

MIX TEST-3 (NEET) — Solutions

Some Basic Concepts + Thermodynamics-1 + Thermochemistry

Q1. A binary mixture of bivalent metals A (15 u) and B (30 u), total mass = 2 g, reacts with HCl to evolve 2.24 L H₂ at STP. Find mass of A.

Approach (Hinglish): Bivalent metal: $M + 2HCl \rightarrow MCl_2 + H_2$ so 1 mol metal \rightarrow 1 mol H₂.
Moles H₂ = $2.24/22.4 = 0.10 \Rightarrow$ total moles of metals = 0.10. Let $m_A = a$, $m_B = 2 - a$.

$$\frac{a}{15} + \frac{2-a}{30} = 0.10 \Rightarrow \frac{a}{30} + \frac{1}{15} = 0.10 \Rightarrow a = 1.00 \text{ g.}$$

Final Answer: (1) 1 g

Q2. 0.078 g hydrocarbon occupies 22.144 mL at STP. Empirical formula CH. Find molecular formula.

Approach (Hinglish): $n = V/22.4 = 0.022144/22.4 = 9.886 \times 10^{-4}$ mol; $M = 0.078/n \approx 79$ g mol⁻¹.
Empirical mass (CH) = 13; factor = $79/13 \approx 6 \Rightarrow C_6H_6$.

Final Answer: (2) C₆H₆

Q3. Mole % of O₂ in 7.0 g N₂ + 8.0 g O₂.

Approach (Hinglish): $n(N_2) = 7/28 = 0.25$, $n(O_2) = 8/32 = 0.25$ mol. Mole % O₂ = $0.25/(0.50) \times 100 = 50\%$.

Final Answer: (4) 50

Q4. Mass of O₂ that occupies 5.6 L at STP.

Approach (Hinglish): $n = 5.6/22.4 = 0.25$ mol; mass = $0.25 \times 32 = 8$ g = $\frac{1}{2}$ gram-atomic mass of O.

Final Answer: (4) Half of the gram atomic mass

Q5. $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$. For 8 g Ca, volume of H₂ at STP?

Approach (Hinglish): $n(Ca) = 8/40 = 0.20$ mol $\Rightarrow n(H_2) = 0.20$ mol; $V = 0.20 \times 22.4 = 4.48$ L = 4480 cm³.

Final Answer: (4) 4480 cm³

Q6. 12 g Mg with excess HCl at NTP gives volume of H₂?

Approach (Hinglish): $Mg + 2HCl \rightarrow MgCl_2 + H_2$; $n = 12/24.3 \approx 0.494$ mol; $V \approx 0.494 \times 22.4 \approx 11.1$ L $\simeq 11.2$ dm³.

Final Answer: (1) 11.2 dm³

Q7. Value of x in potash alum $K_2SO_4 \cdot Al_x(SO_4)_3 \cdot 24H_2O$.

Approach (Hinglish): Potash alum \equiv $\text{KAl}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$. Doubled unit \Rightarrow $\text{K}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$. Hence $x = 2$.

Final Answer: (3) 2

Q8. Molecular wt = 180, empirical CH_2O (= 30). Molecular formula?

Approach (Hinglish): Factor = $180/30 = 6 \Rightarrow (\text{CH}_2\text{O})_6 = \text{C}_6\text{H}_{12}\text{O}_6$.

Final Answer: (1) $\text{C}_6\text{H}_{12}\text{O}_6$

Q9. Which p - V curve gives maximum work?

Approach (Hinglish): Expansion work \propto area under p - V curve. The path with **largest area** (labelled 1 in the given figure) gives maximum work.

Final Answer: (1)

Q10. At 25°C , 1 mol butane \rightarrow CO_2 and H_2O . Work done?

Approach (Hinglish): $\text{C}_4\text{H}_{10} + 6.5 \text{O}_2 \rightarrow 4 \text{CO}_2 + 5 \text{H}_2\text{O}(l)$. $\Delta n_g = 4 - (1 + 6.5) = -3.5$.
At constant T : $w \approx -\Delta n_g RT = 3.5 \times 0.0821 \times 298 \approx \boxed{85.6 \text{ L atm}}$.

Final Answer: (2) 85.6 L atm

Q11. Heat of formation of water corresponds to which reaction?

Approach (Hinglish): Standard formation: 1 mol H_2O from elements in standard states:
 $\text{H}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}$.

