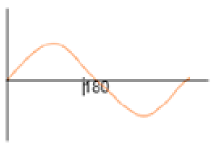
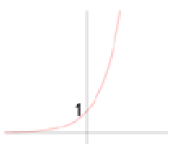
Mark scheme

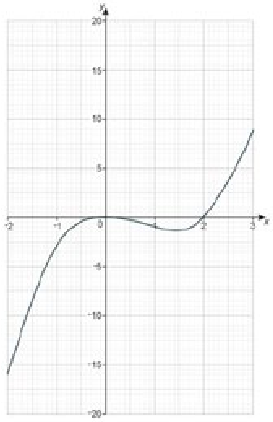
Question			Answer/Indicative content	Marks	Guidance	
1	a		5	1		
	b		No and 5 × 3 + 11 = 26 **oe** Or No and (23 – 11) ÷ 5 = 2.4 **oe** Or No the equation would need to be *y* = 5*x* + 8	2	**M1** for 5 × 3 + 11 or for 23 – 11 ÷ 5	For **2** marks no errors seen accept No and (3, 26) or (2.4, 23) For **M1** allow no/incorrect evaluation
			Total	**3**		
2			Correct increasing curve with 3000 indicated as *y*–intercept	3	**B1** for 3 of 4 correct plots at 1, 2, 3, 4 **B1** for plot or intercept at 3000 **B1** for increasing curve from *x* = 1 tox = 4 through *their* 4 points	3968, 4563 and 5247 should be in the correct small square including the boundaries Do not accept ruled linear graph Ignore if joined to (0, 0) Maximum **2** marks if curve incorrect
			Total	**3**		
3	a		$y \le x + 5$ **oe** and $y < 12$	3	**B2** for $y \le x + 5$ **oe** or **B1** for *y* … *x* + 5 **oe** but with = or an incorrect	Accept inequalities in either order

					inequality symbol **B1** for $y < 12$	
	b		20 **nfww**	4	**B2** for (3, 8) and (8, 8) or (7, 12) and (12, 12) identified or for base 5 and perpendicular height 4 both identified or **B1** for (3, 8) or (8, 8) or (7, 12) or (12, 12) or for base = 5 or height = 4 AND **M1** for *their* base × *their* perpendicularheight	May be seen on diagram Must identify base and perpendicular height of parallelogram in working or on diagram Do not allow if slant height used
			Total	**7**		
4	a		−1.5 or +1.5	2	**M1** for $\frac{20-32}{8}$ or $\frac{32-20}{8}$ oe	For **M1** condone one error in the figures
	b		Tangent drawn at time 13.00 0.4 to 0.8 **nfww** and **dep** on acceptable tangent drawn	1 3	**M1** for using two points on *their* line **M1** for use of $\frac{\text{difference in y}}{\text{difference in x}}$	Tangent should not cross the curve and should touch at 13.00 Condone slight daylight between tangent and curve
			Total	**6**		
5	a	i	$[y =]\sqrt{x-4}$	1		

		ii	$[y =] \frac{4}{x}$	1		
	b		[p =] 40 [r =] 310	1 1		
			Total	**4**		
6	a		Correct curve within tolerance	3	**B2** for 7 points accurately plotted or **B1** for 4 points accurately plotted	Tolerance $\pm\frac{1}{2}$ small square radially for curve and points, some daylight between $y = -6$ and curve, condone a wobbly curve and slight feathering or tram lines in no more than 3 sections but no ruled lines and no dashed lines
	b		$x = 0.5$ **oe**	1		
	c		−2 and 3	2	**B1** for either answer If **1** scored **FT** *their* curve for **2** marks or If **0** scored **FT** *their* curve for **1** or **2** marks	For **FT** use tolerance $\pm\frac{1}{2}$ small square radially
			Total	**6**		
7		i	2 7	2	**B1** for either 2 or 7 in the correct place	
		ii	Translation $\begin{pmatrix} 2 \\ 7 \end{pmatrix}$	2	**B1** for each correct or **FT** the	If more than one transformation score **0**

					vector from *their* answer from **(c)(i)**	
			Total	**4**		
8	a		169	3	**M2** for $\frac{1}{2}$×(*their*6 + 20) × *their*13 **oe** or **M1** for one relevant area e.g. $\frac{1}{2}$× *their*5 × *their*13 or *their*6 × *their*13 or $\frac{1}{2}$× *their*9 × *their*13 <u>Alternative method</u> **M2** for *their*13 × 20 – $\frac{1}{2}$× *their*5 × *their*13 – $\frac{1}{2}$× *their*9 × *their*13 or **M1** for one relevant area e.g. *their*13 × 20 or $\frac{1}{2}$× *their*5 × *their*13 or $\frac{1}{2}$× *their9* × *their*13	e.g. **M2** for $\frac{1}{2}$× *their*5 × *their*13 + *their*6 × *their*13 + $\frac{1}{2}$× *their*9 × *their*13 implied by 32.5 + 78 + 58.5 Implied by 260 – 32.5 – 58.5
	b	i	17	2	**M1** for $\frac{their\,38 - their\,4}{4-2}$ **oe**	Allow any two points on the line joining (2,4) and (4,38)
		ii	Ruled tangent drawn at 3 seconds 15.5 – 17.5	B1 B2dep	**B2 dep** on **B1** correct or **FT** or **M1** for rise ÷ run with values substituted	Tangent – mark intention to touch the curve at 3 seconds(condone thin daylight at 3), ignore other lines, condone dotty/dashed and condone line on one side only. If tangent is ruled and *their* value is outside the range apply **FT** to *their* tangent use accuracy of 2 sf

		iii	[the speed] increases **oe** [because] the gradient is steeper/greater **oe**	1		Accept any correct response, accept accelerates for increase, Refer to 'Qn18biii, 2024 June, Alternative J560/04, Mark Scheme Appendix' within downloadable resource materials.
			Total	**9**		
9	a		Correct sketch of y = sin x with 180 indicated and with amplitude 1 	2	**B1** for sin shape graph with period 360 starting at (0, 0) and amplitude k Or for sin shape graph starting at (0, 0) with amplitude 1 and with a period a factor of 360 Or for sin shape graph with period 360 with 180 indicated where graph crosses x - axis	For **2** marks mark intention e.g. y = 2sin$x$ For **B1** allow poor curvature, mark intention e.g. y = sin 2x, May be errors with amplitude
	b		Correct sketch with y – intercept 1 indicated 	2	**B1** for increasing exponential curve with no ruled sectionsor for any sketch with a single y – intercept at 1	For **2** marks, condone curve touching but not crossing x-axis For **2** marks or **B1** mark intention For **2** marks no ruled sections
			Total	**4**		
10	a		−3 and 9	2	**B1** for one correct value	
	b		Correct curve	3		

					**B2FT** for 6 or 7 points accurately plotted or **B1FT** for 4 or 5 accurately plotted	Mark curve first. Curve must pass within $\frac{1}{2}$ small square of the correct seven points **FT** *their* values from the table in **(a)** but accept only the correct curve Accuracy $\pm\frac{1}{2}$ small square radially If no points plotted mark the curve at the *x*-values Condone curve not having max at (0, 0) as long as it passes through correct points Condone wobbly curve and slight feathering Do not condone straight line segments
	c		2.5	1FT	Strict **FT** from graph to 1 d.p.	Do not accept answers to more than 1 d.p. or answers without a graph If curve is between two grid lines accept either value e.g. if crossing between 2.4 and 2.5 accept 2.4 or 2.5 If curve has more than one *x* value where *y* = 3 then they must give all
			Total	**6**		
11			$\frac{169}{5}$ or $33\frac{4}{5}$ or **33.8** with correct working	5		

					<u>Gradients and equation of straight line</u> **M2** for gradient of tangent = $\frac{5}{12}$ **oe soi** or for gradient of tangent = $\frac{12}{p-5}$ or **M1** for gradient of radius = $-\frac{12}{5}$ **soi** or gradient of tangent = $\frac{-1}{\textit{their}\text{ gradient of radius}}$ AND **M2** for $0 = \frac{5}{12}p - \frac{169}{12}$ or better or for $12 = \frac{5}{12}(p-5)$ or better or for $\frac{12}{p-5} = \frac{5}{12}$ or better or **M1** for $y = \textit{their}\ \frac{5}{12}x + c$ or better or for $y = \frac{12}{p-5}x + c$ or better or for $y - {}^-12 = \textit{their}\ \frac{5}{12}(x-5)$ or better 21 or $\frac{-1}{\textit{their}\text{ gradient of radius}} = \frac{12}{p-5}$ or <u>Alternative method (Pythagoras and trig):</u> **M1** for [O to (5, -12)] $\sqrt{5^2+12^2}$ may be implied by 13 in working or on diagram **M1** for [angle at O] $\sin\theta = \frac{12}{13}$ or $\cos\theta = \frac{5}{13}$ or $\tan\theta = \frac{12}{5}$ or better (do not imply from just an angle) AND **M2** for [p =] $\frac{13}{\frac{5}{13}}$ or **M1** for cos $\textit{their}\theta = \frac{13}{p}$ or $p = \frac{13}{\cos \textit{their}\theta}$	'Correct working' requires evidence of at least **M2M1** or **M1M1M1** **SC3** applies to all methods Mark to candidate's advantage if gradients not labelled Do not mix marks across two methods (ie do not give gradient marks and another **M1** for 13 from Pythagoras) **M2** must be a correct equation solely in terms of p or solely in terms of x e.g. $0 = \frac{5}{12}x - \frac{169}{12}$ or better For **M1** allow FT *their* $\frac{5}{12}$ if from $m_1 = \frac{-1}{m_2}$ <u>Alternative method (Pythagoras and equations)</u> **M2** for 13^2 +

					(*their* θ from earlier trig work) | $(p-5)^2 + 12^2 = p^2$ **oe** or **M1** for $(p-5)^2 + 12^2$ **oe** or for $\sqrt{5^2+12^2}$ may be implied by 13 in working or on diagram AND **M2** for $338 - 10p = 0$ **oe** or **M1** for $169+p^2-10p+144+25 = p^2$ or better
			Total	**5**	
12			⩽ $x < 4$	1 2	**B1** for $x \leqslant 4$ or $x > 4$
			Total	**3**	
13			2 5 4	3	**B1** for each
			Total	**3**	
14	a		−0.5 or +0.5	2	**M1** for $\frac{27-32}{10}$ or $\frac{32-27}{10}$ oe | For **M1** condone one error in the figures **<u>Examiner's Comments</u>** Only about a quarter of candidates scored any marks. Those scoring 1 mark showed the correct method but either had

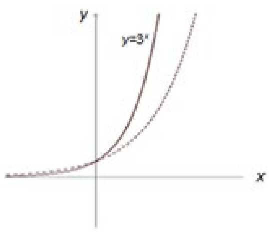
					onewrong value or evaluated their gradient incorrectly. **Misconception** ‘Average rate of change’, like ‘average speed’, is found by using the start and end points of the time period. It is not ‘the average’ of lots of graph readings.
	b		Tangent drawn at time 17.00 1.6 to 2.0 nfww and dep on acceptable tangent drawn	1 3	**M1** for using two points on *their* line **M1** for use of $\frac{difference\ in\ y}{difference\ in\ x}$ Tangent should not cross the curve and should touch at 17.00. Condone slight daylight between tangent and curve. **<u>Examiner’s Comments</u>** Only some candidates drew a tangent at 17.00. These tangents were generally well drawn, scoring 1 mark, but some candidates did not make any further progress. Those that continued often showed the two points they were using on the tangent in order to make their estimate, including constructing a right-angled triangle to help do this, enabling another mark, and a third mark if attempting to find the gradient correctly. There were some errors in the use of time at this stage, for example, a reading of 14.2 being unnecessarily changed to 14 hours and 12 minutes and then 14.12 being used in the gradient calculation.
			Total	**6**	
15	a	i	$[y =] \left(\frac{1}{4}\right)^x$	1	**<u>Examiner’s Comments</u>**

