1	**(i)** $64 + 576x + 2160x^2$	**B1B1B1** **[3]**	Can score in (ii)
	(ii) $576a(x^2) + 2160(x^2) = 0$	**M1**	
	$a = -\frac{2160}{576}$ oe (eg $-\frac{15}{4}$) or –3.75	**A1** **[2]**	
2	Attempt integration	**M1**	
	$f(x) = 2(x+6)^{\frac{1}{2}} - \frac{6}{x}(+c)$	**A1A1**	Accept unsimplified terms
	$2(3) - \frac{6}{3} + c = 1$	**M1**	Sub.x = 3, y = 1. c must be present
	$c = -3$	**A1** **[5]**	
3	**(i)** **DB** = 6**i** + 4**j** – 3**k** cao **DE** = 3**i** +2**j** – 3**k** cao	**B1** **B1** **[2]**	
	(ii) **DB.DE** = 18 + 8 + 9 = 35	**M1**	Use of $x_1x_2 + y_1y_2 + z_1z_2$
	$\lvert \mathbf{DB} \rvert = \sqrt{61}$ or $\lvert \mathbf{DE} \rvert = \sqrt{22}$	**M1**	Correct method for moduli
	$35 = \sqrt{61} \times \sqrt{22} \times \cos\theta$ oe	**M1**	All connected correctly
	$\theta = 17.2°$ (0.300 rad) cao	**A1** **[4]**	Use of e.g. **BD. DE** can score M marks (leads to obtuse angle)
4	**(i)** $4(1 - \cos^2 x) + 8\cos x - 7 = 0$	**M1**	Use $c^2 + s^2 = 1$
	$4c^2 - 8c + 3 = 0 \rightarrow (2\cos x - 1)(2\cos x - 3) = 0$	**M1**	Attempt to solve
	$x = 60°$ or $300°$	**A1A1** **[4]**	
	(ii) $\frac{1}{2}\theta = 60°$ (or 300°)	**M1**	Allow 300° in addition
	$\theta = 120°$ only	**A1** **[2]**	
5	**(i)** $x = (\pm)\sqrt{y-1}$	**B1**	**OR** $y^2 = x - 1$ (x/y interchange 1st)
	$f^{-1} : x \mapsto \sqrt{x-1}$ for $x > 1$	**B1B1** **[3]**	
	(ii) $ff(x) = (x^2+1)^2 + 1$	**B1**	Or $x^4 + 2x^2 - (153/16) = 0$
	$x^2 + 1 = (\pm)13/4$	**M1**	Or $x^2 = 9/4, (-17/4)$
	$x = 3/2$	**A1** **[3]**	www. Condone ± 3/2
Alt. (ii)	$f(x) = f^{-1}(185/16) = 13/4$	**M1**	**Alt.**(ii) f(3/2) = 13/4 **B1**
	$x = f^{-1}(13/4)$	**M1**	f(13/4) = 185/16 **B1**
	$x = 3/2$	**A1**	x = 3/2 **B1**
			SC.B2 answer 1.5 with no working

6	**(i)** $r(2\pi-\alpha)$ $+2r\alpha+2r$ $2\pi r+r\alpha+2r$	**B1B1** **B1√** **[3]**	ft for $r\alpha$ instead of $2r\alpha$ or omission $2r$ SC1 for $2r\alpha+4r$. (Plate = shaded part)
	(ii) $\frac{1}{2}(2r)^2\alpha+\pi r^2-\frac{1}{2}r^2\alpha$ $\frac{3r^2\alpha}{2}+\pi r^2$	**B1B1** **B1** **[3]**	Either B1 can be scored in (iii)
	(iii) $\pi r^2-\frac{1}{2}r^2\alpha=2r^2\alpha$ $\alpha=\frac{2}{5}\pi$	**M1** **A1** **[2]**	For equating *their* 2 parts from (ii)
7	**(i)** mid-point = (3, 4) Grad. $AB=-\frac{1}{2}\rightarrow$ grad. of perp., = 2 $y-4=2(x-3)$ $y=2x-2$	**B1** **M1** **M1** **A1** **[4]**	soi For use of $-1/m$ soi ft on *their* (3, 4) and 2
	(ii) $q=2p-2$ √ $p^2+q^2=4$ oe $p^2+(2p-2)^2=4\rightarrow 5p^2-8p=0$ {OR¼ $(q+2)^2+q^2=4\rightarrow 5q^2+4q-12=0$ } (0,−2) and $\left(\frac{8}{5},\frac{6}{5}\right)$	**B1√ B1** **M1** **A1A1** **[5]**	ft for 1st eqn. Attempt substn (linear into quadratic) & simplify
8	**(i)** $A=2xr+\pi r^2$ $2x+2\pi r=400\ (\Rightarrow x=200-\pi r)$ $A=400r-\pi r^2$	**B1** **B1** **M1A1** **[4]**	Subst & simplify to **AG** (www)
	(ii) $\frac{dA}{dr}=400-2\pi r$ $=0$ $r=\frac{200}{\pi}$ oe $x=0\Rightarrow$ no straight sections **AG** $\frac{d^2A}{dr^2}=-2\pi\ (<0)$ Max	**B1** **M1** **A1** **A1** **B1** **[5]**	Differentiate Set to zero and attempt to find r Dep on -2π, or use of other valid reason

9 **(a)**	$\frac{10}{2}(2a+9d)=400$ oe	**B1**	$\rightarrow 2a+9d=80$
	$\frac{20}{2}(2a+19d)=1400$ OR		
	$\frac{10}{2}[2(a+10d)+9d]=1000$	**B1**	$\rightarrow 2a+19d=140$ or $2a+29d=200$
	$d=6 \quad a=13$	**M1A1A1** **[5]**	Solve sim. eqns both from S_n formulae
(b)	$\frac{a}{1-r}=6 \qquad \frac{2a}{1-r^2}=7$	**B1B1**	
	$\frac{12(1-r)}{1-r^2}=7$ or $\frac{1-r^2}{1-r}=\frac{12}{7}$	**M1**	Substitute or divide
	$r=\frac{5}{7}$ or 0.714	**A1**	
	$a=\frac{12}{7}$ or 1.71(4)	**A1** **[5]**	Ignore any other solns for r and a
10 **(i)**	$\frac{dy}{dx}=\left[3(3-2x)^2\right]\times[-2]$	**B1B1**	OR $-54+72x-24x^2$ B2,1,0
	At $x=\frac{1}{2}, \frac{dy}{dx}=-24$	**M1**	
	$y-8=-24\left(x-\frac{1}{2}\right)$	**DM1**	
	$y=-24x+20$	**A1** **[5]**	
(ii)	Area under curve $=\left[\frac{(3-2x)^4}{4}\right]\times\left[-\frac{1}{2}\right]$	**B1B1**	OR $27x-27x^2+12x^3-2x^4$ B2,1,0
	$-2-\left(-\frac{81}{8}\right)$	**M1**	Limits 0→ ½ applied to integral with intention of subtraction shown
	Area under tangent $=\int(-24x+20)$	**M1**	or area trap =½(20 + 8) × ½
	$=\left\lvert -12x^2+20x \right\rvert$ or 7 (from trap)	**A1**	Could be implied
	$\frac{9}{8}$ or 1.125	**A1** **[6]**	Dep on both M marks