Name _____ Period _____ Date _____

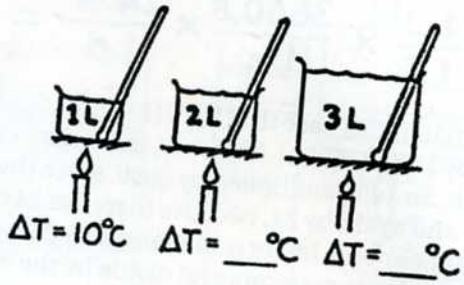
Concept-Development Practice Page **21-1**

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

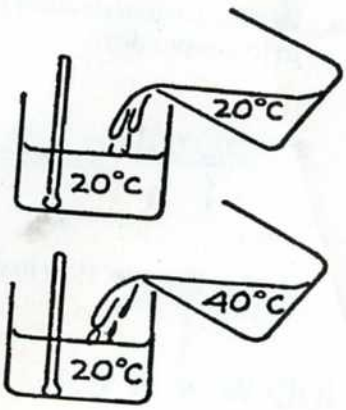
   (10° C) (20°C) (40°C)

   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)



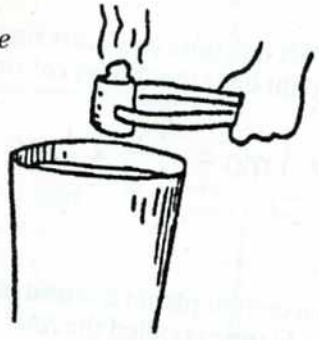
4. A red-hot piece of iron is put into a bucket of cool water. *Mark the following statements true (T) or false (F).* (Ignore heat transfer to the bucket.)

   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._____



Conceptual PHYSICS

5. The Computational Example on page 312 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 hour), (1 hour)/(3600 seconds), and (4184 joules)/(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

$$\frac{1\ \text{J}}{1\ \text{s}} \times \frac{3600\ \text{s}}{1\ \text{h}} \times \frac{24\ \text{h}}{1\ \text{d}} = \_\_\_\_\_\ \text{J/d}$$

Note that 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.

$$\frac{50\ \text{cal}}{1\ \text{h}} \times \frac{\text{h}}{\text{d}} \times \frac{\text{J}}{\text{cal}} = \_\_\_\_\_$$

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

$$100\ \text{W} \times 4\ \text{h} = \frac{\text{J}}{\text{s}} \times 4\ \text{h} \times \frac{\text{s}}{\text{h}} = \_\_\_\_\_\ \text{J}$$

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

$$4\ \text{W} \times 1\ \text{mo} = \frac{4\ \text{J}}{1\ \text{s}} \times 1\ \text{mo} \times \_\_\_\_\_ = \_\_\_\_\_\ \text{J}$$

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.

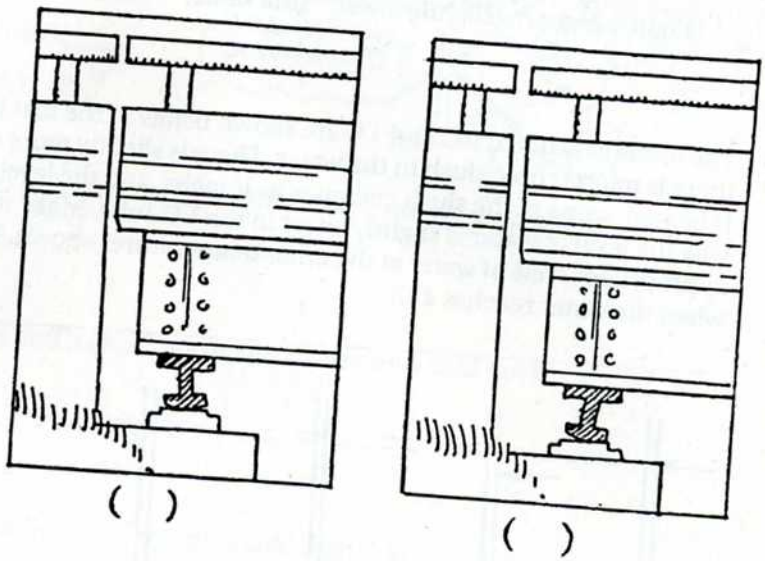
Name

Period Date

Concept-Development Practice Page **21-2**

Thermal Expansion

1. Long steel bridges often have one end fixed while the other end rests on rockers, as shown. Each sketch shows the bridge at a different season of the year. Mark the sketches winter (W) or summer (S). Briefly defend your answer.



