**Q1.**(a) Circle the value of $3^{-2}$

$-6$ $\frac{1}{6}$ $\frac{1}{9}$ $-9$

**(1)**

(b) Work out the value of $(-8)^0 + 8^{-\frac{2}{3}}$

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Answer .....

**(3)**
**(Total 4 marks)**

**Q2.**

Express $\frac{1}{\sqrt[3]{x^2}}$ in the form $x^a$

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Answer .....

**(Total 3 marks)**

**Q3.**(a) Simplify fully $\frac{w^3 \times w^4}{w^2}$

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Answer .....

**(1)**

(b) Simplify fully $2x^2y^3 \times 4xy^2$

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Answer .....

**(2)**

(c) Simplify fully $12a^4b^5 \div 2a^2b$

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Answer .....

**(2)**

**(Total 5 marks)**

**Q4.**(a) Simplify fully $\dfrac{m^3 \times m^5 \times m}{m^2 \times m^4}$

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Answer .....

**(1)**

(b) Expand and simplify $(3 + \sqrt{2})(5 - \sqrt{2})$

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Answer .....

**(2)**

(c) Work out the value of $25^{-\frac{1}{2}} \times 81^{\frac{3}{4}}$

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Answer .....

**(3)**

**(Total 6 marks)**

**Q5.**

(a) Simplify fully $\sqrt{72}$

Circle your answer.

$36\sqrt{2}$ $3\sqrt{8}$ $6\sqrt{2}$ $2\sqrt{18}$

**(1)**

(b) Given that $p = \sqrt{3}$ $q = \sqrt{8}$ and $r = \sqrt{6}$

work out the value of $\frac{pq}{r}$

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Answer .....

**(2)**
**(Total 3 marks)**

**Q6.** Rationalise the denominator and simplify $\frac{10}{3\sqrt{5}}$

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Answer .....

**(Total 2 marks)**

**Q7.**

Show that 12 cos 30° – 2 tan 60° can be written in the form $\sqrt{k}$

where $k$ is an integer.

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**(Total 3 marks)**

**Q8.** Factorise fully $6x^2 - 14x$

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Answer .....

**(Total 2 marks)**

**Q9.**

Solve the simultaneous equations

$2x - 3y = 24$

$6x + 2y = -5$

Do **not** use trial and improvement.
You **must** show your working.

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Answer .....

**(Total 3 marks)**

**Q10.**

Expand and simplify $(t + 4)^3$

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Answer.....

**(Total 3 marks)**

**Q11.**

Factorise $3x^2 + 14x + 8$

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Answer .....

**(Total 2 marks)**

**Q12.** Simplify $\dfrac{4x^2 - 1}{4x^2 + 12x + 5}$

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Answer .....

**(Total 3 marks)**

**Q13.** Solve $\dfrac{6}{x-2} - \dfrac{2}{x+3} = 1$

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Answer .....

**(Total 5 marks)**

**Q14.**

Solve the simultaneous equations

$4x + y = -3$ and $y = x^2 + 2x + 5$

Do **not** use trial and improvement.
You **must** show your working.

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Answer .....

**(Total 6 marks)**

**Q15.**(a) $x^2 + ax + b \equiv (x - 3)^2 - a$ where $a$ and $b$ are integers.

Work out the values of $a$ and $b$.

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$a$ = ..... $b$ = .....

**(3)**

(b) Circle the smallest possible value of $(x - 7)^2 + 2$

–7 –2 2 7

**(1)**
**(Total 4 mark)**

**Q16.**

$2x^2 - 6x + 5$ can be written in the form $a(x - b)^2 + c$

where $a$, $b$ and $c$ are positive numbers.

(a) Work out the values of $a$, $b$ and $c$

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$a$ = .....

$b$ = .....

$c$ = .....

**(3)**

(b) Using your answer to part (a), or otherwise, solve $2x^2 - 6x + 5 = 8.5$

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Answer .....

**(3)**
**(Total 6 marks)**

**Q17.** Make $x$ the subject of $y = \frac{8 - 3x}{4x + 9}$

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Answer .....

**(Total 4 marks)**

**Q18.**

The line $y = mx + c$ passes through the point (4, 3).
It is parallel to the line $y = 5x + 6$

Work out the values of $m$ and $c$.

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$m$ = ....., $c$ = .....

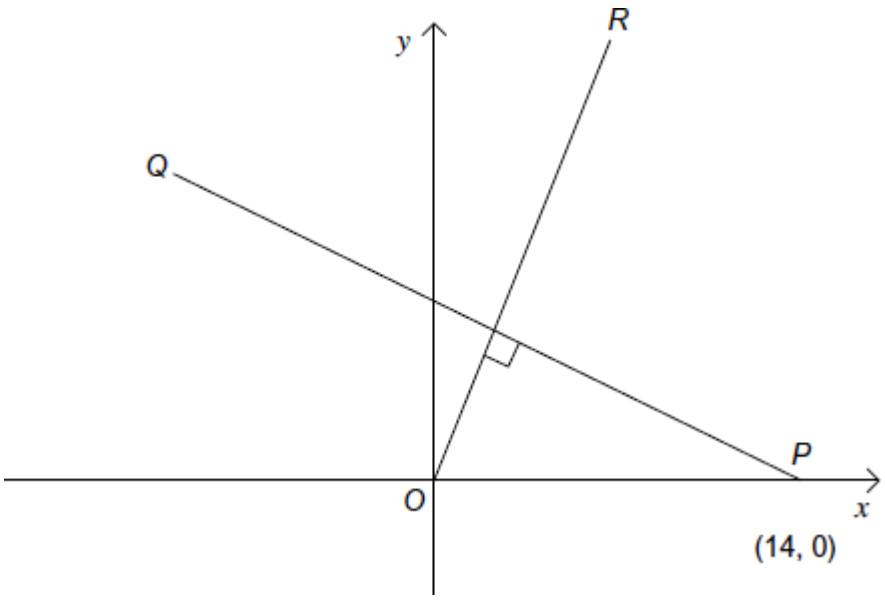
**(Total 3 marks)**

**Q19.**

The gradient of line *OR* is $\frac{7}{4}$

*PQ* is perpendicular to *OR*.
*P* is the point (14, 0).

Not drawn accurately




Work out the equation of line *PQ*.
Give your answer in the form $ax + by = c$, where $a$, $b$ and $c$ are integers.

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Answer .....

**(Total 4 marks)**

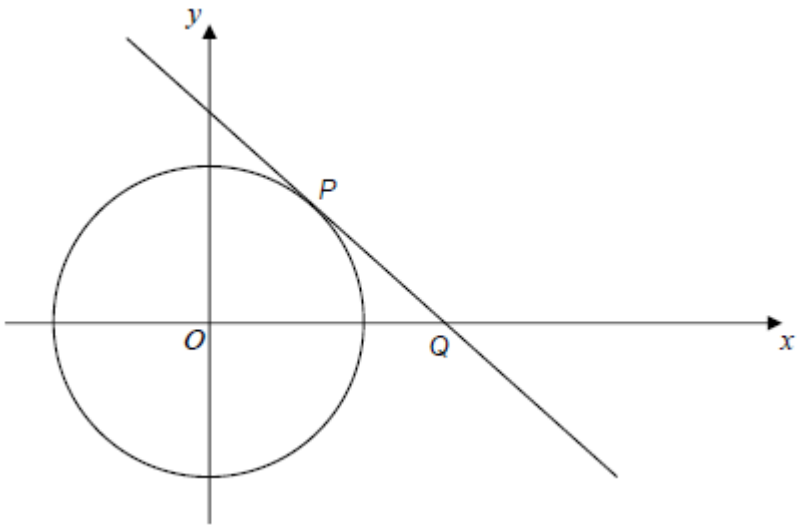
**Q20.**

The diagram shows the circle $x^2 + y^2 + 10$

$P$ lies on the circle and has $x$-coordinate 1

The tangent at $P$ intersects the $x$-axis at $Q$.

Not drawn accurately




Work out the coordinates of $Q$.

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Answer (....., .....)

**(Total 5 marks)**

**Q21.**

(a) The $n$th term of a sequence is $2^n + 2^{n-1}$

Work out the 10th term of the sequence.

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Answer .....

**(1)**

(b) The $n$th term of a different sequence is $4(2^n + 2^{n-1})$

Circle the expression that is equivalent to $4(2^n + 2^{n-1})$

$2^{n+2} + 2^{n+1}$ $2^{2n} + 2^{2(n-1)}$

$8^n + 8^{n-1}$ $2^{n+2} + 2^{n-1}$

**(1)**

**(Total 2 marks)**

**Q22.**

f($x$) = 3$x$

Circle the expression for $f^{-1}(x)$

$-3x$ $\frac{3}{x}$ $\frac{1}{3x}$ $\frac{x}{3}$

**(Total 1 mark)**

**Q23.**

f($x$) = 2$x$ + $c$
g($x$) = $cx$ + 5
fg($x$) = 6$x$ + $d$
$c$ and $d$ are constants.

Work out the value of $d$.

