1 $a = 1, \quad b = 2$	**B1B1** **[2]**	Or $1 + 2\sin x$
2 (i) $(2x-3)^2 - 9$	**B1B1** **[2]**	For −3 and −9
(ii) $2x-3>4 \quad 2x-3<-4$ $x>3\frac{1}{2}$ (or) $x<-\frac{1}{2}$ cao Allow $-\frac{1}{2}>x>3\frac{1}{2}$	**M1** **A1**	At least one of these statements Allow 'and' $3\frac{1}{2}$, $-\frac{1}{2}$ soi scores first M1
OR $4x^2 - 12x - 7 \rightarrow (2x-7)(2x+1)$ $x>3\frac{1}{2}$ (or) $<-\frac{1}{2}$ cao Allow $-\frac{1}{2}>x>3\frac{1}{2}$	**M1** **A1** **[2]**	Attempt to solve 3-term quadratic Allow 'and' $3\frac{1}{2}$, $-\frac{1}{2}$ soi scores first M1
3 $[{}^8C_6 \text{ or } 28]\times[16 \text{ or } 4^2](x^6)\times\left[\frac{1}{(64\text{or } 2^6)(x^6)}\right]$ 7	**B1B1B1** **B1** **[4]**	Seen in expansion ok. Allow ${}^8C_2$ Identified as answer
4 $\frac{dy}{dx} = [-2\times4(3x+1)^{-3}]\times[3]$ When $x=-1$, $\frac{dy}{dx}=3$ When $x=-1$, $y=1$ soi $y-1 = 3(x+1)$ $(\rightarrow y = 3x+4)$	**B1B1** **B1** **B1** **B1**√ **[5]**	$[-2\times4u^{-3}]\times[3]$ is B0B1 unless resolved Ft on *their* '3' only (not $-\frac{1}{3}$). Dep on diffn
5 (i) $200/2(2a+199d) = 4\times100/2(2a+99d)$ $d = 2a$ cao	**M1A1** **A1** **[3]**	Correct formula used (once) M1, correct eqn A1
(ii) $a+99d = a+99\times2a$ $199a$ cao	**M1** **A1** **[2]**	Sub. *their* part(i) into correct formula
6 (i) area $\Delta = \frac{1}{2}\times4\times4\tan\alpha$ oe soi Area sector $=\frac{1}{2}\times2^2\alpha$ oe soi Shaded area $= 8\tan\alpha - 2\alpha$ cao	**B1** **B1** **B1** **[3]**	$4\tan\alpha = \sqrt{16/\cos^2\alpha - 16}$. (Can also score in answer) Accept θ throughout Little/no working – accept terms in answer
(ii) $DC = \frac{4}{\cos\alpha} - 2$ oe soi Arc $DE = 2\alpha$ soi anywhere provided clear Perimeter $= \frac{4}{\cos\alpha} + 4\tan\alpha + 2\alpha$ cao	**B1** **B1** **B1** **[3]**	 $\frac{4}{\cos\alpha} = \sqrt{16+16\tan^2\alpha}$. Can score in answer Little/no working – accept terms in answer

7 $(a-3)^2+(2-b)^2=125$ oe $\frac{2-b}{a-3}=2$ oe $(a-3)^2+(2a-6)^2=125$ (sub for a or b) $(5)(a+2)(a-8)$ $(=0)$ Attempt factorise/solve $a=-2$ or 8, $b=12$ or -8	**B1** **B1** **M1** **M1** **A1A1** **[6]**	 Or $1/4(2-b)^2+(2-b)^2=125$ Or $(5)(b-12)(b+8)$ $(=0)$ Answers (no working) after 2 correct eqns score SCB1B1 for each correct pair (a, b)
8 (i) $\boldsymbol{OA.OB}=-3p^2-4+p^4$ soi $(p^2+1)(p^2-4)=0$ oe e.g. with substitution $p=\pm2$ and no other real solutions	**M1** **M1** **A1** **[3]**	 Put = 0 (soi) and attempt to solve
(ii) $\overrightarrow{BA}=\begin{pmatrix}9\\4\\9\end{pmatrix}-\begin{pmatrix}-3\\-1\\9\end{pmatrix}=\begin{pmatrix}12\\5\\0\end{pmatrix}$ $\lvert\overrightarrow{BA}\rvert=\sqrt{12^2+5^2}=13$ and division by *their* 13 Unit vector $=\frac{1}{13}\begin{pmatrix}12\\5\\0\end{pmatrix}$ cao	**M1** **M1** **A1** **[3]**	Reversed subtraction can score M1M1A0
9 (i) LHS $\equiv\frac{\sin^2\theta-(1-\cos\theta)}{(1-\cos\theta)\sin\theta}$ cao $\equiv\frac{1-\cos^2\theta-1+\cos\theta}{(1-\cos\theta)\sin\theta}$ $\equiv\frac{\cos\theta(1-\cos\theta)}{(1-\cos\theta)\sin\theta}$ $\equiv\frac{1}{\tan\theta}$	**B1** **M1** **M1** **A1** **[4]**	Put over common denominator Use $s^2=1-c^2$ oe Correct factorisation from line 2 **AG**
(ii) $\tan\theta=(\pm)\frac{1}{2}$ 26.6°, 153.4°	**M1** **A1A1**$\sqrt{}$ **[3]**	 Ft for 180 – 1st answer

