

AQA GCSE Additional Science 2011

GCSE Additional Science: Biology

B2.1 Cells and simple cell transport

Candidates should use their skills, knowledge and understanding to:
- relate the structure of different types of cells to their function.

Cells

B2.1.1 Cells and cell structure

a) Most human and animal cells have the following parts:
- a nucleus, which controls the activities of the cell cytoplasm, in which most of the chemical reactions take place
- a cell membrane, which controls the passage of substances into and out of the cell
- mitochondria, which are where most energy is released in respiration
- ribosomes, which are where protein synthesis occurs.

Cells

b) Plant and algal cells also have a cell wall made of cellulose, which strengthens the cell. Plant cells often have:
- chloroplasts, which absorb light energy to make food
- a permanent vacuole filled with cell sap.

Cells

c) A bacterial cell consists of cytoplasm and a membrane surrounded by a cell wall; the genes are not in a distinct nucleus.

Cells

d) Yeast is a single-celled organism. Yeast cells have a nucleus, cytoplasm and a membrane surrounded by a cell wall.

Cells

e) Cells may be specialised to carry out a particular function.

Cells

B2.1.2 Dissolved substances

a) Dissolved substances can move into and out of cells by diffusion.

Diffusion

b) Diffusion is the spreading of the particles of a gas, or of any substance in solution, resulting in a net movement from a region where they are of a higher concentration to a region with a lower concentration. The greater the difference in concentration, the faster the rate of diffusion.

Diffusion

c) Oxygen required for respiration passes through cell membranes by diffusion.

Diffusion

B2.2 Tissues, organs and organ systems

The cells of multicellular organisms may differentiate and become adapted for specific functions. Tissues are aggregations of similar cells; organs are aggregations of tissues performing specific physiological functions. Organs are organised into organ systems, which work together to form organisms.

Multicellular organisms

B2.2.1 Animal organs

a) Large multicellular organisms develop systems for exchanging materials. During the development of a multicellular organism, cells differentiate so that they can perform different functions.

Multicellular organisms

<p>b) A tissue is a group of cells with similar structure and function. Examples of tissues include:</p> <ul style="list-style-type: none"> - muscular tissue, which can contract to bring about movement - glandular tissue, which can produce substances such as enzymes and hormones - epithelial tissue, which covers some parts of the body. 	Multicellular organisms
<p>c) Organs are made of tissues. One organ may contain several tissues. The stomach is an organ that contains:</p> <ul style="list-style-type: none"> - muscular tissue, to churn the contents - glandular tissue, to produce digestive juices - epithelial tissue, to cover the outside and the inside of the stomach. 	Multicellular organisms
<p>d) Organ systems are groups of organs that perform a particular function. The digestive system is one example of a system in which humans and other mammals exchange substances with the environment. The digestive system includes:</p> <ul style="list-style-type: none"> - glands, such as the pancreas and salivary glands, which produce digestive juices - the stomach and small intestine, where digestion occurs - the liver, which produces bile - the small intestine, where the absorption of soluble food occurs - the large intestine, where water is absorbed from the undigested food, producing faeces. 	The Digestive System

B2.2.2 Plant organs

a) Plant organs include stems, roots and leaves.	Leaves
<p>b) Examples of plant tissues include:</p> <ul style="list-style-type: none"> - epidermal tissues, which cover the plant - mesophyll, which carries out photosynthesis - xylem and phloem, which transport substances around the plant. 	Leaves

B2.3 Photosynthesis

<p>Candidates should use their skills, knowledge and understanding to:</p> <ul style="list-style-type: none"> - interpret data showing how factors affect the rate of photosynthesis 	Photosynthesis
<p>Candidates should use their skills, knowledge and understanding to:</p> <ul style="list-style-type: none"> - evaluate the benefits of artificially manipulating the environment in which plants are grown. 	Photosynthesis

