

Problem 1-20

If a man weighs 155 lb on earth, specify (a) his mass in slugs, (b) his mass in kilograms, and (c) his weight in newtons. If the man is on the moon, where the acceleration due to gravity is $g_m = 5.30 \text{ ft/s}^2$, determine (d) his weight in pounds, and (e) his mass in kilograms.

Solution

The formula for the weight is

$$W = mg,$$

where m is the mass and g is the acceleration due to gravity.

Part (a)

The man's mass is

$$m = \frac{W}{g} = \frac{155 \text{ lb}}{32.2 \frac{\text{ft}}{\text{s}^2}} \approx 4.81 \text{ slugs.}$$

Part (b)

Use the conversion factor in Table 1-2 on page 9 to convert pounds to newtons.

$$m = \frac{W}{g} = \frac{155 \cancel{\text{lb}} \times \frac{4.448 \text{ N}}{1 \cancel{\text{lb}}}}{9.81 \frac{\text{m}}{\text{s}^2}} \approx 70.3 \text{ kg}$$

Part (c)

The weight in newtons is

$$155 \cancel{\text{lb}} \times \frac{4.448 \text{ N}}{1 \cancel{\text{lb}}} \approx 689 \text{ N.}$$

Part (d)

Multiply the man's mass by the moon's acceleration due to gravity to get his weight on the moon.

$$W_m = mg_m \approx (4.81 \text{ slugs}) \left(5.30 \frac{\text{ft}}{\text{s}^2} \right) \approx 25.5 \text{ lb}$$

Part (e)

Multiply the man's mass by the moon's acceleration due to gravity to get his weight on the moon.

$$W_m = mg_m \approx (70.3 \text{ kg}) \left(5.30 \frac{\cancel{\text{ft}}}{\text{s}^2} \times \frac{1 \text{ m}}{3.28 \cancel{\text{ft}}} \right) \approx 114 \text{ N}$$