					Nearly half of the candidates scored this mark. There was no common wrong answer, suggesting lots of guesses.
		ii	$[y =]\sqrt{4^2 - x^2}$	1	Accept $[y =]\sqrt{16 - x^2}$ **Examiner's Comments** About a quarter of the candidates scored this mark. Again, there was no common wrong answer.
	b		[*p* =] 50 [*r* =] 310	1 1	**Examiner's Comments** Many candidates did not attempt this part. Some of the candidates scored 1 or 2 marks, with *r* being correct more often than *p*. Many different wrong answers for *r* were seen with no obvious rationale to support them. The correct answer for *p* was 50 but an interesting wrong answer seen a few times was 0.766 or 0.77, which is the value of sin 50.
			Total	**4**	
16			Correct increasing curve with 2500 indicated as *y* – intercept	3	**B1** for 3 of 4 correct plots at 1, 2, 3, 4 **B1** for plot or intercept at 2500 **B1** for increasing curve from x = 1 to x = 4 through *their* 4 points Accuracy use overlay as a guide 4320 and 5187 should be in the correct small square including the boundaries Do not accept ruled linear graph Ignore if joined to (0, 0) Maximum 2 marks if curve incorrect

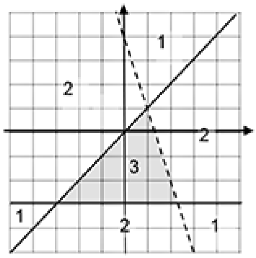
					Examiner's Comments Many were able to plot four correct points from 1 year to 4 years, but most did not plot a point at (0, 2500). The points were often joined by a curve but some incorrectly used straight lines or did not join their points.
			Total	**3**	
17	a		$y \le x + 4$ oe and $y < 9$	3	**B2** for $y \le x + 4$ oe or **B1** for $y \ldots x + 4$ oe but with = or an incorrect inequality symbol **B1** for $y < 9$ Accept inequalities in either order **Examiner's Comments** A small number of candidates fully answered this part correctly. Some candidates found the equations for both boundary lines but were unable to write the correct inequality to describe the region. Candidates were more successful in giving $y < 9$ than $y \le x + 4$. Many struggled to find the equation of the boundary line $y = x + 4$ using the parallel line property with $y = x$ and having y –intercept 4.
	b		12 nfww	4	**B2** for (2, 6) and (6, 6) or (5, 9) and (9, 9) identified or for base 4 and perpendicular height 3 both identified or **B1** for (2, 6) or (6, 6) or (5, 9) or (9, 9) or for base = 4 or height = 3 AND **M1** for *their* base × *their* perpendicular height May be seen on diagram Must identify base and perpendicular height of parallelogram in working or on diagram Do not allow if slant height used

					Examiner's Comments This part was omitted by many candidates. A small number attempting this were successful and others earned method marks by annotating the diagram with correct values for the length and/or the perpendicular height of the parallelogram. Some wrote coordinates of vertices and received partial credit. A misconception for some was to write 3 as the slant height of the parallelogram.
			Total	**7**	
18	a		4	1	**Examiner's Comments** This was well answered. A few candidates gave the answer 9.
	b		No and 4 × 3 + 9 = 21 oe Or No and (23 – 9) ÷ 4 = 3.5 oe Or No the equation would need to be *y* = 4*x* + 11	2	**M1** for 4 × 3 + 9 or for 23 – 9 ÷ 4 For 2 marks no errors seen accept No and (3, 21) or (3.5, 23) For M1 allow no/incorrect evaluation **Examiner's Comments** This was answered well by a number of candidates. The most common approach was to substitute *x* = 3 into *y* = 4*x* + 9 and show that *y* = 21 and not 23. A number of candidates omitted this part.
			Total	**3**	
19	a		correct curve within tolerance	3	**B2** for 8 points accurately plotted or **B1** for 5 points accurately plotted tolerance $\pm\frac{1}{2}$ small square radially for curve and points, some daylight

					between y = -8 and curve , condone a wobbly curve and slight feathering or tram lines in no more than 3 sections but no ruled lines and no dashed lines **Examiner's Comments** There were many candidates who left this question unanswered, those who plotted the points accurately did achieve some credit. The lines drawn did not always go through the points plotted and between x = 0 and x = 1 it is necessary to see the curve dip down and not be drawn as a horizontal line.
	b		x = 0.5 oe	1	**Examiner's Comments** There were very few correct answers, many of the incorrect answers were not the equations of straight lines.
	c		–2.3 or –2.4 3.3 or 3.4	2	**B1** for either answer **SC1** for an answer to more than 1 dp in each of -2.4 to -2.3 and 3.3 to 3.4 If **1** scored **FT** *their* curve for **2** marks or if **0** scored **FT** *their* curve for **1** or **2** marks or for **SC1** tolerance small ±½ square radially **Examiner's Comments** Those candidates who drew the graph correctly usually answered this part correctly as well, but some did give answers that showed they did not know

					where to find these answers, where the curve crosses the x-axis.	
			Total	**6**		
20	a			3	**B1** for correct shape and same y-intercept **B1** for sketch drawn above $y = 2^x$ for positive x-values or has steeper gradient (by eye) **B1** for sketch drawn below $y = 2^x$ for negative x-values	
	b	i	e.g. cos$x$ should initially decrease/be positive [after $x = 0$]	1	Other acceptable answers include: [The sketch is a] reflection of y = cos$x$ [in the x-axis]; First turning point should be a maximum; cos$x$ has a maximum at 0 [and then a minimum at 180].	
		ii	e.g. $y = {}^-\cos x$	1	Accept any other possibly correct equations such as: $y = {}^-k\cos x$ or $y = k\sin(x - 90)$	
			Total	**5**		
21	a		$x^2 + y^2 = 52$	2	**B1** for $x^2 + y^2 = k$	k could be r^2 or $\sqrt{52}^2$ but not 52

	b	i	[gradient =] $\frac{4}{6}$ or $\frac{2}{3}$ $m \times$ *their* $\frac{4}{6}$ = $^-1$ used or implied	M1 M1	If **0** scored, award **SC1** for $\frac{-6}{4}$ without seeing $\frac{4}{6}$	For **M1** allow $\frac{-3}{2} \times \frac{4}{6}$ = $^-1$ or $\frac{-3}{2} \times \frac{2}{3}$ = $^-1$ or e.g. $\frac{-6}{4}$ after $\frac{4}{6}$ seen
		ii	$y = \frac{-3}{2}x + 13$ **oe**	2	**B1** for $y = \frac{-3}{2}x + c$ seen **oe** or $\frac{-3}{2}x + 13$ or c = 13	'c' can be 0 but not 13
			Total	**6**		
22	a		E	1		
	b		A	1		
			Total	**2**		
23			$y = 2x + 4$ **oe**	2	**B1** for answer $y = 2x + k$ **oe** or $y = mx + 4$ **oe**	
			Total	**2**		
24	a		2	1		
	b		Correct curve	3	**B2FT** for 7 or 8 correct plots or **B1FT** for 5 or 6 correct plots	Mark curve first, accuracy ± 1 mm, $\frac{1}{2}$ small square Condone slight feathering Condone ruled segment between $x = {}^-4$ and $x = {}^-3.5$ only If curve incorrect then mark plots, accuracy ± 1 mm If no plot, curve implies plot

	c		${}^{-}1$	1		
			Total	**5**		
25			$y = {}^{-}3$ ruled and $y = {}^{-}3x + 4$ broken line and correct region indicated 	6	**B1** for $y = {}^{-}3$ ruled **B2** for $y = {}^{-}3x + 4$ broken line or **B1** for $y = {}^{-}3x + 4$ solid line AND **B1** for **R** on correct side of $y = x$ **B1** for **R** on correct side of $y = {}^{-}3$ **B1** for **R** on correct side of *their* $y = {}^{-}3x + 4$	Penalise **1** mark only for good freehand lines Additional lines treat as choice Length of line should be fit for purpose to identify *their* region See marks on diagram for the final **B3**, marks provided all lines drawn correctly For region, **FT** *their* $y = {}^{-}3x + 4$ provided line with negative gradient only but no **FT** for $y = {}^{-}3$ if incorrect Condone shading in or out of region provided **R** is clearly identified
			Total	**6**		
26	a		$y = 6 - x^2$	2	**B1** for answer $y = k - x^2$	k is any value including zero
	b		Translation $\begin{pmatrix} -2 \\ -11 \end{pmatrix}$	4	**B3** for translation $\begin{pmatrix} -2 \\ k \end{pmatrix}$ or translation $\begin{pmatrix} k \\ -11 \end{pmatrix}$ OR **M2** for [$y =$] $(x + 2)^2 - 7 - 2^2$ or better or **M1** for [$y =$] $(x + 2)^2$ seen **B1** for translation	If more than one transformation given then **M2** maximum

			Total	**6**	
27			$\frac{169}{12}$ or $14\frac{1}{12}$ or $14.08\dot{3}$ with correct working	5	Gradients and equation of straight line **M2** for gradient of tangent = $\frac{12}{5}$ oe soi or for gradient of tangent = $\frac{5}{p-12}$ or **M1** for gradient of radius = $-\frac{5}{12}$ soi or gradient of tangent = $\frac{-1}{\textit{their}\text{ gradient of radius}}$ AND **M2** for $0 = \frac{12}{5}p - \frac{169}{5}$ or better or for $5 = \frac{12}{5}(p - 12)$ or better or for $\frac{5}{p-12} = \frac{12}{5}$ or better or **M1** for $y =$ *their* $\frac{12}{5}x + c$ or better or for $y = \frac{5}{p-12}x + c$ or better or for $y - {}^{-}5 =$ *their* $\frac{12}{5}(x - 12)$ or better or $\frac{-1}{\textit{their}\text{ gradient of radius}} = \frac{5}{p-12}$ or better If **0**, **1** or **2** scored, instead award **SC3** for answer $\frac{169}{12}$ or $14\frac{1}{12}$ or $14.08\dot{3}$ with
					‘Correct working’ requires evidence of at least **M2M1** or **M1M1M1** **SC3** applies to all methods Mark to candidate’s advantage if gradients not labelled Do not mix marks across two methods (ie do not give gradient marks and another M1 for 13 from Pythagoras) **M2** must be a correct equation solely in terms of p or solely in terms of x e.g. $0 = \frac{12}{5}x - \frac{169}{5}$ or better For **M1** allow FT *their* $\frac{12}{5}$ if from $m_1 = \frac{-1}{m_2}$ PTO for alternative methods

					no or insufficient working <u>Alternative method (Pythagoras and trig):</u> **M1** for [O to (12, -5)] $\sqrt{12^2+5^2}$ may be implied by 13 in working or on diagram **M1** for [angle *at O*] sin θ = $\frac{5}{13}$ or cos θ = $\frac{12}{13}$ or tan θ = $\frac{5}{12}$ or better (do not imply from just an angle) AND **M2** for [p =] $\frac{13}{\frac{12}{13}}$ or **M1** for cos *their*θ = $\frac{13}{p}$ or p = $\frac{13}{\cos their\theta}$ (*Their* θ from earlier trig work) <u>Alternative method (Pythagoras and equations)</u> **M2** for $13^2 + (p - 12)^2 + 5^2 = p^2$ oe or **M1** for $(p - 12)^2 + 5^2$ oe or for $\sqrt{12^2+5^2}$ may be implied by 13 in working or on diagram AND **M2** for $338 - 24p = 0$ oe or **M1** for $169+p^2-24p+144+25 = p^2$ or better **<u>Examiner's Comments</u>** About 10% of candidates scored 5 marks, and a further 30% scored some marks. Candidates who worked in fractions rather than decimals were more likely to get the exact answer requested. The mark scheme covers multiple methods that were commonly seen. The most common approaches involved using gradients and the equation of a straight line in its various forms, of which there were three main methods. The other alternative methods were rarely seen through to a successful conclusion, but did still lead to marks being given (particularly M1 for identifying the radius of the circle as 13, which could have then been used in trigonometry or a similar triangles approach).

Presentation was generally poor, with multiple attempts often being left for the examiner to decide what to mark; it was also often left to their judgement as to what incorrect gradients, such as $\frac{-12}{5}$, represented.

The best responses used some words, for example ‘gradient of radius = $\frac{-5}{12}$, gradient of tangent = $\frac{12}{5}$’ (scoring M1 for the radius, increasing to M2 for the tangent). Most candidates used their tangent gradient in the $y = mx + c$ form for the straight line (scoring M1) and then substituted in (12, $^{-}5$) to try and find c. They then needed to substitute in (p, 0) to reach a correct equation solely in p, such as $0 = \frac{12}{5}p - \frac{169}{5}$ to score the fourth mark.

