1. Atomic structure and the periodic table

Weeks 1–3

原子结构与元素周期表

They should be able to

1. Distinguish atoms, elements, compounds and mixtures, with symbols and formulae.
2. Describe the five physical separation methods and choose one for a given mixture.
3. Recount the development of the model of the atom from sphere to neutron.
4. Use proton, neutron and electron charges and masses, atomic and mass numbers, isotopes and relative atomic mass.
5. Write electronic structures for the first twenty elements.
6. Relate group and period to outer-shell electrons and atomic number.
7. Describe the development of the periodic table, including Mendeleev's gaps and the isotope explanation.
8. Distinguish metals from non-metals by position and properties.
9. State and explain the trends in Groups 0, 1 and 7, including displacement.
10. Compare transition elements with Group 1 in melting point, density, strength, hardness and reactivity.
11. Describe ions with different charges, coloured compounds and catalysis, with named examples.

Stage	Use	Your notes
Starter 10 min · retrieval practice	Topic quiz 01 (10 questions, answers on sheet 2)	
Teach the new content	Handout 01 Slide deck 01 Vocabulary list 01	
Practice guided then independent	Exercise sheets 1.1, 1.2, 1.3 Past-paper sheets 1.1, 1.2, 1.3	
Check before they leave	*nothing in the Library for this stage yet*	
Homework set from the Library	Any unused exercise sheet above	

2. Bonding, structure and the properties of matter

Weeks 4–6

键合、物质结构与性质

They should be able to

1. Explain the three bond types in terms of electrons and electrostatic forces.
2. Draw dot and cross diagrams for electron transfer and for the eight named molecules.
3. Deducie ion charges and empirical formulae from group numbers and lattice models; state model limitations.
4. Link states of matter and state symbols to particle theory, with (HT) its limitations.
5. Explain the melting points and conductivity of ionic compounds, small molecules, polymers and metals.
6. Explain why alloys are harder than pure metals.
7. Explain diamond's properties from its four-bond giant structure.
8. Explain graphite's properties from three bonds, layers and delocalised electrons.
9. Describe graphene and fullerenes, including carbon nanotubes and their uses.
10. Compare nanoparticle, fine and coarse particle size ranges.
11. Apply the surface-area-to-volume factor-of-10 rule to cubes.
12. Explain why nanoparticles differ from bulk materials, their uses and the concerns.

Stage	Use	Your notes
Starter 10 min · retrieval practice	*nothing in the Library for this stage yet*	
Teach the new content	Handout 02 Slide deck 02 Vocabulary list 02	
Practice guided then independent	Exercise sheets 2.1, 2.2, 2.3, 2.4 Past-paper sheets 2.1, 2.2, 2.3, 2.4	
Check before they leave	*nothing in the Library for this stage yet*	
Homework set from the Library	Any unused exercise sheet above	

3. Quantitative chemistry

Weeks 7–10

定量化学

They should be able to

1. Balance symbol equations and use conservation of mass.
2. Calculate relative formula masses and percentage by mass of an element.
3. Explain apparent mass changes when a gas is involved.
4. Estimate uncertainty as the range of repeat measurements about the mean.
5. Use the mole, the Avogadro constant and moles = mass / Mr.
6. Calculate reacting masses from balanced equations.
7. Balance equations from reacting masses.
8. Explain and use the limiting reactant.
9. Calculate concentrations in g/dm3 and, with mol/dm3, mass-volume relations.
10. Give the three reasons yield is below 100 percent.
11. Calculate percentage yield, and (HT) the theoretical mass first.
12. Calculate atom economy and explain its importance.
13. Relate moles, mass, volume and concentration in mol/dm3.
14. Calculate an unknown concentration from titration volumes and the equation ratio.
15. State that equal gas volumes contain equal moles at the same temperature and pressure.
16. Use the equation ratio to relate gas volumes in reactions.