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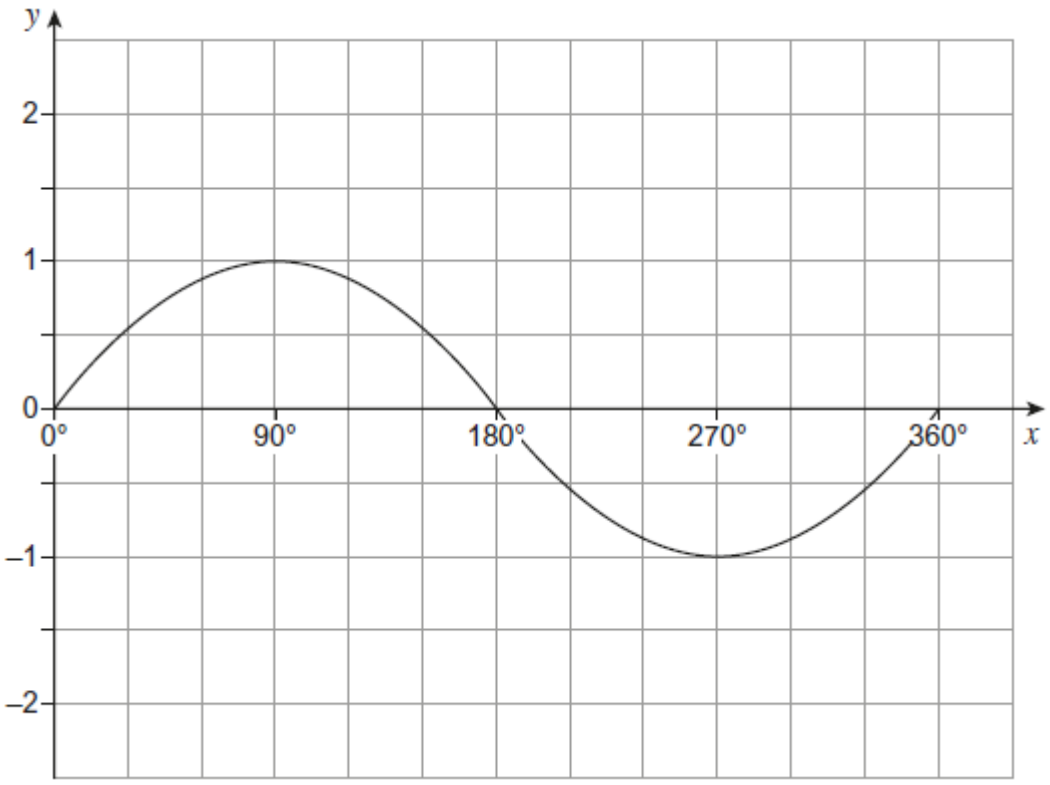
Answer .....

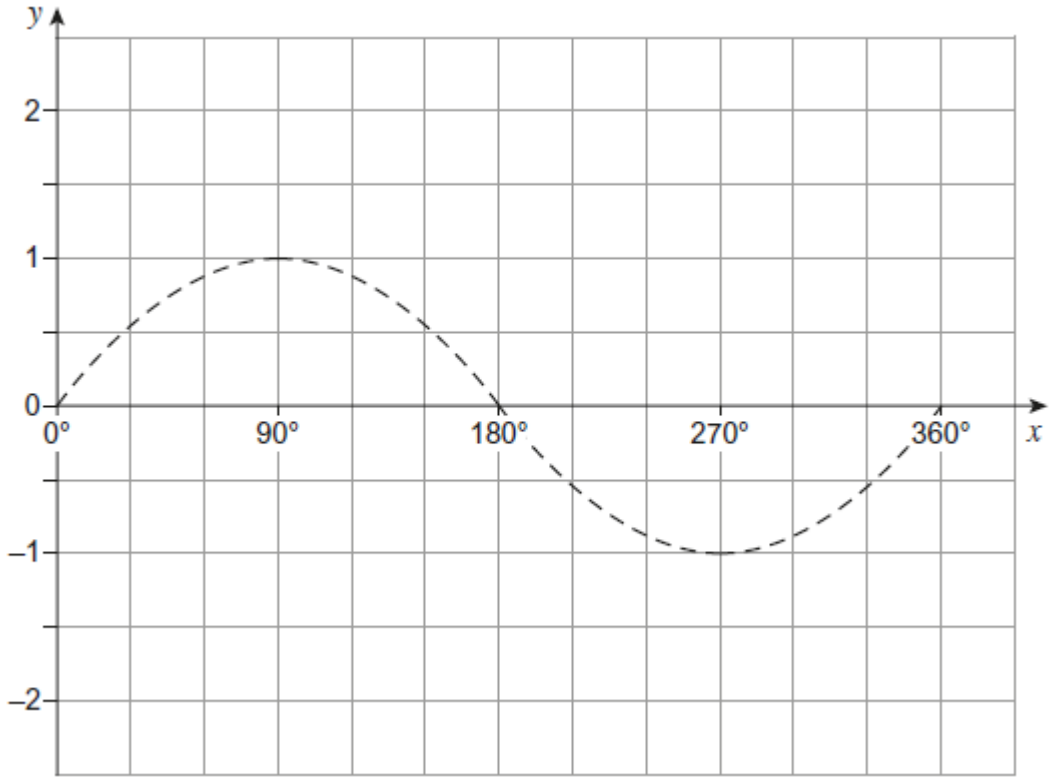
**[Total 3 marks]**

**Q24.** The graph of $y = \sin x$ for $0° \leq x \leq 360°$ is shown.




(a) On the grid below, draw the graph of $y = 1 + \sin x$ for $0° \leq x \leq 360°$

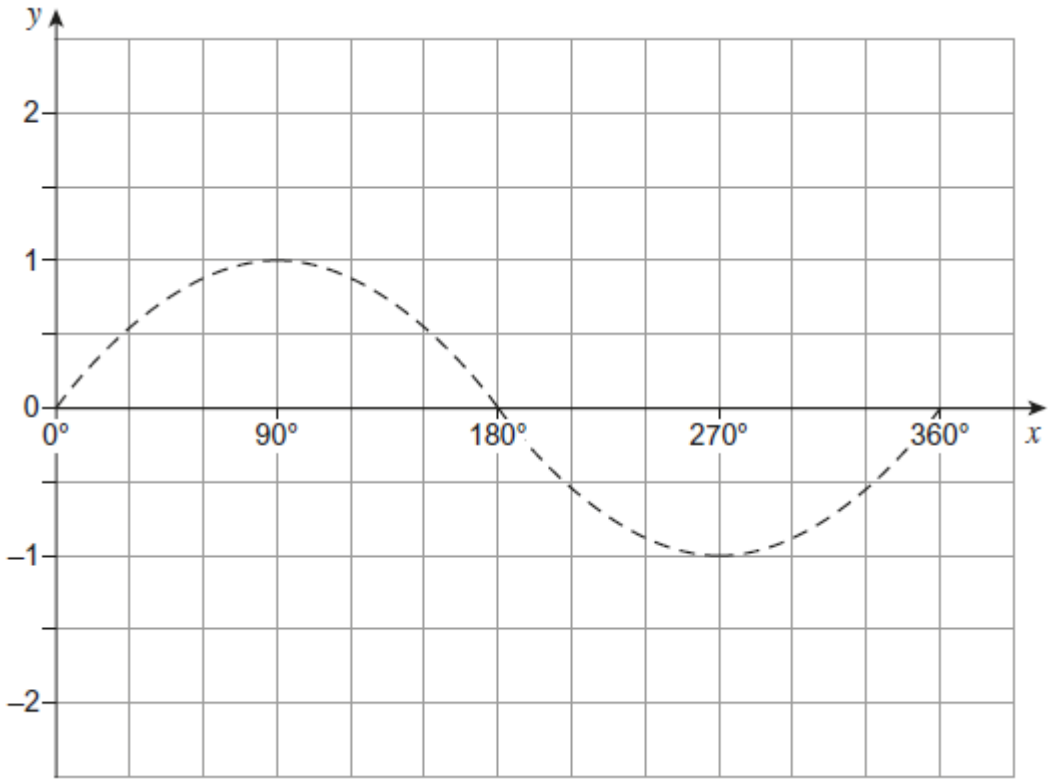
The graph of $y = \sin x$ is shown to help you.




**(1)**

(b) On the grid below, draw the graph of $y = \sin(x + 90°)$ for $0° \leq x \leq 360°$

The graph of $y = \sin x$ is shown to help you.




**(1)**
**(Total 2 marks)**

**Q25.** The square number sequence is

1 4 9 16 25 .....

Prove algebraically that the difference of two consecutive square numbers is an odd number.

