Year 12 AS and A level Maths and Further Maths induction task Instructions

The aim of this task is to 'bridge the gap' between GCSE and A level Mathematics.

There are two levels of questions, GCSE and AS level. Each file contains both questions and answers.

- Complete all of the GCSE questions. Use the mark scheme to mark these when you have finished. You should spend approximately 3 hours on this.
- Complete as many as you can of the AS level questions. Some of these are difficult, but others are no more difficult than the GCSE level questions. Use 'Head start to AS Maths', my maths website to help you. If you are doing Further Maths you should certainly attempt all of these questions.
- Make a note of any questions you cannot do or are unsure of.
- In the first lesson when you start in September you need to bring your answers and queries and some of these will be discussed.
- During the second week you will be given an induction test based on these types of questions.

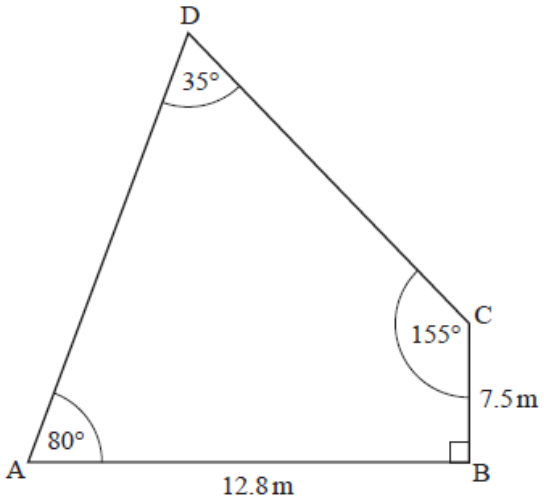
Good Luck and we look forward to seeing you in September!

AS Level Questions

Trigonometry

1

Fig. 10.1 shows Jean's back garden. This is a quadrilateral ABCD with dimensions as shown.



Not to scale

Fig. 10.1

(i) (*A*) Calculate AC and angle ACB. Hence calculate AD. **[6]**

(*B*) Calculate the area of the garden. **[3]**

2

Fig. 7 shows a sketch of a village green ABC which is bounded by three straight roads. AB = 92 m, BC = 75 m and AC = 105 m.

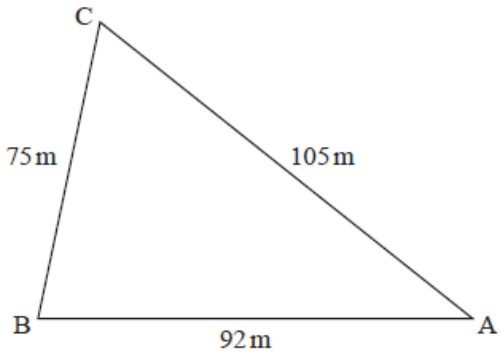


Fig. 7

Calculate the area of the village green. **[5]**

AS Level Questions

Algebra and graphs

3

Make r the subject of the formula $A = \pi r^2 (x + y)$, where $r > 0$. **[2]**

4

Make x the subject of the equation $y = \dfrac{x+3}{x-2}$. **[4]**

5

A line L is parallel to $y = 4x + 5$ and passes through the point $(-1, 6)$. Find the equation of the line L in the form $y = ax + b$. Find also the coordinates of its intersections with the axes. **[5]**

6

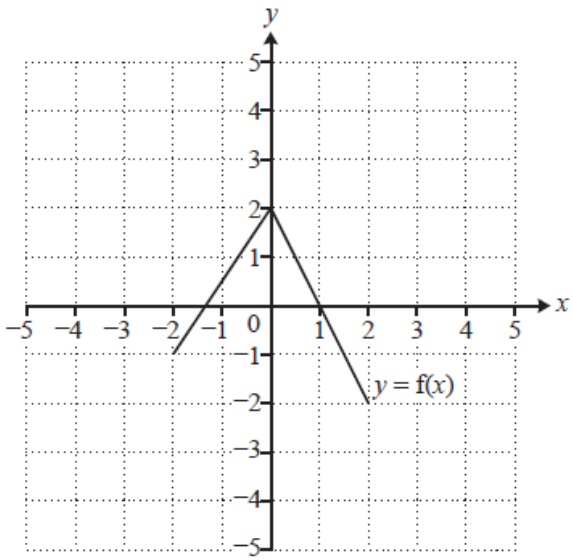


Fig. 3

Fig. 3 shows the graph of $y = \mathrm{f}(x)$. Draw the graphs of the following.

(i) $y = \mathrm{f}(x) - 2$ **[2]**

(ii) $y = \mathrm{f}(x - 3)$ **[2]**

7

The point $\mathrm{R}(6, -3)$ is on the curve $y = \mathrm{f}(x)$.

(i) Find the coordinates of the image of R when the curve is transformed to $y = \frac{1}{2}\mathrm{f}(x)$. **[2]**

(ii) Find the coordinates of the image of R when the curve is transformed to $y = \mathrm{f}(3x)$. **[2]**

AS Level Questions

8

Find the coordinates of the point of intersection of the lines $y = 5x - 2$ and $x + 3y = 8$. **[4]**

Indices and surds

9

Evaluate the following.

(i) 200^0 **[1]**

(ii) $\left(\frac{25}{9}\right)^{-\frac{1}{2}}$ **[3]**

10

(i) Evaluate $\left(\frac{1}{27}\right)^{\frac{2}{3}}$. **[2]**

(ii) Simplify $\frac{(4a^2c)^3}{32a^4c^7}$. **[3]**

11

(i) Expand and simplify $(3+4\sqrt{5})(3-2\sqrt{5})$. **[3]**

(ii) Express $\sqrt{72}+\frac{32}{\sqrt{2}}$ in the form $a\sqrt{b}$, where a and b are integers and b is as small as possible. **[2]**

Inequalities

12

Solve the inequality $\frac{4x-5}{7} > 2x+1$. **[3]**

13

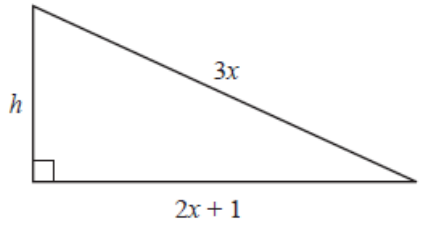
Solve the inequality $3x^2 + 10x + 3 > 0$. **[3]**

AS Level Questions

Quadratics and their graphs

14

Fig. 8 shows a right-angled triangle with base $2x+1$, height h and hypotenuse $3x$.



Not to scale

Fig. 8

(i) Show that $h^2 = 5x^2 - 4x - 1$. **[2]**

(ii) Given that $h = \sqrt{7}$, find the value of x, giving your answer in surd form. **[3]**

15

(i) Express $x^2 - 5x + 6$ in the form $(x-a)^2 - b$. Hence state the coordinates of the turning point of the curve $y = x^2 - 5x + 6$. **[4]**

(ii) Find the coordinates of the intersections of the curve $y = x^2 - 5x + 6$ with the axes and sketch this curve. **[4]**

16

Express $3x^2 - 12x + 5$ in the form $a(x-b)^2 - c$. Hence state the minimum value of y on the curve $y = 3x^2 - 12x + 5$. **[5]**

Proof

17

Factorise $n^3 + 3n^2 + 2n$. Hence prove that, when n is a positive integer, $n^3 + 3n^2 + 2n$ is always divisible by 6. **[3]**

18

$n-1$, n and $n+1$ are any three consecutive integers.

(i) Show that the sum of these integers is always divisible by 3. **[1]**

(ii) Find the sum of the squares of these three consecutive integers and explain how this shows that the sum of the squares of any three consecutive integers is never divisible by 3. **[3]**

Longer questions on graphs

19

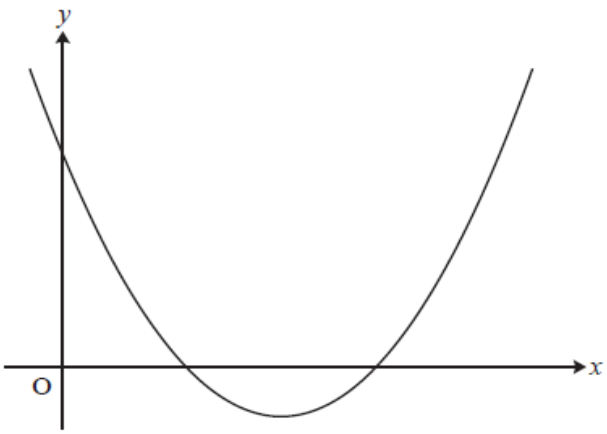


Fig. 11

Fig. 11 shows a sketch of the curve with equation $y = (x-4)^2 - 3$.