B2.3.1 Photosynthesis

<p>a) Photosynthesis is summarised by the equation: carbon dioxide + water + light energy = glucose + oxygen</p>	Photosynthesis
<p>b) During photosynthesis:</p> <ul style="list-style-type: none"> - light energy is absorbed by a green substance called chlorophyll, which is found in chloroplasts in some plant cells and algae - this energy is used by converting carbon dioxide (from the air) and water (from the soil) into sugar (glucose) - oxygen is released as a by-product. 	Photosynthesis

c) The rate of photosynthesis may be limited by: - shortage of light - low temperature - shortage of carbon dioxide.	Photosynthesis
d) Light, temperature and the availability of carbon dioxide interact and in practice any one of them may be the factor that limits photosynthesis.	Photosynthesis
e) The glucose produced in photosynthesis may be converted into insoluble starch for storage. Plant cells use some of the glucose produced during photosynthesis for respiration.	Use of Glucose in Plants
f) Some glucose in plants and algae is used: - to produce fat or oil for storage - to produce cellulose, which strengthens the cell wall - to produce proteins.	Use of Glucose in Plants
g) To produce proteins, plants also use nitrate ions that are absorbed from the soil.	Use of Glucose in Plants

B2.4 Organisms and their environment

Candidates should use their skills, knowledge and understanding to: - suggest reasons for the distribution of living organisms in a particular habitat.	Investigating Ecosystems
Candidates should use their skills, knowledge and understanding to: - evaluate methods used to collect environmental data, and consider the validity of the method and the reproducibility of the data as evidence for environmental change.	Investigating Ecosystems

B2.4.1 Distribution of organisms

a) Physical factors that may affect organisms are: - temperature - availability of nutrients - amount of light - availability of water - availability of oxygen and carbon dioxide.	Investigating Ecosystems
b) Quantitative data on the distribution of organisms can be obtained by: - random sampling with quadrats - sampling along a transect.	Investigating Ecosystems

B2.5 Proteins – their functions and uses

Candidates should use their skills, knowledge and understanding to: - evaluate the advantages and disadvantages of using enzymes in the home and in industry.	Digestive Enzymes
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B2.5.1 Proteins

a) Protein molecules are made up of long chains of amino acids. These long chains are folded to produce a specific shape that enables other molecules to fit into the protein. Proteins act as: - structural components of tissues such as muscles - hormones - antibodies - catalysts.	Genes and Protein Synthesis
b) Catalysts increase the rate of chemical reactions. Biological catalysts are called enzymes. Enzymes are proteins.	Enzymes

B2.5.2 Enzymes

a) The shape of an enzyme is vital for the enzyme's function. High temperatures change the shape.	Enzymes
b) Different enzymes work best at different pH values.	Enzymes
c) Some enzymes work outside the body cells. The digestive enzymes are produced by specialised cells in glands and in the lining of the gut. The enzymes then pass out of the cells into the gut where they come into contact with food molecules. They catalyse the breakdown of large molecules into smaller molecules.	Digestive Enzymes
d) The enzyme amylase is produced in the salivary glands, the pancreas and the small intestine. This enzyme catalyses the breakdown of starch into sugars in the mouth and small intestine.	Digestive Enzymes
e) Protease enzymes are produced by the stomach, the pancreas and the small intestine. These enzymes catalyse the breakdown of proteins into amino acids in the stomach and the small intestine.	Digestive Enzymes
f) Lipase enzymes are produced by the pancreas and small intestine. These enzymes catalyse the breakdown of lipids (fats and oils) into fatty acids and glycerol in the small intestine.	Digestive Enzymes
g) The stomach also produces hydrochloric acid. The enzymes in the stomach work most effectively in these acid conditions.	Digestive Enzymes
h) The liver produces bile, which is stored in the gall bladder before being released into the small intestine. Bile neutralises the acid that is added to food in the stomach. This provides alkaline conditions in which enzymes in the small intestine work most effectively.	Digestive Enzymes
i) Some microorganisms produce enzymes that pass out of the cells. These enzymes have many uses in the home and in industry. In the home: - biological detergents may contain protein-digesting and fat-digesting enzymes (proteases and lipases) - biological detergents are more effective at low temperatures than other types of detergents. In industry: - proteases are used to 'pre-digest' the protein in some baby foods - carbohydrases are used to convert starch into sugar syrup - isomerase is used to convert glucose syrup into fructose syrup, which is much sweeter and therefore can be used in smaller quantities in slimming foods.	Digestive Enzymes
j) In industry, enzymes are used to bring about reactions at normal temperatures and pressures that would otherwise require expensive, energy-demanding equipment. However, most enzymes are denatured at high temperatures and many are costly to produce.	Digestive Enzymes