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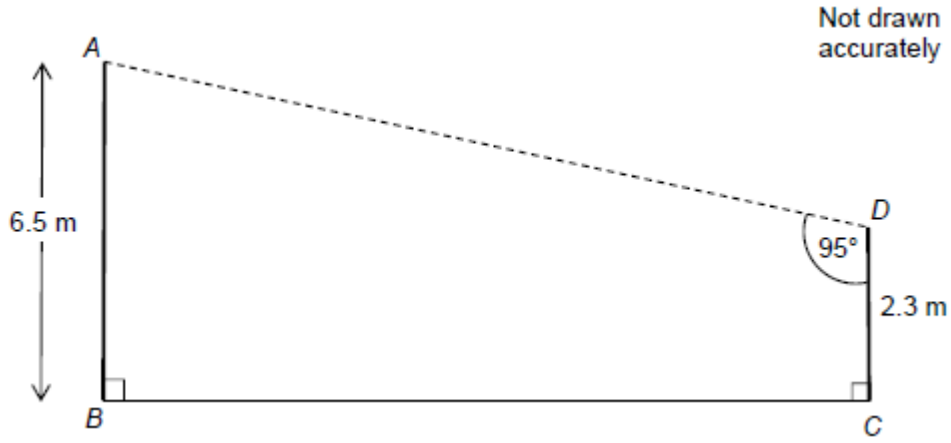
**(Total 4 marks)**

**Q26.**

The diagram shows a design for a zipwire.

The zipwire will run between the top of two vertical posts, *AB* and *CD*.




Work out the distance *AD*.

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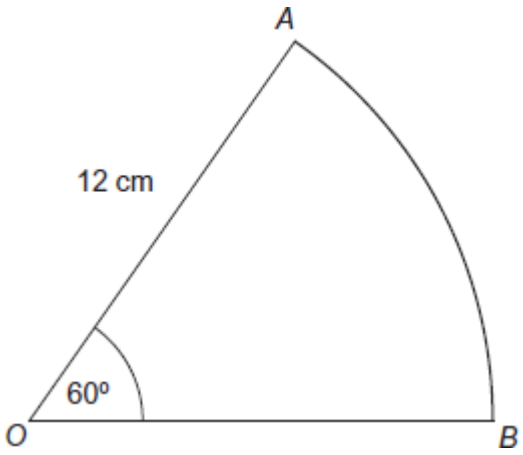
Answer ..... m

**(Total 4 marks)**

**Q27.** *OAB* is a sector of a circle of radius 12 cm

Angle *AOB* = 60°

Not drawn accurately



Work out the length of the arc *AB*.
Give your answer in terms of $\pi$.

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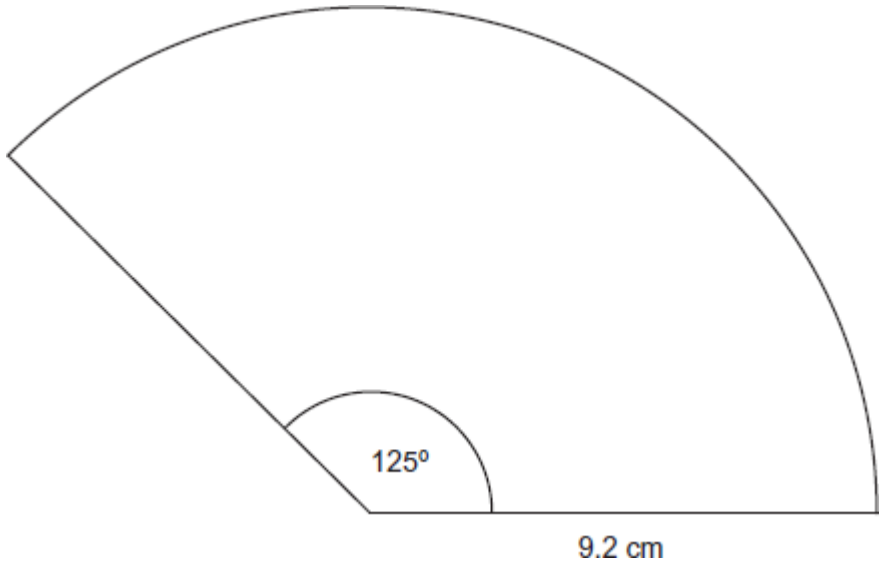
Answer ..... cm

**(Total 2 marks)**

**Q28.** The diagram shows a sector of a circle with radius 9.2 cm

Not drawn accurately




(a) Work out the area of the sector.

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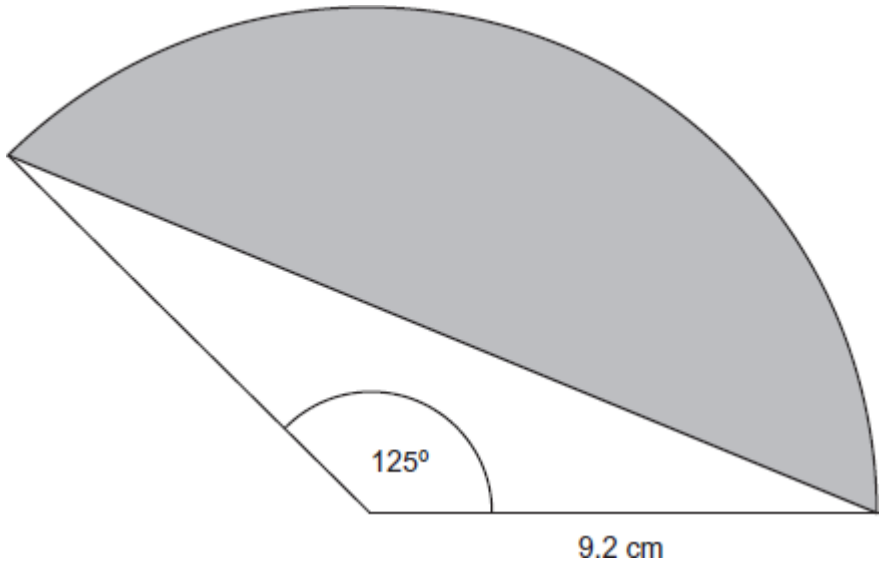
Answer ..... $cm^2$

**(3)**

(b) Work out the area of the shaded segment.

Not drawn accurately

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Answer ..... $cm^2$

**(3)**

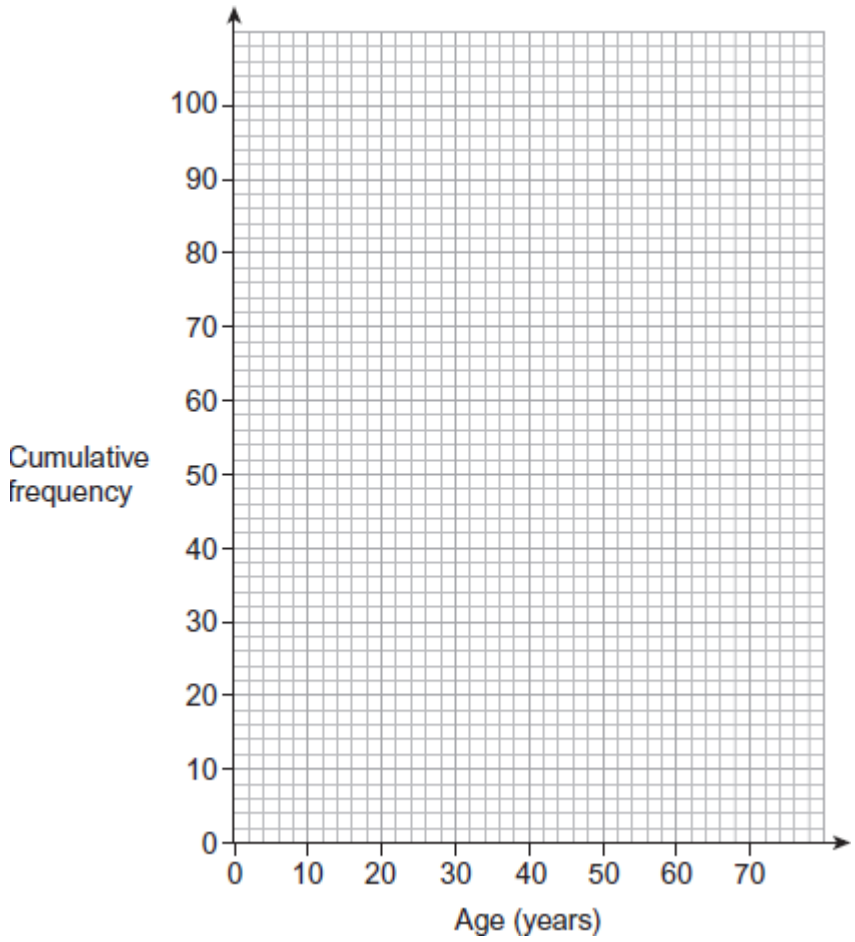
**(Total 6 marks)**

**Q29.**

The table shows information about the ages of 100 rugby supporters.

| Age, $a$ (years) | Frequency |
|---|---|
| $5 \leq a < 15$ | 12 |
| $15 \leq a < 20$ | 11 |
| $20 \leq a < 40$ | 25 |
| $40 \leq a < 55$ | 39 |
| $55 \leq a < 70$ | 13 |

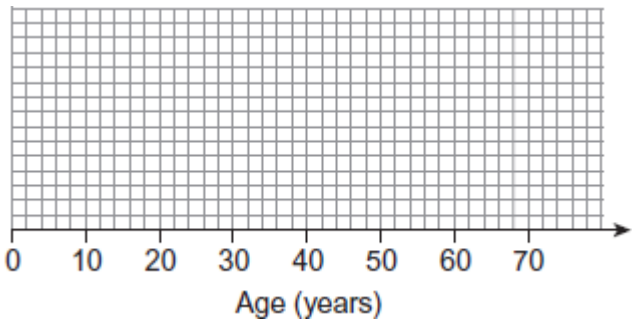
(a) Plot a cumulative frequency diagram for the data.




