## Course: CHM202

## **Energetics and dynamics of chemical reactions**

## Assignment – III

Q.1 The standard reaction enthalpy for the hydrogenation of propene,

$$CH_2 = CHCH_3(g) + H_2(g) \rightarrow CH_3CH_2CH_3(g)$$

is -124 kJ mol-1. The standard reaction enthalpy for the combustion of propane,

$$CH_3CH_2CH_3(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$$

is -2220 kJ mol-1. Calculate the standard enthalpy of combustion of propene employing the Hess's law.

Q.2 Given the following heats of reaction at 25 °C:

$$C_2H_4(g) + 3O_2(g) = 2CO_2(g) + 2H_2O(1); \Delta H^0 = -337.3 \text{ KCal}$$

$$2H_2(g) + O_2(g) = 2H_2O(1); \Delta H^o = -136.6 \text{ KCal}$$

$$2C_2H_6(g) + 7O_2 = 4CO_2(g) + 6H_2O(1); \Delta H^o = -745.6 \text{ KCal}$$

Calculate the enthalpy for the reaction;  $C_2H_4(g) + H_2(g) = C_2H_6(g)$  at 25 °C.

Q.3 At constant volume at 27 °C,

$$2C_6H_6(g) + 15O_2(g) = 12CO_2(g) + 6H_2O(l); \Delta U = -1600 \text{ KCal}$$

$$C_2H_2(g) + 5O_2(g) = 4CO_2(g) + 2H_2O(1); \Delta U = -620 \text{ KCal}$$

Find the heat of polymerisation of acetylene to benzene at constant pressure.

- Q.4 Heat of neutralization of
  - (i)  $NH_4OH + HCl = NH_4Cl + H_2O$ ;  $\Delta H^0 = -51.46$  K.J./mole,
  - (ii)  $CH_3COOH + NaOH = CH_3COONa + H_2O$ ;  $\Delta H^0 = -50.63$  K.J./mole,
  - (iii) NaOH + HCl = NaCl + H<sub>2</sub>O;  $\Delta H^o = -57.54$  K.J./mole.

Calculate the heat of neutralization of NH<sub>4</sub>OH and CH<sub>3</sub>COOH.

**Q.5** At 25 °C the heats of the following reactions are:

(a) Na(s) + 
$$\frac{1}{2}$$
Cl<sub>2</sub>(g) = NaCl(s);  $\Delta H^o$  = -98,230 Cal

(b) 
$$H_2(g) + S(g) + 2O_2(g) = H_2SO_4(1); \Delta H^0 = -193,910 \text{ Cal}$$

(c) 
$$2\text{Na}(s) + \text{S}(s) + 2\text{O}_2(g) = \text{Na}_2\text{SO}_4(s)$$
;  $\Delta H^o = -330,500 \text{ Cal}$ 

(d) 
$$\frac{1}{2}$$
H<sub>2</sub>(g) +  $\frac{1}{2}$ Cl<sub>2</sub>(g) = HCl(g);  $\Delta H^0$  = -22,060 Cal

Calculate the heat of reaction at constant volume at 25 °C for

$$2NaCl(s) + H_2SO_4(l) = Na_2SO_4(s) + 2HCl(g).$$

**Q.6** Calculate the enthalpy of formation of  $N_2O_5(g)$  from the following data:

$$2NO(g) + O_2(g) = 2NO_2(g); \Delta H^o = -114 \text{ KJ mole}^{-1}$$

$$4NO_2(g) + O_2(g) = 2N_2O_5(g); \, \Delta H^o = \text{--}110 \text{ KJ mole}^{\text{-}1}$$

$$N_2(g) + O_2(g) = 2NO(g); \Delta H^o = -181 \text{ KJ mole}^{-1}.$$