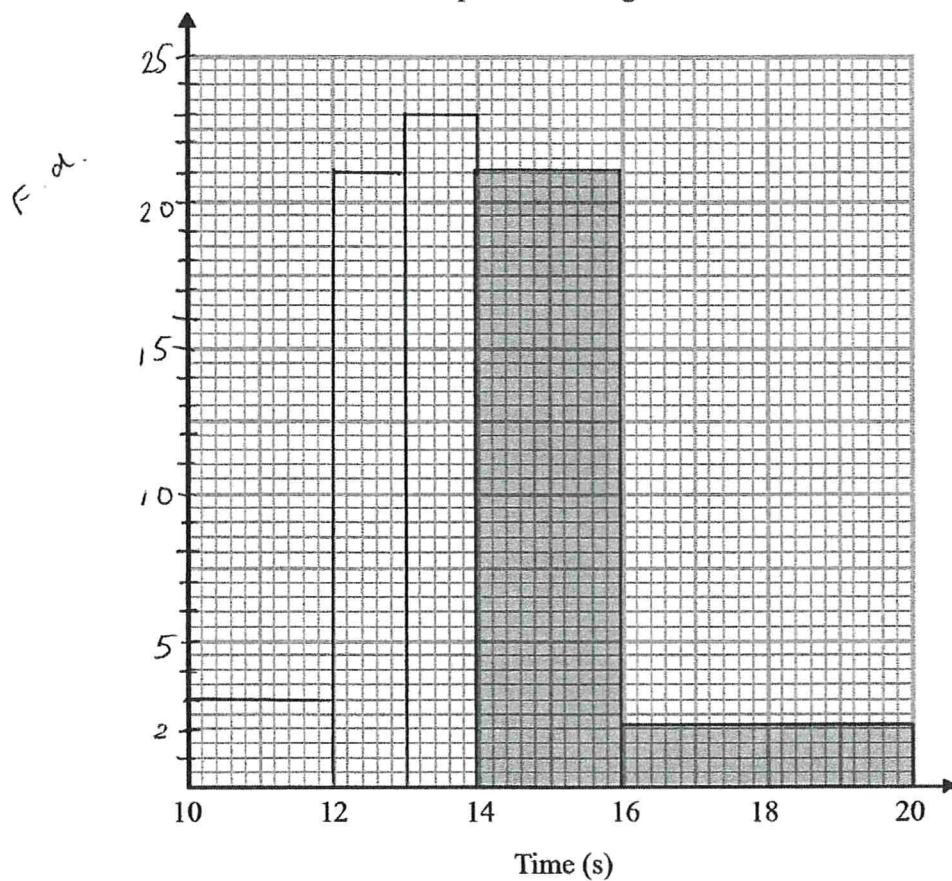
21

23

21

2

- (a) Use the information on the table to complete the histogram.



- (b) Use the histogram to complete the table.

$$21 \times 2 = 42$$

(Total for question 4 is 4 marks)

- 5 The table shows information about the time, in seconds, taken for some people to complete a puzzle.

Time (s)	Frequency
$10 < t \leq 25$	12
$25 < t \leq 35$	28
$35 < t \leq 40$	42
$40 < t \leq 45$	30
$45 < t \leq 60$	9