B2.6 Aerobic and anaerobic respiration

Candidates should use their skills, knowledge and understanding to: - interpret the data relating to the effects of exercise on the human body.	Respiration
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B2.6.1 Aerobic respiration

a) The chemical reactions inside cells are controlled by enzymes.	Respiration
b) During aerobic respiration (respiration that uses oxygen) chemical reactions occur that: - use glucose (a sugar) and oxygen - release energy.	Respiration
c) Aerobic respiration takes place continuously in both plants and animals.	Respiration
d) Most of the reactions in aerobic respiration take place inside mitochondria.	Respiration
e) Aerobic respiration is summarised by the equation: glucose + oxygen = carbon dioxide + water (+ energy)	Respiration
f) Energy that is released during respiration is used by the organism. The energy may be used: - to build larger molecules from smaller ones - in animals, to enable muscles to contract - in mammals and birds, to maintain a steady body temperature in colder surroundings - in plants, to build up sugars, nitrates and other nutrients into amino acids which are then built up into proteins.	Respiration
g) During exercise a number of changes take place: - the heart rate increases - the rate and depth of breathing increases.	Respiration
h) These changes increase the blood flow to the muscles and so increase the supply of sugar and oxygen and increase the rate of removal of carbon dioxide.	Respiration
i) Muscles store glucose as glycogen, which can then be converted back to glucose for use during exercise.	Respiration

B2.6.2 Anaerobic respiration

a) During exercise, if insufficient oxygen is reaching the muscles they use anaerobic respiration to obtain energy.	Anaerobic Respiration
b) Anaerobic respiration is the incomplete breakdown of glucose and produces lactic acid.	Anaerobic Respiration
c) (HT) As the breakdown of glucose is incomplete, much less energy is released than during aerobic respiration. Anaerobic respiration results in an oxygen debt that has to be repaid in order to oxidise lactic acid to carbon dioxide and water.	Anaerobic Respiration
d) If muscles are subjected to long periods of vigorous activity they become fatigued, ie they stop contracting efficiently. One cause of muscle fatigue is the build-up of lactic acid in the muscles. Blood flowing through the muscles removes the lactic acid.	Anaerobic Respiration

B2.7 Cell division and inheritance

Candidates should use their skills, knowledge and understanding to: - explain why Mendel proposed the idea of separately inherited factors and why the importance of this discovery was not recognised until after his death	Inheritance
Candidates should use their skills, knowledge and understanding to: - interpret genetic diagrams, including family trees	Inheritance

Candidates should use their skills, knowledge and understanding to: - (HT) construct genetic diagrams of monohybrid crosses and predict the outcomes of monohybrid crosses and be able to use the terms homozygous, heterozygous, phenotype and genotype	Inheritance
Candidates should use their skills, knowledge and understanding to: - predict and /or explain the outcome of crosses between individuals for each possible combination of dominant and recessive alleles of the same gene	Inheritance
Candidates should use their skills, knowledge and understanding to: - make informed judgements about the social and ethical issues concerning the use of stem cells from embryos in medical research and treatments	Stem Cells
Candidates should use their skills, knowledge and understanding to: - make informed judgements about the economic, social and ethical issues concerning embryo screening.	Inherited Disorders

B2.7.1 Cell division

a) In body cells the chromosomes are normally found in pairs. Body cells divide by mitosis.	Mitosis
b) The chromosomes contain the genetic information.	Mitosis
c) When a body cell divides by mitosis: - copies of the genetic material are made - then the cell divides once to form two genetically identical body cells.	Mitosis
d) Mitosis occurs during growth or to produce replacement cells.	Mitosis
e) Body cells have two sets of chromosomes; sex cells (gametes) have only one set.	Meiosis and Reproduction
f) Cells in reproductive organs – testes and ovaries in humans – divide to form gametes.	Meiosis and Reproduction
g) The type of cell division in which a cell divides to form gametes is called meiosis.	Meiosis and Reproduction
h) (HT) When a cell divides to form gametes: - copies of the genetic information are made - then the cell divides twice to form four gametes, each with a single set of chromosomes.	Meiosis and Reproduction
i) When gametes join at fertilisation, a single body cell with new pairs of chromosomes is formed. A new individual then develops by this cell repeatedly dividing by mitosis.	Meiosis and Reproduction
j) Most types of animal cells differentiate at an early stage whereas many plant cells retain the ability to differentiate throughout life. In mature animals, cell division is mainly restricted to repair and replacement.	Plant and Animal Growth
k) Cells from human embryos and adult bone marrow, called stem cells, can be made to differentiate into many different types of cells, eg nerve cells.	Stem Cells
l) Human stem cells have the ability to develop into any kind of human cell.	Stem Cells
m) Treatment with stem cells may be able to help conditions such as paralysis.	Stem Cells
n) The cells of the offspring produced by asexual reproduction are produced by mitosis from the parental cells. They contain the same alleles as the parents.	Asexual Reproduction

