6.1 Biology

Core	Supplement
B1. Characteristics of living organisms	
1 List and describe the characteristics of living organisms.	2 Define the terms: • *nutrition* as taking in of nutrients which are organic substances and mineral ions, containing raw materials or energy for growth and tissue repair, absorbing and assimilating them • *excretion* as removal from organisms of toxic materials, the waste products of metabolism (chemical reactions in cells including respiration) and substances in excess of requirements • *respiration* as the chemical reactions that break down nutrient molecules in living cells to release energy • *sensitivity* as the ability to detect or sense changes in the environment (stimuli) and to make responses • *reproduction* as the processes that make more of the same kind of organism • *growth* as a permanent increase in size and dry mass by an increase in cell number or cell size or both • *movement* as an action by an organism or part of an organism causing a change of position or place.

Core	Supplement
B2. Cells	
2.1 Cell structure	
1 State that living organisms are made of cells. 2 Identify and describe the structure of a plant cell (palisade cell) and an animal cell (liver cell), as seen under a light microscope. 3 Describe the differences in structure between typical animal and plant cells. 6 Calculate magnification and size of biological specimens using millimetres as units.	4 Relate the structures seen under the light microscope in the plant cell and in the animal cell to their functions. 5 Relate the structure of the following to their functions: • red blood cells – transport • root hair cells – absorption.
2.2 Movement in and out of cells	
1 Define *diffusion* as the net movement of molecules from a region of their higher concentration to a region of their lower concentration down a concentration gradient, as a result of their random movement. 2 Describe the importance of diffusion of gases and solutes and of water as a solvent.	3 Define *osmosis* as the diffusion of water molecules from a region of their higher concentration (dilute solution) to a region of their lower concentration (concentrated solution), through a partially permeable membrane. 4 Describe the importance of osmosis in the uptake of water by plants, and its effects on plant and animal cells. 5 Describe and explain the importance of a water potential gradient in the uptake of water by plants.
B3. Enzymes	
1 Define *enzymes* as proteins that function as biological catalysts. 2 Investigate and describe the effect of changes in temperature and pH on enzyme activity.	3 Explain the effect of changes in temperature and pH on enzyme activity.

Core	Supplement
B4. Nutrition	
4.1 Nutrients	
1 List the chemical elements that make up: • carbohydrates • fats • proteins. 3 Describe the structure of large molecules made from smaller basic units, i.e. • simple sugars to starch and glycogen • amino acids to proteins • fatty acids and glycerol to fats and oils. 4 Describe tests for: • starch (iodine solution) • reducing sugars (Benedict's solution) • protein (biuret test) • fats (ethanol). 5 List the principal sources of, and describe the importance of: • carbohydrates • fats • proteins • vitamins (C and D only) • mineral salts (calcium and iron only) • fibre (roughage) • water. 6 Describe the deficiency symptoms for: • vitamins (C and D only) • mineral salts (calcium and iron only).	2 Define *nutrition* as taking in of nutrients which are organic substances and mineral ions, containing raw materials or energy for growth and tissue repair, absorbing and assimilating them. 7 Describe the use of microorganisms in the manufacture of yoghurt.

Core	Supplement
4.2 Plant nutrition	
1 Define *photosynthesis* as the fundamental process by which plants manufacture carbohydrates from raw materials using energy from light. 3 State the word equation for the production of simple sugars and oxygen.	2 Explain that chlorophyll traps light energy and converts it into chemical energy for the formation of carbohydrates and their subsequent storage. 4 State the balanced equation for photosynthesis in symbols $6CO_2 + 6H_2O \xrightarrow[\text{chlorophyll}]{\text{light}} C_6H_{12}O_6 + 6O_2$
5 Investigate the necessity for chlorophyll, light and carbon dioxide for photosynthesis, using appropriate controls. 7 Describe the intake of carbon dioxide and water by plants. 8 Identify and label the cuticle, cellular and tissue structure of a dicotyledonous leaf, as seen in cross-section under the light microscope and describe the significance of the features of a leaf in terms of functions, to include: • distribution of chloroplasts – photosynthesis • stomata, palisade and mesophyll cells – gas exchange • vascular bundles (xylem and phloem) – transport and support.	6 Investigate and state the effect of varying light intensity on the rate of photosynthesis (e.g. in submerged aquatic plants).
9 Describe the importance of: • nitrate ions for protein synthesis • magnesium ions for chlorophyll synthesis.	10 Explain the effects of nitrate ion and magnesium ion deficiency on plant growth. 11 Describe the uses, and the dangers of overuse, of nitrogen-containing fertilisers.
4.3 Animal nutrition	
1 State what is meant by the term *balanced diet* and describe a balanced diet related to the age, sex and activity of an individual. 3 Define *ingestion* as taking substances (e.g. food, drink) into the body through the mouth. 4 Define *egestion* as passing out of food that has not been digested, as faeces, through the anus.	2 Describe the effects of malnutrition in relation to starvation, coronary heart disease, constipation and obesity.

Core	Supplement
5 Identify the main regions of the alimentary canal and associated organs, including mouth, salivary glands, oesophagus, stomach, small intestine: duodenum and ileum, pancreas, liver, gall bladder, large intestine: colon and rectum, anus.	
6 Describe the functions of the regions of the alimentary canal listed above, in relation to ingestion, digestion, absorption, assimilation and egestion of food.	
7 Define *digestion* as the breakdown of large, insoluble food molecules into small, water-soluble molecules using mechanical and chemical processes.	
8 Identify the types of human teeth and describe their structure and functions.	
9 State the causes of dental decay and describe the proper care of teeth.	
10 State the significance of chemical digestion in the alimentary canal in producing small, soluble molecules that can be absorbed.	11 Outline the role of bile in emulsifying fats, to increase the surface area for the action of enzymes.
12 State where, in the alimentary canal, amylase, protease and lipase enzymes are secreted.	
13 State the functions of a typical amylase, a protease and a lipase, listing the substrate and end-products.	
14 Define *absorption* as movement of digested food molecules through the wall of the intestine into the blood.	15 Describe the significance of villi in increasing the internal surface area of the small intestine.
16 Identify the small intestine as the region for the absorption of digested food.	17 Describe the structure of a villus, including the role of capillaries and lacteals.
18 Describe the role of the liver in the metabolism of glucose (glucose ⇌ glycogen).	
19 Describe the role of fat as an energy storage substance.	

