Enthalpy Change Questions

Enthalpy is a thermodynamic parameter that gauges the total heat present in a thermodynamic system where the pressure is regular. It is equivalent to the sum of the internal energy and the product of the pressure and volume of a thermodynamic system.

$H = E + PV$

Various factors that affect the enthalpy of an atom are the amount of reactant and product, the physical state of reactants and products, allotropic modification, temperature and pressure.

Definition: The enthalpy change of an atom is defined as the amount of heat absorbed or evolved in a reaction carried out at a steady pressure.

Enthalpy Change Chemistry Questions with Solutions

Q1. If the activation energy is equal for both forward and backward reactions, then

(a) $\Delta H = 0$

(b) $\Delta G = 0$

(c) $\Delta S = 0$

(d) $\Delta H = \Delta G = \Delta S = 0$

Answer: (a) If the activation energy is equal for both forward and backward reactions, then ΔH should be zero.

Q2. The change in enthalpy of a system is equivalent to the heat absorbed by the system at a

(a) Constant temperature

(b) Constant pressure

(c) Constant volume

(d) None of the above

Answer: (b) The change in enthalpy of a system is equivalent to the heat absorbed by the system at a constant pressure.

Q3. The change in enthalpy of an exothermic reaction is

(a) Always positive

(b) Always negative

(c) Can be positive or negative

(d) None of the above

Answer: (b) The change in enthalpy of a steady chemical reaction is always negative.

Q4. If the heat is transmitted to a system at a steady pressure. In that case, the enthalpy of the system will

(a) Increase

(b) Decrease

(c) First increase then decrease

(d) First decrease then increase

Answer: (a) If the heat is transmitted to a system at a steady pressure, the enthalpy of the system will increase.

Q5. The change in enthalpy when 1 mole of the compound is formed under standard conditions is known as

(a) Standard enthalpy of neutralisation

(b) Standard enthalpy of formation

(c) Standard enthalpy of combustion

(d) None of the above

Answer: (b) The change in enthalpy when 1 mole of the compound is formed under standard conditions is known as standard enthalpy of formation.

Q6. What is enthalpy?

Answer: Enthalpy is a thermodynamic parameter that gauges the total heat present in a thermodynamic system where the pressure is regular. It is equivalent to the sum of the internal energy and the product of the pressure and volume of a thermodynamic system.

H = E + PV

Q7. What are the various factors that affect the enthalpy of an atom?

Answer: Enthalpy is a thermodynamic parameter that gauges the total heat present in a thermodynamic system where the pressure is regular. Various factors that affect the enthalpy of an atom are mentioned below.

1. Amount of reactant and product.

2. Physical State of Reactants and Products.

3. Allotropic Modification

4. Temperature and Pressure

Q8. What is the enthalpy change?

Answer: The enthalpy change of an atom is defined as the amount of heat absorbed or evolved in a reaction carried out at a steady pressure.

Q9. Calculate the enthalpy change for the following reaction:

$CH_4\ (g) + 2\ O_2\ (g) \rightarrow CO_2\ (g) + 2\ H_2O\ (l)$

Given that enthalpies of formation of CH_4, CO_2 and H_2O are 74.8 kJ $mol^{-1,}$ - 393.5 kJ $mol^{-1,}$ and - 286 kJ $mol^{-1,}$ respectively.

Answer: Enthalpy of formation of CH_4 = 74.8 kJ $mol^{-1,}$

Enthalpy of formation of CO_2 = - 393.5 kJ mol^{-1}

Enthalpy of formation of H_2O = - 286 kJ mol^{-1}

Enthalpy change = $\Delta H^o_{PRODUCTS} - \Delta H^o_{REATANTS}$

Enthalpy change = ($\Delta H_{CO_2} + \Delta H_{H_2O}$) – ($\Delta H_{CH_4} + 2\,\Delta H_{O_2}$)

Enthalpy change = (- 393.5 kJ mol^{-1} + - 286 kJ mol^{-1}) – (74.8 kJ mol^{-1} + 2 x 0)

Enthalpy change = – 890.7 kJ mol^{-1}

Q10. Calculate the enthalpy of formation of OH^- ions at 25° C from the following thermochemical data:

H_2O (l) → H^+ (aq) + OH^- (aq); Δ H^O = 57.3 kJ

H_2 + ½ O_2 (g) → H_2O (l); Δ H^O = – 285.9 kJ

Answer: Foremost, we will add first two-equation.

H_2 (g) + ½ O_2 (g) → H^+ (aq) + OH^- (aq); Δ H^O = 57.3 kJ – 285.9 kJ = – 228.6 kJ.

