Calorimetry Worksheet

C_p (H_2O) = 4.184 J / g^{0}C

$\Delta H = mC_p\Delta T$

1) A compound is burned in a bomb calorimeter that contains 3.00 L of water. If the combustion of 0.285 moles of this compound causes the temperature of the water to rise 36.0^0 C, what is the molar heat of combustion of the compound?

2) When 62.3g of a compound was burned in a bomb calorimeter that contained 0.500 L of water the temperature rise of the water in the calorimeter was 48.0^0 C. If the heat of combustion of the compound is 1,160 kJ/mol, what is the molar mass of the compound?

3) The molar heat of combustion of a compound is 1,350 kJ/mol. If 0.875 moles of this compound was burned in a bomb calorimeter containing 1.70 L of water, what would the increase in temperature be?

1) A compound is burned in a bomb calorimeter that contains 3.00 L of water. If the combustion of 0.285 moles of this compound causes the temperature of the water to rise 36.0^0 C, what is the molar heat of combustion of the compound?

$$3.00 \text{ L } H_2O = 3000\text{mL } H_2O = 3.00 \times 10^3 \text{ g } H_2O$$

$$\Delta H = (3.00 \times 10^3 \text{ g } H_2O)(4.184 \text{ J/g}^0\text{C})(36.0^0 \text{ C}) = 452000 \text{ J}$$
$$\Delta H = 452 \text{ kJ}$$

We now have the heat generated by the combustion of the compound so to find the molar heat of combustion we need only divide this by the number of moles of compound burned.

$$\frac{452 \text{ kJ}}{0.285 \text{ mol}} = 1590 \text{ kJ/mol}$$

2) When 62.3 g of a compound was burned in a bomb calorimeter that contained 0.500 L of water the temperature rise of the water in the calorimeter was 48.0^0 C. If the heat of combustion of the compound is 1,160 kJ/mol, what is the molar mass of the compound?

$$0.500 \text{ L } H_2O = 5\underline{00} \text{ mL } H_2O = 5.00 \times 10^2 \text{ g } H_2O$$

$$\Delta H = (5.00 \times 10^2 \text{ g } H_2O)(4.184 \text{ J/g}^0\text{C})(48.0^0 \text{ C}) = 100000 \text{ J}$$
$$\Delta H = 1\underline{00} \text{ kJ}$$

Now that we have the heat generated by the combustion of the compound we divide it by the given molar heat of combustion to find the number of moles of the compound that was burned.

$$\frac{100. \text{ kJ}}{1160 \text{ kJ/mol}} = 0.0862 \text{ mol}$$

Since we know that 62.3 g of the compound was combusted and that this is equal to the number of moles burned we can divide the mass by the moles to get the molar mass of the compound.

$$\frac{62.3 \text{ g}}{0.0862 \text{ mol}} = 723 \text{ g/mol}$$

3) The molar heat of combustion of a compound is 1,350 kJ/mol. If 0.875 moles of this compound was burned in a bomb calorimeter containing 1.70 L of water, what would the increase in temperature be?

We are given both the number of moles of compound and the molar heat of combustion so by multiplying them together we can find the heat generated.

$$(0.875 \text{ mol})(1350 \text{ kJ/mol}) = 1180 \text{ kJ} = 118000 \text{ J}$$

Plug this value into our equation and then rearrange to find the change in the temperature.

$$118000 \text{ J} = (1.70 \times 10^3 \text{ g } H_2O)(4.184 \text{ J/g}^0\text{C})(\Delta T)$$

$$\Delta T = \frac{118000 \text{ J}}{(1.70 \times 10^3 \text{ g } H_2O)(4.184 \text{ J/g}^0\text{C})} = 16.6\ ^0\text{C}$$