Core	Supplement
B5. Transportation	
5.1 Transport in plants	
1 State the functions of xylem and phloem. 2 Identify the positions of xylem and phloem tissues as seen in transverse sections of unthickened, herbaceous, dicotyledonous roots, stems and leaves. 3 Identify root hair cells, as seen under the light microscope, and state their functions. 5 State the pathway taken by water through root, stem and leaf (root hair, root cortex cells, xylem, mesophyll cells). 6 Investigate, using a suitable stain, the pathway of water through the above-ground parts of a plant. 7 Define *transpiration* as evaporation of water at the surfaces of the mesophyll cells followed by loss of water vapour from plant leaves, through the stomata. 9 Describe the effects of variation of temperature, humidity and light intensity on transpiration rate.	4 Relate the structure and functions of root hairs to their surface area and to water and ion uptake. 8 Describe how water vapour loss is related to cell surfaces, air spaces and stomata. 10 Explain the mechanism of water uptake and movement in terms of transpiration producing a tension ('pull') from above, creating a water potential gradient in the xylem, drawing cohesive water molecules up the plant. 11 Define *translocation* in terms of the movement of sucrose and amino acids in phloem; from regions of production to regions of storage or to regions of utilisation in respiration or growth.

Core	Supplement
5.2 Transport in humans	
1 Describe the circulatory system as a system of tubes with a pump and valves to ensure one-way flow of blood.	2 Describe double circulation in terms of a low-pressure circulation to the lungs and a high-pressure circulation to the body tissues and relate these differences to the different functions of the two circuits.
3 Describe the structure of the heart, including the muscular wall and septum, atria, ventricles, valves and associated blood vessels. 5 Describe the function of the heart in terms of muscular contraction and the working of the valves.	4 Describe coronary heart disease in terms of the blockage of coronary arteries, and state the possible causes (diet, stress, smoking and genetic factors) and preventive measures.
6 Investigate the effect of physical activity on pulse rate.	7 Investigate, state and explain the effect of physical activity on pulse rate.
8 Name the main blood vessels to and from the heart, lungs, liver and kidney.	
9 Describe the structure and functions of arteries, veins and capillaries.	10 Explain how structure and function are related in arteries, veins and capillaries.
11 Identify red and white blood cells as seen under the light microscope on prepared slides, and in diagrams and photomicrographs. 12 List the components of blood as red blood cells, white blood cells, platelets and plasma.	
13 State the functions of blood: • red blood cells – haemoglobin and oxygen transport • white blood cells – phagocytosis and antibody formation • platelets – causing clotting (no details) • plasma – transport of blood cells, ions, soluble nutrients, hormones and carbon dioxide.	14 Describe the immune system in terms of antibody production, tissue rejection and phagocytosis.

Core	Supplement
B6. Respiration	
6.1 Aerobic and anaerobic respiration	
1 Define *respiration* as the chemical reactions that break down nutrient molecules in living cells to release energy. 2 State the uses of energy in the body of humans: muscle contraction, protein synthesis, cell division, growth, the passage of nerve impulses and the maintenance of a constant body temperature. 3 State the word equation for aerobic respiration.	4 Define *aerobic respiration* as the release of a relatively large amount of energy in cells by the breakdown of food substances in the presence of oxygen. 5 State the equation for aerobic respiration, using symbols: ($C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$). 6 Define *anaerobic respiration* as the release of a relatively small amount of energy by the breakdown of food substances in the absence of oxygen. 7 State the word equation for anaerobic respiration in muscles during hard exercise (glucose → lactic acid) and the microorganism yeast (glucose → alcohol + carbon dioxide). 8 Describe the effect of lactic acid in muscles during exercise (include oxygen debt in outline only). 9 Describe the role of anaerobic respiration in yeast during brewing and bread-making. 10 Compare aerobic respiration and anaerobic respiration in terms of relative amounts of energy released.

Core	Supplement
6.2 Gas exchange	
1 Identify on diagrams and name the larynx, trachea, bronchi, bronchioles, alveoli and associated capillaries.	2 List the features of gas exchange surfaces in animals. 3 Explain the role of mucus and cilia in protecting the gas exchange system from pathogens and particles. 4 Describe the effects of tobacco smoke and its major toxic components (tar, nicotine, carbon monoxide, smoke particles) on the gas exchange system.
5 State the differences in composition between inspired and expired air. 6 Use limewater as a test for carbon dioxide to investigate the differences in composition between inspired and expired air.	
7 Investigate and describe the effects of physical activity on rate and depth of breathing.	8 Explain the effects of physical activity on rate and depth of breathing.
B7. Co-ordination and response	
7.1 Nervous control in humans	
1 Describe the human nervous system in terms of the central nervous system (brain and spinal cord as areas of coordination) and the peripheral nervous system which together serve to coordinate and regulate body functions. 3 Identify motor (effector), relay (connector) and sensory neurones from diagrams. 4 Describe a simple reflex arc in terms of sensory, relay and motor neurones, and a reflex action as a means of automatically and rapidly integrating and coordinating stimuli with responses.	2 Describe the structure and function of the eye, including accommodation and pupil reflex.

Core	Supplement
7.2 Hormones	
1 Define a *hormone* as a chemical substance, produced by a gland, carried by the blood, which alters the activity of one or more specific target organs and is then destroyed by the liver. 2 State the role of the hormone adrenaline in the chemical control of metabolic activity, including increasing the blood glucose concentration and pulse rate. 3 Give examples of situations in which adrenaline secretion increases.	4 Compare nervous and hormonal control systems.
7.3 Tropic responses	
1 Define and investigate *geotropism* (as a response in which a plant grows towards or away from gravity) and *phototropism* (as a response in which a plant grows towards or away from the direction from which light is coming).	2 Explain the chemical control of plant growth by auxins including geotropism and phototropism in terms of auxins regulating differential growth.
7.4 Homeostasis	
1 Define *homeostasis* as the maintenance of a constant internal environment. 2 Identify, on a diagram of the skin: hairs, sweat glands, temperature receptors, blood vessels and fatty tissue. 3 Describe the maintenance of a constant body temperature in humans in terms of insulation and the role of temperature receptors in the skin, sweating, shivering, vasodilation and vasoconstriction of arterioles supplying skin-surface capillaries and the coordinating role of the brain.	4 Explain the concept of control by negative feedback. 5 Describe the control of the glucose content of the blood by the liver, and by insulin and glucagon from the pancreas.

