Mole Concept-1[NEET]— Solutions (Q1–25)

— Some Basic Concepts of Chemistry-1

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1. The number of protons, neutrons and electrons in $^{175}_{71}$Lu respectively are [NEET 2020 (Sep.)]

Explanation (simple words): Isotope ka mass number $A = 175$ aur atomic number $Z = 71$ diya hai. Neutral atom me electrons = protons.

Approach: $p = Z$, $n = A - Z$, $e = Z$.

Steps:

$$\text{Protons} = Z = 71$$
$$\text{Neutrons} = A - Z = 175 - 71 = 104$$
$$\text{Electrons} = Z = 71$$

Why this formula? $A = p + n$, $Z = p$; neutral atom me $e = p$.

Answer: $\boxed{71,\ 104,\ 71}$ (Option d).

Similar practice: $^{31}_{15}$P me p, n, e nikaaliye.

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2. One mole of carbon atom weighs 12 g. The number of atoms in it is (mass of one ^{12}C atom $= 1.9926 \times 10^{-23}$ g) [NEET 2020 (Oct.)]

Explanation: 1 mole ⇒ utne hi atoms jitne 12 g ^{12}C me hote hain.

Approach: Atoms $= \dfrac{\text{sample mass}}{\text{mass of one atom}}$.

Steps:

$$N = \frac{12\,\text{g}}{1.9926 \times 10^{-23}\,\text{g}} = 6.022 \times 10^{23} \text{ atoms}$$

Why this formula? Total particles $= \dfrac{\text{total mass}}{\text{mass per particle}}$.

Answer: $\boxed{6.022 \times 10^{23}}$ (Option d).

Similar practice: 11.5 g Na me atoms? ($m_{\text{one Na}} = 3.82 \times 10^{-23}$ g)

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3. Which of the followings has maximum number of atoms? [NEET 2020 (Sep.)]

(a) 1 g Mg(s) (b) 1 g O_2(g) (c) 1 g Li(s) (d) 1 g Ag(s)

Explanation: Same 1 g me jiska molar mass sabse chhota, usme moles (& atoms) sabse zyada.

Approach: $n = \dfrac{m}{M}$; O_2 ke liye atoms = 2× molecules.

Steps:

$$\text{Mg: } n = \tfrac{1}{24} = 0.0417 \text{ mol} \qquad [\text{atoms} = 0.0417 N_A]$$
$$\text{O in } O_2: \ n = \tfrac{1}{32} = 0.03125 \text{ mol mol.; atoms} = 2n = 0.0625\,\text{mol atoms}$$
$$\text{Li: } n = \tfrac{1}{7} = 0.1429 \text{ mol} \qquad [\textbf{largest}]$$
$$\text{Ag: } n = \tfrac{1}{108} = 0.00926 \text{ mol}$$

Why this formula? Particles $= nN_A$ and $n = \dfrac{m}{M}$.

Answer: $\boxed{\text{1 g Li (Option c)}}$.

Similar practice: 0.5 g H vs 0.5 g He — kis me zyada atoms?

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4. In which case is the number of molecules of water maximum? [NEET 2018]

(a) 0.00224 L water vapour at 1 atm, 273 K (b) 0.18 g water (c) 18 mL water (d) 10^{-3} mol water

Explanation: Molecules $\propto$ moles. Liquids: $\rho \approx 1$ g mL^{-1}; gases at STP: 22.4 L per mol.
Approach: Har option ke moles nikaal-kar compare.
Steps:

$$
\begin{aligned}
&(a): \; n = \frac{0.00224}{22.4} = 1.0 \times 10^{-4} \text{ mol} \\
&(b): \; n = \frac{0.18}{18} = 1.0 \times 10^{-2} \text{ mol} \\
&(c): \; m = 18\,\text{g} \Rightarrow n = \frac{18}{18} = 1.0\,\text{mol} \qquad [\text{largest}] \\
&(d): \; n = 1.0 \times 10^{-3}\,\text{mol}
\end{aligned}
$$

Answer: $\boxed{\text{18 mL water (Option c)}}$.
Similar practice: 36 mL water vs 2.24×10^{-3} L water vapour at STP.