**(4)**

(b) The youngest supporter is 8 years old.
The oldest supporter is 69 years old.

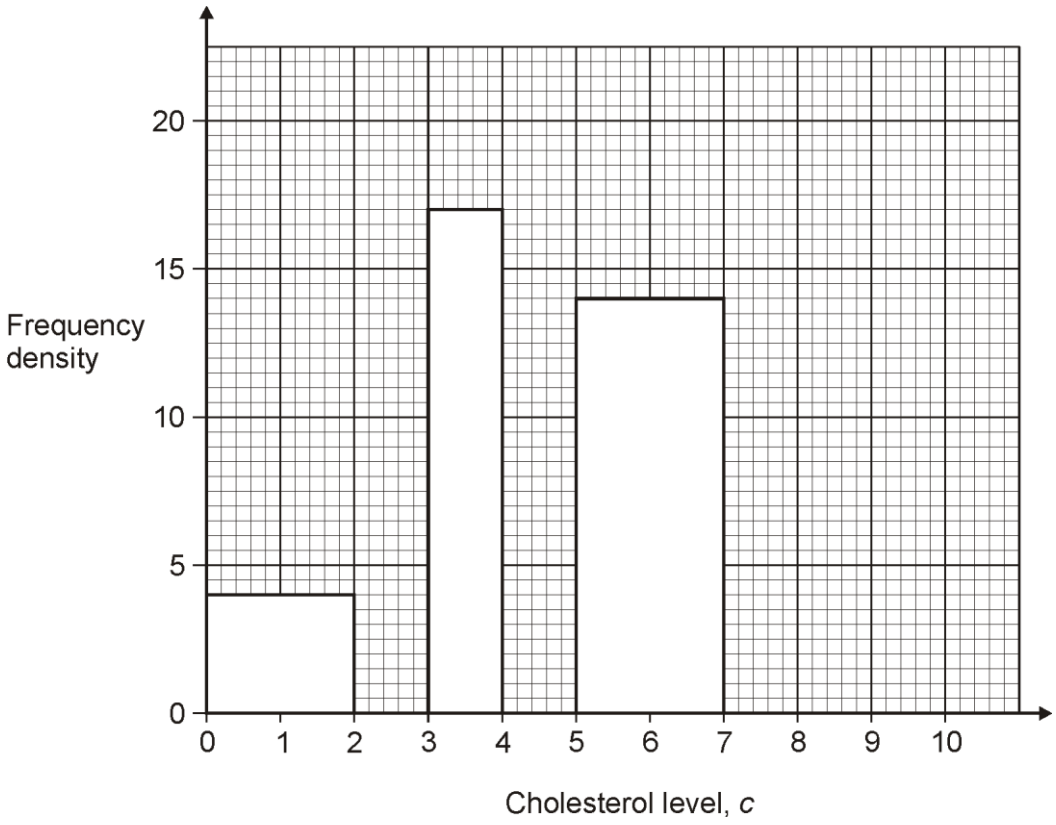
Draw a box plot for the data.




**(3)**
**(Total 7 marks)**

**Q30.** The table and histogram show some information about the cholesterol level in the blood of 100 hospital patients.

| **Cholesterol level, $c$** | **Frequency** |
|---|---|
| $0 < c \leq 2$ | 8 |
| $2 < c \leq 3$ | 13 |
| $3 < c \leq 4$ | |
| $4 < c \leq 5$ | 19 |
| $5 < c \leq 7$ | |
| $7 < c \leq 10$ | 15 |




(a) Use the table to complete the histogram.

**(2)**

(b) Use the histogram to complete the table.

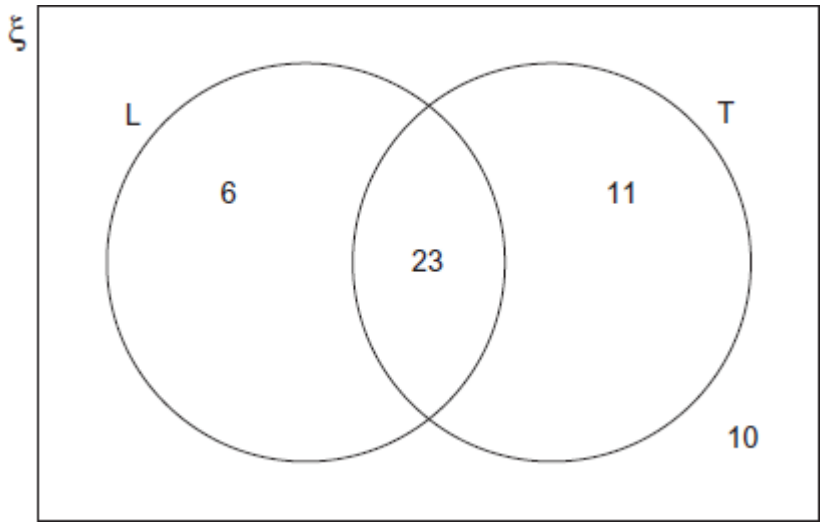
**(2)**

**(Total 4 marks)**

**Q31.**

Here is a Venn diagram.
It shows information about the number of students who have a laptop or a TV.

Set L represents students with a laptop.
Set T represents students with a TV.




There are 50 students altogether.

A student is chosen at random.

(a) Work out P(L).

Answer .....

**(1)**

(b) Work out P(L ∩ T).

Answer .....

**(1)**

(c) Complete the following using set notation.

P( ..... ) = $\frac{21}{50}$

**(1)**

(d) Complete the following using set notation.

P( ..... ) = $\frac{4}{5}$

**(2)**
**(Total 5 marks)**

**Q32.** A bag contains 10 counters.
4 of the counters are black and 6 are white.

Two counters are picked at random.

Work out the probability that they are both black.

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Answer .....

**(Total 3 marks)**

**Q33.**

Bag X contains 9 blue balls and 18 red balls.

Bag Y contains 7 blue balls and 14 red balls.

Liz picks a ball at random from bag X.

She puts the ball into bag Y.

Mike now picks a ball at random from bag Y.

Show that

P (Liz picks a blue ball) = P (Mike picks a blue ball)

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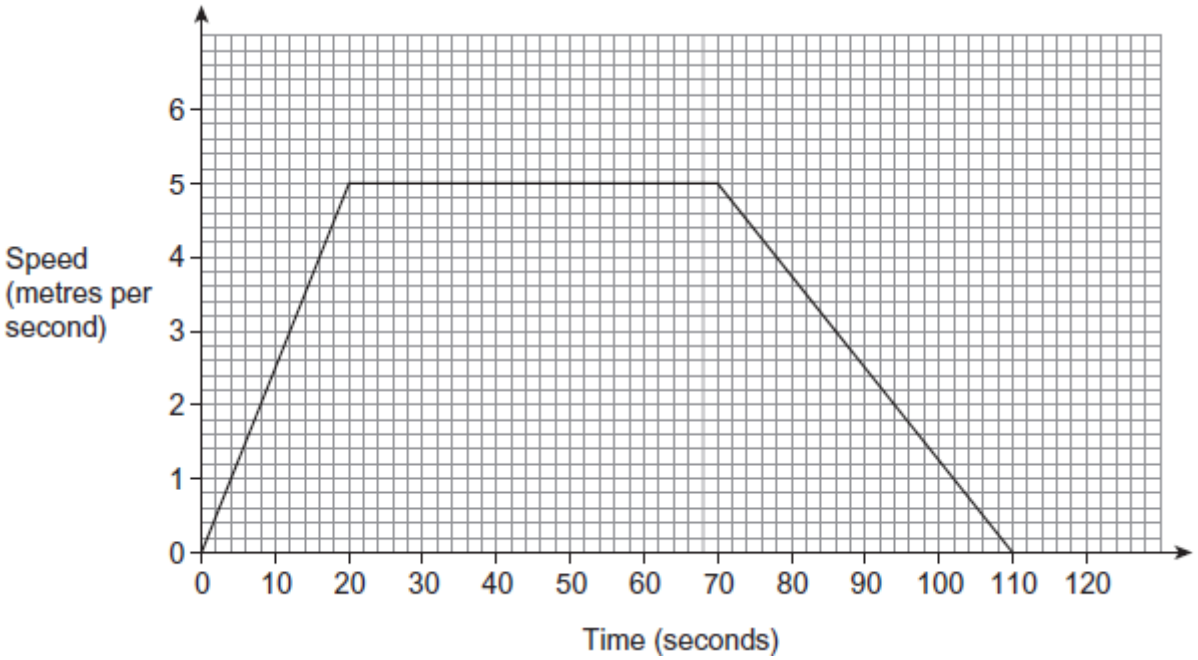
**(Total 4 marks)**

**Q34.**

The distance around a cycle track is 400 metres.

