A satellite is observed to orbit a large planet close to its surface with a period of 6.00 hours. Find the average mass density of the planet. Assume that the planet is spherical.

A. 2725 kg/(m**3)
B. 1.29 kg/(m**3)
C. 170 kg/(m**3)
D. 303 kg/(m**3)
E. 5522 kg/(m**3)

$$T^2 = \left(\frac{4\pi^2}{GM}\right) r^3$$

$$T^2 = \frac{4}{3}\pi r^3 \left(\frac{3\pi}{GM}\right) = \left(\frac{V}{M}\right)\frac{3\pi}{G} = \frac{1}{\rho}\ \frac{3\pi}{G}$$

$$\Rightarrow \quad \rho = \frac{3\pi}{G T^2} = 303 \text{ kg/m}^3$$

change to seconds

At what altitude (in earth's radii) above the surface of the earth would the acceleration of gravity be 1/8 of that on the surface ? (Re = radius of the earth)

A. 0.65 * Re
B. 1.83 * Re
C. 2.51 * Re
D. 1.02 * Re
E. 0.44 * Re

$$a_g = \frac{GM}{(R_E+h)^2} = \frac{1}{8}\ \frac{GM}{R_E^2}$$

$$\Rightarrow \quad (R_E+h)^2 = 8 R_E^2$$

$$R_E + h = \sqrt{8}\, R_E \Rightarrow \boxed{h = 1.83 R_E}$$

A 100 kg spaceship is in circular orbit of radius 1.38 * 10**7 m around the earth. How much energy is required to transfer the spaceship to a circular orbit of radius 1.92 * 10**7 m ?

A. 9.51 * 10**9 J
B. 4.08 * 10**8 J
C. 3.42 * 10**8 J
D. 6.59 * 10**9 J
E. 6.72 * 10**8 J

$$\Delta E = E_f - E_i$$

$$= -\frac{GMm}{2r_f} + \frac{GMm}{2r_i}$$

$$= +\frac{GMm}{2}\left(\frac{1}{r_i} - \frac{1}{r_f}\right)$$

$$= \frac{(6.67\times10^{-11})(5.98\times10^{24})(100)}{2}\left(\frac{1}{1.38\times10^{7}} - \frac{1}{1.92\times10^{7}}\right)$$

$$\boxed{\Delta E = 4.08\times10^{8}\ \text{J}}$$

A particle is at a height of 1000 km from the surface of the earth. Calculate the escape velocity of this particle. Assume the earth to be a perfect sphere of radius 6400 km and of mass 5.98*(10**24) kg.

A. 10.05 kilometers/second
B. 11.20 kilometers/second
C. 10.75 kilometers/second
D. 10.38 kilometers/second
E. 9.75 kilometers/second

$$U_i + K_i = \cancel{U_f}^{\,0} + \cancel{K_f}^{\,0}$$

$$-\frac{GMm}{r_i} + \frac{1}{2}m v_{esc}^2 = 0 \Rightarrow v_{esc} = \sqrt{\frac{2GM}{r_i}}$$

$$\boxed{v_{esc} = 10.4\times10^{3}\ \text{m/s}}$$