1	**(i)** $1 + 8(-2x^2) + {}^8C_2(-2x^2)^2$ $1 - 16x^2 + 112x^4$	B2, 1	[2]	Loses 1 for each error
	(ii) $(2 - x^2) \times$ *their* $(1 - 16x^2 + 112x^4)$ $(2 \times$ *their* $112) -$ *their* (-16) 240	M1 A1√	[2]	Must consider exactly 2 terms
2	**LHS** = $\sin^2x/\cos^2x - \sin^2x$ $\sin^2x(1 - \cos^2x)/\cos^2x$ $\dfrac{\sin^2 x \sin^2 x}{\cos^2 x}$ oe $\tan^2x\sin^2x$	M1 M1 M1 A1		Replace t² by s²/c² or sec² − 1 Use of $1 - \cos^2x = \sin^2x$ Valid overall method **AG**
	OR RHS = $\dfrac{\sin^2 x}{\cos^2 x} . \sin^2 x$ $\sin^2x(1 - \cos^2x)/\cos^2x$ $(\sin^2x/\cos^2x) - \sin^2x$ $\tan^2x - \sin^2x$	M1 M1 M1 A1	[4]	Replace t² by s²/c² Use of $1 - \cos^2x = \sin^2x$ Valid overall method **AG**
3	**(i)** $(k(2t - 1)^{-1/2}$ $0.7(2t - 1)^{-1/2}$	M1 A1	[2]	$k \neq 1$ oe
	(ii) Sub $t = 5$ into *their* deriv 0.23(3)	M1 A1	[2]	 Ignore units
4	**(i)** 1.683(18…)	B1	[1]	
	(ii) $(2) \times ½ \times 3^2\sin2.3$ $½ \times 3^2 \times$ *their* 1.683 Triangle *AOC* + *COB* + sector 14.3	M1 M1 M1 A1	[4]	Condone omission of factor 2 NB M0 if using angle of 2.3 Two correct triangles + sector co
5	**(a)** $d = -7$ used $(m/2)[322 + (m - 1)(-7)] = 0$ 47	B1 M1 A1	[3]	co Condone omission of $(m/2)$. Statement co (condone $m = 0$)
	(b) $\dfrac{a(1-r^n)}{1-r} < \dfrac{0.9a}{1-r}$ $1 - r^n < 0.9$ $r^n > 0.1$	M1 M1 A1	[3]	Allow for =, <, >, ≤, ≥ Needs inequality sign correct **co**

6	**(i)** $kx^2 - kx + 1 = 0$ $k^2 - 4k < 0$ $0 < k < 4$	M1 M1 A1	[3]	y eliminated Applying $b^2 - 4ac < 0$ or $=$ or $\leq$ or $\geq$ co
	(ii) $k = 4$ only $(2x - 1)^2 = 0$ $x = ½$, $y = 2$ or (½, 2)	B1√ M1 A1, A1	[4]	ft from *their* $k^2 - 4k = 0$. (Not $k = 0$) ft from *their* k
7	**(i)** $(x - 2)^2$ $(x - 2)^2 + 3$ $\mathrm{f}(x) > 3$	M1 A1 B1√	[3]	Must be "–2" ± k co ft on *their* '3'
	(ii) $x - 2 = (\pm)\sqrt{y - 3}$ $\mathrm{f}^{-1}(x) = 2 + \sqrt{x - 3}$ domain is $x > 3$	M1 A1 B1√	[3]	± not required for M mark f(x) + removal of minus sign needed ft domain of f^{-1} = range of f or for f^{-1}
	(iii) $\mathrm{h}(x) = x^2 + 3$	B1	[1]	co
8	**(i)** $3x^2 + x - 2 = 0$ $(x + 1)(3x - 2) \to x = -1$ or ⅔ (–1, 1), (⅔, 6)	M1A1 M1 A1	[4]	Eliminates x or y. Sets quadratic to 0. Attempt to solve *their* equation co
	(ii) $AB^2 = (5/3)^2 + 5^2$ $AB = 5.27(0\ldots)$ mid-point = (–1/6, 7/2)	M1 A1 B1√	[3]	√ their coordinates from **(i)** Or (5√10)/3 oe ft from *their* **(i)**
9	**(i)** $\dfrac{10 - a}{10} = \dfrac{6}{10}$ oe $a = 4$	M1 A1	[2]	**or** PDE is isos hence $PD = 6$ (M1) **AG**
	(ii) $\overrightarrow{BG} = -10\mathbf{j} - 10\mathbf{i} + 4\mathbf{k} + 6\mathbf{j}$ $= -10\mathbf{i} - 4\mathbf{j} + 4\mathbf{k}$	B2,1	[2]	Any acceptable notation. Loses 1 for each error.