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5. Volume occupied by one molecule of water (density $= 1$ g cm^{-3}) is [CBSE AIPMT 2008]

Explanation: 1 mol water ka volume $= \dfrac{18\,\text{g}}{1} = 18$ cm^3.
Approach: Per molecule volume $= \dfrac{V_{1\text{ mol}}}{N_A}$.
Steps:

$$
\begin{aligned}
V_{\text{per molecule}} &= \frac{18\,\text{cm}^3}{6.022 \times 10^{23}} = 2.99 \times 10^{-23}\,\text{cm}^3 \\
&\approx \boxed{3.0 \times 10^{-23}\,\text{cm}^3}
\end{aligned}
$$

Why this formula? 1 mol me N_A molecules; isliye per molecule volume $= \dfrac{\text{total}}{N_A}$.
Similar practice: Ethanol (M=46, $\rho = 0.789$) ka per-molecule volume?

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6. The maximum number of molecules are present in [CBSE AIPMT 2004]

(a) 15 L H_2 at STP (b) 5 L N_2 at STP (c) 0.5 g H_2 (d) 10 g O_2
Explanation: Same T, P par molecules $\propto$ volume (Avogadro's law). Given mass par $n = \dfrac{m}{M}$.
Approach: Har option ke moles.
Steps:

$$
\begin{aligned}
&(a): \; n = \frac{15}{22.4} = 0.6696 \\
&(b): \; n = \frac{5}{22.4} = 0.223 \\
&(c): \; n = \frac{0.5}{2.016} \approx 0.248 \\
&(d): \; n = \frac{10}{32} = 0.3125
\end{aligned}
$$

Answer: $\boxed{\text{(a) 15 L } H_2 \text{ at STP}}$.
Similar practice: 22.4 L CH_4 vs 16 g O_2 — kisme molecules zyada?

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7. The number of atoms in 4.25 g of NH_3 is approximately [CBSE AIPMT 1999]

Explanation: Har NH_3 molecule me 4 atoms (1N + 3H) hote hain.
Approach: $n(NH_3) \to$ total atoms $= 4nN_A$.

Steps:

$$n(\mathrm{NH_3}) = \frac{4.25}{17.0} = 0.25\,\mathrm{mol}$$
$$N_{\text{atoms}} = 4 \times 0.25 \times N_A = 1 \times N_A \approx \boxed{6 \times 10^{23}} \text{ atoms}$$

Why? Total atoms = atoms per molecule × (no. of molecules).
Similar practice: 0.5 g CH_4 me atoms kitne?

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8. Haemoglobin contains 0.33% of iron by weight. Molar mass of haemoglobin = 67200 g. One molecule me Fe atoms kitne? (A.W. Fe=56) [CBSE AIPMT 1998]
Explanation: 0.33% ka matlab 67200 g (1 mol Hb) me Fe mass = 0.0033 × 67200 g.
Approach: Mass of Fe per mole Hb → moles Fe = $\frac{m}{56}$ → atoms per molecule.
Steps:

$$m_{\text{Fe}} = 0.0033 \times 67200 = 221.76\,\mathrm{g}$$
$$n_{\text{Fe}} = \frac{221.76}{56} = 3.96\,\text{mol Fe per mol Hb}$$
$$\text{Fe atoms per Hb molecule} \approx 4$$

Answer: $\boxed{4}$ (Option c).
Similar practice: Protein 1.20% Mg by mass, $M = 50{,}000$ g. Ek molecule me Mg^{2+} kitne?

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9. The number of atoms in 0.1 mole of a triatomic gas is (take N_A) [CBSE AIPMT 2010]
Explanation: Triatomic molecule me 3 atoms.
Approach: Atoms = $3 \times n \times N_A$.
Steps:

$$N_{\text{atoms}} = 3 \times 0.1 \times N_A = 0.3N_A = 1.806 \times 10^{23}$$

Answer: $\boxed{1.806 \times 10^{23}}$ (Option b).
Similar practice: 0.2 mol tetra-atomic gas me atoms?

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10. 1 L air (21% O_2 by volume) at STP me O_2 ke moles? [CBSE AIPMT 1995]
Explanation: Gases ke liye volume % ≡ mole % (same T, P). 1 mol gas at STP ⇒ 22.4 L.
Approach: $n_{\text{total}} = \frac{V}{22.4}$; $n(\mathrm{O_2}) = 0.21\,n_{\text{total}}$.
Steps:

$$n_{\text{total}} = \frac{1}{22.4} = 0.04464\,\mathrm{mol}$$
$$n_{\mathrm{O_2}} = 0.21 \times 0.04464 = 9.37 \times 10^{-3}\,\mathrm{mol}$$

Answer: $\boxed{9.3 \times 10^{-3}\,\mathrm{mol}}$ (Option a).
Similar practice: 5 L air (78% N_2) me N_2 ke moles?