Core	Supplement
B8. Reproduction	
8.1 Asexual and sexual reproduction	
1 Define *asexual reproduction* as the process resulting in the production of genetically identical offspring from one parent. 3 Define *sexual reproduction* as the process involving the fusion of haploid nuclei to form a diploid zygote and the production of genetically dissimilar offspring.	2 Discuss the advantages and disadvantages to a species of asexual reproduction. 4 Discuss the advantages and disadvantages to a species of sexual reproduction.
8.2 Sexual reproduction in plants	
1 Identify and draw, using a hand lens if necessary, the sepals, petals, stamens, anthers, carpels, ovaries and stigmas of one locally available, named, insect-pollinated, dicotyledonous flower, and examine the pollen grains under a light microscope or in photomicrographs. 3 State the functions of the sepals, petals, anthers, stigmas and ovaries. 4 Candidates should expect to apply their understanding of the flowers they have studied to unfamiliar flowers. 5 Define *pollination* as the transfer of pollen grains from the male part of the plant (anther or stamen) to the female part of the plant (stigma). 6 Name the agents of pollination. 8 Investigate and state the environmental conditions that affect germination of seeds: requirement for water and oxygen and a suitable temperature.	2 Use a hand lens to identify and describe the anthers and stigmas of one locally available, named, wind-pollinated flower. 7 Compare the different structural adaptations of insect-pollinated and wind-pollinated flowers. 9 Investigate and describe the structure of a non-endospermic seed in terms of the embryo (radicle, plumule and cotyledons) and testa, protected by the fruit. 10 State that seed and fruit dispersal by wind and by animals provides a means of colonising new areas. 11 Describe, using named examples, seed and fruit dispersal by wind and by animals.

Core	Supplement
8.3 Sexual reproduction in humans	
1 Identify on diagrams of the male reproductive system: the testes, scrotum, sperm ducts, prostate gland, urethra and penis, and state the functions of these parts. 3 Identify on diagrams of the female reproductive system: the ovaries, oviducts, uterus, cervix and vagina, and state the functions of these parts. 4 Describe the menstrual cycle in terms of changes in the uterus and ovaries. 5 Describe fertilisation in terms of the joining of the nuclei of male gamete (sperm) and the female gamete (egg). 6 Outline early development of the zygote simply in terms of the formation of a ball of cells that becomes implanted in the wall of the uterus. 10 Describe the methods of transmission of human immunodeficiency virus (HIV), and the ways in which HIV/AIDS can be prevented from spreading.	2 Compare male and female gametes in terms of size, numbers and mobility. 7 Indicate the functions of the amniotic sac and amniotic fluid. 8 Describe the function of the placenta and umbilical cord in relation to exchange of dissolved nutrients, gases and excretory products (no structural details are required). 9 Describe the advantages and disadvantages of breast-feeding compared with bottle-feeding using formula milk. 11 Outline how HIV affects the immune system in a person with HIV/AIDS.

Core	Supplement
B9. Inheritance	
9.1 Chromosomes and genes	
1 Define *inheritance* as the transmission of genetic information from generation to generation. 2 Define the terms: • *chromosome* as a thread of DNA, made up of a string of genes • *gene* as a length of DNA that is the unit of heredity and codes for a specific protein; a gene may be copied and passed on to the next generation • *allele* as any of two or more alternative forms of a gene. 4 Describe the inheritance of sex in humans (XX and XY chromosomes).	3 Define the terms: • *haploid nucleus* as a nucleus containing a single set of unpaired chromosomes (e.g. sperm and egg) • *diploid nucleus* as a nucleus containing two sets of chromosomes (e.g. in body cells).
9.2 Cell division	
	1 Define *mitosis* as nuclear division giving rise to genetically identical cells in which the chromosome number is maintained by the exact duplication of chromosomes (details of stages are **not** required). 2 State the role of mitosis in growth, repair of damaged tissues, replacement of worn out cells and asexual reproduction. 3 Define *meiosis* as reduction division in which the chromosome number is halved from diploid to haploid (details of stages are **not** required). 4 State that gametes are the result of meiosis. 5 State that meiosis results in genetic variation so the cells produced are not all genetically identical.

Core	Supplement
9.3 Monohybrid inheritance	
1 Define the terms: • *genotype* as the genetic makeup of an organism in terms of the alleles present (e.g. Tt or GG) • *phenotype* as the physical or other features of an organism due to both its genotype and its environment (e.g. tall plant or green seed) • *homozygous* as having two identical alleles of a particular gene (e.g. TT or gg). Two identical homozygous individuals that breed together will be pure-breeding • *heterozygous* as having two different alleles of a particular gene (e.g. Tt or Gg), not pure-breeding • *dominant* as an allele that is expressed if it is present (e.g. T or G) • *recessive* as an allele that is only expressed when there is no dominant allele of the gene present (e.g. t or g). 2 Calculate and predict the results of monohybrid crosses involving 1 : 1 and 3 : 1 ratios.	

Core	Supplement
9.4 Variation and selection	
	1 State that continuous variation is influenced by genes and environment, resulting in a range of phenotypes between two extremes, e.g. height in humans. 2 State that discontinuous variation is caused by genes alone and results in a limited number of distinct phenotypes with no intermediates, e.g. A, B, AB and O blood groups in humans. 3 Define *mutation* as a change in a gene or chromosome. 4 Outline the effects of ionising radiation on the rate of mutation.
5 Describe the role of artificial selection in the production of varieties of animals and plants with increased economic importance. 7 Define *natural selection* as the greater chance of passing on of genes by the best-adapted organisms.	6 Describe variation, and state that competition leads to differential survival of, and reproduction by, those organisms best fitted to the environment. 8 Explain the importance of natural selection as a possible mechanism for evolution. 9 Describe the development of strains of antibiotic resistant bacteria as an example of natural selection.