An efficient alternative approach that was sometimes seen (perhaps with a variation) was to draw a vertical from (12, $^{-}5$) to the x-axis to create a right-angled triangle. The gradient of the tangent ($\frac{12}{5}$, from before) is the gradient of the hypotenuse of the triangle, so $\frac{12}{5} = \frac{5}{p-12}$, leading to $p = \frac{169}{12}$.

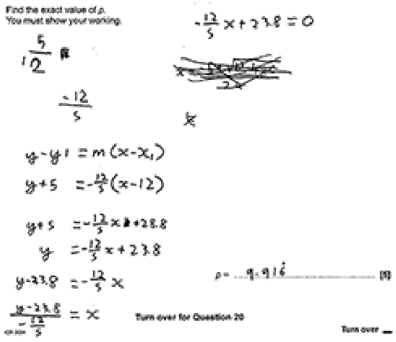
Exemplar 1

$$R \quad \frac{0 - -5}{p - 12} = \frac{5}{p-12}$$

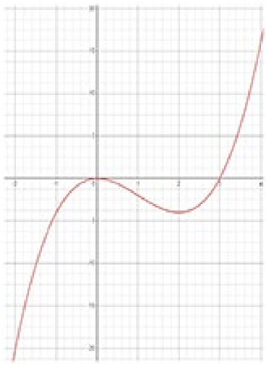
$$y = mx + c$$
$$y = \frac{5}{p-12}x + c$$

It may have been helpful to both the candidate and the examiner if a vertical line from (12, $^{-}5$) to the x-axis had been drawn or ‘gradient of tangent =’ had been added, however $\frac{5}{p-12}$ is a correct gradient for the tangent and so M2 is given. This is then correctly substituted into $y = mx + c$, scoring another M1.

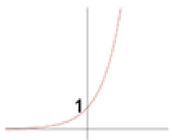
Exemplar 2

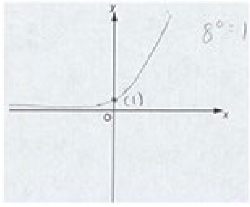
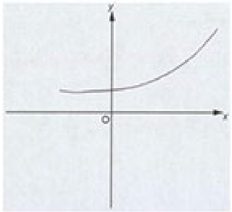
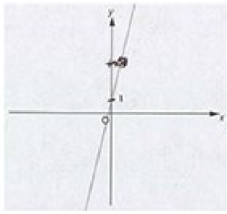
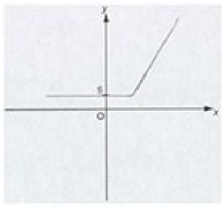


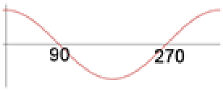
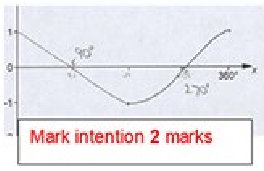
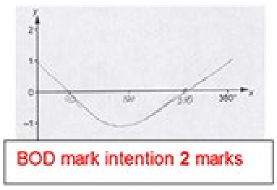
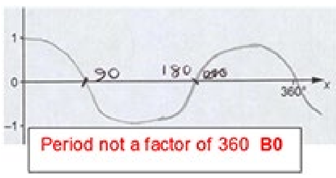
					Neither gradient is correct, but it looks as though $\frac{-12}{5}$ is intended to be their gradient of the tangent and it is the negative reciprocal of the other gradient, so M1 is given. Their gradient is then presented correctly with (12, $^-$5) in a (y – y_1) = m(x – x_1) form of the equation of straight line, scoring another M1. Although they reach an equation solely in x, it will be an incorrect equation because of the wrong gradient and so M2 is not given.
			Total	**5**	
28	a		-4 and 0	2	**B1** for one correct value **<u>Examiner's Comments</u>** Many could not correctly evaluate y when x = $^-$1, with responses of 2 or $^-$10 being very common. However, the vast majority of candidates correctly worked out that when x = 3, y would be 0. **Assessment for learning** Candidates often struggle to evaluate formulae or expressions that involve negative numbers. Sometimes, they may be more successful applying mental or pen and paper techniques (or at least using these methods to check their calculator's answer). When using a calculator, it is essential that candidates are aware how to correctly use brackets

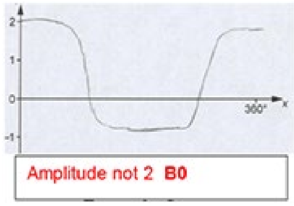
					around negative numbers. For example, here many will have keyed: (i) ⁻1 ‘x^3’ – 3 × ⁻1 ‘x^2’, which gives an answer of 2, or (ii) (⁻1) ‘x^3’ – (3 × ⁻1) ‘x^2’, which gives an answer of ⁻10.
	b		Correct curve 	3	**B2FT** for 6 or 7 points accurately plotted or **B1FT** for 4 or 5 accurately plotted Mark curve first. Curve must pass within ½ small square of the correct seven points **FT** *their* values from the table in **(a)** but accept only the correct curve Accuracy ± ½ small square radially If no points plotted mark the curve at the *x*-values Condone curve not having max at (0, 0) and min at (2, -4) as long as it passes through correct points Condone wobbly curve and slight feathering Do not condone straight line segments **<u>Examiner’s Comments</u>** Most candidates were able to plot at least six of their points with sufficient accuracy to score B2. There were however instances of candidates incorrectly using the vertical scale when trying to plot at y = ⁻2 or y = ⁻4. The correct curve was required for the full 3 marks.
	c		3.4	1FT	

					Strict **FT** from graph to 1 d.p. Do not accept answers to more than 1 d.p. or answers without a graph If curve is between two grid lines accept either value eg if crossing between 3.4 and 3.5 accept 3.4 or 3.5 If curve has more than one x value where y = 5 then they must give all **Examiner's Comments** Most candidates with a graph in part (b) attempted to use it correctly to solve the equation here. Some made an error in reading the x-axis scale.
			Total	**6**	
29			≤ $x < 2$	1 2	**B1** for $x \le 2$ or $x > 2$ **Examiner's Comments** Knowledge of the inequality symbols and the notation for showing regions was limited and about 40% of candidates scored 0 marks. The second line was completed with almost equal occurrences of <, ≤, =, > and ≥. The final line was often a repeat of the second line, except with a different inequality symbol. Other common wrong answers were $x > 2$, $x \le 2$ and $y < 2$.
			Total	**3**	
30			2 5 1	3	**B1** for each

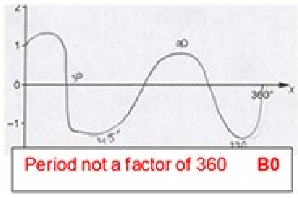
					Examiner's Comments This is probably the first time a question has been set that so explicitly assessed the content of statement 7.04a in the specification, 'graphs of real-world contexts' including 'temperature conversion' and 'direct and inverse proportion'. It highlighted a considerable lack of understanding among all abilities. While providing an accessible start to the paper with virtually all candidates responding, about 25% of the candidates got all three graphs wrong and less than 10% got all three correct. The temperature graph was the most successfully identified, probably because the equation was given and could be recognised as a $y = mx + c$ straight line (graph 2). The time/distance/speed context is a common example of inverse proportion (graph 5). The mass/volume context is an example of direct proportion (graph 1). Together the three graphs covered 7.04a.
			Total	**3**	
31	a		Correct sketch with y – intercept 1 indicated 	2	**B1** for increasing exponential curve with no ruled sections or for any sketch with a single y – intercept at 1 For 2 marks, condone curve touching but not crossing x- axis For 2 marks or B1 mark intention For 2 marks no ruled sections See AG **Example A**

					 Correct shape, mark intention passes through $y = 1$ 2 marks **Example B**  Correct shape **B1** **Example C**  y – intercept at 1 **B1** **Example D**  Ruled wrong shape **B0** **<u>Examiner's Comments</u>** Some candidates had a good knowledge of the shape of the graph and were able to draw a reasonable sketch with an indication that it passed through (0, 1). One mark was given to those that sketched an increasing exponential graph without the correct point, as well as those that sketched an incorrect graph with an indication that it passed through (0, 1).The

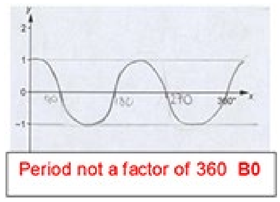
					majority of candidates demonstrated little knowledge of the shape of the graph. There were a wide range of incorrect sketches involving ruled lines, parabolas, cubics and reciprocals.
	b		Correct sketch of $y = \cos x$ with 90 and 270 indicated and starting at 1 on y-axis 	2	**B1** for cos shape graph with period 360 starting at (0, k), $k > 0$ and amplitude k Or for cos shape graph starting at (0, 1) with amplitude 1 and with a period a factor of 360 Or for cos shape graph with period 360 with 90 and 270 indicated where graph crosses x - axis For 2 marks mark intention e.g. $y = 2\cos x$ For B1 allow poor curvature, mark intention e.g. $y = \cos 2x$, May be errors with amplitude See AG **Example A**  **Example B**  **Example C**  **Example D**



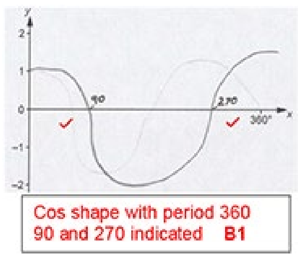
Example E



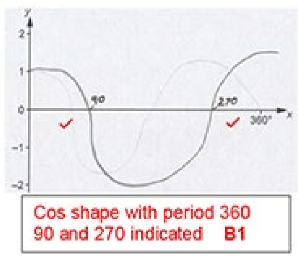
Example F



Example G



Example H



<u>Examiner's Comments</u>

Some candidates had a good knowledge of the shape of the cosine graph and drew a reasonable sketch, indicating that it passed through 90 and 270 on the *x*-axis. Some knew that the graph started at (0, 1), but made errors with the period and/or the amplitude of the curve. A number sketched the graph of *y* = sin *x*.

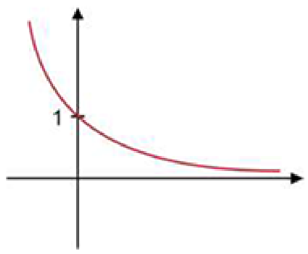
			Total	**4**	
32		i	3 8	2	**B1** for either 3 or 8 in the correct place **Examiner's Comments** This was well answered. The most common error was one or both numbers being written as negative.
		ii	Translation $\binom{3}{8}$	2	**B1** for each correct or **FT** the vector from *their* answer from **(c)(i)** — If more than one transformation score **0** **Examiner's Comments** Very few answered this part correctly. Most guessed rotation or enlargement. The link with part (c)(i) often didn't seem to be recognised.
			Total	**4**	
33	a		162	3	**M2** for $\frac{1}{2}$×(*their*7 + 20) × *their*12 oe or **M1** for one relevant area e.g. $\frac{1}{2}$× *their*8 × *their*12 or *their*7 × *their*12 or $\frac{1}{2}$× *their*5 × *their*12 — e.g. **M2** for $\frac{1}{2}$× *their*8 × *their*12 + *their*7 × *their*12 + $\frac{1}{2}$× *their*5 × *their*12 implied by 48 + 84 + 30 alternative method : **M2** for *their*12 × 20 – $\frac{1}{2}$× *their*8 × *their*12 – $\frac{1}{2}$× *their*5 × *their*12 — implied by 240 – 48 – 30 or **M1** for one relevant area e.g. *their*12 × 20 or $\frac{1}{2}$× *their*8 × *their*12 or $\frac{1}{2}$× *their*5 × *their*12 **Examiner's Comments** Many candidates answered this correctly. The main problem seemed to be forgetting to include '$\frac{1}{2}$ ×' in their formulae for the

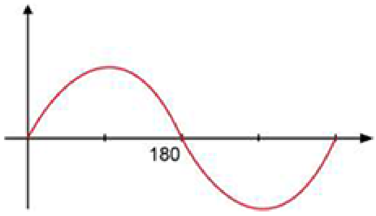
					area of a triangle (as had also been seen in question 2 earlier on) , so a common response was 96 + 84 + 60 = 240. Some misread the figures on the graph, for example 8 on the ‘Time’ axis was often considered to be 5.6.
	b	i	14	2	**M1** for $\frac{their32 - their4}{4-2}$ oe | Allow any two points on the line joining (2,4) and (4,32) **<u>Examiner’s Comments</u>** This proved more difficult than expected. The difference in distance should have been calculated using 32 – 4 = 28, but many calculated 32 + 4 = 36 instead. This should then have been divided by 4 – 2 = 2, but many divided by just 4.
		ii	Ruled tangent drawn at 3 seconds 14.0 – 16.0	B1 B2dep	**B2 dep** on **B1** correct or **FT** or **M1** for rise ÷ run with values substituted | Tangent – mark intention to touch the curve at 3 seconds(condone thin daylight at 3), ignore other lines, condone dotty/dashed and condone line on one side only. If tangent is ruled and *their* value is outside the range apply **FT** to *their* tangent use accuracy of 2 sf **<u>Examiner’s Comments</u>** This question expected candidates to draw a tangent, although we are aware of other correct methods and sometimes we did see those. Most of the candidates who drew a tangent went on to attempt ‘rise divided by run’, although some used the point (3, 13) so divided these to get 4.33… .

