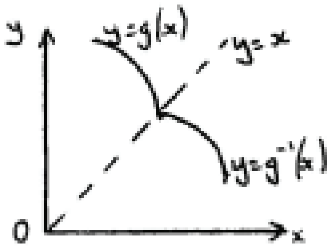
1 $\tan^2\theta - \sin^2\theta = \tan^2\theta\sin^2\theta$		
(i) $\frac{s^2}{c^2} - s^2$		
$\rightarrow \frac{s^2 - s^2c^2}{c^2} = \frac{s^2(1-c^2)}{c^2}$	M1	Use of $s \div c = t$
	M1	Use of $s^2 + c^2 = 1$
$\rightarrow t^2s^2$	A1	All ok
	[3]	
(ii) RHS > 0 $\rightarrow \tan^2\theta > \sin^2\theta$ QED $\tan\theta > \sin\theta$ if θ acute.	B1	Realises RHS > 0
	[1]	
2 $\overrightarrow{OA} = \begin{pmatrix} 2 \\ -1 \\ 4 \end{pmatrix}$, $\overrightarrow{OB} = \begin{pmatrix} 4 \\ 2 \\ -2 \end{pmatrix}$, $\overrightarrow{OC} = \begin{pmatrix} 1 \\ 3 \\ p \end{pmatrix}$.		
(i) $\overrightarrow{AB} = \begin{pmatrix} 2 \\ 3 \\ -6 \end{pmatrix}$ Modulus = $\sqrt{(4+9+36)}$	B1 M1	co. Correct method for modulus
Unit Vector = $\frac{1}{7}\begin{pmatrix} 2 \\ 3 \\ -6 \end{pmatrix}$	A1√	co for his vector **AB**.
	[3]	
(ii) $\overrightarrow{OB}.\overrightarrow{OC} = 4 + 6 - 2p$ $= 0 \rightarrow p = 5$	M1A1	Dot product = 0. co
	[2]	
3 $(1-2x)^2(1+ax)^6$		
Coeff of x in $(1+ax)^6 = 6ax$	B1	6C1 needs removing (here or later)
Coeff of x^2 in $(1+ax)^6 = 15a^2x^2$	B1	6C2 needs removing (here or later)
Multiplies by $(1 - 4x + 4x^2)$	M1	Needs to consider 2 terms in equation
2 terms in x $6a - 4 = -1$ $\rightarrow a = ½$	A1	Co
3 terms in x^2 $15a^2 - 24a + 4 = b$	M1	Needs to consider 3 terms in equation
$\rightarrow b = -4¼$	A1	
	[6]	
4 $\sin 2x + 3\cos 2x = 0$		
(i) $\rightarrow \tan 2x = -3$	M1	Uses $\tan 2x = k$ and works with "$2x$".
$2x = 180 - 71.6$ or $360 - 71.6$	M1	Finds "$2x$" before ÷ 2
$x = 54.2°$ or $144.2°$	A1A1√	co. co√ (both of these need 2nd M)
Also 234.2° and 324.2°	A1√	for 180° + his answer(s)
	[5]	
(ii) 12 answers.	B1√	for 3 times the number of solns to (i).
	[1]	