Core	Supplement
B10. Energy flow in ecosystems	
1 State that the Sun is the principal source of energy input to biological systems. 2 Define the terms: • *food chain* as the flow of energy (food) from one organism to the next beginning with a producer (e.g. mahogany tree → caterpillar → song bird → hawk) • *food web* as a network of interconnected food chains showing the energy flow through part of an ecosystem • *producer* as an organism that makes its own organic nutrients, usually using energy from sunlight, through photosynthesis • *consumer* as an organism that gets its energy by feeding on other organisms • *herbivore* as an animal that gets its energy by eating plants • *carnivore* as an animal that gets its energy by eating other animals. 6 Describe the carbon cycle.	3 Describe energy losses between trophic levels. 4 Define the terms: • *decomposer* as an organism that gets its energy from dead or waste organic matter • *ecosystem* as a unit containing all of the organisms and their environment, interacting together, in a given area, e.g. decomposing log or a lake • *trophic level* as the position of an organism in a food chain or food web. 5 Explain why food chains usually have fewer than five trophic levels. 7 Discuss the effects of the combustion of fossil fuels and the cutting down of forests on the oxygen and carbon dioxide concentrations in the atmosphere.
B11. Human influences on the ecosystem	
1 List the undesirable effects of deforestation (to include extinction, loss of soil, flooding, carbon dioxide build-up). 3 Describe the undesirable effects of pollution, to include: • water pollution by sewage and chemical waste • air pollution by greenhouse gases (carbon dioxide and methane) contributing to global warming. 6 Describe the need for conservation of: • species and their habitats • natural resources (limited to water and non-renewable materials including fossil fuels).	2 Describe the undesirable effects of overuse of fertilisers (to include eutrophication of lakes and rivers). 4 Discuss the causes and effects on the environment of acid rain, and the measures that might be taken to reduce its incidence. 5 Explain how increases in greenhouse gases (carbon dioxide and methane) are thought to cause global warming.

6.2 Chemistry

Core	Supplement
C1. The particulate nature of matter	
See P4.1 and P4.2 for details of essential common content. 1 Demonstrate understanding of the terms *atom* and *molecule*.	
C2. Experimental techniques	
1 Describe paper chromatography. 2 Interpret simple chromatograms. 3 Describe methods of separation and purification: filtration, crystallisation, distillation, fractional distillation. 4 Understand the importance of purity in substances in everyday life, e.g. foodstuffs and drugs. 6 Suggest suitable purification techniques, given information about the substances involved.	5 Identify substances and assess their purity from melting point and boiling point information.
C3. Atoms, elements and compounds	
3.1 Physical and chemical changes	
1 Identify physical and chemical changes, and understand the differences between them.	
3.2 Elements, compounds and mixtures	
1 Describe the differences between elements, compounds and mixtures.	2 Demonstrate understanding of the concepts of element, compound and mixture.

Core	Supplement
3.3 Atomic structure and the Periodic Table	
1 Describe the structure of an atom in terms of electrons and a nucleus containing protons and neutrons. 3 State the relative charges and approximate relative masses of protons, neutrons and electrons. 4 Define *atomic (proton) number* and *mass (nucleon) number*. 5 Use atomic (proton) number and the simple structure of atoms to explain the basis of the Periodic Table (see C9), with special reference to the elements with atomic (proton) numbers 1 to 20. (A copy of the Periodic Table will be provided in Papers 1 and 3.) 6 Define *isotope*.	2 Describe the build-up of electrons in 'shells' and understand the significance of the noble gas electronic structures and of valency electrons (the ideas of the distribution of electrons in s and p orbitals and in d block elements are **not** required). (A copy of the Periodic Table will be provided in Papers 2 and 4.)
3.4 Ions and ionic bonds	
1 Describe the formation of ions by electron loss or gain. 2 Describe the formation of ionic bonds between metals and non-metals as exemplified by elements from Groups I and VII.	3 Explain the formation of ionic bonds between metallic and non-metallic elements. 4 Describe the lattice structure of ionic compounds as a regular arrangement of alternating positive and negative ions, exemplified by the sodium chloride structure.
3.5 Molecules and covalent bonds	
1 State that non-metallic elements form non-ionic compounds using a different type of bonding called covalent bonding. 3 Describe the differences in volatility, solubility and electrical conductivity between ionic and covalent compounds.	2 Draw dot-and-cross diagrams to represent the sharing of electron pairs to form single covalent bonds in simple molecules, exemplified by (but not restricted to) H_2, Cl_2, H_2O, CH_4 and HCl. 4 Draw dot-and-cross diagrams to represent the multiple bonding in N_2, C_2H_4 and CO_2.

Core	Supplement
3.6 Giant structures	
	1 Describe the giant covalent structures of graphite and diamond. 2 Relate their structures to the use of graphite as a lubricant and of diamond in cutting. 3 Describe the structure of silicon(IV) oxide (silicon dioxide).
C4. Stoichiometry	
1 Use the symbols of the elements to write the formulae of simple compounds. 2 Deduce the formula of a simple compound from the relative numbers of atoms present. 3 Deduce the formula of a simple compound from a model or a diagrammatic representation. 5 Construct and use word equations.	4 Determine the formula of an ionic compound from the charges on the ions present. 6 Construct and use symbolic equations with state symbols, including ionic equations. 7 Deduce the balanced equation for a chemical reaction, given relevant information. 8 Define *relative atomic mass*, A_r. 9 Define *relative molecular mass*, M_r, as the sum of the relative atomic masses (*relative formula mass* or M_r will be used for ionic compounds).
4.1 The mole concept	
	1 Define the *mole* in terms of a specific number of particles called Avogadro's constant. (Questions requiring recall of Avogadro's constant will **not** be set.) 2 Use the molar gas volume, taken as 24 dm^3 at room temperature and pressure. 3 Calculate stoichiometric reacting masses and reacting volumes of solutions; solution concentrations will be expressed in mol / dm^3. (Calculations involving the idea of limiting reactants may be set.)

Core	Supplement
C5. Electricity and chemistry	
1 State that electrolysis is the chemical effect of electricity on ionic compounds, causing them to break up into simpler substances, usually elements.	
2 Use the terms *electrode*, *electrolyte*, *anode* and *cathode*.	3 Describe electrolysis in terms of the ions present and the reactions at the electrodes.
4 Describe the electrode products, using inert electrodes, in the electrolysis of: • molten lead(II) bromide • aqueous copper chloride • dilute sulfuric acid.	5 State and use the general principle that metals or hydrogen are formed at the negative electrode (cathode), and that non-metals (other than hydrogen) are formed at the positive electrode (anode). 6 Relate the products of electrolysis to the electrolyte and electrodes used, exemplified by the specific examples in the Core content, together with aqueous copper(II) sulfate using carbon electrodes and using copper electrodes (as used in the refining of copper).
7 Describe the electroplating of metals, using laboratory apparatus.	8 Predict the products of the electrolysis of a specified binary compound in the molten state, or in aqueous solution. 9 Describe, in outline, the chemistry of the manufacture of: • aluminium from pure aluminium oxide in molten cryolite • chlorine, hydrogen and sodium hydroxide from concentrated aqueous sodium chloride.
C6. Energy changes in chemical reactions	
1 Relate the terms *exothermic* and *endothermic* to the temperature changes observed during chemical reactions.	2 Demonstrate understanding that exothermic and endothermic changes relate to the transformation of chemical energy to heat (thermal energy), and vice versa.

