1	$5C2\left(\frac{1}{x}\right)^3\left(3x^2\right)^2$	B1	Can be seen in expansion
	$10(\times 1)\times 3^2$	B1	Identified as leading to answer
	$90\ (x)$	B1 [3]	
2	$(\pi)\int\left(x^3+1\right)\mathrm{d}x$	M1	Attempt to resolve y^2 and attempt to integrate
	$(\pi)\left[\frac{x^4}{4}+x\right]$	A1	
	6π or 18.8	DM1A1 [4]	Applying limits 0 and 2. (Limits reversed: Allow M mark and allow A mark if final answer is 6π)
3 (i)	$6+k=2 \rightarrow k=-4$	B1 [1]	
(ii)	$(y)=\frac{6x^3}{3}-\frac{4}{-2}x^{-2}\quad(+c)$	B1B1√	ft on *their k*. Accept $+\frac{k}{-2}x^{-2}$
	$9=2+2+c$ *c* must be present	M1	Sub (1,9) with numerical *k*. Dep on attempt $\int$
	$(y)=2x^3+2x^{-2}+5$	A1 [4]	Equation needs to be seen Sub (2, 3) →c = −13½ scores M1A0
4	$r=\frac{3+2d}{3}$ or $\frac{3+12d}{3+2d}$ or $r^2=\frac{3+12d}{3}$	B1	1 correct equation in *r* and *d* only is sufficient
	$(3+2d)^2=3(3+12d)$ oe OR sub $2d=3r-3$	M1	Eliminate *r* or *d* using valid method
	$(4)d(d-6)=0$ OR $3r^2=18r-15\rightarrow(r-1)(r-5)$	DM1	Attempt to simplify and solve quadratic
	$d=6$	A1	Ignore $d=0$ or $r=1$
	$r=5$	A1 [5]	Do not allow −5 or ±5

5	$\frac{dy}{dx} = [8] + [-2]\,[(2x-1)^{-2}]$	**B2,1,0**	
	$=0 \to 4(2x-1)^2 = 1$ oe eg $16x^2 - 16x + 3 = 0$	**M1**	Set to zero, simplify and attempt to solve soi
	$x = \frac{1}{4}$ and $\frac{3}{4}$	**A1**	Needs both x values. Ignore y values
	$\frac{d^2y}{dx^2} = 8(2x-1)^{-3}$	**B1√***	ft to $k(2x-1)^{-3}$ where $k > 0$
	When $x = \frac{1}{4}$, $\frac{d^2y}{dx^2}(=-64)$ and/or <0 MAX	**DB1**	Alt. methods for last 3 marks (values either side of 1/4 & 3/4) must indicate <u>which</u> x-values and cannot use $x = 1/2$. (M1A1A1)
	When $x = \frac{3}{4}$, $\frac{d^2y}{dx^2}(=64)$ and/or >0 MIN	**DB1** [7]	
6	$BAC = \sin^{-1}(3/5)$ or $\cos^{-1}(4/5)$ or $\tan^{-1}(3/4)$	**B1**	Accept 36.8(7)°
	$ABC = \sin^{-1}(4/5)$ or $\cos^{-1}(3/5)$ or $\tan^{-1}(4/3)$	**B1**	Accept 53.1(3)°
	$ACB = \pi/2$ (Allow 90°)	**B1**	
	Shaded area = ΔABC – sectors ($AEF + BEG + CFG$)	**M1**	
	$\Delta ABC = \frac{1}{2} \times 4 \times 3$ oe	**B1**	
	Sum sectors $= \frac{1}{2}\left[3^2 0.6435\right) + 2^2 0.9273 + 1^2 1.5708]$ **OR** $\frac{\pi}{360}\left[3^2 36.8(7) + 2^2 53.1(3) + 1^2 90\right]$	**M1**	
	$6 - 5.536 = 0.464$	**A1** [7]	
7	$\frac{dy}{dx} = 2x - 5x^{1/2} + 5$	**B1**	
	$\frac{dy}{dx} = 2$	**B1**	
	$2x - 5x^{1/2} + 5 = 2$	**M1**	Equate their dy/dx to *their* 2 or ½.
	$2x - 5x^{1/2} + 3(=0)$ or equivalent 3-term quadratic	**A1**	
	Attempt to solve for $x^{1/2}$ e.g. $(2x^{1/2} - 3)(x^{1/2} - 1) = 0$	**DM1**	Dep. on 3-term quadratic
	$x^{1/2} = 3/2$ and 1	**A1**	ALT $5x^{1/2} = 2x + 3 \to 25x = (2x+3)^2$
	$x = 9/4$ and 1	**A1** [7]	$4x^2 - 13x + 9(=0)$ $x = 9/4$ and 1

