88. Assume the thickness of the layer is \( d \). So the mass is \( M = \rho \pi \frac{4}{3} (R_E - d)^3 \).

Also \( a_E = \frac{GM}{(R_E - d)^2} = \frac{4\pi}{3} \times G\rho (R_E - d) \), so

\[
d = \frac{3a_E}{4\pi G \rho} - R_E = \frac{3(10.0 \text{ m/s}^2)}{4\pi(6.67 \times 10^{-11} \text{ N m}^2/\text{kg}^2)(5.52 \times 10^3 \text{ kg/m}^3)} - 6.38 \times 10^6 \text{ m} = 1.04 \times 10^3 \text{ m} = \boxed{104 \text{ km}}.
\]

89. (a) \( U_{\text{int}} = - \frac{Gm_1 m_2}{r_{12}} - \frac{Gm_1 m_3}{r_{13}} - \frac{Gm_2 m_3}{r_{23}} \)

\[
U_{\text{int}} = - (6.67 \times 10^{-11} \text{ N m}^2/\text{kg}^2) \left[ \frac{(1.0 \text{ kg})^2}{0.80 \text{ m}} + \frac{(1.0 \text{ kg})^2}{0.80 \text{ m}} + \frac{(1.0 \text{ kg})^2}{0.80 \text{ m}} \right] = -2.5 \times 10^{-10} \text{ J}.
\]

(b) From symmetry, the force at the center is zero. So the force per unit mass is also \( 0 \).

90. (c).

91. (c), according to Kepler’s second law.

92. (a) \( 0 \), because the direction of the force and the displacement (velocity) are perpendicular and work is equal to \( W = Fd \cos \theta (\cos 90^\circ = 0) \).

(b) \( \text{No} \). When the person comes down, it is still a free fall.

93. (a) Rockets are launched \textbf{eastward} to get more velocity relative to space because the Earth rotates toward the east.

(b) The \textbf{tangential speed of the Earth is higher in Florida} because Florida is closer to the equator than California hence a greater distance from the axis of rotation. Also, the launch is over the ocean for safety.

94. (a) \( \text{No} \), you cannot speed up in the same orbit with one rocket burst. Speed is dependent on orbital radius. Once you speed up, you will be at a different orbit of different radius.

(b) \textbf{Decreasing the orbital radius} to increase speed and then increasing the orbital radius to catch the equipment.