(i) Write down the equation of the line of symmetry of the curve and the coordinates of the minimum point. **[2]**

(ii) Find the coordinates of the points of intersection of the curve with the x-axis and the y-axis, using surds where necessary. **[4]**

(iii) The curve is translated by $\begin{pmatrix} 2 \\ 0 \end{pmatrix}$. Show that the equation of the translated curve may be written as $y = x^2 - 12x + 33$. **[2]**

20

You are given that $\mathrm{f}(x) = (x+3)(x-2)(x-5)$.

(i) Sketch the curve $y = \mathrm{f}(x)$. **[3]**

(ii) Show that $\mathrm{f}(x)$ may be written as $x^3 - 4x^2 - 11x + 30$. **[2]**

(iii) Describe fully the transformation that maps the graph of $y = \mathrm{f}(x)$ onto the graph of $y = \mathrm{g}(x)$, where $\mathrm{g}(x) = x^3 - 4x^2 - 11x - 6$. **[2]**

AS Level Questions

Statistics and probability

1 The ages, x years, of the senior members of a running club are summarised in the table below.

Age (x)	$20 \leqslant x < 30$	$30 \leqslant x < 40$	$40 \leqslant x < 50$	$50 \leqslant x < 60$	$60 \leqslant x < 70$	$70 \leqslant x < 80$	$80 \leqslant x < 90$
Frequency	10	30	42	23	9	5	1

(i) Draw a cumulative frequency diagram to illustrate the data. **[5]**

(ii) Use your diagram to estimate the median and interquartile range of the data. **[3]**

2

Candidates applying for jobs in a large company take an aptitude test, as a result of which they are either accepted, rejected or retested, with probabilities 0.2, 0.5 and 0.3 respectively. When a candidate is retested for the first time, the three possible outcomes and their probabilities remain the same as for the original test. When a candidate is retested for the second time there are just two possible outcomes, accepted or rejected, with probabilities 0.4 and 0.6 respectively.

(i) Draw a probability tree diagram to illustrate the outcomes. **[3]**

(ii) Find the probability that a randomly selected candidate is accepted. **[2]**

(iii) Find the probability that a randomly selected candidate is retested at least once, given that this candidate is accepted. **[3]**

3

Each weekday, Marta travels to school by bus. Sometimes she arrives late.

- L is the event that Marta arrives late.
- R is the event that it is raining.

You are given that $\mathrm{P}(L) = 0.15$, $\mathrm{P}(R) = 0.22$ and $\mathrm{P}(L \mid R) = 0.45$.

(i) Use this information to show that the events L and R are not independent. **[1]**

(ii) Find $\mathrm{P}(L \cap R)$. **[2]**

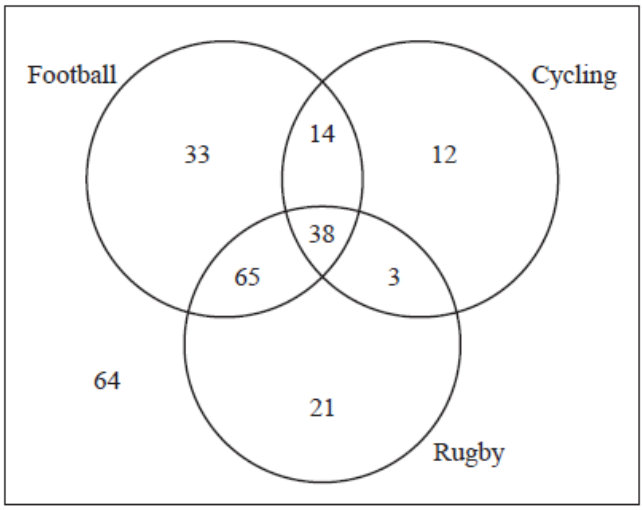
(iii) Draw a Venn diagram showing the events L and R, and fill in the probability corresponding to each of the four regions of your diagram. **[3]**

4

A survey is being carried out into the sports viewing habits of people in a particular area. As part of the survey, 250 people are asked which of the following sports they have watched on television in the past month.

- Football
- Cycling
- Rugby

The numbers of people who have watched these sports are shown in the Venn diagram.



One of the people is selected at random.

(i) Find the probability that this person has in the past month

(*A*) watched cycling but not football, **[1]**

(*B*) watched either one or two of the three sports. **[2]**

(ii) Given that this person has watched cycling, find the probability that this person has not watched football. **[2]**

Kinematic graphs

5

Fig. 1 shows the velocity-time graph of a cyclist travelling along a straight horizontal road between two sets of traffic lights. The velocity, v, is measured in metres per second and the time, t, in seconds. The distance travelled, s metres, is measured from when $t = 0$.

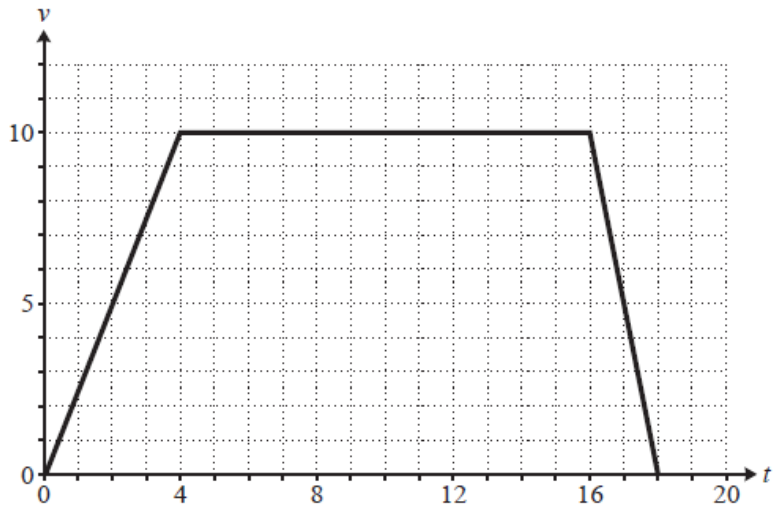


Fig. 1

(i) Find the values of s when $t = 4$ and when $t = 18$. **[3]**

(ii) Sketch the graph of s against t for $0 \leqslant t \leqslant 18$. **[3]**

AS Level Questions

1

Question		Answer	Marks	Guidance	
(i)	(A)	$AC^2 = 12.8^2 + 7.5^2$ oe	M1	allow correct application of cosine rule or from finding relevant angle and using trig	
		$AC = 14.83543056..$	A1	rot to 3 or more sf , or 15	B2 for 14.8 or better unsupported
		$\tan C = {}^{12.8}/_{7.5}$	M1	or $\sin C = {}^{12.8}/_{their14.8}$	or $\frac{\sin C}{12.8} = \frac{\sin 90}{their14.8}$
		or $C = 90 - \tan^{-1}({}^{7.5}/_{12.8})$ oe		or $\cos C = {}^{7.5}/_{their14.8}$	or $\cos C = \frac{their14.8^2 + 7.5^2 - 12.8^2}{2 \times 7.5 \times their14.8}$
		59.6 to 59.64	A1		
		$\frac{AD}{\sin(155 - their59.6)} = \frac{their14.8}{\sin 35}$ oe	M1		
		25.69 to 25.8	A1	allow **B2** for $25.69 \leq AD < 25.8$ unsupported.....but **B0** for 25.8 unsupported	**M0A0** for ${}^{14.8}/_{\cos 55} = 25.803...$
			[6]		
(i)	(B)	area of $ABC = 48$ soi	B1	may be implied by correct final answer in range or by sight of ½ × 12.8 × 7.5 oe	condone 48.0...
		½×their 14.8...×their 25.7...×sin(their 59.6 − 10)	M1	may be implied by 144.8 to 146	
		192.8 to 194[m^2]	A1		B3 for correct answer in range if unsupported
			[3]		

AS Level Questions

2

Answer	Marks	Guidance	
$\cos A = \frac{105^2 + 92^2 - 75^2}{2 \times 105 \times 92}$ oe	M1	or $\cos B = \frac{75^2 + 92^2 - 105^2}{2 \times 75 \times 92}$ oe	or $\cos C = \frac{105^2 + 75^2 - 92^2}{2 \times 105 \times 75}$ oe
0.717598…soi	A1	0.2220289…soi	0.519746…soi
A = 44.14345…° soi [0.770448553…]	A1	B = 77.1717719……° soi [1.346901422]	C = 58.6847827…° soi [1.024242678…]
			ignore minor errors due to premature rounding for second **A1** condone *A*, *B* or *C* wrongly attributed
½ × 92 × 105 × sin (*their* A)	M1	or ½ × 75 × 92 × sin (*their* B)	or ½ × 75 × 105 × sin (*their* C)
3360 or 3361 to 3365	A1		
			or **M3** for $\sqrt{136(136-75)(136-105)(136-92)}$ **A2** for correct answer 3360 or 3363 - 3364
	[5]		

