Mix Test–1 Solutions

Atomic Structure + Some Basic Concepts of Chemistry

NEET

Q1. What mass of 95% pure $CaCO_3$ is required to neutralize 50 mL of 0.5 M HCl? (Reaction: $CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$; calculate to 2 d.p.)
Approach: Use stoichiometric ratio $CaCO_3$:HCl = 1:2. **Steps:**

$$\begin{aligned} n(\text{HCl}) &= 0.050\ \text{L} \times 0.5\ \text{mol L}^{-1} = 0.025\ \text{mol}, \\ n(\text{CaCO}_3) &= \frac{0.025}{2} = 0.0125\ \text{mol}, \\ m_{\text{pure}}(\text{CaCO}_3) &= 0.0125 \times 100.09 \approx 1.251\ \text{g}, \\ m_{\text{required}} &= \frac{1.251}{0.95} = 1.3168\ \text{g} \approx \boxed{1.32\ \text{g}}. \end{aligned}$$

Explanation: PDF options seem mismatched (given in integers); the correct computed mass is 1.32 g. **Ans: 1.32 g.**

Q2. Volume of O_2 (at STP) needed to burn 1 L of C_3H_8. **Approach:** For gases at same T,P, $V \propto n$. From $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$, ratio $5:1$. **Ans: 5 L.**

Q3. Total number of protons in 10 g of $CaCO_3$ ($N_0 = 6.023 \times 10^{23}$). **Approach:** Count protons per formula unit and multiply by number of formula units. **Steps:**

$$\text{Protons per } CaCO_3 = 20(\text{Ca}) + 6(\text{C}) + 3 \times 8(\text{O}) = 50.$$

$$n = \frac{10}{100.09} \approx 0.1\ \text{mol} \Rightarrow N \approx 0.1N_0.$$

$$\text{Total protons} = 50 \times 0.1N_0 = 5N_0 = 3.0115 \times 10^{24}.$$

Ans: 3.0115×10^{24}.

Q4. Heaviest among: (A) 0.2 mol H_2 (B) 6.023×10^{22} molecules N_2 (C) 0.1 g Ag (D) 0.1 mol O_2. **Steps:**

$$m_A = 0.4\ \text{g}, \quad m_B = 0.1 \times 28 = 2.8\ \text{g}, \quad m_C = 0.1\ \text{g}, \quad m_D = 0.1 \times 32 = 3.2\ \text{g}.$$

Ans: (D) 3.2 g.

Q5. Number of atoms of He in 100 amu of He (atomic weight 4). **Steps:** Atoms $= \frac{100}{4} = 25$. **Ans: 25.**

Q6. Mass of one molecule of $C_{60}H_{122}$. **Steps:**

$$M = 60(12) + 122(1) = 842\ \text{g mol}^{-1}, \quad m = \frac{842}{6.023 \times 10^{23}} \approx 1.40 \times 10^{-21}\ \text{g}.$$

Ans: 1.40×10^{-21} **g.**

Q7. Significant figures in 60.0001. Ans: 6.

Q8. 5.2 molal aqueous CH_3OH. Find mole fraction of CH_3OH. Approach: Take 1 kg water: $n_{\text{water}} = 1000/18 = 55.556$ mol; $n_{\text{solute}} = 5.2$.

$$x_{\text{MeOH}} = \frac{5.2}{5.2 + 55.556} \approx 0.0856 \approx 0.086.$$

Ans: 0.086.

Q9. Number of atoms in 16 g methane. Approach: 16 g CH_4 = 1 mol = N_0 molecules; each has 5 atoms. **Ans:** $5N_0 = 3.01 \times 10^{24}$.

Q10. Solution has 1.2046×10^{24} HCl molecules in 1 dm^3. Find normality. Approach: Moles $= \frac{\text{particles}}{N_0} = 2.0$; HCl is monoprotic $\Rightarrow N = M$. **Ans: 2 N.**

Q11. Molality of 10% w/w NaOH (aq). Steps:

$$10 \text{ g NaOH in } 100 \text{ g soln} \Rightarrow m_{\text{solvent}} = 90 \text{ g} = 0.09 \text{ kg}, \; n = \frac{10}{40} = 0.25.$$

$$m = \frac{0.25}{0.09} = 2.777\ldots \approx 2.778.$$

Ans: 2.778 m.

Q12. Max electrons in shell $n = 4$. Ans: $2n^2 = 32$.

Q13. If Bohr radii r_3, r_4, find r_3/r_4. Approach: $r_n \propto n^2$. **Ans:** $\frac{9}{16}$.

Q14. AIR New Delhi at 1368 kHz: wavelength ($c = 3.0 \times 10^8$ m/s). Steps:

$$\lambda = \frac{3.0 \times 10^8}{1.368 \times 10^6} = 2.193 \times 10^2 \text{ m} \approx 219.3 \text{ m}.$$

Ans: 219.3 m.

Q15. Orbital angular momentum of an electron in 2s. Approach: For s, $\ell = 0 \Rightarrow L = \sqrt{\ell(\ell+1)}\hbar = 0$. **Ans: 0.**

Q16. Which is *not* in accordance with Aufbau principle? Explanation: In option 3 2s orbital is not completely filled and 2p orbital is filled.(aufbau's rule says that lower energy(2s) orbital should fill first then higher energy(2p) orbital.

Q17. For Na atom, number of electrons with $m_\ell = 0$. Approach: Count electrons in orbitals that have $m_\ell = 0$: 1s, 2s, 3s each contribute all their e^-; for 2p (three orbitals), only the $m_\ell = 0$ orbital holds 2 e^-.

$$1s^2\,(2) + 2s^2\,(2) + 2p^6\,(2) + 3s^1\,(1) = 7.$$

Ans: 7.

Q18. Which orbital is not possible? (3f, 4f, 5f, 6f) **Approach:** For f, $\ell = 3$ requires $n \geq 4$; thus 3f impossible. **Ans: 3f.**

Q19. Compare energies for $\lambda_1 = 800$ nm and $\lambda_2 = 400$ nm. **Approach:** $E \propto 1/\lambda \Rightarrow E_2 = 2E_1$. **Ans: $E_2 = 2E_1$.**

Q20. H: transition $n = 5 \to 2$ belongs to which region/series? Ans: Balmer series, visible region.

Q21. Match the following (Column I vs Column II). **Explanation:** answer:B...

Q22. Which statement about the electron is incorrect? **Approach:** Known facts: $m_e \ll m_n$; electrons exist in all atoms; cathode rays are electrons. **Ans: "Mass of electron equals mass of neutron" is incorrect.**