Robin cycles on the track.
Here is his speed-time graph.




(a) Show that Robin cycles **exactly** once around the track in 110 seconds.

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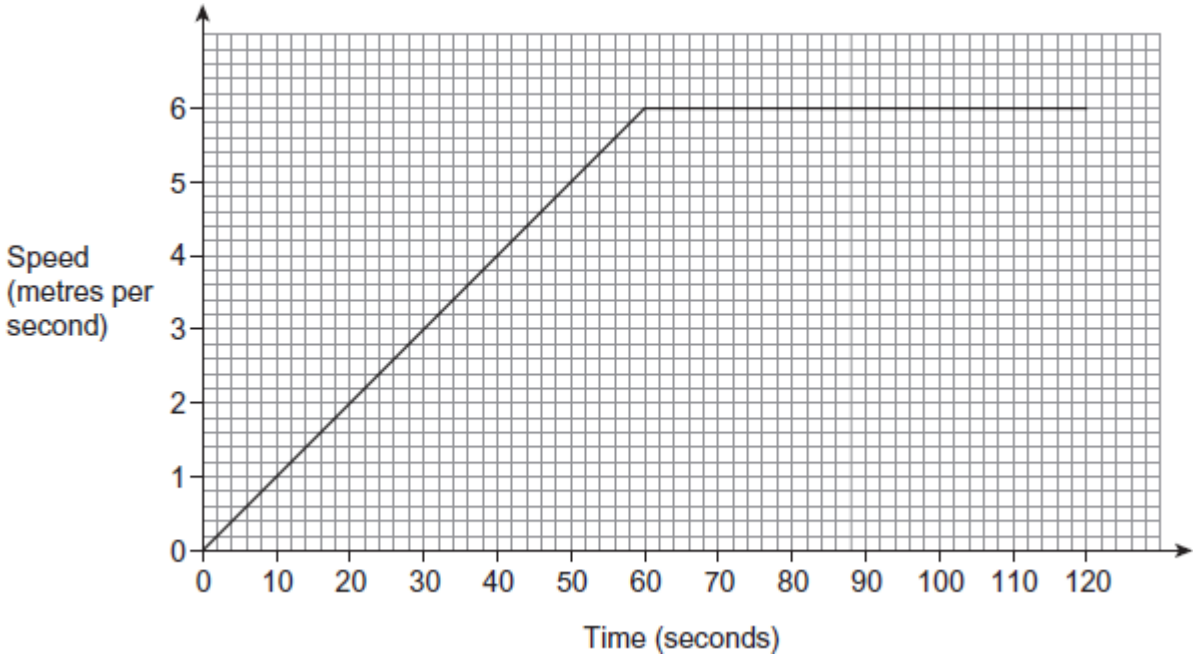
**(2)**

(b) Sanjay cycles on the same track.

Here is his speed-time graph.




Does Sanjay cycle the first 400 metres in a quicker time than Robin?
You **must** show your working.

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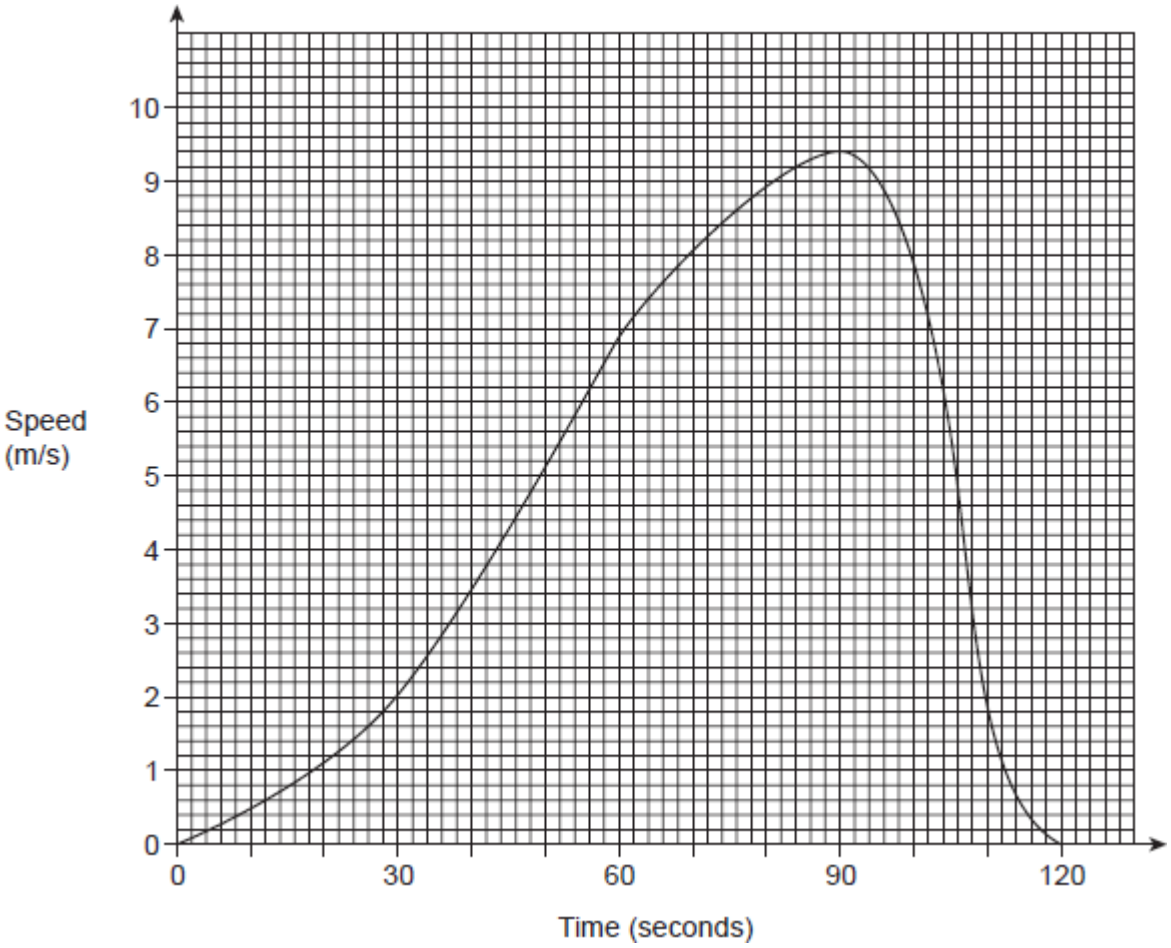
**(3)**
**(Total 5 marks)**

**Q35.**

The graph shows the speed of a snowboarder for 2 minutes.




(a) Estimate the distance travelled by the snowboarder.
State the units of your answer.

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Answer .....

**(4)**

(b) Work out the gradient of the graph at 70 seconds.

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Answer ..... m/s²

**(3)**

**(Total 7 marks)**

**M1.**(a) $\frac{1}{9}$

**B1**

$\frac{1}{8^{\frac{2}{3}}}$ or $2^{-2}$ or $(\sqrt[3]{8})^{-2}$ or $(\sqrt[3]{8}) = 2$

or $64^{\frac{1}{3}}$ or $(\sqrt[3]{64})^{-1}$ or $(8^2) = 64$

(b) or $(-8)^0 = 1$ seen or implied

**M1**

$\frac{1}{\sqrt[3]{8^2}}$ or $\frac{1}{\sqrt[3]{64}}$ or $\frac{1}{(\sqrt[3]{8})^2}$ or $\left(\frac{1}{\sqrt[3]{8}}\right)^2$

or $\sqrt[3]{\left(\frac{1}{8}\right)^2}$ or $\sqrt[3]{\frac{1}{64}}$ or $\frac{1}{64^{\frac{1}{3}}}$

or $\sqrt[3]{\frac{1}{8}} = \frac{1}{2}$ or $\left(8^{\frac{2}{3}}\right) = 4$

or $\frac{1}{4}$ or $\frac{1}{2^2}$ or $\left(\frac{1}{2}\right)^2$ or $4^{-1}$

*oe*

**M1**

$1\frac{1}{4}$

*oe*

**A1**

**Additional Guidance**

$8^{\frac{2}{3}} = \frac{1}{64}$ with answer $1\frac{1}{64}$

**M1M0A0**

**[4]**

**M2.**

$x^{-\frac{2}{3}}$ or $a = -\frac{2}{3}$

*B2* $(x^{\frac{1}{3}})^2$ *or* $(x^2)^{\frac{-1}{3}}$ *or* $(x^{\frac{2}{3}})^{-1}$ *or* $(x^{-2})^{\frac{1}{3}}$ *or* $(x^{\frac{1}{3}})^{-2}$ *or* $\frac{1}{x^{\frac{2}{3}}}$ *or* $-\frac{2}{3}$