3

Answer	Marks	Guidance	
$[r =]\sqrt{\frac{A}{\pi(x+y)}}$ or $[r =]\sqrt{\frac{A}{\pi x + \pi y}}$ as final answer	2	square root symbol must extend below fraction line; accept to power ½ with appropriate brackets **M1** for a triple decker fraction or for $r^2 = \frac{A}{\pi(x+y)}$ or for $[r =] \pm \sqrt{\frac{A}{\pi(x+y)}}$ or for their final answer for r ft their r^2	condone missing end bracket in denominator eg M1 for $[r =] \sqrt{\frac{A}{\frac{\pi}{(x+y)}}}$
	[2]		

AS Level Questions

4

$y(x-2) = (x+3)$	M1	for multiplying by $x-2$; condone missing brackets
$xy - 2y = x + 3$ or ft [ft from earlier errors if of comparable difficulty – no ft if there are no xy terms]	M1	for expanding bracket and being at stage ready to collect x terms
$xy - x = 2y + 3$ or ft	M1	for collecting x and 'other' terms on opposite sides of eqn
$[x =]\frac{2y+3}{y-1}$ o.e. or ft	M1	for factorising and division

5

$y = 4x + 10$	B3	**M1** for $y = 4x + b$ oe and **M1** for $y - 6 =$ their $a(x + 1)$ oe or for $(-1, 6)$ subst in $y =$ (their a)$x + b$ oe or **M1** for $y = ax + 10$
$(0, 10)$ or ft	B1	condone $y = 10$ isw
$(-10/4, 0)$ oe or ft	B1	condone $x = -10/4$ isw
	[5]	

6

Question		Answer	Marks	Guida
(i)		graph of shape with vertices at $(-2, -3)$, $(0, 0)$ and $(2, -4)$	2 [2]	M1 for 2 vertices correct
(ii)		graph of shape with vertices at $(1, -1)$, $(3, 2)$ and $(5, -2)$	2 [2]	M1 for 2 vertices correct or for shape with vertices at $(-5, -1)$, $(-3, 2)$ and $(-1, -2)$

AS Level Questions

7

Question	Answer	Marks	Guidanc
(i)	(6, −1.5) oe	B2 [2]	B1 for each value; allow $x = 6$, $y = -1.5$
(ii)	(2, −3)	B2 [2]	B1 for each value; allow $x = 2$, $y = -3$

8

$x + 3(5x - 2) = 8$ or $y = 5(8 - 3y) - 2$	M1	for subst to eliminate one variable; condone one error;
$16x = 14$ or $16y = 38$	M1	for collecting terms and simplifying; condoning one error ft
(7/8, 19/8) oe	A2 [4]	or $x = 14/16$, $y = 38/16$ oe isw allow **A1** for each coordinate

9

Question	Answer	Marks	Guidance
(i)	1	1 [1]	
(ii)	$\frac{3}{5}$ or 0.6	3 [3]	allow **B3** for ±0.6 oe; **M1** for $\left(\frac{25}{9}\right)^{-\frac{1}{2}} = \left(\frac{9}{25}\right)^{\frac{1}{2}}$ soi or $\frac{1}{\left(\frac{25}{9}\right)^{\frac{1}{2}}}$ and **M1** for at least one of 3 and 5 found

10

Question	Answer	Marks	Guida
(i)	$\frac{1}{9}$	2 [2]	isw conversion to decimal M1 for 9 or for 3^{-2} or for $\frac{1}{3}$ Except M0 for 9 from 27/3 or $\sqrt[3]{27}$
(ii)	$2a^2c^{-4}$ or $\frac{2a^2}{c^4}$ as final answer	3 [3]	B1 for each element; must be multiplied if B0, allow SC1 for $64a^6c^3$ obtained from numerator or for all elements correct but added

AS Level Questions

11

Question	Answer	Marks	Guidance
(i)	$-31+6\sqrt{5}$	3 [3]	**B2** for -31 or **B1** for $9-40$ or **SC1** for 49 and **B1** for $6\sqrt{5}$ if 0, allow **M1** for three terms correct in $9-6\sqrt{5}+12\sqrt{5}-40$
(ii)	$22\sqrt{2}$	2 [2]	**M1** for $\sqrt{72}=6\sqrt{2}$ soi or for $\frac{32}{\sqrt{2}}=16\sqrt{2}$ soi or for $\frac{12+32}{\sqrt{2}}$ oe

12

$4x-5>14x+7$	M1	for correctly multiplying by 7 to eliminate the fraction, including expanding bracket if this step done first
$-12>10x$ or $-10x>12$ or ft	M1	for correctly collecting x terms on one side and number terms on the other and simplifying
$x<-\frac{12}{10}$ or $-\frac{12}{10}>x$ oe isw or ft	M1 [3]	ft their ax [inequality] b, where $b\neq 0$ and $a\neq 0$ or ± 1

13

$(3x+1)(x+3)$	M1	or $3(x+1/3)(x+3)$ or for $-1/3$ and -3 found as endpoints eg by use of formula
$x<-3$ [or] $x>-1/3$ oe	A1 A1	mark final answers; allow only A1 for $-3>x>-1/3$ oe as final answer or for $x\leq -3$ and $x\geq -1/3$ if M0, allow SC1 for sketch of parabola the right way up with their solns ft their endpoints
	[3]	

14

Question	Answer	Marks	Guidance
(i)	$(3x)^2 = h^2 + (2x+1)^2$ oe	B1	for a correct Pythagoras statement for this triangle, in terms of x, with correct brackets
	$9x^2 = h^2 + 4x^2 + 4x + 1$ and completion to given answer , $h^2 = 5x^2 - 4x - 1$	B1	for correct expansion, with brackets or correct signs; must complete to the given answer with no errors in any interim working may follow $3x^2 = h^2 + (2x+1)^2$ oe for **B0 B1**
		[2]	
(ii)	$[0 =] 5x^2 - 4x - 8$	B1	for subst and correctly rearranging to zero
	$\frac{4 \pm \sqrt{(-4)^2 - 4\times5\times-8}}{2\times5}$ or ft	M1	for use of formula in their eqn rearranged to zero, condoning one error; ft only if their rearranged eqn is a 3-term quadratic; no ft from $5x^2 - 4x - 1$ [=0]
	$\frac{4+\sqrt{176}}{10}$ or $\frac{2}{5}+\frac{\sqrt{44}}{5}$ oe	A1	isw wrong simplification; **A0** if negative root also included
		[3]	

15

(i)		$\left(x - \frac{5}{2}\right)^2 - \frac{1}{4}$ oe	B3	B1 for $a = 5/2$ oe and M1 for $6 - $ *their* a^2 soi;
		$\left(\frac{5}{2}, -\frac{1}{4}\right)$ oe or ft	B1	accept $x = 2.5, y = -0.25$ oe
			[4]	

Question	Answer	Marks	Guida
(ii)	(2, 0) and (3, 0)	B2	B1 each or B1 for both correct plus an extra or M1 for $(x-2)(x-3)$ or correct use of formula or for $their\ a \pm \sqrt{their\ b}$ ft from (i)
	(0, 6)	B1	
	graph of quadratic the correct way up and crossing both axes	B1	ignore label of their tp; condone stopping at y-axis

16

$3(x-2)^2 - 7$ isw or $a = 3$, $b = 2$ $c = 7$ www	4	B1 each for $a = 3$, $b = 2$ oe and B2 for $c = 7$ oe or M1 for $[-]\frac{7}{3}$ or for $5 - their\ a(their\ b)^2$ or for $\frac{5}{3} - (their\ b)^2$ soi
-7 or ft	B1	B0 for $(2, -7)$
	[5]	

17

$n\,(n+1)(n+2)$	**M1**	condone division by n and then $(n+1)(n+2)$ seen, or separate factors shown after factor theorem used;
argument from general consecutive numbers leading to:		
at least one must be even	**A1**	or divisible by 2;
[exactly] one must be multiple of 3	**A1**	if M0: allow **SC1** for showing given expression always even

18

(i)		$3n$ isw	1 **[1]**

(ii)		at least one of $(n-1)^2$ and $(n+1)^2$ correctly expanded	M1	must be seen
		$3n^2+2$	B1	
		comment eg $3n^2$ is always a multiple of 3 so remainder after dividing by 3 is always 2	B1	dep on previous B1 B0 for just saying that 2 is not divisible by 3 – must comment on $3n^2$ term as well allow B1 for $\frac{3n^2+2}{3} = n^2 + \frac{2}{3}$
			[3]	