F.d

0.8

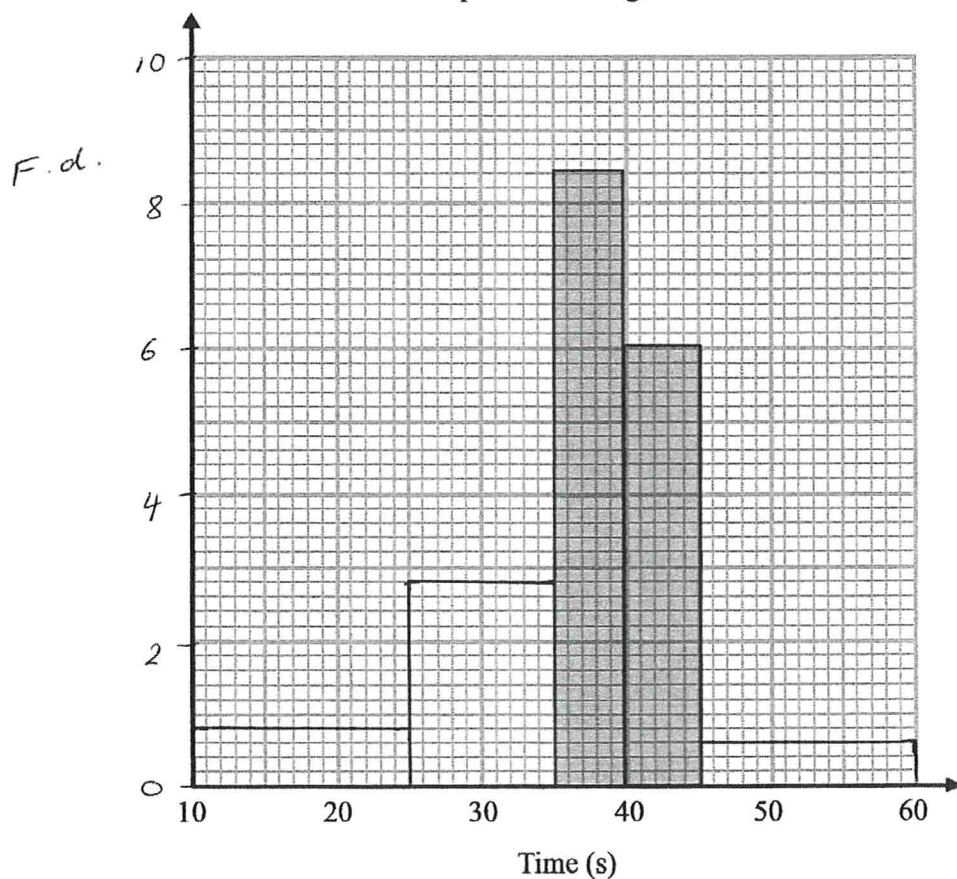
2.8

8.4

6

0.6

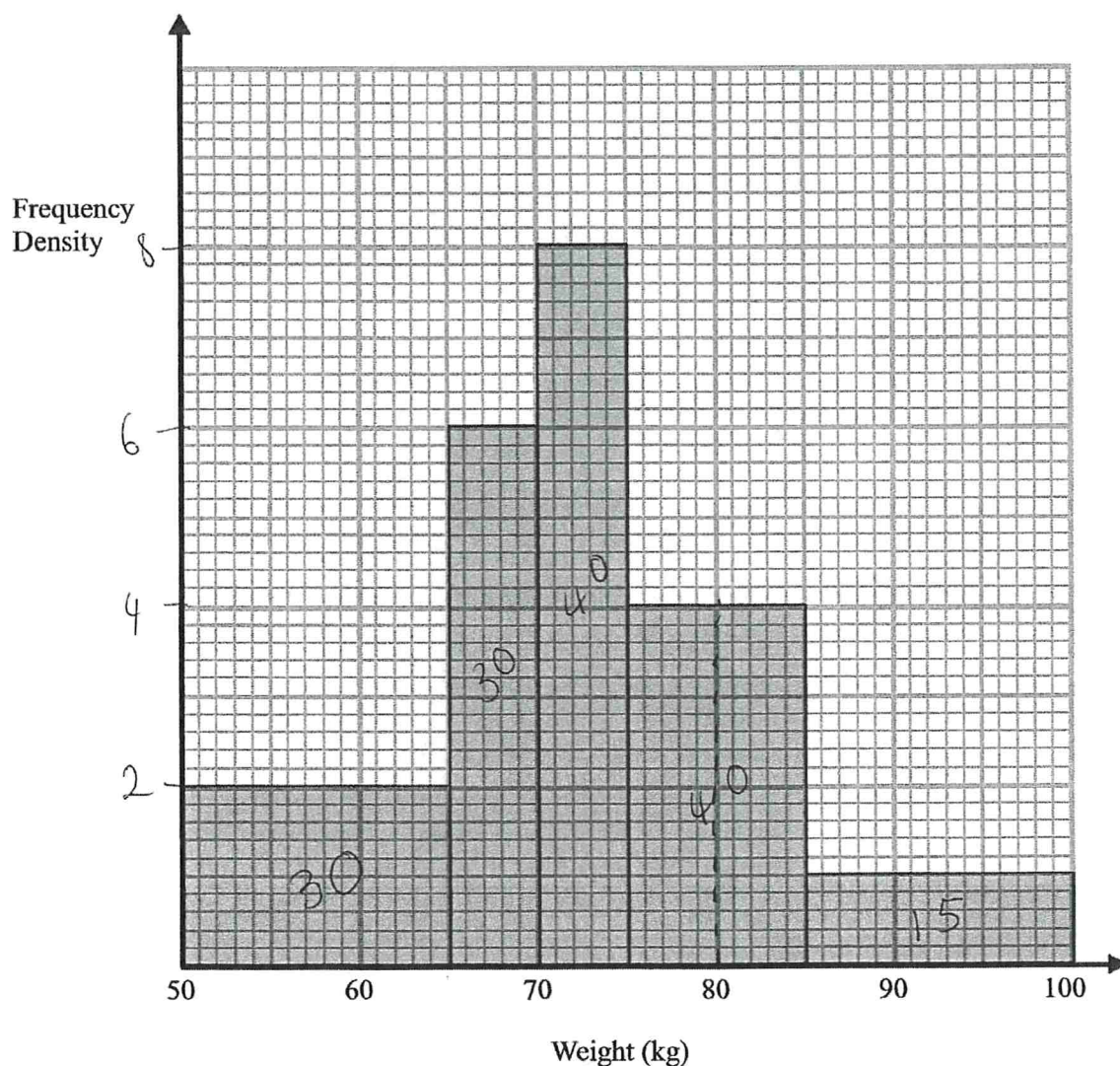
- (a) Use the information on the table to complete the histogram.