B2.7.2 Genetic variation

a) Sexual reproduction gives rise to variation because, when gametes fuse, one of each pair of alleles comes from each parent.	Inheritance
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b) In human body cells, one of the 23 pairs of chromosomes carries the genes that determine sex. In females the sex chromosomes are the same (XX); in males the sex chromosomes are different (XY).	Inheritance
c) Some characteristics are controlled by a single gene. Each gene may have different forms called alleles.	Inheritance
d) An allele that controls the development of a characteristic when it is present on only one of the chromosomes is a dominant allele.	Inheritance
e) An allele that controls the development of characteristics only if the dominant allele is not present is a recessive allele.	Inheritance
f) Chromosomes are made up of large molecules of DNA (deoxyribo nucleic acid) which has a double helix structure.	DNA
g) A gene is a small section of DNA.	Genes and Protein Synthesis
h) (HT) Each gene codes for a particular combination of amino acids which makes a specific protein.	Genes and Protein Synthesis
i) Each person (apart from identical twins) has unique DNA. This can be used to identify individuals in a process known as DNA fingerprinting.	DNA

B2.7.3 Genetic disorders

a) Some disorders are inherited.	Inherited Disorders
b) Polydactyly – having extra fingers or toes – is caused by a dominant allele of a gene and can therefore be passed on by only one parent who has the disorder.	Inherited Disorders
c) Cystic fibrosis (a disorder of cell membranes) must be inherited from both parents. The parents may be carriers of the disorder without actually having the disorder themselves. It is caused by a recessive allele of a gene and can therefore be passed on by parents, neither of whom has the disorder.	Inherited Disorders
d) Embryos can be screened for the alleles that cause these and other genetic disorders.	Inherited Disorders

B2.8 Speciation

Candidates should use their skills, knowledge and understanding to: - suggest reasons why scientists cannot be certain about how life began on Earth.	Fossils and Species Development
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B2.8.1 Old and new species

a) Evidence for early forms of life comes from fossils.	Fossils and Species Development
b) Fossils are the 'remains' of organisms from many years ago, and are found in rocks. Fossils may be formed in various ways: - from the hard parts of animals that do not decay easily - from parts of organisms that have not decayed because one or more of the conditions needed for decay are absent - when parts of the organism are replaced by other materials as they decay - as preserved traces of organisms, eg footprints, burrows and rootlet traces.	Fossils and Species Development
c) Many early forms of life were soft-bodied, which means that they have left few traces behind. What traces there were have been mainly destroyed by geological activity.	Fossils and Species Development
d) We can learn from fossils how much or how little organisms have changed as life developed on Earth.	Fossils and Species Development

<p>e) Extinction may be caused by:</p> <ul style="list-style-type: none">- changes to the environment over geological time- new predators- new diseases- new, more successful, competitors- a single catastrophic event, eg massive volcanic eruptions or collisions with asteroids- through the cyclical nature of speciation.	<p>Fossils and Species Development</p>
<p>f) New species arise as a result of:</p> <ul style="list-style-type: none">- isolation – two populations of a species become separated, eg geographically- (HT) genetic variation – each population has a wide range of alleles that control their characteristics- (HT) natural selection – in each population, the alleles that control the characteristics which help the organism to survive are selected- (HT) speciation – the populations become so different that successful interbreeding is no longer possible.	<p>Fossils and Species Development</p>

AQA GCSE Additional Science 2011

GCSE Additional Science: Chemistry

3.4 Unit 2: Chemistry 2**Boardworks Presentation****C2.1 Structure and bonding**

Candidates should use their skills, knowledge and understanding to:
- write formulae for ionic compounds from given symbols and ionic charges.

Ions and Ionic Bonding

Candidates should use their skills, knowledge and understanding to:
- represent the electronic structure of the ions in sodium chloride, magnesium oxide and calcium chloride in the following form: (dot and cross notation) for sodium ion (Na⁺)

Ions and Ionic Bonding

Candidates should use their skills, knowledge and understanding to:
- represent the covalent bonds in molecules such as water, ammonia, hydrogen, hydrogen chloride, methane and oxygen, and in giant structures such as diamond and silicon dioxide, in the following forms: (see specification)

Covalent Bonding

Candidates should use their skills, knowledge and understanding to:
- (HT) represent the bonding in metals in the following form: (see specification)

Metallic Bonding**C2.1.1 Structure and bonding**

a) Compounds are substances in which atoms of two or more elements are chemically combined.

