Question	Answer	Marks	Guidance
1	$5C3\left[(-)(px)^3\right]$ soi	B1	Can be part of expansion. Condone omission of – sign
	$(-1)10p^3 = -2160$ then ÷ and cube root	M1	Condone omission of – sign.
	$p = 6$	A1	
		3	

Question	Answer	Marks	Guidance
2	$y = \frac{1}{3}kx^3 - x^2 \ (+c)$	M1A1	Attempt integration for M mark
	Sub (0, 2)	DM1	Dep on c present. Expect $c = 2$
	Sub (3, –1) → $-1 = 9k - 9 + \textit{their } c$	DM1	
	$k = 2/3$	A1	
		5	

Question	Answer	Marks	Guidance
3	Angle $CBA = \sin^{-1}\left(\frac{7}{8}\right) = 1.0654$ or $CBD = \cos^{-1}\left(\frac{-17}{32}\right) = 2.13$	**B1**	Accept 61.0°, 66° or 122°
	Sector $BCYD = ½ \times 8^2 \times 2 \times their 1.0654(\text{rad})$ soi or sector $CBY = ½ \times 8^2 \times their 1.0654(\text{rad})$	**M1**	Expect 68.1(9). Angle must be in radians (or *their* 61/360 × 2 × 8^2) Or sector DBY
	$\Delta BCD = 7 \times \sqrt{8^2 - 7^2}$ or $½ \times 8^2 \times \sin(2 \times their 1.0654)$ soi	**M1**	Expect 27.1(1). Award M1 for ABC or ABD
	Semi-circle $CXD = ½\pi \times 7^2 = 76.9(7)$	**M1**	M1M1 for segment area formula used correctly
	Total area = *their*68.19 – *their*27.11 + *their*76.97 = 118.0–118.1	**M1A1**	Cannot gain M1 without attempt to find angle CBA or CBD
		6	

Question	Answer	Marks	Guidance
4(i)	$dy/dx = -2(2x-1)^{-2} + 2$	**B2,1,0**	Unsimplified form ok (–1 for each error in ‘–2’, ‘$(2x-1)^{-2}$’ and ‘2’)
	$d^2y/dx^2 = 8(2x-1)^{-3}$	**B1**	Unsimplified form ok
		3	

Question	Answer	Marks	Guidance
4(ii)	Set dy/dx to zero and attempt to solve – at least one correct step	**M1**	
	$x = 0, 1$	**A1**	Expect $(2x-1)^2 = 1$
	When $x = 0$, $d^2y/dx^2 = -8$ (or < 0). Hence MAX	**B1**	
	When $x = 1$, $d^2y/dx^2 = 8$ (or > 0). Hence MIN	**B1**	Both final marks dependent on correct x and correct d^2y/dx^2 and no errors May use change of sign of dy/dx but not at $x = 1/2$
		4	

Question	Answer	Marks	Guidance
5(i)	**u.v** = $8q + 2q - 2 + 6q^2 - 42$	**B1**	May be unsimplified
	$6q^2 + 10q - 44 = 0$ oe	**M1**	Simplify, set to zero and attempt to solve
	$q = 2, -11/3$	**A1**	Both required. Accept –3.67
		3	

Question	Answer	Marks	Guidance
5(ii)	$\mathbf{u} = \begin{pmatrix} 0 \\ 2 \\ 6 \end{pmatrix}$ $\mathbf{v} = \begin{pmatrix} 8 \\ -1 \\ -7 \end{pmatrix}$ $\mathbf{u.v} = -2 - 42$	**M1**	Correct method for scalar product
	$\lvert\mathbf{u}\rvert \times \lvert\mathbf{v}\rvert = \sqrt{2^2 + 6^2} \times \sqrt{8^2 + 1^2 + 7^2}$	**M1**	Prod of mods. At least one methodically correct.
	$\cos\theta = \dfrac{-44}{\sqrt{40} \times \sqrt{114}} = \dfrac{-44}{4\sqrt{285}} = \dfrac{-4}{\sqrt{11}}$	**M1**	All linked correctly and inverse cos used correctly
	$\theta = 130.7°$ or 2.28(05) rads	**A1**	No other angles between 0° and 180°
		4	

Question	Answer	Marks	Guidance
6(i)	$S_n = \dfrac{p(2^n - 1)}{2 - 1}$ soi	**M1**	
	$p(2^n - 1) > 1000p \rightarrow 2^n > 1001$ **AG**	**A1**	
		2	

Question	Answer	Marks	Guidance
6(ii)	$p+(n-1)p=336$	**B1**	Expect $np = 336$
	$\frac{n}{2}\left[2p+(n-1)p\right]=7224$	**B1**	Expect $\frac{n}{2}(p+np)=7224$
	Eliminate n or p to an equation in one variable	**M1**	Expect e.g. $168(1 + n) = 7224$ or $1 + 336/p = 43$ etc
	$n = 42, p = 8$	**A1A1**	
		5	

Question	Answer	Marks	Guidance
7(a)	$3\left(1-\cos^2 2\theta\right)+8\cos 2\theta=0 \rightarrow 3\cos^2 2\theta-8\cos 2\theta-3\ (=0)$	**M1**	Use $s^2=1-c^2$ and simplify to 3-term quadratic in 2θ
	$\cos 2\theta=-\frac{1}{3}$ soi	**A1**	Ignore other solution
	$2\theta = 109.(47)^\circ$ or $250.(53)^\circ$	**A1**	One solution is sufficient, may be implied by either of the next solns
	$\theta = 54.7^\circ$ or 125.3°	**A1A1ft**	Ft for 180° – other solution Use of double angles leads to $3c^4-7c^2+2=0 \Rightarrow c=\pm 1/\sqrt{3}$ for M1A1A1 then A1A1 for each angle Similar marking if $3\sin^2 2\theta=-8\cos 2\theta$ is squared leading to $9\sin^4 2\theta+64\sin^2 2\theta-64=0$
		5	