Core	Supplement
C7. Chemical reactions	
7.1 Rate of reaction	
1 Describe the effect of concentration, particle size, catalysis and temperature on the rates of reactions. 2 Describe a practical method for investigating the rate of a reaction involving gas evolution. 3 Devise a suitable method for investigating the effect of a given variable on the rate of a reaction. 5 Describe the application of the above factors to the danger of explosive combustion with fine powders (e.g. flour mills) and gases (e.g. mines). 7 Define *catalyst* as an agent which increases rate but which remains unchanged.	4 Interpret data obtained from experiments concerned with rate of reaction. 6 Describe and explain the effects of temperature and concentration in terms of collisions between reacting particles (the concept of activation energy will **not** be examined).
7.2 Redox	
1 Define *oxidation* and *reduction* in terms of oxygen loss/gain, and identify such reactions from given information.	2 Define *redox* in terms of electron transfer, and identify such reactions from given information.
C8. Acids, bases and salts	
8.1 The characteristic properties of acids and bases	
1 Describe neutrality and relative acidity and alkalinity in terms of pH (whole numbers only) measured using full-range indicator and litmus. 2 Describe the characteristic reactions of acids with metals, bases (including alkalis) and carbonates. 3 Describe and explain the importance of controlling acidity in the environment (air, water and soil).	
8.2 Types of oxides	
1 Classify oxides as either acidic or basic, related to the metallic and non-metallic character of the other element in the oxide.	2 Further classify some other oxides as neutral, given relevant information.

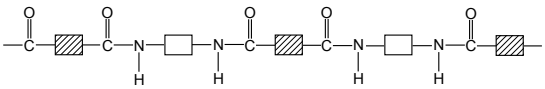
Core	Supplement
8.3 Preparation of salts	
1 Describe the preparation, separation and purification of salts using techniques selected from section C2.1 and the reactions specified in section C8.1.	2 Suggest a method of making a given salt from suitable starting materials, given appropriate information.
8.4 Identification of ions and gases	
1 Use the following tests to identify: **aqueous cations:** • *ammonium*, *copper(II)*, *iron(II)*, *iron(III)* and *zinc* by means of aqueous sodium hydroxide and aqueous ammonia as appropriate (formulae of complex ions are **not** required) **anions:** • *carbonate* by means of dilute acid and then limewater • *chloride* by means of aqueous silver nitrate under acidic conditions • *nitrate* by reduction with aluminium • *sulfate* by means of aqueous barium ions under acidic conditions **gases:** • *ammonia* by means of damp red litmus paper • *carbon dioxide* by means of limewater • *chlorine* by means of damp litmus paper • *hydrogen* by means of a lighted splint • *oxygen* by means of a glowing splint.	
C9. The Periodic Table	
1 Describe the way the Periodic Table classifies elements in order of atomic (proton) number.	2 Use the Periodic Table to predict properties of elements by means of groups and periods.
9.1 Periodic trends	
1 Describe the change from metallic to non-metallic character across a period.	2 Describe the relationship between Group number, number of outer-shell (valency) electrons and metallic/non-metallic character.

Core	Supplement
9.2 Group properties	
1 Describe lithium, sodium and potassium in Group I as a collection of relatively soft metals showing a trend in melting point and reaction with water. 3 Describe the trends in properties of chlorine, bromine and iodine in Group VII, including colour, physical state and reactions with other halide ions.	2 Predict the properties of other elements in Group I, given data where appropriate. 4 Predict the properties of other elements in Group VII, given data where appropriate.
9.3 Transition elements	
1 Describe the transition elements as a collection of metals having high densities, high melting points and forming coloured compounds, and which, as elements and compounds, often act as catalysts.	
9.4 Noble gases	
1 Describe the noble gases as being unreactive. 2 Describe the uses of the noble gases in providing an inert atmosphere, i.e. argon in lamps, helium for filling balloons.	
C10. Metals	
10.1 Properties of metals	
1 Distinguish between metals and non-metals by their general physical and chemical properties. 3 Explain why metals are often used in the form of alloys.	2 Identify and interpret diagrams that represent the structure of an alloy.
10.2 Reactivity series	
1 Place in order of reactivity: potassium, sodium, calcium, magnesium, zinc, iron, hydrogen and copper, by reference to the reactions, if any, of the elements with: • water or steam • dilute hydrochloric acid (except for alkali metals).	2 Compare the reactivity series to the tendency of a metal to form its positive ion, illustrated by its reaction, if any, with: • the aqueous ions of other listed metals • the oxides of the other listed metals. 3 Deduce an order of reactivity from a given set of experimental results.

Core	Supplement
10.3 Extraction of metals	
1 Describe the use of carbon in the extraction of some metals from their ores.	2 Describe the essential reactions in the extraction of iron in the blast furnace. 3 Relate the method of extraction of a metal from its ore to its position in the reactivity series.
10.4 Uses of metals	
1 Explain the use of aluminium in aircraft manufacture in terms of the properties of the metal and alloys made from it. 3 Explain the use of aluminium in food containers because of its resistance to corrosion.	2 Explain the use of zinc for galvanising steel, and for sacrificial protection.

Core	Supplement
C11. Air and water	
1 Describe a chemical test for water. 2 Describe and explain, in outline, the purification of the water supply by filtration and chlorination. 3 State some of the uses of water in industry and in the home. 5 Describe the composition of clean air as being a mixture of 78% nitrogen, 21% oxygen and small quantities of noble gases, water vapour and carbon dioxide. 6 State the common air pollutants as carbon monoxide, sulfur dioxide and oxides of nitrogen, and describe their sources. 9 State the adverse effect of common air pollutants on buildings and on health. 10 Describe the formation of carbon dioxide: • as a product of complete combustion of carbon-containing substances • as a product of respiration • as a product of the reaction between an acid and a carbonate • as a product of thermal decomposition. 12 Describe the rusting of iron in terms of a reaction involving air and water, and simple methods of rust prevention, including paint and other coatings to exclude oxygen. 13 Describe the need for nitrogen-, phosphorus- and potassium-containing fertilisers. 14 Describe the displacement of ammonia from its salts by warming with an alkali.	4 Describe the separation of oxygen and nitrogen from liquid air by fractional distillation. 7 Explain the presence of oxides of nitrogen in car exhausts and their catalytic removal. 8 Explain why the proportion of carbon dioxide in the atmosphere is increasing, and why this is important. 11 Describe the essential conditions for the manufacture of ammonia by the Haber process, including the sources of the hydrogen and nitrogen, i.e. hydrocarbons or steam and air.
C12. Sulfur	
	1 Describe the manufacture of sulfuric acid by the Contact process, including essential conditions. 2 Describe the properties of dilute sulfuric acid as a typical acid.