Final Answer: (2) $\text{H}_2 + \frac{1}{2}\text{O}_2 \rightarrow \text{H}_2\text{O}$; $\Delta H = -58 \text{ kcal}$

Q12. Complete combustion of $\text{C}_4\text{H}_9\text{OH}(l)$: relation between ΔE and ΔH .

Approach (Hinglish): $\text{C}_4\text{H}_9\text{OH}(l) + 6 \text{O}_2(\text{g}) \rightarrow 4 \text{CO}_2(\text{g}) + 5 \text{H}_2\text{O}(l)$; $\Delta n_g = 4 - 6 = -2$.
 $\Delta H = \Delta E + \Delta n_g RT \Rightarrow \Delta H = \Delta E - 2RT \Rightarrow \Delta E > \Delta H$.

Final Answer: (3) $\Delta E > \Delta H$

Q13. Which is endothermic?

Approach (Hinglish): Only $\text{N}_2 + \text{O}_2 + 180.8 \text{ kJ} \rightarrow 2\text{NO}$ absorbs heat (positive on LHS).

Final Answer: (2)

Q14. ΔH_f° : $\text{CO}_2(-393.5)$, $\text{CO}(-110.5)$, $\text{H}_2\text{O}(\text{g})(-241.8) \text{ kJ mol}^{-1}$. For $\text{CO}_2 + \text{H}_2 \rightarrow \text{CO} + \text{H}_2\text{O}(\text{g})$, ΔH ?

Approach (Hinglish): $\Delta H_{\text{rxn}} = \sum \Delta H_f^\circ(\text{prod}) - \sum \Delta H_f^\circ(\text{react}) = [(-110.5) + (-241.8)] - [(-393.5) + 0] = +41.2 \text{ kJ}$.

Final Answer: (4) 41.2

Q15. At constant volume, one mole gas absorbs 200 J from 298 K. ΔU ?

Approach (Hinglish): Constant V : $q_V = \Delta U \Rightarrow \Delta U = +200$ J.

Final Answer: (1) 200 J

Q16. (2.0 atm, 3.0 L, 95 K) \rightarrow (4.0 atm, 5.0 L, 245 K), given $\Delta U = 30.0$ L atm. Find ΔH (L atm).

Approach (Hinglish): $H = U + PV$ (definition, valid for any gas). $\Delta H = \Delta U + \Delta(PV)$.
 $\Delta(PV) = P_2V_2 - P_1V_1 = 4 \times 5 - 2 \times 3 = 20 - 6 = 14$ L atm. Hence $\Delta H = 30 + 14 = 44$ L atm.

Final Answer: (3) 44.0

Q17. Assertion: U is a state function. Reason: T is intensive.

Approach (Hinglish): A true; R true; but R does *not* explain A.

Final Answer: (2)

Q18. Which are extensive properties?

Approach (Hinglish): Extensive depend on amount: V (yes), E (internal energy, yes), C_p (Molar heat capacity, intensive), T, P are intensive.

Final Answer: (1) V & E

Q19. Choose reaction where $\Delta H \neq \Delta U$.

Approach (Hinglish): $\Delta H - \Delta U = \Delta n_g RT$. If $\Delta n_g \neq 0$, then $\Delta H \neq \Delta U$.
(1) $1 - 1 = 0$; (2) $1 - (1 + 1) = -1 \neq 0$; (3) $1 - (0 + 1) = 0$; (4) $2 - (1 + 1) = 0$.

Final Answer: (2) $C_2H_4 + H_2 \rightarrow C_2H_6$

Q20. Correct thermochemical equation.

Approach (Hinglish): Include states; exothermic combustion: negative ΔH .

Final Answer: (3) $C(s) + O_2(g) \rightarrow CO_2(g)$; $\Delta H = -94$ kCal

Q21. Standard heat of formation of CH_4 .

Approach (Hinglish): From elements in standard states: C(graphite), $H_2(g)$; 1 mol CH_4 .

Final Answer: (2) $C(\text{graphite}) + 2H_2(g) \rightarrow CH_4(g)$

Q22. $H_2 + I_2 \rightarrow 2HI$; $\Delta H = +12.40$ kCal. Heat of formation of HI?

Approach (Hinglish): Formation (per mol): $\frac{1}{2}H_2 + \frac{1}{2}I_2 \rightarrow HI$. Given reaction makes 2 mol with +12.40 kCal, so per mol +6.20 kCal.

Final Answer: (4) +6.20 kCal