Chemistry in society			
Controlling the rate			
(i) Collision theory	**RP1**	**RP2**	**RP3**
Reaction rates **must be controlled** in industrial processes.	Y/N	Y/N	Y/N
If the **rate** is **too low** then the process will **not be economically viable**; if it is **too high** there will be a **risk of explosion**.	Y/N	Y/N	Y/N
Calculations can be performed **using the relationship between** reaction **time** and **relative rate** with **appropriate units**.	Y/N	Y/N	Y/N
Collision theory can be used **to explain the effects** of the following on reaction rates:			
♦ **concentration**	Y/N	Y/N	Y/N
♦ **pressure**	Y/N	Y/N	Y/N
♦ **surface area (particle size)**	Y/N	Y/N	Y/N
♦ **temperature**	Y/N	Y/N	Y/N
♦ **collision geometry**	Y/N	Y/N	Y/N
(ii) Reaction pathways			
A **potential energy diagram** can be used to show the **energy pathway** for a reaction.	Y/N	Y/N	Y/N
The **enthalpy change** is the **energy difference between** the **products** and the **reactants**.	Y/N	Y/N	Y/N

The **enthalpy change** has a **negative value** for **exothermic** reactions or a **positive value** for **endothermic** reactions.	Y/N	Y/N	Y/N
The **activation energy** is the **minimum energy required** by **colliding particles** to form an **activated complex** and can be **calculated** from **potential energy diagrams**.	Y/N	Y/N	Y/N
The **activated complex** is an **unstable arrangement** of **atoms** formed at the **maximum** of the **potential energy barrier**, during a reaction.	Y/N	Y/N	Y/N
A **catalyst** provides an **alternative reaction pathway** with a **lower activation energy.**	Y/N	Y/N	Y/N
A **potential energy diagram** can be used to show **the effect of a catalyst** on **activation energy**.	Y/N	Y/N	Y/N
(iii) Kinetic energy distribution			
Temperature is a measure of the **average kinetic energy** of the **particles** in a substance.	Y/N	Y/N	Y/N
The **activation energy** is the **minimum kinetic energy required by colliding particles** before a reaction may occur.	Y/N	Y/N	Y/N
Energy distribution diagrams can be used to explain **the effect of changing temperature** on the **kinetic energy of particles** and reaction rate.	Y/N	Y/N	Y/N
The effects of **temperature** and of **adding a catalyst** can be explained in terms of a change in the **number of particles** with **energy greater than** the **activation energy**.	Y/N	Y/N	Y/N

Chemistry in society

Getting the most from reactants

	RP1	RP2	RP3
Industrial processes are **designed** to **maximise profit** and **minimise** the **impact** on the **environment**.	Y/N	Y/N	Y/N
Factors influencing industrial process design include: ♦ availability, sustainability and cost of feedstock(s) ♦ opportunities for recycling ♦ energy requirements ♦ marketability of by-products ♦ product yield	Y/N	Y/N	Y/N
Environmental considerations include: ♦ minimising waste ♦ avoiding the use or production of toxic substances ♦ designing products which will biodegrade if appropriate	Y/N	Y/N	Y/N
Chemical equations, using **formulae** and **state symbols**, can be **written** and **balanced** to show the **mole ratio(s)** of **reactants** and **products**.	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
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

The **molar volume** (**litres mol^{-1}**) is the **volume occupied by one mole of any gas** at a certain **temperature** and **pressure**.	Y/N	Y/N	Y/N
The **molar volume** is the **same for all gases** at the **same temperature** and **pressure**.	Y/N	Y/N	Y/N
Calculations can be performed **using the relationship between** the **volume of gas**, **molar volume** and the **number of moles** of a substance.	Y/N	Y/N	Y/N
Calculations can be performed given a **balanced equation** using data including:			
♦ **gram formula masses** (**GFM**)	Y/N	Y/N	Y/N
♦ **masses**	Y/N	Y/N	Y/N
♦ **numbers of moles**	Y/N	Y/N	Y/N
♦ **concentrations** and/or **volumes of solutions**	Y/N	Y/N	Y/N
♦ **molar volumes**	Y/N	Y/N	Y/N
♦ **volumes for gases**	Y/N	Y/N	Y/N
The **efficiency** with which **reactants** are **converted** into **the desired product** is measured in terms of the **percentage yield** and **atom economy**.	Y/N	Y/N	Y/N
By considering a **balanced equation**, the **limiting reactant** and the **reactant(s) in excess** can be **identified by calculation**.	Y/N	Y/N	Y/N
In order **to ensure** that a **costly reactant** is converted into product, an **excess of the less expensive reactant**(s) can be **used**.	Y/N	Y/N	Y/N

The '**theoretical yield**' is the **quantity of desired product obtained**, **assuming full conversion of the limiting reagent**, as calculated from the balanced equation.	Y/N	Y/N	Y/N
The '**actual yield**' is the **quantity of the desired product formed** under the **prevailing reaction conditions**.	Y/N	Y/N	Y/N
For a particular set of reaction conditions, the **percentage yield** provides a **measure of the degree** to which the **limiting reagent** is **converted** into the **desired product**.	Y/N	Y/N	Y/N
The **percentage yield** can be **calculated** using the **equation**: $\% \text{ yield} = \frac{\text{Actual yield}}{\text{Theoretical yield}} \times 100$	Y/N	Y/N	Y/N
Using a **balanced equation**, **calculations** involving **percentage yield** can be **performed** from **data provided**.	Y/N	Y/N	Y/N
Given **costs** for the **reactants**, a **percentage yield** can be **used to calculate** the **cost of reactant(s) required** to produce a **given mass** of **product**.	Y/N	Y/N	Y/N
The **atom economy** measures **the proportion** of the **total mass of all starting materials** converted into the **desired product** in the balanced equation.	Y/N	Y/N	Y/N
The **percentage atom economy** can be **calculated** using the **equation**: $\% \text{ atom economy} = \frac{\text{Mass of desired product}}{\text{Total mass of reactants}} \times 100$	Y/N	Y/N	Y/N
Reactions which have a **high percentage yield** may have a **low atom economy value** if **large quantities of by-products** are formed.	Y/N	Y/N	Y/N