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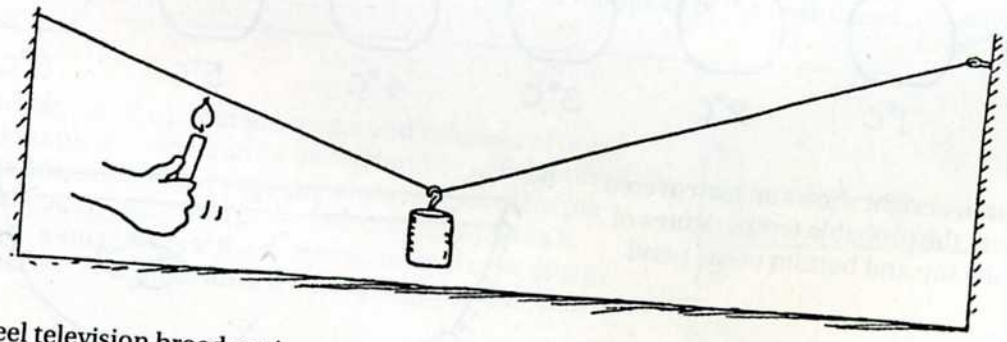
2. The weight hangs above the floor from the copper wire. When a candle is moved along the wire and heats it, what happens to the height of the weight above the floor? Why?

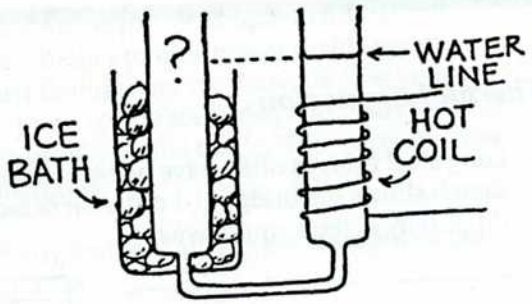


3. A steel television broadcasting tower is taller in the daytime than it is in the cooler nighttime. This is because steel expands (or contracts) about 1 part in 100 000 for each degree Celsius change. By this we mean that a piece of steel 100 000 units long will be 100 001 units long when its temperature increases by 1°C. What is the change in height for a 500-m steel tower when its temperature changes 20°C from day to night?

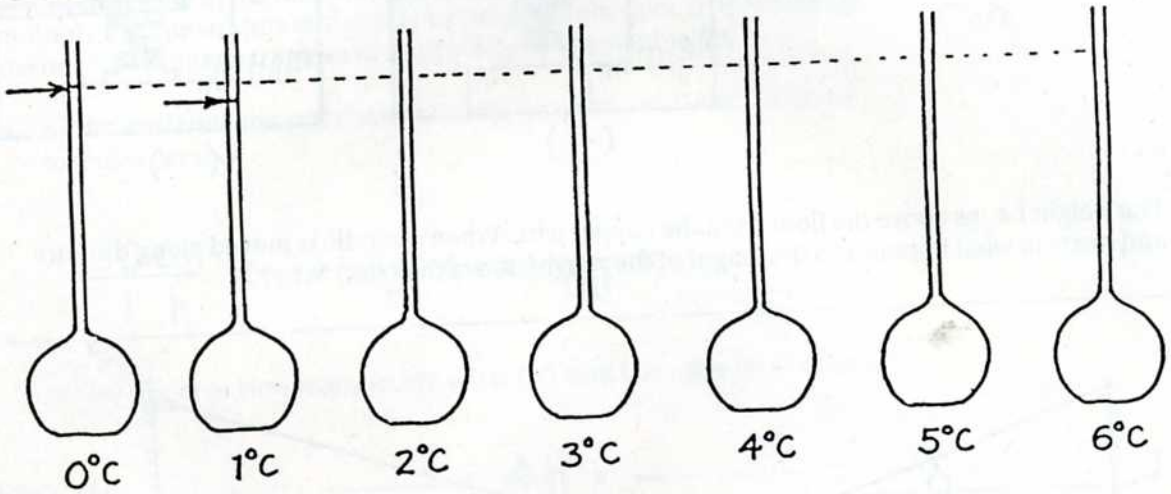
_____ cm

4. A common saying is "water seeks its own level," and usually it does. Here we see a container of water that is cooled on the left and warmed on the right. Consider the effect of temperature on density. Compared to the water level in the right tube, the water level in the left tube is

(slightly higher) (slightly lower) (the same)



5. The levels of water at 0°C and 1°C are shown below in the first two flasks. At these temperatures there is microscopic slush in the water. There is slightly more slush at 0°C than at 1°C. As the water is heated, some of the slush collapses as it melts, and the level of the water falls in the tube. That's why the level of water is slightly lower in the 1°C-tube. Make rough estimates and sketch in the appropriate levels of water at the other temperatures shown. What is important about the level when the water reaches 4°C?



6. The diagram at right shows an ice-covered pond. Mark the probable temperatures of water at the top and bottom of the pond.