Name: ______________________________ Date: __________ **Skill and Practice**

3G Mass, Weight, and Gravity

Read:

How do we define mass, weight, and gravity?

mass	weight	gravity
• Mass is a measure of the amount of matter in an object. Mass is not related to gravity. • The mass of an object does not change when it is moved from one place to another. • Mass is commonly measured in grams or kilograms.	• Weight is a measure of the gravitational force between two objects. • The weight of an object does change when the amount of gravitational force changes, as when an object is moved from Earth to the moon. • Weight is commonly measured in newtons or pounds.	• The force that causes all masses to attract one another. The strength of the force depends on the size of the masses and their distance apart.

How are mass, weight, and gravity related?

The weight equation $W = mg$ shows that an object's weight (in newtons) is equal to its mass (in kilograms) multiplied by the strength of gravity (in newtons per kilogram) where the object is located. The weight equation can be rearranged to find weight, mass, or the strength of gravity if you know any two of the three.

Use...	if you want to find...	and you know...
$W = mg$	weight (W)	mass (m) and strength of gravity (g)
$m = W/g$	mass (m)	weight (W) and strength of gravity (g)
$g = W/m$	strength of gravity (g)	weight (W) and mass (m)

Example:

- Calculate the weight (in newtons) of a 5.0-kilogram backpack on Earth (g = 9.8 N/kilogram).

  Solution:

$$W = m(g)$$
$$W = (5.0 \text{ kg})(9.8 \text{ N/kg})$$
$$W = 49 \text{ N}$$

- The same backpack weighs 8.2 newtons on Earth's moon. What is the strength of gravity on the moon?

  Solution:

$$g = W/m$$
$$g = 8.2 \text{ N} / 5.0 \text{ kg}$$
$$g = 1.6 \text{ N/kg}$$

Skill and Practice

Practice:

1. A physical science textbook has a mass of 2.2 kilograms.
   a. What is its weight on Earth?

   b. What is its weight on Mars? (g = 3.7 N/kg)

   c. If the textbook weighs 19.6 newtons on Venus, what is the strength of gravity on that planet?

2. An astronaut weighs 104 newtons on the moon, where the strength of gravity is 1.6 newtons per kilogram.
   a. What is her mass?

   b. What is her weight on Earth?

   c. What would she weigh on Mars?

3. Of all the planets in our solar system, Jupiter has the greatest gravitational strength.
   a. If a 0.500-kilogram pair of running shoes would weigh 11.55 newtons on Jupiter, what is the strength of gravity there?

   b. If the same pair of shoes weighs 0.3 newtons on Pluto (a dwarf planet), what is the strength of gravity there?

   c. What does the pair of shoes weigh on Earth?

4. A tractor-trailer truck carrying boxes of toy rubber ducks stops at a weigh station on the highway. The driver is told that the truck weighs 44,000 pounds.

   a. If there are 4.448 newtons in a pound, what is the weight of the toy-filled truck in newtons?

   b. What is the mass of the toy-filled truck?

   c. The truck drops off its load of toys, then stops at a second weigh station. Now the truck weighs 33,000 pounds. What is its weight in newtons?

   d. Challenge! Find the total mass of the rubber duck-filled boxes that were carried by the truck.