Chemical changes and structure

Periodicity

	RP1	RP2	RP3
Elements are arranged in the periodic table in order of **increasing atomic number**.	Y/N	Y/N	Y/N
The periodic table allows chemists to make accurate **predictions** of **physical properties** and **chemical behaviour** for any **element**, based on its **position**.	Y/N	Y/N	Y/N
Features of the table are:			
♦ **groups**: **vertical columns** within the table contain elements with similar chemical properties resulting from a common number of electrons in the outer shell	Y/N	Y/N	Y/N
♦ **periods**: **rows of elements** arranged with increasing atomic number, demonstrating an increasing number of outer electrons and a move from metallic to non-metallic characteristics	Y/N	Y/N	Y/N
The **first 20 elements** in the periodic table are categorised according to **bonding and structure**:			
♦ **metallic** (Li, Be, Na, Mg, Al, K, Ca)	Y/N	Y/N	Y/N
♦ **covalent molecular** — H_2, N_2, O_2, F_2, Cl_2, P_4, S_8 and fullerenes (eg C_{60})	Y/N	Y/N	Y/N
♦ **covalent network** — B, C (diamond, graphite), Si	Y/N	Y/N	Y/N
♦ **monatomic** (noble gases)	Y/N	Y/N	Y/N

The **covalent radius** is a measure of the **size of an atom**.	Y/N	Y/N	Y/N
The **trends in covalent radius** across periods and down groups can be explained in terms of the number of occupied shells, and the nuclear charge.	Y/N	Y/N	Y/N
The **first ionisation energy** is the energy required to remove **one mole of electrons** from **one mole of gaseous atoms**.	Y/N	Y/N	Y/N
The second and subsequent ionisation energies refer to the energies required to remove further moles of electrons.	Y/N	Y/N	Y/N
The **trends in ionisation energies** across periods and down groups can be explained in terms of the atomic size, nuclear charge and the screening effect due to inner shell electrons.	Y/N	Y/N	Y/N
Atoms of different elements have different attractions for bonding electrons.	Y/N	Y/N	Y/N
Electronegativity is a measure of the **attraction** an atom involved in a bond has **for the electrons of the bond**.	Y/N	Y/N	Y/N
The **trends in electronegativity** across periods and down groups can be rationalised in terms of covalent radius, nuclear charge and the screening effect due to inner shell electrons.	Y/N	Y/N	Y/N

Chemical changes and structure

Structure and bonding

(i) Types of chemical bond

	RP1	RP2	RP3
In a **covalent** bond, atoms **share pairs of electrons**.	Y/N	Y/N	Y/N
The covalent bond is a result of **two positive nuclei** being held together by their **common attraction for the shared pair of electrons**.	Y/N	Y/N	Y/N
Polar covalent bonds are formed when the **attraction** of the atoms for the **pair of bonding electrons** is **different**.	Y/N	Y/N	Y/N
Delta positive (δ+) and **delta negative** (δ-) notation can be used to indicate the **partial charges** on atoms, which give rise to a **dipole**.	Y/N	Y/N	Y/N
Ionic formulae can be written giving the **simplest ratio** of each type of ion in the substance.	Y/N	Y/N	Y/N
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**.	Y/N	Y/N	Y/N
Pure covalent bonding and **ionic** bonding can be considered as **opposite ends** of a **bonding continuum**, with **polar** covalent bonding **lying between these two extremes**.	Y/N	Y/N	Y/N
The **difference in electronegativities** between bonded atoms gives an indication of the **ionic character**.	Y/N	Y/N	Y/N
The **larger the difference**, the **more polar the bond** will be.	Y/N	Y/N	Y/N

If the **difference is large**, then the movement of bonding electrons from the element of lower electronegativity to the element of higher electronegativity is complete, resulting in the **formation of ions**.	Y/N	Y/N	Y/N
Compounds formed between metals and non-metals are often, but **not always**, ionic.	Y/N	Y/N	Y/N
Physical properties of a compound, such as its state at room temperature, melting point, boiling point, solubility, electrical conductivity, should be **used to deduce the type of bonding** and **structure** in the compound.	Y/N	Y/N	Y/N

Chemical changes and structure

Structure and bonding

(ii) Intermolecular forces

	RP1	RP2	RP3
All molecular elements and **compounds** and **monatomic elements** condense and freeze at sufficiently low temperatures. For this to occur, some **attractive forces** must exist **between** the **molecules** or **discrete atoms**.	Y/N	Y/N	Y/N
Intermolecular forces acting between molecules are known as **van der Waals forces**.	Y/N	Y/N	Y/N
There are **several different types** of these, such as **London dispersion forces** and **permanent dipole-permanent dipole interactions** that include **hydrogen bonding**.	Y/N	Y/N	Y/N
London dispersion forces are forces of attraction that can operate **between all atoms and molecules**.	Y/N	Y/N	Y/N
These forces are **much weaker** than **all other types of bonding**.	Y/N	Y/N	Y/N
They are formed as a result of electrostatic attraction between temporary dipoles and induced dipoles caused by movement of electrons in atoms and molecules.	Y/N	Y/N	Y/N
The strength of London dispersion forces is related to the number of electrons within an atom or molecule.	Y/N	Y/N	Y/N
A molecule is described as polar if it has a permanent dipole.	Y/N	Y/N	Y/N
The spatial arrangement of polar covalent bonds can result in a molecule being polar.	Y/N	Y/N	Y/N

