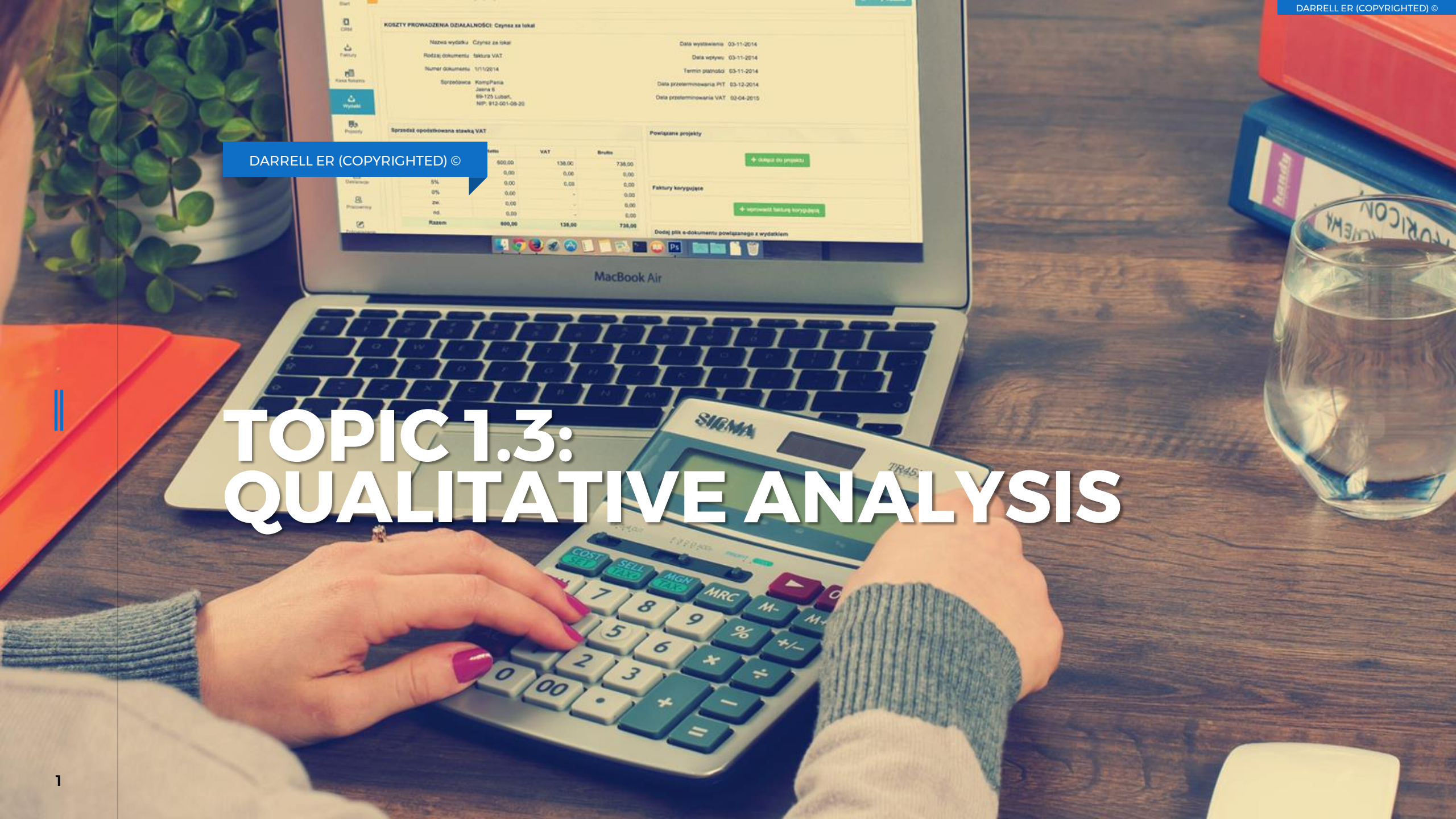

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TOPIC 1.3: QUALITATIVE ANALYSIS

THE ABOUT

CHAPTER ANALYSIS

TIME

- Heavy memorising
- 3 **key** concepts

EXAM

- Always tested
- Typical format is a flowchart question which involves backtracking to identify ions

WEIGHTAGE

- Medium overall weightage
- Constitute to **3.5%** of marks for past 5 year papers

