College of science for women
Department of Chemistry

Second Stage

Gravimetric Analysis

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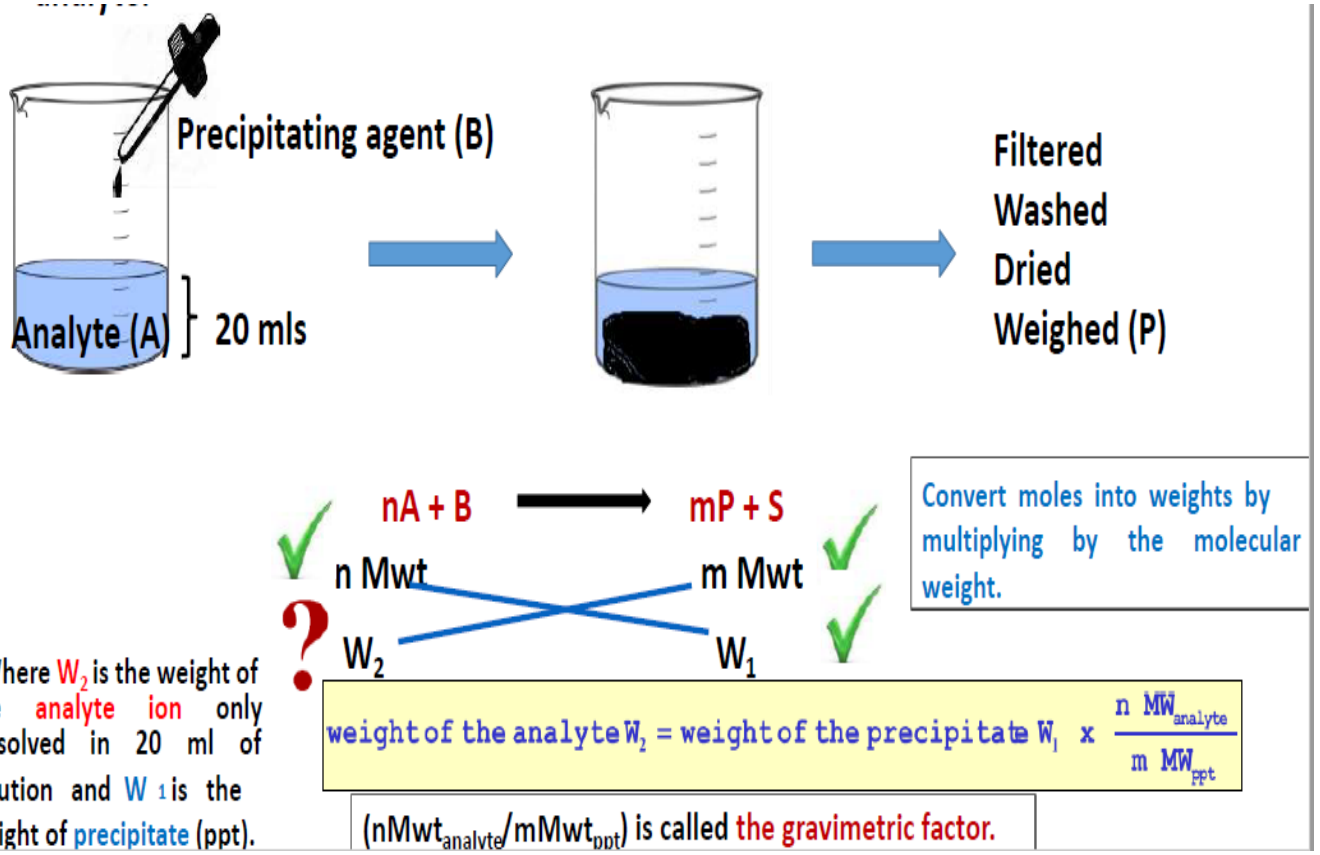
7- Calculations

Gravimetric calculations relate moles of the product finally weighed to moles of

analyte.