Permanent dipole-permanent dipole interactions are additional electrostatic forces of attraction between polar molecules.	Y/N	Y/N	Y/N
Permanent dipole-permanent dipole interactions are stronger than London dispersion forces for molecules with similar numbers of electrons.	Y/N	Y/N	Y/N
Bonds consisting of a hydrogen atom bonded to an atom of a strongly electronegative element such as fluorine, oxygen or nitrogen are highly polar.	Y/N	Y/N	Y/N
Hydrogen bonds are electrostatic forces of attraction between molecules that contain these highly polar bonds.	Y/N	Y/N	Y/N
A hydrogen bond is stronger than other forms of permanent dipole-permanent dipole interaction but weaker than a covalent bond.	Y/N	Y/N	Y/N
Melting points, boiling points, and viscosity can all be rationalised in terms of the nature and strength of the intermolecular forces that exist between molecules.	Y/N	Y/N	Y/N
By considering the polarity and number of electrons present in molecules, it is possible to make qualitative predictions of the strength of the intermolecular forces.	Y/N	Y/N	Y/N
The melting and boiling points of polar substances are higher than the melting and boiling points of non-polar substances with similar numbers of electrons.	Y/N	Y/N	Y/N
Boiling points, melting points, viscosity and solubility/miscibility in water are properties of substances that are affected by hydrogen bonding.	Y/N	Y/N	Y/N
The anomalous boiling points of ammonia, water and hydrogen fluoride are a result of hydrogen bonding.	Y/N	Y/N	Y/N

Hydrogen bonding between molecules in ice results in an expanded structure that causes the density of ice to be less than that of water at low temperatures.	Y/N	Y/N	Y/N
Ionic compounds and polar molecular compounds tend to be soluble in polar solvents such as water, and insoluble in non-polar solvents.	Y/N	Y/N	Y/N
Non-polar molecular substances tend to be soluble in non-polar solvents and insoluble in polar solvents.	Y/N	Y/N	Y/N
To predict the solubility of a compound, key features to be considered are the:			
♦ presence in molecules of O-H or N-H bonds, which implies hydrogen bonding	Y/N	Y/N	Y/N
♦ spatial arrangement of polar covalent bonds, which could result in a molecule possessing a permanent dipole	Y/N	Y/N	Y/N

Chemical changes and structure

Oxidising and Reducing agents

	RP1	RP2	RP3
Reduction is **a gain of electrons by a reactant** in any reaction.	Y/N	Y/N	Y/N
Oxidation is a **loss of electrons by a reactant** in any reaction.	Y/N	Y/N	Y/N
In a **redox** reaction, **reduction and oxidation** take place **at the same time**.	Y/N	Y/N	Y/N
An **oxidising agent** is a substance that **accepts electrons**.	Y/N	Y/N	Y/N
A **reducing agent** is a substance that **donates electrons**.	Y/N	Y/N	Y/N
Oxidising and reducing agents can be identified in redox reactions.	Y/N	Y/N	Y/N
Elements with **low electronegativities** tend **to form ions by losing electrons** and so **act as reducing agents**.	Y/N	Y/N	Y/N
Elements with **high electronegativities** tend **to form ions by gaining electrons** and so **act as oxidising agents**.	Y/N	Y/N	Y/N
In the **periodic table**, the **strongest reducing agents** are in **Group 1**, and the **strongest oxidising agents** are in **Group 7**.	Y/N	Y/N	Y/N
The **electrochemical series** represents a series of **reduction reactions**.	Y/N	Y/N	Y/N
The **strongest oxidising agents** are at the **bottom of the left-hand** column of the **electrochemical series**.	Y/N	Y/N	Y/N
The **strongest reducing agents** are at the **top of the right-hand** column of the **electrochemical series**.	Y/N	Y/N	Y/N

	RP1	RP2	RP3
An **ion-electron equation** can be **balanced** by adding the appropriate numbers of **water molecules**, **hydrogen ions** and **electrons**.	Y/N	Y/N	Y/N
Ion-electron equations can be **combined** to produce **redox equations**.	Y/N	Y/N	Y/N
Compounds, group ions and molecules can act as oxidising or reducing agents:			
♦ **hydrogen peroxide** is a molecule that is an **oxidising agent**	Y/N	Y/N	Y/N
♦ **dichromate** and **permanganate ions** are group ions that are **strong oxidising agents** in **acidic solutions**	Y/N	Y/N	Y/N
♦ **carbon monoxide** is a gas that can be used as a **reducing agent**	Y/N	Y/N	Y/N
Oxidising agents are widely used because of the effectiveness with which they can **kill fungi & bacteria** and **inactivate viruses**.	Y/N	Y/N	Y/N
The oxidation process is also an effective means of breaking down coloured compounds making **oxidising agents** ideal for use as '**bleach**' for **clothes & hair**.	Y/N	Y/N	Y/N