*B1* $(\sqrt[3]{x}3)^{-2}$ *or* $(\sqrt[3]{x^2})^{-1}$ *or* $(\frac{1}{x^2})^{\frac{1}{3}}$ *or* $\frac{1}{(x^2)^{\frac{1}{3}}}$ *or* $(\frac{1}{\sqrt[3]{x}})^2$ *or base* $x$ *with any negative index.*

**B3**

**[3]**

**M3.**(a) $w^5$

*Any letter is OK, eg* $x^5$

**B1**

(b) $8x^3y^5$

*B1 If all parts correct but × or one + included*
*B1 for 2 correct (× may be included but + may not)*
*B1 if wrong further work after correct answer seen*

**B2**

**Additional Guidance**

$8x^3y^6$

**B1**

$6x^3y^5$

**B1**

$8x^2y^5$

**B1**

$8 \times x^3 \times y^5$

**B1**

$8 \times x^3 + y^5$

**B1**

$8x^3y^5 = 8xy^8$

**B1**

$8 \times x^3 \times y^6$

**B1**

$8 + x^3 + y^5$

**B0**

**[5]**

**M4.**(a) $m^2$

*Do not accept* $m \times m \times m$

**B1**

(b) $3 \times 5 + 5 \times \sqrt{2} - 3 \times \sqrt{2} - \sqrt{2} \times \sqrt{2}$
or $3 \times 5 + 2\sqrt{2} - \sqrt{2}\ \sqrt{2}$
or $13 + 5\sqrt{2} - 3\sqrt{2}$

*oe 4 terms or correct combination of 3 terms needed. If 4 terms given, 3 must be correct for M1*

*Allow in 'box method' or FOIL but watch out for correct signs (still allow one error).*

**M1**

$13 + 2\sqrt{2}$

**A1**

**Additional Guidance**

If answer correct allow 2 marks.

$15 + 5\sqrt{2} - 3\sqrt{2} + 4$

**M1**

$19 + 2\sqrt{2}$

**A0**

| × | 3 | $\sqrt{2}$ |
|---|---|---|
| 5 | 15 | $5\sqrt{2}$ |
| $\sqrt{2}$ | $3\sqrt{2}$ | 2 |

$17 + 8\sqrt{2}$

**M0**
**(Only two terms correct)**

| × | 3 | $\sqrt{2}$ |
|---|---|---|
| 5 | 15 | $5\sqrt{2}$ |
| $-\sqrt{2}$ | $3\sqrt{2}$ | 2 |

$13 + 2\sqrt{2}$

**M1**
**A1**
**(Terms incorrect in table but 'recovered')**

$5 \times 3 = 15$, $3 \times \sqrt{2} = 3\sqrt{2}$, $5 \times \sqrt{2} = 5\sqrt{2}$, $-\sqrt{2} \times \sqrt{2} = -2$

**M1**

$13 + 8\sqrt{2}$

**A0**

(c) $\frac{27}{5}$ or $5\frac{2}{5}$ or 5.4

*B2 for 27 and* $\frac{1}{5}$

*B2 for* $\frac{1}{5} \times 3^3$

*B1 for 27 or* $\frac{1}{5}$

*B1 for 5* ***and*** *3 seen*

**Additional Guidance**

$\frac{1}{5} \times 3^3 = \frac{1}{5} \times 9 = 1.8$

**B2**

$\frac{1}{5} \times 9 = 1.8$

**B1**

$\sqrt{25} = \pm 5$ and $\sqrt[4]{81} = \pm 3$ (allow a mixture or + and – for 3 and 5 but negative elsewhere not allowed)

**B1**

**[6]**

**M5.**

(a) $6\sqrt{2}$

**B1**

(b) $\sqrt{\frac{24}{6}}$ or $\sqrt{\frac{8}{2}}$ or $\sqrt{4}$

or $\frac{\sqrt{8}}{\sqrt{2}}$ or $\frac{2\sqrt{2}}{\sqrt{2}}$

or $\frac{\sqrt{8} \times \sqrt{2}}{\sqrt{2} \times \sqrt{2}}$ or $\frac{\sqrt{16}}{2}$ or $\frac{4}{2}$

or $\frac{\sqrt{3} \times 2\sqrt{2}}{\sqrt{6}}$ or $\frac{2\sqrt{6}}{\sqrt{6}}$

or $\frac{\sqrt{3} \times 2\sqrt{2} \times \sqrt{2}}{\sqrt{6} \times \sqrt{2}}$ or $\frac{2\sqrt{12}}{\sqrt{12}}$

or $\frac{\sqrt{3} \times \sqrt{8} \times \sqrt{6}}{\sqrt{6} \times \sqrt{6}}$ or $\frac{\sqrt{24} \times \sqrt{6}}{\sqrt{6} \times \sqrt{6}}$

or $\frac{\sqrt{144}}{6}$ or $\frac{12}{6}$

**M1**

2

**A1**

**Additional Guidance**

$\frac{\sqrt{24}}{\sqrt{6}}$ does not score alone without further working

**M0**

**[3]**

**M6.**

$\frac{10}{3\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}}$ or $\frac{10\sqrt{5}}{15}$

$\frac{10}{3\sqrt{5}} \times \frac{3\sqrt{5}}{3\sqrt{5}}$ or $\frac{30\sqrt{5}}{45}$

or $\frac{\sqrt{20}}{3}$

*oe*

*Must multiply numerator and denominator*

*eg* $\frac{10}{\sqrt{45}}$ *is M0*

$\frac{10}{\sqrt{45}} \times \frac{\sqrt{45}}{\sqrt{45}}$ *is M1*

**M1**

$\frac{2\sqrt{5}}{3}$

**A1**

**[2]**

**M7.**

$\cos 30° = \frac{\sqrt{3}}{2}$ or $\tan 60° = \sqrt{3}$

**M1**

$4\sqrt{3}$

**A1**

$\sqrt{48}$ or $k = 48$

*ft value seen in the form* $a\sqrt{b}$ *where a and b are integers > 1*

**B1ft**

**[3]**

**M8.** $2x(3x - 7)$

*B1* $2(3x^2 - 7x)$ *or* $x(6x - 14)$

*SC1* $2x(3x + 7)$

**B2**

**Additional Guidance**

Allow multiplication signs for B2 or B1
eg $2x \times (3x - 7)$

**B2**

Condone missing final bracket
eg $2x(3x - 7$

**B2**

Accept $(2x + 0)(3x – 7)$

**B2**

**[2]**

**M9.**

**Alternative method 1**

$4x - 6y = 48$
and
$18x + 6y = -15$

$6x - 9y = 72$

(and
$6x + 2y = -5$)

*oe*
*Equating coefficients*

**M1**

$22x = 33$

or $x = 1.5$

$-11y = 77$

or $y = -7$

*oe*
*Elimination of one variable*

**M1 dep**

$x = 1.5$ and $y = -7$

*oe*
*SC1 for $x = 1.5$ and $y = -7$ without working or using trial and improvement*

**A1**

**Alternative method 2**

$x = \frac{24 + 3y}{2}$ or $y = \frac{2x - 24}{3}$

or $x = \frac{-5-2y}{6}$ or $y = \frac{-5-6x}{2}$

*oe*
*Rearranging*

**M1**

$22x = 33$

or $x = 1.5$

$-11y = 77$

or $y = -7$

*oe*

*Elimination of one variable*

**M1 dep**

$x = 1.5$ and $y = -7$

*oe*

*SC1 for $x = 1.5$ and $y = -7$ without working or using trial and improvement*

**A1**

**[3]**

**M10.**

$(t + 4)(t^2 + 4t + 4t + 16)$

*oe Must be correct*

**M1**

$t^3 + 4t^2 + 4t^2 + 16t + 4t^2 + 16t + 16t + 64$

*ft From their $(t + 4)(t^2 + 4t + 4t + 16)$*

*oe Must have at least 4 terms correct*

*M2 $t^3 + 3t^2(4) + 3t\,(4)^2 + 4^3$ oe*

**M1**

$t^3 + 12t^2 + 48t + 64$

**A1**

**[3]**

**M11.**

$(3x + a)(x + b)$

where $ab = 8$ or $a + 3b = 14$

or

$3x\,(x + 4) + 2(x + 4)$

or

$x(3x + 2) + 4(3x + 2)$

**M1**

$(3x + 2)(x + 4)$

*oe*

**A1**

**[2]**

**M12.** $(2x + 1)(2x - 1)$

**M1**

$(2x + 5)(2x + 1)$

**M1**

$$\frac{2x-1}{2x+5}$$

*Do not allow further work*

**A1**

**[3]**

**M13.** $6(x + 3)$ or $(–)2(x – 2)$
or $6x + 18$ or $2x – 4$ or $–2x + 4$
or $(x – 2)(x + 3)$

**M1**

$6x + 18 – 2x + 4$
or $4x + 22$
or $x^2 – 2x + 3x – 6$
or $x^2 + x – 6$

*allow three correct terms after expansion ignore RHS and denominator*

*allow three correct terms after expansion as denominator or RHS*

**M1**

$x^2 – 3x – 28 = 0$

**A1**

$(x – 7)(x + 4)$ $(= 0)$

*correct method to solve their quadratic equation by*
*correct substitution into the quadratic formula*
*or correct completion of the square*
*or correct factorisation*