Hence, Δ H^O = – 228.6 kJ = 0 + Δ H_f^O (OH^- (aq)) – (0+0), since, by convention, Δ H_f^O [H^+(aq)] = 0,

Hence, Δ H_f^O [OH^- (aq)] = – 228.6 kJ.

Q11. The enthalpy of combustion of glucose $C_6H_{12}O_6$ (s) is – 2816 kJ mol^{-1} at 25° C. Calculate Δ H_f^O $C_6H_{12}O_6$. The H_f^O values for CO_2 (g) and H_2O (l) are – 393.5 and – 285.9 kJ $mol^{-1,}$ respectively.

Answer: $C_6H_{12}O_6$ (s) + 6 O_2 (g) → 6 CO_2 (g) + 6 H_2O (l); Δ H^O = – 2816 kJ.

Since Δ H = ∑ Δ H_f^O (products) – ∑ Δ H_f^O (reactants), we find that

– 2816 kJ = (6 X 393.5 kJ mol^{-1}) + (6 X – 285.9 kJ mol^{-1}) – Δ H_f^O ($C_6H_{12}O_6$) – 6 Δ H_f^O (O_2)

We know that, Δ H_f^O (O_2) = 0

So, Δ H_f^O ($C_6H_{12}O_6$) = – 1260.4 kJ $mol^{-1.}$

Q12. Calculate the enthalpy of combustion of methane at 25° C and 1 atm pressure.

Given that Δ H_f^O (CO_2) = – 393.5 kJ $mol^{-1,}$ Δ H_f^O (H_2O) = – 285.9 kJ mol^{-1} and Δ H_f^O (CH_4) = -74.8 kJ $mol^{-1.}$

Answer: The combustion of methane is referenced as

CH_4 (g) + 2 O_2 (g) → CO_2 (g) + 2 H_2O

Δ H° = Δ H_f^o (CO_2) + 2 Δ H_f^o (H_2O) – Δ H_f^o (CH_4) – 0

Δ H° = (- 393.5 kJ mol^{-1}) + 2 X (- 285.9 kJ mol^{-1}) – (- 74.8 kJ mol^{-1})

Δ H° = – 890.5 kJ $mol^{-1.}$

Thus, the enthalpy of combustion of methane at 25° C and 1 atm pressure = – 890.5 kJ $mol^{-1.}$

Q13. One mole of a non-ideal gas undergoes a state change from (2 atm, 3 L, 95 K) to (4 atm, 5 L, 245 K) with a change of internal energy, Δ U = 30 L atm. What is the difference in enthalpy (Δ H)?

Answer: Change in enthalpy = Δ H = Δ U + Δ (PV)

Change in enthalpy = Δ H = Δ U + ($P_2 V_2 – P_1 V_1$)

Change in enthalpy = Δ H = 30 + (20 – 6)

Change in enthalpy = Δ H = 44 L atm.

Q14. The reaction of cyanamide NH_2CN (s) with dioxygen was carried out in a bomb calorimeter, and Δ U was found to be - 742.7 kJ mol^{-1} at 298 K.

NH_2CN (g) + 23 O_2 (g) → N_2 (g) + CO_2 (g) + H_2O (l)

Calculate the enthalpy change for the reaction at 298 K?

Answer: For the given reaction, Δ n = 1 + 1 - 1.5 = 0.5.

Moreover, Δ H = Δ U + Δ n_g RT

Δ H = - 742.7 + 0.5 X 8.314 X 10^{-3} X 298

$\Delta H = -741.5$ kJ mole^{-1}.

Q15. The combustion of one mole of benzene occurs at 298 K, and 1 atm after combustion, CO_2 (g) and H_2O (l) are produced, and 3267.0 KJ of heat is liberated. Calculate the standard enthalpy of formulation ΔH_f of benzene. Given the standard enthalpy of formation of CO_2 (g) and H_2O (l) are – 393.5 kJ mole^{-1} and – 285.83 kJ mole^{-1}.

Answer: Reaction: $C_6H_6 + 15/2\ O_2 \rightarrow 6\ CO_2 + 3\ H_2O$, $\Delta H_{rxn} = -3267$ KJKJ mole^{-1}

$\Delta H_{rxn} = 6\ \Delta H_f\ CO_2 + 3\ \Delta H_f\ H_2O - \Delta H_f\ C_6H_6$

ΔH_f (Benzene) = 6 X (- 393.5) + 3 X (- 285.8) + 3267

ΔH_f (Benzene) = - 3218.49 + 3267

ΔH_f (Benzene) = 48.51 KJ.

