Given:
A Lunar Roving Vehicle (LRV) was used on the moon in the last three missions of the Apollo program (Apollo 15, 16, and 17). The LRV weighed 463 lbf on Earth.

Required:
What is its mass on Earth in pounds-mass? In kilograms? What is its weight on Earth in Newtons? If the weight of the LRV on the Moon is 77 lbf, what is its mass on the Moon? What is the gravity on the Moon in ($\frac{ft}{s^2}$ and $\frac{m}{s^2}$)? What is the weight on the Moon in Newtons?

Solution:
The weight of the LRV on Earth is defined as

$W_e := 463\ \text{lbf}$

The weight of the LRV on the Moon is defined as

$W_m := 77\ \text{lbf}$

The mass of the LRV in pounds-mass is

$$m_{LRV} := \frac{W_e}{g_e} = 463\ \text{lbm} \qquad \frac{463\ \text{lbf}}{32.174\ \frac{\text{ft}}{\text{s}^2}} \cdot \left(\frac{32.174\ \text{lbm}\ \frac{\text{ft}}{\text{s}^2}}{\text{lbf}} \right) = 463\ \text{lbm}$$

The mass of the LRV in kilograms is

$$\boxed{m_{LRV} = 210.0\ \text{kg}} \qquad 463\ \text{lbm} \cdot \left(\frac{0.45359\ \text{kg}}{\text{lbm}} \right) = 210.0\ \text{kg}$$

The weight of the LRV on Earth is

$$\boxed{W_e = 2059.5\ \text{N}} \qquad (210.0\ \text{kg}) \cdot \left(9.807\ \frac{\text{m}}{\text{s}^2} \right) = 2059.5\ \text{N}$$

The mass of the LRV on the Moon is the same as the mass on Earth. Mass remains constant for the same body regardless of its location.

The gravity on the moon in ft/s2 is then

$$\boxed{g_m := \frac{W_m}{m_{LRV}} = 5.351\ \frac{\text{ft}}{\text{s}^2}} \qquad \frac{77\ \text{lbf}}{463\ \text{lbm}} \cdot \left(\frac{32.174\ \frac{\text{lbm ft}}{\text{s}^2}}{\text{lbf}} \right) = 5.351\ \frac{\text{ft}}{\text{s}^2}$$

The gravity on the moon in m/s2 is then

$$\boxed{g_m = 1.631\ \frac{\text{m}}{\text{s}^2}} \qquad 5.35\ \frac{\text{ft}}{\text{s}^2} \cdot \left(\frac{12\ \text{in}}{\text{ft}} \right) \cdot \left(\frac{2.54\ \text{cm}}{\text{in}} \right) \cdot \left(\frac{\text{m}}{100\ \text{cm}} \right) = 1.631\ \frac{\text{m}}{\text{s}^2}$$

The weight on the Moon in Newtons is

$$\boxed{W_m = 342.5\ \text{N}}$$

$$77\ \text{lbf} \cdot \left(\frac{32.174\ \text{lbm}\ \frac{\text{ft}}{\text{s}^2}}{\text{lbf}} \right) \cdot \left(\frac{0.45359\ \text{kg}}{\text{lbm}} \right) \cdot \left(\frac{12\ \text{in}}{\text{ft}} \right) \cdot \left(\frac{2.54\ \text{cm}}{\text{in}} \right) \cdot \left(\frac{\text{m}}{100\ \text{cm}} \right) \cdot \left(\frac{\text{N}}{\text{kg}\ \frac{\text{m}}{\text{s}^2}} \right) = 342.5\ \text{N}$$