

## Heat Equations

add thermochemical equations - add enthalpies

$$\Delta H_{\text{rxn}} = \sum(\text{coeff})\Delta H_{\text{f,prods}} - \sum(\text{coeff})\Delta H_{\text{f,reacts}}$$

$q = \text{heat (J or kJ)}$                        $\Delta H = \text{enthalpy (J/mole or kJ/mole)}$

$$q = C_{\text{cal}}\Delta T \quad (\text{measure heat w calorimeter})$$

$$q = n \Delta H \quad (\text{reaction or phase change})$$

$$q = \text{mass } C_p \Delta T \quad (\text{heat a single substance})$$

$$\text{heat system} + \text{heat surroundings} = 0$$

- 1) A calorimeter has a heat capacity of 3150 J/°C. If the temperature of the calorimeter changes from 23.0°C to 34.3 °C, how much heat was transferred?
- 2) The specific heat capacity of liquid water is 4.184 J•g<sup>-1</sup>•°C<sup>-1</sup>. Calculate the heat change for 355 mL of liquid water cooling from 30.0 °C to 0.0 °C.                      density = 1.00 g/mL for liquid water
- 3) The specific heat capacity of aluminum metal is 0.901 J•g<sup>-1</sup>•°C<sup>-1</sup>. Calculate the heat required to raise the temperature of 10.0 grams of aluminum metal from 25.0°C to 225.0°C.
- 4)  $\Delta H^\circ = 43.5 \text{ kJ/mol}$  for the vaporization of ethanol. How much heat is required to evaporate 20.0 grams of ethanol (MW = 46.07 g/mole)?
- 5)  $\Delta H^\circ = 6.01 \text{ kJ/mol}$  for the fusion reaction of water. How much heat must be removed to make a tray of ice cubes? (12 cubes/tray ; 60.0 g water/cube)
- 6) A 25.00 g cylinder of stainless steel at 200.0 °C is added to 100.0 mL of water at 22.0 °C in an insulated cup. The final temperature is 27.3 °C. What is the specific heat capacity of stainless steel?
- 7) A reaction ( $\Delta H^\circ_{\text{rxn}} = -327.9 \text{ kJ/mol}$ ) is run in a calorimeter with  $C_{\text{cal}} = 4234 \text{ J/}^\circ\text{C}$ . What will be the temperature change of the calorimeter for 0.111 moles of reaction?
- 8) A calorimeter has a heat capacity of 5618 J/°C.  $4.30 \times 10^{-3}$  moles of reaction changes the temperature of the calorimeter from 22.2°C to 29.7 °C. What is the enthalpy of the reaction?

- 1)  $3.56 \times 10^4 \text{ J}$    2)  $-4.46 \times 10^4 \text{ J}$    3)  $1.80 \times 10^3 \text{ J}$    4) 18.9 kJ   5) -240. kJ   6) 0.514 J/g•°C  
 7) 8.60 °C   8)  $-9.80 \times 10^3 \text{ kJ/mole}$