

## Chemistry 2.1 Carry out qualitative analysis

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### Subject content

Your teacher will guide you in following good practice and safety in carrying out your analysis.

This achievement standard involves analytical chemistry where the analysis identifies the components of an ionic solution. The techniques used here involve precipitation reactions and the formation of complex ions to identify the ions.

Precipitation reactions:

- Ions that you may be tested on include:
  - $\text{Ag}^+$ ,  $\text{Al}^{3+}$ ,  $\text{Ba}^{2+}$ ,  $\text{Cu}^{2+}$ ,  $\text{Fe}^{2+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Mg}^{2+}$ ,  $\text{Pb}^{2+}$ ,  $\text{Na}^+$ ,  $\text{NH}_4^+$ ,  $\text{Zn}^{2+}$ ,  $\text{Cl}^-$ ,  $\text{CO}_3^{2-}$ ,  $\text{I}^-$ ,  $\text{NO}_3^-$ ,  $\text{OH}^-$ ,  $\text{SO}_4^{2-}$
  - $\text{Na}^+$  and  $\text{NO}_3^-$  are identified by a process of elimination
  - $\text{NH}_4^+$  will be identified using its reaction with  $\text{NaOH}$ .
- Complex ions may include  $\text{FeSCN}^{2+}$  and those formed when  $\text{OH}^-(\text{aq})$  or  $\text{NH}_3(\text{aq})$  react with the cations that are included in the above lists, such as:
  - $[\text{Ag}(\text{NH}_3)_2]^+$ ,  $[\text{Al}(\text{OH})_4]^-$ ,  $[\text{Pb}(\text{OH})_4]^{2-}$ ,  $[\text{Zn}(\text{OH})_4]^{2-}$ ,  $[\text{Zn}(\text{NH}_3)_4]^{2+}$ ,  $[\text{Cu}(\text{NH}_3)_4]^{2+}$ .

## Chemistry 2.2 Carry out an acid-base volumetric analysis

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### Subject content

Your teacher will guide you in following good practice and safety in carrying out your analysis.

This achievement standard involves analytical chemistry where a volumetric analysis is carried out using the technique titration to identify the concentration of an acid or base.

The analysis is restricted to acid-base volumetric analysis.

- Interactive and animated slides of about acids and bases. It includes revision topics, with some calculations, for acid and bases, and neutralisation and titration.
- Seven-steps to calculating acid-base titrations.

## Chemistry 2.3 Solve simple quantitative chemical problems

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### Subject content

There is no assessment of practical work in this achievement standard.

Make sure your notes are up to date. Revise the following stoichiometry terms, with examples of problems to solve:

- mole
- Avagadro's number
- molar mass.

## Chemistry 2.4 Describe the nature of structure and bonding in different substances

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### Subject content

Questions may involve the following concepts:

- Drawing Lewis diagrams of simple molecules (ie molecules having no more than four electron pairs about any atom, including multiple-bonded species).

You should be able to:

- determine the polarity of the bonds using concepts such as electronegativity to justify your choice
  - identify the molecular shape based on the number of bonding and non-bonding pairs of electrons
  - determine overall molecular polarity based on shape and bond polarity
  - recognise bond angles of common shapes.
- Types of solids are restricted to molecular, ionic, metallic, and covalent network. The nature of solids will be limited to the type of constituent particles (ions, atoms, or molecules) and the attractive force between them (ionic, covalent, metallic bonds or weak intermolecular forces).
  - Properties of solids include:
    - electrical conductivity
    - melting point
    - solubility in polar and non-polar solvents.

Although not listed, it is common to see properties from level 1 included such as ductility and malleability.

- Trends across the periodic table and the relationship between structures and properties of different substances.

You should be able to recognise the trend of ionic to covalent structures across the periodic table and relate this bonding to the properties of the substances.

## Chemistry 2.5 Describe the structural formulae and reactions of compounds containing selected organic functional groups

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### Subject content

- Follow the symbols, nomenclature, spelling, and formatting of the current IUPAC (International Union of Pure and Applied Chemistry) convention as outlined in the reference sheet in the assessment specifications.

Make sure you understand the following:

- Recognise selected organic functional groups:
  - haloalkanes or halogen alkanes
  - alcohol
  - alkene
  - alkyne
  - ester
  - carboxylic acid.

