Chemical changes and structure

Rates of reaction

	RP1	RP2	RP3
To follow the progress of chemical reactions, **changes** in **mass**, **volume** and **other quantities** can be **measured**.	Y/N	Y/N	Y/N
Graphs can then be **drawn** and be **interpreted** in terms of:			
♦ end-point of a reaction	Y/N	Y/N	Y/N
♦ quantity of product	Y/N	Y/N	Y/N
♦ quantity of reactant used	Y/N	Y/N	Y/N
♦ effect of changing conditions	Y/N	Y/N	Y/N
Rates of reaction can be **increased**:			
♦ by **increasing** the **temperature**	Y/N	Y/N	Y/N
♦ by **increasing** the **concentration** of a reactant	Y/N	Y/N	Y/N
♦ by **increasing surface area/decreasing particle size**	Y/N	Y/N	Y/N
♦ through the **use of a catalyst**	Y/N	Y/N	Y/N
Catalysts are substances that **speed up chemical reactions** but can be **recovered chemically unchanged** at the end of the reaction.	Y/N	Y/N	Y/N
The **average rate** of a chemical reaction can be **calculated**, with **appropriate units**, using the equation: **rate** = Δ**quantity** ÷ Δ**t**	Y/N	Y/N	Y/N
The **rate of a reaction** can be shown to **decrease over time** by **calculating** the **average rate** at **different stages of the reaction.**	Y/N	Y/N	Y/N

Chemical changes and structure

Atomic structure and bonding related to properties of materials

(a) Periodic Table and atoms

	RP1	RP2	RP3
Elements in the **Periodic Table** are arranged in order of **increasing atomic number**.	Y/N	Y/N	Y/N
The **Periodic Table** can be used to determine whether an **element** is a **metal** or **non-metal.**	Y/N	Y/N	Y/N
Groups are **columns** in the Periodic Table containing elements with the **same number of outer electrons**, indicated by the **group number**.	Y/N	Y/N	Y/N
Elements **within a group** share the **same valency** and have **similar chemical properties** because they have the **same number of electrons** in their **outer energy levels**.	Y/N	Y/N	Y/N
The **electron arrangement** of the **first 20 elements** can be **written**.	Y/N	Y/N	Y/N
An **atom** has a **nucleus**, containing **protons** and **neutrons**, and **electrons** that **orbit the nucleus**.	Y/N	Y/N	Y/N
Protons have a **charge** of **one-positive**, **neutrons** are **neutral** and **electrons** have a **charge** of **one-negative**.	Y/N	Y/N	Y/N
Protons and **neutrons** have an **approximate mass** of **one atomic mass unit** and **electrons**, in comparison, have **virtually no mass**.	Y/N	Y/N	Y/N
The **number of protons** in an atom is given by the **atomic number**.	Y/N	Y/N	Y/N

In a **neutral atom** the **number** of **electrons** is **equal** to the **number** of **protons**.	Y/N	Y/N	Y/N
The **mass number** of an **atom** is **equal** to the **number of protons added to** the **number of neutrons**.	Y/N	Y/N	Y/N
Isotopes are defined as **atoms** with the **same atomic number** but **different mass numbers**, or as atoms with the **same number** of **protons** but **different numbers** of **neutrons**.	Y/N	Y/N	Y/N
Nuclide notation is used to show the **atomic number**, **mass number** (and ***charge***) of **atoms** (***ions***) from which the **number** of **protons**, **electrons** and **neutrons** can be **determined**.	Y/N	Y/N	Y/N
Most elements have **two** or **more isotopes**.	Y/N	Y/N	Y/N
The **average atomic mass** has been calculated for each **element** using the **mass** and **proportion** of each **isotope present**.	Y/N	Y/N	Y/N
These values are known as **relative atomic masses**.	Y/N	Y/N	Y/N