Chemistry in society

Chemical energy

	RP1	RP2	RP3
Enthalpy is a measure of the **chemical energy** in a substance.	Y/N	Y/N	Y/N
A **reaction** or **process** that **releases heat energy** is described as **exothermic**.	Y/N	Y/N	Y/N
In **industry**, **exothermic reactions** may require heat to be **removed** to **prevent** the **temperature rising**.	Y/N	Y/N	Y/N
A **reaction** or **process** that **takes in heat energy** is described as **endothermic**.	Y/N	Y/N	Y/N
In **industry**, **endothermic reactions** may **incur costs in supplying heat energy** in order to **maintain** the **reaction rate**.	Y/N	Y/N	Y/N
The **enthalpy change** associated with a reaction can be **calculated** from the **quantity of heat energy released**.	Y/N	Y/N	Y/N
The **quantity of heat energy released** can be **determined experimentally** and **calculated** using $E_h = cm\Delta T$.	Y/N	Y/N	Y/N
The quantities E_h, c, m or ΔT can be **calculated**, in the **correct units**, given relevant **data**.	Y/N	Y/N	Y/N
The **enthalpy of combustion** of a substance is the **enthalpy change** when **one mole** of the substance **burns completely** in **oxygen**.	Y/N	Y/N	Y/N
Hess's law states that the **enthalpy change** for a chemical reaction is **independent of** the **route taken**.	Y/N	Y/N	Y/N
The **enthalpy change** for a reaction can be **calculated** using **Hess's law**, given appropriate **data**.	Y/N	Y/N	Y/N

The **molar bond enthalpy** is the **energy required** to **break one mole of bonds** in a **diatomic molecule**.	Y/N	Y/N	Y/N
A **mean molar bond enthalpy** is the **average energy required** to **break one mole of bonds**, for a **bond that occurs in a number of compounds**.	Y/N	Y/N	Y/N
Bond enthalpies can be **used to estimate** the **enthalpy change** occurring for a **gas phase reaction**, by **calculating** the **energy required to break bonds** in the **reactants** and the **energy released when new bonds are formed** in the **products**.	Y/N	Y/N	Y/N

Chemistry in society			
Equilibria			
	RP1	**RP2**	**RP3**
In a **closed system**, **reversible reactions** attain a state of **dynamic equilibrium** when the **rates of forward** and **reverse reactions** are **equal**.	Y/N	Y/N	Y/N
At **equilibrium**, the **concentrations** of **reactants** and **products remain constant**, but are **rarely equal**.	Y/N	Y/N	Y/N
To **maximise profits**, chemists **employ strategies** to **move the position of equilibrium** in **favour** of the **products**.	Y/N	Y/N	Y/N
For a given **reversible reaction**, the **effect** of **altering temperature** or **pressure** or of **adding/removing reactants/products** can be predicted.	Y/N	Y/N	Y/N
The **addition** of a **catalyst increases** the **rates** of the **forward** and **reverse** reactions **equally**.	Y/N	Y/N	Y/N
The **catalyst increases the rate** at which **equilibrium is achieved** but **does not affect** the **position of equilibrium**.	Y/N	Y/N	Y/N

Chemistry in society

Chemical analysis

	RP1	RP2	RP3
(i) Chromatography			
Chromatography is a **technique** used to **separate** the **components present** within a **mixture**.	Y/N	Y/N	Y/N
Chromatography **separates substances** by **making use** of **differences** in their **polarity** or **molecular size**.	Y/N	Y/N	Y/N
The **details** of any **specific chromatographic method** or **experiment** are **<u>not</u> required**.			
Depending on the **type of chromatography used**, the **identity of a component** can be indicated either **by the distance it has travelled**, or **by the time it has taken to travel through the apparatus** (**retention time**).	Y/N	Y/N	Y/N
The **results** of a **chromatography experiment** can **sometimes** be **presented graphically**, showing an **indication** of the **quantity of substance present** on the **y-axis** and **retention time** of the **x-axis**.	Y/N	Y/N	Y/N

(ii) Volumetric analysis			
Volumetric analysis involves **using** a **solution** of **accurately known concentration** in a **quantitative reaction** to **determine the concentration** of **another substance**.	Y/N	Y/N	Y/N
Titration is used to **determine**, **accurately**, the **volumes of solution required** to reach the **end-point** of a chemical reaction.	Y/N	Y/N	Y/N
An **indicator** is **normally used** to **show** when the **end-point** is reached.	Y/N	Y/N	Y/N
Titre volumes within **0·2 cm^3** are considered **concordant**.	Y/N	Y/N	Y/N
Solutions of **accurately known concentration** are known as **standard solutions**.	Y/N	Y/N	Y/N
Redox titrations are based on **redox reactions**.	Y/N	Y/N	Y/N
In **titrations** using **acidified permanganate**, an indicator is **not required**, as **purple permanganate solution** turns **colourless** when **reduced**.	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
♦ **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