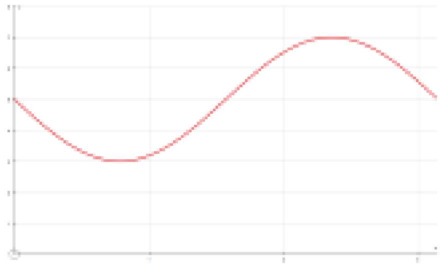
1	$(y) = 8(4x+1)^{\frac{1}{2}}$ ÷ ½ ÷ 4 (+*c*) Uses $x = 2$ and $y = 5$ $c = -7$	**B1** **B1** **M1** **A1**	[4]	Correct integrand (unsimplified) without ÷4 ÷4. Ignore *c*. Substitution of correct values into an integrand to find c. $y = 4\sqrt{4x+1} - 7$
2 (i)	2sin2*x* = 6cos2*x* tan2*x* = *k* → tan2*x* = 3 or *k* =3	 **M1** **A1**	[2]	 Expand and collect as far as tan2*x* = a constant from sin ÷ cos soi cwo
(ii)	$x = (\tan^{-1}(\textit{their } k)) \div 2$ (71.6° or −108.4°) ÷2 *x* = 35.8°, −54.2° *x* = 0.624^c, – 0.946^c *x* = 0.198π^c, – 0.301π^c	**M1** **A1 A1**√	[3]	Inverse then ÷2. soi. √ on 1st answer +/ − 90° if in given range but no extra solutions in the given range. Both SR A1A0
3 (i)	$2x^2 - 6x + 5 > 13$ $2x^2 - 6x - 8 (> 0)$ (*x* =) −1 and 4. $x > 4$, $x < -1$	 **M1** **A1** **A1**	[3]	 Sets to 0 + attempts to solve Both values required Allow all recognisable notation.
(ii)	$2x^2 - 6x + 5 = 2x + k$ → $2x^2 - 8x + 5 - k (= 0)$ Use of $b^2 - 4ac$ → −3 **OR** $\frac{dy}{dx} = 4x - 6$ $4x - 6 = 2$ $x = 2$ $x = 2 \rightarrow y = 1$ Using *their* (2,1) in $y = 2x + k$ or $y = 2x^2 - 6x + 5$ $\rightarrow k = -3$	 **M1*** **DM1** **A1** **M1*** **DM1** **A1**	[3] [3]	 Equates and sets to 0. Use of discriminant Sets (their $\frac{dy}{dx}$) = 2 Uses *their* *x* = 2 and *their* *y* = 1

4	Term in $x = \frac{nx}{2}$	B1		Could be implied by use of a numerical *n*.
	$(3-2x)(1+\frac{nx}{2}+\ldots) \rightarrow 7 = \frac{3n}{2} - 2$	M1		(Their 2 terms in *x*) = 7
	$\rightarrow n = 6$	A1		
	Term in $x^2 = \frac{n(n-1)}{2}\left(\frac{x}{2}\right)^2$	B1		May be implied by (their *n*) × (their *n-1*) ÷ 8.
	Coefficient of $x^2 = \frac{3n(n-1)}{8} - \frac{2n}{2}$	M1		Considers 2 terms in x^2.
	$= \frac{21}{4}$	A1	[6]	aef
5	$A(a, 0)$ and $B(0, b)$	B1		soi
	$a^2 + b^2 = 100$	M1*		Uses Pythagoras with their *A* & *B*.
	M has coordinates $\left(\frac{a}{2}, \frac{b}{2}\right)$	B1√		√ on their *A* and *B*.
	M lies on $2x + y = 10$ $\rightarrow a + \frac{b}{2} = 10$	M1*		Subs into given line, using their M, to link *a* and *b*.
	Sub $\rightarrow a^2 + (20-2a)^2 = 100$ or $\left(10 - \frac{b}{2}\right)^2 + b^2 = 100$	DM1		Forms quadratic in *a* or in *b*.
	$\rightarrow a = 6, b = 8.$	A1	[6]	cao

6 (i)	$\frac{r}{10} = \sin 0.6$ or $\frac{r}{10} = \cos 0.97$ or $BD = \sqrt{200 - 200\cos 1.2}\left(= 11.3\right)$ $r = 10 \times 0.5646$, $r = 10 \times \sin 0.6$, $r = 10 \times \cos 0.971$ or $r = ½\, BD$ $\rightarrow\ r = 5.646$ AG	M1 A1	 [2]	Or other valid alternative.
(ii)	Major arc $= 10(\theta)$ $(= 50.832)$ $\theta = 2\pi - 1.2$ $(= 5.083)$ or $C = 2\pi \times 10$, Minor arc $= 1.2 \times 10$ Semicircle $= 5.646\pi$ $(= 17.737)$ Major arc + semicircle $= 68.6$	M1 B1 A1	 [3]	$\theta = 2\pi - 1.2$ or $\pi - 1.2$ Implied by 5.1
(iii)	Area of major sector $= ½10^2\left(\theta\right)$ $(= 254.159)$ Area of triangle *OBD* $= ½10^2\sin 1.2$ $(= 46.602)$ Area = semicircle + sector + triangle $(= 50.1 + 254.2 + 46.6)$ $= 351$	 M1 M1 A1	 [3]	 $\theta = 2\pi - 1.2$ or $\pi - 1.2$ Use of $½ab\sin C$ or other complete method
7 (i)	$\frac{dy}{dx} = \frac{-3}{\left(2x - 1\right)^2} \times 2$	B1 B1	 [2]	B1for a single correct term (unsimplified) without ×2.
(ii)	e.g. Solve for $\frac{dy}{dx} = 0$ is impossible.	B1√	[1]	Satisfactory explanation.
(iii)	If $x = 2$, $\frac{dy}{dx} = \frac{-6}{9}$ and $y = 3$ Perpendicular has $m = \frac{9}{6}$ $\rightarrow\ y - 3 = \frac{3}{2}\left(x - 2\right)$ Shows when x=0 then y=0 AG	M1* M1* DM1 A1	 [4]	Attempt at both needed. Use of $m_1 m_2 = -1$ numerically. Line equation using (2, their 3) and their *m*.
(iv)	$\frac{dx}{dt} = -0.06$ $\frac{dy}{dt} = \frac{dy}{dx} \times \frac{dx}{dt}\ \rightarrow\ -\frac{2}{3} \times -0.06 = 0.04$	 M1 A1	 [2]	