**M1**

$(x =)$ 7 and $(x =) – 4$

*SC2 $(x =) 7$ or $(x =) – 4$*

**A1**

**Additional Guidance**

Correct substitution into quadratic formula

$$x = \frac{--3 \pm \sqrt{(-3)^2 - 4 \times 1 \times -28}}{2 \times 1}$$

**[5]**

**M14.**

**Alternative method 1**

$y = −3 − 4x$

**B1**

$x^2 + 2x + 5 =$ their $−3 − 4x$

**M1**

$x^2 + 6x + 8 = 0$

*ft their $−3 − 4x$*

**A1ft**

$(x + 4)(x + 2)$ $(= 0)$

*Correct method to solve their quadratic equation*

**M1**

$x = -4, -2$

*ft their quadratic equation*

**A1ft**

$y = 13, 5$

*SC2 Both pairs of correct values without valid working*

**A1**

**Alternative method 2**

$x = (\text{their } \frac{-3-y}{4})^2 + 2(\frac{-3-y}{4})$

**B1**

$y = (\text{their } \frac{-3-y}{4})^2 + 2(\frac{-3-y}{4}) + 5$

**M1**

$y^2 - 18y + 65 = 0$

*ft their* $\frac{-3-y}{4}$

*oe may have common denominator 16*

**A1ft**

$(y - 5)(y - 13) (= 0)$

*Correct method to solve their quadratic equation*

**M1**

$y = 13, 5$

*ft their quadratic equation*

**A1ft**

$x = -4, -2$

*SC2 Both pairs of correct values without valid working*

**A1**

**Alternative method 3**

$4x + x^2 + 2x + 5 = -3$

*oe*

**B1**

$x^2 + 6x + 5 = -3$

**M1**

$x^2 + 6x + 8 = 0$

**A1**

$(x + 4)(x + 2) (= 0)$

*Correct method to solve their quadratic equation*

**M1**

$x = -4, -2$

*ft their quadratic equation*

**A1ft**

$y = 13, 5$

*SC2 Both pairs of correct values with no valid working*

**A1**

**Alternative method 4**

$4x + y = -3$ and

$y - x^2 - 2x = 5$

or

$4x + y = -3$ and

$-2x + y = x^2 + 5$

*oe*

*the equations must be used as simultaneous equations*

**B1**

$4x + x^2 + 2x = -8$ or $x^2 + 6x = -8$
or
$6x = -3 - x^2 - 5$

*oe*

**M1**

$x^2 + 6x + 8 = 0$

**A1**

$(x + 4)(x + 2)\ (= 0)$

*Correct method to solve their quadratic equation*

**M1**

$x = -4, -2$

*ft their quadratic equation*

**A1ft**

$y = 13, 5$

*SC2 Both pairs of correct values with no valid working*

**A1**

**[6]**

**M15.**(a) **Alternative method 1**

$x^2 - 3x - 3x$
or $x^2 - 6x$
or $b = 9 - a$
or $\frac{a}{2} = -3$

*oe*

**M1**

**Alternative method 2**

Substitutes a value for $x$ into the identity and obtains a correct equation in $a$

and $b$

**M1**

$a = -6$

**A1**

$b = 15$

**A1**

**Additional Guidance**

$x = 0$ gives $b = 9 - a$

$x = 1$ gives $1 + a + b = 4 - a$

$x = 2$ gives $4 + 2a + b = 1 - a$

$x = 3$ gives $9 + 3a + b = -a$

(b) 2

**B1**

**[4]**

**M16.**

(a) **Alternative method 1**

$a = 2$ or $2(x^2 - 3x + 2.5)$ or
$2(x^2 - 3x) + 5$

**M1**

$x^2 - 3x = (x - 1.5)^2 - 1.5^2$
*oe*
*ft their* $x^2 - 3x$

**M1dep**

$a = 2$ and $b = 1.5$ and $c = 0.5$
*oe eg* $2(x - 1.5)^2 + 0.5$

**A1**

**Alternative method 2**

$a = 2$

**B1**

$x^2 - bx - bx + b^2$ or
$x^2 - 2bx + b^2$ or
$-2ab = -6$ or
$-ab = -3$ or
$b = 1.5$
*oe*

**M1**

$a = 2$ and $b = 1.5$ and $c = 0.5$
*oe eg* $2(x - 1.5)^2 + 0.5$ **A1**

(b) **Alternative method 1**

their $2(x - 1.5)^2 = 8.5 -$ their 0.5

**M1**

their $(x - 1.5) = \pm \sqrt{\frac{8.5 - \text{their } 0.5}{2}}$

*oe*

**M1dep**

3.5 and –0.5

*oe*

**A1**

**Alternative method 2**

$2x^2 - 6x - 3.5 (= 0)$ or
$4x^2 - 12x - 7 (=0)$

*oe 3-term quadratic equation or expression*

**M1**

Correct use of quadratic formula

eg $\frac{--12 \pm \sqrt{(-12)^2 - 4 \times 4 \times -7}}{2 \times 4}$

or correct factorisation
eg $(2x - 7)(2x + 1) = 0$

*oe*

**M1dep**

3.5 and –0.5

*oe*

**A1**

**[6]**

**M17.** $y(4x + 9)$ or $4xy + 9y$

*oe*

**M1**

$4xy + 9y = 8 - 3x$

*oe*

**M1dep**

$4xy + 3x = 8 - 9y$
or $x(4y + 3) = 8 - 9y$

*oe*

**M1dep**

$x = \frac{8 - 9y}{4y + 3}$

*SC3* $\frac{8 - 9y}{4y + 3}$

**A1**

**Additional Guidance**

$y \times (4x + 9)$

**M1**

$x = \frac{8 - 9y}{4y + 3}$ seen with answer $\frac{8 - 9y}{4y + 3}$

**M1M1M1A1**

**[4]**

**M18.**

$m = 5$

**B1**

$3 = 5 \times 4 + c$ **or** $3 = 20 + c$

*$y - 3 = 5(x - 4)$ or $y - 3 = 5x - 20$ oe*

**M1**

$c = -17$

*SC1 for $y = -0.2x + 3.8$ (using the perpendicular gradient)*

**A1**

**[3]**

**M19.**

(Gradient of $PQ$ =) $\frac{-4}{7}$

*Allow 0.57 or better for $\frac{4}{7}$*

**B1**

$0 = \frac{-4}{7} \times 14 + K$

*$(K =) 14 \times$ their $\frac{4}{7}$ or $-14 \times$ their $\frac{-4}{7} (= 8)$*

*8 marked at the y-intercept*

*ft non-integer gradient*

**M1**

$y = \frac{-4}{7}x + 8$

*ft non-integer gradient*

**A1ft**

$4x + 7y = 56$

*oe*

*ft their equation with a non-integer coefficient of x and M1 awarded*

**A1ft**

**[4]**

**M20.**

**Alternative method 1**

$P$ (1, 3) or $y = 3$ or grad $OP = 3$

**B1**

$\text{grad } PQ = -\dfrac{1}{\text{their } 3}$ or $-\dfrac{1}{3}$

**M1**

$y = \left(\text{their } -\dfrac{1}{3}\right)x + c$

and substitutes (1, their 3)

or

$y - \text{their } 3 = \left(\text{their } -\dfrac{1}{3}\right)(x-1)$

*oe*

$\dfrac{\textit{their } 3}{x-1}$ *or* $-\dfrac{\textit{their } 3}{x-1}$

**M1dep**

Substitutes $y = 0$ in their equation

$$-\frac{\textit{their } 3}{x-1} = \textit{their } -\frac{1}{3}$$

**M1dep**

(10, 0)