19

Question		Answer	Marks	Guida
(i)		$x = 4$	B1	
		$(4, -3)$	B1	or $x = 4, y = -3$
			[2]	
(ii)		$(0, 13)$ isw	1	or [when $x = 0$], $y = 13$ isw 0 for just $(13, 0)$ or $(k, 13)$ where $k \neq 0$
		[when $y = 0$,] $(x-4)^2 = 3$	M1	or $x^2 - 8x + 13$ [= 0]
		$[x =] 4 \pm \sqrt{3}$ or $\frac{8 \pm \sqrt{12}}{2}$ isw	A2	need not go on to give coordinate form A1 for one root correct
			[4]	
(iii)		replacement of x in their eqn by $(x-2)$	M1	may be simplified; eg $[y =] (x-6)^2 - 3$ or allow M1 for $(x - 6 - \sqrt{3})(x - 6 + \sqrt{3})$ [=0 or y]
		completion to given answer $y = x^2 - 12x + 33$, showing at least one correct interim step	A1	cao; condone using $f(x-2)$ in place of y
			[2]	

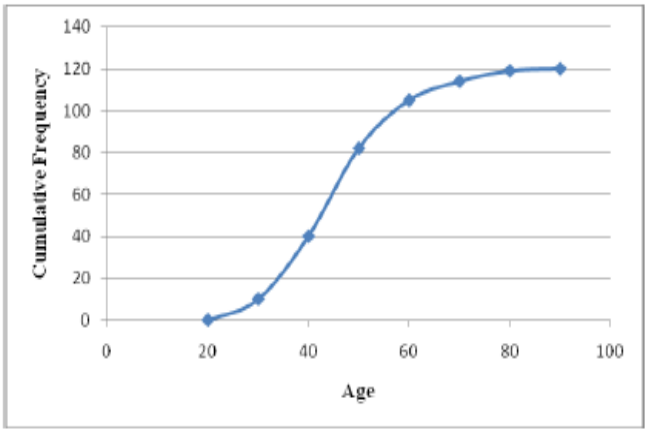
20

(i)		graph of cubic correct way up	B1	**B0** if stops at x-axis
		crossing x-axis at -3, 2 and 5	B1	on graph or nearby; may be in coordinate form mark intent for intersections with both axes
		crossing y-axis at 30	B1	or $x = 0$, $y = 30$ seen if consistent with graph drawn
			[3]	
(ii)		correct expansion of two of the linear factors	M1	may be 3 or 4 terms
		correct expansion and completion to given answer, $x^3 - 4x^2 - 11x + 30$	A1	must be working for this step before given answer
			[2]	

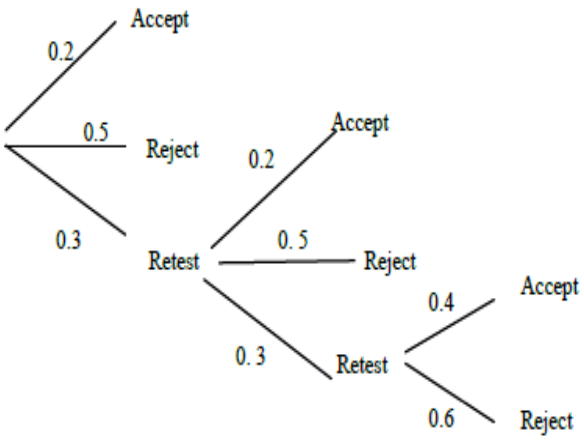
(iii)		translation	B1	0 for shift or move etc without stating translation
		$\begin{pmatrix} 0 \\ -36 \end{pmatrix}$	B1	or 36 down, or -36 in y direction oe
			[2]	

Statistics and probability

1

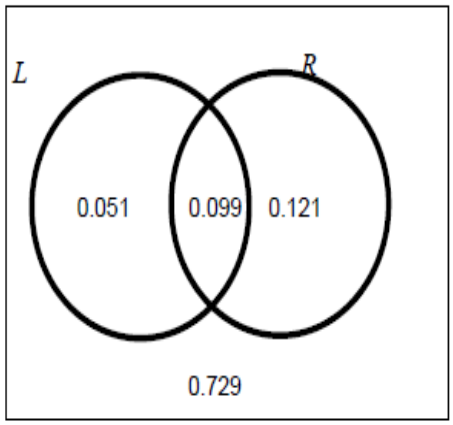
Question		Answer	Marks	Gu
(i)		<table><tr><td>Upper Bound</td><td>20</td><td>30</td><td>40</td><td>50</td><td>60</td><td>70</td><td>80</td><td>90</td></tr><tr><td>Cumulative Freq</td><td>0</td><td>10</td><td>40</td><td>82</td><td>105</td><td>114</td><td>119</td><td>120</td></tr></table> 	B1 G1 G1 G1 G1 [5]	Cumulative frequencies All correct For plotted points (Provided plotted at correct UCB positions) For joining points (within ½ a square) For scales For labels All marks dep on good attempt at cumulative frequency, but not cumulative fx's or other spurious values.
(ii)		Median = 45 Q1 = 37 Q3 = 53 Inter-quartile range = 53 – 37 = 16	B1 B1 B1 [3]	Allow answers between 44 and 46 without checking curve. Otherwise check curve. No marks if not using diagram. For Q3 or Q1 Allow Q1 between 37 and 38 without checking Allow Q3 between 52 and 54 without checking For IQR providing both Q1 and Q3 are correct

2

Question		Answer	Marks	Gu
(i)			G1 G1 G1 [3]	Do a vertical scan and give: First column Second column Final column Do not award if first two branches missing Branches two and three should come out of 'retest'
(ii)		$P(\text{Accepted}) = 0.2 + (0.3 \times 0.2) + (0.3 \times 0.3 \times 0.4)$ $= 0.2 + 0.06 + 0.036 = 0.296$	M1 A1 [2]	For second or third product CAO
(iii)		P(At least one retest given accepted) $= \frac{P(\text{At least one retest and accepted})}{P(\text{Accepted})}$ $= \frac{0.3 \times 0.2 + 0.3 \times 0.3 \times 0.4}{0.296} = \frac{0.096}{0.296}$ $= 0.324$	M1 M1 A1 [3]	For numerator For denominator FT their 0.296 and 0.096 Allow 0.32 with working

AS Level Questions

3

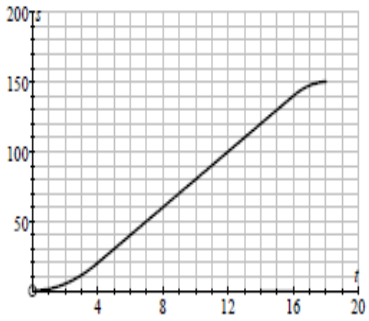
Question		Answer	Marks	Gu
(i)		Because $P(L \mid R) \neq P(L)$	E1 [1]	If two or more methods given and only one correct, do not award the mark Allow $0.45 \neq 0.15$
(ii)		$P(L \cap R) = P(L \mid R) \times P(R) = 0.45 \times 0.22$ $= 0.099$	M1 A1 [2]	For product CAO
(iii)			G1 G1 G1 [3]	For two labelled intersecting circles, provided no incorrect labelling. For at least 2 correct probabilities. FT their $P(L \cap R)$ from part (ii) provided ≤ 0.15 For remaining probabilities. FT their $P(L \cap R)$ providing probabilities between 0 and 1.

4

Question		Answer	Marks	
(i)	(A)	P(Watched cyc but not fb) $= \frac{15}{250} = \frac{3}{50} = 0.06$	B1 [1]	CAO (aef)
(i)	(B)	P(Watched one or two) $= \frac{33+12+21+14+3+65}{250}$ $= \frac{148}{250} = \frac{74}{125} = 0.592$	M1 A1 [2]	OR: $\frac{250-(64+38)}{250} =$ CAO (aef)
(ii)		P(Not watched fb|watched cyc) $= \frac{15}{67} = 0.224$ (0.223880597…)	M1 A1 [2]	 CAO (aef)

Kinematics

5

Question	Answer	Marks	Guidance
(i)	When $t=4$, $s=\frac{1}{2}\times 4\times 10$		Finding the area of the triangle or equivalent.
	$s=20$	B1	
	When $t=18$, $s=\frac{1}{2}\times(18+12)\times 10$	M1	A complete method of finding the area of the trapezium or equivalent.
	$s=150$	A1	CAO
		[3]	
(ii)			
	Graph joining (0,0), (4,20) and (18, 150)	B1	Allow FT for their (4,20) and (18, 150) Condone extension to (20, 150) with a horizontal line.
	The graph goes through (16, 140)	B1	
			Allow SC1 for the first two marks if there is a consistent displacement from a correct scale, eg plotting (18,150) at (19, 150)
	Curves at both ends	B1	The sections from $t=0$ to $t=4$ and from $t=16$ to $t=18$ are both curves
		[3]	

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 = ...