8 (a) (i)	$200+(15-1)(+/-5)$ $= 130$	**M1** **A1**	[2]	Use of *n*th term with $a = 200$, $n = 14$ or 15and $d = +/- 5$.
(ii)	$\frac{n}{2}\left[400+(n-1)(+/-5)\right] = (3050)$ $\rightarrow\ 5n^2-405n+6100\ (=0)$ $\rightarrow\ 20$	**M1** **A1** **A1**	[3]	Use of S_n a=200 and $d = +/- 5$.
(b) (i)	ar^2, ar^5 $\rightarrow$ $r = ½$ $\frac{63}{2}=\frac{a\left(1-½^6\right)}{½}$ $\rightarrow$ $a = 16$	**M1 A1** **M1 A1**	[4]	Both terms correct. Use of $S_n = 31.5$ with a numeric r.
(ii)	Sum to infinity = $\frac{16}{½}$ = 32	**B1**√	[1]	√ for their a and r with $\lvert r\rvert < 1$.
9 (i)	$-4-6-6=-16$ $\sqrt{x_1^2+y_1^2+z_1^2}$ or $\sqrt{x_2^2+y_2^2+z_2^2}$ $3 \times 7 \times \cos\theta = -16$ $\rightarrow\ \theta = 139.6^{\circ}$ or 2.44^{c} or 0.776π	**M1** **M1** **M1** **A1**	[4]	Use of $x_1x_2 + y_1y_2 + z_1z_2$ on their $\overrightarrow{OA}$ & $\overrightarrow{OB}$ Modulus once on either their $\overrightarrow{OA}$ *or* $\overrightarrow{OB}$ All linked using their $\overrightarrow{OA}$ & $\overrightarrow{OB}$
(ii)	$\overrightarrow{AC} =$ c – a = $\begin{pmatrix}0\\8\\6\end{pmatrix}$ Magnitude = 10 Scaling $\rightarrow$ $\frac{15}{their10} \times \begin{pmatrix}0\\8\\6\end{pmatrix} = \begin{pmatrix}0\\12\\9\end{pmatrix}$	**B1** **M1** **A1**	[3]	For 15 × *their* unit vector.
(iii)	$\begin{pmatrix}2+2p\\6-2p\\5-p\end{pmatrix}$ $\rightarrow -2(2+2p) + 3(6-2p) + 6(5-p) = 0$ $\rightarrow\ p = 2¾$	**B1** **M1** **A1**	[3]	Single vector soi by scalar product. Dot product of ($p\,\overrightarrow{OA} + \overrightarrow{OC}$) and $\overrightarrow{OB} = 0$.

10 (i)	$3 \leqslant f(x) \leqslant 7$	**B1** **B1**	[2]	Identifying both 3 and 7 or correctly stating one inequality. Completely correct statement. **NB** $3 \leqslant x \leqslant 7$ scores B1B0
(ii)		**B1*** **DB1**	[2]	One complete oscillation of a sinusoidal curve between 0 and π. All correct, initially going downwards, all above $f(x)=0$
(iii)	$5\text{-}2\sin 2x = 6 \rightarrow \sin 2x = -½$ $\rightarrow 2x = \frac{7\pi}{6}$ or $\frac{11\pi}{6}$ $\rightarrow x = \frac{7\pi}{12}$ or $\frac{11\pi}{12}$ 0.583π or 0.917π $\frac{\pi + 0.524}{2}$ or $\frac{2\pi - 0.524}{2}$ 1.83^c or 2.88^c	**M1** **A1 A1**√	[3]	Make $\sin 2x$ the subject. √ for $\frac{3\pi}{2}$ – 1st answer from $\sin 2x = -½$ only, if in given range SR A1A0 for both.
(iv)	$k = \frac{\pi}{4}$	**B1**	[1]	
(v)	$2\sin 2x = 5 - y \rightarrow \sin 2x = ½(5 - y)$ $(g^{-1}(x)) = ½ \sin^{-1} \frac{(5 - x)}{2}$	**M1** **M1** **A1**	[3]	Makes ±sin2x the subject soi by final answer. Correct order of operations including correctly dealing with " – ". Must be a function of x