Question Number	Answer		Mark
21(a)(i)	Use of $V_{\text{grav}} = -\frac{GM}{r}$	**(1)**	
	$V_{\text{grav}} = (-)\ 5.53 \times 10^7\ (\text{J kg}^{-1})$	**(1)**	**2**
	Example of calculation $V_{\text{grav}} = -\frac{6.67 \times 10^{-11}\ \text{N m}^2\ \text{kg}^{-2} \times 5.98 \times 10^{24}\ \text{kg}}{(6.36 \times 10^6 + 8.5 \times 10^5)\ \text{m}} = -5.532 \times 10^7\ \text{J kg}^{-1}$		
21(a)(ii)	Use of $\Delta V \times m$	**(1)**	
	$\Delta E_{grav} = 3.7 \times 10^{10}$ J	**(1)**	**2**
	Example of calculation $\Delta E_{\text{grav}} = (-5.53 - (-6.27)) \times 10^7\ \text{J kg}^{-1} \times 4990\ \text{kg} = 3.69 \times 10^{10}\ \text{J}$		
21(b)	Equate $F = \frac{GMm}{r^2}$ with $F = m\omega^2 r$	**(1)**	
	Substitute for ω using $\omega = \frac{2\pi}{T}$	**(1)**	
	Use of $T^2 = \frac{4\pi^2 r^3}{GM}$	**(1)**	
	T = 6090 s **Or** T = 1.69 hours	**(1)**	
	Number of orbits in 1 day = 14.2, so claim is not valid	**(1)**	
	OR		
	Equate $F = \frac{GMm}{r^2}$ with $F = \frac{mv^2}{r}$	**(1)**	
	Substitute for v using $v = \frac{2\pi r}{T}$	**(1)**	
	Use of $T^2 = \frac{4\pi^2 r^3}{GM}$	**(1)**	
	T = 6090 s **Or** T = 1.69 hours	**(1)**	
	Number of orbits in 1 day = 14.2, so claim is not valid	**(1)**	**5**
	Example of calculation $\frac{GMm}{r^2} = m\omega^2 r$ $\therefore T = 2\pi \times \sqrt{\frac{r^3}{GM}} = 2\pi \times \sqrt{\frac{(6.36 \times 10^6\ \text{m} + 8.5 \times 10^5\ \text{m})^3}{6.67 \times 10^{-11}\ \text{N m}^2\ \text{kg}^{-2} \times 5.98 \times 10^{24}\ \text{kg}}} = 6091\ \text{s}$ $\therefore T = \frac{6090\ \text{s}}{(60 \times 60)\ \text{s hour}^{-1}} = 1.69\ \text{hours}$ $\text{Number of orbits in 1 day} = \frac{24\ \text{hours}}{1.69\ \text{hours}} = 14.2$		