Concept-Development Practice Page **3-1**

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## *Mass and Weight*

Learning physics is learning the connections among concepts in nature, and also learning to distinguish between closely related concepts. Velocity and acceleration, which are treated in the next chapter, are often confused. Similarly in this chapter, we find that mass and weight are often confused. They aren't the same! Please review the distinction between mass and weight in your textbook. To reinforce your understanding of this distinction, circle the correct answers below.

Comparing the concepts of mass and weight, one is basic—fundamental—depending only on the internal makeup of an object and the number and kind of atoms that compose it. The concept that is fundamental is (mass) (weight).

The concept that additionally depends on location in a gravitational field is (mass) (weight).

(Mass) (Weight) is a measure of the amount of matter in an object and only depends on the number and kind of atoms that compose it.

It can correctly be said that (mass) (weight) is a measure of "laziness" of an object.

(Mass) (Weight) is related to the gravitational force acting on the object.

(Mass) (Weight) depends on an object's location, whereas (mass) (weight) does not.

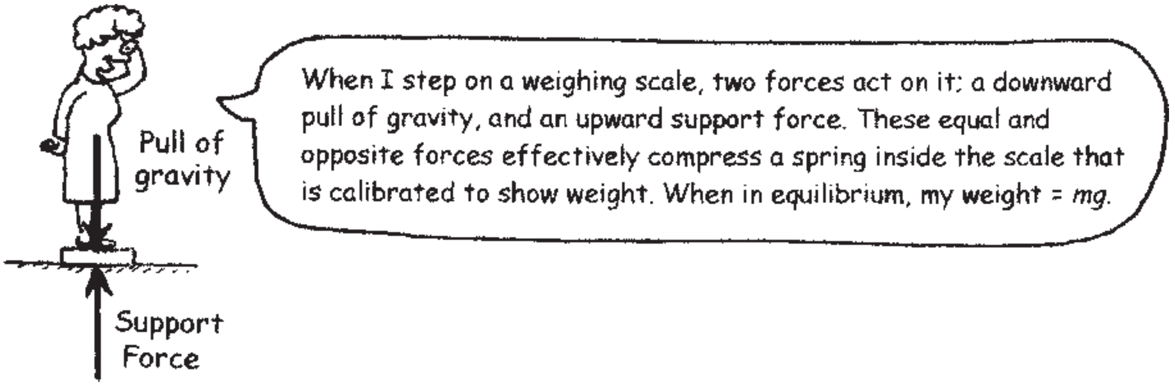
In other words, a stone would have the same (mass) (weight) whether it is on the surface of Earth or on the surface of the moon. However, its (mass) (weight) depends on its location.

On the moon's surface, where gravity is only about one sixth of Earth gravity (mass) (weight) (both the mass and the weight) of the stone would be the same as on Earth.

While mass and weight are not the same, they are (directly proportional) (inversely proportional) to each other. In the same location, twice the mass has (twice) (half) the weight.

The International System of Units (SI) unit of mass is the (kilogram) (newton), and the SI unit of force is the (kilogram) (newton).

In the United States, it is common to measure the mass of something by measuring its gravitational pull to Earth, its weight. The common unit of weight in the U.S. is the (pound) (kilogram) (newton).

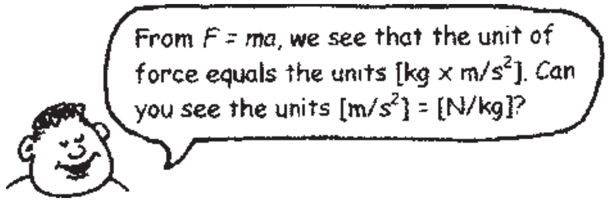


## *Converting Mass to Weight*

Objects with mass also have weight (although they can be weightless under special conditions). If you know the mass of something in **kilograms** and want its weight in **newtons**, at Earth's surface, you can take advantage of the formula that relates weight and mass.

Weight = mass × acceleration due to gravity
$W = mg$

This is in accord with Newton's second law, written as $F = ma$. When the force of gravity is the only force, the acceleration of any object of mass $m$ will be $g$, the acceleration of free fall. Importantly, $g$ acts as a proportionality constant, 10 N/kg, which is equivalent to 10 m/s$^2$.




*Sample Question:*
How much does a 1-kg bag of nails weigh on Earth?

$W = mg = (1\text{ kg})(10\text{ m/s}^2) = 10\text{ m/s}^2 = 10\text{ N}$,
or simply, $W = mg = (1\text{ kg})(10\text{ N/kg}) = 10\text{ N}$.

*Answer the following questions.*
Felicia the ballet dancer has a mass of 45.0 kg.

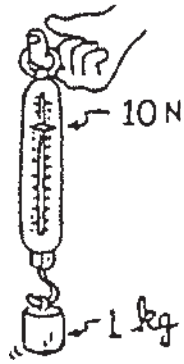
1. What is Felicia's weight in newtons at Earth's surface? ____________

2. Given that 1 kilogram of mass corresponds to 2.2 pounds at Earth's surface, what is Felicia's weight in pounds on Earth? ____________

3. What would be Felicia's mass on the surface of Jupiter? ____________

4. What would be Felicia's weight on Jupiter's surface, where the acceleration due to gravity is 25.0 m/s$^2$? ____________

Different masses are hung on a spring scale calibrated in newtons.
The force exerted by gravity on 1 kg = 10 N.




5. The force exerted by gravity on 5 kg = __________ N.

6. The force exerted by gravity on __________ kg = 100 N.

Make up your own mass and show the corresponding weight:
The force exerted by gravity on __________ kg = __________ N.

By whatever means (spring scales, measuring balances, etc.), find the mass of your physics book. Then complete the table.

| OBJECT | MASS | WEIGHT |
|---|---|---|
| MELON | 1 kg | |
| APPLE | | 1 N |
| BOOK | | |
| A FRIEND | 60 kg | |

**CONCEPTUAL PHYSICS**