Ions and Ionic Bonding

b) Chemical bonding involves either transferring or sharing electrons in the highest occupied energy levels (shells) of atoms in order to achieve the electronic structure of a noble gas.

Ions and Ionic Bonding

c) When atoms form chemical bonds by transferring electrons, they form ions. Atoms that lose electrons become positively charged ions. Atoms that gain electrons become negatively charged ions. Ions have the electronic structure of a noble gas (Group 0).

Ions and Ionic Bonding

d) The elements in Group 1 of the periodic table, the alkali metals, all react with non-metal elements to form ionic compounds in which the metal ion has a single positive charge.

Ions and Ionic Bonding

e) The elements in Group 7 of the periodic table, the halogens, all react with the alkali metals to form ionic compounds in which the halide ions have a single negative charge.

Ions and Ionic Bonding

f) An ionic compound is a giant structure of ions. Ionic compounds are held together by strong electrostatic forces of attraction between oppositely charged ions. These forces act in all directions in the lattice and this is called ionic bonding.

Ionic Compounds

g) When atoms share pairs of electrons, they form covalent bonds. These bonds between atoms are strong. Some covalently bonded substances consist of simple molecules such as H₂, Cl₂, O₂, HCl, H₂O, NH₃ and CH₄. Others have giant covalent structures (macromolecules), such as diamond and silicon dioxide.

Covalent Bonding

h) Metals consist of giant structures of atoms arranged in a regular pattern.

Metallic Bonding

i) (HT) The electrons in the highest occupied energy levels (outer shell) of metal atoms are delocalised and so free to move through the whole structure. This corresponds to a whole structure. This corresponds to a between the ions holding them together by strong electrostatic attractions.

Metallic Bonding**C2.2 How structure influences the properties and uses of substances**

Candidates should use their skills, knowledge and understanding to:
- relate the properties of substances to their uses

Metallic Bonding

Candidates should use their skills, knowledge and understanding to: - suggest the type of structure of a substance given its properties	Metallic Bonding
Candidates should use their skills, knowledge and understanding to: - evaluate developments and applications of new materials, eg nanomaterials, fullerenes and shape memory materials.	New Materials

C2.2.1 Molecules

a) Substances that consist of simple molecules are gases, liquids or solids that have relatively low melting points and boiling points.	Covalent Bonding
b) (HT) Substances that consist of simple molecules have only weak forces between the molecules (intermolecular forces). It is these intermolecular forces that are overcome, not the covalent bonds, when the substance melts or boils.	Covalent Bonding
c) Substances that consist of simple molecules do not conduct electricity because the molecules do not have an overall electric charge.	Covalent Bonding

C2.2.2 Ionic compounds

a) Ionic compounds have regular structures (giant ionic lattices) in which there are strong electrostatic forces in all directions between oppositely charged ions. These compounds have high melting points and high boiling points because of the large amounts of energy needed to break the many strong bonds.	Ionic Compounds
b) When melted or dissolved in water, ionic compounds conduct electricity because the ions are free to move and carry the current.	Ionic Compounds

C2.2.3 Covalent structures

a) Atoms that share electrons can also form giant structures or macromolecules. Diamond and graphite (forms of carbon) and silicon dioxide (silica) are examples of giant covalent structures (lattices) of atoms. All the atoms in these structures are linked to other atoms by strong covalent bonds and so they have very high melting points.	Giant Covalent Structures
b) In diamond, each carbon atom forms four covalent bonds with other carbon atoms in a giant covalent structure, so diamond is very hard.	Giant Covalent Structures
c) In graphite, each carbon atom bonds to three others, forming layers. The layers are free to slide over each other because there are no covalent bonds between the layers and so graphite is soft and slippery. (HT) Explain the properties of graphite in terms of weak intermolecular forces between the layers.	Giant Covalent Structures
d) (HT) In graphite, one electron from each carbon atom is delocalised. These delocalised electrons allow graphite to conduct heat and electricity.	Giant Covalent Structures
e) (HT) Carbon can also form fullerenes with different numbers of carbon atoms. Fullerenes can be used for drug delivery into the body, in lubricants, as catalysts, and in nanotubes for reinforcing materials, eg in tennis rackets.	Giant Covalent Structures

