Mole Concept

1. (uses)
   - NO (nitric oxide) acts as a messenger in nerve signals in human brain.
   - Sodium benzoate is used as a food preservative.
   - Cis-platin and taxol are used in cancer treatment.
   - Azido thymidine (AZT) is used as an HIV drug.

2. (conversion)

1 atm $= 760$ mm Hg $= 1.01$ barr
$= 760$ torr $= 1.01 \times 10^5$ Pascal.

1 lit-atm $= 101.3$ J $= 101.3 \times 10^7$ erg

R = gas constant $= 2$ cal/mol/K
$= 0.0821$ lit-atm/mol.K
$= 8.314$ J/mol K.

$°C = \frac{5}{9}(°F - 32)$

1 cal $= 4.2$ J.

1 J $= 10^7$ erg.

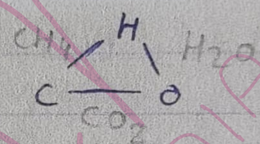
$1L = 1dm^3$

3. (Laws) Law of conservation of mass ⇒ Lavoisier

Law of definite proportions/constant compositions ⇒ Proust
(Rain water/sea water/tap water, etc. $H_2O = 2:16 = 1:8 =$ constant).

Law of multiple proportions ⇒ Dalton Eg- $NO, N_2O_2, N_2O_3, N_2O_4, N_2O_5$
$O = 1:2:3:4:5$

Law of reciprocal proportions ⇒ Richter.



$CH_4 = 3:1$ $\therefore CO_2 = 3:8$
$H_2O = 1:8$

4. Avogadro's law - equal volumes of all gases, under the same conditions of temperature and pressure, contain the same/equal number of molecules.

5. (VD) Vapour density - $VD = \frac{d_{gas}}{d_{H_2(g)}} = \frac{M_{gas}}{M_{H_2(g)}} = \frac{M_{gas}}{2}$.

$\therefore 2 \times VD =$ molecular mass. $(d_{H_2} = 0.089$ g/Lit$)$.

6. 1 amu $= 1$ Aston $= 1$ Dalton $= 1$ avogram $= \frac{1}{N_A} = 1.66 \times 10^{-27}$ k

7. (mass) Ag = 108 Cu = 63.5 Fe = 56
Br = 80 Cl = 35.5 P = 31

8. moles $= \frac{\text{Wt. of atom}}{\text{Atomic mass}} = \frac{\text{Wt. of compound}}{\text{GMM}} = \frac{\text{Vol.}}{22.4L} = \frac{\text{No. of given partic}}{N_A}$.

Loschmidt number $= 2.68 \times 10^{19}$ = no. of entities in 1 mL.
$(N_A = 6.023 \times 10^{23} \longrightarrow 22400$ mL$)$.

9. No. of particles in a given compound = moles $\times N_A \times$ no. of atoms/molecules/ions/e^-/p/n.

10. Concept of limiting reagent - $2H_2 + O_2 \longrightarrow 2H_2O$
(4g) (40g)
$\therefore H_2$ = limiting reagent

11. % of element = $\frac{\text{no. of atoms of the element} \times \text{its GAM}}{\text{GMM}} \times 100$.

12. Empirical formula - (EF) (molecular formula = MF)
$n = \frac{\text{Mol. formula weight}}{\text{EF weight}}$. molecular formula = $n \times EF$

C	12	75%	75/12 = 6.25	6.25/6.25 = 1
H	1	25%	25/1 = 25	25/6.25 = 4

$\therefore CH_4$. (= EF)

13. gram equivalent mass = $\frac{\text{at. wt}}{\text{Valency}} = \frac{\text{GMM}}{n\text{-factor}}$ = GEW

gram Equivalents (eq.) = $\frac{W}{\text{GEW}}$ = moles $\times$ n-factor. (GAM = Gram atomic mass)

Dulang-petit method - At. wt = $\frac{6.4}{\text{specific heat (cal/gm)}}$.

14. $M = \frac{\text{moles of substance (solute)}}{\text{vol. of solution (L)}} = \frac{n}{V} = \frac{10 \times d \times (w/w)\%}{\text{GMW}}$.

$N = \frac{\text{equivalents of solute}}{\text{Vol. of solution (L)}} = \frac{W}{\text{GEW}} \times \frac{1}{V(L)} = \frac{\text{moles}}{V} \times n\text{-factor}$

$\boxed{N = M \times n\text{-factor}}$

$m = \frac{\text{moles of solute}}{\text{wt. of solvent (kg)}} = \frac{1000 \times M}{1000 \times d - M(\text{GMW})}$

15. % $\frac{w}{w} = \frac{\text{wt. of solute (g)} \times 100}{\text{wt. of solution (g)}}$

% $\frac{W}{V} = \frac{\text{wt. of solute (g)}}{\text{vol. of solution (mL)}} \times 100$

$$\% \frac{V}{V} = \frac{\text{vol. of solute (mL)} \times 100}{\text{vol. of solution (mL)}}$$

→ $$\underset{(S)}{\text{strength of solution}} = \frac{\text{wt. of solute (g)}}{\text{Vol. of solution (L)}}$$

$$S = M \times GMW$$

$$S = N^{\circ} \times GEW.$$

16. $$X_A = \frac{n_A}{n_A + n_B} \qquad X_B = \frac{n_B}{n_A + n_B} \qquad [X_A + X_B = 1]$$

$$\underset{\text{(parts per million)}}{\underline{\text{PPM}}} = \frac{\text{wt. of solute}}{\text{wt. of solution}} \times 10^6.$$

17. $$F = \frac{\text{wt}}{\text{formal mass}} \times \frac{1}{V\,(\text{lit})}.$$ {In case of association or dissociation}

18. Demal (D) = Molarity (M) <u>at 0°C</u>.

19. <u>Mixing</u> -

① <u>Physical mixing [A+A or B+B]</u>

$$M = \frac{n}{V} = \frac{n_1 + n_2}{V_1 + V_2} = \frac{M_1V_1 + M_2V_2}{V_1 + V_2}.$$

$$N = \frac{N_1V_1 + N_2V_2}{V_1 + V_2}.$$

② <u>Chemical change</u>

$$N = \frac{|eq_1 - eq_2|}{V_1 + V_2} = \frac{N_1V_1 - N_2V_2}{V_1 + V_2}.$$

$$M = \frac{N}{\text{n-factor}}$$ → of excessive/remaining equivalents of acid/base.

20. <u>n-factor</u> -

(n-factor = valency factor)

① acids = basicity (no. of OH)

② bases = acidity (no. of OH)

③ salt = total +ve charge

4. Homo molecule = total valency (eg- $O_2 = 4$) ($N_2 = 6$) ($H_2 = 2$)
5. ion = |charge|