Stage	Use	Your notes
Starter 10 min · retrieval practice	*nothing in the Library for this stage yet*	
Teach the new content	Handout 03 Slide deck 03 Vocabulary list 03	
Practice guided then independent	Exercise sheets 3.1, 3.2, 3.3, 3.4, 3.5 Past-paper sheets 3.1, 3.2, 3.3, 3.4, 3.5	
Check before they leave	*nothing in the Library for this stage yet*	
Homework set from the Library	Any unused exercise sheet above	

4. Chemical changes

Weeks 11–14

化学变化

They should be able to

1. Recall the reactivity series order including carbon and hydrogen, with water and acid reactions.
2. Explain reactivity as the tendency to form positive ions and deduce order from results.
3. Relate extraction method to reactivity: carbon reduction vs electrolysis.
4. (HT) Use OIL RIG to write ionic equations for displacement and redox.
5. Predict acid-metal and acid-base products, naming salts from acid and base.
6. Describe RP1 salt preparation from an insoluble oxide or carbonate.
7. Use the pH scale, universal indicator and pH probe; write the neutralisation ionic equation.
8. (Chem) Describe titration method (RP2) and (HT) strong vs weak acids with the factor-of-10 pH rule.
9. Describe electrolytes, electrode attraction and discharge.
10. Predict products for molten binary compounds and aqueous solutions.
11. Explain aluminium extraction: cryolite mixture and anode replacement.
12. (HT) Write balanced half-equations at both electrodes.

Stage	Use	Your notes
Starter 10 min · retrieval practice	*nothing in the Library for this stage yet*	
Teach the new content	Handout 04 Slide deck 04 Vocabulary list 04	
Practice guided then independent	Exercise sheets 4.1, 4.2, 4.3 Past-paper sheets 4.1, 4.2, 4.3	
Check before they leave	*nothing in the Library for this stage yet*	
Homework set from the Library	Any unused exercise sheet above	

5. Energy changes

Weeks 15–16

能量变化

They should be able to

1. Define exothermic and endothermic from temperature change, with examples and uses.
2. Draw and interpret reaction profiles with activation energy and overall energy change.
3. (HT) Calculate overall energy change from bond energies and explain the difference between the two reaction types.
4. Explain how cells produce electricity and what the voltage depends on.
5. Compare non-rechargeable and rechargeable cells.
6. Describe hydrogen fuel cells and (HT) their electrode half-equations, evaluating them against rechargeable cells.

Stage	Use	Your notes
Starter 10 min · retrieval practice	*nothing in the Library for this stage yet*	
Teach the new content	Handout 05 Slide deck 05 Vocabulary list 05	
Practice guided then independent	Exercise sheets 5.1, 5.2 Past-paper sheets 5.1, 5.2	
Check before they leave	*nothing in the Library for this stage yet*	
Homework set from the Library	Any unused exercise sheet above	

6. The rate and extent of chemical change

Weeks 17–19

化学反应的速率与限度

They should be able to

1. Calculate mean rates in g/s, cm3/s and (HT) mol/s, and read product-time graphs with tangents.
2. Recall the five factors affecting rate and investigate concentration (RP5).
3. Explain each factor with collision theory and activation energy.
4. Describe catalysts and their effect on the reaction profile, including enzymes.
5. Represent reversible reactions and their opposite energy changes.
6. Define dynamic equilibrium in a closed system.
7. (HT) Predict the effect of concentration, pressure and temperature changes with Le Chatelier's principle, and the catalyst's null effect.

Stage	Use	Your notes
Starter 10 min · retrieval practice	*nothing in the Library for this stage yet*	
Teach the new content	Handout 06 Slide deck 06 Vocabulary list 06	
Practice guided then independent	Exercise sheets 6.1, 6.2 Past-paper sheets 6.1, 6.2	
Check before they leave	*nothing in the Library for this stage yet*	
Homework set from the Library	Any unused exercise sheet above	

7. Organic chemistry

Weeks 20–22

有机化学

They should be able to

1. Describe crude oil's origin and composition; name and formulate the first four alkanes.
2. Explain fractional distillation and match fraction properties to uses.
3. Relate molecule size to boiling point, viscosity and flammability.
4. Describe cracking conditions and products, balance cracking equations and use the bromine-water test.
5. Recognise alkenes CnH2n as unsaturated and describe their addition reactions.
6. Describe the four reactions and uses of the first four alcohols, with fermentation conditions.
7. Describe the reactions of the first four carboxylic acids, including ester formation, and (HT) weak-acid ionisation.
8. Draw addition polymers from alkene monomers and relate repeating units back to monomers.
9. (HT) Explain condensation polymerisation with functional groups, polyester and polypeptide examples.
10. Name DNA's structure and the monomers of proteins, starch and cellulose.

