MOLARITY AND NORMALITY

MISSION MBBS | NEET 2024

MOLE CONCEPT

– L8

CLASS 11 | CHEMISTRY

PDF

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Molarity

Number of moles of the **solute** present in **1 litre** of the **solution**

Molarity

(1)

Molarity (M) = $\frac{\text{No. of moles of solute}}{\text{Volume of solution in litres}}$

$\frac{n}{V(L)} = \frac{mol}{L^{-1}}$

(2) if mass of solute is given ($w_2 g$)

$$M = \frac{w_2}{M_2 \times V_{soln}(Lit)} = \frac{w_2}{M_2} \times \frac{1000}{V_{soln}(ml)}$$

Molarity

1 L = 1 dm^3

= 1000 ml

1 ml = 1 cm^3

SI unit

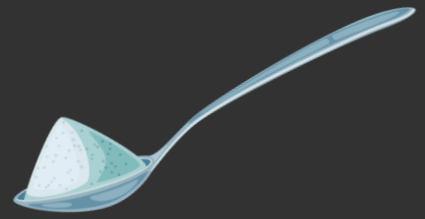
- mol L^{-1}
- mol dm^{-3}
- M
- Molar

Volume of beaker = 750 mL

$$M = \frac{n}{V(L)} = n \times \frac{1000}{V_{ml}}$$

$$= 2 \times \frac{1000}{500} = 4M$$

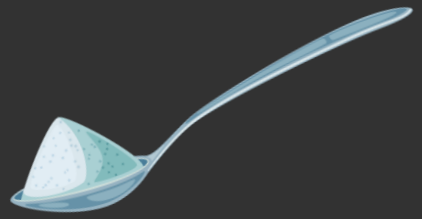
$$= 4\ mol\ L^{-1}$$



Mixing NaCl **(2 moles)** in Water **(500 mL)**

Molarity of Salt Solution

Volume of beaker = 1 L



Mixing NaCl **(117 g)** in Water **(750 mL)**

Molarity of Salt Solution

→ Molarity depends upon temp

Temp ↑, Volume of solution ↑, molarity ↓

→ $M = \frac{n \text{ (moles)}}{V_{soln}(L)}$

$$\text{moles} = M \times V(L)$$

1 mol = 1000 millimol

$$\text{millimol} = M \times V(\text{ml})$$

Que :- 4.9 (g) H_2SO_4 dissolves in 500 ml H_2O

Find Molarity of H_2SO_4 ?

$H_2SO_4 = 2\times1 + 32 + 16\times4$

$= 98\ g\,mol^{-1}$

Given :- $w_2 = 4.9\ g$

$M_2 = 98\ g\,mol^{-1}$

$V_{soln} = 500\ ml$

$$M = \frac{w_2}{M_2} \times \frac{1000}{V\ ml} = \frac{4.9}{98} \times \frac{1000}{500} \Rightarrow 0.1\ M$$

$0.1\ mol\ L^{-1}$

Que :- 3.42 g $Al_2(SO_4)_3$ dissolve in to 2 L H_2O.
Find the Molarity of SO_4^{2-} ion

$$Al_2(SO_4)_3 \longrightarrow 2Al^{3+} + 3SO_4^{2-}$$
$$x\,M \qquad\qquad .01\,2x\,M \qquad 3x\,M$$

$Al_2(SO_4)_3$ = 23, 23, 96, 96, 96 = 342 g

$w_2 = 3.42\,g$

$M_2 = 342\,g\,mol^{-1}$

$V_{sol^n} = 2\,L$

$$M = \frac{w_2}{M_2} \times \frac{1}{V(L)}$$

$$M = \frac{3.42}{342} \times \frac{1}{2}\cdot 5$$

$$M = .005\ mol\,L^{-1}$$

Calculate the molarity of H^+ ions in a solution of H_2SO_4 prepared by dissolving 49 g of H_2SO_4 in 250 mL of water. (Assume H_2SO_4 to be completely dissociated)