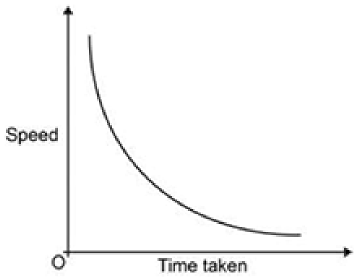
					Accept any correct response, accept accelerates for increase, see appendix
		iii	[the speed] increases oe [because] the gradient is steeper/greater oe	1	**Mark** Increases and gradient is steeper/greater **1** Accelerates as curve is getting steeper **1** Increases as the distance per second increases **1** Increases as the distance travelled in the same time increases **1** Increases and curve goes upwards **0** **<u>Examiner's Comments</u>** Many candidates did explain this correctly, but a number said that the speed is increasing because the curve is going up, which wasn't enough for the mark.
			Total	**9**	
34	a		(0, 10)	1	
	b		$-\sqrt{51}$	3	**B2** for $\sqrt{51}$ or –7.141[…] or –7.14 or **B1** for 7.141[…] or 7.14 or **M1** for 49 + y^2 = 100 oe ± answers treat as choice
	c		$(3\sqrt{10}, \sqrt{10})$ and $(-3\sqrt{10}, -\sqrt{10})$ with correct working	5	**B4** for $(3\sqrt{10}, \sqrt{10})$ with correct working or $(-3\sqrt{10}, -\sqrt{10})$ with correct working "Correct working" requires evidence of at least **M2** Allow $\sqrt{90}$ for $3\sqrt{10}$

					or **M2** for $(3y)^2 + y^2 = 100$ oe **A1** for [$y = \pm$] $\sqrt{10}$ or **M1** for 3y seen If **0** or **1 or 2** scored, instead award **SC3** for answer $(3\sqrt{10}, \sqrt{10})$ and $(-3\sqrt{10}, -\sqrt{10})$ with no working or insufficient working If **0** or **M1** scored, instead award **SC2** for answer $(3\sqrt{10}, \sqrt{10})$ or $(-3\sqrt{10}, -\sqrt{10})$ or for (15, 5) and (– 15, –5) with no working or insufficient working If **0** scored, instead award **SC1** for [$y = \pm$] $\sqrt{10}$ or for (15, 5) and (– 15, –5) with no working	Condone for **M1** if seen as $3y^2 + y^2 = 100$
			Total	**9**		
35	a		0	1		
	b		11 with correct working	5	**M3** for $\frac{(15+40)\times16}{2}$	"Correct working" requires evidence of at least **M3** Areas may be found in stages e.g. **M3** for

					or **M2** for attempt at total area with one reading or one calculation error or **M1** for one area calculation AND **M1dep** for *their* 440 ÷ 40 If **0** or **1** scored, instead award **SC2** for answer 11 with no working or insufficient working If **0** scored **SC1** for 440 with no working or insufficient working	$\left(\frac{1}{2} \times 15 \times 16\right)$+ (15 × 16) $+\left(\frac{1}{2} \times 10 \times 16\right)$implied by 120 + 240 + 80 e.g. use of 17 rather than 16 throughout is one error but both triangles incorrect is two errors e.g. one of the above soi by 120, 240 or 80 Dep on at least **M1**
			Total	**6**		
36	a		[gradient =] (7.5 – 5) ÷ (5 – 0) oe y = (*their* 0.5)x + c or $y = mx + 5$ or $y - y_1$ = *their* 0.5$(x - x_1)$ or $y - 7.5 = m(x - 5)$ or $y - 5 = m(x$ [– 0]) $y = 0.5x + 5$ or $y - 7.5 = 0.5(x - 5)$ oe or $y - 5 = 0.5(x$ [– 0]) oe AND $2y = x + 10$	1 1 1	Must show a correct calculation of the gradient Or **7.5 = 5m + 5 oe** This can be y = 0.5x + 5 or $\frac{y-5}{x\,[-0]}$ = *their* 0.5 oe or $y - 7.5 = 0.5(x - 5)$ oe If **0** scored **SC1** for verification of A and B	Working backwards scores **0**
	b		$x \leq$ 5 oe	5		

			$x + y \geq 5$ oe $2y < x + 10$ oe		**B2** for $x \leq 5$ oe or **B1** for $x = 5$ oe or $x < 5$ oe or **SC1** for $x \geq 5$ oe or for $0 \leq x \leq 5$ AND **B2** for $x + y \geq 5$ oe or **B1** for $x + y = 5$ oe or **SC1** for $x + y > 5$ oe AND **B1** for $2y < x + 10$	
			Total	**8**		
37	a		$72 \div 40$	1		Accept $\frac{72}{40}$
	b		Tangent drawn to graph at $t = 20$ 1[.0] to 1.5	B1 B2	**Dep** on tangent or close attempt **M1dep** for rise/run with values substituted	Tangent - mark intention but no daylight
			Total	**4**		
38	a		Correct sketch with y – intercept indicated at 1  	2	**B1** for correct decreasing shape or any sketch with y – intercept at 1	For 2 marks, condone curve touching but not crossing x- axis
	b		Correct sketch through (0, 0), (180, 0) and (360, 0) indicated	2	**B1** for the correct shaped curve with 180 not indicated	

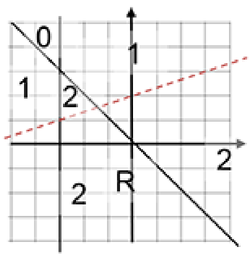
						
			Total	**4**		
39			$y = -2x - 3$ final answer oe	3	**M1** for $m_2 = -2$ **M1** for $5 = their\ m_2 \times -4 + c$ or $y - 5 = their\ m_2 (x + 4)$	Implied by ($^-4$, 5) satisfying *their* answer but not when their $m_2 = \frac{1}{2}$
			Total	**3**		
40			Translation $\begin{pmatrix} 2 \\ 1 \end{pmatrix}$	1 2	**B1** for $\begin{pmatrix} 2 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ 1 \end{pmatrix}$ or a correct vector with a line	If more than one transformation score **0** Condone 2 right and 1 up for **B2** Or **B1** for either correct
			Total	**3**		
41			Circle Centre (0, 0) **oe** Radius $\sqrt{10}$ or 3.16[2..] or 3.2	1 1 1		Accept circular graph Accept origin or O for (0, 0) but not turning point (0, 0) If *their* description uniquely defines the circle then award full marks e.g. After “circle” and “centre (0, 0)”, passes through one correct stated point, scores **3** “circle” and ($\pm\sqrt{10}$, 0) and (0, $\pm\sqrt{10}$), scores **3**

						“circle” and two correct stated points, scores **1**
			Total	**3**		
42			Heidi with at least one bullet point and no incorrect statements: • The roots are $^-2.5$ and 4 • The turning point is at [x =] $\frac{3}{4}$ **oe** and only one root is positive/negative • The turning point is at [x =] $\frac{3}{4}$ **oe** and y-intercept is $^-20$ or negative	2	**B1** for Heidi with one bullet point and no incorrect statements: • Turning point is at [x =] $\frac{3}{4}$ **oe** • y-intercept is $^-20$ or negative or **SC1** for any of the following with no incorrect statements: Taylor and y-intercept is $^-20$ or negative or Finley and turning point is at [x =] $\frac{3}{4}$ **oe** or A person linked correctly to a **FT** turning point from (a)	Turning point position may **FT** from **(a)**
			Total	**2**		
43			Correct shape, not touching the axes 	2	Condone slight curvature away from axes at the extremes **B1** for correct curve but touching, not crossing, one or both axes	Ignore scales
			Total	**2**		
44			16.4 with correct working	5		

						"Correct working" requires evidence of at least **M1** AND **M2** Condone letters other than v and working could be on the diagram
					M1 for 10.25 × 24 implied by 246 AND **M2** for $\frac{1}{2}$(24 + 17 – 11)) × v implied by 15v or $\frac{30}{2}v$ or **M1** for an attempt at area e.g. one of the three areas correct e.g. $\frac{1}{2}$× 11 × v	in parts $\frac{1}{2}$× 11 × v + (17 – 11) × v + $\frac{1}{2}$× (24 – 17 × v) For **M2** allow a proportionality argument e.g. $\frac{1}{2}$× 11 mins + (17 – 11) mins + $\frac{1}{2}$× (24 – 17) mins [= 15 mins at v m/min]
					M1 for *their* 246 ÷ *their* 15 **oe** If **0** or **M1** scored, instead award **SC2** for answer 16.4 with no or insufficient working	*their* 246 is any number derived from 10.25 and implied by 0.68 or 0.68{3…] and *their* 15 has got to be an attempt at the whole 'area' implied by e.g. 24 condone the use of trials, we must see one at 16.4, award **M2** for a trial at 16.4 and **M1** for any other positive trial
					Trials are for values of v and evaluate the area ÷ 24 so here are some:	

v	average speed
1	0.625

2	1.25
3	1.875
4	2.5
5	3.125
6	3.75
7	4.375
8	5
9	5.625
10	6.25
11	6.875
12	7.5
13	8.125
14	8.75
15	9.375
16	10
17	10.625
18	11.25
19	11.875
20	12.5
16.4	10.25

<table>
<tr><td></td><td></td><td></td><td>Total</td><td>5</td><td></td><td></td></tr>
<tr><td>45</td><td></td><td></td><td>Correct region indicated


</td><td>5</td><td>B2 for $y - 2 = \frac{1}{3}x$ broken line

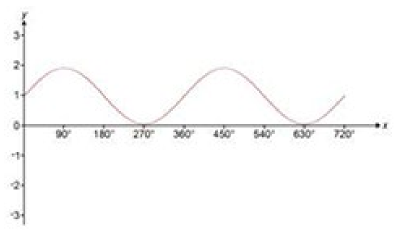
or
B1 for $y - 2 = \frac{1}{3}x$ solid line

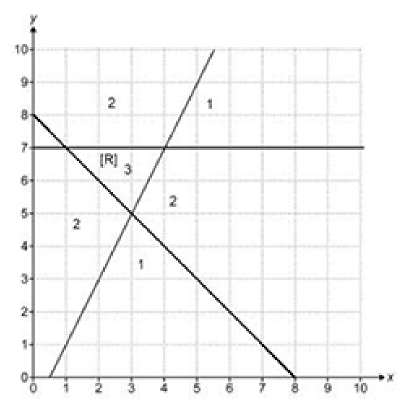
AND
B1FT for R correct side of $y - 2 = \frac{1}{3}x$

B1 for R correct</td><td>Allow shorter accurate line provided it defines their region

See marks on diagram for next 3 marks
Grid assumes $y - 2 = \frac{1}{3}x$ is correct