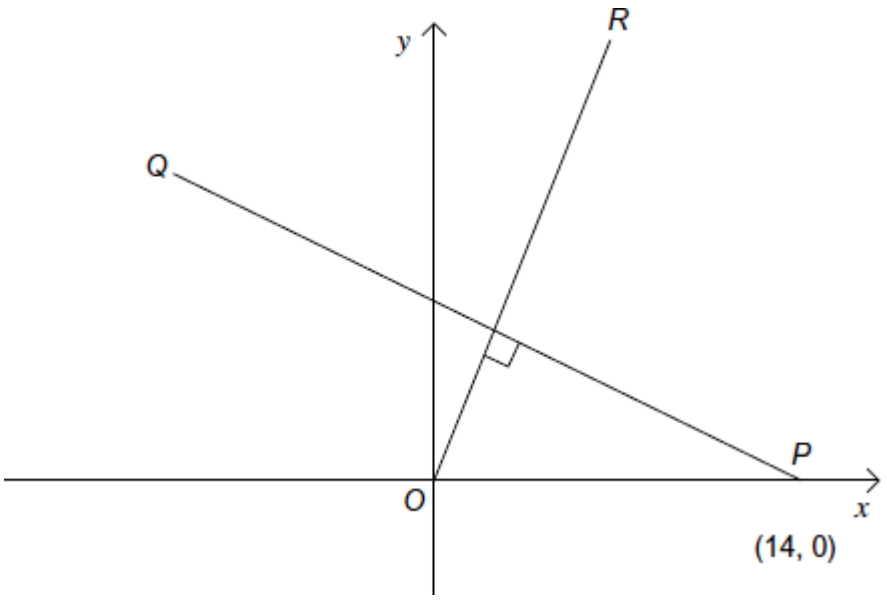
(Total 3 marks)

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)

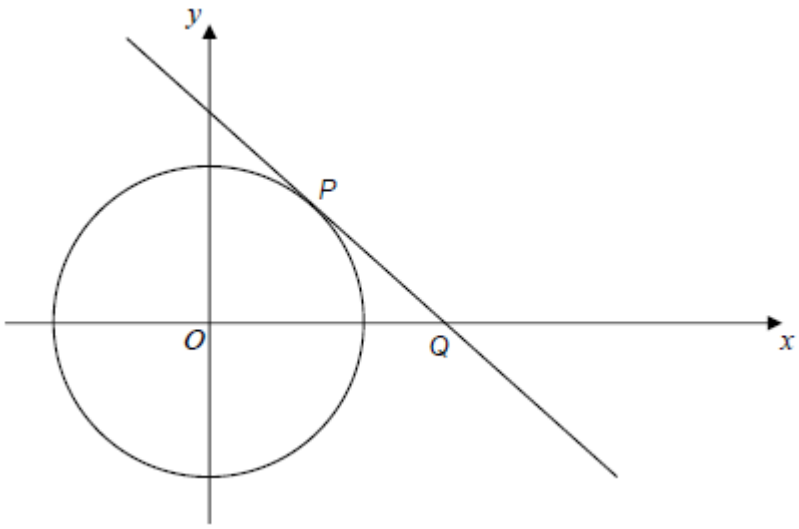
Q20.

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 nth 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 nth 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) = 3x

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

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

(Total 1 mark)

Q23.

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

Work out the value of d.

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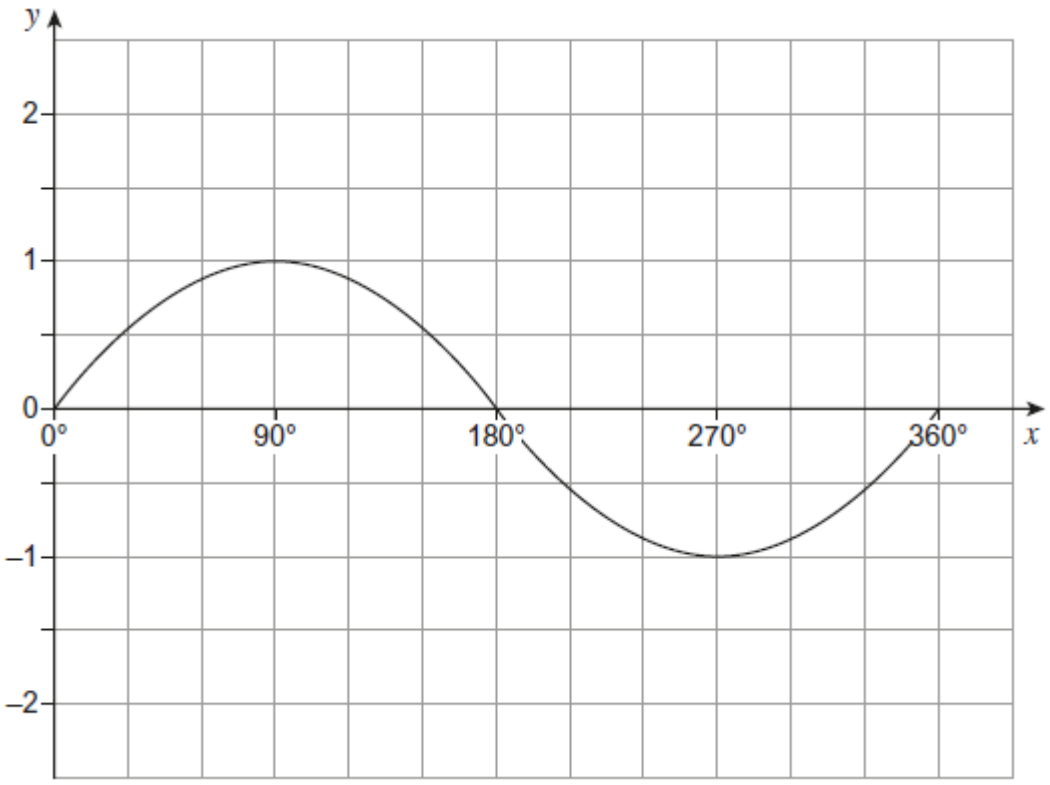
Answer .....

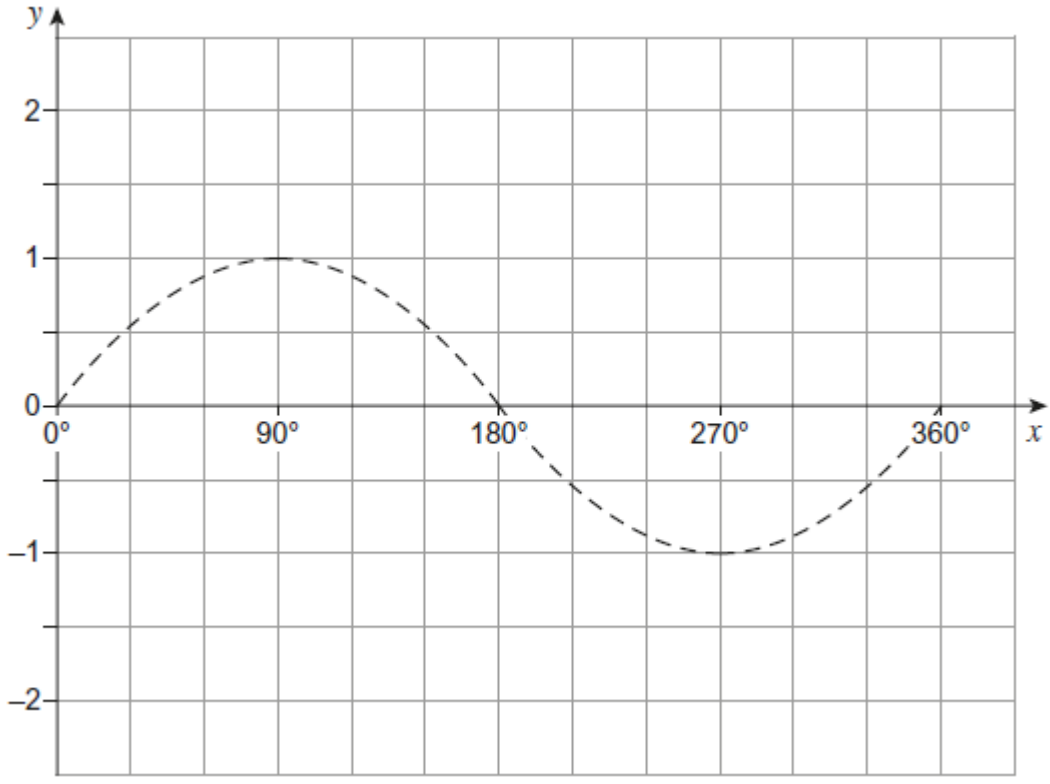
[Total 3 marks]