Chemical changes and structure

Atomic structure and bonding related to properties of materials

(b) Covalent bonding & (c) Ionic bonding

Covalent bonding	RP1	RP2	RP3
Covalent bonds form between **non-metal atoms**.	Y/N	Y/N	Y/N
A covalent bond forms when **two positive nuclei** are held together by their **common attraction** for a **shared pair** of **electrons**.	Y/N	Y/N	Y/N
Diagrams can be **drawn** to show how **outer electrons** are **shared** to form the **covalent bond(s)** in a **molecule**.	Y/N	Y/N	Y/N
7 elements exist as **diatomic molecules** through the **formation** of **covalent bonds**: H_2, N_2, O_2, F_2, Cl_2, Br_2, I_2.	Y/N	Y/N	Y/N
The **shape** of **simple covalent molecules** depends on the **number of bonds** and the **orientation of these bonds** around the **central atom**.	Y/N	Y/N	Y/N
These **molecules** can be **described** as **linear, angular, trigonal pyramidal** or **tetrahedral**.	Y/N	Y/N	Y/N
More than one bond can be **formed** between **atoms** leading to **double** and **triple** covalent bonds.	Y/N	Y/N	Y/N
Covalent substances can form either **discrete molecular** or **giant network structures**.	Y/N	Y/N	Y/N
Covalent molecular substances:			

	Y/N	Y/N	Y/N
♦ have **strong covalent** bonds **within the molecules** and only **weak** attractions **between the molecules**	Y/N	Y/N	Y/N
♦ have **low melting** and **boiling points** as only **weak forces of attraction between** the **molecules** are **broken** when a **substance changes state**	Y/N	Y/N	Y/N
♦ do **not conduct electricity** because they **do not have charged particles** which are **free to move**	Y/N	Y/N	Y/N
Covalent molecular substances which are **insoluble in water** may **dissolve** in **other solvents**.	Y/N	Y/N	Y/N
Covalent network structures:			
♦ have a **network** of **strong covalent bonds** within **one giant structure**	Y/N	Y/N	Y/N
♦ have **very high melting** and **boiling points** because the **network** of **strong covalent bonds** is **not easily broken**	Y/N	Y/N	Y/N
♦ do **not dissolve**	Y/N	Y/N	Y/N
In general, **covalent network** substances **do not** conduct electricity. This is because they **do not** have **charged particles** which are **free to move**.	Y/N	Y/N	Y/N
Ionic compounds			
Ions are **formed** when **atoms lose** or **gain electrons** to obtain the **stable electron arrangement** of a **noble gas**.	Y/N	Y/N	Y/N
In general, **metal** atoms **lose electrons** forming **positive ions** and **non-metal** atoms **gain electrons** forming **negative ions**.	Y/N	Y/N	Y/N
	Y/N	Y/N	Y/N

Ion-electron equations can be **written** to show the **formation of ions** through **loss or gain of electrons**.			
Ionic bonds are the **electrostatic attraction** between **positive** and **negative ions**.	Y/N	Y/N	Y/N
Ionic compounds form **lattice structures** of **oppositely charged ions** with each **positive ion surrounded** by **negative ions** and each **negative ion surrounded** by **positive ions**.	Y/N	Y/N	Y/N
Ionic compounds have **high melting** and **boiling points** because **strong ionic bonds** must be **broken** in order to **break up** the **lattice**.	Y/N	Y/N	Y/N
Many **ionic compounds** are **soluble in water**.	Y/N	Y/N	Y/N
As they **dissolve** the **lattice** structure **breaks up** allowing **water molecules** to **surround** the separated **ions**.	Y/N	Y/N	Y/N
Ionic compounds **conduct electricity** only **when molten** or **in solution** as the **lattice structure breaks up** allowing the **ions** to be **free to move**.	Y/N	Y/N	Y/N
Conduction in **ionic compounds** can be **explained** by the **movement of ions** towards **oppositely charged electrodes**.	Y/N	Y/N	Y/N