	(iii) $\overrightarrow{BG}.\overrightarrow{BA} = 40$ $\cos GBA = \dfrac{40}{\sqrt{132}\sqrt{100}}$ $GBA = 69.6°$	M1 M1 DM1 A1	[4]	Use of $x_1x_2 + y_1y_2 + z_1z_2$ Modulus worked correctly for either All ok – must be using $\pm\overrightarrow{BG}\ .\pm\overrightarrow{AB}$. Must be the acute angle

10	(i)	$h = \dfrac{8}{x^2}$	M1 A1		Uses $lbh = 4$ co
		$A = \dfrac{1}{2}x^2 + 2\times\dfrac{1}{2}xh + 2xh + \dfrac{5}{4}x\times\dfrac{4}{5}x$	M1		Allow 1 error but needs the lid
		$A = (3/2)x^2 + 3xh$			
		$A = \dfrac{3}{2}x^2 + 3x\times\dfrac{8}{x^2}$	M1		For substitution of h as f(x)
		$A = \dfrac{3}{2}x^2 + \dfrac{24}{x}$	A1	[5]	**AG**
	(ii)	$\dfrac{dA}{dx} = 3x - \dfrac{24}{x^2} = 0$	B1 M1		Correct derivative. Sets to 0 and attempts to solve.
		$x = 2$	A1		co
		$\dfrac{d^2A}{dx^2} = 3 + \dfrac{48}{x^3}$	M1		Reasonable attempt – allow 1 error
		> 0 when $x = 2$ hence minimum	A1	[5]	co **AG** (Result consistent with their f'')
11	(i)	$A = (0, 1)$ $B = (5, ½)$	B1 B1		
		$y - 1 = -\dfrac{1}{10}(x - 0)$	M1		ft *their A,B*
		$y = -\dfrac{1}{10}x + 1$	A1	[4]	**AG**
	(ii)	Curve: $(\pi)\int_0^5 (3x+1)^{-1/2}\,dx$	M1		Attempt $\int_0^5 y^2\,dx$ (π not vital)
		$\dfrac{2\pi}{3}[(3x+1)^{\frac{1}{2}}]_0^5$	A1A1		(π not vital). 2nd A mark is for ÷ 3.
		$\dfrac{2\pi}{3}[4-1]$ $[2\pi]$	DM1		Application of limits to *their* integral (in either integral). Limits 0 to 5 only.
		Line: $(\pi)\int_0^5 (\dfrac{1}{100}x^2 - \dfrac{1}{5}x + 1)dx$	M1		Attempt $\int_0^5 y^2\,dx$ (π not vital)
		$(\pi)[\dfrac{1}{300}x^3 - \dfrac{1}{10}x^2 + x]_0^5$ $(\pi)[\dfrac{125}{300} - \dfrac{25}{10} + 5]$ $[\dfrac{35\pi}{12}]$	A2,1		Also directly $-\dfrac{10}{3}(-\dfrac{1}{10}x+1)^3$ or $-\dfrac{10}{3}\left[(-\dfrac{1}{2}+1)^3 - 1^3\right]$ (π not vital) – applying limits to *their* integral
		Volume $= \dfrac{35\pi}{12} - 2\pi = \dfrac{11\pi}{12}$	DM1 A1	[9]	Subtraction of *their* volumes co