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11. The percentage weight of Zn in white vitriol $(\mathrm{ZnSO_4 \cdot {}_7H_2O})$ is approximately (At. masses: Zn=65, S=32, O=16, H=1) [CBSE AIPMT 1995]
Explanation:
Approach: Molar mass of $\mathrm{ZnSO_4 \cdot {}_7H_2O}$ nikaal kar $\frac{65}{M} \times 100$.

Steps:

$$M(\text{ZnSO}_4) = 65 + 32 + 4 \times 16 = 161\,\text{g mol}^{-1}$$
$$M(7\text{H}_2\text{O}) = 7 \times (2 \times 1 + 16) = 7 \times 18 = 126$$
$$M_{\text{salt}} = 161 + 126 = 287$$
$$\%\,\text{Zn} = \frac{65}{287} \times 100 = 22.65\% \approx \boxed{22.65\%}$$

Why this formula? Percent by mass definition.
Similar practice: $CuSO_4 \cdot {}_5H_2O$ me Cu ka

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12. The total number of valence electrons in 4.2 g of N_3^- ion is (given N_A) [CBSE AIPMT 1994]
Explanation: N_3^- (azide) me 3 N atoms (5 valence each) + extra 1 electron for charge.
Approach: Ions $= \frac{4.2}{42} N_A = 0.1N_A$; per ion valence $e^- = 16$; total $= 1.6N_A$.
Steps:

$$n(\text{N}_3^-) = \frac{4.2}{3 \times 14} = 0.1\,\text{mol} = 0.1N_A\ \text{ions}$$
$$\text{Valence e}^- \text{ per ion} = 3 \times 5 + 1 = 16$$
$$N_{\text{valence e}^-} = 0.1N_A \times 16 = \boxed{1.6\,N_A}$$

Why? Valence electrons element's group se aate hain; negative charge +1 electron add karta hai.
Similar practice: 8.1 g PO_4^{3-} me total valence electrons?

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13. If Avogadro number N_A is changed from 6.022×10^{23} mol^{-1} to 6.022×10^{20} mol^{-1}, which of the following would change? [CBSE AIPMT 2015]
Explanation: Mole ka size hi badal jaayega (ab 1 mol me particles bahut kam honge).
Approach: Sochiye—kya ratios, formulas, balanced equations badlenge? Nahi. Par "1 mole" ka mass badal jayega.
Key point: Mass of one mole of carbon change ho jaayega; stoichiometric ratios nahi.
Answer: $\boxed{\text{(b) the mass of one mole of carbon}}$.
Similar practice: Agar N_A dugna hota, to 1 mol H_2O ka mass kitna hota?

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14. Elements X and Y form XY_2 and X_3Y_2. When 0.1 mol XY_2 weighs 10 g and 0.05 mol X_3Y_2 weighs 9 g, atomic weights of X and Y are [NEET 2016 (Phase II)]
Explanation: Dono compounds ke molar masses mil gaye; unse linear equations banenge.
Approach: Let $M_X = x$, $M_Y = y$. $x + 2y = 100$, $3x + 2y = 180$.
Steps:

$$M(\text{XY}_2) = \frac{10}{0.1} = 100 \Rightarrow x + 2y = 100$$
$$M(\text{X}_3\text{Y}_2) = \frac{9}{0.05} = 180 \Rightarrow 3x + 2y = 180$$
$$\text{Subtract}: \ 2x = 80 \Rightarrow x = 40$$
$$\text{Put in (1)}: \ 40 + 2y = 100 \Rightarrow y = 30$$

Answer: $\boxed{X = 40,\ Y = 30}$ (Option a).
Similar practice: XY_3 ka molar mass 160 aur X_2Y_3 ka 230 ho to M_X, M_Y nikaaliye.

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15. $M(O_2) = 32$ and $M(SO_2) = 64$. At 15°C and 150 mmHg, 1 L of O_2 contains N molecules. Under same conditions, 2 L of SO_2 contains how many molecules? [CBSE

AIPMT 1990]

Explanation: Same T, P par **Avogadro's law**: volume $\propto$ molecules (gas type se independent).
Approach: 1 L me N to 2 L me $2N$ — gas chahe SO_2 ho.
Answer: $\boxed{2N}$ (Option c).
Similar practice: Same conditions me 3 L H_2 me molecules kitne (jab 1 L N_2 me K ho)?

