78.114 g/mol 123.111 g/mol <- Formula weights

22.4 g 31.6 g ACTUAL

$$C_6H_6 + HNO_3 \longrightarrow C_6H_5NO_2 + H_2O$$

benzene nitric acid nitrobenzene

22.4 grams of benzene are reacted with excess nitric acid. If 31.6 grams of nitrobenzene are collected from the reaction, what is the percent yield?

To determine the percent yield, we need to first calculate the THEORETICAL YIELD - the amount of nitrobenzene that could be produced if all 22.4 grams of benzene reacted.

$78.114\ g\ C_6H_6 = mol\ C_6H_6 \mid mol\ C_6H_6 = mol\ C_6H_5NO_2$

$123.111\ g\ C_6H_5NO_2 = mol\ C_6H_5NO_2$

$$22.4\ g\ C_6H_6 \times \frac{mol\ C_6H_6}{78.114\ g\ C_6H_6} \times \frac{mol\ C_6H_5NO_2}{mol\ C_6H_6} \times \frac{123.111\ g\ C_6H_5NO_2}{mol\ C_6H_5NO_2} =$$

$= 35.3\ g\ C_6H_5NO_2$ (theoretical yield)

$$\text{Percent yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100\% = \frac{31.6\ g}{35.3\ g} \times 100\% = \boxed{89.5\%}$$

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?

$$\frac{\text{mol } HC_2H_3O_2}{\text{L solution}} \leftarrow = 25.0\text{mL or } 0.025\text{0L}$$

Since we already know the volume of solution, what we're really being asked to find is the moles of acetic acid. (Once we know that, we can divide and find concentration!)

$1\text{mL} = 10^{-3}\text{L}$ $\quad 0.150\text{ mol NaOH} = 1\text{L}$ $\quad \text{mol NaOH} = \text{mol } HC_2H_3O_2$

$$37.3\text{mL} \times \frac{10^{-3}\text{L}}{\text{mL}} \times \frac{0.150\text{ mol NaOH}}{\text{L}} \times \frac{\text{mol } HC_2H_3O_2}{\text{mol NaOH}} = 0.005595\text{ mol } HC_2H_3O_2$$

To get molarity, divide by the volume OF ACETIC ACID.

$$M = \frac{\text{mol } HC_2H_3O_2}{\text{L solution}} = \frac{0.005595\text{ mol } HC_2H_3O_2}{0.025\text{0L}} = \boxed{0.224\ \underline{M}\ HC_2H_3O_2}$$

42.081 g/mol — 53.064 g/mol

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

propylene — acrylonitrile

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

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

$42.081\,g\ C_3H_6 = 1\,mol\ C_3H_6$ | $4\,mol\ C_3H_6 = 4\,mol\ C_3H_3N$

$53.064\,g\ C_3H_3N = 1\,mol\ C_3H_3N$ | $kg = 10^3\,g$

$$651\,kg\ C_3H_6 \times \frac{10^3\,g}{kg} \times \frac{mol\ C_3H_6}{42.081\,g\ C_3H_6} \times \frac{4\,mol\ C_3H_3N}{4\,mol\ C_3H_6} \times \frac{53.064\,g\ C_3H_3N}{mol\ C_3H_3N} =$$

① ② ③

$$= 621000\,g\ C_3H_3N \quad (621\,kg)$$

110 151.90 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 permangenate are needed to react with 3.36 g of iron(II) sulfate?

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1 - Convert mass iron(II) sulfate to moles using formula weight.
2 - Convert moles iron(II) sulfate to moles potassium permangenate using chemical equation
3 - Convert moles potassium permangenate to volume using molar concentration.

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

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

① ② 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?

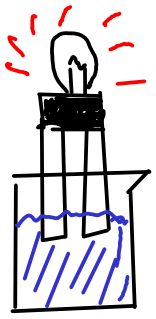
- Soluble ionic compounds
- Acids (strong AND weak)
- Bases (strong AND weak)

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 is a NONCONDUCTOR.

SOLID SODIUM CHLORIDE

No light. SOLID sodium chloride does not conduct electricity. The ions in this compound are bound in the solid crystal structure of the compound.

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

Like water, sucrose is made of neutral molecules, and is a nonconductor.

MOLECULAR AND IONIC SOLUTIONS

SODIUM CHLORIDE + WATER

Bright light. Sodium chloride (like other soluble ionic compounds) is a STRONG ELECTROLYTE. It breaks apart in water to form free ions.

SUCROSE + WATER

No light. The sugar water is a NONELECTROLYTE. Sucrose molecules do not break apart in water to form ions. (Typical of many molecular substances...)

ACIDS

PURE (GLACIAL) ACETIC ACID

No light. Pure acetic acid is a MOLECULAR SUBSTANCE (like watet and sucrose). In the liquid state, there are no charge carriers.

ACETIC ACID + WATER

Dim light. Acetic acid is a WEAK ELECTROLYTE. Some molecules of acetic acid must react with water to produce ions, but not all of them!

2M ACETIC ACID (AQUEOUS)

Somewhat dim light, meaning that acetic acid is a weak electrolyte!

2M HYDROCHLORIC ACID (AQUEOUS)

Bright light. HCl is a strong electrolyte ... or at least, a much stronger elecrolyte than acetic acid!