25.0 mL of acetic acid solution requires 37.3 mL of 0.150 M sodium hydroxide for complete reaction. The equation for this reaction is:

$$NaOH + HC_2H_3O_2 \rightarrow NaC_2H_3O_2 + H_2O$$

What is the molar concentration of the acetic acid?

$$\frac{mol\ HC_2H_3O_2}{L\ solution} \leftarrow = 25.0\ mL\ or\ 0.0250\ L$$

Since we already know the volume of acetic acid solution, we need to calculate the moles of acetic acid if we want to find out the concentration.

$0.150\ mol\ NaOH = L \qquad mol\ NaOH = mol\ HC_2H_3O_2$

units: $37.3\ mL\ NaOH\ solution = 0.0373\ L\ NaOH\ solution$

$$0.0373\ L \times \frac{0.150\ mol\ NaOH}{L} \times \frac{mol\ HC_2H_3O_2}{mol\ NaOH} = 0.005595\ mol\ HC_2H_3O_2$$

To get molarity, divide moles of acetic acid and volume:

$$M = \frac{mol\ HC_2H_3O_2}{L\ solution} = \frac{0.005595\ mol\ HC_2H_3O_2}{0.0250\ L} = \boxed{0.224\ M\ HC_2H_3O_2}$$

Shortcut: Use millimoles

$$37.3\ mL \times \frac{0.150\ mol\ NaOH}{L} \times \frac{mol\ HC_2H_3O_2}{mol\ NaOH} = 5.595\ mmol\ HC_2H_3O_2$$

$$M = \frac{mol\ HC_2H_3O_2}{L\ solution} = \frac{mmol}{mL} = \frac{5.595\ mmol\ HC_2H_3O_2}{25.0\ mL} = 0.224\ M\ HC_2H_3O_2$$

42.081 g/mol $\qquad$ 53.064 g/mol

$$4\,C_3H_6 + 6\,NO \longrightarrow 4\,C_3H_3N + 6\,H_2O + N_2$$

propylene $\qquad$ acrylonitrile

Calculate how many grams of acrylonitrile could be obtained from 651 kg of propylene, assuming there is excess NO present. (651000 g)

1 - Convert mass propylene to moles. Use formula weight of propylene.
2 - Convert moles propylene to moles acrylonitrile. Use chemical equation.
3 - Convert moles acrylonitrile to mass acrylonitrile. Use formula weight of acrylonitrile.

42.081 g C_3H_6 = mol C_3H_6	4 mol C_3H_6 = 4 mol C_3H_3N	53.064 g C_3H_3N = mol C_3H_3N

$$651000\text{ g } C_3H_6 \times \underset{①}{\frac{\text{mol } C_3H_6}{42.081\text{ g } C_3H_6}} \times \underset{②}{\frac{4\text{ mol } C_3H_3N}{4\text{ mol } C_3H_6}} \times \underset{③}{\frac{53.064\text{ g } C_3H_3N}{\text{mol } C_3H_3N}} =$$

$$= \boxed{821000\text{ g } C_3H_3N} \quad (821\text{ kg})$$

151.90 g/mol

$$10\,FeSO_4 + 2\,KMnO_4 + 8\,H_2SO_4 \rightarrow 5\,Fe_2(SO_4)_3 + 2\,MnSO_4 + K_2SO_4 + 8\,H_2O$$

How many mL of 0.250M potassium permanganate are needed to react with 3.36 g of iron(II) sulfate?

---

1 - Convert mass of iron(II) sulfate to moles using formula weight.
2 - Convert moles of iron(II) sulfate to moles potassium permanganate using chemical equation.
3 - Convert moles potassium permanganate to volume solution using concentration (0.250 M)

151.90 g $FeSO_4$ = mol $FeSO_4$ | 10 mol $FeSO_4$ = 2 mol $KMnO_4$ | 0.250 mol $KMnO_4$ = L | mL = 10^{-3} L

$$3.36\text{ g }FeSO_4 \times \underbrace{\frac{\text{mol }FeSO_4}{151.90\text{ g }FeSO_4}}_{①} \times \underbrace{\frac{2\text{ mol }KMnO_4}{10\text{ mol }FeSO_4}}_{②} \times \underbrace{\frac{\text{L}}{0.250\text{ mol }KMnO_4} \times \frac{\text{mL}}{10^{-3}\text{ L}}}_{③} =$$

= **17.7 mL of 0.250 M $KMnO_4$**

Electrolytes and Ionic Theory

- electrolytes: substances that dissolve in water to form charge-carrying solutions

* Electrolytes form ions in solution - (ions that are mobile are able to carry charge!). These IONS can undergo certain kinds of chemistry!

IONIC THEORY

- the idea that certain compounds DISSOCIATE in water to form free IONS

What kind of compounds?

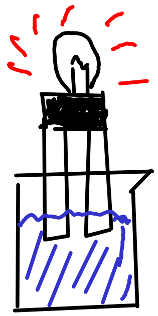
- Soluble ionic compounds
- Acids (strong AND weak)
- Bases (strong AND weak)

The ions formed may interact with each other to form NEW compounds!

Strong vs weak?

- If an electrolyte COMPLETELY IONIZES in water, it's said to be STRONG
- If an electrolyte only PARTIALLY IONIZES in water, it's said to be WEAK
- Both kinds of electrolyte undergo similar kinds of chemistry.

Ionic theory experiment



Simple conductivity tester: The stronger the electrolyte, the brighter the light.

SOME PURE COMPOUNDS (MOLECULAR AND IONIC)

DISTILLED WATER No light. Pure water does not conduct electricity (NONELECTROLYTE)

SOLID SODIUM CHLORIDE

Contains ions, but the ions are locked into the crystal structure of the solid and cannot move freely. No light.

SOLID SUCROSE $C_{12}H_{22}O_{11}$

No light. Like water, sucrose is a molecular substance. No charge carriers.

MOLECULAR AND IONIC SOLUTIONS

SODIUM CHLORIDE + WATER

Bright light. Sodium chloride is a STRONG ELECTROLYTE - it breaks apart in water to form free ions!

SUCROSE + WATER

No light. The sugar water does not conduct, and sugar is a NONELECTROLYTE. A sucrose solution exists as dissolved molecules; no ions form.

ACIDS

PURE (GLACIAL) ACETIC ACID

No light. Pure acetic acid is a nonconductor. This means that in the liquid state, there are no ions present. Acetic acid must therefore be a MOLECULE.

ACETIC ACID + WATER

Bulb lights, but somewhat dim. Acetic acid is a WEAK ELECTROLYTE. (Acetic acid must react with water to make ions, but not all of the acid ionizes)

2M ACETIC ACID (AQUEOUS)

Light bulb lights, but is dim. WEAK ELECTROLYTE

2M HYDROCHLORIC ACID (AQUEOUS)

Light bulb lights brightly. STRONG ELECTROLYTE. (Or, at the very least hydrochloric acid is a much stronger electrolyte than acetic acid is!). HCl is considered to be a strong electrolyte like NaCl