Core	Supplement
C13. Carbonates	
1 Describe the manufacture of lime (calcium oxide) from calcium carbonate (limestone) in terms of the chemical reactions involved, and its uses in treating acidic soil and neutralising industrial waste products.	
C14. Organic chemistry	
14.1 Fuels	
1 Recall coal, natural gas and petroleum as fossil fuels that produce carbon dioxide on combustion. 2 Name methane as the main constituent of natural gas. 3 Describe petroleum as a mixture of hydrocarbons and its separation into useful fractions by fractional distillation. 5 State the use of: • refinery gas for bottled gas for heating and cooking • gasoline fraction for fuel (petrol) in cars • diesel oil / gas oil for fuel in diesel engines.	4 Understand the essential principle of fractional distillation in terms of differing boiling points (ranges) of fractions related to molecular size and intermolecular attractive forces.
14.2 Introduction to organic compounds	
1 Identify and draw the structures of methane, ethane, ethene and ethanol. 3 State the type of compound present, given a chemical name ending in *-ane*, *-ene* and *-ol*, or a molecular structure.	2 Describe the concept of homologous series of alkanes and alkenes as families of compounds with similar properties. 4 Name, identify and draw the structures of the unbranched alkanes and alkenes (**not** *cis-trans*), containing up to four carbon atoms per molecule.

Core	Supplement
14.3 Hydrocarbons	
1 Describe the properties of alkanes (exemplified by methane) as being generally unreactive, except in terms of burning. 2 State that the products of complete combustion of hydrocarbons, exemplified by methane, are carbon dioxide and water. 3 Name *cracking* as a reaction which produces alkenes. 5 Recognise saturated and unsaturated hydrocarbons: • from molecular structures • by their reaction with aqueous bromine.	4 Describe the manufacture of alkenes by cracking. 6 Describe the addition reactions of alkenes, exemplified by ethene, with bromine, hydrogen and steam.
14.4 Alcohols	
1 State that ethanol may be formed by reaction between ethene and steam. 3 Describe the complete combustion reaction of ethanol. 4 State the uses of ethanol as a solvent and as a fuel.	2 Describe the formation of ethanol by the catalytic addition of steam to ethene.
14.5 Macromolecules	
	1 Describe macromolecules in terms of large molecules built up from small units (monomers), different macromolecules having different units.
14.6 Synthetic polymers	
1 Describe the formation of poly(ethene) as an example of addition polymerisation of monomer units.	2 Draw the structure of poly(ethene). 3 Describe the formation of a simple condensation polymer exemplified by nylon, the structure of nylon being represented as: 

Core	Supplement
14.7 Natural macromolecules	
	1 Describe proteins as possessing the same (amide) linkages as nylon but formed from the linking of amino acids. 2 State that proteins can be hydrolysed to amino acids under acid or alkaline conditions (the structures and names are **not** required).

6.3 Physics

Core	Supplement
P1. Motion	
1 Define speed and calculate average speed from: $\frac{\text{total distance}}{\text{total time}}$ 3 Plot and interpret a speed-time graph and a distance-time graph. 4 Recognise from the shape of a speed-time graph when a body is: • at rest • moving with constant speed • moving with changing speed. 8 Demonstrate a qualitative understanding that acceleration is related to changing speed.	2 Distinguish between *speed* and *velocity*. 5 Recognise linear motion for which the acceleration is constant and calculate the acceleration. 6 Recognise motion for which the acceleration is not constant. 7 Calculate the area under a speed-time graph to work out the distance travelled for motion with constant acceleration.
P2. Matter and forces	
2.1 Mass and weight	
1 Be able to distinguish between the mass and weight of an object. 3 Know that the Earth is the source of a gravitational field.	2 Demonstrate understanding that mass is a property that 'resists' change in motion. 4 Describe, and use the concept of, weight as the effect of a gravitational field on a mass.
2.2 Density	
1 Describe an experiment to determine the density of a liquid and of a regularly shaped solid, and make the necessary calculation using the equation: density = mass / volume or $d = m / V$ 2 Describe the determination of the density of an irregularly shaped solid by the method of displacement, and make the necessary calculation.	

Core	Supplement
2.3 Effects of forces	
1 Know that a force is measured in newtons (N). 2 Describe how forces may change the size, shape and motion of a body. 3 Plot extension-load graphs and describe the associated experimental procedure. 8 Find the resultant of two or more forces acting along the same line. 9 Explain how a system is in equilibrium when there is no resultant force.	4 Interpret extension-load graphs. 5 State and use Hooke's Law and recall and use the expression: force = constant × extension ($F = kx$) 6 Recognise the significance of the term 'limit of proportionality' for an extension-load graph. 7 Recall and use the relation between force, mass and acceleration (including the direction): $F = ma$
2.4 Pressure	
1 Relate (without calculation) pressure to force and area.	2 Recall and use the equation $P = F/A$
P3. Energy, work and power	
3.1 Energy	
1 Know that energy and work are measured in joules (J), and power in watts (W). 2 Demonstrate understanding that an object may have energy due to its motion (kinetic energy, K.E.) or its position (potential energy, P.E.), and that energy may be transferred and stored. 4 Give and identify examples of energy in different forms, including kinetic, gravitational, chemical, strain, nuclear, thermal (heat), electrical, light and sound. 5 Give and identify examples of the conversion of energy from one form to another, and of its transfer from one place to another.	3 Recall and use the expressions K.E. = $\frac{1}{2}mv^2$ and P.E. = mgh 6 Apply the principle of energy conservation to simple examples.