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16. 6.02×10^{24} molecules of CO contain how many gram-molecules of oxygen? [CBSE AIPMT 1990]

Explanation: CO me 1 O atom per molecule hota hai. "Gram-molecule of oxygen" se murad O_2 ke moles.
Approach: CO molecules → moles CO; O atoms = same moles; O_2 moles $= \dfrac{\text{O-atom moles}}{2}$.
Steps:

$$\begin{aligned} n(\text{CO molecules}) &= \frac{6.02 \times 10^{24}}{6.02 \times 10^{23}} = 10\,\text{mol} \\ n(\text{O atoms}) &= 10\,\text{mol} \qquad [\text{1 O atom per CO}] \\ n(O_2) &= \frac{10}{2} = \boxed{5\,\text{gram-molecules}} \end{aligned}$$

Why? O_2 molecule banane ko 2 O atoms chahiye.
Similar practice: 3.01×10^{23} CO molecules me O_2 ke gram-molecules?

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17. Number of oxygen atoms in 4.4 g of CO_2 is [CBSE AIPMT 1993]

Explanation: 1 molecule CO_2 me 2 oxygen atoms.
Approach: $n(CO_2) = \dfrac{m}{44}$; atoms $= 2nN_A$.
Steps:

$$\begin{aligned} n(CO_2) &= \frac{4.4}{44} = 0.10\,\text{mol} \\ N(\text{O atoms}) &= 2 \times 0.10 \times N_A = 0.20 N_A = \boxed{1.2 \times 10^{23}} \end{aligned}$$

Similar practice: 22 g CO_2 me O atoms?

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18. 1 cc of N_2O at NTP contains how many (i) atoms, (ii) molecules, (iii) electrons? [CBSE AIPMT 1988]

Explanation: 1 mol gas at NTP = 22400 cc. 1 molecule N_2O me 3 atoms, total electrons per molecule $= 7 + 7 + 8 = 22$.
Approach: Molecules $= \dfrac{N_A}{22400}$ per cc; atoms $= 3\times$ molecules; electrons $= 22\times$ molecules.
Steps:

$$\begin{aligned} N_{\text{mol.}}(1\,\text{cc}) &= \frac{N_A}{22400} = \left(\frac{6.022}{22400}\right) \times 10^{23}\,\text{molecules} \\ N_{\text{atoms}} &= 3 \times N_{\text{mol.}} \\ N_{e^-} &= 22 \times N_{\text{mol.}} \end{aligned}$$

Answer: Teeno expressions sahi $\Rightarrow$ $\boxed{\text{All of the above}}$.
Similar practice: 2 cc NH_3 at STP me molecules/atoms/electrons?

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19. At STP, the density of CCl_4 vapour (g L^{-1}) is nearest to [CBSE AIPMT 1988]

Explanation: Ideal gas at STP: 1 mol volume = 22.4 L; density $= \dfrac{M}{22.4}$.

Approach: $M(\text{CCl}_4) = 12.01 + 4 \times 35.45 \approx 153.8$ g mol^{-1}.
Steps:

$$\rho = \frac{153.8}{22.4} = 6.869\,\text{g L}^{-1} \approx \boxed{6.87\,\text{g L}^{-1}}$$

Similar practice: STP par SO_2 ki density?

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20. The weight of a single atom of oxygen is (take $N_A = 6.022 \times 10^{23}$) [AIIMS 1997]

Explanation: 1 mol O atoms (= 16 g) me N_A atoms. So per atom mass = $\dfrac{16}{N_A}$.

Approach: $m_{\text{one atom}} = \dfrac{M}{N_A}$.
Steps:

$$m_{\text{O atom}} = \frac{16}{6.022 \times 10^{23}} = 2.656 \times 10^{-23}\,\text{g} = \boxed{2.656 \times 10^{-23}\,\text{g}}$$

Similar practice: Ek Cl atom ka mass (35.5 g mol^{-1})?

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21. The weight of one molecule of a compound with formula $C_{60}H_{122}$ is [AIIMS 2002]

Explanation: Pehle molar mass, phir per-molecule mass = $\dfrac{M}{N_A}$.