Note that organic compounds will involve no more than eight carbon atoms. However, larger organic molecules may be used in questions around the linking of structure and reactivity.

- Draw structures and name:
  - straight or branched chain hydrocarbons (up to eight carbon atoms)
  - haloalkanes
  - alcohols
  - carboxylic acids (containing up to eight carbon atoms)
  - esters formed from straight chain alcohols and carboxylic acids (up to 8 carbon atoms).
- Identify and draw structural geometric (*cis-trans*) isomers.
- Classify an alcohol or haloalkane as primary, secondary, or tertiary.
- Reactions may involve:
  - the addition reactions of alkenes of up to eight carbon atoms with  $\text{H}_2/\text{Pt}$ ,  $\text{Cl}_2$ ,  $\text{Br}_2$ ,  $\text{H}_2\text{O}/\text{H}^+$ , and  $\text{HCl}$  (identification of major and minor products on addition to asymmetric alkenes is included)
  - the reactions of alkenes with and  $\text{MnO}_4^-$
  - polymerisation of alkenes
  - halogenation of alkanes (limited to monosubstitution)
  - oxidation of primary alcohols to form carboxylic acids
  - elimination of water from alcohols
  - acid reactions of carboxylic acids
  - formation of esters (may include triglycerides) from carboxylic acids and alcohols
  - hydrolysis of esters (may include triglycerides).

## Chemistry 2.6 Describe thermochemical and equilibrium principles

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### Subject content

Thermochemical principles that you may be tested on include:

- classification of reactions as exothermic and endothermic
- determination of enthalpy changes
- factors affecting rates of reaction. Restricted to changes in:
  - concentration
  - temperature
  - surface area
  - the presence of a catalyst.

Enthalpy change relates to the change of energy in a chemical reaction.

Thermodynamics is another name given to the chemistry concerned with changes in heat, which is one form of energy.

- Classification of reactions as exothermic or endothermic given:
  - energy diagrams
  - the sign of  $\Delta_r H$ , or
  - heat changes.
- Calculation of enthalpy changes from:
  - given amounts or mass of substances
  - a balanced equation, and
  - $\Delta_r H$ .

Note that delta H is the same as saying  $\Delta_r H$  and refers to the change in enthalpy or energy of a reaction.

Equilibrium principles that you may be tested on include:

- Describing the dynamic nature of equilibrium.
- Explanation of the direction in which reaction occurs on changing a system at equilibrium. Restricted to changes in:
  - temperature ( $\Delta_r H$  given)
  - concentration
  - pressure, or
  - addition of a catalyst.
- Writing equilibrium constant expressions for homogeneous systems from given equations and the significance of the magnitude of  $K$ .
- Description of acids and bases in terms of proton transfer.
- Calculations involving  $K_w$  and pH.

- Properties of aqueous solutions of strong and weak acids and bases including ionic species such as  $\text{NH}_4^+$ . The properties are restricted to:
  - conductivity
  - rate of reaction
  - pH.
- Recognition of acid-base properties of ionic compounds that contain only one ion that changes the pH of water.

## Chemistry 2.7 Describe oxidation–reduction reactions

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### Subject content

You need to understand the following:

- Knowledge of appearance and state of the following reactants and their products:

- oxidants – limited to  $O_2$ ,  $I_2$ ,  $Cl_2$ ,  $Fe^{3+}$ ,  $H_2O_2$ ,  $MnO_4^-(aq)/H^+$ ,  $Cr_2O_7^{2-}(aq)/H^+$
- reductants – limited to metals, C, CO,  $H_2$ ,  $Fe^{2+}$ ,  $Br^-$ ,  $I^-$ ,  $SO_2$ ,  $(HSO_3^-)$ .

Appropriate information relating to any other oxidants and reactants will be provided.

- Aspects of oxidation-reduction include:

- Determine oxidation numbers.
- Write balanced oxidation–reduction equations.
- Identify the oxidant and/or reductant from a given reaction.
- Recognise the ability of halogens to act as oxidants in reactions with other elements, water, or halide ions.

Principles of simple electrolytic cells. An electrolytic cell is a type of electrochemical cell where electrical energy is used to drive an oxidation-reduction reaction in a direction that does not occur spontaneously. This is called electrolysis. The link explains the principles behind electrolytic cells.

Note that knowledge of preferential discharge, where one ion has a greater tendency to be discharged during electrolysis before another ion, is not required.