10 **(i)** $-5 \leqslant f(x) \leqslant 4$ For f(x) allow x or y; allow $<$, [–5, 4], (–5,4)	**B1** **[1]**	Allow less explicit answers (eg $-5 \to 4$)
(ii) $f^{-1}(x)$ approximately correct (independent of f)	**B1**	
Closed region between (1, 1) and (4, 4); line reaches x-axis	**DB1** **[2]**	Ignore line $y = x$
(iii) LINE: $f^{-1}(x) = \frac{1}{3}(x+2)$	**B1**	Allow $y =$ ..... but must be a function of x
for $-5 \leqslant x \leqslant 1$	**B1B1**	cao but allow $<$
CURVE: $5 - y = \frac{4}{x}$ OR $x = 5 - \frac{4}{y}$	**M1**	
$f^{-1}(x) = 5 - \frac{4}{x}$ oe	**A1**	cao
for $1 < x \leqslant 4$	**B1** **[6]**	cao but allow $<$ or $<$
11 **(i)** $x^2 + 4x + c - 8$ (= 0)	**M1**	Attempt to simplify to 3-term quadratic
$16 - 4(c - 8) = 0$	**M1**	Apply $b^2 - 4ac = 0$. '= 0' soi
$c = 12$	**A1**	
OR		
$-2 - 2x = 2 \to x = (-2)$	**M1**	Equate derivs of curve and line. Expect $x=-2$
$-4 + c = 8 + 4 - 4$	**M1**	Sub *their* $x = -2$ into line and curve, and equate
$c = 12$	**A1** **[3]**	
(ii) $x^2 + 4x + 3 \to (x + 1)(x + 3)$ (= 0) $\to$ $x = -1$ or -3	**B1**	
$\int(8 - 2x - x^2) - [\int(2x + 11)$ or area of trapezium$]$	**M1M1**	Attempt to integrate. At some stage subtract
$\left[8x - x^2 - \frac{x^3}{3}\right] - \left[x^2 + 11x\right]$ or $\left[8x - x^2 - \frac{x^3}{3}\right] - \frac{1}{2}(5+9) \times 2$	**A1B1**	A1 for curve, B1 for line **OR** $\left[-3x - 2x^2 - \frac{x^3}{3}\right]$ A2,1,0
Apply *their* limits to at least integral for curve	**M1**	For M marks allow reversed limits and/or subtraction of areas but then final A0
$1\frac{1}{3}$ oe	**A1** **[7]**	

12 **(i)** $y=\frac{2}{3}x^{\frac{3}{2}}-2x^{\frac{1}{2}}+(c)$ oe	**B1B1**	Attempt to integrate
$\frac{2}{3}=\frac{16}{3}-4+c$	**M1**	Sub $\left(4,\frac{2}{3}\right)$. Dependent on c present
$c=-\frac{2}{3}$	**A1** **[4]**	
(ii) $\frac{1}{2}x^{-\frac{1}{2}}+\frac{1}{2}x^{-\frac{3}{2}}$ oe	**B1B1** **[2]**	
(iii) $x^{\frac{1}{2}}-x^{-\frac{1}{2}}=0\rightarrow\frac{x-1}{\sqrt{x}}=0$	**M1**	Equate to zero and attempt to solve
$x=1$	**A1**	
When $x=1$, $y=\frac{2}{3}-2-\frac{2}{3}=-2$	**M1A1**	Sub. *their* '1' into *their* 'y'
When $x=1$, $\frac{d^2y}{dx^2}(=1)>0$ Hence minimum	**B1** **[5]**	Everything correct on final line. Also dep on correct (ii). Accept other valid methods