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 $0° \leq x \leq 360°$

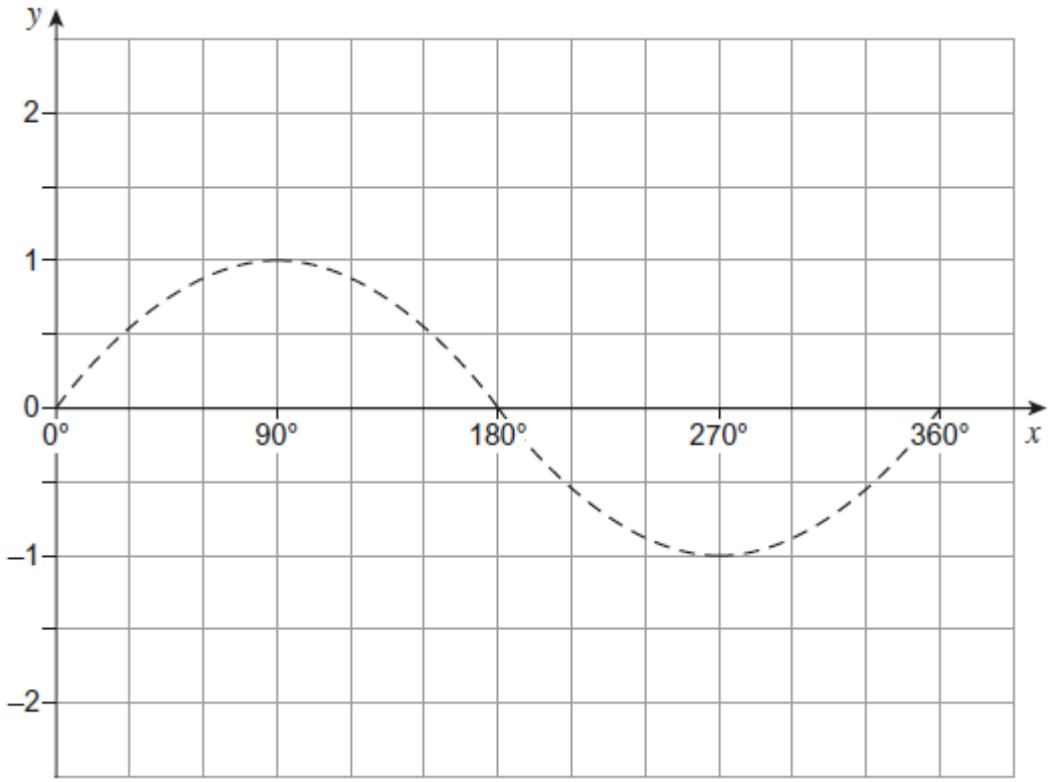
The graph of $y = \sin x$ is shown to help you.



(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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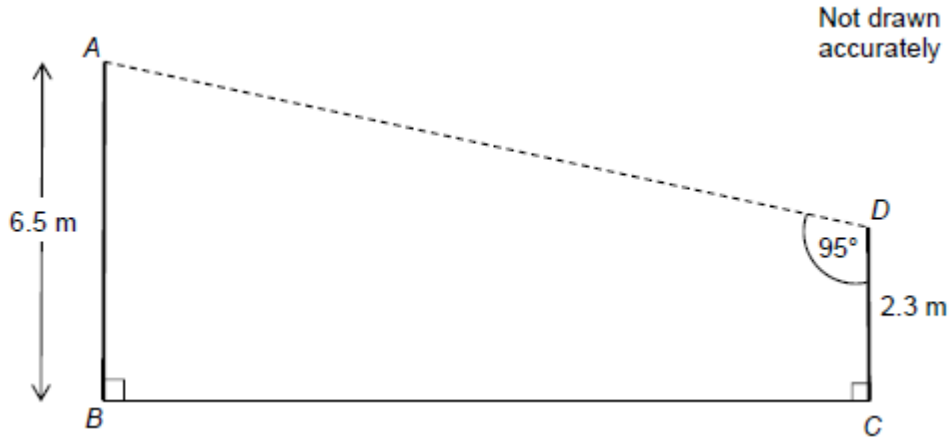
(Total 4 marks)

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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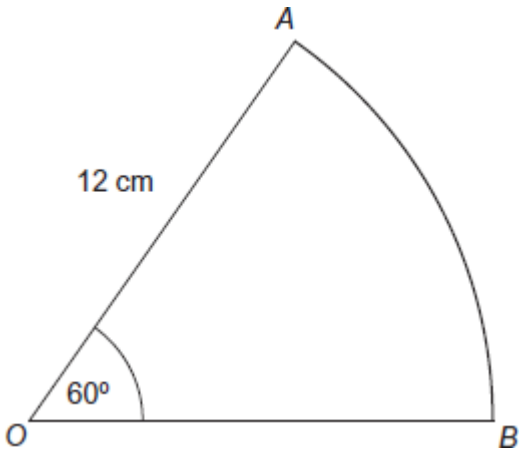
Answer ..... m

(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 π.

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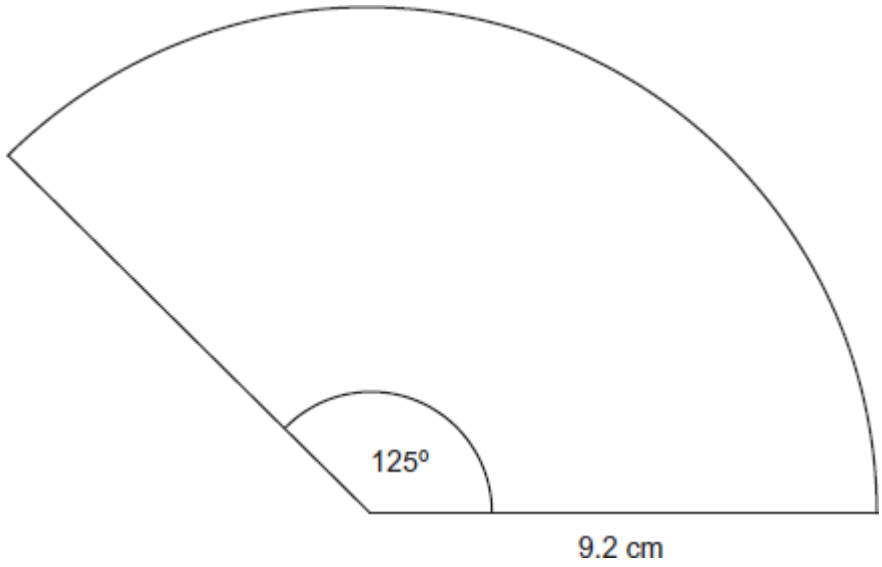
Answer ..... cm

(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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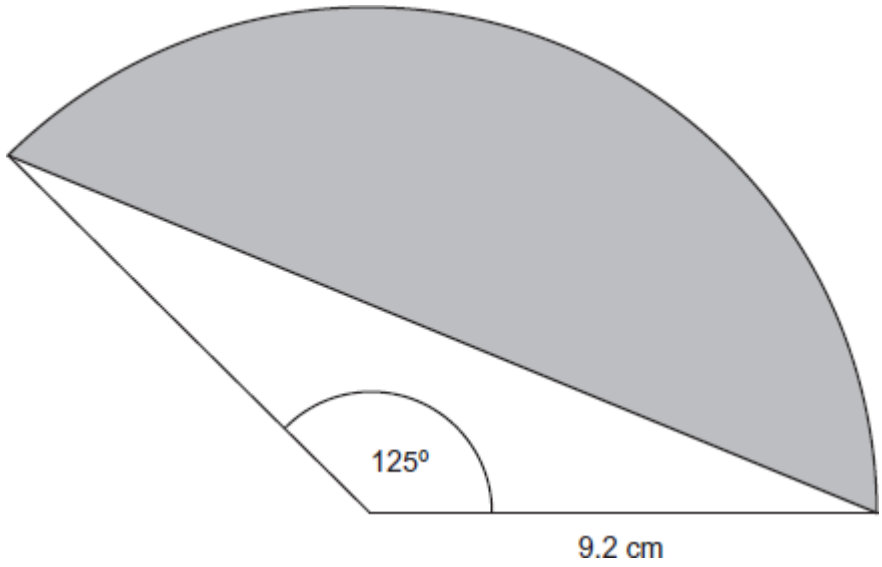
Answer ..... cm^2

(3)

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

Not drawn accurately



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Answer ..... cm²

(3)

