CHM151 Q1 25 Pts Fall 2004 Name: Key

SHOW WORK TO RECEIVE CREDIT.

1. What is the specific heat of ethyl alcohol if 700.0 J of heat are required to raise the temperature of an 80.0-g sample from 30.0°C to 45.0°C?

$$\frac{700.0\ J}{80.0\ g \mid 15.0\ ^\circ C} = 0.583\ \frac{J}{g\ ^\circ C}$$

2. A 150.0 g sample of metal at 80.0°C is added to 150.0 g of H_2O at 20.0°C. The temperature rises to 23.3°C. Assuming that the calorimeter is a perfect insulator, what is the specific heat of the metal? (Specific heat of H_2O is 4.18 J/g°C.)

Heat gained H_2O = Heat lost Metal

For H_2O: $\frac{4.18\ J}{g\ ^\circ C} \mid 150.0\ g \mid 3.3\ ^\circ C = 2069.1\ J$ (GAINED)

For metal Sp Ht: $\frac{2069.1\ J}{150.0\ g \mid 56.7\ ^\circ C} = 0.243\ \frac{J}{g\ ^\circ C}$

3. How much heat is lost when 35.5 g of iron cools from 429°C to 18.6°C? (The specific heat of iron is 0.450 J/(g · °C).

$$\frac{0.450\ J}{g\ ^\circ C} \mid 35.5\ g \mid (429 - 18.6)\ ^\circ C = -5556\ J$$

4. What is the change in enthalpy when 4.5 moles of carbon monoxide are oxidized to carbon dioxide?

← Heat is a product, so $\Delta H = -566$ kJ

$$2CO(g) + O_2(g) \longrightarrow 2CO_2(g) + 566\ kJ$$

4.5 mol

$$\frac{4.5\ mol\ CO}{2\ mol\ CO} \mid -566\ kJ = -1273\ kJ$$

5. Calculate the enthalpy change, ΔH°, for the combustion of $C_3H_6(g)$:

$$C_3H_6(g) + 9/2O_2(g) \longrightarrow 3CO_2(g) + 3H_2O(l)$$

ΔH°_f values in kJ/mol are as follows: $C_3H_6(g) = 21$; $CO_2(g) = -394$; $H_2O(l) = -286$.

$\Delta H = \sum \Delta H_{prod} - \sum \Delta H_{react}$

$$\Delta H = [3(-394) + 3(-286)] - [1(21) + \tfrac{9}{2}(0)] = -2061\ kJ$$

$-2040 \quad -21$

6. Using the following data, calculate the heat of reaction for the coal gasification process $2C(s) + 2H_2O(g) \longrightarrow CH_4(g) + CO_2(g)$.

1 $C(s) + H_2O(g) \longrightarrow CO(g) + H_2(g)$ $\Delta H^\circ = +131.3$ kJ

2 $CO(g) + H_2O(g) \longrightarrow CO_2(g) + H_2(g)$ $\Delta H^\circ = -41.2$ kJ

3 $CO(g) + 3H_2(g) \longrightarrow CH_4(g) + H_2O(g)$ $\Delta H^\circ = -206.1$ kJ

$2C_{(s)}$: #1 x2 $\quad 2C_{(s)} + 2H_2O_{(g)} \rightarrow \cancel{2CO_{(g)}} + \cancel{2H_{2(g)}}$ $\quad 2(+131.3)$

$2H_2O$: Skip

CH_4: #3 as is $\quad \cancel{CO_{(g)}} + \cancel{3H_{2(g)}} \rightarrow CH_{4(g)} + \cancel{H_2O_{(g)}}$ $\quad -206.1$

CO_2: #2 as is $\quad \cancel{CO} + \cancel{H_2O_{(g)}} \rightarrow CO_{2(g)} + \cancel{H_{2(g)}}$ $\quad -41.2$

$2C_{(s)} + 2H_2O_{(g)} \rightarrow CH_{4(g)} + CO_{2(g)}$ $\quad +15.3$ kJ