ZNOTES // A-LEVEL SERIES

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Updated to 2019-21 Syllabus

CIE AS-LEVEL CHEMISTRY 9701

SUMMARIZED NOTES ON THE SYLLABUS

PRACTICAL NOTES

1. ERRORS

$$Estimated\ error = No.of\ readings \times \frac{smallest\ div.}{2}$$

$$\%\ Uncertainty = \frac{Estimated\ Error}{Reading}$$

- **Random error:** usually result from the experimenter's inability to take consistent measurements e.g. in the disappearing cross experiment. It is often due to a problem which persists throughout the entireexperimente.g. random fluctuations in room temperature.
- **Systematic error:**usually caused by measuring incorrectly calibrated apparatus or incorrectly used apparatuse.g. thermometers that consistently read $1°C$ above the actual temperature, or reading volumes consistently from the wrong part of the meniscus.

2. ACCURACY

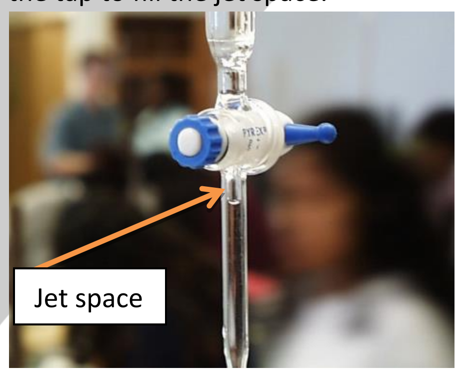
APPARATUS	SMALLEST DIVISION	MAX ERROR
BURETTE	• $0.05\ cm^3$	• $0.1cm^3$
PIPETTE ($25cm^3$)		• $0.06cm^3$
VOLUMETRIC FLASK($250cm^3$)		• $0.2cm^3$

3. TITRATIONS

- Burette has to be written to 2 DP.
- Two best titres must be within $0.1cm^3$ of each other
- If first two titres are within $0.1cm^3$ then no need for the 3rdtitre
- Repeat and find the average titre volume with total spread of not more than $0.20cm^3$.

Use of a Burette	
Advantage	**Disadvantage**
• Lower % error • More accurately calibrated	• Takes longer to add the reagent

- Clean all apparatus properly with distilled water prior starting the experiments.
- Whilst pipetting, the tip of the pipette should be placed against the wall of the container. In this way, droplets of the solvent will not spill out of the container.
  - Clean the walls with distilled water to ensure you include all moles of solution.
  - Add indicator as per the instructions. Add too much, and you would get incorrect results.
- Clean burette and pipette with solution, but not volumetric and conical flask as it will give inaccurate values.
- Always read the bottom meniscus of the burette and ensure the burette does not have any air bubbles to remove the jet space.
  - Tap it to free air bubbles.
  - Open the tap to fill the jet space.



- Always swirl the conical flask.
  - Use a white tile underneath to observe any colour change.
  - Titration ends when any colour change is permanent.

- In your second titration attempt (after the rough titre), adjust the burette tap so that it dispenses drop-wise when the reading is near the end-point to find the exact titre value.

- **Titration table should look like this:**

Initial Burette Reading/ cm^3	0.00 (It must never start from 50 cm^3)	0.00	0.00
Final Burette Reading/ cm^3			
Titre/ cm^3			
Best Results	(add tick here)		

4. Temperature

- Record to nearest 0.5^oC when thermometer calibrated in 1^oC intervals
- Record to nearest 0.1^oC when thermometer calibrated in 0.2^oC intervals.
- If one procedure has a greater temperature change, it has higher accuracy due to a lower percentage error.