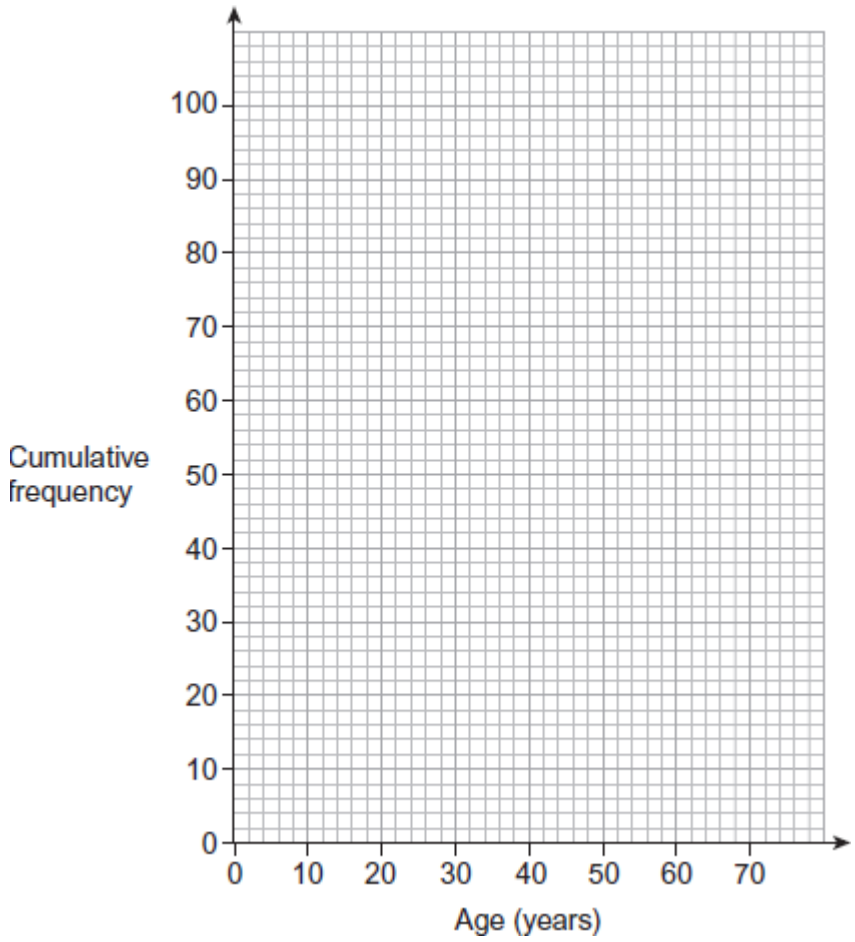
(Total 6 marks)

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

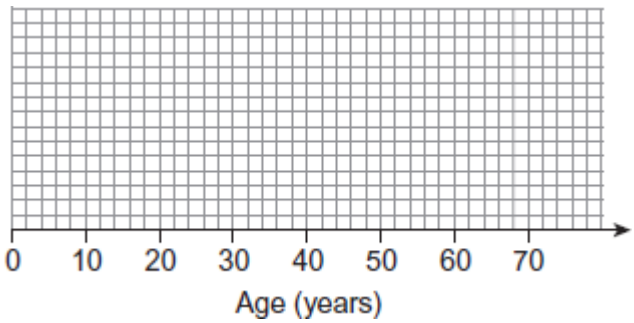
(a) Plot a cumulative frequency diagram for the data.



(4)

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

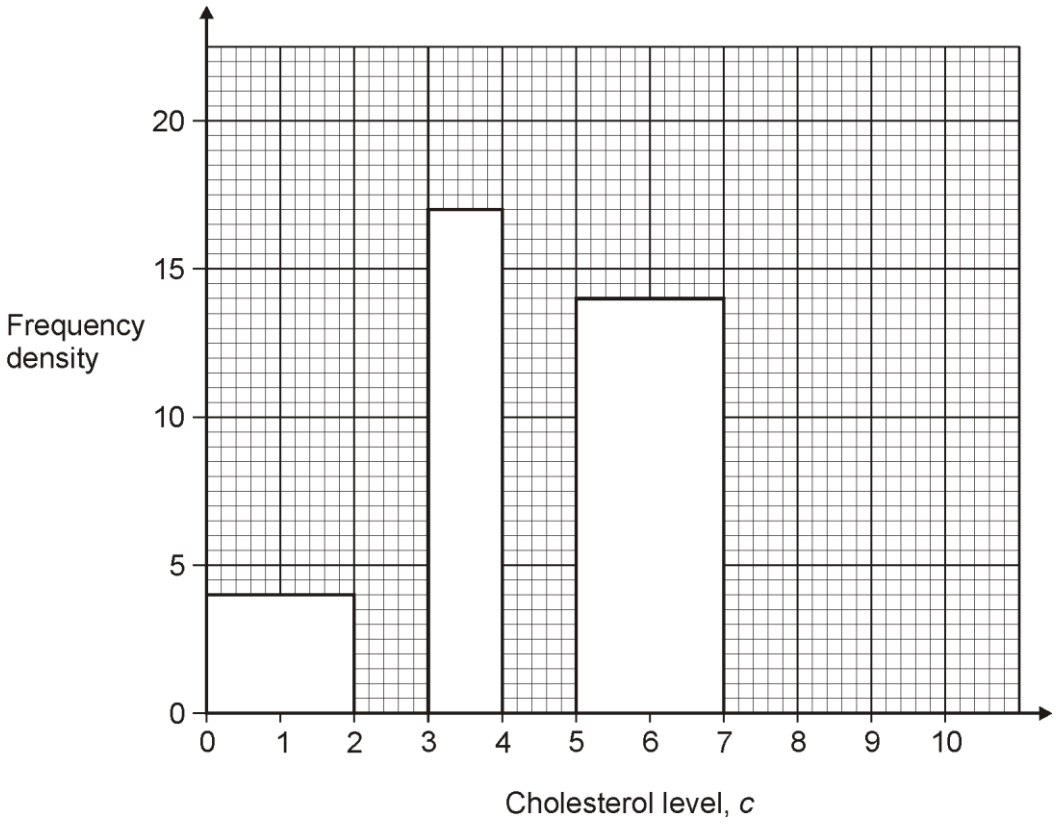
Draw a box plot for the data.



(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.

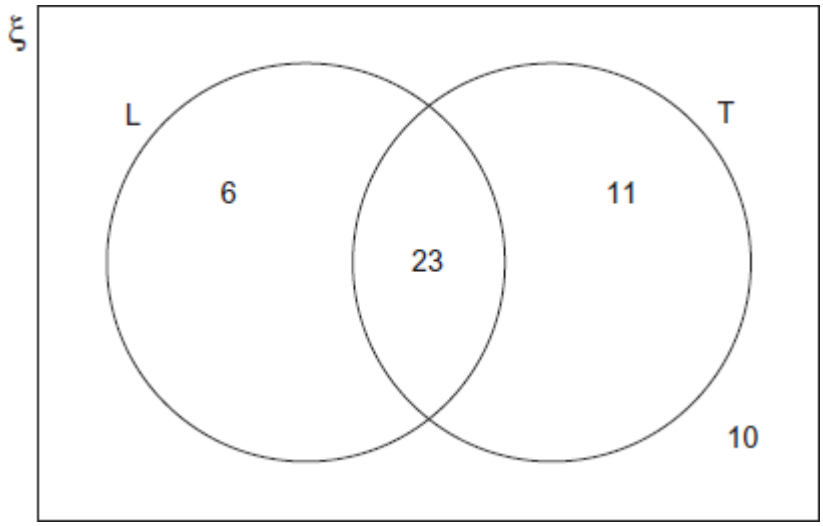
(2)

