Question	Answer	Marks	Partial marks
4(b)	$\left[\text{When } x=\frac{\pi}{6}\right]\ y=\sqrt{3}$	**B1**	
	Gradient of normal = $\frac{1}{4}$	**M1**	**FT** $\frac{-1}{\textit{their}\left.\frac{\mathrm{d}y}{\mathrm{d}x}\right\|_{x=\frac{\pi}{6}}}$ from part **(a)**
	Equation of normal: $y=\frac{1}{4}x+\sqrt{3}-\frac{\pi}{24}$ or $y=\frac{1}{4}x+c$ and $\sqrt{3}=\frac{1}{4}\left(\frac{\pi}{6}\right)+c$ or $y-\sqrt{3}=\frac{1}{4}\left(x-\frac{\pi}{6}\right)$ oe	**M1**	**FT** $\frac{-1}{\textit{their}\left.\frac{\mathrm{d}y}{\mathrm{d}x}\right\|_{x=\frac{\pi}{6}}}$ and *their y* , providing *their y* ≠ 0
	$0-\sqrt{3}=\frac{1}{4}\left(x-\frac{\pi}{6}\right)$	**M1**	**FT** *their* equation of normal providing gradient is $\frac{-1}{\textit{their}\left.\frac{\mathrm{d}y}{\mathrm{d}x}\right\|_{x=\frac{\pi}{6}}}$
	$\left(\frac{\pi}{6}-4\sqrt{3},0\right)$ or exact equivalent; mark final answer	**A1**	**dep** on all previous marks awarded and a fully correct solution to (a) or a correct derivative and gradient of tangent at $x=\frac{\pi}{6}$ stated in this part
5(a)(i)	300	**B1**	
5(a)(ii)	252	**2**	**M1** for 21 × 4 × 3 × 1 oe OR Starts with 5 OR ends with 0: 1 × 4 × 3 × 5 oe or 60 or Starts with 2, 4, 6 or 8 OR ends with 2, 4, 6 or 8: 4 × 4 × 3 × 4 oe or 192 OR [All possible –] ends with 5: 4 × 4 × 3 × 1 oe or 48

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Question	Answer	Marks	Partial marks
5(a)(iii)	108	**2**	**M1** for $9 \times 4 \times 3 \times 1$ oe OR Ends with 5: $4 \times 4 \times 3 \times 1$ oe or 48 or Ends with 0: $5 \times 4 \times 3 \times 1$ oe or 60 OR Starts 5, ends 0: $1 \times 4 \times 3 \times 1$ oe or 12 or Does not start 5: $4 \times 4 \times 3 \times 2$ oe or 96
5(b)	Correct simplified equation: $(n+1)^2 = 33 \times 12 \times 11$ oe, nfww	**B2**	**B1** for an equation with simplified algebraic component $(n+1)^2$ oe or simplified numerical component $33 \times 12 \times 11$ oe, nfww
	$n = 65$	**B1**	**dep** on **B2**; must be the only solution

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Question	Answer	Marks	Partial marks
6	$r = 3$ nfww	**B1**	stated or very clearly implied
	$2\pi = 4\pi r^2 \times \frac{dr}{dt}$ soi or $\frac{dr}{dt} = \frac{1}{2r^2}$ oe and $\frac{dS}{dr} = 8\pi r$	**M1**	Uses relevant chain rule e.g. $\frac{dV}{dt} = \frac{dV}{dr} \times \frac{dr}{dt}$ to find the derivatives and values of $\frac{dr}{dt}$ and $\frac{dS}{dr}$
	$\frac{dr}{dt} = \frac{1}{18}$ and $\frac{dS}{dr} = 24\pi$ soi	**A1**	
	Correct chain rule including $\frac{dS}{dt}$	**B1**	e.g. $\frac{dS}{dt} = \frac{dS}{dr} \times \frac{dr}{dt}$ or $\frac{dr}{dt} = \frac{dS}{dt} \times \frac{dr}{dS}$ oe
	$\frac{dS}{dt} = \frac{4\pi}{3}$ isw or 4.19 or 4.188 to 4.1888	**2**	**M1** for $\frac{dS}{dt} = 24\pi \times \frac{1}{18}$
	Alternative method 1		
	$r = 3$ nfww	**(B1)**	stated or very clearly implied
	$\frac{dV}{dr} = 4\pi r^2$ and $\frac{dS}{dr} = 8\pi r$	**(M1)**	Finds correct expressions for and values of $\frac{dV}{dr}$ and $\frac{dS}{dr}$
	$\frac{dV}{dr} = 36\pi$ and $\frac{dS}{dr} = 24\pi$ soi	**(A1)**	
	Correct chain rule including $\frac{dS}{dt}$	**(B1)**	e.g. $\frac{dS}{dt} = \frac{dS}{dr} \times \frac{dr}{dV} \times \frac{dV}{dt}$ or $\frac{dS}{dt} = \frac{dS}{dV} \times \frac{dV}{dt}$
	$\frac{dS}{dt} = \frac{4\pi}{3}$ isw or 4.19 or 4.188 to 4.1888	**(2)**	**M1** for $\frac{dS}{dt} = 24\pi \times \frac{1}{36\pi} \times 2\pi$ or $\frac{2}{3} \times 2\pi$

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