1	$7C3 \times 2^4 \times \left(-\frac{(x)}{2}\right)^3$ powers 4 and 3 35 seen or implied –70	M1 B1 A1 [3]	
2	$f'(x) = -3x^{-4} - 3x^2$ $< 0 \Rightarrow$ decreasing function	B1 B1 B1 [3]	Dependent upon minus signs & even powers
3	$7\cos x + 5 = 2(1 - \cos^2 x)$ $(2\cos x + 1)(\cos x + 3) = 0$ $\cos x = -0.5$ $x = 120°, 240°$	M1 A1 A1 A1√ [4]	Use of $c^2 + s^2 = 1$ ft for 360 – 1st solution
4	area $\Delta = 2\sqrt{3}$ $\tan A = \frac{2\sqrt{3}}{2} \Rightarrow A = \frac{\pi}{3}$ Area sector $= \frac{1}{2} \times 2^2 \times \frac{\pi}{3} = \frac{2\pi}{3}$ Shaded area $= 2\sqrt{3} - \frac{2\pi}{3}$	B1 B1 M1 A1 [4]	 Accept 60° Use of $\frac{1}{2}r^2\theta$ with θ in radians cao
5	**(i)** $2\frac{1}{4} = 5\frac{1}{3}r^3$ $r^3 = \frac{9}{4} \times \frac{3}{16} = \frac{27}{64}$ $r = \frac{3}{4}$ or 0.75 **(ii)** $S_\infty = \frac{5\frac{1}{3}}{1 - \frac{3}{4}} = \frac{64}{3}$ (or $21\frac{1}{3}$ or 21.3)	M1 A1 A1 [3] M1 A1 [2]	 cao
6	**(i)** $\cos\left(\frac{1}{2}x + \frac{\pi}{6}\right) (= 1)$ $x = -\frac{\pi}{3}$ **(ii)** $\frac{1}{2}\cos x + \frac{\pi}{6} = 1$ $\cos x = 0.9528$ $x = \pm 0.31$	B1 B1 [2] B1 B1 B1 B1√ [4]	 cao √ for negative of first answer
7	**(i)** $11 - x^2 = 5 - x \Rightarrow x^2 - x - 6 (= 0)$ $(x + 2)(x - 3)$ $p = 3; \quad q = 2$ **(ii)** $f^{-1}(x) = \begin{cases} \sqrt{11 - x} & \text{for } 2 \le x \le 11 \\ 5 - x & \text{for } x < 2 \end{cases}$	B1 B1 B1 [3] B1 B1 B1 B1 B1 [5]	oe cao

8	**(i)** $f''(x)=[9]\times\left[(3x+4)^{\frac{1}{2}}\right]-[6]$	B2,1,0 [2]	1 each error
	(ii) $f'(-1)=2+6-8=0$ hence stat value at $x=-1$ $f''(-1)=9-6=3 \quad >0$ hence minimum	B1 B1 [2]	AG
	(iii) $y=\left[\frac{4}{15}\text{ oe}\right]\times\left[(3x+4)^{\frac{5}{2}}\right]-[3x^2+8x]+(c)$ Sub $(-1, 5)\rightarrow\frac{4}{15}-3+8+c=5 \quad \rightarrow c=-\frac{4}{15}$	B1 B1 B1 M1 A1 [5]	allow unsimplified $\frac{4}{15}$ Dependent on c present cao
9	**(i)** $p=2$ Unit vector $\frac{1}{\sqrt{6}}\begin{pmatrix}2\\1\\1\end{pmatrix}$ or $\frac{1}{\sqrt{24}}\begin{pmatrix}4\\2\\2\end{pmatrix}$ oe	B1 M1 A1 √ [3]	ft for *their p*
	(ii) $\overrightarrow{AB}=\begin{pmatrix}4\\2\\p\end{pmatrix}-\begin{pmatrix}p\\1\\1\end{pmatrix}=\begin{pmatrix}4-p\\1\\p-1\end{pmatrix}$ $\overrightarrow{OA}.\overrightarrow{AB}=0\Rightarrow 4p-p^2+1+p-1=0$ $5p-p^2=0\Rightarrow p=0$ or 5	M1 A1 M1 A1 √ A1 [5]	ft from *their AB* cao
	(iii) $\overrightarrow{OC}=\overrightarrow{OB}-\overrightarrow{OA}=\begin{pmatrix}4\\2\\3\end{pmatrix}-\begin{pmatrix}3\\1\\1\end{pmatrix}$ oe $=\begin{pmatrix}1\\1\\2\end{pmatrix}$	M1 A1 [2]	
10	**(i)** $-2x+k=\frac{2}{x-3}\Rightarrow 2x^2-(6+k)x+2+3k=0$	B1 [1]	AG
	(ii) $(6+k)^2-(4)(2)(2+3k)=0$ $k^2-12k+20\ (=0)$ $(k-10)(k-2)=0$ $k=2$ or 10	M1 A1 A1 [3]	Apply b^2-4ac cao
	(iii) $k=2\Rightarrow 2(x-2)^2=0$ $x=2, y=-2$ or $(2,-2)$ $k=10\Rightarrow 2(x-4)^2=0$ $x=4, \quad y=2$ or $(4, 2)$ AB: $y-2=2(x-4)$ or $y+2=2(x-2)$	M1 A1 M1 A1 M1 A1 [6]	$(y=2x-6)$

11	**(i)** $a = 2$	B1 [1]	
	(ii) $y = x^3 - 4x^2 + 4x$	B1	
	$\frac{dy}{dx} = 3x^2 - 8x + 4$	B2, 1, 0 √	–1 for eeoo
	$(x-2)(3x-2) = 0$		
	$b = \frac{2}{3}$	B1 [4]	cao
	(iii) area $= \int y\,dx = \left[\frac{x^4}{4} - \frac{4x^3}{3} + 2x^2\right]$	B2, 1, 0	–1 for eeoo
	$4 - \frac{32}{3} + 8$	M1	Apply limits 0→2 – ft *their a* from **(i)**
	$\frac{4}{3}$	A1 [4]	cao
	(iv) $\frac{d^2y}{dx^2} = 6x - 8 = 0 \Rightarrow x = \frac{4}{3}$	M1 A1	Attempt $\frac{d^2y}{dx^2}$ and set = 0
	When $x = \frac{4}{3}$, $\frac{dy}{dx}$ (or m) $= -\frac{4}{3}$	DM1 A1 [4]	cao