Question	Answer	Marks	Guidance
5(b)	Correct derivative: $4\pi r - \frac{2000}{r^2}$ oe, isw	**B2**	**B1** for one correct term
	$4\pi r - \frac{2000}{r^2} = 0$ and solves for r	**M1**	**FT** *their* derivative providing that at least one term is correct
	$r = \sqrt[3]{\frac{2000}{4\pi}}$ oe, isw or 5.42 or 5.419[26…] rot to 3 or more dp	**A1**	
	Second derivative $\frac{\mathrm{d}^2S}{\mathrm{d}r^2} = 4\pi + 4000r^{-3}$ **and** When $r = 5.42$, $\frac{\mathrm{d}^2S}{\mathrm{d}r^2} > 0$ oe [hence minimum] or $4\pi + 4000(5.42)^{-3} > 0$ oe [hence minimum] or $\frac{\mathrm{d}^2S}{\mathrm{d}r^2} = 12\pi$ or 37 to 38 [hence minimum] or as $r > 0$, $\frac{\mathrm{d}^2S}{\mathrm{d}r^2} > 0$ [hence minimum] OR correctly finds the values of the first derivative at 5.42 oe ± h, where h is small [hence minimum]	**A1**	**Dep** on previous mark
6(a)	Velocity: $\frac{8t}{4t^2-5} - 1$	**B2**	**B1** for $\frac{\mathrm{f}(t)}{4t^2-5} - 1$ or for $\frac{8t}{4t^2-5} + \mathrm{g}(t)$
	Correct structure of quotient rule or equivalent product rule	**M1**	**FT** *their v* if possible; must be of equivalent difficulty
	Acceleration: $\frac{(4t^2-5)(8)-(8t)(8t)}{(4t^2-5)^2}$ oe, isw	**A1**	**FT** $\frac{8t}{4t^2-5} + k$ where k is a constant
6(b)	$4t^2 - 8t - 5 = 0$ oe	**B1**	
	$(2t+1)(2t-5) = 0$	**M1**	**FT** *their* 3-term quadratic in t
	$t = 2.5$ and no other values	**A1**	**dep** on correct quadratic seen
6(c)	$\frac{(4\times 2.5^2-5)(8)-(8\times 2.5)(8\times 2.5)}{(4\times 2.5^2-5)^2}$ oe, soi	**M1**	Substitutes a value of $t > 2$ in an expression for a which has at least one term with a factor of $\frac{1}{(4t^2-5)^2}$ or $\frac{1}{16t^4-40t^2+25}$
	$a = -\frac{3}{5}$ oe only	**A1**	

Question	Answer	Marks	Guidance
7(a)	$\frac{BC}{\sin 60} = \frac{\sqrt{2}}{\sin 45}$ oe	**M1**	
	$BC = \sqrt{3}$ oe	**A1**	
	$\frac{1}{2} \times \sqrt{2} \times \sqrt{3} \times \sin 75 = \frac{3+\sqrt{3}}{4}$ OR $\text{height} = \left(\frac{3+\sqrt{3}}{4}\right) \times \frac{2}{\sqrt{3}}$ oe	**M1**	**FT** *their BC* providing it has not been found using the given result for sin75
	$\sin 75 = \frac{2(3+\sqrt{3})}{4\sqrt{6}}$ oe OR $\sin 75 = \frac{\left(\frac{3+\sqrt{3}}{4}\right) \times \frac{2}{\sqrt{3}}}{\sqrt{2}}$ oe $\left[= \frac{\frac{1+\sqrt{3}}{2}}{\sqrt{2}} = \frac{1+\sqrt{3}}{2\sqrt{2}}\right]$	**A1**	**dep** on all previous marks being awarded Isolates sin 75 correctly or deals with surds on LHS of correct equation e.g. $\frac{1}{2} \times 6 \times \sin 75 = \left(\frac{3+\sqrt{3}}{4}\right) \times \sqrt{6}$
	correct completion to given answer $\frac{\sqrt{6}+\sqrt{2}}{4}$	**A1**	must be convincing with an intermediate step if needed
	Alternative methods (finding *AC* first)		
	$\frac{1}{2} \times \sqrt{2} \times AC \times \sin 60 = \frac{3+\sqrt{3}}{4}$ oe	**(M1)**	
	$AC = \frac{2}{\sqrt{2}} \times \frac{2}{\sqrt{3}} \times \frac{3+\sqrt{3}}{4}$ oe	**(A1)**	Isolates *AC* correctly
	$AC = \frac{\sqrt{2}+\sqrt{6}}{2}$	**(A1)**	Must be convinced no calculator is being used
	$\frac{\sin 75}{\frac{\sqrt{2}+\sqrt{6}}{2}} = \frac{\sin 45}{\sqrt{2}}$ oe	**(M1)**	**FT** *their AC* May simplify to $\sin 75 = \frac{AC}{2}$ before inserting *their AC*
	correct completion to given answer $\frac{\sqrt{6}+\sqrt{2}}{4}$	**(A1)**	**dep** on all previous marks being awarded must be convincing with an intermediate step if needed