The mole concept

1. (a) 16*g* O_2has no. of moles $= \frac{16}{32} = \frac{1}{2}$

14*g* N_2 has no. of moles $= \frac{14}{28} = \frac{1}{2}$

No. of moles are same, so no. of molecules are same.

2. (b) $\boldsymbol{Na_2SO_4 \,.\, 10H_2O = 2 \times 23 + 32 + 4 \times 16 + 10 \times 18}$

$$\boldsymbol{= 46 + 32 + 64 + 180 = 322gm}$$

322*gm* $Na_2SO_4.10H_2O$ contains = 224 *gm* oxygen

32.2*gm* $Na_2SO_4.10H_2O$ contains

$= \frac{32.2 \times 224}{322} = 22.4gm$

3. (b) Molarity $= \frac{W(gm) \times 1000}{\text{molecular wt.} \times V(ml.)}$

$$= \boldsymbol{\frac{2.65 \times 1000}{106 \times 250} = 0.1M}$$

10*ml* of this solution is diluted to 1000*ml* $N_1V_1 = N_2V_2$

$10 \times 0.1 = 1000 \times x$

$x = \frac{0.1 \times 10}{1000} = 0.001M.$

4. (c) According to definition of molar solution→A molar solution is one that contains one mole of a solute in one litre of the solution.

5. (a) 44*g* of CO_2 has $2 \times 6 \times 10^{23}$atoms of oxygen

4.4*g of* CO_2 has $= \frac{12 \times 10^{23}}{44} \times 4.4$

$= 1.2 \times 10^{23}$ atoms.

6. (b) 44*g* CO_2 occupies 22.4*L* at STP

4.4*g* CO_2 occupies $= \frac{22.4}{44} \times 4.4 = 2.24L$.

7. (a) Density= $\frac{\text{Mass}}{\text{Volume}}$; $1 = \frac{g}{ml}$ or $g = ml$

0.0018*ml* = 0.0018*gm*

No. of moles= $\frac{\text{weight}}{\text{Molecular weight}} = \frac{0.0018}{18} = 1 \times 10^{-4}$

$\therefore$ No. of water molecules $= 6.023 \times 10^{23} \times 1 \times 10^{-4}$

$= 6.023 \times 10^{19}$.

8. (c) $\boldsymbol{Ca_3P_2 + 6H_2O \rightarrow 2PH_3 + 3Ca(OH)_2}$

9. (d) Amount of gold= $19.7kg = 19.7 \times 1000gm$=19700*gm*

No. of moles $= \frac{19700}{197} = 100$

$\therefore$ No. of atoms $= 100 \times 6.023 \times 10^{23}$

$= 6.023 \times 10^{25}$atoms.

10. (c) $\because$ 100*gm* $CaCO_3$ $= 6.023 \times 10^{23}$molecules

$\therefore$ 10*gm* $CaCO_3 = \frac{6.023 \times 10^{23}}{100} \times 10$

$= 6.023 \times 10^{22}$ molecule

1 molecule of $CaCO_3$= 50 protons

6.023×10^{22}molecule of $CaCO_3 = 50 \times 6.023 \times 10^{22}$

$= 3.0115 \times 10^{24}$

11. (b) 16*gm* of CH_4= 1mole $= 6.023 \times 10^{23}$ molecules.

12. (c) According to avogadro's hypothesis equal volumes of all gases under similar conditions of temperature and pressure contains equal no. of molecules.

13. Answer: (c) g mol⁻¹

Explanation:
For H_2O_2, adding atomic masses gives 2×1 + 2×16 = **34**.

- If we say **molecular weight** (more precisely, *relative molecular mass*,), it's a **pure number** (no unit).
- But when the value **34** is used with units, it refers to the **molar mass**, which is **34 g mol⁻¹**.

Since the options are units, the correct choice is **g mol⁻¹**

14. (d) $d = \frac{M}{V}$ (*d* = density, *M*= mass, *V* =volume)

Since *d* = 1

So, $M = V$

18*gm* = 18*ml*

18*ml* = N_A molecules (N_A = avogadro's no.)