5. Conversions

$$1000cm^3 = 1dm^3 = 0.001m^3$$
$$0^oC = 273^oK$$
$$1cm^3 \ of \ water = 1g$$
$$1\text{KJ} = 1000\text{J}$$

6. Graphs and Tables

- When finding gradient, always use a triangle with hypotenuse greater than half of the line.
- Label axis with quantity and unit.
- Plot graph with a fine cross or encircle dots.
- For each heading in a table, write the quantity measured with the unit separated with a slash.
- Keep significant figures consistent in values in a table.
- Make **only one** table of result for each question.
- Circle anomalous results and exclude them from calculations.
- The line of best fit drawn should ignore anomalous results.
- Ensure your graph covers greater than half the page.
- Points must be within half a small square of the correct position.

7. Practical Skills

7.1 Measuring a Quantity

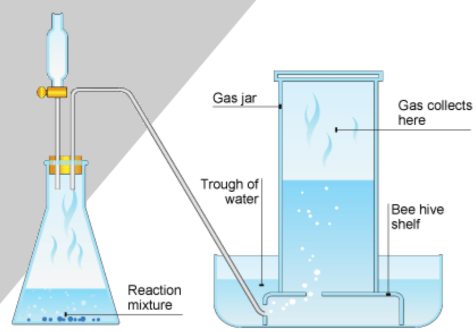
Temperature	Use a thermocouple
Volume	Use burette If $25cm^3$ use pipette
Mass	Use electronic scale

- Repeat and average values

7.2 Thermal Experiments

- Insulate container to stop thermal conduction
- Use a lid to seal container to stop thermal convection
- When heating a hydrated salt, heat to constant mass

7.3 How to Collect CO_2



- Water vapour condenses in the water trough
- Ensure there's no air bubbles in the gas jar when setting up the apparatus.

8. Salt Analysis

- If acid added to a salt produces effervescence, carbonate ion is present, so write "effervescence produced turns limewater milky".
- Label your test tubes.
- Cover the mouth of the test tube with your thumb to sense presence of gas.
- Do not add solutions more than that is required. If the question says to add $1cm^3$ of X solution, add roughly around that amount.
- When testing for cations using NaOH and NH_3, mention the observations when excess of these are added.
- If there are series of colour changes observed, mention all of the colours.

8.1 Test for Gases: techniques

- $\mathbf{NH_3}$**:** Damp a red litmus paper with distilled water and keep it near the mouth of the tube. Do not let it touch the test tube. It should turn blue.
- $\mathbf{SO_2}$**:** Smells like rotten eggs.
  - **There's a number of ways to test this:**
    - You could dip a paper in Potassium dichromate and watch its colour turn from orange to green.
    - If you were to pipe the gas to a solution of Potassium Permanganate, it would turn from pink to colourless.
    - If you dipped damp blue litmus paper, it would turn red.
- $\mathbf{NO_2}$**:** the test tube turns pale brown and disappears if you remove your thumb.

8.2 Test for ions: techniques

- If you are confused between iron (II) and chromium precipitate, keep an eye out for brown precipitate on the surface of the solution. If present, then it is Fe^{2+}.
- If you are confused between $Ba^{2+}$and $NH_4{}^{1+}$, heat it. If $NH_4{}^{1+}$, ammonia gas will be given out. If you add sulfuric acid to it and it forms white precipitate, then it is barium ion.
- Manganese ions have white precipitate that turns brown in contact with air.
- It's a good idea to revise the solubility table to confirm what the precipitate is.
- If the observations are like the ones mentioned in the Qualitative Analysis Notes at the back of your paper, use that description in the answer.
- **A general salt analysis table:**

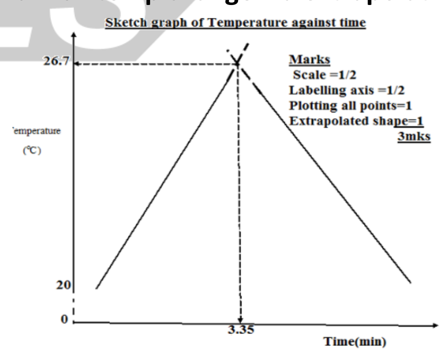
Reagent	Observation
NaOH	
Excess	
NH_4	
Excess	