Mark position of R first. If R not labelled then accept other clear indication</td></tr>
</table>

					side of $x = {}^-3$ **B1** for R correct side of $y = {}^-x$	If $y - 2 = \frac{1}{3}x$ not attempted then allow B1B1 max for region FT dep on **sloping** line drawn that is long enough to define the region chosen on grid
			Total	**5**		
46			[y =] $^-3x + 11$ final answer	4	**B2** for grad = $^-3$ **soi** or **M1** for diagonals cross at 90° **soi** **M1** for substituting (2, 5) into y = (*their m*)$x + c$ **oe soi**	Accept $\frac{-3}{1}$ for all marks **B2** implied by e.g. [y =] $^-3x + c$ **oe** **M1** could be on a diagram e.g. $y - 5 =$ (*their m*)$(x - 2)$ Answer [y =] $\frac{1}{3}x + 4\frac{1}{3}$ implies **M1** **M1 soi** by answer with their gradient e.g. $y = 3x - 1$ satisfies (2, 5) so gets **M1**
			Total	**4**		
47				3	**B1** for general shape of sine curve **B1** for max at $y = 2$, minimum at $y = 0$ **B1** for max at x = 90, 450	Starting at [their] centre and completing at least one full cycle; condone incorrect period For full marks, it must be a curve and have correct curvature Only these two max between $0 < x \leq 720$

			Total	**3**		
48	a		E.g. [$y =$]$(x + 2)(x - 3)$ AND either [$y = x^2 - 3x + 2x$] - 6 or [Constant/y-intercept =] $2 \times {}^-3 = {}^-6$ <u>Alternative method using simultaneous equations</u> $y = x^2 + bx + c$ $0 = ({}^-2)^2 + ({}^-2)b + c$ and $0 = 3^2 + 3b + c$ [$b = {}^-1$] $c = {}^-6$	3	**M2** for [$y =$]$(x + 2)(x - 3)$ or **M1** for $k(x + 2)(x - 3)$ **M2** for $0 = ({}^-2)^2 + ({}^-2)b + c$ and $0 = 3^2 + 3b + c$ or **M1** for $y = x^2 + bx + c$	For full marks, all shown parts of their expansion must be correct
	b		The equation could be a multiple e.g. [$y =$]$k(x + 2)(x - 3)$ So the intercept could be a multiple of ${}^-6$	2	**B1** for giving an example in the form $k(x + 2)(x - 3)$ (where $k > 0$, $k \neq 1$, k need not be an integer) or stating that the intercept could be a multiple of ${}^-6$	Allow full or part marks for a fully correct algebraic example e.g. [$y =$]$2(x + 2)(x - 3)$ would have a y-intercept of -12
			Total	**5**		
49			E.g. Correct inequalities shown on diagram, correct region R identified and correct area calculation ½ × 3 × 2 [= 3] 	6	**B1** for line $y = 7$ **B1** for line $x + y = 8$ AND	Condone good freehand lines, which can be dashed or solid. Lines need only be one square long for line mark but they must be fit for purpose to define their region Mark the region that is labelled, but if no labelling mark the single region

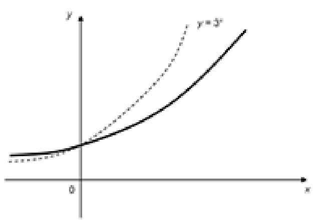
					B1 for correct side of $y = 2x - 1$ **B1** for correct side of $y = 7$ **B1** for correct side of $x + y = 8$ AND **M1dep** for ½ × 3 × 2 [= 3] oe	that is shaded (or unshaded) or implied by area calculation of correct region R Use diagram for these three marks If extra lines, mark those bounding R. If no R, mark poorest two Dep on region R being correct Accept counting squares but check areas bounding $y = 2x - 1$ Accept split into two triangles 2 and 1 oe
			Total	**6**		
50	a		$8^2 + ([^-]6)^2$ $64 + 36 = 100$ or $\sqrt{64+36} = 10$ and $\sqrt{100} = 10$	1 1	Accept equivalent reasoning e.g. For first mark $10^2 - 8^2$ e.g. For second mark $100 - 64 = 36$ $\sqrt{36} = \pm6$	If $8^2 + {}^-6^2$ do not allow first mark If $\sqrt{100}$ evaluated then it must be 10 For 2 marks there must be no errors leading to the answer
	b		$y = \frac{4}{3}x - \frac{50}{3}$ final answer	5	**B4** for answer $\frac{4}{3}x - \frac{50}{3}$ oe (no $y =$) or correct 3-term answer in different form e.g. $6y - 8x = 100$	Accept e.g. $y = 1.33[..]x - 16.6[..]$

					OR **M1** for $-\frac{3}{4}$ oe and **M1** [tangent gradient =] $^{-}1 \div$ *their* $-\frac{3}{4}$ oe AND **M1dep** for $y + 6 =$ *their* $\frac{4}{3}(x - 8)$ oe or **M1dep** for $y =$ *their* $\frac{4}{3}x + c$	$\frac{4}{3}$ oe implies M1M1 unless contradicted **Dep on at least M1** oe e.g. $-6 =$ *their* $\frac{4}{3} \times 8 + c$ Do not allow M1 for e.g. grad $-\frac{3}{4}$ used if the gradient is then changed subsequently to e.g. $\frac{4}{3}$ **Dep on at least M1** Allow 'c' or any value including 0 Answer $y = \frac{4}{3}x$ [+ c] oe implies M1M1M1
			Total	**7**		
51	a		0	1		
	b		2 with correct working	5	**M3** for method for three areas correct or for 3000 **or** 900 and 1500 and 600 nfww	"correct working" requires at least M3 Treat as three separate areas, so trapezium from 0 to 1500 is three areas, trapezium from 0 to 1100 is 2 areas, trapezium from

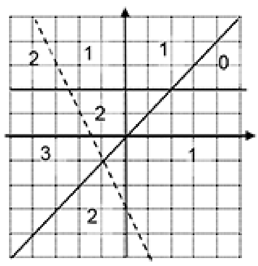
					or **M2** for method for two areas correct (method towards two from 900, 1500, 600) or **M1** for method for one area correct (method towards 900 or 1500 or 600) or for 1500 seen AND **M1dep** for *their* 3000 ÷ 1500, dep on at least M2 If 0 or 1 scored instead award **SC2** for 2 with no or insufficient working but not from wrong working	600 to 1500 is 2 areas. For M marks, mark method not accuracy, so M1 for $\frac{600\times3}{2}$ even if not evaluated as 900.
			Total	**6**		
52			$x^2 + y^2 = 4^2$ oe final answer	2	**B1** for $x^2 + y^2 = k$ (not 16)	k could be r^2
			Total	**2**		
53	a		accurate curve	3	**B2** for 7 or 8 points accurately plotted or **B1** for 4, 5 or 6 points accurately plotted	tolerance $\pm\frac{1}{2}$ small square radially for curve and points, condone a wobbly curve and slight feathering or tram lines in no more than 3 sections but no ruled lines
	b		$x = {}^{-}1.5$ oe	1		
	c		${}^{-}3.9$ or ${}^{-}3.8$ or ${}^{-}3.7$ 0.7 or 0.8 or 0.9	2		

					B1 for either If **0** or **1** scored **FT** *their* curve for **1** or **2** marks or **SC1** for an answer in each of $^-3.9$ to $^-3.7$ and 0.7 to 0.9	tolerance ±1 small square radially
			Total	**6**		
54			$y = -\frac{x}{3} - 1$ **oe** simplified form	4	**B3** for correct equation not in required form OR **B1** for gradient of perp line = $-\frac{1}{3}$ **oe soi** **M1** for $y + 3 =$ *their* grad × $(x - 6)$ or $^-3 =$ *their* grad × $6 + c$ **M1** for correct simplification to $y = mx + c$ form of *their* $y + 3 =$ *their* grad × $(x - 6)$ or using *their* $c = {}^-3 -$ *their* grad × 6	*Their* grad may be 3 i.e. they are finding the equation of the parallel line Max **M1** if *their* grad is 'm'
			Total	**4**		
55			$x^2 + y^2 = 124$ final answer	4	**B2** for 124 Or **B1** for 108 Or **M1** for $4^2 + (6\sqrt{3})^2$ **oe** **B1** for $x^2 + y^2 = k$ as final answer	Accept '$= k$' or numeric value where $k > 0$
			Total	**4**		
56	a		$^-1$	1		

	b		Correct graph	3	Curves must not be joined or touch either axis **B2FT** for 7 or 8 correct plots Or **B1FT** for 5 or 6 correct plots	Condone slight feathering, no ruled segments If curve incorrect, mark the plots If large blob for plot, check centre of blob
			Total	**4**		
57	a		≤ ≤ ≥	2	**B1** for two correct or "< < >"	i.e. correct but no equals
	b		$x + 2y \geq 6$ **oe**	3	**B1** for the correct straight line drawn, from (6, 0) to (0, 3) – but line need not go past intersection with $y = 2x$. **B1** for correct equation for *their* line e.g. $x + 2y = 6$ **oe**	Implied by e.g. $x + 2y = 6$ **oe** and accept a ruled or good freehand line Implied by e.g. answer of $x + 2y \leq 6$ **oe**
			Total	**5**		
58			4, $^-11$	4	**B1** for $(x – 4)^2$ or 8 ÷ 2 **B2FT** for -11, correct or FT *their* $(x – 4)^2$ Or **M1** for $(\textit{their} + 4)^2 – 8 \times (\textit{their} + 4) + 5$ **B1FT** for $(^-a, b)$ FT *their* $((x + a)^2 + b))$ to a maximum of **3** marks	Accept any correct method **B3** implied by $(x – 4)^2 – 11$

					If no working **B2** for either ordinate correct <u>Alternative method – find the line of symmetry</u> Find the two points where e.g. $y = 5$ **M1** for $x^2 - 8x + 5 = 5$ **A1** for $x(x - 8) = 0$ so $x = 0$ or $x = 8$ **B1** each for line of symmetry is $x = 4$ and by substitution $y = {}^-11$ to a maximum of **3** marks	
			Total	**4**		
59	a	i	sin x	1		
		ii	$\left(\frac{1}{3}\right)^x$	1		
	b	i	Graph of $y = \frac{1}{2}x^3$	1		Mark intent
		ii	$y = x^3$ translated vertically 8 up y-intercept 8 x-intercept ${}^-2$	1 1 1		Intercepts must be marked on graph and accept given as coordinates
			Total	**6**		
60	a			3	**B1** for correct shape and same y – intercept **B1** for sketch drawn below $y = 3^x$ for positive x-values or has shallower gradient (by eye) **B1** for sketch drawn above $y = 3^x$ for negative x-values	

					Examiner's Comments Few candidates gained three marks, but most made an attempt at the question. Many drew the correct shape but had all of their curve beneath the given curve; this gained B1. Few candidates drew their curve to pass through the same y-intercept as the given curve, despite some labelling their intercept as (0, 1).
	b	i	eg. sin$x$ should initially increase/be positive [after x = 0]	1	Other acceptable answers include: [The sketch is a] reflection of y = sin$x$ [in the x-axis]; First turning point should be a maximum; sin$x$ has a maximum at 90 [and then a minimum at 270]. **Examiner's Comments** Most acceptable responses noted that y = sin x should initially be an increasing curve or have positive values of y.
		ii	eg. y = –sin x	1	Accept any other possibly correct equations such as: y = –k sin x or y = sin(-x) or y = k cos (x + 90) **Examiner's Comments** This question had a high omission rate. y

					= -sin x was the most common correct equation, but a few alternatives, such as y = sin (-x), were seen.
			Total	**5**	
61			y = 2 ruled and y = –2x –3 broken line and correct region indicated  	6	**B1** for y = 2 ruled **B2** for y = –2x –3 broken line or **B1** for y = –2x –3 solid line AND **B1** for *R* on correct side of y = x **B1** for *R* on correct side of y = 2 **B1** for *R* on correct side of *their* y = –2x – 3 Penalise one mark only for good freehand lines Additional lines treat as choice Length of line should be fit for purpose to identify *their* region See marks on diagram for the final **B3** marks provided all lines drawn correctly For region, FT *their* y = –2x – 3 provided line with negative gradient only but no FT for y = 2 if incorrect Condone shading in or out of region provided R is clearly identified **<u>Examiner's Comments</u>** Few candidates gave a fully correct response for the region. Others were able

					to draw two correct lines and identify the correct region, but did not draw $y = {}^{-}2x - 3$ as a broken line. Most candidates struggled to draw $y = {}^{-}2x - 3$, but were able to draw y = 2. Many were given partial marks for identifying a region that satisfied at least one of the lines. Examiners allowed a follow-through mark for the region if the line $y = {}^{-}2x - 3$ had been drawn incorrectly, provided it was a ruled line with a negative gradient. **Assessment for learning** Before drawing a boundary line, candidates should consider whether it is included in the required region or not. Lines should always be ruled and where the line is not included in the region, it should be drawn as a ruled broken line.
			Total	**6**	
62	a		$y = 4 - x^2$	2	**B1** for answer $y = k - x^2$ — k is any value including zero **<u>Examiner's Comments</u>** Some candidates gave a correct equation. Others recognised that the equation must be in the form $y = k - x^2$ and they were given partial marks for answer such as $y = -x^2$. Many omitted this part.
	b		Translation $\binom{-3}{-14}$	4	**B3** for translation $\binom{-3}{k}$ or translation $\binom{k}{-14}$ OR **M2** for [y =] $(x + 3)^2 - 5 - 3^2$ or better or **M1** for [y =] $(x + 3)^2$ seen **B1** for translation — If more than one transformation given then **M2** maximum