(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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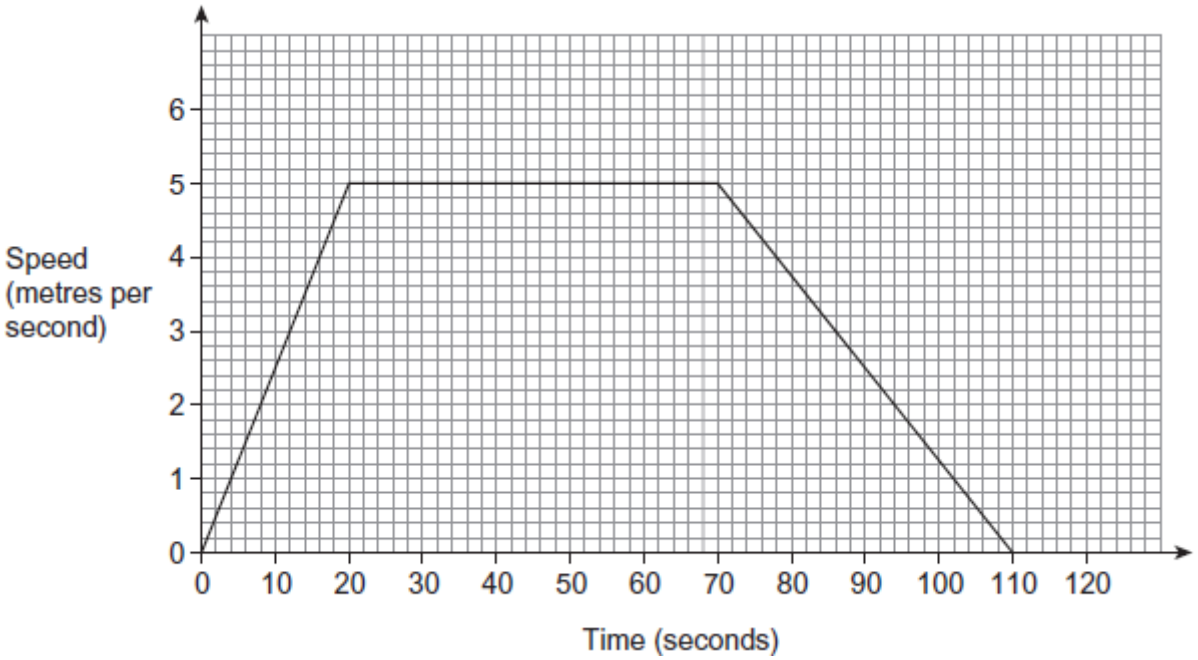
(Total 4 marks)

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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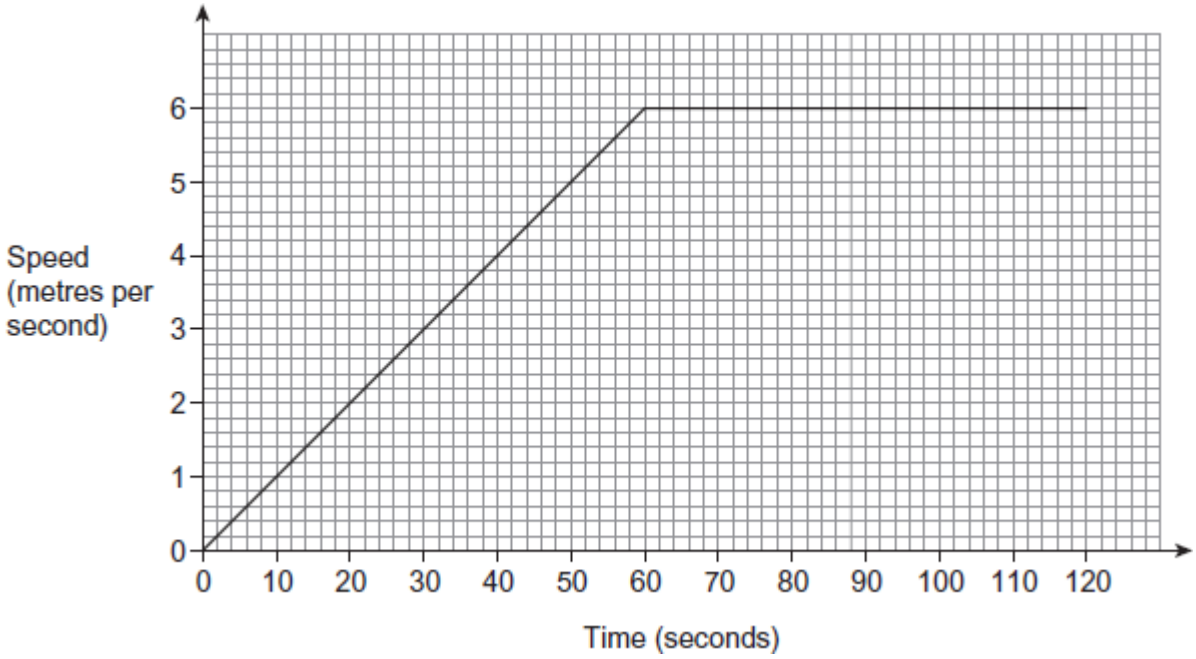
(2)

(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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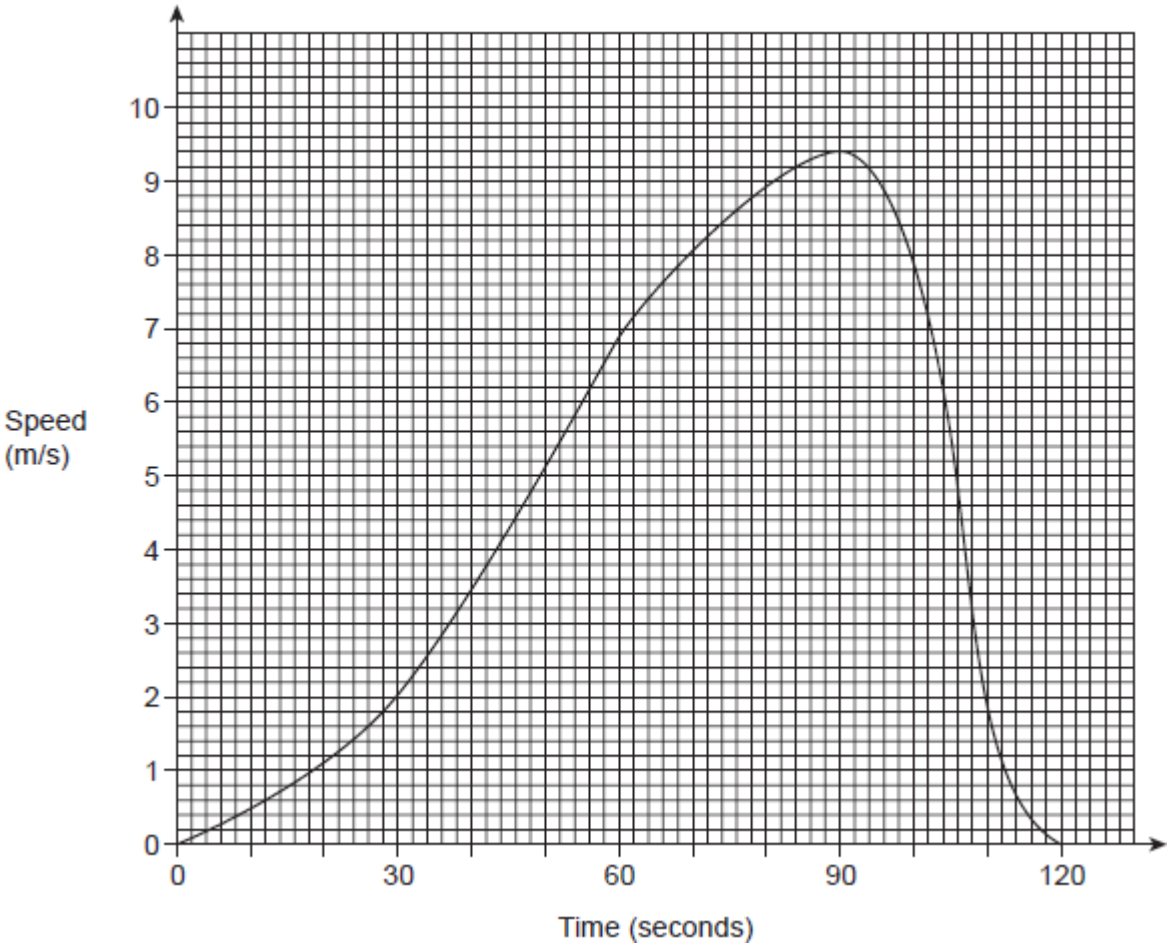
(3)
(Total 5 marks)

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 $(\sqrt[3]{x3})^{-2}$ *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

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

M1

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

and substitutes (1, their 3)

or

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

oe

$\frac{\text{their } 3}{x-1}$ *or* $-\frac{\text{their } 3}{x-1}$

M1dep

Substitutes $y = 0$ in their equation

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

M1dep

(10, 0)

A1

Alternative method 2

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

B1

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

M1dep

their 3 × their 3 or 9

M1dep

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

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

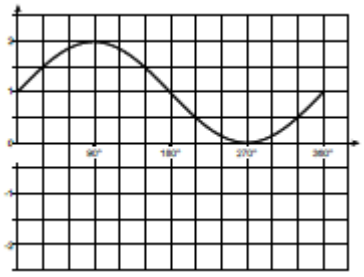
13

SC2 for 11

A1

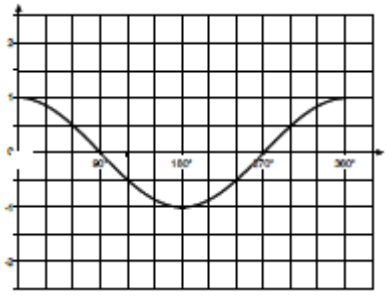
[3]

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

4π 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* (± 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]