Problem 1-21

Two particles have a mass of 8 kg and 12 kg, respectively. If they are 800 mm apart, determine the force of gravity acting between them. Compare this result with the weight of each particle.

Solution

Newton's law of gravitation says that the force between two masses is given by

$$F = G\frac{m_1 m_2}{r^2},$$

where G is the universal gravitational constant $G \approx 6.67 \times 10^{-1}\ \text{m}^3/(\text{kg} \cdot \text{s}^2)$. For the two particles in question,

$$F \approx \left(6.67 \times 10^{-11}\ \frac{\text{m}^3}{\text{kg} \cdot \text{s}^2}\right) \frac{(8\ \text{kg})(12\ \text{kg})}{(0.8\ \text{m})^2} \approx 1.00 \times 10^{-8}\ \text{N}$$

The weights of the 8 kg and 12 kg masses are respectively

$$W_1 = m_1 g \approx (8\ \text{kg})\left(9.81\ \frac{\text{m}}{\text{s}^2}\right) \approx 78.5\ \text{N}$$
$$W_2 = m_2 g \approx (12\ \text{kg})\left(9.81\ \frac{\text{m}}{\text{s}^2}\right) \approx 118\ \text{N}.$$

The graviational force F between the masses is negligible compared to their weights.