					Examiner's Comments This proved to be challenging for almost all candidates. Many omitted this part. Some candidates completed the square and then linked it to the coordinates of the turning point of $y = x^2 + 6x – 5$ before giving a correct transformation. Some others recognised the transformation and gave the answer translation, but without any algebraic work to establish the vector required.
			Total	**6**	
63			$y = 3x + 1$ **oe**	2	**B1** for answer $y = 3x + k$ **oe** or for $y = mx + 1$ **oe** **Examiner's Comments** Few candidates were successful here. Many did not demonstrate an understanding that the equation should have a gradient of 3. Answers of $y = −3x \pm c$ or $y = mx – 5$ where m was 1 were among incorrect responses given. Some candidates showed understanding of one of the properties and were given partial marks for an equation with the correct gradient or the correct y-intercept.
			Total	**2**	
64	a		3	1	**Examiner's Comments** Few gave the correct value of 3. An answer of 5 was common and ⁻17 was also seen.
	b		Correct curve	3	**B2FT** for 7 or 8 correct plots or **B1FT** for 5 or 6 correct plots Use overlay as a guide Mark curve first accuracy ±

						1mm, ½ small sq Condone slight feathering Condone ruled segment between $x = -5$ and $x = -4.5$ only If curve incorrect then mark plots accuracy ± 1mm If no plot, curve implies plot
					Examiner's Comments Few candidates gave a fully correct curve. Many were given partial marks for correctly plotting their points. The plots at (⁻4.5, ⁻10.1), (⁻3, ⁻9) and (⁻2, ⁻8) were those most commonly plotted incorrectly, where candidates were not able to correctly interpret the vertical scale of the graph.	
	c		–1 cao	1	**Examiner's Comments** This part proved challenging and there were a range of incorrect values given. To be successful, candidates needed to look for the 'highest' horizontal line through an integer on the y-axis that crossed the curve once only.	
			Total	**5**		
65	a		$x^2 + y^2 = 20$	2	**B1** for $x^2 + y^2 = k$	k could be r^2 or $\sqrt{20}^2$ but not 20
					Examiner's Comments	

					Many candidates wrote down the formula $x^2 + y^2 = r^2$ but most were not able to find the value of r^2. A few used r^2 as $\sqrt{20}$ and a few as 20.
	b	i	[gradient =] $\frac{2}{4}$ or $\frac{1}{2}$ $m \times their \frac{2}{4} = -1$ used or implied	M1 M1	If **0** scored **SC1** for $-\frac{4}{2}$ or $-\frac{2}{1}$ without seeing $\frac{2}{4}$ or $\frac{1}{2}$ for **M1** allow $-2 \times \frac{2}{4} = -1$ or e.g. $-\frac{4}{2}$ after $\frac{2}{4}$ seen or $-\frac{2}{1}$ after $\frac{1}{2}$ seen **<u>Examiner's Comments</u>** Few candidates attempted this part. Most were able to show the gradient of the radius from (0, 0) to (4, 2) is $\frac{2}{4}$ but they did not clearly show how to get from that to −2. They need to use or imply $m_1 \times m_2 = {}^-1$ for perpendicular lines.
		ii	$y = -2x + 10$ oe	2	**B1** for $y = -2x + c$ seen oe or $-2x + 10$ or $c = 10$ 'c' can be 0 but not 10 **<u>Examiner's Comments</u>** Although candidates were told that the gradient was ${}^-2$, we did not see many responses with the equation $y = {}^-2x + c$. A few did work out from (4, 2) that $c = 10$.
			Total	**6**	
66	a		C	1	**<u>Examiner's Comments</u>** There were many correct responses. The common incorrect responses were D and E.

	b		E	1	**Examiner's Comments** There were many correct responses. The common incorrect responses were D and F.
			Total	**2**	
67			16.5 with correct working	5	"Correct working" requires evidence of at least **M1** AND **M2** **M1** for 11.55 × 20 implied by 231 Condone letters other than *v* and working could be on the diagram. AND **M2** for $\frac{1}{2}$(20+(15 – 7)) × *v* implied by 14*v* or $\frac{28v}{2}$ in parts or **M1** for an attempt at area e.g. one of the three areas correct e.g. $\frac{1}{2} \times 7 \times v$ $\frac{1}{2}$× 7 × *v* + (15−7) × *v* + $\frac{1}{2}$×(20−15) × *v* For **M2** allow a proportionality argument e.g. $\frac{1}{2}$× 7 mins + (15 − 7) mins + $\frac{1}{2}$× (20 − 15) mins [= 14 mins at *v* m/min] **M1** for *their* 231 ÷ *their* 14 oe *their* 231 is any number derived from 11.55 and implied by 0.825 and *their* 14 has got to be an attempt at the whole 'area' implied by e.g 20 If **0** or **M1** scored, instead award **SC2** for answer 16.5 with no or insufficient working

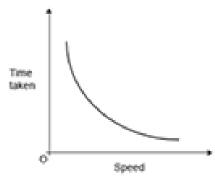
condone the use of trials, we must see one at 16.5, award **M2** for a trial at 16.5 and **M1** for any other positive trial

Trials are for values of v and evaluate the area ÷20 so here are some :

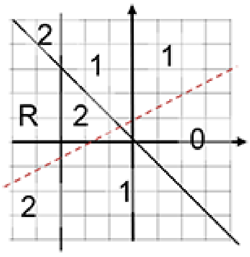
v	average speed
1	0.7
2	1.4
3	2.1
4	2.8
5	3.5
6	4.2
7	4.9
8	5.6
9	6.3
10	7
11	7.7
12	8.4
13	9.1
14	9.8
15	10.5
16	11.2
17	11.9
18	12.6
19	13.3
20	14
16.5	11.55

					Examiner's Comments Many candidates were able to get credit by working out 231 or by making an attempt at part of the area. Most candidates split the area under the graph into a triangle, a rectangle, and another triangle to find the area under the graph. Once an expression for the area was found, most candidates then struggled to manipulate the algebra to obtain 14*v* = 11.55 × 20. A common error was to multiply through by 2, but many did not multiply 8*v* by 2, and therefore they showed an incorrect expression for the area of 7*v* + 8*v* + 5*v*. Those who attempted the area as an entire trapezium were often more successful.
			Total	**5**	
68			Circle Centre (0, 0) oe Radius $\sqrt{20}$ or $2\sqrt{5}$ or 4.47[2..] or 4.5	1 1 1	Accept circular graph Accept origin or O for (0, 0) but not turning point (0, 0) If their description uniquely defines the circle then award full marks eg After "circle" and "centre (0, 0)", passes through one correct stated point, scores 3 "circle" and $(\pm\sqrt{20}, 0)$ and $(0, \pm\sqrt{20})$, scores 3 "circle" and two correct stated points, scores 1

					Examiner's Comments Many candidates did not recognise this as a circle. There were numerous wrong answers, the most common being that it was a graph of direct proportion, positive correlation, a straight line or a quadratic (U-shaped) graph. Most of the candidates who did state the centre of the circle were correct, but there was more variation in values for the radius. The most common wrong answers for the radius were 20 and 10. It was not unusual for candidates to give the radius or the centre correctly, but neglect to mention that the graph was that of a circle.
			Total	**3**	
69			Charlie with at least one bullet point and no incorrect statements: • The roots are –4 and 2.5 • The turning point is at $[x =] -\frac{3}{4}$ oe and only one root is positive/negative • The turning point is at $[x =] -\frac{3}{4}$ oe and y-intercept is –20 or negative	2	**B1** for Charlie with one bullet point and no incorrect statements: • Turning point is at $[x =] -\frac{3}{4}$ oe • y-intercept is –20 or negative or **SC1** for any of the following with no incorrect statements: Dev and y-intercept is –20 or negative or Eve and turning point is at $[x =] -\frac{3}{4}$ oe or Turning point position may **FT** from **(a)** •

					A person linked correctly to a FT turning point from (a) **Examiner's Comments** Most candidates gave an answer, but few were successful. Answers frequently consisted of a vague statement not supported by values. The most common reason for selecting Charlie was stating the roots correctly as $\frac{5}{2}$ and $^-4$, but candidates could also have referred to the *y*-intercept being $^-20$ together with the turning point being at $x = -\frac{3}{4}$. Some candidates gave the roots incorrectly as $^-5$ and 4. The most common awards of the SC1 mark were for a correct follow through of the candidate's turning point in support of the selection of Eve, or for Dev and a *y*-intercept of $^-20$.
			Total	**2**	
70			Correct shape, not touching the axes 	2	Condone slight curvature away from axes at the extremes **B1** for correct curve but touching, not crossing, one or both axes Ignore scales **Examiner's Comments** Very few candidates drew the correct graph. Those that did produce an appropriate decaying curve usually realised that it should not touch the axes. Most sketches were straight lines. Some had a negative gradient and either reached the axes or stopped slightly short,

					while others were straight lines through the origin.
			Total	**2**	
71			[y =] –2x + 9 final answer	4	**B2** for grad = – 2 **soi** — Accept $\frac{-2}{1}$ for all marks; B2 implied by e.g. [y =] −2x + c oe or **M1** for diagonals cross at 90° **soi** — M1 could be on a diagram **M1** for substituting (1, 7) into y = (*their m*)x + c **oe soi** — e.g. y – 7 = (their m)(x – 1) Answer [y =] ½ x + 6.5 implies M1 M1 soi by answer with their gradient e.g. y = 2x + 5 satisfies (1, 7) so gets M1 **<u>Examiner's Comments</u>** This question was one that candidates struggled with most on the paper. The most common error was to consider that the other diagonal also had a gradient of $\frac{1}{2}$, but passed through (1, 7). Answers of $y = \frac{1}{2}x + 6.5$ were very common. Those candidates who understood the diagonals of a rhombus were perpendicular and used a gradient of ⁻2 for the required diagonal invariably went on to give a correct equation. Only a few candidates attempted to sketch a rhombus, which may have helped some to establish the perpendicular property of the diagonals.
			Total	**4**	
72			Correct region indicated	5	**B2** for $y - 1 = \frac{1}{2}x$ broken line or — Use overlay as a guide for accuracy must pass through or touch small circles (when

					**B1** for $y-1=\frac{1}{2}x$ solid line AND **B1FT** for *R* correct side of $y-1=\frac{1}{2}x$ **B1** for *R* correct side of $x = -3$ **B1** for *R* correct side of $y = -x$	extended if necessary) position is 2 small dots each way from correct position of ends of line Allow shorter accurate line provided it defines their region See marks on diagram for next 3 marks Grid assumes $y-1=\frac{1}{2}x$ is correct Mark position of R first. If R not labelled then accept other clear indication. If $y-1=\frac{1}{2}x$ not attempted then allow B1B1 max for region FT dep on **sloping** line drawn that is long enough to define the region chosen on grid
					Examiner's Comments A small number of candidates scored full marks here. Some scored 4 marks with the only error being drawing a solid line instead of a broken line for $y-1>\frac{1}{2}x$, however the majority of candidates drew the line incorrectly. After drawing an incorrect line, follow through marks for identifying the region were available and most candidates secured a follow through mark for a correct region relative to their line. Many candidates also gained the mark for a region satisfying $y \le {}^-x$, but fewer gained the mark for a region satisfying $x \le {}^-3$. A few candidates did not	

					clearly label or shade their region and in those cases, marks were not given. **Misconception** When drawing the line $y - 1 > \frac{1}{2}x$, most candidates drew a solid line rather than a broken line. The strict inequality > indicated that the line should not be included in the region.
			Total	**5**	
73	a		0	1	**Examiner's Comments** Less than half of the candidates gave the correct answer of 0. Many read the vertical axis and gave an answer of 18.
	b		12.37[5] or 12.38 or 12.4 all oe and with correct working	5	**M3** for $\frac{(15+40)\times 18}{2}$ or **M2** for attempt at total area with one reading or one calculation error or "Correct working" requires evidence of at least **M3** Areas may be found in stages e.g. **M3** for $\left(\frac{1}{2}\times 10\times 18\right)+(15\times 18)$ $+\left(\frac{1}{2}\times 15\times 18\right)$ implied by 90 + 270 + 135 e.g. use of 16 rather than 18 throughout is one error but both triangles incorrect is two errors

M1 for one area calculation	e.g. one of the above soi by 90, 270 or 135
AND	
M1dep for *their* 495 ÷ 40	Dep on at least **M1**
If **0** or **1** scored, instead award **SC2** for answer 12.37[5] or 12.38 or 12.4 all oe with no working or insufficient working	
If **0** scored **SC1** for 495 with no working or insufficient working	

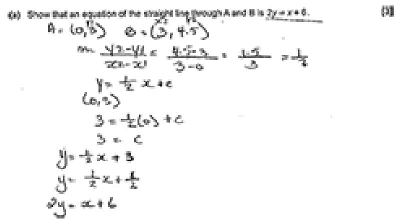
<u>Examiner's Comments</u>

Few candidates scored full marks. Most attempted to find three separate areas rather than the area of the trapezium. A very common error when attempting to find the areas of the triangles was to only perform base × height. Misreading the vertical scale as 16 rather than 18 was also common. Candidates with the correct area often stopped at that point and did not divide by 40 to obtain the average speed.

