# Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Period \_\_\_\_\_

###### Thermal Energy Review Problems

Rate of

heat transfer

=

k·A·(T1-T2)

d

 Q = m(TF – TI)cp

**Specific heats:**

H2O = 4.184 J/(g xoC) Ag = 0.235 J/(g xoC) Al = 0.899 J/(g xoC) Pb =0.129 J/(g xoC)

Fe = 0.460 J/(g xoC) Alcohol = 2.29 J/g **.** oC Zn = 0.385 J/(g xoC)

## I. Finding Q or Change in Thermal Energy Problems

1. A piece of silver is placed in a flame for 5 minutes and the temperature rises from 22.0 oC to 57.0 oC. It is then taken out of the fire for 10 minutes and cools from 57.0 oC to 42.0 oC. It is then massed on a triple beam balance and has a mass of 13.7 g.

 What is the change in thermal energy for the first 5 minutes?

 What is the change in thermal energy for the last 10 minutes?

 What is the change in thermal energy for the whole 15 minutes?

2. A beaker containing 13.7 g of water is placed into the same flame for 5 seconds and its temperature

rises from 22 oC to 24.1 oC. What is the change in thermal energy?

## II. Specific Heat Problems

3. A metal teapot, which has a mass of 450.0 g, is at 14.0 oC when 500.0 g of boiling water (100.0 oC) are poured into it. If the temperature of the water and the metal teapot are 93.3 oC after the water is poured in, what is the specific heat of the metal? What metal is the teapot probably made of?

4. A piece of metal with a mass of 60.0 g is heated to 100.0 oC and dropped into 105 g of water that is at

20.0 oC. The final temperature of the water and the metal is 30.0 oC. What is the specific heat of the metal? What type of metal is it?

5. Predict the effect of the following variations upon the rate at which heat is transferred through a rectangular object by filling in the blanks.

 a. If the area through which heat is transferred is doubled, then the rate of heat transfer is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ .

 b. If the thickness of the material through which heat is doubled, then the rate of heat transfer is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

 c. If the thickness of the material through which heat is transferred is 1/3 as much, then the rate of heat transfer is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

 d. If the thermal conductivity of the material through which heat is transferred is 5 times as high, then the rate of heat transfer is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

 e. If the thermal conductivity of the material through which heat is transferred is increased10 times, then the rate of heat transfer is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

 f. If the temperature difference on opposite sides of the material through which heat is transferred is doubled, then the rate of heat transfer is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

6. Explain why the 2-4 inch thick layer of *blubber* on a polar bear helps to keep polar bears warm during frigid artic weather.

7. Calculate the rate of heat transfer on a cold day through a rectangular window that is 1.15 m wide and 2.23 m high, has a thickness of 4.12 mm, a thermal conductivity value of 0.270 W/m/°C. The temperature inside the home is 23.0°C and the temperature outside the home is 4.00°C.

8. Consider the example problem above. Suppose that a wall with thick insulation replaces the area where the window is located. The thermal conductivity of the same area will be decreased to 0.00391 W/m/°C and the thickness will be increased to 16.0 cm. Determine the rate of heat transfer through this area.

Using the specific heats on the front of this page, answer the following questions:

9. Two identical beakers are placed side by side on a hot plate. One contains 100.0 g of alcohol, and the other contains 65 g of water, both at 20.0 oC. Which will have the greatest change in Q to reach a temperature of 50.0 oC? How much more?

10. A piece of iron and a piece of zinc are heated from 25.0 oC to 30.0 oC. They both have a mass of 75.3g each. Calculate the change in thermal energy for each metal.