Calorimetry

-a lab technique used to measure energy changes that occur during a chemical reaction

*need to minimize any heat exchange with the surroundings

Calorimeters -two types:

1)simple or polystyrene calorimeter

-constant pressure (open to the atmosphere)

-requires a known amount of substance (usually water) which absorbs the heat produced by the process

-use $Q=mc\Delta T$

-use during dissolving reactions, neutralizations, heating and cooling

2)bomb calorimeter

-constant volume

-reaction occurs inside a metal chamber called a bomb

-use $Q=c\Delta T$ (c is in $J/^{\circ}C$, there is no mass in this c)

-used during dissolving reactions, neutralizations, heating cooling

-calibrated for a constant volume of water($\therefore$ no need for mass)

-used to measure heat of combustion

ex: simple calorimeter

70g of a metal was heated to 95.0°C then transferred to a polystyrene calorimeter. The calorimeter contained 100.0g of H2O at an initial temperature of 19.8°C. The final temperature of the contents was 22.6°C.

a)how much heat did the water gain?

b)how much heat did the metal lose?

c)what is the specific heat capacity of the metal?

a) $m_{H_2O} = 100.0g$

$c_{H_2O} = 4.184J/g°C$ $= 22.6°C - 19.8°C = 2.8°C$

$\Delta T = T_f - T_i$

$Q_w = mc\Delta T$

$Q_w = (100.0g)(4.184J/g°C)(2.8°C)$

$Q_w = 1172\ J$

b) $\Delta T_m = 95°C - 19.8°C$

$= -72.4°C$

c) $Q_m = m_m c_m \Delta T$

$Q_m = -1172\ J$

$-1172\ J = (70g)(c_m)(-72.4°C)$

$c_m = 0.231J/g°C$

ex: bomb calorimeter

16.0g of peanut butter is placed in a bomb calorimeter. The temperature increased by 50.5°C. The heat capacity of the calorimeter is 8.28 kJ/°C

a)how much heat was released?

b)What is the heat of combustion per gram of peanut butter?

a) $Q = c\Delta T$

$Q = (8.28\ kJ/°C)(50.5°C)$

$Q = 418\ kJ$

$$Q_{sample} = -Q_{calorimeter}$$

$$= -418\ kJ$$

$\therefore$ 418 kJ were released

b) $$\frac{Q\ sample}{mass\ sample} = \frac{Heat\ of\ combustion}{g}$$

$$\frac{-418\ kJ}{16g} = -26.2\ kJ/g$$

$\therefore$ the heat of combustion of 1 gram of peanut butter is

-26.2 kJ/g