- (b) Use the histogram to complete the table.

(Total for question 5 is 4 marks)

6 The histogram shows information about the weight of pigs.



30 pigs weigh between 50 and 65 kg.

(a) Work out an estimate for the number of pigs which weigh more than 80kg.

$$20 + 15$$

35

(3)

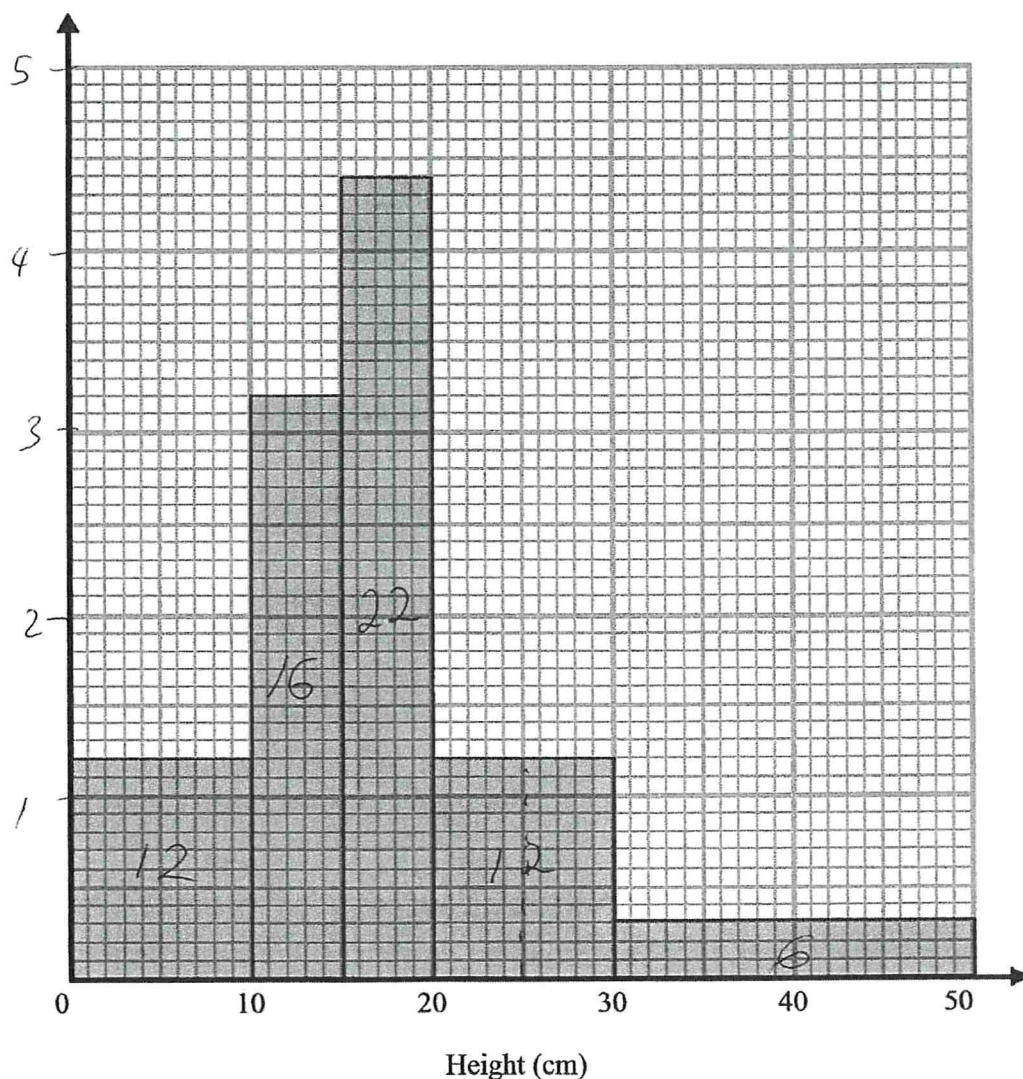
(b) Explain why your answer to part a is only an estimate.

we are using grouped data. We don't know how many pigs weigh between 80 and 85kg.

(1)

(Total for question 6 is 4 marks)

7 The histogram shows information about the height of some plants.



(a) Work out an estimate for the proportion of plants over 25cm tall.

$$6 + 6 = 12$$

$$12 + 16 + 22 + 12 + 6 = 68$$

$$\frac{12}{68} \text{ or } \frac{3}{17}$$

$$\frac{12}{68}$$

(3)

(b) Explain why your answer to part a is only an estimate.

we are using grouped data. we don't know how many plants are between 25 and 30 cm tall

(1)

(Total for question 7 is 4 marks)