CBSE TEST PAPER 02

CLASS XI CHEMISTRY (Thermodynamics)

General Instruction:

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

1. Define enthalpy. [1]
2. Give the mathematical expression of enthalpy. [1]
3. With the help of first law of thermodynamics and H = U + PV, prove that: ΔH = q_p [2]
4. When is enthalpy change (ΔH) -

(i) positive (ii) negative. [1]

5. Why is the value of ΔH and ΔU not significant for solids or liquids? [1]
6. Give the relationship between ΔU and ΔH for gases. [2]
7. What is an extensive and intensive property? Give example of each . [2]
8. Give an expression for

(i) isothermal irreversible change

(ii) isothermal reversible change. [2]

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[ANSWERS]

Ans 1. Enthalpy is defined as total heat content of the system.

Ans 2. Mathematically,

H = U +PV where U is internal energy ,PV is pressure-volume work

Ans 3. The enthalpy is defined as

H = U + PV

So, the change in enthalpy

ΔH =ΔU + Δ(PV)

ΔH =ΔU +PΔV +VΔP .....(i)

The first law of thermodynamics states that –

ΔH = q +W

or ΔU =q -PΔV.....(ii)

From (i) and (ii),

ΔH =q -PΔV + PΔV+ VΔP

ΔH =q + VΔP

When the pressure is constant,

ΔP=0, then VΔP = 0

Hence, ΔH =q_P (at constant pressure)

Ans 4. (i) ΔH is positive for endothermic reaction which absorbs heat from the surroundings.

(ii) ΔH is negative for exothermic reactions which evolve heat to the surroundings.

Ans 5. The value of ΔH and ΔU is not usually significant for systems consisting of only solids and / or liquids because they do not undergo any significant volume changes upon heating.

Ans 6. For gases the volume change is appreciable.

let V_A be the total volume of gaseous reactants, and

V_B be the total volume of gaseous product.

n_A be the number of moles of the reactant and

n_B be the number of moles of the product,

Then at constant pressure and temperature,

$PV_A = n_A RT$.....(i)

$PV_B = n_B RT$.....(ii)

Subtracting eq(i) from eq(ii) ,we get , $P (V_B - V_A) = (n_B - n_A) RT$

or $P\Delta V = \Delta n_g RT$

where $\Delta n_g = n_B - n_A$ and is equal to the difference between the number of moles of gaseous products and gaseous reactants.

Substituting the value of PΔV we get.

$$\Delta H = \Delta U + (\Delta n)_g RT$$

$\Delta H = q_p$(heat change at constant pressure)

$\Delta U = q_V$(heat change at constant volume)

$\therefore$ for gaseous system.

$q_p = q_V + \Delta n_g RT$

Ans 7. Extensive property is a property whose value depends on the quantity of matter present in the system. eg. internal energy,mass,volume,etc.

Intensive property is a property which do not depend upon the quantity of matter present but depend only upon the nature of the substance present in the system.eg boiling point,density,etc.

Ans 8. (i) For isothermal irreversible change : $q = -W = P_{exp} (v_f - v_i)$

(ii) For isothermal reversible change: $q = - W = - nRT \ln \frac{v_f}{v_i}$

$= -2.303\ nRT \log \frac{v_f}{v_i}$