Chemical changes and structure

Formula and reacting quantities

Chemical formulae	RP1	RP2	RP3
Compound names are **derived** from the **names** of the **elements** from which they are **formed**.	Y/N	Y/N	Y/N
Most compounds with a **name ending in '-ide'** contain the **two elements** indicated.	Y/N	Y/N	Y/N
The **ending '-ite' or '-ate'** indicates that **oxygen** is **also present**.	Y/N	Y/N	Y/N
Chemical formulae can be **written** for **two element compounds** using **valency rules** and a **Periodic Table**.	Y/N	Y/N	Y/N
Roman numerals can be used, in the **name of a compound**, to **indicate** the **valency** of an **element**.	Y/N	Y/N	Y/N
The **chemical formula** can also be **determined** from **names with prefixes**.	Y/N	Y/N	Y/N
The **chemical formula** of a **covalent molecular** substance gives the **number** of **each type of atom** present in a molecule.	Y/N	Y/N	Y/N
The **formula** of a **covalent network** gives the **simplest ratio** of **each type of atom** in the substance.	Y/N	Y/N	Y/N
Ions containing **more than one type of atom** are often **referred to** as **group ions**.	Y/N	Y/N	Y/N
Chemical formulae can be **written** for **compounds containing group ions** using **valency rules** and the **data booklet**.	Y/N	Y/N	Y/N
Ionic formulae give the **simplest ratio** of **each type of ion** in the substance and **can show** the **charges** on **each ion**, if required.	Y/N	Y/N	Y/N

In formulae, **charges** must be **superscript** and **numbers of atoms/ions** must be **subscript**.	Y/N	Y/N	Y/N
Calculations involving the mole and balanced equations			
Chemical equations, using **formulae** and **state symbols**, can be **written** and **balanced**.	Y/N	Y/N	Y/N
The **mass of a mole of any substance**, in **grams** (*g*), is **equal to** the **gram formula mass** and can be **calculated** using **relative atomic masses**.	Y/N	Y/N	Y/N
Calculations can be **performed** using the **relationship between the mass** and **the number of moles** of a **substance**.	Y/N	Y/N	Y/N
A **solution** is **formed** when a **solute** is **dissolved** in a **solvent**.	Y/N	Y/N	Y/N
For **solutions**, the **mass of solute** (***grams or g***), the **number of moles of solute** (***moles or mol***), the **volume of solution** (***litres or l***) or the **concentration of the solution** (***moles per litre or*** ***mol*** l^{-1}) can be **calculated** from **data** provided.	Y/N	Y/N	Y/N
Given a **balanced equation**, the **mass** or **number of moles** of a **substance** can be **calculated** given the **mass** or **number of moles** of **another substance** in the reaction.	Y/N	Y/N	Y/N
Percentage composition			
The **percentage composition** of an **element** in any compound can be **calculated** from the **formula** of the **compound**.	Y/N	Y/N	Y/N

Chemical changes and structure			
Acids and bases			
(a) pH, (b) Neutralisation reactions & (c) Neutralisation reactions can be used to prepare soluble salts			
pH	**RP1**	**RP2**	**RP3**
The **pH scale** is an **indication of** the **hydrogen ion concentration** and runs from **below 0 to above 14**.	Y/N	Y/N	Y/N
A **neutral solution** has **equal concentrations** of **H^+(aq)** and **OH^-(aq)** ions.	Y/N	Y/N	Y/N
Water is **neutral** as it dissociates according to the equation $H_2O(\ell) \rightleftharpoons H^+(aq) + OH^-(aq)$ producing **equal concentrations** of **hydrogen** and **hydroxide** ions. At any time, **only a few water molecules** are **dissociated into free ions**.	Y/N	Y/N	Y/N
The **symbol** ⇌ indicates that a **reaction is reversible** and **occurs in both directions**.	Y/N	Y/N	Y/N
Acidic solutions have a **higher concentration** of **H^+(aq)** ions **than OH^-(aq)** and have a **pH below 7**.	Y/N	Y/N	Y/N
Alkaline solutions have a **higher concentration of OH^-(aq)** ions **than H^+(aq)** ions and have a **pH above 7**.	Y/N	Y/N	Y/N
Dilution of an **acidic solution** with **water** will **decrease the concentration of H^+(aq)** and the **pH will increase towards 7**.	Y/N	Y/N	Y/N
Dilution of an **alkaline solution** with **water** will **decrease the concentration of OH^-(aq)** and the **pH will decrease towards 7**.	Y/N	Y/N	Y/N

