1	**(i)** $3(2\sin x - \cos x) = 2(\sin x - 3\cos x)$ $\rightarrow\ 6s - 3c = 2s - 6c\ \rightarrow\ 4s = -3c$ $\rightarrow\ \tan x = -\frac{3}{4}$	M1 A1 [2]	Expanding, collecting, use of $t = s \div c$ Answer given. All correct.
	(ii) $x = 180 - 36.9 = 143.1°$ or $x = 360 - 36.9 = 323.1°$	B1 B1√ [2]	co For 180 + first answer.
2	$y = \frac{a}{x}$ Volume $= \pi\int\left(\frac{a^2}{x^2}\right)\mathrm{d}x = (\pi)\left[\frac{-a^2}{x}\right]$	M1 B1	For using correct formula with π. For correct integration of x^{-2} only
	Use of limits 1 to 3 $\rightarrow\ \frac{2\pi a^2}{3}$	M1	Must be using y^2 or πy^2.
	Equates to $24\pi\ \rightarrow\ a = 6$	A1 [4]	Co, allow ±6.
3	f : $x \mapsto 4x - 2x^2$, g : $x \mapsto 5x + 3$.		
	(i) Turning point at $x = 1$. Range is $\leqslant 2$.	M1 A1 [2]	Calculus or completing the square etc. Condone < instead of $\leqslant$.
	(ii) $\mathrm{gf}(x) = 5(4x - 2x^2) + 3$ $= k$ and use of $b^2 - 4ac$ $\rightarrow\ k = 13$	B1 M1 A1 [3]	For putting f into g. Setting to k, using $b^2 - 4ac$ co
4	Gradient of L_1 is $\frac{1}{3}$.		
	Equation of L_1 is $y - 3 = \frac{1}{3}(x + 1)$	M1 A1	M1 for equation for his m. A1 co.
	Gradient of AB is $-\frac{1}{2}$. Perp = 2.	M1	Use of $m_1 m_2 = -1$
	Equation of L_2 is $y - 1 = 2(x - 3)$.	A1	co
	Sim eqns $3y = x + 10$, $y = 2x - 5$. $\rightarrow$ (5, 5)	M1 A1 [6]	Method of solution co

5	**(i)** $-8+3+p=0$ $\rightarrow p=5.$	M1 A1 [2]	Must be scalar. co.
	(ii) Vector $\overrightarrow{AB}=\mathbf{b}-\mathbf{a}$ $=6\mathbf{i}-2\mathbf{j}+(p-1)\mathbf{k}$	M1	Must be **b** – **a** or **a** − **b**
	$36+4+(p-1)^2=49$ $\rightarrow p=4$ or $p=-2$	M1 A1 A1 [4]	Must be sum of 3 squares. A1 √ lost. co.
6	**(i)** $1+5ax+10a^2x^2$	B2,1 [2]	Loses 1 mark for each incorrect term.
	(ii) $\times(1-2x) \rightarrow 5ax-2x$ $\rightarrow a=\frac{2}{5}$	M1 A1 [2]	Needs to consider exactly 2 terms. co
	(iii) Coeff of x^2 is $-10a+10a^2$ $\rightarrow -4+1.6=-2.4$	M1 A1√ A1 [3]	Needs to consider exactly 2 terms. co
7	**(a)** $a=100,\ d=5,$ $n=41$ $\rightarrow S=8200$	 B1 M1 A1 [3]	 co Use of correct sum formula. co
	(b) **(i)** $a+ar+ar^2$ or $a\frac{(1-r^3)}{1-r}$ $=35 \rightarrow a=45$	B1 M1 A1 [3]	co Solution of equation. co
	(ii) $S_\infty=\frac{a}{1-r}=27$	M1 A1√ [2]	Correct use of formula. √ for his a.
8	**(i)** $4xh+2x^2=96$ $\rightarrow h=\frac{24}{x}-\frac{x}{2}$ $V=x^2h \rightarrow V=24x-\frac{x^3}{2}.$	M1 A1 M1 [3]	Needs to consider at least 5 areas. co for $V=x^2h$ with h as f(x)
	(ii) $\frac{dV}{dx}=24-\frac{3x^2}{2}$ $=0$ when $x=4$ $\rightarrow V=64.$	B1 M1 A1 [3]	co Sets differential to 0 **and** solves. co
	(iii) $\frac{d^2V}{dx^2}=-3x \rightarrow$ Max.	M1 A1√ [2]	Any valid method. co.

9 $y = (x-2)^2$ and $y + 2x = 7$ Elimination of $y \rightarrow x^2 - 2x - 3 = 0$ $\rightarrow$ $A(-1, 9)$ and $B(3, 1)$	M1 DM1A1	y (or x) removed completely. Soln of quadratic. Both points correct.
Area under line = ½ × 4 × 10 or $\left[7x - x^2\right]$ from −1 to 3.	M1	Uses any valid method – integration or area of trapezium etc.
Area under curve = $\left[\dfrac{(x-2)^3}{3}\right]$	M1	Any attempt at integration.
	A1	Correct integration in either form.
or $\left[\dfrac{x^3}{3} - 2x^2 + 4x\right]$ from −1 to 3	M1	Correct use of limits in an integral.
$\rightarrow$ 10⅔. [ok to use $\int(y_1 - y_2)\,dx$ – marks the same]	A1 [8]	co
10 $y = \frac{1}{6}(2x-3)^3 - 4x$		
(i) $\dfrac{dy}{dx} = \frac{1}{6} \times 3 \times (2x-3)^2 \times 2 - 4$	B2,1	Everything but the "×2"
	B1 [3]	For the "×2", even if B0 given above.
(ii) $x = 0$, $y = -\frac{27}{6}$, $y + \frac{27}{6} = 5x \rightarrow 2y + 9 = 10x$	B1 M1 A1 [3]	For correct y value Must be using calculus for m. co. (ok unsimplified)
(iii) $(2x-3)^2 - 4 \quad (> 0)$	M1	Links $\dfrac{dy}{dx}$ with 0
$\rightarrow$ x = 2½ or ½ $\rightarrow$ $x > 2½$, $x < ½$.	DM1 A1 [3]	Method for quadratic – lead to 2 answers Correct set of values.
11 f : $x \mapsto 4 - 3\sin x$		
(i) $4 - 3\sin x = 2 \rightarrow \sin x = ⅔$ $\rightarrow$ $x = 0.730$ or 2.41	M1 A1 A1√ [3]	Makes sin x the subject + solution. co. √ for $\pi -$ first answer.
(ii)	B1 B1 [2]	Must be 1 complete oscillation. Shape and position correct, in 1st quadrant, curve not lines.
(iii) $k < 1$, $k > 7$.	B1 B1 [2]	B1 for k = 1, 7, B1 for answer Or B1 for $k < 1$, B1 for $k > 7$
(iv) $A = \dfrac{3\pi}{2}$.	B1 [1]	co
(v) sin x = ⅓ – or using inverse $g^{-1}(3)$ = 2.80	M1A1 [2]	M1 for soln of 3 = 4 − 3sin x or inverse.