**A1**

**Alternative method 2**

$P$ (1, 3) or $y = 3$ or grad $OP = 3$

**B1**

$\dfrac{\text{their } 3}{1} = \dfrac{QN}{\text{their } 3}$

**M1dep**

their 3 × their 3 or 9

**M1dep**

$\tan PON = \dfrac{\text{their } 3}{1}$

*N is on the x-axis*

*PN is perpendicular to the x-axis*

**M1**

(10, 0) **A1** **[5]**

**M21.**

(a) 1536

**B1**

(b) $2^{n+2} + 2^n + 1$

**B1**

**[2]**

**M22.**

$\frac{x}{3}$

**B1**

**[1]**

**M23.**

$2(cx + 5) + c$ or $2cx + 10 + c$

**M1**

their $2cx = 6x$ or their $2c = 6$
or $c = 3$

*Must have attempted fg(x)*

**M1**

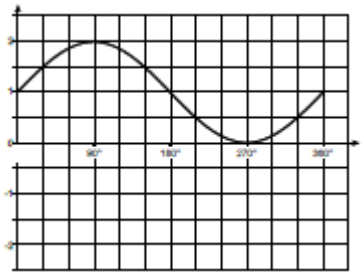
13

*SC2 for 11*

**A1**

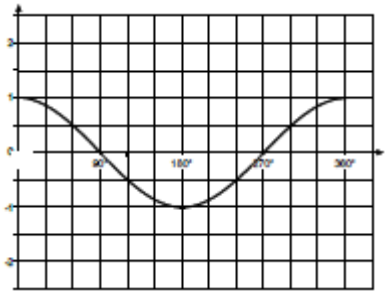
**[3]**

**M24.**(a) Fully correct graph



**B1**

(b) Fully correct graph



**B1**

**[2]**

**M25.** $n$ and $n + 1$ seen

*Two consecutive integers expressed algebraically, eg n – 1 and n*

**M1**

$(n + 1)^2 - n^2$

*Subtraction of their consecutive integers squared*

**M1dep**

$n^2 + 2n + 1 - n^2$

*Correct expansion*

**A1**

$2n + 1$ and explanation why this expression must be odd

*Strand (i). Explanation why their expression must be odd*

**Q1**

**[4]**

**M26.**

6.5 – 2.3 or 4.2 and 5 or 85 seen

**M1**

$\sin 5 = \frac{6.5 - 2.3}{AD}$ or

$\cos 85 = \frac{6.5 - 2.3}{AD}$ or

$\left(\frac{6.5 - 2.3}{\tan 5}\right)^2 + (6.5 - 4.2)^2$

*oe*

**M1**

$\frac{6.5 - 2.3}{\sin 5}$ or $\frac{6.5 - 2.3}{\cos 85}$ or

$\sqrt{\left(\frac{6.5-2.3}{\tan 5}\right)^2 + (6.5-4.2)^2}$

*oe*

**M1dep**

[48, 48.2]

**A1**

**[4]**

**M27.** $\frac{60}{360} \times 2 \times \pi \times 12$

*oe Mark complete method*

**M1**

$4\pi$ or [12.56, 12.6] or $\pi 4$

*NB 4π + 24 is M1, A0*

*NB 4π ÷ 2 implies M0*

*12.4 implies M1*

**A1**

**[2]**

**M28.**(a) $\pi \times 9.2 \times 9.2$ or 265.(...)

*oe*

**M1**

$\frac{125}{360} \times \pi \times 9.2 \times 9.2$

*oe*

**M1dep**

[92, 92.5]

**A1**

(b) ½ × 9.2 × 9.2 × sin 125

*oe*

**M1**

[34.6, 34.7]

**A1**

[57, 58]

*ft their (a) − [34.6, 34.7]*

*Allow rounding of final answer*

**A1ft**

**[6]**

**M29.**

(a) Four correct cumulative frequencies

*23, 48, 87 and 100*

**B1**

Five correct heights plotted

*(…, 12), (…, 23), (…, 48), (…, 87) and (…, 100)*

**B1**

Five points plotted at correct upper boundaries

*(15, …), (20, …), (40, …), (55, …) and (70, …)*

*Must be an increasing function*

**B1**

Straight lines or smooth curve going through the five points

*ft **their** 5 plotted points.*

*Must be an increasing function*

**B1ft**

**Additional Guidance**

Ignore anything to the left of *their* (15, 12)

Ignore anything to the right of *their* (70, 100), must be an increasing function

tolerance $\pm\frac{1}{2}$ square

Accept histograms / bars for heights plotted but upper boundary points must be identified either by plots or curve / polygon

(b) *their* LQ plotted
and *their* median plotted
and *their* UQ plotted

*ft* ***their*** *cf graph provided increasing function*

*tolerance* $\pm\frac{1}{2}$ *square* $(\pm 1)$

*B1ft for 2 correctly plotted*

**B2ft**

Box plot with 8 and 69 correct

*Correct diagrammatic representation*

**B1**

**Additional Guidance**
Allow values plotted as points for B2ft

**[7]**

**M30.**(a) Bar between 2 and 3 to a height of 13

Bar between 4 and 5 to a height of 19

Bar between 7 and 10 to a height of 5

*B1 for bar between 7 and 10 correct*

**B2**

**Additional Guidance.** Two of the values, 13 and 19 come straight from the table, so students who draw a 'bar chart' rather than a histogram will get two of the heights correct. This is why they have to get all three bars correct for 2 marks, and the only way they can score 1 mark is to get the bar between 7 and 10 at a height of 5. This mark is independent, so if they mess up the bars for 2 to 3 and/or 4 to 5, for example by misreading scales, then as long as the 7 to 10 bar is at a height of 5 award B1.
Note: Any 'gaps' between bars, eg 2 to 3 being draw from 2.1 to 3 counts as an error.

(b) 17 and 28

*B1 for 28 correct*

**B2**

**Additional Guidance.** One of the values, 17 comes straight from the histogram, so students who read it as a 'bar chart' rather than a histogram will get one of the entries correct. This is why they have to get both entries correct for 2 marks, and the only way they can score 1 mark is to get the entry for $5 < c \leq 7$ as 28. This mark is independent, so if they mess up the entry for $3 < c \leq 4$ for example 8.5 or 34, as long as the other entry is 28 this scores B1

**[4]**

**M31.**

(a) $\frac{29}{50}$

*oe 0.58*

**B1**

(b) $\frac{23}{50}$

*oe 0.46*

*SC1 incorrect but consistent denominator, greater than 29, in (a) and (b) with correct numerators.*

**B1**

(c) L'

**B1**

(d) $\frac{40}{50}$ or 40 seen

*6, 23 and 11 identified*

**M1**

L ∪ T

*T ∪ L*

*SC1 A ∪ B or B ∪ A*

**A1**

**[5]**

**M32.Alternative method 1**

$\frac{4}{10}$ (black)

*oe*

*May be on diagram*

**M1**

$\frac{4}{10} \times \frac{3}{9}$

*oe*

*0.4 × 0.33...*

*May be on diagram*

**M1dep**

$\frac{12}{90} = \frac{1}{9}$

*oe*

*0.13... or 13.(...)%*

**A1**

**Alternative method 2**

4 × 3 or 12
or 10 × 9 or 90

**M1**

4 × 3 or 12
and 10 × 9 or 90

**M1dep**

$\frac{12}{90} = \frac{1}{9}$

*oe*

*0.13... or 13.(...)%*

**A1**

**Additional Guidance**

$\frac{12}{90} = \frac{1}{9}$, ingore fw

**M1M1A1**

**[3]**

**M33.**

$\frac{9}{27}$ or $\frac{18}{27}$ or fraction with denominator 22

*oe*

**M1**

$\frac{9}{27} \times \frac{8}{22}$ or $\frac{72}{594}$ or

$\frac{18}{27} \times \frac{7}{22}$ or $\frac{126}{594}$

*oe*

**M1**

their $\frac{72}{594}$ + their $\frac{126}{594}$ or $\frac{198}{594}$

*oe*

*dep on 2nd M1*

**M1dep**

Clear indication that $\frac{198}{594}$ and $\frac{9}{27}$ are equivalent fractions

**A1**

**[4]**

**M34.**

(a) 0.5 × 20 × 5 or 50
or
5 × 50 or 250
or
0.5 × 40 × 5 or 100
or
0.5 × 5 × (110 + 50)

*oe*

*Working may be on the diagram*

*e.g.1 Trapezium rule*

*e.g.2 Attempt to count squares and convert to a distance*

*For example*

*0.5 × 2 × 5 = 5 and their 5 × 10*

**M1**

0.5 × 20 × 5 + 5 × 50 + 0.5 × 40 × 5 = 400
or
50 + 250 + 100 = 400

or
0.5 × 5 × (110 + 50) = 400
*oe*

**A1**

(b) **Alternative method 1**

0.5 × 60 × 6 or 180
*oe*
*Distance for first 60 seconds*

**M1**

0.5 × 60 × 6 + 50 × 6 or 480
*oe*
*Distance for first 110 seconds*
*This mark implies the first M1*
*0.5 × (110 + 50) × 6 is M2*

**M1**

480 and Yes

**A1**

**Alternative method 2**

0.5 × 60 × 6 or 180
*oe*
*Distance for first 60 seconds*

**M1**

(400 − their 180) ÷ 6 or [36, 37]
or
(400 − their 180) ÷ 50 or 4.4
or
Correctly builds up to a distance ≥ 400
*Remaining distance ÷ speed → time*
*or*
*Remaining distance ÷ time → speed*

**M1**

[96, 97] and Yes
or
4.4 and Yes
or
Correct time for their build up and Yes

**A1**

**[5]**

**M35.**

(a) Attempts to calculate an area

eg $\frac{1}{2}$ × 90 × 9.4
*Attempts to calculate average speeds over*
***equal*** *time intervals* ***and*** *divides by number of intervals (****and*** *multiplies by 120)*

**M1**

[545, 565]

*A1 [530, 580]*

**A2**

m(etres)

*Allow correct conversion to other units if supported by an area*
*eg 0.564 km after 564 calculated for area*

**B1**

(b) Tangent drawn at 70 seconds

**B1**

Attempt at $\frac{y_2 - y_1}{x_2 - x_1}$ for their tangent

*At least one of numerator or denominator correct*

**M1**

[0.06, 0.14]

**A1**

**[7]**