CBSE TEST PAPER 04

CLASS XI CHEMISTRY (Thermodynamics)

General Instructions:

- All questions are compulsory.
- Marks are given alongwith their questions.

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1. Define reaction enthalpy. [1]

2. Define standard enthalpy change. [1]

3. The standard heat of formation of Fe_2O_3 (s) is 824.2kJ mol^{-1} Calculate heat change for the reaction.

$4Fe(s) + 3O_2 (g) \rightarrow 2Fe_2O_3(s)$ [1]

4. 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. [2]

5. Give two examples of reactions which are driven by enthalpy change . [2]

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

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

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

7. What is the relation between the enthalpy of reaction and bond enthalpy? [2]

8. The reaction C (graphite) + O_2 (g) $\rightarrow CO_2(g)$ + 393.5 kJ mol^{-1} represents the formation of CO_2 and also combustion of carbon. Write the ΔH^0 values of the two processes. [2]

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[ANSWERS]

Ans 1. The enthalpy change accompanying a reaction is called the reaction enthalpy (ΔrH).

Ans 2. The standard enthalpy changeof reaction is defined as the enthalpy change for a reaction when all the reactant and products are in their standard states i.e.at temperature 298 K and a pressure of 1 atm.

Ans 3. $\Delta H^\circ = \sum \Delta H_f^\circ (products) - \sum \Delta H_f^\circ (reac\tan ts)$

= [2 X ΔH_f^O $Fe_2O_3(s)$] – [4 $\Delta H_f{}^O Fe$ (s) + 3 $\Delta H_f{}^O O_2(g)$]

= 2(-824.2kJ) – [4 x o + 3 x o]

$= \underline{\underline{-1648.4kJ}}$

Ans 4. C_2H_4 (g) + 30_2(g) $\rightarrow$ $2CO_2$(g) + $2H_2O$ (g)

$\Delta H_f(CO_2)$ = -393.7kJ

$\Delta H_f(H_2O)$ = -241.8kJ

$\Delta H_f(C_2H_4)$ = +52.3kJ

$\Delta Hreaction = \sum \Delta H_f^\circ products - \sum \Delta H_f^\circ$ reactants

= [2 x $\Delta H_f{}^O(CO_2)$ + 2 x $\Delta H_f{}^O(H_2O)$] – $\left[\Delta H_f{}^O(C_2H_4) +\ 3 \text{ x } \Delta H_f{}^O(O_2)\right]$

= 2 x[(-393.7)m+2x (-241.8)] – [(52.3) + 0)]

($\Delta H_f{}^\circ$ for elementary substance = 0)

= [-787.4 – 483.6] -52.3

= - 1323.3 kJ.

Ans 5. Examples of reactions driven by enthalpy change:

The process which is highly exothermic, i.e. enthalpy change is negative and has large value but are accompanied with decrease in number of molecules i.e. 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) $N_2(g)+3H_2(g)\rightarrow 2NH_3(g)$

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

Ans 6. 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).

Ans 7. 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 absorbed (to break the bonds) - Bond energy released (to form the bonds)

= Bond energy of reactants – Bond energy of products.

Ans 8. (i) The standard enthalpy of formation of CO_2 is -393.5 kJ per mole of CO_2.

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

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

$\Delta H_{comb}^{o}(C)$ = -393.5kJ $\mathrm{mol^{-1}}$