Core	Supplement
3.2 Energy resources	
1 Distinguish between renewable and non-renewable sources of energy. 2 Know that the Sun is the source of energy for all our energy resources except geothermal and nuclear. 4 Describe how electricity or other useful forms of energy may be obtained from: • chemical energy stored in fuel • water, including the energy stored in waves, in tides, and in water behind hydroelectric dams • geothermal resources • nuclear fission • heat and light from the Sun (solar cells and panels) • wind. 5 Give advantages and disadvantages of each method in terms of reliability, scale and environmental impact. 6 Demonstrate a qualitative understanding of efficiency.	3 Demonstrate understanding that energy is released by nuclear fusion in the Sun. 7 Recall and use the equation: $\text{efficiency} = \frac{\text{useful energy output}}{\text{energy input}} \times 100\%$
3.3 Work	
1 Relate (without calculation) work done to the magnitude of a force and the distance moved.	2 Describe energy changes in terms of work done. 3 Recall and use $W = F \times d$
3.4 Power	
1 Relate (without calculation) power to work done and time taken, using appropriate examples.	2 Recall and use the equation $P = E/t$ in simple systems.
P4. Simple kinetic molecular model of matter	
4.1 States of matter	
1 State the distinguishing properties of solids, liquids and gases.	

Core	Supplement
4.2 Molecular model	
1 Describe qualitatively the molecular structure of solids, liquids and gases. 3 Interpret the temperature of a gas in terms of the motion of its molecules. 4 Describe qualitatively the pressure of a gas in terms of the motion of its molecules. 5 Describe qualitatively the effect of a change of temperature on the pressure of a gas at constant volume.	2 Relate the properties of solids, liquids and gases to the forces and distances between molecules and to the motion of the molecules.
4.3 Evaporation	
1 Describe evaporation in terms of the escape of more energetic molecules from the surface of a liquid. 3 Relate evaporation to the consequent cooling.	2 Demonstrate understanding of how temperature, surface area and air flow over a surface influence evaporation.
4.4 Pressure changes	
	1 Relate the change in volume of a gas to change in pressure applied to the gas at constant temperature and use the equation PV = constant at constant temperature.
P5. Matter and thermal properties	
5.1 Thermal expansion of solids, liquids and gases	
1 Describe qualitatively the thermal expansion of solids, liquids and gases. 3 Identify and explain some of the everyday applications and consequences of thermal expansion. 4 Describe qualitatively the effect of a change of temperature on the volume of a gas at constant pressure.	2 Explain in terms of motion and arrangement of molecules the relative order of magnitude of the expansion of solids, liquids and gases.

Core	Supplement
5.2 Thermal capacity	
	1 Demonstrate understanding of the term *thermal capacity*. 2 Describe an experiment to measure the specific heat capacity of a substance. 3 Recall and use the equation: energy = mass × specific heat capacity × change in temperature
5.3 Melting and boiling	
1 Describe melting and boiling in terms of energy input without a change in temperature. 3 Describe condensation and solidification. 5 State the meaning of *melting point* and *boiling point*.	2 Distinguish between boiling and evaporation. 4 Use the terms *latent heat of vaporisation* and *latent heat of fusion*, and give a molecular interpretation of latent heat.
P6. Transfer of thermal energy	
6.1 Conduction	
1 Describe experiments to demonstrate the properties of good and bad conductors of heat.	2 Explain heat transfer in solids in terms of molecular motion.
6.2 Convection	
1 Recognise convection as the main method of heat transfer in liquids and gases. 3 Describe experiments to illustrate convection in liquids and gases.	2 Relate convection in fluids to density changes.
6.3 Radiation	
1 Recognise radiation as the method of heat transfer that does not require a medium to travel through. 2 Identify infra-red radiation as the part of the electromagnetic spectrum often involved in heat transfer by radiation.	3 Describe experiments to show the properties of good and bad emitters and good and bad absorbers of infra-red radiation.
6.4 Consequences of energy transfer	
1 Identify and explain some of the everyday applications and consequences of conduction, convection and radiation.	

Core	Supplement
P7. Waves	
7.1 General wave properties	
1 Demonstrate understanding that wave motion transfers energy without transferring matter in the direction of wave travel. 2 Describe what is meant by *wave motion* as illustrated by vibration in ropes and springs and by experiments using water waves. 3 State the meaning of and use the terms *speed*, *frequency*, *wavelength* and *amplitude*. 5 Distinguish between transverse and longitudinal waves and give suitable examples. 6 Identify how a wave can be reflected off a plane barrier and can change direction as its speed changes.	4 Recall and use the equation $v = f\lambda$ 7 Interpret reflection and refraction using wave theory.
P8. Light	
8.1 Reflection of light	
1 Describe the formation and characteristics of an optical image seen in a plane mirror. 3 Use the law: angle of incidence, i = angle of reflection, r	2 Perform simple constructions, measurements and calculations based on reflections in plane mirrors.
8.2 Refraction of light	
1 Describe an experimental demonstration of the refraction of light. 2 Describe, using ray diagrams, the passage of light through parallel-sided transparent material, indicating the angle of incidence i and angle of refraction r. 3 State the meaning of *critical angle*. 4 Identify and describe internal and total internal reflection using ray diagrams.	5 Describe the action of optical fibres and their use in medicine and communications technology.

Core	Supplement
8.3 Thin converging lens	
1 Describe the action of a thin converging lens on a beam of light using ray diagrams. 2 Use the terms *principal focus* and *focal length.* 4 Draw ray diagrams to illustrate the formation of a real image by a single lens.	3 Draw and interpret simple ray diagrams that illustrate the formation of real and virtual images by a single converging lens.
8.4 Dispersion of light	
1 Describe the dispersion of light by a glass prism.	
P9. Electromagnetic spectrum	
1 Describe the main features of the electromagnetic spectrum. 3 Describe the role of electromagnetic waves in: • radio and television communications (radio waves) • satellite television and telephones (microwaves) • electrical appliances, remote controllers for televisions and intruder alarms (infra-red) • medicine and security (X-rays). 4 Demonstrate understanding of safety issues regarding the use of microwaves and X-rays.	2 State the approximate value of the speed of all electromagnetic waves *in vacuo.*
P10. Sound	
1 Describe the production of sound by vibrating sources. 3 State the approximate human range of audible frequencies. 4 Demonstrate understanding that a medium is needed to transmit sound waves. 5 Describe and interpret an experiment to determine the speed of sound in air. 7 Relate the loudness and pitch of sound waves to amplitude and frequency. 8 Describe how the reflection of sound may produce an echo.	2 Describe transmission of sound in air in terms of compressions and rarefactions. 6 State the typical values of the speed of sound in air, liquids and solids.