9. ENTHALPHY CHANGE

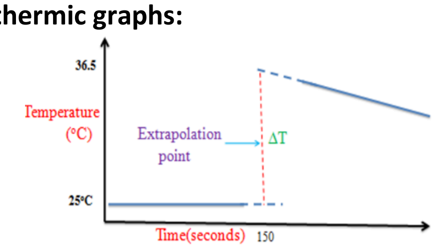
- Temperature is measured in 1 decimal places and units given in degree Celsius.
- When measuring masses, a table with values in 2 d. p. must be setup**. For example:**

Mass of the container + mass of the lid/g	
Mass of the container + mass of the lid + the sample/g	
Mass of the container + mass of the lid + residue/g	
Mass of sample used/g	

- All the data must have the same number of decimal places.
- **Use the equation $Q = mc\Delta T$ for heat released:**
  - M is the mass of the total mixture
    - Assuming mass is equivalent to volume where $1g$ is $1\ cm^3$
  - C is specific heat capacity (assuming it's the same as wateri.e.4.12)
  - ΔT is temperature change
  - No incomplete combustion of fuel occurs
  - Density of the solution is the same as water
  - Units in $J\ mol^{-1}$
- **To calculate enthalpy change:**
  - Use the equation $\Delta H = Q/mol$
    - **Units:** $KJ\ mol^{-1}$, so divide heat released (Q) by 1000.
- **Enthalpy graphs**
  - **To find max temp change via extrapolation:**

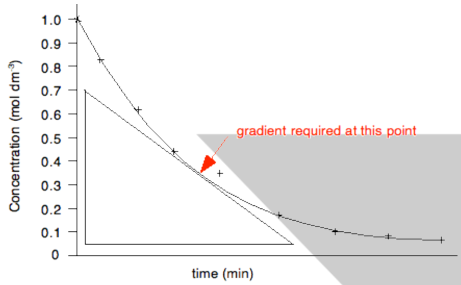


  - **Exothermic graphs:**



10. Rates of Reaction

- **To calculate rate:**
  - Appearance of product/change in concentration of product
  - Disappearance of reactants/change in mass
  - **Unit:** 1/time (s^{-1})
  - Finding gradient of a concentration-time graph
    - The higher the gradient (the steeper the graph), the higher the rate of reaction.
    - The gradient of the graph decreases with time;thus, rate is inversely proportional to time.



- **A general rates table for investigation effect of concentration on rates:**

Experiment number	Vol of reagent/ cm^3	Vol of distilled water/ cm^3	Reaction time/s	Rate of reaction /s^{-1}

  - Replace the IV columns with other factors that affect rate depending on the question.
  - Take a minimum of 3 experimental readings.
  - Ensure all other variables are kept constant so that any change in rate is caused by the IV.
- **To improve rate of reaction:**
  - Increase the concentration of a reactant.
  - Increase the temperature of the reactants.
  - Increase the surface area of a reactant.
  - Add a catalyst to the reaction.

11. Modifications

- **How do repeats improve the reliability of errors?**
  - Shows consistent results
  - Proves/shows values or trend is similar
  - Eliminates anomalous results
- **How can you make sure a reagent is in excess?**
  - If solid in excess, then solid remains at the bottom
  - If liquid (e.g. acid in excess), then all of the solid dissolves.

Problem	Solution
CO_2 dissolved in a solution	Heat solution to drive off CO_2
CO_2 escapes	Use smaller surface area of substance
Unequal distribution of heat	Stir
Heat loss	• Extra/thicker lagging • Use a lid • Use a vacuum flask
Measurement of volume	Use a burette/pipette
Identification of colour change	Use of colorimeter
Temperature fluctuations	• Use of a thermostatic water bath • Switch off the air conditioning • Clean dry thermometer/container • Make sure thermometer doesn't touch walls of container • Use a stirrer to ensure even distribution of heat.
Measurement of temperature	• Use a thermometer with a smaller scale division • Use an electronic thermometer to avoid parallax error
Uncertainty in graph intersection/ line of best fit	Repeat/extra readings
Water present in hydrated salt crystals	Heat to constant mass

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