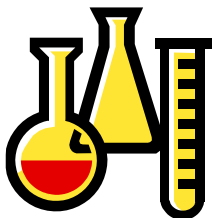


Chemistry Worksheet: Heat & Calorimetry Problems

(show your work & BOX your answers)

Equations: $Q = m \times C_p \times \Delta T$ (for a single mass being heated)
 $(m_{\text{water}})(4.18 \text{ J/g}^\circ\text{C})(\Delta T_{\text{water}}) = (m_{\text{metal}})(C_{p\text{-metal}})(\Delta T_{\text{metal}})$ (for an object dropped into water, i.e., a calorimeter problem)
HEAT PROBLEMS

- How many J of heat is required to raise the temp. of 200. g of water from 20.0°C to 50.0°C?
- If 700. g of water loses 27.0 kiloJoules of heat, what is its ΔT ?
- Some water is heated from 10.0°C to 50.0°C. During the process, 50.0 kiloJoules of heat is added to the water. What is the mass (grams) of water heated?
- What is the specific heat of an unknown substance, if 950. J of heat raises the temperature of a 20.00 g sample from 18.0°C to 42.0°C?
- Hg has a specific heat of 0.139 J/g°C. How much heat is required to raise the temperature of a 22.80 g sample from 16.1°C to 32.5°C?
- How many kJ of heat are needed to raise the T of 1.50 L of water from 20.0°C to 37.0°C?
- The specific heats (C_p 's) of 3 different substances are listed as:
carbon tetrachloride: 0.856 J/g°C benzene: 1.74 J/g°C acetic acid: 2.05 J/g°C
A chemistry student finds that 1.47 kJ of heat raised the temperature of 19.70 g of an unknown substance by 36.4°C. Which of the three substances listed is the unknown substance?
- How many kJ is released from a 2.00 L bottle of Surge when it cools from 70.0°F (294 K) to its freezing point? (Assume that the pop has the same properties as water.)
- What mass of glass ($C_p = 0.749 \text{ J/g}^\circ\text{C}$) is needed to absorb $5.00 \times 10^4 \text{ J}$ of heat, if it starts at 26.0°C and has a final temp of 275.0°C?
- What final temperature will 120.00 g of benzene at 7.00°C have after it absorbs 2.20 kJ of heat? The C_p of benzene is 1.74 J/g°C. Recall that $\Delta T = \text{final temp} - \text{initial temp}$ or $\text{final temp} = \text{initial temp} + \Delta T$.
- 3.0 kg of Osmium (Os) metal at 241 K is heated to 394 K. How much heat energy is needed for this? The C_p of Os is 0.130 J/g°C.
- 14.22 g of a substance absorbs 1.77 kJ of heat. Its temperature changes from -23.0°C to 31.0°C. What is the specific heat of the substance?
- The density of gold (Au) is 19.3 g/cm³. What volume in cm³ of Au can absorb 2.30 kJ of heat when $\Delta T = 5.00^\circ\text{C}$? The C_p of Au is 0.128 J/g°C.

14. Calculate the **final temperature** of a sample of Tellurium (Te, $C_p = 0.201 \text{ J/g}^\circ\text{C}$), when 82.50 g of Te at 12.0°C releases $2.00 \times 10^3 \text{ J}$ of heat. Recall that $\Delta T = (\text{final temperature} - \text{initial temperature})$.

CALORIMETRY PROBLEMS

1. Calculate the specific heat of a metal if 2.36×10^2 grams of it at 99.5°C is added to 125.0 mL of water at 22.0°C . The final temperature of the system is 25.4°C .
2. A lump of chromium (Cr) has a mass of 95.3 grams and a temperature of 90.5°C . It is placed into a calorimeter with 75.2 mL of water at 20.5°C . After stirring, the final temperature of the water, Cr metal, and calorimeter is 28.6°C . What is the specific heat of Cr metal?
3. A 100.0 gram sample of water at 50.0°C is mixed with a 50.00 gram sample of water at 20.0°C . What is the final temperature of the 150.0 grams of water?

Extra Credit (3 pts each) - Do either problem (or both)

1. When coal is mined, it is tested for how much heat it can produce when it burns. A 1.245 g sample of coal was placed into a calorimeter containing 2000.0 mLs of water at 17.5°C . After the coal was combusted in the calorimeter, the water's temperature was found to be 24.7°C .
 - a) How many J of heat were produced by the burning of this coal sample?
 - b) How much heat would 1.00 kg of this coal produce?
 - c) How many BTU's/pound would this coal produce? 1 Joule = 9.5×10^{-4} BTU of heat. (A BTU is a British Thermal Unit). There are 453.6 grams in 1 pound.
2. A sample of food with a mass of 3.440 g is combusted (burned) in a calorimeter. The calorimeter contains 165.00 grams of water at 24.1°C . The final temperature of the calorimeter (after combustion of the food) is 67.2°C .
 - a) Calculate the amount of heat in kJ released by the combustion of the food.
 - b) Determine the kJ that each gram of food contains.
 - c) If 1 calorie = 4.18 J, how many calories/gram does this food contain?
 - d) A food Calorie is really a kilocalorie (1000 calories). Convert your answer in (c) to Cal/gram.
 - e) If a serving of this food is 120 grams, how many Calories/serving does this food contain?