

Problem

11) Assume that somehow our planet undergoes a gravitational collapse in such a way that its final radius is 10 times smaller, **without losing any mass in the process**.

Find the escape speed from the surface.

$$\begin{aligned} v &= \sqrt{\frac{2GM_E}{R}} = \sqrt{\frac{2GM_E}{R_E} \left(\frac{R_E}{R}\right)} \\ &= \underbrace{\sqrt{\frac{2GM_E}{R_E}}}_{11.2 \text{ km/s}} \sqrt{10} = \underline{\underline{35.4 \text{ km/s}}} \end{aligned}$$

What would the weight of a 4 kg baby be on the surface of this planet?

$$\begin{aligned} g &= \frac{GM_E}{R^2} = \frac{GM_E}{R_E^2} \frac{R_E^2}{R^2} \\ &= (9.81 \text{ m/s}^2)(10)^2 = 981 \text{ m/s}^2 \end{aligned}$$

$$\rightarrow W = (4 \text{ kg})(981 \text{ m/s}^2) = \underline{\underline{3924 \text{ N}}}$$