1000*ml* = $\frac{N_A}{18} \times 1000$ = 55.555 N_A.

15. (a) This is fact.

16. (a) ∵ 3 moles of oxygen is that in 1 mole of $BaCO_3$

∴ 1.5 moles of oxygen is that in mole of $BaCO_3$ $= \frac{1}{3} \times 1.5 = \frac{1}{2} = \mathbf{0.5}$.

17. (b) The no. of molecules present in 1*ml* of gas at STP is known as Laschmidt number.

22400*ml* of gas has total no. of molecules

$= 6.023 \times 10^{23}$

1*ml* of gas has total no. of molecules $= \frac{6.023\times10^{23}}{22400}$

$= 2.69 \times 10^{19}$.

18. (b) ∵ 2*gm* of hydrogen $= 6.02 \times 10^{23}$molecules

∴ 1*gm* of hydrogen

$= \frac{6.02\times10^{23}}{2} = 3.01 \times 10^{23}$molecule.

19. (a) Molecular weight of SO_2Cl_2

$= 32 + 32 + 2 \times 35.5 = 135gm$

∵ 135 *gm* of SO_2Cl_2 = 1*gm* molecule

∴ 13.5*gm* of $SO_2Cl_2 = \frac{1}{135} \times 13.5 = 0.1$.

20. (a) (a) 34*gm* of water

∵ 18*gm* H_2O =6.023×10^{23} molecule

∴ 34*gm* $H_2O = \frac{6.023\times10^{23}}{18} \times 34$

$= \mathbf{11.37 \times 10^{23}}$mole

(b) 28*gm* of CO_2

∵44*gm* $CO_2 = 6 \times 10^{23}$ molecules

∴ 28*gm* $CO_2 = \frac{6\times10^{23}}{44} \times 28 = 3.8 \times 10^{23}$

(c) 46*gm* of CH_3OH

∵32*gm* $CH_3OH = 6 \times 10^{23}$ molecules

∴ 46*gm* $CH_3OH = \frac{6\times10^{23}}{32} \times 46 = 8.625 \times 10^{23}$

(d) ∵108*gm* of $N_2O_5 = 6 \times 10^{23}$ molecules

$\therefore$ 54*gm* of $N_2O_5 = \frac{6\times10^{23}}{108} \times 54 = 3 \times 10^{23}$ molecules.

21. (b) Sodium oxide → Na_2O

Molecular weight = 46 +16 = 62

62*gm* of Na_2O = 1 mole

620*gm* of Na_2O = 10 mole.

22. (b) 2*gm* of oxygen contains atom= $\frac{2}{16} = \frac{1}{8}$mole

also 4*g* of sulphur $= \frac{4}{32} = \frac{1}{8}$mole.

23. (c) Molarity = mole/litre

∵ 1*cc* contains 1.17*gm*

$\therefore$ 1000*cc* contains 1170*gm* $\frac{1170gm}{\text{Mol.wt.}} = \frac{1170}{36.5}$

$= 32.05 mole/litre$ (Mol. wt. of *HCl*=36.5)

24. (a) 1 mole of sucrose contains 6.023×10^{23}molecules

∵ 1 molecule of sucrose has 45 atoms

$\therefore$ 6.023×10^{23}molecule of sucrose has $45 \times 6.023 \times 10^{23}$ atoms/mole

25. (a) wt of $CO_2 = 44$

mol wt of $CO_2 = 44$

No. of molecule $= \frac{\text{wt. of } CO_2}{molwtofCO_2} \times 6.02 \times 10^{23}$

$= \frac{44}{44} \times 6.02 \times 10^{23} = 6.02 \times 10^{23}$

26. (c) No. of atoms in one molecule

= no. of moles $\times 6.022 \times 10^{23}$

$= 1.4 \times 6.022 \times 10^{23} = 8.432 \times 10^{23}$

27. (d) As we know that four sodium atom are present in sodium ferrocyanide $[Na_4Fe(CN)_6]$

Hence, number of Na atoms = No. of moles ×number of atom ×Avogadro's number

$2 \times 4 \times 6.023 \times 10^{23} = 48 \times 10^{23}$