Calorimetry

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CALORIMETRY PROBLEMS

1. Calculate the heat gained by 125.0 g of water when it is put into a calorimeter and its temperature is increased by 90.0°C. The specific heat of water is 4.18 J/g·°C. (ans. 47.0 kJ)

$Q = mc\Delta T$

$Q = (125.0\,g)(4.18\,\frac{J}{g\,°C})(+90.0\,°C) = 47025\,J \div 1000 = 47.0\,KJ$

2. When 5.0 g of NaOH is dissolved in 100 mL of water the temperature rises from 20.0°C to 33.2 °C. ← fixed

a) Is the dissolving process endo or exothermic?

b) Calculate how much energy is absorbed when NaOH dissolves in kJ/g of NaOH? (1.1 kJ/g)

$Q = mc\Delta T$

$= (100\,g)(4.18\,\frac{J}{g\,°C})(13.2) = 5517.6\,J = \frac{5.5176\,KJ}{5.0\,g\,NaOH} = \frac{1.1\,KJ}{g\,NaOH}$

3. 1.65 g of napthalene ($C_{10}H_8$) is burned in a calorimeter (assume energy absorbed by the calorimeter is negligible) containing 2000.0 g of water. The temperature of the water rose from 20.20°C to 25.85°C. Calculate the heat of released by the naphthalene (moth balls) in KJ/g. (ans. 28.6 kJ/g)

$Q = mc\Delta T$

$= (2000\,g)(4.18\,\frac{J}{g\,°C})\,5.65\,°C$

$= 47234\,J \rightarrow 47.2\,KJ \Rightarrow$

$\frac{47.2\,Kg}{1.65\,g\ C_{10}H_8} = \frac{28.6\,KJ}{g}$

4. A 6.22 kg piece of copper (c = 0.385 J/g °C) is heated from 20.5 °C to 324.3 °C. Calculate the heat absorbed by the Cu in kJ. (728 kJ).

$Q = (6220\,g)(0.385\,\frac{J}{g\,°C})(303.8\,°C)$

$= \frac{727510\,J}{1000} = 728\,KJ$

5. How much heat (kJ) is released when 366 g of mercury (c = 0.139 J/g °C) cools from 77.0°C to 12.0°C?

(3.31 kJ)

$$Q = 366\,g\left(0.139\,\frac{J}{g^\circ C}\right)(-65\,^\circ C)$$

$$Q = -3307\,J \div 1000 = -3.31\,kJ$$

6. A piece of copper metal (c= 0.385 J/ g °C) with a mass of 6.22 kg at 20.5°C absorbs 727.5 KJ of heat energy. What is the final temperature of the copper? **(ans. = 324** °C)

X 1000

$$Q = mc\Delta T$$

$$727500\,J = (6220\,g)\left(0.385\,\frac{J}{g^\circ C}\right)(\Delta T)$$

$$303.8\,^\circ C = \Delta T$$

$$T_{final} = 303.8 + 20.5 = 342\,^\circ C \quad (3\ sf)$$

7. Determine the specific heat capacity of zinc from the following experiment. A 50.0 g piece of zinc is heated to 204 °C . The hot zinc is place in 200.0 g of water (c=4.18 J/g °C) at 25.0 °C . The final temperature of the water and zinc is 29.1 °C. (ans. 0.392 J/g °C)

Zn

$mc\Delta T$

H_2O

$mc\Delta T$

$$|(50\,g)(c)(-174.9\,^\circ C)| = |(200.0\,g)\left(4.18\,\frac{J}{g^\circ C}\right)(4.1\,^\circ C)|$$

$$c = 0.392\,\frac{J}{g^\circ C}$$