C2.2.4 Metals

a) (HT) Metals conduct heat and electricity because of the delocalised electrons in their structures.	Metallic Bonding
b) The layers of atoms in metals are able to slide over each other and so metals can be bent and shaped.	Metallic Bonding

c) Alloys are usually made from two or more different metals. The different sized atoms of the metals distort the layers in the structure, making it more difficult for them to slide over each other, and so make alloys harder than pure metals.	New Materials
d) Shape memory alloys can return to their original shape after being deformed, eg Nitinol used in dental braces.	New Materials

C2.2.5 Polymers

a) The properties of polymers depend on what they are made from and the conditions under which they are made. For example, low density (LD) and high density (HD) poly(ethene) are produced using different catalysts and reaction conditions.	New Materials
b) Thermosoftening polymers consist of individual, tangled polymer chains. Thermosetting polymers consist of polymer chains with cross-links between them so that they do not melt when they are heated. (HT) Explain the properties of thermosoftening polymers in terms of intermolecular forces.	New Materials

C2.2.6 Nanoscience

a) Nanoscience refers to structures that are 1–100 nm in size, of the order of a few hundred atoms. Nanoparticles show different properties to the same materials in bulk and have a high surface area to volume ratio, which may lead to the development of new computers, new catalysts, new coatings, highly selective sensors, stronger and lighter construction materials, and new cosmetics such as sun tan creams and deodorants.	New Materials
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C2.3 Atomic structure, analysis and quantitative chemistry

Candidates should use their skills, knowledge and understanding to: - evaluate sustainable development issues relating the starting materials of an industrial process to the product yield and the energy requirements of the reactions involved.	Yield
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C2.3.1 Atomic structure

a) Atoms can be represented as shown in this example: (Na symbol with mass number (23) positioned top left and atomic number (11) positioned bottom left)	Atomic Structure
b) The relative masses of protons, neutrons and electrons are: Proton - mass = 1 Neutron - mass = 1 Electron - mass = very small	Atomic Structure
c) The total number of protons and neutrons in an atom is called its mass number.	Atomic Structure
d) Atoms of the same element can have different numbers of neutrons; these atoms are called isotopes of that element.	Isotopes
e) (HT) The relative atomic mass of an element (Ar) compares the mass of atoms of the element with the 12C isotope. It is an average value for the isotopes of the element.	
f) The relative formula mass (Mr) of a compound is the sum of the relative atomic masses of the atoms in the numbers shown in the formula.	Formulae and Equations
g) The relative formula mass of a substance, in grams, is known as one mole of that substance.	Formulae and Equations

C2.3.2 Analysing substances	
a) Elements and compounds can be detected and identified using instrumental methods. Instrumental methods are accurate, sensitive and rapid and are particularly useful when the amount of a sample is very small.	Chromatography
b) Chemical analysis can be used to identify additives in foods. Artificial colours can be detected and identified by paper chromatography.	Chromatography
c) Gas chromatography linked to mass spectroscopy (GC-MS) is an example of an instrumental method: - gas chromatography allows the separation of a mixture of compounds - the time taken for a substance to travel through the column can be used to help identify the substance - the output from the gas chromatography column can be linked to a mass spectrometer, which can be used to identify the substances leaving the end of the column - (HT) the mass spectrometer can also give the relative molecular mass of each of the substances separated in the column.	Chromatography

C2.3.3 Quantitative chemistry	
a) The percentage of an element in a compound can be calculated from the relative mass of the element in the formula and the relative formula mass of the compound.	Formulae and Equations
b) (HT) The empirical formula of a compound can be calculated from the masses or percentages of the elements in a compound.	Formulae and Equations
c) (HT) The masses of reactants and products can be calculated from balanced symbol equations.	Quantitative Chemistry
d) Even though no atoms are gained or lost in a chemical reaction, it is not always possible to obtain the calculated amount of a product because: - the reaction may not go to completion because it is reversible - some of the product may be lost when it is separated from the reaction mixture - some of the reactants may react in ways different from the expected reaction.	Yield
e) The amount of a product obtained is known as the yield. When compared with the maximum theoretical amount as a percentage, it is called the percentage yield. (HT) Calculate percentage yields of reactions.	Yield
f) In some chemical reactions, the products of the reaction can react to produce the original reactants. Such reactions are called reversible reactions and are represented: $A + B \rightleftharpoons C + D$ For example: ammonium chloride \rightleftharpoons ammonia + hydrogen chloride	Reversible Reactions