Some candidates found the mean of the gradients of the three lines; others found the mean of the speeds at 5, 10, 15 … seconds.

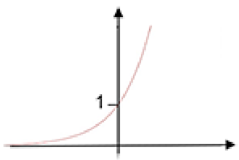
Misconception

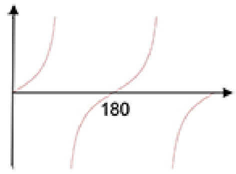
					Some candidates may associate ‘average’ with adding values and dividing by the number of values. Average speed is calculated by dividing the total distance travelled by the time taken to travel that distance. In speed-time graphs the time taken can be read from the *x*-axis, but the distance travelled is represented by the area under the graph.
			Total	**6**	
74	a		[gradient =] $(4.5 – 3) \div (3 – 0)$ oe $y = (\textit{their } 0.5)x + c$ or $y = mx + 3$ or $y – y_1 = \textit{their } 0.5(x – x_1)$ or $y – 4.5 = m(x – 3)$ or $y – 3 = m(x [– 0])$ $y = 0.5x + 3$ or $y – 4.5 = 0.5(x – 3)$ oe or $y – 3 = 0.5(x [– 0])$ oe AND $2y = x + 6$	1 1 1	Must show a correct calculation of the gradient Working backwards scores 0 This can be $y = 0.5x + 3$ or $^{3\text{ or }}\frac{y-3}{x\,[-0]}$ = their 0.5 oe or $y – 4.5 = 0.5(x – 3)$ oe If **0** scored **SC1** for verification of A and B **<u>Examiner’s Comments</u>** More able candidates usually understood how to ‘Show that…’ for an algebraic answer. Their working was clear and easily followed, and they used a variety of approaches including $y = mx + c$ and $y – y_1 = m(x – x_1)$. Some candidates scored a mark for using points A and B to find the gradient as 0.5 and then stopped, while a small number of candidates verified that the two points, A and B, satisfied the equation that they had been asked to show. Candidates who worked backwards from the given equation to obtain a gradient of 0.5 were

					given 0. Exemplar 3  In this fully correct response the candidate has shown clear working which flows from one line to the next. The middle two lines, where c is established as being 3, are not strictly necessary for full marks since the value is the *y*-intercept and could be read from the graph.
	b		$x \le 3$ oe $x + y > 3$ oe $2y \le x + 6$ oe	5	**B2** for $x \le 3$ oe or **B1** for $x = 3$ oe or $x < 3$ oe or **SC1** for $x \ge 3$ oe or for $0 \le x \le 3$ AND **B2** for $x + y > 3$ oe or **B1** for $x + y = 3$ oe or **SC1** for $x + y \ge 3$ oe AND **B1** for $2y \le x + 6$ <u>**Examiner's Comments**</u> A few candidates scored full marks. Some

					candidates scored 1, 2 or 3 marks for at least one partly correct response, often with an error in the inequality notation. Many candidates did not know how to write the inequalities though.
			Total	**8**	
75	a		(10, 0)	1	**Examiner's Comments** More able candidates usually answered this correctly. A wide variety of incorrect answers was seen, including (0, 0), (100, 0) and (0, 10).
	b		$-\sqrt{91}$	3	**B2** for $\sqrt{91}$ or −9.539[…] or −9.54 or **B1** for 9.539[…] or 9.54 or **M1** for $9 + y^2 = 100$ oe ± answers treat as choice **Examiner's Comments** Few candidates gave the correct answer of $-\sqrt{91}$. Rather more candidates gave either $\sqrt{91}$ or −9.539…. which scored 2 marks. A method mark was available for $9 + y^2 = 100$ but this was rarely seen from less able candidates.
	c		$(\sqrt{2}, 7\sqrt{2})$ and $(-\sqrt{2}, -7\sqrt{2})$ with correct working	5	**B4** for $(\sqrt{2}, 7\sqrt{2})$ with correct working "Correct working" requires evidence of at least **M2**

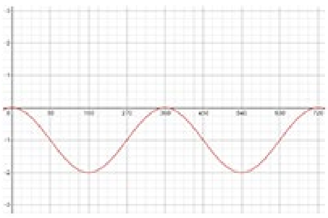
						or $(-\sqrt{2}, -7\sqrt{2})$ with correct working	Allow $\sqrt{98}$ for $7\sqrt{2}$
						or	
						M2 for $x^2 + (7x)^2 = 100$ oe	
						A1 for $[x = \pm]\ \sqrt{2}$	
						or	
						M1 for $7x$ seen	Condone for **M1** if seen as $x^2 + 7x^2 = 100$
						If **0** or **1 or 2** scored, instead award	
						SC3 for answer $(\sqrt{2},\ 7\sqrt{2})$ and $(-\sqrt{2}, -7\sqrt{2})$ with no working or insufficient working	
						If **0** or **M1** scored, instead award	
						SC2 for answer $(\sqrt{2},\ 7\sqrt{2})$ or $(-\sqrt{2}, -7\sqrt{2})$	
						or for $(\frac{5\sqrt{2}}{2}, \frac{35\sqrt{2}}{2})$ and $(-\frac{5\sqrt{2}}{2}, -\frac{35\sqrt{2}}{2})$	
						with no working or insufficient working	
						If **0** scored, instead award	
						SC1 for $[x = \pm]\ \sqrt{2}$	
						or for $(\frac{5\sqrt{2}}{2}, \frac{35\sqrt{2}}{2})$ and $(-\frac{5\sqrt{2}}{2}, -\frac{35\sqrt{2}}{2})$	

					with no working **Examiner's Comments** Some of the more able candidates scored full marks. There was a wide variety of wrong answers with no working. Candidates could score a mark for 7*x*, which was often seen substituted incorrectly for y as $x^2 + 7x^2 = 100$. These candidates usually abandoned the question soon after, whereas the correct answer for *x* at this stage of $\pm\sqrt{2}$ usually enabled candidates to continue.
			Total	**9**	
76	a		Correct sketch with *y* – intercept indicated at 1  	2	**B1** for correct increasing shape or any sketch with *y* – intercept at 1 For 2 marks, condone curve touching but not crossing *x*- axis **Examiner's Comments** Two of the last three questions assessed content from some higher tier topics (graphs of exponential and trigonometric functions and Pythagoras' in 3-D figures). These questions were found to be challenging for all candidates and very few responses were seen. **OCR support** Check in tests and Section check in tests covering all higher tier topics are available here: Check-in tests

	b		Correct sketch through (0, 0), (180, 0) and (360, 0) indicated  	2	**B1** for three correct sections but joined and/or 180 not indicated	
			Total	**4**		
77	a		Tangent drawn to graph at t = 10 1[.0] to 1.5	B1 B2	**Dep** on tangent or close attempt **M1dep** for rise/run with values substituted **<u>Examiner's Comments</u>** The key to answering this question was to realise that a tangent to the curve was needed to estimate the change in distance over time at time = 10 seconds. Only a few attempted to draw a tangent. The majority of those attempting this part divided 30 by 10. **Misconception** On a distance-time graph, a straight line indicates constant speed, and a curve indicates non-constant speed. To estimate the speed at a particular point on a curve, a tangent must be drawn to the curve at that point. The tangent is then used to estimate the change in distance over time (speed) at that point.	Tangent - mark intention but no daylight
	b		36 ÷ 20	1		Accept $\frac{36}{20}$

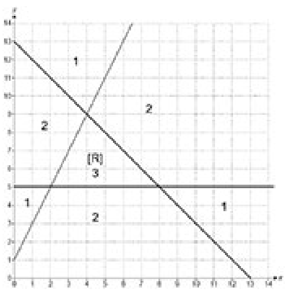
					Examiner's Comments This was well answered by most. Some misread the scale and worked out 35 ÷ 20 before rounding to 1.8 and a few chose unrelated calculations to get to the given answer, such as 18 ÷ 10.
			Total	**4**	
78			$y = -\frac{1}{2}x + 7$ final answer oe	3	**M1** for $m_2 = -\frac{1}{2}$ **M1** for 5 = *their* m_2 × 4 + *c* or *y* – 5 = *their* m_2 (*x* – 4) — implied by (4,5) satisfying *their* answer but not when *their* m_2 = 2 **Examiner's Comments** Most candidates did not know how to find the gradient of a line that is perpendicular to a given line, using $m_1 \times m_2 = -1$. Some used the point (4, 5) to find the gradient and usually gave $\frac{5}{4}$. Other common gradients seen were 4 and 8. More candidates knew to use the point (4, 5) to find the value of '*c*'. There were a few diagrams drawn to try to find the value of the constant.
			Total	**3**	
79			translation $\begin{pmatrix} -3 \\ 5 \end{pmatrix}$	1 2	If more than one transformation score 0 **B1** for $\begin{pmatrix} -3 \\ k \end{pmatrix}$ or $\begin{pmatrix} k \\ 5 \end{pmatrix}$ or a correct vector with a line — condone 3 left and 5 up for **B2** or **B1** for either correct **Examiner's Comments** Very few knew how to interpret the equation as a transformation. A small number of candidates wrote 'translation'

					but the vector defining the translation was often wrong.
			Total	**3**	
80			$x^2 + y^2 = 3^2$ oe final answer	2	**B1** for $x^2 + y^2 = k$ (not 9) — k could be r^2 **Examiner's Comments** Many candidates knew that the equation was $x^2 + y^2 = r^2$ but they did not know what r represented. Some tried to write down a linear equation.
			Total	**2**	
81	a		accurate curve	3	**B2** for 6 or 7 points accurately plotted or **B1** for 4 or 5 points accurately plotted — tolerance $\pm\frac{1}{2}$ small square radially for curve and points, condone a wobbly curve and slight feathering or tram lines in no more than 3 sections but no ruled lines **Examiner's Comments** The plotting was usually very accurate with the exception that the point (1, 1) was often plotted at (1, 0). Some curves were drawn very inaccurately. When marking, particular attention is given to check that the curve goes through the correctly plotted points. A few candidates used a ruler but the expectation is that curves are to be drawn by hand.
	b		$x = {}^-1$ oe	1	**Examiner's Comments** This was usually answered well with $y = {}^-1$ as a very common incorrect answer. Some candidates tried to use $y = mx + c$ which made this part very tricky.
	c		${}^-2.8$ or ${}^-2.7$ 0.7 or 0.8	2	

