

PROBLEM 1.13

Weight refers to the force of gravity: $F_{\text{grav}} = mg$.

Thus, when her mass is 120 lb and weight is 119 lbf, we have

$$g = \frac{F_{\text{grav}}}{m} = \frac{119 \text{ lbf}}{120 \text{ lb}} \left| \frac{32.174 \text{ lb} \cdot \text{ft}/\text{s}^2}{1 \text{ lbf}} \right| = 31.906 \text{ ft}/\text{s}^2 \leftarrow$$

When her mass is 120 lb and $g = 32.05 \text{ ft}/\text{s}^2$, we have

$$F_{\text{grav}} = mg = (120 \text{ lb})(32.05 \text{ ft}/\text{s}^2) \left| \frac{1 \text{ lbf}}{32.174 \text{ lb} \cdot \text{ft}/\text{s}^2} \right| \\ = 119.54 \text{ lbf} \leftarrow$$

COMMENT: Her mass remains constant, but weight depends on the local acceleration of gravity.

PROBLEM 1.14

The actual forces developed when birds and aircraft collide are difficult to determine precisely, but estimates can be calculated using average values of acceleration and force magnitudes, as follows:

The goose is accelerated from a very low velocity to 150 miles/h in 10^{-3} s . Thus the average acceleration magnitude is

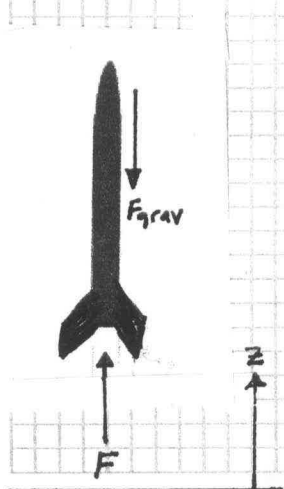
$$|a| = \left(\frac{150 \text{ miles/h} - 0}{10^{-3} \text{ s}} \right) \left| \frac{1 \text{ h}}{3600 \text{ s}} \right| \left| \frac{5280 \text{ ft}}{1 \text{ mile}} \right| = 2.2 \times 10^5 \frac{\text{ft}}{\text{s}^2}$$

The magnitude of the average force applied is

$$|F| = m|a| = (12 \text{ lb})(2.2 \times 10^5 \frac{\text{ft}}{\text{s}^2}) \left| \frac{1 \text{ lbf}}{32.2 \text{ lb} \cdot \text{ft}/\text{s}^2} \right| = 82,000 \text{ lbf} \leftarrow$$

rounded

PROBLEM 1.15



$$m = 4.5 \text{ lb}$$

$$a = 3g, \text{ where } g = 32.2 \text{ ft}/\text{s}^2$$

$$\sum F_z = ma$$

Neglecting air resistance,

$$F - F_{\text{grav}} = ma$$

$$\Rightarrow F = ma + F_{\text{grav}}$$

$$= ma + mg = m(3g) + mg$$

$$= m(4g)$$

$$= (4.5 \text{ lb})(4 \times 32.2 \text{ ft}/\text{s}^2) \left| \frac{1 \text{ lbf}}{32.2 \text{ lb} \cdot \text{ft}/\text{s}^2} \right| = 18 \text{ lbf} \leftarrow$$

rounded