

Part A: Mass vs. Weight

1. For each statement, write **mass**, **weight**, or **both**.

- a. Measured in newtons.
- b. Measured with a pan balance.
- c. Stays the same on the Moon.
- d. Is a force with a direction.
- e. Doubles when you double the amount of matter (in the same place).

a. weight **b.** mass **c.** mass **d.** weight **e.** both ($F_g = mg$, so weight is directly proportional to mass)

2. Elena takes a pan balance and a spring scale to the Moon. She measures the same rock with each tool on Earth and again on the Moon. Which tool gives a different reading on the Moon? Explain why.

The **spring scale** reads less on the Moon. It measures weight, the pull of gravity, and the Moon's g is smaller. The pan balance compares the rock to known masses, and gravity pulls on both sides equally, so it reads the same mass anywhere.

3. A student says, "I weigh 54 kg." Explain what is wrong with this statement in physics, and give the student's actual weight on Earth.

54 kg is a **mass**, not a weight. Weight is a force measured in newtons.

$$F_g = mg = (54 \text{ kg})(9.8 \text{ m/s}^2) = 529.2 \text{ N, so } \mathbf{530 \text{ N}} \text{ (2 sig figs)}$$

Part B: Calculating Weight

Use $F_g = mg$, with $g = 9.8 \text{ m/s}^2$ on Earth. Show Knowns, Equation, Substitute, and Answer with units.

4. A bag of dog food has a mass of 18 kg. What is its weight on Earth?

Knowns: $m = 18 \text{ kg}$, $g = 9.8 \text{ m/s}^2$

Equation: $F_g = mg$

Substitute: $F_g = (18 \text{ kg})(9.8 \text{ m/s}^2) = 176.4 \text{ kg} \cdot \text{m/s}^2$

Answer: $F_g = \mathbf{180 \text{ N down}}$ (2 sig figs; 176 N is also accepted)

5. A watermelon weighs 63.7 N on Earth. What is its mass?

Knowns: $F_g = 63.7 \text{ N}$, $g = 9.8 \text{ m/s}^2$

Equation: $F_g = mg$, so $m = F_g / g$

Substitute: $m = 63.7 \text{ N} / 9.8 \text{ m/s}^2 = 63.7 \text{ kg}\cdot\text{m/s}^2 / 9.8 \text{ m/s}^2$

Answer: $m = 6.5 \text{ kg}$

6. A NASA rover has a mass of 1,025 kg. Use the table to answer each part.

World	$g \text{ (m/s}^2\text{)}$
Earth	9.8
Moon	1.6
Mars	3.7
Jupiter	24.8

- What is the rover's mass on Mars?
 - What is the rover's weight on Mars?
 - How many times heavier would the rover be on Jupiter than on Earth?
 - Mass does not change with location: $m = 1,025 \text{ kg}$ on Mars.
 - $F_g = mg = (1,025 \text{ kg})(3.7 \text{ m/s}^2) = 3,792.5 \text{ kg}\cdot\text{m/s}^2 = 3,800 \text{ N down}$ ($3.8 \times 10^3 \text{ N}$)
 - Weight is proportional to g : $24.8 / 9.8 = 2.5 \text{ times}$ heavier (Jupiter: 25,420 N, about 25,000 N; Earth: 10,045 N, about 10,000 N)
-

7. On a planet in another solar system, a robot probe with a mass of 250 kg has a weight of 2,750 N. Find the value of g on this planet. Would a person weigh more there or on Earth? Explain.

Knowns: $m = 250 \text{ kg}$, $F_g = 2,750 \text{ N}$

Equation: $F_g = mg$, so $g = F_g / m$

Substitute: $g = 2,750 \text{ N} / 250 \text{ kg} = 2,750 \text{ kg}\cdot\text{m/s}^2 / 250 \text{ kg}$

Answer: $g = 11.0 \text{ m/s}^2$. A person would weigh **more** there, because g is bigger than Earth's 9.8 m/s^2 and their mass is the same.