Practise Questions on Enthalpy Change

Q1. What is Hess law? Explain the feasibility of Hess law with an example.

Q2. Calculate the standard enthalpy of formation of methanol using the following data.

C (graphite) + O_2 (g) → CO_2 (g) ($\Delta H = -393$ kJmol^{-1})

CH_3OH (l) + 2 O_2 (g) → CO_2 (g) + 2 H_2O (l) ($\Delta H = -726$ kJmpl^{-1})

H_2 (g) + 2 O_2 (g) → H_2O (l) ($\Delta H = -286$ kJmol^{-1})

Q3. How will you differentiate between enthalpy from entropy?

Q4. How will you differentiate between extensive and intensive functions?

Q5. If the combustion of 1 g of graphite produces 20.7 kJ of heat. What will be the molar enthalpy change? What is the significance of the sign of enthalpy?

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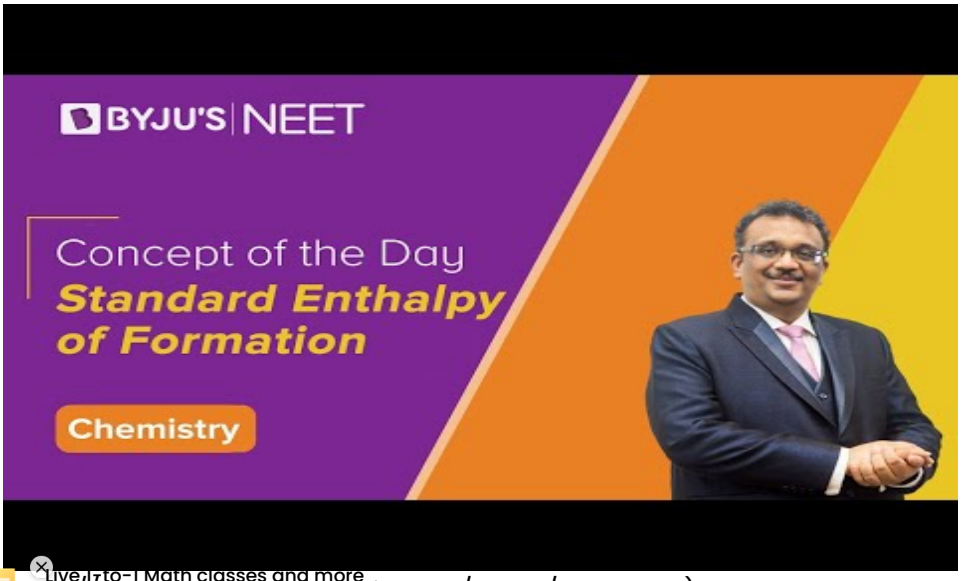

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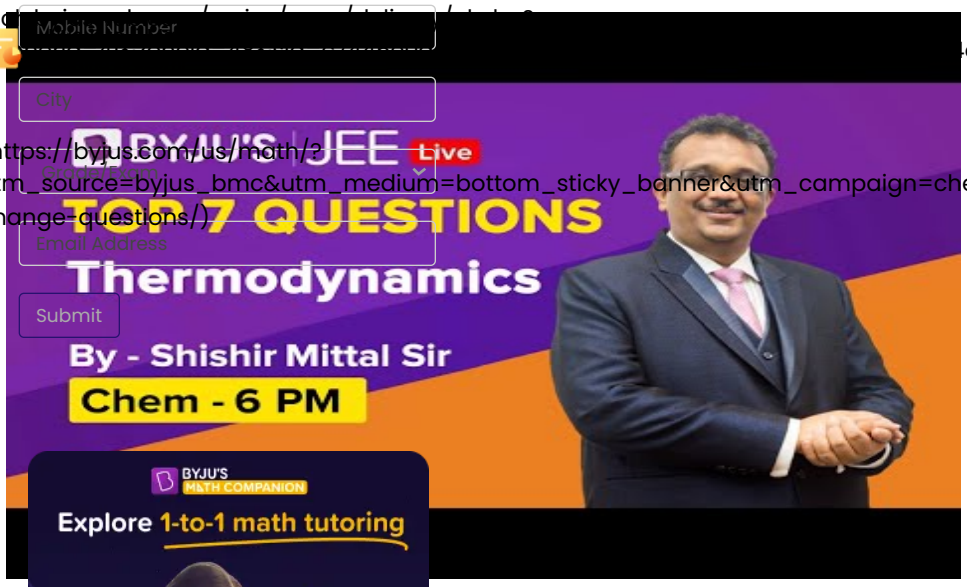

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