YEAR 12 CHEMISTRY: ACID-BASE TITRATIONS

Acid-base titrations are a means of finding the concentration of an "unknown" acid or base solution by measuring the volume of the unknown that is required to react with a known volume of a "standard" solution. This type of work is also called "volumetric analysis".

1 Preparation of a primary standard.

(a) Calculate the mass of solid needed to make the required volume of the concentration of solution needed.

(b) Weigh out, accurately, approximately this mass.

(c) Dissolve the weighed primary standard solid in distilled water, and make up to the mark in the appropriate volumetric flask.

(d) Calculate the exact molarity of the solution you have made up.

2 Titration of an unknown solution with the primary standard

(a) Choose which reagent solution will be delivered from the burette (it is a good practice to avoid using solutions which may damage a burette, eg alkaline solutions).

(b) Pipette the other solution into a conical flask.

(c) Add 2 or 3 drops of a suitable indicator to the solution in the flask (eg for a titration between strong acid like HCℓ and a weak base like Na_2CO_3, use methyl orange).

(d) Record the volume reading on the burette (should be able to read to 2 decimal places).

(e) Add the solution from the burette until the colour of the solution in the conical flask is the <u>transitional</u> colour (eg for methyl orange, a pale orange colour).

(f) Record the final volume reading on the burette (should be able to read to 2 decimal places).

(g) Calculate the volume delivered from the burette, by subtraction.

(i) <u>Repeat</u> the procedure until at least 2 volumes delivered agree, to ± 0.1 mL.

(j) <u>Average those results that agree</u>, and calculate the molarity of the unknown solution.

(k) The concentration of the unknown is now known, and it may be used as a secondary standard.

3 Titration of an unknown solution with a secondary standard

This procedure is the same as for titration with a primary standard.

SUMMARY OF PROCEDURES IN ACID-BASE TITRATIONS

Primary standard used	anhydrous Na_2CO_3 dissolved in distilled water

Titrated against	dilute HCl solution (which becomes a secondarystandard)
Indicator used	methyl orange
Secondary standard titrated against	NaOH solution (which may become a secondary standard) or NH_3 solution
Indicators used	HCl vs NaOH: any
	HCl vs NH_3: methyl orange
	NaOH vs CH_3COOH: phenolphthalein

MINIMISING ERRORS

Rinsing procedures

(a) Rinse delivery equipment (pipette, burette) before use with the solution to be delivered

(b) Rinse volumetric & conical flasks before use with distilled water

(c) Rinse storage equipment (stock bottle) before use with the solution to be stored

Using equipment

(a) Make sure that equipment is used correctly:

* don't blow the last drop out of a pipette

* remove air bubbles from the tap of a burette before use

* read volumes so as to minimise error

(b) Retain solutions from previous titrations in a series to compare final colours

(c) use a minimum, but consistent, amount of indicator

Safety

(a) Wear safety glasses, shoes, lab coat if available

(b) Clean up spills immediately

(c) Label all beakers & storage glassware

(d) Use a pipette filler

(e) When filling volumetric flasks or burettes, ensure that

* the liquid being poured is below eye level

* no air locks occur

(f) Ensure you have enough elbow room to work safely before starting the titration.

SUMMARY OF ACID-BASE TITRATIONS

STANDARD USED	EXPT	TITRATED AGAINST	INDICATOR USED
PRIMARY STANDARD: anhydrous Na_2CO_3 dissolved in distilled water	45	dilute hydrochloric acid solution	methyl orange
SECONDARY STANDARD: dilute hydrochloric acid solution	46	dilute sodium hydroxide solution	any

SECONDARY STANDARD: dilute sodium hydroxide solution	47	vinegar (dilute acetic acid solution)	phenolphthalein
SECONDARY STANDARD: dilute hydrochloric acid solution	48	ammonia solution	methyl orange