Example 1

- **Calculate the gravimetric factor for each of the following:**

P → Ag_3PO_4 K_2HPO_4 → $AgPO_4$ Bi_2S_3 → BaSO4

As_2O_3 → Ag_3AsO_4 K_2O → $KB(C_6H_5)_4$

- **P/Ag_3PO_4** = atwt P/ Mwt Ag_3PO_4
- **K_2HPO_4/Ag_3PO_4** = Mwt K_2HPO_4 /MwtAg P_3O_4
- **$Bi_2S_3/BaSO_4$** = MWt Bi_2S_3 /3MWt $BaSO_4$
- **As_2O_3/Ag_3AsO_4** = Mwt As_2O_3 /2MWt Ag_3AsO_4
- **$K_2O/KB(C_6H_5)_4$** = Mwt K_2O/ 2MWt $KB(C_6H_5)_4$

Example 2

- **Orthophosphate (PO_4^{3-}) is determined by weighing as ammonium phosphomolybdate, $(NH_4)PO_4 12MoO_3$ Calculate the percent P in the sample and the percent P_2O_5 if 1.1682g precipitate were obtained from a 0.2711 g sample.**
- Remember: Wt of analyte = Wt of ppt x Gravimetric Factor

- Wt of P = $1.1682 \times \frac{\text{At. wt P}}{\text{Mwt } (NH_4)_3PO_4.12MoO_3} =$

$$= 1.1682 \times \frac{30.97}{1876.5} = 0.0193 \text{ g}$$

% P = (0.0193/0.2711) x 100 = 7.11%

In general,

$$\%ppt = \frac{Wt_{ppt} \text{ X gravimetric factor}}{\text{Wt of sample}} x100$$

$$\therefore \%P_2O_5 = \frac{1.1682 \text{ x } \dfrac{\text{Mwt } P_2O_5}{2 \text{ Mwt } (NH_4)_3PO_4.12MoO_3}}{0.2711} \text{ X } 100$$

$$= \frac{1.1682x \dfrac{141.95}{2x1876.5}}{0.2711} x100 = 16.30\%$$

Example 3

- An ore is analyzed for the manganese content by converting the manganese to Mn_3O_4 and weighing it. If a 1.52 g sample yields Mn_3O_4 weighing 0.126g, what would be the percent Mn and Mn_2O_3 in the sample?

$$\%Mn_2O_3 = \frac{0.126 \times \frac{3\ Mwt\ Mn_2O_3}{2\ Mwt\ Mn_3O_4}}{1.52} \times 100$$

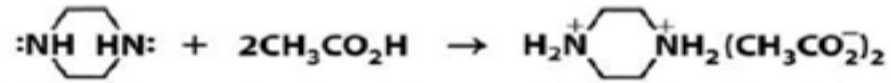
$$= \frac{0.126 \times \frac{3\ (157.9)}{2\ (228.8)}}{1.52} \times 100 = 8.58\%$$

$$\%\ Mn = \frac{0.126 \times \frac{3\ At.wt\ Mn}{Mwt\ Mn_3O_4}}{1.52} \times 100$$

$$= \frac{0.126 \times \frac{3\ (54.94)}{228.8}}{1.52} \times 100 = 5.97\%$$

Example 4

The piperazine content of an impure commercial material can be determined by precipitating and weighing the diacetate



Piperazine FM 86.136 | Acetic acid FM 60.052 | Piperazine diacetate FM 206.240

In one experiment, 0.3126 g of the sample was dissolved in 25 mL of acetone and 1 mL of acetic acid was added. After 5 min, the precipitate was filtered, washed with acetone, dried at 110 °C, and found to weigh 0.7121 g. What is the percent of piperazine in the commercial material?

$$\%\text{piperazine} = \frac{0.7121 \times \dfrac{MW_{\text{piperazine}}}{MW_{\text{ppt}}}}{0.3126} \times 100$$

$$= \frac{0.7121 \times \dfrac{86.136}{206.240}}{0.3126} \times 100 = 95.14\%$$

- **Properties of the Precipitate**
- The ideal product (precipitate) of a gravimetric analysis should be:
- 1-Sufficiently insoluble (the precipitate is of such low solubility that losses from dissolution are negligible)
- 2-Easily filterable (crystals of large particle size so as not to pass through the filtering system).
- 3-Very pure (less possibility that the precipitates carry some of the other constituents of the solution with them).
- 4-Should possess a known composition (known chemical structure).

- **Properties of precipitating reagent**
- 1- The analyte should selectively react with the Precipitating agent
- 2- Which should preferably have high molecular mass because this will increase the sensitivity of the method
- 3- Lower the conc. Limit of the analyte that can be determined
- 4- The resulting precipitate should have minimum solubility so as de
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