Theory on Practical Skills

Qn 1. Preparation of salt by neutralization, followed by crystallization [2006]

Explain how you would prepare a crystalline sample of zinc sulfate starting from zinc oxide.

ans: Add excess zinc oxide to 200cm^3 of dilute sulfuric acid in a beaker and stir.
Filter the insoluble excess zinc oxide and obtain zinc sulfate solution as filtrate.
Boiling off 1/3 of the filtrate to get a saturated zinc sulfate solution.
Leave it to cool and crystallise.
Filter the crystal, briefly rinse with cold distilled water and dry between filter papers.

Qn 2. Using titration to determine concentration of a solution [2004]

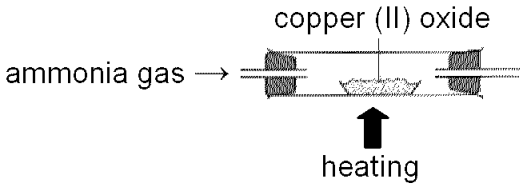
The concentration of a solution may be more accurately determined by titration. Name the apparatus you would use and briefly describe how you would titrate solutions of sodium hydroxide and hydrochloric acid. You do not need to explain how the results are used in a calculation.

ans: The apparatus are conical flask, burette and pipette.
Transfer 25cm^3 of sodium hydroxide into a conical flask using the pipette.
Add a few drops of pH indicator.
Titrate with hydrochloric acid using a pipette until the colour of the pH indicator shows that the mixture is neutral.

Qn 3. Reacting a solid with gas. [2003]

The gas produced in (d) (which is ammonia) can be used to convert heated copper (II) oxide into copper. Draw a labelled diagram of the apparatus you would use to carry out this reaction. How would you know that copper had been formed?

ans:



*must label the 3 parts clearly.

The black copper (II) oxide turns brown, indicating that copper had been formed.

Qn 4. Separation technique [2001]

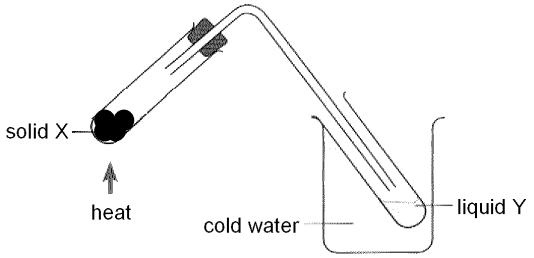
One of the solids in mixture M is soluble in water. Describe how you would carry out an experiment to separate the solids in mixture M and produce a dry sample of the soluble solid.

ans: Add about 200cm^3 of distilled water to a sample of M in a beaker.
Stir to ensure the soluble component of M dissolves.
Filter to remove the insoluble component of M, and obtain a solution of the soluble solid as filtrate.
Boiling off 1/3 of the filtrate to get a saturated solution.
Leave it to cool and crystallise.
Filter the crystal, briefly rinse with cold distilled water and dry between filter papers.

Qn 5. Chemical and Physical Change ***[2000]***

Y is a liquid formed by cooling the gas given off when solid X is heated. Draw a diagram of the apparatus you would use to prepare a small sample of liquid Y from solid X.

ans: *note: There are 2 process involved. Heating X is a chemical change that produces the gas Y. Gas Y is then condensed and collected as a liquid. In the diagram, there must be 'heating' and 'condensation'.



Qn 6. Preparation of salt by precipitation

Starting with sulfuric acid, name another suitable reagent and briefly describe how you can prepare a dry solid sample of lead (II) sulfate.

ans: *recall: lead (II) sulfate is an insoluble salt. It can be prepared by precipitation.
Add 100cm^3 of dilute sulfuric acid to 100cm^3 of lead (II) nitrate solution and stir.
A white precipitate of lead (II) sulfate will be produced.
Filter and obtain the insoluble lead (II) sulfate as residue.
Wash it with distilled water and dry it between filter papers.

Qn 7. Identification of lead(II) ion and aluminium ion.

A colourless aqueous solution of X produces a white ppt with aqueous ammonia. The white ppt is insoluble in excess aqueous ammonia. Deduce the possible cations present in X. Name another suitable reagent and briefly describe how it can be used to identify the cation in X.

ans: *recall: 2 cations produced the exact same observations with aqueous ammonia.
They are lead (II) ions and aluminium ions.
To the unknown aqueous solution X, add equal volume of potassium iodide solution.
A bright yellow precipitate will be produced if X contains lead (II) ions.
If there's no visible reaction, then X contains aluminium ions.

Qn 8. Displacement reaction

You are given a metal X, aqueous nitrate solution of X, aqueous nitrate solution of copper. Briefly describe how you would determine if X is more or less reactive than copper.

ans: *recall: a more reactive metal will displace a less reactive metal from its solution.
Add X to the aqueous nitrate solution of copper and stir.
If X is more reactive than copper, pink brown deposit of copper will be observed.
If X is less reactive than copper, there will be no visible reaction.

Qn 9. Separation technique

Mixture X consists of copper (II) oxide and carbon powder. Both are black in colour, so the mixture is made up of black powder. Briefly describe how you could obtain carbon powder from the mixture.

ans: *recall: carbon is quite inert. It will burn in presence of oxygen, but it is relative unreactive with acids.
Add excess dilute sulfuric acid to a beaker containing the mixture X and stir.

The copper (II) oxide will react with sulfuric acid to form a blue solution of copper (II) sulfate while carbon has no reaction with the acid.
Filter and obtain the carbon powder as residue.
Rinse with more sulfuric acid to ensure any copper (II) oxide is reacted away.
Rinse with lots of distilled water.
Dry the carbon residue between filter papers or leave it to dry on a clean filter paper.

NOTES FOR QUALITATIVE ANALYSIS

Test for anions

anion	test	test result
carbonate (CO_3^{2-})	add dilute acid	effervescence, carbon dioxide produced
chloride (Cl^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
iodide (I^-) [in solution]	acidify with dilute nitric acid, then add aqueous lead(II) nitrate	yellow ppt.
nitrate (NO_3^-) [in solution]	add aqueous sodium hydroxide, then aluminium foil; warm carefully	ammonia produced
sulfate (SO_4^{2-}) [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt.

Test for aqueous cations

cation	effect of aqueous sodium hydroxide	effect of aqueous ammonia
aluminium (Al^{3+})	white ppt., soluble in excess giving a colourless solution	white ppt., insoluble in excess
ammonium (NH_4^+)	ammonia produced on warming	-
calcium (Ca^{2+})	white ppt., insoluble in excess	no ppt.
copper(II) (Cu^{2+})	light blue ppt., insoluble in excess	light blue ppt., soluble in excess giving a dark blue solution
iron(II) (Fe^{2+})	green ppt., insoluble in excess	green ppt., insoluble in excess
iron(III) (Fe^{3+})	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
lead(II) (Pb^{2+})	white ppt., soluble in excess giving a colourless solution	white ppt., insoluble in excess
zinc (Zn^{2+})	white ppt., soluble in excess giving a colourless solution	white ppt., soluble in excess giving a colourless solution

[Lead(II) ions can be distinguished from aluminium ions by the insolubility of lead(II) chloride.]

Test for gases

gas	test and test result
ammonia (NH_3)	turns damp red litmus paper blue
carbon dioxide (CO_2)	gives white ppt. with limewater (ppt. dissolves with excess CO_2)
chlorine (Cl_2)	bleaches damp litmus paper
hydrogen (H_2)	"pops" with a lighted splint
oxygen (O_2)	relights a glowing splint
sulfur dioxide (SO_2)	turns aqueous acidified potassium dichromate(VI) from orange to green