A. 4 M

B. 2 M

C. 1 M

D. 6 M

$$\underset{x\,M}{H_2SO_4} \longrightarrow \underset{2x\,M}{2H^+} + \underset{x\,M}{SO_4^{2-}}$$

$$M_{(H_2SO_4)} = \frac{w_2}{m_2} \times \frac{1000}{V(ml)}$$

$$M_{(H_2SO_4)} = \frac{49}{98} \times \frac{1000}{250} = 2\,M$$

$$M_{H^+} = M_{H_2SO_4} \times 2 = 2 \times 2 = 4\,M$$

What is the molarity of a 49% H_3PO_4 solution by mass? (Density of the solution = 1.33 g/mL)

A. 0.66 M

B. 4.9 M

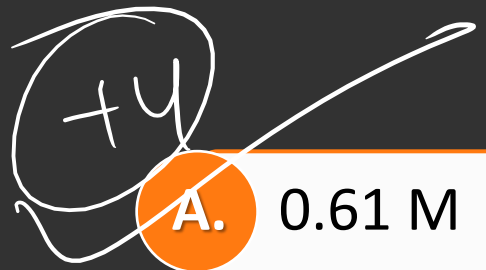
C. 6.64 M

D. 5 M

$$M = \frac{w_2}{M_2} \times \frac{1000 \times d_{soln}}{100}$$

$$M = \frac{w_2 \times 10 \times d_{soln}\ (g\,mL^{-1})}{M_2}$$

What is the molarity of 4.9% H_2SO_4 solution by mass? (density of H_2SO_4 solution = 1.22 g/mL)



A. 0.61 M

B. 4.9 M

C. 1.22 M

D. 1 M

$$M = \frac{w_2}{m_2} \times 10 \times d_{soln}$$

$$M = \frac{4.9 \times 10 \times 1.22}{98_2} = .61\ M$$

Strength of solution

Strength of solution : weight of solute (g) present in 1 L of solution

$$= \frac{w_2\,(g)}{V_{soln}\,(L)}$$

Unit = g/L

4:3

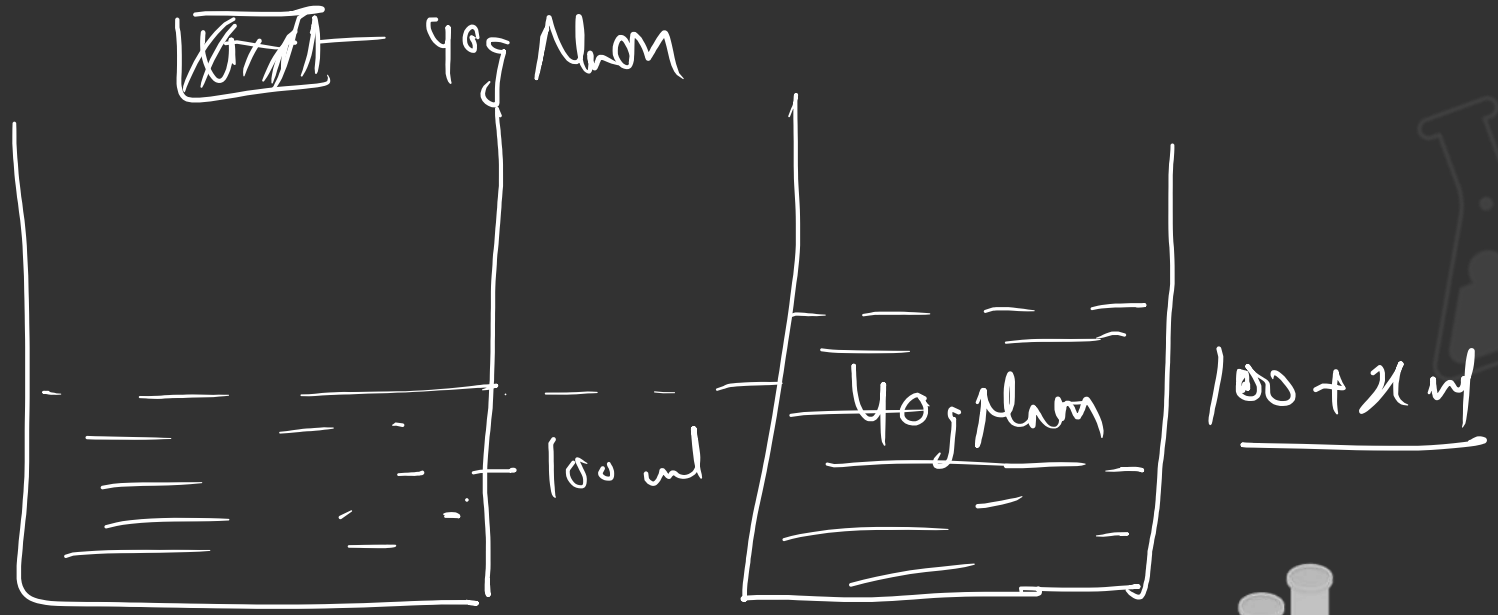
Take a beaker containing 100 mL of water. Add to it, 40 g of NaOH. What will be the percentage strength of NaOH in the solution? (take the density of NaOH to be 2 g/cm^3)