8 (i)	$3\sin^2 x - \cos^2 x + \cos x = 0$	**M1**	Multiply by $\cos x$
	Use $s^2 = 1 - c^2$ and simplify to 3-term quad	**M1**	Expect $4c^2 - c - 3 = 0$
	$\cos x = -3/4$ and 1	**A1**	
	$x = 2.42$ (allow 0.77π) or 0 (extra in range max 1)	**A1A1** [5]	SC1 for 0.723 (or 0.23π), π following $4c^2 + c - 3 = 0$
(ii)	$2x = 2\pi - \textit{their}\,2.42$ or 360 – 138.6	**B1**√	Expect $2x = 3.86$
	$x = 1.21$ (0.385π), 1.93 (0.614/5π), 0, π (3.14) (extra max 1)	**B1B1** [3]	Any 2 correct B1. Remaining 2 correct B1. SCB1for all 69.3, 110.7, 0, 180 (degrees) SCB1 for .361, π/2, 2.78 after $4c^2 + c - 3 = 0$
9 (i)	**AB** = **OB** – **OA** = $\begin{pmatrix} -1 \\ 2 \\ p+4 \end{pmatrix}$	**B1**	Ignore labels. Allow **BA** or **BC**
	CB = **OB** – **OC** = $\begin{pmatrix} -4 \\ 5 \\ p-2 \end{pmatrix}$	**B1**	
	$1 + 4 + (p+4)^2 = 16 + 25 + (p-2)^2$	**M1**	
	$p = 2$	**A1** [4]	
(ii)	**AB.CB** = 4+10−5 = 9	**M1**	Use of $x_1x_2 + y_1y_2 + z_1z_2$
	$\lvert \mathbf{AB} \rvert = \sqrt{1+4+25} = \sqrt{30}$, $\lvert \mathbf{CB} \rvert = \sqrt{16+25+1} = \sqrt{42}$	**M1**	Product of moduli
	$\cos ABC = \dfrac{9}{\sqrt{30}\sqrt{42}}$ or $\dfrac{9}{6\sqrt{35}}$	**M1**	Allow one of **AB**, **CB** reversed - but award **A0**
	$ABC = 75.3°$ or 1.31rads (ignore reflex angle 285°)	**A1** [4]	
10 (i)	$2(ax^2 + b) + 3 = 6x^2 - 21$	**M1**	
	$a = 3$, $b = -12$	**A1A1** [3]	
(ii)	$3x^2 - 12 \geqslant 0$ or $6x^2 - 21 \geqslant 3$	**M1**	Allow = or ⩽ or > or <. Ft from *their a, b*
	$x \leqslant -2$ i.e. (max) $q = -2$	**A1** [2]	Must be in terms of q (eg $q \leqslant -2$)
(iii)	$y \geqslant 6(-3)^2 - 21 \Rightarrow$ range is $(y) \geqslant 33$	**B1** [1]	Do not allow $y > 33$.Accept all other notations e.g. [33, ∞) or [33, ∞]

(iv)	$y = 6x^2 - 21 \Rightarrow x = (\pm)\sqrt{\frac{y+21}{6}}$	M1	
	$(\text{fg})^{-1}(x) = -\sqrt{\frac{x+21}{6}}$	A1	Allow y =..... . Must be a function of x
	Domain is $x \geqslant 33$	B1√ [3]	ft from *their* part **(iii)** but x essential
11 (i)	$AB^2 = 6^2 + 7^2 = 85$, $BC^2 = 2^2 + 9^2 = 85$ (→ isosceles)	B1B1	Or $AB = BC = \sqrt{85}$ etc
	$AC^2 = 8^2 + 2^2 = 68$	B1	
	$M = (2, -2)$ or $BM^2 = (\sqrt{85})^2 - (½\sqrt{68})^2$	B1	Where M is mid-point of AC
	$BM = \sqrt{2^2 + 8^2} = \sqrt{68}$ or $\sqrt{85 - 17} = \sqrt{68}$	B1	
	Area $\Delta ABC = \frac{1}{2}\sqrt{68}\sqrt{68} = 34$	B1 [6]	
(ii)	Gradient of $AB = 7/6$	B1	
	Equation of AB is $y + 1 = \frac{7}{6}(x + 2)$	M1	Or $y - 6 = \frac{7}{6}(x - 4)$
	Gradient of $CD = -6/7$	M1	
	Equation of CD is $y + 3 = \frac{-6}{7}(x - 6)$	M1	
	Sim Eqns $2 = \frac{-6}{7}x + \frac{36}{7} - \frac{7}{6}x - \frac{14}{6}$	M1	
	$x = \frac{34}{85} = \frac{2}{5}$ oe	A1 [6]	