Soluble non-metal oxides dissolve in water forming **acidic solutions**.	Y/N	Y/N	Y/N
Soluble metal oxides dissolve in water to form **alkaline solutions**: metal oxide + water → metal hydroxide	Y/N	Y/N	Y/N
Metal **oxides**, metal **hydroxides**, metal **carbonates** and **ammonia neutralise acids** and are **called bases**. Those **bases** that **dissolve** in water form **alkaline solutions**.	Y/N	Y/N	Y/N
Neutralisation reactions			
A **neutralisation reaction** is one in which a **base** reacts with an **acid** to form **water**. A **salt** is also formed in this reaction.	Y/N	Y/N	Y/N
Equations can be **written** for the following neutralisation reactions:			
a metal oxide + an acid → a salt + water	Y/N	Y/N	Y/N
a metal hydroxide + an acid → a salt + water	Y/N	Y/N	Y/N
a metal carbonate + an acid → a salt + water + carbon dioxide	Y/N	Y/N	Y/N
The **name** of the **salt** produced **depends on** the **acid** and **base** used. **Hydrochloric** acid produces **chlorides**, **sulfuric** acid produces **sulfates** and **nitric** acid produces **nitrates**.	Y/N	Y/N	Y/N
Spectator ions are ions that **remain unchanged** by the reaction.	Y/N	Y/N	Y/N
Reaction **equations** can be used to **identify spectator ions**.	Y/N	Y/N	Y/N
For neutralisation reactions, **equations** can be **written omitting spectator ions**:			
for metal oxides **$2H^+(aq) + O^{2-}(s) \rightarrow H_2O(\ell)$**	Y/N	Y/N	Y/N

for metal hydroxides $H^+(aq) + OH^-(aq) \rightarrow H_2O(\ell)$	Y/N	Y/N	Y/N
for aqueous metal carbonates $2H^+(aq) + CO_3^{2-}(aq) \rightarrow H_2O(\ell) + CO_2(g)$	Y/N	Y/N	Y/N
for insoluble metal carbonates $2H^+(aq) + CO_3^{2-}(s) \rightarrow H_2O(\ell) + CO_2(g)$	Y/N	Y/N	Y/N
In an **acid-base titration**, the **concentration** of the **acid or base** is **determined** by **accurately measuring** the **volumes used** in the neutralisation reaction. An **indicator** can be **added** to **show** the **end-point** of the reaction.	Y/N	Y/N	Y/N
Given a balanced equation for the reaction occurring in any titration:			
♦ the **concentration** of **one reactant** can be **calculated given the concentration** of the **other reactant** and the **volumes of both solutions**	Y/N	Y/N	Y/N
♦ the **volume** of **one reactant** can be **calculated given the volume** of the **other reactant** and the **concentrations of both solutions**	Y/N	Y/N	Y/N
Neutralisation reactions can be used to prepare soluble salts			
Titration can be used to produce a **soluble salt**. Once the **volumes** of acid and alkali have been **noted**, the reaction can be **repeated without the indicator** to produce an **uncontaminated salt solution**. The **solution** can then be **evaporated to dryness**.	Y/N	Y/N	Y/N
Insoluble metal carbonates and **insoluble metal oxides** can be used to produce **soluble salts**. **Excess base** is added to the appropriate acid, the mixture is **filtered** and the **filtrate evaporated to dryness**.	Y/N	Y/N	Y/N