A. 333.33 g/L

B. 33.33 g/L

C. 66.66 g/L

D. 666.66 g/L



Take a beaker containing 100 mL of water. Add to it, 40 g of NaOH. What will be the percentage strength of NaOH in the solution? (take the density of NaOH to be 2 g/cm^3)

Step 1 :- Find the Volume of soln

$(V_{H_2O} + V_{NaOH})$

100 ml 20 ml = 120

$$d_{NaOH} = \frac{m_{NaOH}}{V_{NaOH}}$$

$$V_{NaOH} = \frac{m}{d} = \frac{40}{2} = 20 \text{ ml}$$

$$S = \frac{w_2}{V(L)} = \frac{40}{\frac{120}{1000}} = \frac{40 \times 1000}{120} = 333.33$$

Normality

Normality (N) : Normality is the number of **equivalents of solute** present in **1 L of the solution**.

Unit = eqv/L or Normal (N)

$$N = \frac{\text{gram Equivalents (Eq)}}{\text{Volume (L)}}$$

$$\text{unit} = \text{Eq } L^{-1}$$

Equivalents = ?

$$\text{moles} = \frac{\text{Given mass}}{\text{Molar mass}}$$

$$\text{No of eqv} \Rightarrow \frac{\text{Given mass (g)}}{\text{Equivalent mass}} \quad (1)$$

$$\text{Equivalent mass} \Rightarrow \frac{\text{Molar mass}}{n_{factor}(?)} \quad (2)$$

$$\text{No of eqv} \Rightarrow \frac{\text{mass}}{\text{molar mass}} \times n_{factor} \quad (3)$$

$$\text{No of eqv} = \text{moles} \times n_{factor} \quad (4)$$

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Important

n factor of Acid :-

No of H^+ produce by acid.

① $HCl \longrightarrow H^+ + Cl^-$ $\quad n = 1$

② $H_2SO_4 \longrightarrow 2H^+ + SO_4^{2-}$ $\quad n = 2$

③ $H_3PO_4 \longrightarrow 3H^+ + PO_4^{3-}$ $\quad n = 3$

Qu:- $H_2SO_4 \longrightarrow H^+ + HSO_4^-$ $\quad n = 1$

H_3PO_4

$3H^+ + PO_4^{3-}$ $\quad n = 3$

$2H^+ + HPO_4^{2-}$ $\quad n = 2$

$H^+ + H_2PO_4^-$ $\quad n = 1$

Factor of Base :-

No of OH^- produce by Base in aq soln.

$NaOH \longrightarrow Na^+ + OH^- \quad n=1$

$Ca(OH)_2 \longrightarrow Ca^{2+} + 2OH^- \quad n=2$

$Al(OH)_3 \longrightarrow Al^{3+} + 3OH^- \quad n=3$

n factor of Salt :-

After ionisation Total +ve or -ve charge produce

$NaCl \longrightarrow Na^{+} + Cl^{-}$ $\quad n = 1$

$CaSO_4 \longrightarrow Ca^{2+} + SO_4^{2-}$ $\quad n = 2$

$Na_2SO_4 \longrightarrow 2Na^{+} + SO_4^{2-}$ $\quad n = 2$

$AlCl_3 \longrightarrow Al^{3+} + 3Cl^{-}$ $\quad n = 3$

Que (i) $Al_2(SO_4)_3 \rightarrow 2Al^{3+} + 3SO_4^{2-}$ $\quad n = 6$

(ii) $Na_2SO_4 \cdot Al_2(SO_4)_3 \cdot nH_2O \rightarrow \underbrace{2Na^{+} + 2Al^{3+}}_{+6} + \underbrace{4SO_4^{2-}}_{-6}$

