IMPORTANT QUESTIONS CLASS – 11 PHYSICS CHAPTER – 11 THERMODYNAMICS

1.Change in internal energy is a state function while work is not, why?

Ans. The change in internal energy during a process depends only upon the initial and final state of the system. Therefore it is a state function. But the work is related the path followed. Therefore, it is not a state function.

2.With the help of first law of thermodynamics and H = U + pv, prove = q_p

Ans. The enthalpy is defined as

H = U + pv

For a change in the stales of system,

$\Delta H = \Delta\ (U + \mathrm{pv})$

$= \Delta U + \Delta(pv)$

$\Delta U + p\Delta v + v\Delta p$ = …………(i)

The first law of thermodynamics states that –

$\Delta U = q + w$

$= q - \Delta v$ …………………….(ii)

From (i) and (ii),

$\Delta H = q - \cancel{\Delta}v + p\cancel{\Delta}v + v\Delta p$

$= q + V\Delta p$

When the pressure is constant,

$\Delta p = o$, then $v\Delta p = o$, $\therefore \Delta H = q\,(at$ constant pressure$)$

$\Delta H = qp$

3.Show that for an ideal gas, the molar heat capacity under constant volume conditions is equal to 3/2 R.

Ans. For an ideal gas, from kinetic theory of gases, the average kinetic energy per mole (Ek) of the gas at any temperature T_k is given by $Ek = \frac{3}{2}RT$

At (T+1)k, the kinetic energy per mole (Ek^1) is Ek^1 = $\frac{3}{2}R(T+1)$

Therefore increase in the average kinetic energy of the gas for 1^oC (or 1K) rise in temperature is

$$\Delta\overline{E}_k = \frac{3}{2}R(T+1) - \frac{3}{2}RT = \frac{3}{2}R$$

$\overline{E}_k$ by definition is to the molar heat capacity of a gas at constant volume, Cv.

$$\therefore Cv = \frac{3}{2}R$$

4.A 1.25g sample of octane (C_{18} H_{18}) is burnt in excess of oxygen in a bomb calorimeter. The temperature of the calorimeter rises from 294.05 to 300.78K. If heat capacity of the calorimeter is 8.93 KJ/K. find the heat transferred to calorimeter.

Ans . Mass of octane,

M = 1.250g.

= 0.00125.

Heat capacity, c = 8.93 kJ/k

Rise in temp, $\Delta T = 300.78 - 294.05$

= 6.73K

Heat transferred to calorimeter

$= m$ x c x ΔT

= 0.00125 x 8.93 x 6.73

= 0.075 kJ

5.Calculate the heat of combustion of ethylene (gas) to from CO_2 (gas) and H_2O (gas) at 298k and 1 atmospheric pressure. The heats of formation of CO_2, H_2O and C_2H_4 are – 393.7, – 241.8, + 52.3 kJ per mole respectively.

Ans. C_2H_4 (g) + 30_2(g) → $2CO_2$(g) + $2H_2O$ (g)

reactants

= [2 x ΔH_f^O (CO_2) + 2 x $\Delta H_f^O(H_2O)$] –

= 2 x[(-393.7)m+2x (-241.8)] – [(523.0) + 0)]

= [-787.4 – 483.6] -53.3

= – 1323.3 kJ.

$$\Delta H_f(CO_2) = -393.7\text{kJ}$$

$$\Delta H_f(H_2O) = -241.8\text{kJ}$$

$$\Delta H_f(C_2H_4) = +52.3\text{kJ}$$

$$\Delta H reaction = \sum \Delta H_f^\circ\, products - \sum \Delta H_f^\circ$$

$$\left[\Delta H_f^O(C_2H_4) + 3 \text{ x } \Delta H_f^O(O_2)\right]$$

$$\left[\therefore \Delta H_f^O \text{ fot elementary substance } = 0\right]$$

6.Give two examples of reactions which are driven by enthalpy change.

Ans. Examples of reactions driven by enthalpy change:

The process which is highly exothermic, i.e. enthalpy change is negative and has large value but entropy change is negative is said to be driven by enthalpy change, eg.

(i)

$$H_2(g)+\frac{1}{2}O_2(g)\rightarrow H_2O(l)$$

$$\Delta H_f^O = -285.8kJ\ mol^{-1}$$

(ii)

$$N_2(g)+3H_2(g)\rightarrow 2NH_3(g)$$

$$\Delta H^O = -92k\ J\ mol^{-1}.$$

7.Will the heat released in the following two reactions be equal? Give reasons in support of your answer.

(i)H_2 (g) +

$$H_2(g)+\frac{1}{2}O_2(g)\rightarrow H_2O(l)$$

Ans. No, the heats released in the two reactions are not equal. The heat released in any reaction depends upon the reactants, products and their physical states. Here in reaction (i), the water produced is in the gaseous state whereas in reaction (ii) liquid is formed. As we know, that when water vapors condensed to from water, heat equal to the latent heat of vaporization is released. Thus, more heat is released in reaction (ii).

8.What is the relation between the enthalpy of reaction and bond enthalpy?

Ans .A chemical reaction involves the breaking of bonds in reactants and formation of new bonds in products. The heat of reaction (enthalpy change) depends on the values of the heat needed to break the bond formation .Thus

(Heat of reaction = (Heat needed to break the bonds in reactants – Heat liberated to from bonds in products).

ΔH^{o} = Bond energy in (to break the bonds) – Bond energy out (to form the bonds)

= Bond energy of reactants – Bond energy of products.

9.The reaction C (graphite) + O_2 (g) CO_2(g) + 393.5 kJ mol^{-1} represents the formation of CO_2 and also combustion of carbon. Write the values of the two processes.

Ans.(i) The standard enthalpy of formation of CO_2 is -393.5 kJ per mole of CO_2.

That is $\Delta H_f^{o}(CO_2, g) = -393.5 kJ\ mol^{-1}$.

(ii) The staard enthalpy of combustion of carbon is –393.5 kJ per mole of carbon i.e.

$\Delta H^{o} comb(c) = -393.5\ kJ\ mol^{-1}$.

10.Explain how is enthalpy related to spontaneity of a reaction?

Ans. Majority of the exothermic reactions are spontaneous because there is decrease in energy.

Burning of a substance is a spontaneous process.

C(s) +O_2(g) $\rightarrow CO_2(g);\ \Delta H = -\ 394 kJ\ mol^{-1}$

Neutralisation of an acid with a base is a spontaneous reaction.

$$HCl + Na\ \mathrm{OH} \rightarrow \mathrm{NaCl} + \mathrm{H_2O}.\Delta \mathrm{H} = \text{-}57\mathrm{kJ\ mol^{-1}}$$

Many spontaneous reactions proceed with the absorption of heat. Conversion of water into water vapour is an endothermic spontaneous change. Therefore change in enthalpy is not the only criterion for deciding the spontaneity of a reaction.