5 $x = \frac{8}{y^2} - 2$; at $x = 0, y = 2$	B1	co
$\rightarrow x^2 = \frac{64}{y^4} - \frac{32}{y^2} + 4$		
Integral of $x^2 = \frac{64y^{-3}}{-3} - \frac{32y^{-1}}{-1} + 4y$	B1B1B1	All co.
Uses limits 1 to 2	M1	Uses 1 to 2 or 2 to 1.
$\rightarrow 6\frac{2}{3}\pi$	A1 [6]	co.
6 **(i)** Uses S_n		
$\frac{9}{2}(24 + 8d) = 135 \rightarrow d = \frac{3}{4}$	M1 A1 [2]	Uses correct formula co
(ii) 9^{th} term of AP = $12 + 8\times\frac{3}{4} = 18$	B1√	√ on "d"
GP 1^{st} tern 12, 2^{nd} term 18		
Common ratio = $r = 18 \div 12 = 1\frac{1}{2}$	M1	Uses "ar"
3^{rd} term of GP = $ar^2 = 27$	M1	Uses ar^2 or "ar" × r
nth term of AP is $12 + (n - 1)\frac{3}{4}$		
$12 + (n - 1)\frac{3}{4} = 27 \rightarrow n = 21$	M1A1 [5]	Links AP with GP. co
7 $y = \frac{10}{2x+1} - 2$		
(i) $\frac{dy}{dx} = \frac{-10}{(2x+1)^2} \times 2$	B1 B1	Without the "×2". For the "×2".
At A, $y = 0$, $\rightarrow x = 2$		
m at $x = 2$, is $-\frac{4}{5}$	B1	For $x = 2$
Eqn of tangent is $y = -\frac{4}{5}(x - 2)$	M1	Must be using differential as m
$\rightarrow 5y + 4x = 8$	A1 [5]	co – answer given.
(ii) C (0, 1.6)		
$d = \sqrt{(1.6^2 + 2^2)} = 2.56$	M1 A1 [2]	Correct method – needs √. co
8 **(i)** $OBX = 90°$, $\cos\theta = \frac{r}{2r}$	M1	Needs 90° + cos (or Pyth + sin or tan)
$\rightarrow \theta = \frac{1}{3}\pi$.	A1 [2]	co ag
(ii) Arc length $AB = \frac{1}{3}r\pi$	B1	r + sum of other two
$BX = r\tan(\frac{1}{3}\pi) = r\sqrt{3}$	B1	
$P = r + (\frac{1}{3}r\pi + r\sqrt{3})$	B1 [3]	
(iii) Area = $\frac{1}{2}r^2\sqrt{3} - \frac{1}{6}r^2\pi$	B1√ B1 [2]	√ on tan($\frac{1}{3}\pi$). co

9 $\frac{d^2y}{dx^2} = -4x$		
(i) $\frac{dy}{dx} = -2x^2 + c$	B1	For $-2x^2$
$\frac{dy}{dx} = 0$ when $x = 2$, $\rightarrow$ $c = 8$	B1	$c = 8$
$y = -\frac{2x^3}{3} + 8x$ $(+C)$	B1 B1√	For each term – √ on "c"– ignore $(+C)$
Subs (2, 12) $\rightarrow$ $C = \frac{4}{3}$	M1 A1 [6]	Uses (2, 12) to find C.
(iii) $\frac{dy}{dt} = \frac{dy}{dx} \times \frac{dx}{dt}$	M1	
$= -10 \times 0.05$ $\rightarrow$ decreasing at 0.5 units per second	A1 [2]	Must use. Enough to see product of gradient and rate. bod over notation.
10 $2y + x = k$ $xy = 6$		
(i) $2y + x = 8$ $\rightarrow$ $y(8 - 2y) = 6$	M1	Complete elimination of x (or y)
$2y^2 - 8y + 6 = 0$ or $x^2 - 8x + 12 = 0$ $\rightarrow$(6, 1) and (2, 3)	DM1A1	DM1 soln of quadratic. co
Midpoint M (4, 2)	M1	for their 2 points
$m = -\frac{1}{2}$ Perpendicular $m = 2$	M1	Uses $m_1m_2 = -1$ to find perp. gradient
$\rightarrow$ $y - 2 = 2(x - 4)$	A1 [6]	co unsimplified
(ii) $(k - 2y)y = 6$		
$\rightarrow$ $2y^2 - ky + 6 = 0$ or $x^2 - kx + 12 = 0$		
Uses $b^2 - 4ac$ (0)	M1	Any use of $b^2 - 4ac$ on a quadratic = 0
$\rightarrow$ $k^2 > 48$	A1	For √48 on its own
$\rightarrow$ $k < -\sqrt{48}$ and $k > \sqrt{48}$	A1 [3]	All correct.

11 $f(x) = 8 - (x-2)^2$,		
(i) Stationary point at $x = 2$ y – coordinate = 8 Nature Maximum (or y $y = -x^2 + 4x + 4$ $-2x + 4 = 0 \rightarrow (2, 8)$ Max)	B1 B1 B1 [3]	co co co independent of first two marks
(ii) $k = 2$	B1√ [1]	√ on "x-value"
(iii) $y = 8 - (x-2)^2$ $\rightarrow (x-2)^2 + y = 8$ $\rightarrow (x-2) = \pm\sqrt{8-y}$ $\rightarrow g^{-1} = 2 + \sqrt{8-x}$	 M1 M1 A1 [3]	 Attempt to make x the subject Order of operations correct Must be f(x).
(iv) 	B1 B1 B1 [3]	B1 arc 1st quad (no tp, no axes) B1 Evidence of symmetry about $y = x$ B1 all correct as shown left