Approach: $M = 60 \times 12 + 122 \times 1 = 842$ g mol^{-1}.
Steps:

$$m_{\text{one molecule}} = \frac{842}{6.022 \times 10^{23}} = 1.398 \times 10^{-21}\,\text{g} \approx \boxed{1.4 \times 10^{-21}\,\text{g}}$$

Similar practice: $C_{20}H_{42}$ ke ek molecule ka mass?

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22. 10^{21} molecules are removed from 200 mg of CO_2. Moles of CO_2 left are [AIIMS 2001]

Explanation: Pehle initial moles, fir hataye gaye molecules ke moles minus kar do.

Approach: $n_0 = \dfrac{0.200}{44}$; $n_{\text{removed}} = \dfrac{10^{21}}{N_A}$; $n_{\text{left}} = n_0 - n_{\text{rem}}$.
Steps:

$$n_0 = \frac{0.200}{44} = 4.545 \times 10^{-3}\,\text{mol}$$
$$n_{\text{rem}} = \frac{10^{21}}{6.022 \times 10^{23}} = 1.661 \times 10^{-3}\,\text{mol}$$
$$n_{\text{left}} = 4.545 \times 10^{-3} - 1.661 \times 10^{-3} = \boxed{2.88 \times 10^{-3}\,\text{mol}}$$

Similar practice: $5{\times}10^{21}$ molecules remove kiye gaye 1.1 g CO_2 se — moles left?

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23. Volume of a gas at NTP is 1.12×10^{-7} cc. The number of molecules in it is [AIIMS 1998]

Explanation: NTP pe 1 mol = 22400 cc. Molecules = $\dfrac{V}{22400} N_A$.

Approach: Units ka dhyaan — cc (cm^3) diya hai.
Steps:

$$n = \frac{1.12 \times 10^{-7}}{22400} = 5.00 \times 10^{-12}\,\text{mol}$$
$$N = n\,N_A = 5.00 \times 10^{-12} \times 6.022 \times 10^{23} = \boxed{3.01 \times 10^{12}\ \text{molecules}}$$

Similar practice: 2.24×10^{-6} cc gas at STP me molecules?

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24. Which has the maximum number of molecules among the following? [AIIMS 2014]

(a) 44 g CO_2 (b) 48 g O_3 (c) 8 g H_2 (d) 64 g SO_2

Explanation: Zyada moles ⇒ zyada molecules.

Approach: $n = \dfrac{m}{M}$ compare.

Steps:

$$\begin{aligned} n(CO_2) &= \frac{44}{44} = 1 \\ n(O_3) &= \frac{48}{48} = 1 \\ n(H_2) &= \frac{8}{2} = 4 \quad \textbf{(largest)} \\ n(SO_2) &= \frac{64}{64} = 1 \end{aligned}$$

Answer: $\boxed{8\,\mathrm{g}\ H_2}$ (Option c).

Similar practice: 32 g O_2, 22 g CO_2, 4 g H_2 — maximum molecules?

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25. Arrange in increasing mass (O=16, Cu=63, N=14) [AIIMS 2016]

I. one atom of oxygen II. one atom of nitrogen III. 1×10^{-10} mol of oxygen IV. 1×10^{-10} mol of copper

Explanation: Single atoms ka mass $= \dfrac{\text{atomic mass}}{N_A}$; while given moles ka mass $= nM$.

Approach: Approx values likh kar compare karein.

Steps:

$$\begin{aligned} m(\mathrm{II}) &= \frac{14}{N_A} = 2.32 \times 10^{-23}\,\mathrm{g} \\ m(\mathrm{I}) &= \frac{16}{N_A} = 2.66 \times 10^{-23}\,\mathrm{g} \\ m(\mathrm{III}) &= 10^{-10} \times 16 = 1.6 \times 10^{-9}\,\mathrm{g} \\ m(\mathrm{IV}) &= 10^{-10} \times 63 \approx 6.3 \times 10^{-9}\,\mathrm{g} \end{aligned}$$

Clearly: II $<$ I $<$ III $<$ IV.

Answer: $\boxed{\mathrm{II} < \mathrm{I} < \mathrm{III} < \mathrm{IV}}$.

Similar practice: I: one atom of Na; II: one atom of Mg; III: 5×10^{-11} mol of Na — order by mass.
