

## 3.E: Matter and Energy (Exercises)

### 3.1: In Your Room

### 3.2: What Is Matter?

1. What is matter?
2. What does weight mean?
3. In this chapter, we'll learn about atoms, which are the building blocks of all matter in the universe. As of 2011, scientists only know of 118 different types of atoms. How do you think it's possible to generate so many different forms of matter using only 118 types of building blocks?
4. Which do you think has more matter, a cup of water or a cup of mercury? Explain.
5. Decide whether each of the following statements is true or false.
  - a. Mass and weight are two words for the same concept.
  - b. Molecules are bonded together to form atoms.
  - c. Alchemists couldn't make gold out of common metals because gold is an element.
  - d. The symbol for Gold in the periodic table is Gd.
6. Would you have more mass on the moon or on Earth?
7. Would you have more weight on the moon or on Earth? The force of gravity is stronger on the Earth than it is on the moon.
8. Match the following terms with their meaning.

Terms	Definitions
(a) Mass	a. a measure of the total quantity of matter in an object
(b) Volume	b. a measure of how strongly gravity pulls on an object
(c) Weight	c. a measure of the space occupied by an object

9. For the following statements, circle all of the options that apply:

- Mass depends on...
  - (a) the total quantity of matter
  - (b) the temperature
  - (c) the location
  - (d) the force of gravity
- Volume depends on...
  - (a) the total quantity of matter
  - (b) the temperature
  - (c) the object's shape (independent of size)
  - (d) the object's size (independent of shape)
- Weight depends on...
  - (a) the total quantity of matter
  - (b) the temperature
  - (c) the location
  - (d) the force of gravity

### 3.3: Classifying Matter According to Its State: Solid, Liquid, and Gas

### 3.4 Classifying Matter According to Its Composition

### 3.5: Differences in Matter: Physical and Chemical Properties

### 3.6: Changes in Matter: Physical and Chemical Changes

### 3.7: Conservation of Mass: There is No New Matter

### 3.8: Energy

1. Classify each of the following as energy primarily transferred as heat, or energy primarily transferred as work:
  - a. The energy transferred from your body to a shopping cart as you push the shopping cart down the aisle.
  - b. The energy transferred from a wave to your board when you go surfing.
  - c. The energy transferred from the flames to your hotdog when you cook your hotdog over a campfire.
2. Decide whether each of the following statements is true or false:
  - a. When heat is transferred to an object, the object cools down.
  - b. Any time you raise the temperature of an object, you have done work.
  - c. Any time you move an object by applying force, you have done work.
  - d. Any time you apply force to an object, you have done work.
3. Rank the following scenarios in order of increasing work:
  - a. You apply 100 N of force to a boulder and successfully move it by 2 m.
  - b. You apply 100 N of force to a boulder and successfully move it by 1 m.
  - c. You apply 200 N of force to a boulder and successfully move it by 2 m.
  - d. You apply 200 N of force to a boulder but cannot move the boulder.
4. In science, a vacuum is defined as space that contains absolutely no matter (no molecules, no atoms, etc.) Can energy be transferred as heat through a vacuum? Why or why not?
5. Classify each of the following energies as kinetic energy or potential energy:
  - a. The energy in a chocolate bar.
  - b. The energy of rushing water used to turn a turbine or a water wheel.
  - c. The energy of a skater gliding on the ice.
  - d. The energy in a stretched rubber band.
6. Decide which of the following objects has more kinetic energy:
  - a. A 200 lb. man running at 6 mph or a 200 lb. man running at 3 mph.
  - b. A 200 lb. man running at 7 mph or a 150 lb. man running at 7 mph.
  - c. A 400 lb. man running at 5 mph or a 150 lb. man running at 3 mph.
7. A car and a truck are traveling along the highway at the same speed.
  - a. If the car weighs 1500 kg and the truck weighs 2500 kg, which has more kinetic energy, the car or the truck?
  - b. Both the car and the truck convert the potential energy stored in gasoline into the kinetic energy of motion. Which do you think uses more gas to travel the same distance, the car or the truck?
8. You mix two chemicals in a beaker and notice that as the chemicals react, the beaker becomes noticeably colder. Which chemicals have more chemical potential energy, those present at the start of the reaction or those present at the end of the reaction?

### 3.9: Energy and Chemical and Physical Change

### 3.10: Temperature: Random Motion of Molecules and Atoms

### 3.11: Temperature Changes: Heat Capacity

### 3.12: Energy and Heat Capacity Calculations

1. A pot of water is set on a hot burner of a stove. What is the direction of heat flow?
2. Some uncooked macaroni is added to a pot of boiling water. What is the direction of heat flow?
3. How much energy in calories is required to heat 150 g of  $\text{H}_2\text{O}$  from  $0^\circ\text{C}$  to  $100^\circ\text{C}$ ?
4. How much energy in calories is required to heat 125 g of Fe from  $25^\circ\text{C}$  to  $150^\circ\text{C}$ ?
5. If 250 cal of heat were added to 43.8 g of Al at  $22.5^\circ\text{C}$ , what is the final temperature of the aluminum?

6. If 195 cal of heat were added to 33.2 g of Hg at 56.2°C, what is the final temperature of the mercury?
7. A sample of copper absorbs 145 cal of energy, and its temperature rises from 37.8°C to 41.7°C. What is the mass of the copper?
8. A large, single crystal of sodium chloride absorbs 98.0 cal of heat. If its temperature rises from 22.0°C to 29.7°C, what is the mass of the NaCl crystal?
9. If 1.00 g of each substance in Table 7.3 were to absorb 100 cal of heat, which substance would experience the largest temperature change?
10. If 1.00 g of each substance in Table 7.3 were to absorb 100 cal of heat, which substance would experience the smallest temperature change?
11. Determine the heat capacity of a substance if 23.6 g of the substance gives off 199 cal of heat when its temperature changes from 37.9°C to 20.9°C.
12. What is the heat capacity of gold if a 250 g sample needs 133 cal of energy to increase its temperature from 23.0°C to 40.1°C?

## Answers

1. Heat flows into the pot of water.
3. 15,000 cal
5. 49.0°C
7. 404 g
9. Mercury would experience the largest temperature change.
11. 0.496 cal/g•°C

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