Core	Supplement
P11. Magnetism	
1 Describe the properties of magnets. 3 Identify the pattern of field lines round a bar magnet. 4 Distinguish between the magnetic properties of iron and steel. 5 Distinguish between the design and use of permanent magnets and electromagnets.	2 Give an account of induced magnetism.
P12. Electricity	
12.1 Electrical quantities	
1 Demonstrate understanding of *current*, *potential difference*, *e.m.f.* and *resistance*, and use with their appropriate units. 3 Use and describe the use of an ammeter and a voltmeter.	2 State that charge is measured in coulombs (C).
12.2 Electric charge	
1 Describe and interpret simple experiments to show the production and detection of electrostatic charges. 2 State that there are positive and negative charges. 4 State that unlike charges attract and that like charges repel. 5 Distinguish between electrical conductors and insulators, and give typical examples.	3 Describe an electric field as a region in which an electric charge experiences a force.
12.3 Current, electromotive force and potential difference	
1 State that current is related to the flow of charge. 2 State that the current in metals is due to a flow of electrons. 4 Use the term potential difference (p.d.) to describe what drives the current between two points in a circuit.	3 Demonstrate understanding that a current is a rate of flow of charge, and recall and use the equation $I = Q/t$ 5 Distinguish between the direction of flow of electrons and conventional current. 6 Demonstrate understanding that e.m.f. is defined in terms of energy supplied by a source in driving charge round a complete circuit.

Core	Supplement
12.4 Resistance	
1 State that resistance = p.d./current and understand qualitatively how changes in p.d. or resistance affect current. 2 Recall and use the equation $R = V/I$ 3 Describe an experiment to determine resistance using a voltmeter and an ammeter. 5 Relate (without calculation) the resistance of a wire to its length and to its diameter.	4 Recall and use quantitatively the proportionality between resistance and length, and the inverse proportionality between resistance and cross-sectional area of a wire.
12.5 Electrical energy	
	1 Recall and use the equations $P = IV$ and $E = IVt$
12.6 Dangers of electricity	
1 Identify electrical hazards, including: • damaged insulation • overheating of cables • damp conditions. 3 Demonstrate understanding of the use of fuses.	2 Demonstrate understanding of the use of circuit-breakers.
P13. Electric circuits	
13.1 Circuit diagrams	
1 Draw and interpret circuit diagrams containing sources, switches, resistors (fixed and variable), lamps, ammeters voltmeters, and fuses.	2 Draw and interpret circuit diagrams containing magnetising coils, transformers, bells and relays.

Core	Supplement
13.2 Series and parallel circuits	
1 Demonstrate understanding that the current at every point in a series circuit is the same. 3 Calculate the combined resistance of two or more resistors in series. 4 State that, for a parallel circuit, the current from the source is larger than the current in each branch. 6 State that the combined resistance of two resistors in parallel is less than that of either resistor by itself. 8 State the advantages of connecting lamps in parallel in a lighting circuit.	2 Recall and use the fact that the sum of the p.d.s across the components in a series circuit is equal to the total p.d. across the supply. 5 Recall and use the fact that the current from the source is the sum of the currents in the separate branches of a parallel circuit. 7 Calculate the effective resistance of two resistors in parallel.
13.3 Action and use of circuit components	
	1 Describe the action of thermistors and light-dependent resistors and show understanding of their use as input transducers. 2 Describe the action of a relay and show understanding of its use in switching circuits. 3 Recognise and demonstrate understanding of circuits operating as light-sensitive switches and temperature-operated alarms using a relay.
P14. Electromagnetic effects	
14.1 Electromagnetic induction	
	1 Describe an experiment that shows that a changing magnetic field can induce an e.m.f. in a circuit. 2 State the factors affecting the magnitude of an induced e.m.f.
14.2 a.c. generator	
	1 Describe a rotating-coil generator and the use of slip rings. 2 Sketch a graph of voltage output against time for a simple a.c. generator.

Core	Supplement
14.3 Transformer	
	1 Describe the construction of a basic iron-cored transformer as used for voltage transformations. 2 Recall and use the equation $(V_p / V_s) = (N_p / N_s)$ 3 Describe the use of the transformer in high-voltage transmission of electricity. 4 Recall and use the equation $V_p I_p = V_s I_s$ (for 100% efficiency). 5 Explain why energy losses in cables are lower when the voltage is high.
14.4 The magnetic effect of a current	
1 Describe the pattern of the magnetic field due to currents in straight wires and in solenoids. 3 Describe applications of the magnetic effect of current, including the action of a relay.	2 Describe the effect on the magnetic field of changing the magnitude and direction of the current.
14.5 Force on a current-carrying conductor	
1 Describe and interpret an experiment to show that a force acts on a current-carrying conductor in a magnetic field, including the effect of reversing: • the current • the direction of the field.	2 State and use the relative directions of force, field and current.
14.6 d.c. motor	
	1 Describe the turning effect on a current-carrying coil in a magnetic field. 2 Relate this turning effect to the action of an electric motor. 3 Describe the effect of increasing: • the number of turns in the coil • the current.

Core	Supplement
P15. Radioactivity	
15.1 Detection of radioactivity	
1 Demonstrate understanding of background radiation. 2 Describe the detection of α-particles, β-particles and γ-rays (β^+ are not included; β-particles will be taken to refer to β^-).	
15.2 Characteristics of the three kinds of emission	
1 State that radioactive emissions occur randomly over space and time. 2 Recall for radioactive emissions, and use to identify them: • their nature • their relative ionising effects • their relative penetrating abilities.	3 Describe the deflection of α-particles, β-particles and γ-rays in electric fields and magnetic fields. 4 Interpret their relative ionising effects.
15.3 Radioactive decay	
1 State the meaning of radioactive decay.	2 Use equations (involving words or symbols) to represent changes in the composition of the nucleus when particles are emitted.
15.4 Half-life	
	1 Use the term *half-life* in simple calculations, including the use of information in tables or decay curves.
15.5 Safety precautions	
1 Describe the hazards of ionising radiation to living things. 2 Describe how radioactive materials are handled, used and stored in a safe way to minimise the effects of these hazards.	
15.6 The nuclear atom	
1 Describe the composition of the nucleus in terms of protons and neutrons. 2 Use the term *atomic (proton) number Z.* 3 Use the term *mass (nucleon) number A.*	

Core	Supplement
15.7 Isotopes	
1 Use the term *isotope*. 2 Give and explain examples of practical applications of isotopes. 3 Use the term *nuclide* and use the nuclide notation ${}^{A}_{Z}X$	