Stage	Use	Your notes
Starter 10 min · retrieval practice	*nothing in the Library for this stage yet*	
Teach the new content	Handout 07 Slide deck 07 Vocabulary list 07	
Practice guided then independent	Exercise sheets 7.1, 7.2, 7.3 Past-paper sheets 7.1, 7.2, 7.3	
Check before they leave	*nothing in the Library for this stage yet*	
Homework set from the Library	Any unused exercise sheet above	

8. Chemical analysis

Weeks 23–25

化学分析

They should be able to

1. Distinguish pure substances from mixtures using melting and boiling point data.
2. Identify formulations and explain their purpose.
3. Explain paper chromatography, calculate Rf values and interpret chromatograms.
4. Describe the tests and positive results for hydrogen, oxygen, carbon dioxide and chlorine.
5. Give flame-test colours for Li, Na, K, Ca and Cu, noting masking in mixtures.
6. Identify metal ions with sodium hydroxide solution, including the aluminium excess test.
7. Test for carbonates, halides and sulfates with reagents and precipitate colours.
8. (HT) Describe flame emission spectroscopy and its advantages.

Stage	Use	Your notes
Starter 10 min · retrieval practice	*nothing in the Library for this stage yet*	
Teach the new content	Handout 08 Slide deck 08 Vocabulary list 08	
Practice guided then independent	Exercise sheets 8.1, 8.2, 8.3 Past-paper sheets 8.1, 8.2, 8.3	
Check before they leave	*nothing in the Library for this stage yet*	
Homework set from the Library	Any unused exercise sheet above	

9. Chemistry of the atmosphere

Weeks 26–27

大气化学

They should be able to

1. Describe the evidence for and composition of the early atmosphere.
2. Explain how oceans, carbonates and photosynthesis changed the atmosphere to today's proportions.
3. Name the greenhouse gases and explain the mechanism in terms of wavelength.
4. Relate human activities to rising gas levels and interpret given climate data.
5. Describe consequences of global climate change and the basis of scientific consensus.
6. Link complete and incomplete combustion to the products CO2, water, CO and particulates, with effects.
7. Explain the formation and effects of sulfur dioxide and oxides of nitrogen, including acid rain and its reduction.

Stage	Use	Your notes
Starter 10 min · retrieval practice	*nothing in the Library for this stage yet*	
Teach the new content	Handout 09 Slide deck 09 Vocabulary list 09	
Practice guided then independent	Exercise sheets 9.1, 9.2, 9.3 Past-paper sheets 9.1, 9.2, 9.3	
Check before they leave	*nothing in the Library for this stage yet*	
Homework set from the Library	Any unused exercise sheet above	

10. Using resources

Weeks 28–30

资源利用

They should be able to

1. Distinguish finite from renewable resources and define sustainable development.
2. Distinguish potable from pure water and describe UK treatment; compare with desalination.
3. Describe sewage treatment in order, and compare ease of obtaining potable water from waste, ground and salt water.
4. (HT) Describe phytomining and bioleaching for low-grade copper ores.
5. List the four LCA stages and explain why LCAs are not purely objective.
6. Evaluate reduce, reuse and recycling for given materials, with reasons.
7. Describe corrosion and its prevention, including sacrificial zinc.
8. Recall named alloys with compositions and uses, and interpret alloy data.
9. Compare glasses, clay ceramics, polymers and composites, including thermosoftening vs thermosetting.
10. State the raw material sources and conditions of the Haber process.
11. Describe the separation and recycling of ammonia and unreacted gases.
12. (HT) Apply equilibrium principles to explain the compromise conditions.
13. Name the NPK compounds and how they are produced, evaluating fertiliser manufacture.

Stage	Use	Your notes
Starter 10 min · retrieval practice	*nothing in the Library for this stage yet*	
Teach the new content	Handout 10 Slide deck 10 Vocabulary list 10	
Practice guided then independent	Exercise sheets 10.1, 10.2, 10.3, 10.4 Past-paper sheets 10.1, 10.2, 10.3, 10.4	
Check before they leave	*nothing in the Library for this stage yet*	
Homework set from the Library	Any unused exercise sheet above	