

المحاضرة رقم 2

The normality

or the equivalent concentration

$$\text{Molarity (mole/L)} = \frac{\text{Number of mole of solute}}{\text{Volume of solution (L)}} \rightarrow M \left(\frac{\text{mole}}{\text{L}} \right) = \frac{\text{no. mole (mole)}}{v(\text{L})}$$

$$\text{Normality (eq/L)} = \frac{\text{Number of equivalent of solute}}{\text{Volume of solution (L)}} \rightarrow N \left(\frac{\text{eq}}{\text{L}} \right) = \frac{\text{no. eq (eq)}}{v(\text{L})}$$

$$\text{no. eq(eq)} = \frac{\text{mass (g)}}{\text{Equivalent weight (g/eq)}} \rightarrow \text{no. eq(eq)} = \frac{m(\text{g})}{EW \left(\frac{\text{g}}{\text{eq}} \right)}$$

$$\text{no. mole(mole)} = \frac{\text{mass (g)}}{\text{Formule weight (g/mole)}} \rightarrow \text{no. mole(mole)} = \frac{\text{mass (g)}}{F. wt \left(\frac{\text{g}}{\text{mole}} \right)}$$

What's an equivalent ?

An equivalent of a substance is the mass (grams) of that substance that will combine with one mole of another reactant.

$$EW \left(\frac{\text{g}}{\text{eq}} \right) = \frac{F. wt \left(\frac{\text{g}}{\text{mole}} \right)}{n \left(\frac{\text{eq}}{\text{mole}} \right)}$$

$$EW \left(\frac{\text{g}}{\text{eq}} \right) = \frac{\text{Formule weight (g/mol)}}{\text{number of reacting units (eq/mol)}}$$

- The normality of a solution is the gram equivalent weight of a **solute** per liter of **solution**.
- It may also be called the **equivalent concentration**.
- It is indicated using the symbol **N**, **eq/L**, or **meq/L**.

$$\rightarrow \text{no. eq} = N \left(\frac{\text{eq}}{\text{L}} \right) \cdot V(\text{L})$$

$$\text{Number of equivalents (eq)} = \frac{m(\text{g})}{eq. wt \left(\frac{\text{g}}{\text{eq}} \right)} = \text{normality (eq/L)} \times \text{volume (L)}$$

$$\text{Number of milliequivalents (meq)} = \frac{m(\text{mg})}{eq. wt \left(\frac{\text{mg}}{\text{meq}} \right)} = \text{normality (meq/L)} \times \text{volume (L)}$$

Reaction Type	Reacting Unit
Acid , base	H ⁺ , OH ⁻
Oxidation–reduction	electron

Number of reactant

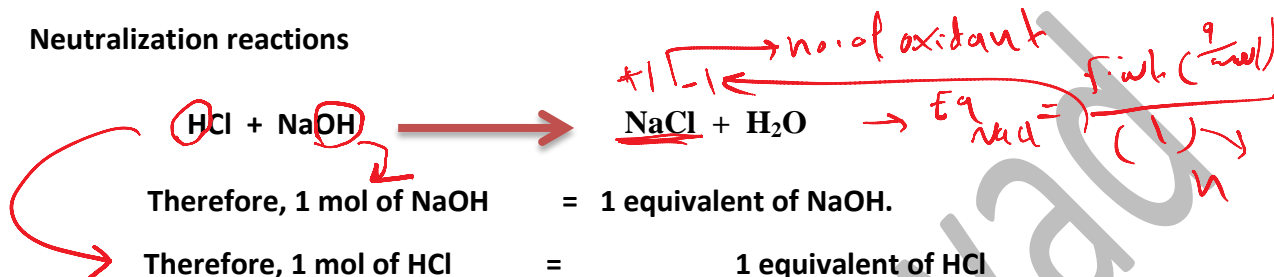
Neutralization reactions

Precipitation reactions

Oxidation-Reduction reactions

Complexation reactions

• Neutralization reactions



What is the n of:

- | | | |
|----|--|-----------|
| A. | 1 M HCl = | n = 1 H+ |
| B. | 1 M CH ₃ COOH = | n = 1 H+ |
| C. | 0.3 M H ₃ PO ₄ = | n = 3 H+ |
| D. | 1 M NaOH = | n = 1 OH- |

• Precipitation reactions

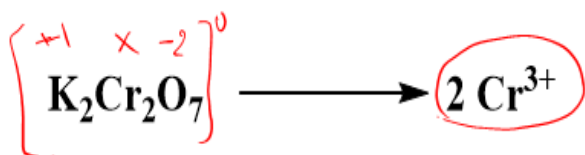


Handwritten notes:
 $\text{AgCl} \Rightarrow \text{EW} = \frac{\text{f.wt.} (1/\text{mol})}{n(e)} \Rightarrow \text{EW} = \frac{\text{f.wt.}}{(1) \Rightarrow n}$

Handwritten notes:
 $n = +1, +1$

Handwritten notes:
 $\text{BaSO}_4 \Rightarrow n = 2 \Rightarrow \text{EW} = \frac{\text{f.wt.}}{2}$

• Oxidation-Reduction reactions



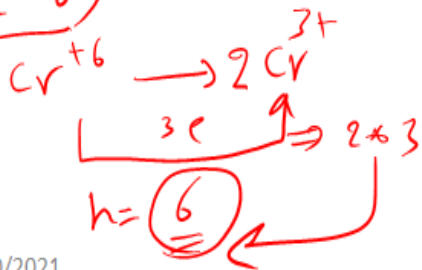
$$(1 \times 2) + (2 \times x) + (-2 \times 7) = 0$$