Question	Answer	Marks	Guidance
7(b)	$\sqrt{3} = a + \tan 0 \to a = \sqrt{3}$	**B1**	$b = 8$ or -4 (or -10, 14 etc) scores M1A0
	$0 = \tan(-b\pi / 6) + \sqrt{3}$ taken as far as $\tan^{-1}$, angle units consistent	**M1**	A0 if $\tan^{-1}\left(-\sqrt{3}\right)$ is not exact; (b=2 no working scores B2)
	$b = 2$	**A1**	
		3	

Question	Answer	Marks	Guidance
8(i)	$\left[(x-2)^2\right] + [3]$	**B1 DB1**	2nd B1 dependent on ±2 in 1st bracket
		2	
8(ii)	Largest k is 2 Accept $k \leqslant 2$	**B1**	Must be in terms of k
		1	
8(iii)	$y = (x-2)^2 + 3 \Rightarrow x - 2 = (\pm)\sqrt{y-3}$	**M1**	
	$\Rightarrow f^{-1}(x) = 2 - \sqrt{x-3}$ for $x > 4$	**A1B1**	
		3	

Question	Answer	Marks	Guidance
8(iv)	$\text{gf}(x) = \dfrac{2}{x^2 - 4x + 7 - 1} = \dfrac{2}{(x-2)^2 + 2}$	B1	Either form
	Since $\text{f}(x) > 4 \Rightarrow \text{gf}(x) < 2/3$ (or since $x < 1$ etc)	M1A1	2/3 in answer implies M1 www
	range of gf(x) is 0 < gf(x)(< 2/3)	B1	Accept 0 < y < 2/3, (0, 2/3) but 0 < x < 2/3 is SCM1A1B0
		4	

Question	Answer	Marks	Guidance
9(i)	$V = (\pi)\int\left(x^3 + x^2\right)(\text{d}x)$	M1	Attempt $\int y^2 \text{d}x$
	$(\pi)\left[\dfrac{x^4}{4} + \dfrac{x^3}{3}\right]_0^3$	A1	
	$(\pi)\left[\dfrac{81}{4} + 9 \quad (-0)\right]$	DM1	May be implied by a correct answer
	$\dfrac{117\pi}{4}$ oe	A1	Accept 91.9 If additional areas rotated about x-axis, maximum of M1A0DM1A0
		4	

Question	Answer	Marks	Guidance
9(ii)	$\frac{dy}{dx} = \frac{1}{2}\left(x^3 + x^2\right)^{-1/2} \times \left(3x^2 + 2x\right)$	B2,1,0	Omission of $3x^2 + 2x$ is one error
	(At $x = 3$,) $y = 6$	B1	
	At $x = 3$, $m = \frac{1}{2} \times \frac{1}{6} \times 33 = \frac{11}{4}$ soi	DB1ft	Ft on *their* dy/dx providing differentiation attempted
	Equation of normal is $y - 6 = -\frac{4}{11}(x - 3)$	DM1	Equation through (3, *their* 6) and with gradient –1/*their* *m*
	When $x = 0$, $y = 7\frac{1}{11}$ oe	A1	
		6	

Question	Answer	Marks	Guidance
10(i)	$4x^{1/2} = x + 3 \rightarrow$ $(x^{1/2})^2 - 4x^{1/2} + 3\ (=0)$ **OR** $16x = x^2 + 6x + 9$	M1	Eliminate y from the 2 equations and then: **Either** treat as quad in $x^{1/2}$ **OR** square both sides and RHS is 3-term
	$x^{1/2} = 1 \text{ or } 3 \quad x^2 - 10x + 9\ (=0)$	A1	If in 1st method $x^{1/2}$ becomes x, allow only M1 unless subsequently squared
	$x = 1$ or 9	A1	
	$y = 4 \text{ or } 12$	A1ft	Ft from *their* x values If the 2 solutions are found by trial substitution B1 for the first coordinate and B3 for the second coordinate
	$AB^2 = (9-1)^2 + (12-4)^2$	M1	
	$AB = \sqrt{128} \text{ or } 8\sqrt{2}$ oe or 11.3	A1	
		6	
10(ii)	$dy/dx = 2\,x^{-1/2}$	B1	
	$2\,x^{-1/2} = 1$	M1	Set *their* derivative = *their* gradient of AB and attempt to solve
	(4, 8)	A1	Alternative method without calculus: $M_{AB} = 1$, tangent is $y = mx + c$ where m = 1 and meets $y = 4x^{1/2}$ when $4x^{1/2} = x + c$. This is a quadratic with $b^2 = 4ac$, so $16 - 4 \times 1 \times c = 0$ so c = 4 B1 Solving $4x^{1/2} = x + 4$ gives $x = 4$ and $y = 8$ M1A1
		3	

Question	Answer	Marks	Guidance
10(iii)	Equation of normal is $y-8=-1(x-4)$	M1	Equation through *their* *T* and with gradient –1/*their* gradient of AB. Expect $y=-x+12$,
	Eliminate *y* (or *x*) → $-x+12=x+3$ or $y-3=12-y$	M1	May use *their* equation of AB
	(4½, 7½)	A1	
		3	