					B1 for either If **0** or **1** scored **FT** *their* curve for **1** or **2** marks or **SC1** for an answer in each of ⁻2.8 to ⁻2.7 and 0.7 to 0.8 **Examiner's Comments** Many candidates tried to calculate the answers from the equation and completely ignored the instruction to 'use the graph'. Many gave the answer to more than 1 decimal place despite the request in the question. **Assessment for learning** Read each question very carefully and give the answer(s) in the form requested.	tolerance $\pm\frac{1}{2}$ small square radially
			Total	**6**		
82				3	**B1** for general shape of cosine curve **B1** for max at *y* = 0, minimum at *y* = −2 **B1** for max at *x* = 360, 720 **Examiner's Comments** About half of the candidates started their sketch with a maximum on the *y*-axis and many proceeded to sketch the graph of *y* = cos *x* with the maximum points correct at 360° and 720°. This scored 2 marks. Some candidates were able to apply the translation correctly and therefore had the maximum points at *y* = 0 and minimum points at *y* = ⁻2.	Starting at its max and completing at least one full cycle; condone incorrect period For full marks, it must be a curve and have correct curvature Only these two max between 0 < *x* ≤ 720

					Other candidates either sketched the graph of $y = \sin x$, $y = -\sin x$ or a straight line. The demand of the question was to “sketch” the graph. Candidates who only plotted points needed to draw the curve through the points.
			Total	**3**	
83	a		E.g. [y=]$-(x + 3)(x - 5)$ AND either [$y = -x^2 - 3x + 5x$] + 15 or [Constant/y-intercept =] $^{-}3 \times {}^{-}5 = 15$ <u>Alternative method using simultaneous equations</u> $y = -x^2 + bx + c$ $0 = -(-3)^2 - 3b + c$ and $0 = {}^{-}5^2 + 5b + c$ [b = 2] $c = 15$	3	**M2** for [y=]$-(x + 3)(x - 5)$ or **M1** for $k(x + 3)(x - 5)$ **M2** for $0 = -(-3)^2 - 3b + c$ and $0 = -5^2 + 5b + c$ or **M1** for $y = -x^2 + bx + c$ or for $0 = (-3)^2 - 3b + c$ and $0 = 5^2 + 5b + c$ For full marks, all shown parts of their expansion must be correct Accept k implied as 1 **<u>Exemplar Responses</u>** $(x + 3)(x - 5) = x^2 - 2x - 15$. This line on its own scores M1 But the quadratic is upside down so it will be $-x^2 + 2x + 15$ [there then was an arrow from the +15 to the intercept] The response doesn’t quite fit the scheme but is thought worthy of full marks. But this line makes it equivalent to the M2 and it also a correct expansion with + 15 The linking of +15 to the intercept is an added bonus **<u>Examiner’s Comments</u>** Very few candidates were able to answer this question correctly as they did not recognise the graph as a negative

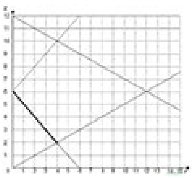
					quadratic. Those who realised that the roots came from the factors $(x + 3)(x - 5)$ gained some credit, but far fewer coped correctly with the fact that the graph was 'upside-down' and knew that this meant the coefficient of x^2 was negative. Very occasionally, candidates started from this perspective and used the known roots with $y = -x^2 + bx + c$ to set up and solve simultaneous equations. Many candidates mistakenly used $(x - 3)(x + 5)$. Those using $(x + 3)(x - 5)$ often identified their intercept as $^-15$. Similarly, just $^-3 \times 5$ was very common. Work involving $y = mx + c$, sometimes involving tangents, or for completing the square to find the turning point, were often seen. **Misconception** A common misconception was that an "intercept" must be associated with a straight line.
	b		The equation could be a multiple E.g. [y=]$-k(x + 3)(x - 5)$ So the intercept could be a multiple of 15	2	**B1** for Giving an example in the form $-k(x + 3)(x - 5)$ (where k>0, k≠1, k need not be an integer) or stating that the intercept could be a multiple of 15 Allow full or part marks for a fully correct algebraic example E.g. [y=]$-2(x + 3)(x - 5)$ would have a y-intercept of 30 **<u>Examiner's Comments</u>** While only a few candidates could explain a 'multiplier' approach in words or symbols, some candidates did realise that the same roots could be obtained with a different negative x^2 term. These candidates often started with an example in factorised form such as $^-2(x + 3)(x - 5)$,

					which they expanded and then highlighted that the intercept was no longer 15.
			Total	**5**	
84			E.g. Correct inequalities shown on diagram, correct region R identified and correct area calculation ½ × 6 × 4 [= 12] 	6	**B1** for line $y = 5$ **B1** for line $x + y = 13$ AND **B1** for correct side of $y = 2x + 1$ **B1** for correct side of $y = 5$ **B1** for correct side of $x + y = 13$ AND **M1dep** for ½ × 6 × 4 [= 12] oe Condone good freehand lines, which can be dashed or solid. Lines need only be one square long for line mark but they must be fit for purpose to define their region Mark the region which is labelled, but if no labelling mark the single region which is shaded (or unshaded) or implied by area calculation of correct region R Use diagram for these three marks If extra lines, mark those bounding R. If no R, mark poorest two Dep on region R being correct Accept counting squares but check areas bounding $y = 2x + 1$ Accept split into two triangles 4 and 8 oe **<u>Examiner's Comments</u>** Many candidates drew the correct line for $y = 5$, with only a few instances of $y = 4$, $y = 6$ or $x = 5$ being seen. Candidates had greater difficulty in drawing $x + y = 13$ and the line was often either omitted or else interpreted as meaning the two lines $x = 13$ and $y = 13$.

					Candidates who drew the correct lines often proceeded to identify the correct region for R. Although it should have been straightforward to then find the area of the triangle through ½ × base × height, some candidates attempted $\frac{1}{2}ab\sin C$, often measuring *a*, *b* and *C* and then fudging the values to obtain an answer of 12 cm^2. Such attempts scored 0 marks for the area unless absolutely accurate. Candidates who did not draw $x + y = 13$ correctly sometimes added the line $y = 9$, therefore creating a trapezium of area 12 cm^2 for an incorrect region R bounded by $y = 5$, $y = 9$, $y = 2x + 1$ and the *y*-axis. This is an example that scored 2 marks, because $y = 5$ was correct and their region R was the correct side of $y = 5$ but not the correct side of $y = 2x + 1$.
			Total	**6**	
85	a		$([–]12)^2 + 5^2$ $144 + 25 = 169$ or $\sqrt{144+25} = 13$ and $\sqrt{169} = 13$	1 1	Accept equivalent reasoning e.g. For first mark $13^2 – ([–]12)^2$ e.g. For second mark $169 – 144 = 25$ $\sqrt{25} = 5$ If $–12^2 + 5^2$ do not allow first mark If $\sqrt{169}$ evaluated then it must be 13 For 2 marks there must be no errors leading to the answer **<u>Examiner's Comments</u>** Although a number of candidates omitted this part, many that attempted it were able to earn at least partial credit. As this is a 'show that' question, candidates must communicate correctly and make no errors in their mathematics for full credit. Many used substitution of –12 and 5 into the circle formula but most wrote $–12^2 + 5^2$ instead of $(–12)^2 + 5^2$ before giving 144 + 25. In these cases 1 of the 2 marks was awarded only.
	b		$y = \frac{12}{5}x + \frac{169}{5}$ final answer	5	

					B4 for answer $\frac{12}{5}x + \frac{169}{5}$ oe (no y =) or correct 3 – term answer in different form e.g. $5y - 12x = 169$ OR	Accept e.g. $y = 2.4x + 33.8$ $\frac{12}{5}$ oe implies M1M1 unless contradicted	
					M1 for $-\frac{5}{12}$ oe	**Dep on at least M1** oe e.g. $5 = their\ \frac{12}{5} \times -12 + c$	
					and **M1** [tangent gradient =] $-1 \div their\ -\frac{5}{12}$ oe	Do not allow M1 for e.g. grad – $-\frac{5}{12}$ used if the gradient is then changed subsequently to e.g. $\frac{12}{5}$	
					AND **M1 dep** for $y - 5 = their\ \frac{12}{5}(x - (-12))$ oe	**Dep on at least M1** Allow 'c' or any value including 0	
					M1 dep for $y = their\ \frac{12}{5}x + c$	Answer $y = \frac{12}{5}x\ [+ c]$ oe implies M1M1M1	
					Examiner's Comments This part of the final question was designed to stretch candidates. There were a small number of excellent answers to this part where candidates worked methodically, first of all finding the gradient of the radius from (0, 0) to (–12, 5) before showing a clear understanding that the gradient of the tangent is perpendicular to the radius. These candidates then correctly substituted the point (–12, 5) into the equation with gradient $\frac{12}{5}$ to find the constant value before giving the final answer in the required form. A few made errors in the arithmetic when finding the constant after the substitution. Other candidates were able to earn part credit for showing some understanding of gradients, perpendiculars and substitution within their method. For these candidates		

					the main errors were with incorrect signs in gradients. For most candidates this question proved very challenging, however, and there were many ‘no response’ as well as some candidates who did not consider gradients at all within their method.
			Total	**7**	
86			0	1	**Examiner’s Comments** Some candidates recognised there is no change in speed during the time period specified. Some calculated the difference between the initial and final speed and divided by time correctly, while others deduced the correct answer from the horizontal gradient. Many did not understand acceleration as change in speed over time. Common errors were to give an answer of 4 or attempt an area calculation.
			Total	**1**	
87			$y=-\frac{x}{4}+3$ oe simplified form	4	**B3** for correct equation not in required form OR **B1** for gradient of perp line = ⁻½ oe soi **M1** for *y* – 1 = *their* grad × (*x* – 8) or 1 = *their grad* × 8 + *c* **M1** for correct simplification to *y* = *mx* + *c* form of *their* *y* – 1 = *their* grad × (*x* – 8) or using *their c* = 1 – *their* grad × 8 *their* grad may be 4 ie they are finding the equation of the parallel line. Max **M1** if *their* grad is ‘m’
			Total	**4**	
88			$x^2 + y^2 = 123$ final answer	4	**B2** for 123 or **B1** for 98 or **M1** for 5^2 + $5^2+(7\sqrt{2})^2$ **oeB1** for x^2 Accept ‘= *k*’ or numeric value where *k* > 0

					+ $y^2 = k$ as final answer	
			Total	**4**		
89	a		C	1		
	b		D	1		
			Total	**2**		
90	a	i	tan x	1		
		ii	3^x	1		
	b	i	Graph of $y = {}^{-}x^3$	1		Mark intent
		ii	$y = x^3$ translated vertically 8 down y-intercept $^{-}8$ x-intercept 2	1 1 1		Intercepts must be marked on graph and accept given as coordinates
			Total	**6**		
91	a		≥ ≤ ≤	2	**B1** for two correct or "> < <"	i.e correct but no equals
	b		$x + y \geq 6$ or $y \geq 6 - x$ oe	3	**B1** for the correct straight line drawn  **B1** for correct equation for *their* line e.g. $x + y = 6$ oe	implied by e.g. $x + y = 6$ oe and accept a ruled or good freehand line bold line shows minimum length implied by e.g. answer of $x + y \leq 6$ oe
			Total	**5**		
92	a		– 3	1		
	b		Correct graph	3	Curves must not be joined or touch either axis	Mark in 50% zoom, use overlay, mark curve first For 3 marks, curve

					B2FT for 7 or 8 correct plots Or **B1FT** for 5 or 6 correct plots must pass through or touch circles on overlay Condone slight feathering, no ruled segments If curve incorrect, mark the plots use the overlay, plots must lie inside or touch circles. If large blob for plot, check centre of blob **<u>Examiner's Comments</u>** Many candidates either did not join the plotted points or joined them with ruled lines. A few joined the two branches of the graph together demonstrating an unfamiliarity with the shape of this graph function.
			Total	**4**	
93			−3, 8	4	**B1** for $(x + 3)^2$ or $-6 \div 2$ **B2FT** for +8, correct or ft *their* $(x + 3)^2$ or **M1** for (*their* −3)^2 + 6 × (*their* −3) + 17 **B1FT** for $(-a, b)$ **FT** *their*$\{(x + a)^2 + b\}$ to a maximum of **3** marks If no working **B2** for either ordinate correct accept any correct method(see appendix) **B3** implied by $(x + 3)^2 + 8$
			Total	**4**	