C2.4 Rates of reaction	
Candidates should use their skills, knowledge and understanding to: - interpret graphs showing the amount of product formed (or reactant used up) with time, in terms of the rate of the reaction	Measuring Reaction Rates
Candidates should use their skills, knowledge and understanding to: - explain and evaluate the development, advantages and disadvantages of using catalysts in industrial processes.	Catalysts

C2.4.1 Rates of reaction

a) The rate of a chemical reaction can be found by measuring the amount of a reactant used or the amount of product formed over time: Rate of reaction = amount of reactant used / time Rate of reaction = amount of product formed / time	Measuring Reaction Rates
b) Chemical reactions can only occur when reacting particles collide with each other and with sufficient energy. The minimum amount of energy particles must have to react is called the activation energy.	Changing Reaction Rates
c) Increasing the temperature increases the speed of the reacting particles so that they collide more frequently and more energetically. This increases the rate of reaction.	Changing Reaction Rates
d) Increasing the pressure of reacting gases increases the frequency of collisions and so increases the rate of reaction.	Changing Reaction Rates
e) Increasing the concentration of reactants in solutions increases the frequency of collisions and so increases the rate of reaction.	Changing Reaction Rates
f) Increasing the surface area of solid reactants increases the frequency of collisions and so increases the rate of reaction.	Changing Reaction Rates
g) Catalysts change the rate of chemical reactions but are not used up during the reaction. Different reactions need different catalysts.	Catalysts
h) Catalysts are important in increasing the rates of chemical reactions used in industrial processes to reduce costs.	Catalysts

C2.5 Exothermic and endothermic reactions

Candidates should use their skills, knowledge and understanding to: - evaluate everyday uses of exothermic and endothermic reactions.	Energy and Reactions
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C2.5.1 Energy transfer in chemical reactions

a) When chemical reactions occur, energy is transferred to or from the surroundings.	Energy and Reactions
b) An exothermic reaction is one that transfers energy to the surroundings. Examples of exothermic reactions include combustion, many oxidation reactions and neutralisation. Everyday uses of exothermic reactions include self-heating cans (eg for coffee) and hand warmers.	Energy and Reactions
c) An endothermic reaction is one that takes in energy from the surroundings. Endothermic reactions include thermal decompositions. Some sports injury packs are based upon endothermic reactions.	Energy and Reactions
d) If a reversible reaction is exothermic in one direction, it is endothermic in the opposite direction. The same amount of energy is transferred in each case. For example: hydrated copper sulphate (blue) \rightleftharpoons anhydrous copper sulphate (white) + water	Reversible Reactions

C2.6 Acids, bases and salts

Candidates should use their skills, knowledge and understanding to: - select an appropriate method for making a salt, given appropriate information.	Making Salts
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C2.6.1 Making salts

a) The state symbols in equations are (s), (l), (g) and (aq).	Making Salts
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b) Soluble salts can be made by reacting acids with: - metals – not all metals are suitable; some are too reactive and others are not reactive enough - insoluble bases – the base is added to the acid until no more will react and the excess solid is filtered off - alkalis – an indicator can be used to show when the acid and alkali have completely reacted to produce a salt solution.	Making Salts
c) Salt solutions can be crystallised to produce solid salts.	Making Salts
d) Insoluble salts can be made by mixing appropriate solutions of ions so that a precipitate is formed. Precipitation can be used to remove unwanted ions from solutions, for example in treating water for drinking or in treating effluent	Precipitation Reactions

C2.6.2 Acids and bases

a) Metal oxides and hydroxides are bases. Soluble hydroxides are called alkalis.	Acids and Alkalis
b) The particular salt produced in any reaction between an acid and a base or alkali depends on: - the acid used (hydrochloric acid produces chlorides, nitric acid produces nitrates, sulfuric acid produces sulfates) - the metal in the base or alkali.	Acids and Alkalis
c) Ammonia dissolves in water to produce an alkaline solution. It is used to produce ammonium salts. Ammonium salts are important as fertilisers.	Acids and Alkalis
d) Hydrogen ions, $H^+(aq)$, make solutions acidic and hydroxide ions, $OH^-(aq)$, make solutions alkaline. The pH scale is a measure of the acidity or alkalinity of a solution.	Acids and Alkalis
e) In neutralisation reactions, hydrogen ions react with hydroxide ions to produce water. This reaction can be represented by the equation: $H^+(aq) + OH^-(aq) = H_2O(l)$	Acids and Alkalis

