DPP-5 – Solutions

Enthalpy of Neutralisation (Thermochemistry)

"Assignment se bhagna nahi; concept pe pakad banao."

Q1. The change in the enthalpy of NaOH + HCl → NaCl + H_2O is called:

Hinglish Soch: Strong acid + strong base ⇒ net ionic: $H^+ + OH^- \rightarrow H_2O$. Iss reaction ke enthalpy ko *heat of neutralisation* kehte hain.

Final Answer: (1) Heat of neutralisation.

Q2. If water is formed from H^+ and OH^-, the heat of formation of water is:

Strong acid–strong base ke liye $\Delta H^\circ_{\text{neut}} \approx -57.1$ kJ mol^{-1} ≈ -13.7 kcal mol^{-1} per mole H_2O formed.

Final Answer: (1) -13.7 kCal.

Q3. Which of the following data represents the heat of neutralisation (strong acid vs strong base)?

Standard value: ≈ -57.2 kJ mol^{-1} $\equiv -13.7$ kcal mol^{-1} $\equiv -5.72 \times 10^4$ J mol^{-1}. }.

Final Answer: (4) All the above .

Q4. Enthalpy of neutralisation of acetic acid with KOH will be numerically:

Weak acid (CH_3COOH) ko ionise karne ke liye energy chahiye (endothermic). Isliye net heat evolved *magnitude* < 57.2 kJ mol^{-1} hota hai.

Final Answer: (3) $<$ 57.2 kJ.

Q5. Heat liberated when 1 mol NH_4OH reacts with 1 mol HCl is:

NH_4OH weak base hai; uski ionisation ke liye energy lagti hai. Net neutralisation heat (magnitude) strong–strong se *kam* hoti hai.

Final Answer: (3) Less than 13.7 kCal.

Q6. The most exothermic neutralisation reaction would be between:

Strong acid + strong base ⇒ maximum magnitude (about -57.1 kJ mol^{-1}). Weak species se magnitude kam ho jata hai.

Final Answer: (4) NaOH and HCl.

Q7. For $MgO(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2O(\ell)$, the *absolute* enthalpy of neutralisation is:

MgO basic oxide hai; acid mein effectively *weak base* ki tarah act karta hai. Neutralising species banne ke liye extra endothermic steps (hydration/ionisation of oxide, protonation of O^{2-}) lagte hain. Isliye per mole H_2O formed, observed ΔH_{neut} strong acid–strong base (-57.33 kJ mol^{-1}) se *kam exothermic* hota hai (i.e., less negative).

Final Answer: (3) Greater than -57.33 kJ mol^{-1} (*numerically greater*, i.e., less negative).

Q8. Heat of neutralisation of a strong dibasic acid in dilute solution by NaOH is nearly:

Per *equivalent*, standard value ≈ -13.7 kcal eq^{-1}. Dibasic acid (2 eq) ke per *mole* it is ≈ -27.4 kcal mol^{-1}.

Final Answer: (2) -13.7 kCal eq^{-1} (*or* -27.4 kCal mol^{-1} per mole acid).

Q9. If $H^+ + OH^- = H_2O + 13.7$ kCal, then heat of complete neutralisation of 1 mol H_2SO_4 with strong base is:

H_2SO_4 dibasic $\Rightarrow$ 2 mol H_2O banenge $\Rightarrow 2 \times 13.7 = 27.4$ kcal heat evolve hogi.

Final Answer: (2) 27.4 kCal.

Q10. 1 mol H_2SO_4 completely neutralised with 2 mol NaOH (dilute). Heat evolved:

2 mol H_2O form $\Rightarrow 2 \times 57.2 = 114.4$ kJ (standard per mole water basis).

Final Answer: (4) 114.4 kJ.

Q11. 100 mL of 3 M H_2SO_4 reacts with 100 mL of 3 M NaOH. Enthalpy of neutralisation is:

Moles: $H_2SO_4 = 0.1 \times 3 = 0.3$ mol $\Rightarrow$ 0.6 eq; NaOH $= 0.1 \times 3 = 0.3$ eq. Limiting = NaOH (0.3 eq). H_2O formed = 0.3 mol.

$$\Delta H = 0.3 \times (-57.1 \text{ kJ mol}^{-1}) \approx -17.1 \text{ kJ}.$$

Final Answer: (3) -0.3×57.1 kJ.

Q12. Heat of neutralisation: HCl by NaOH $= -55.9$ kCal mol^{-1}; HCN by NaOH $= -12.1$ kCal mol^{-1}. Energy of dissociation (ionisation) of HCN is:

Weak acid ke case me: $\Delta H_{obs} = \Delta H_{\text{std (strong-strong)}} - \Delta H_{ion}$.
So, $\Delta H_{ion} = 55.9 - 12.1 = 43.8$ **kcal mol^{-1}**. **Note (Units)**: Options kJ me diye gaye hain; correct magnitude 43.8 *kcal* ≈ 183 kJ.

Final Answer: Closest option: (2) 43.8 kJ (*unit typo—should be* 43.8 kcal $\approx$ 183 kJ).

Q13. Heat of neutralisation of oxalic acid is -106.7 kJ mol^{-1} (with NaOH). Then ΔH of: $H_2C_2O_4 \rightarrow 2CO_2 + 2H^+$ is:

Strong–strong benchmark (per mole oxalic, 2 eq): $-2 \times 57.2 = -114.4$ kJ mol^{-1}. Given is -106.7; kam exothermic $\Rightarrow$ ionisation enthalpy (endothermic) $\approx 114.4 - 106.7 = 7.7$ kJ mol^{-1} (text often rounds to 7.5).

Final Answer: (4) 7.5 kJ mol^{-1} (approximately).