K Cr O

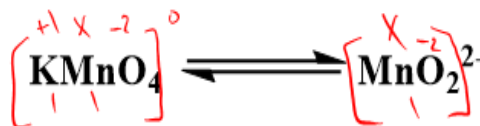
$$2 + 2x - 14 = 0$$

$$2x - 12 = 0 \Rightarrow x = 6$$

$$n = 6$$



1/30/2021



$$\frac{+1 \times 1}{\text{K}} + \frac{x \times 1}{\text{Mn}} + \frac{-2 \times 4}{\text{O}} = 0$$

$$1 + x - 8 = 0$$

$$x = +7$$

↓
Mn

$$\frac{x \times 1}{\text{Mn}} + \frac{-2 \times 2}{\text{O}} = -2$$

$$x - 4 = -2$$

$$x = 2$$

↓
Mn



$$5e$$

$$n = 5$$

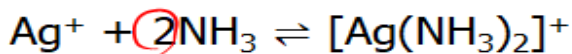
م.د. منار علي عواد

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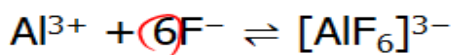
• Complexation reactions



$4 \Rightarrow \text{:CN} \Rightarrow n = \text{number of pair electron need to form complex}$
 $n = 4$



$n = 2 \Rightarrow 2 \Rightarrow \text{:NH}_3 \Rightarrow \text{EW} [\text{Ag}(\text{NH}_3)_2]^+ = \frac{\text{p.wt}}{2} \rightarrow n$



$n = 6 \Rightarrow 6 = \text{:F}^- \Rightarrow \text{EW} (\text{AlF}_6)^{3-} = \frac{\text{p.wt}}{6} \rightarrow n$

Calculate the Normality of 2.35 g/250 ml solution of KMnO_4 (F.wt=158.04 g/mol) if Mn^{7+} is reduced to Mn^{2+} ?

Solution:

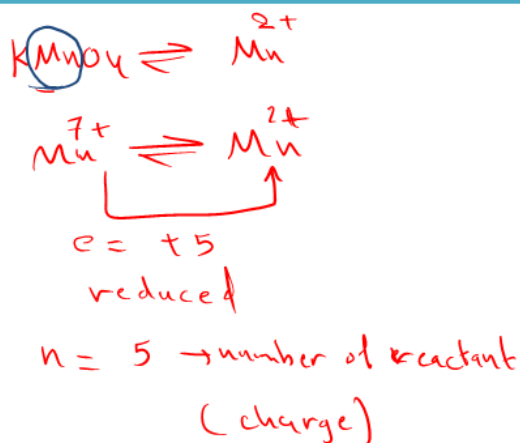
$$Ew \left(\frac{eq}{g} \right) = \frac{F.wt \left(\frac{g}{mol} \right)}{n \left(\frac{eq}{mol} \right)}$$

$$Ew \left(\frac{eq}{g} \right) = \frac{158 \left(\frac{g}{mol} \right)}{5 \left(\frac{eq}{mol} \right)} \rightarrow E.W = 31.6 \left(\frac{g}{eq} \right)$$

$$N \left(\frac{eq}{L} \right) = \frac{m(g)}{eq.wt \left(\frac{g}{eq} \right)} \times \frac{1000 \text{ ml/L}}{v \text{ (ml)}}$$

$$N \left(\frac{eq}{L} \right) = \frac{2.35(g)}{31.6 \left(\frac{g}{eq} \right)} \times \frac{1000 \text{ ml/L}}{250 \text{ (ml)}}$$

$$N \left(\frac{eq}{L} \right) = 0.2974 \left(\frac{eq}{L} \right)$$



Calculate the Normality of 0.53 g/100 ml solution of Na_2CO_3 (F.wt=106 g/mol) as the following reaction?



Solution:

$$Ew \left(\frac{eq}{g} \right) = \frac{F.wt \left(\frac{g}{mol} \right)}{n \left(\frac{eq}{mol} \right)}$$

$$Ew \left(\frac{eq}{g} \right) = \frac{106 \left(\frac{g}{mol} \right)}{2 \left(\frac{eq}{mol} \right)} \rightarrow E.W = 53 \left(\frac{g}{eq} \right)$$

$$N \left(\frac{eq}{L} \right) = \frac{no. eq \text{ (eq)}}{v(L)}$$

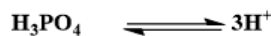
$$N \left(\frac{eq}{L} \right) = \frac{m(g)}{eq.wt \left(\frac{g}{eq} \right) \cdot v(L)}$$

$$N \left(\frac{eq}{L} \right) = \frac{m(g)}{eq.wt \left(\frac{g}{eq} \right)} \times \frac{1000 \text{ ml/L}}{v \text{ (ml)}}$$

$$N \left(\frac{eq}{L} \right) = \frac{0.53(g)}{53 \left(\frac{g}{eq} \right)} \times \frac{1000 \text{ ml/L}}{100 \text{ (ml)}}$$

$$N \left(\frac{eq}{L} \right) = 0.1 \left(\frac{eq}{L} \right)$$

What is normality of 2 M of H_3PO_4 ?



Solution:

$$Ew \left(\frac{eq}{g} \right) = \frac{F.wt \left(\frac{g}{mol} \right)}{n \left(\frac{eq}{mol} \right)} \rightarrow n = 3 \text{ (H+)}$$

$$N = n \times M$$

$$N = 3 \left(\frac{eq}{mol} \right) \times 2 \left(\frac{mol}{L} \right)$$

$$N = 6 \left(\frac{eq}{L} \right)$$