

## SOLUTIONS TO END-OF-CHAPTER PROBLEMS

### Section 1.1 Standards of Length, Mass, and Time

**P1.1** (a) Modeling the Earth as a sphere, we find its volume as

$$\frac{4}{3}\pi r^3 = \frac{4}{3}\pi(6.37 \times 10^6 \text{ m})^3 = 1.08 \times 10^{21} \text{ m}^3$$

Its density is then

$$\rho = \frac{m}{V} = \frac{5.98 \times 10^{24} \text{ kg}}{1.08 \times 10^{21} \text{ m}^3} = \boxed{5.52 \times 10^3 \text{ kg/m}^3}$$

(b) This value is intermediate between the tabulated densities of aluminum and iron. Typical rocks have densities around 2000 to 3000 kg/m<sup>3</sup>. The average density of the Earth is significantly higher, so higher-density material must be down below the surface.

**P1.2** (a)  $\rho = m/V$  and  $V = (4/3)\pi r^3 = (4/3)\pi(d/2)^3 = \pi d^3/6$ , where  $d$  is the diameter.

$$\text{Then } \rho = 6m / \pi d^3 = \frac{6(1.67 \times 10^{-27} \text{ kg})}{\pi(2.4 \times 10^{-15} \text{ m})^3} = \boxed{2.3 \times 10^{17} \text{ kg/m}^3}$$

(b)  $\frac{2.3 \times 10^{17} \text{ kg/m}^3}{22.6 \times 10^3 \text{ kg/m}^3} = \boxed{1.0 \times 10^{13} \text{ times the density of osmium}}$

**P1.3** For sphere the volume is  $V = \frac{4}{3}\pi r^3$  and the mass is  $m = \rho V = \rho \frac{4}{3}\pi r^3$ .

We divide this equation for the larger sphere by the same equation for the smaller:

$$\frac{m_L}{m_s} = \frac{\rho(4/3)\pi r_L^3}{\rho(4/3)\pi r_s^3} = \frac{r_L^3}{r_s^3} = 5$$

Then  $r_L = r_s \sqrt[3]{5} = (4.50 \text{ cm})\sqrt[3]{5} = \boxed{7.69 \text{ cm}}$

# Physics Solution Manual Chapter 12

**Jerry J. Shi**



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