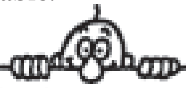
Name ____________________ Class ____________ Date ____________

Concept-Development Practice Page 21-1

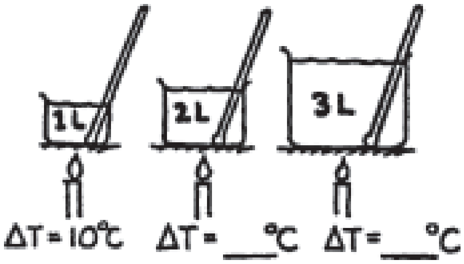
Temperature and Heat

1. Complete the table.

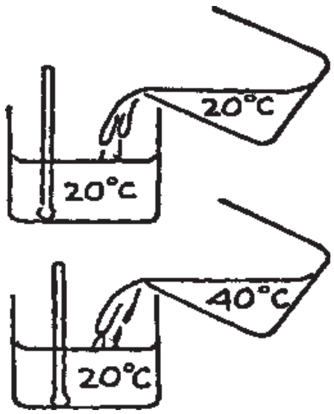


TEMPERATURE OF MELTING ICE	°C	32 °F	K
TEMPERATURE OF BOILING WATER	°C	212°F	K

2. Suppose you apply a flame and heat one liter of water, raising its temperature 10°C. If you transfer the same heat energy to two liters, how much will the temperature rise? For three liters? Record your answers on the blanks in the drawing at the right.



3. A thermometer is in a container half-filled with 20°C water.



   a. When an equal volume of 20°C water is added, the temperature of the mixture is

   (10°C) (20°C) (40°C).

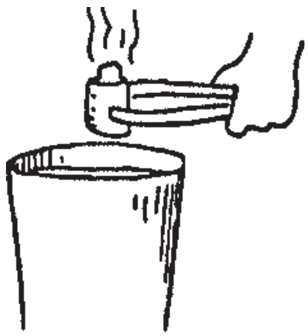
   b. When instead an equal volume of 40°C water is added, the temperature of the mixture will be

   (20°C) (30°C) (40°C).

   c. When instead a small amount of 40°C water is added, the temperature of the mixture will be

   (20°C) (between 20°C and 30°C) (30°C) (more than 30°C).

4. A red-hot piece of iron is put into a bucket of cool water. *Mark the following statements true (T) or false (F).* (Ignore heat transfer to the bucket.)



   a. The decrease in iron temperature equals the increase in the water temperature. ________

   b. The quantity of heat lost by the iron equals the quantity of heat gained by the water. ________

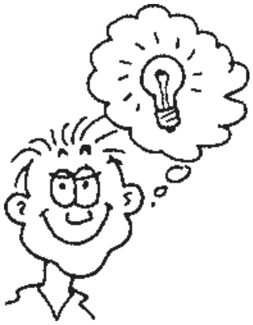
   c. The iron and water both will reach the same temperature. ________

   d. The final temperature of the iron and water is halfway between the initial temperatures of each. ________

5. The Do the Math! example on page 412 of your textbook shows the technique of unit conversion, called *dimensional analysis,* which indicates whether to multiply or divide when converting one quantity to another. The example converts Calories per day to watts. The *conversion factors* used in the example are (1 day)/(24 hours), (1 hour)/(3600 seconds), and (4184 joules)/(1 Calorie). The Calorie here is the "big" Calorie, commonly used in rating foods. Note carefully how the units cancel just as numbers do when multiplying fractions.

We will use this technique to solve the following: How many joules of energy are transferred per day at the rate of 1 watt? We know that 1 W is equal to 1 J/s. So

$$\frac{1\ \text{J}}{1\ \cancel{\text{s}}} \times \frac{3600\ \cancel{\text{s}}}{1\ \cancel{\text{h}}} \times \frac{24\ \cancel{\text{h}}}{1\ \text{d}} = \underline{\hspace{3cm}}\ \text{J/d}$$



Note in this case that (1 J)/(1 s) is multiplied by (3600 s)/(1 h) rather than by (1 h)/(3600 s). This way, the units s cancel. The same is true for units h. So 1 J is multiplied by 3600, since there are 3600 seconds in 1 hour, and again by 24, because there are 24 hours in 1 day. These numbers appear only in the numerators, so they are simply multiplied. We multiply the numerators and divide by the denominators. In this case we see only the numerical values of 1 appear in the demoninators.

a. By *dimensional analysis* convert 50 calories per hour *(small* calories) to joules per day.

$$\frac{50\ \text{cal}}{1\ \text{h}} \times \frac{\underline{\hspace{2cm}}\ \text{h}}{\text{d}} \times \frac{\underline{\hspace{2cm}}\ \text{J}}{\text{cal}} = \underline{\hspace{2cm}}$$

b. Try this one: How many joules will a 100-watt bulb give off in 4 hours?

$$100\ \text{W} \times 4\ \text{h} = \frac{\underline{\hspace{2cm}}\ \text{J}}{\text{s}} \times 4\ \text{h} \times \frac{\underline{\hspace{2cm}}\ \text{s}}{\text{h}} = \underline{\hspace{3cm}}\ \text{J}$$

c. This one puts you more on your own: Find the number of joules given off by a 4-W bulb in a night light that burns continously for one month (1 mo).

$$4\ \text{W} \times 1\ \text{mo} = \frac{4\ \text{J}}{1\ \text{s}} \times 1\ \text{mo} \times \underline{\hspace{5cm}} = \underline{\hspace{3cm}}\ \text{J}$$

6. On a certain planet the unit of heat energy is called the OOH, where 1 OOH = 3 calories, and the unit of time is called the AAH, where 1 AAH = 12.56 seconds. By *dimensional analysis* show that 1 watt = 1 OOH/AAH.