KEY CONCEPT

QUALITATIVE ANALYSIS
TEST FOR CATIONS
TEST FOR ANIONS
TEST FOR GASES

KEY CONCEPT

TEST FOR CATIONS

Cation	Reaction with NaOH (aq) (strong alkaline)	Reaction with NH_3 (aq) (weak alkaline)
BLUE **Copper(II)** **Cu^{2+}**	Forming **blue precipitate** of $Cu(OH)_2$ Precipitate is **insoluble in excess** NaOH	Forming **blue precipitate** of $Cu(OH)_2$ Precipitate **dissolves in excess** NH_3 to give **dark blue** complex ion
GREEN **Iron(II)** **Fe^{2+}**	Forming **green precipitate** of $Fe(OH)_2$ Precipitate is **insoluble in excess** NaOH	Forming **green precipitate** of $Fe(OH)_2$ Precipitate is **insoluble in excess** NH_3
REDDISH BROWN **Iron(III)** **Fe^{3+}**	Forming **reddish-brown** precipitate of $Fe(OH)_3$ Precipitate is **insoluble in excess** NaOH	Forming **reddish-brown precipitate** of $Fe(OH)_3$ Precipitate is **insoluble in excess** NH_3
Calcium **Ca^{2+}**	Forming **white precipitate** of $Ca(OH)_2$ Precipitate is **insoluble in excess** NaOH	**No observable reaction**
Lead(II) **Pb^{2+}**	Forming **white precipitate** of $Pb(OH)_2$ Precipitate **dissolves in excess** NaOH to give colourless solution	Forming **white precipitate** of $Pb(OH)_2$ Precipitate is **insoluble in excess** NH_3
Zinc **Zn^{2+}**	Forming **white precipitate** of $Zn(OH)_2$ Precipitate **dissolves in excess** NaOH to give colourless solution	Forming **white precipitate** of $Zn(OH)_2$ Precipitate **dissolves in excess** NH_3 to give colourless solution
Ammonium **NH_4^+**	**No precipitate formed** Warming the solution produces pungent **ammonia gas** which turns moist red litmus blue	**No observable reaction**

PPT formed is **amphoteric oxide** and is able to react with alkaline to produce soluble salt.

KEY CONCEPT

TEST FOR ANIONS

Anions	Test	Observation
Carbonate CO_3^{2-}	Add **dilute** H_2SO_4 and bubble gas produced through limewater. (Any other suitable dilute acid can be used.) $2H^+ (aq) + CO_3^{2-} (aq) \rightarrow CO_2 (g) + H_2O (l)$	Bubbles of CO_2 **gas** produced which gives a **white precipitate of** $CaCO_3$ in limewater.
Sulfate SO_4^{2-}	Add **dilute** HNO_3, followed by adding $Ba(NO_3)_2$ solution. $Ba^{2+} (aq) + SO_4^{2-} (aq) \rightarrow BaSO_4 (s)$	A **white precipitate of** $BaSO_4$ is formed.
Chloride Cl^-	Add **dilute** HNO_3, followed by adding $AgNO_3$ solution. $Ag^+ (aq) + Cl^-(aq) \rightarrow AgCl (s)$ Alternative test: Add **dilute** HNO_3, followed by adding $Pb(NO_3)_2$ solution. $Pb^{2+} (aq) + 2Cl^- (aq) \rightarrow PbCl_2 (s)$	**A white precipitate of AgCl** is formed. For alternative test: A **white precipitate of** $PbCl_2$ is formed.
Nitrate NO_3^-	Add **dilute NaOH**, followed by adding a little **aluminium powder**. Warm the mixture. Aluminium reduces NO_3^- to NH_4^+ ions: $NH_4^+ (aq) + OH^- (aq) \rightarrow$ **NH_3 (aq)** $+ H_2O (l)$	Pungent NH_3 **gas** is produced which turns **moist red litmus blue**.

We are adding reagents with cations that can form an **insoluble salt** with the anion.

The **insoluble salt** is the white ppt we observe.

Dilute HNO_3 is first added to **remove other possible anions present** such as **carbonates** and **hydroxides**.

As presence of these anions might also produce precipitates with silver or lead.

Nitric acid is not needed if there is only one anion.

KEY CONCEPT

TEST FOR GASES

Gas	Smell	Test	Observation
Ammonia, NH_3	colourless, pungent	Test with a **moist** piece of **red litmus paper**	Moist **red litmus paper** turns **blue**
Carbon dioxide, CO_2	colourless, odourless	Bubble the gas through **limewater**, $Ca(OH)_2$	A **white precipitate** (**$CaCO_3$**) is formed
Chlorine, Cl_2	greenish-yellow, pungent	Test with a **moist** piece of **blue litmus paper**	**Blue litmus paper** first turns **red** and then **bleached**
Hydrogen, H_2	colourless, odourless	Place a **lighted splint** near the gas	Gas **extinguishes lighted splint** with a "**pop**" **sound**
Oxygen, O_2	colourless, odourless	Place a **glowing splint** near the gas	Gas **reignites glowing** splint
Sulfur dioxide, SO_2	colourless, pungent	Bubble the gas through a solution of **acidified potassium dichromate(VI), $K_2Cr_2O_7$.** Alternative: Bubble the gas through a solution of **acidified potassium manganate(VII), $KMnO_4$.** Recall: SO_2 is a reducing agent! Redox reaction occurs.	Acidified potassium dichromate (VI) turns from **orange to green** Acidified potassium manganate (VII) turns from **purple to colourless**

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