$n = 6$

n_f of $Ca_3(PO_4)_2 \longrightarrow 3Ca^{2+} + 2PO_4^{3-}$

n - factor

$+ve = 3 \times +2 = +6$ $\quad -ve = 2 \times -3 = -6$

$n = 6$

For Acids	For Bases	For Salts
HCl	KOH	NaCl
H_2SO_4	$Ca(OH)_2$	$BaCl_2$
H_3PO_4	$Al(OH)_3$	$Ca_3(PO_4)_2$

$$N = \frac{\text{eqv}}{V(L)}$$

① No of Eqv $\Rightarrow$ $N \times V(L)$

② 1 Eqv = 1000 milleqv

No of milli eqv = $N \times V(ml)$

③ No of Eqv $\Rightarrow$ $\frac{\text{Given mass}}{\text{Eqv mass}}$

④ No of Eqv = $\frac{\text{Given mass}}{\text{Molar mass}} \times n_{factor}$

⑤ No of Eqv

= molar $\times$ n_{factor}

Relation b/w Normality & Molarity

$$N = \frac{Eq}{V(L)} = \frac{\frac{\text{Given mass } (w_2)}{\text{Eq mass}}}{\frac{V_{ml}}{1000}} = \frac{w_2}{\text{Eq mass}} \times \frac{1000}{V(ml)} = \frac{w_2}{\frac{\text{Molar mass}}{n_{factor}}} \times \frac{1000}{V(ml)}$$

$$N = \frac{w_2}{M_2} \times \frac{1000}{V_{ml}} \times n_{factor}$$

$$\boxed{N = M \times n_{factor}}$$

Take a glass containing 100 mL of water. Add to it, 40 g of NaOH. What will be the normality of the solution? (Take the density of NaOH to be 2 g/cm^3)

A. 1.32 N

B. 11.46 N

C. 3.82 N

D. 8.33 N

Take a glass containing 100 mL of water. Add to it, 40 g of NaOH. What will be the normality of the solution? (Take the density of NaOH to be 2 g/cm^3)

Calculate the molarity and normality of 1/10 moles of H_2SO_4 in 500 mL solution.

A. 0.2, 0.1

B. 0.4, 0.2

C. 0.2, 0.4

D. 0.1, 0.2

$$N = M \times n$$

$$n_{H_2SO_4} = n_{factor} = 2$$

$$M = \frac{n_{H_2SO_4} \times 1000}{V_{ml}}$$

$$= \frac{1}{10} \times \frac{1000}{500} 2 = 0.2 \text{ mol } L^{-1}$$

$$N = M \times n_{factor}$$

$$= 2 \times 0.2 = 0.4 \text{ eq } L^{-1}$$

Calculate the molarity and normality of 1/10 moles of H_2SO_4 in 500 mL solution.

What is the equivalent mass of H_3PO_4 for the given reaction? (Molar mass is given as 'M')

$$H_3PO_4 + Ca(OH)_2 \longrightarrow CaHPO_4 + 2H_2O$$

A. M/1

B. M/2

C. 2M

D. M/4

$$\text{Eq wt} = \frac{M \cdot M}{n_{factor}} = \frac{M}{2}$$

$$= \frac{M}{2}$$

What is the equivalent mass of H_3PO_4 for the given reaction? (Molar mass is given as 'M')

$H_3PO_4 + Ca(OH)_2 \rightarrow CaHPO_4 + 2H_2O$

Which of the following properties will change on increasing the temperature?

A. Molality

B. Mole fraction

C. Molarity

D. Percentage mass

Next class wed -> 6 - 7

Mole Conc Molarity / Normality

"Stay Positive, Work Hard, Make It Happen"

THANK YOU