C2.7 Electrolysis

Candidates should use their skills, knowledge and understanding to: - predict the products of electrolysis solutions of ions	Electrolysis
Candidates should use their skills, knowledge and understanding to: - explain and evaluate processes that use the principles described in this unit, including the use of electroplating.	Electrolysis

C2.7.1 Electrolysis

a) When an ionic substance is melted or dissolved in water, the ions are free to move about within the liquid or solution.	Electrolysis
b) Passing an electric current through ionic substances that are molten, for example lead bromide, or in solution breaks them down into elements. This process is called electrolysis and the substance that is broken down is called the electrolyte.	Electrolysis
c) During electrolysis, positively charged ions move to the negative electrode, and negatively charged ions move to the positive electrode.	Electrolysis
d) Electrolysis is used to electroplate objects. This may be for a variety of reasons and includes copper plating and silver plating.	Electrolysis
e) At the negative electrode, positively charged ions gain electrons (reduction) and at the positive electrode, negatively charged ions lose electrons (oxidation).	Electrolysis

f) If there is a mixture of ions, the products formed depend on the reactivity of the elements involved.	Electrolysis
g) (HT) Reactions at electrodes can be represented by half equations, for example: $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$ or $2\text{Cl}^- - 2\text{e}^- \rightarrow \text{Cl}_2$	Electrolysis
h) Aluminium is manufactured by the electrolysis of a molten mixture of aluminium oxide and cryolite. Aluminium forms at the negative electrode and oxygen at the positive electrode. The positive electrode is made of carbon, which reacts with the oxygen to produce carbon dioxide.	Electrolysis
i) The electrolysis of sodium chloride solution produces hydrogen and chlorine. Sodium hydroxide solution is also produced. These are important reagents for the chemical industry, eg sodium hydroxide for the production of soap and chlorine for the production of bleach and plastics.	Electrolysis

AQA GCSE Additional Science 2011

GCSE Additional Science: Physics

P2.1 Forces and their effects

Candidates should use their skills, knowledge and understanding to: - interpret data from tables and graphs relating to speed, velocity and acceleration	Acceleration
Candidates should use their skills, knowledge and understanding to: - evaluate the effects of alcohol and drugs on stopping distances	Stopping Distances
Candidates should use their skills, knowledge and understanding to: - evaluate how the shape and power of a vehicle can be altered to increase the vehicle's top speed	Falling Objects Powering Cars
Candidates should use their skills, knowledge and understanding to: - draw and interpret velocity–time graphs for objects that reach terminal velocity, including a consideration of the forces acting on the object.	Falling Objects

P2.1.1 Resultant forces

a) Whenever two objects interact, the forces they exert on each other are equal and opposite.	Forces
b) A number of forces acting at a point may be replaced by a single force that has the same effect on the motion as the original forces all acting together. This single force is called the resultant force.	Forces
c) A resultant force acting on an object may cause a change in its state of rest or motion.	Forces
d) If the resultant force acting on a stationary object is: - zero, the object will remain stationary - not zero, the object will accelerate in the direction of the resultant force.	Forces
e) If the resultant force acting on a moving object is: - zero, the object will continue to move at the same speed and in the same direction - not zero, the object will accelerate in the direction of the resultant force.	Forces

P2.1.2 Forces and motion

a) The acceleration of an object is determined by the resultant force acting on the object and the mass of the object. $a = F / m$ or $F = m \times a$	Acceleration
b) The gradient of a distance–time graph represents speed.	Speed
c) (HT) Calculation of the speed of an object from the gradient of a distance–time graph.	Speed
d) The velocity of an object is its speed in a given direction.	Speed
e) The acceleration of an object is given by the equation: $a = (v - u) / t$	Acceleration
f) The gradient of a velocity–time graph represents acceleration.	Acceleration
g) (HT) Calculation of the acceleration of an object from the gradient of a velocity–time graph.	Acceleration
h) (HT) Calculation of the distance travelled by an object from a velocity–time graph.	Acceleration

P2.1.3 Forces and braking

a) When a vehicle travels at a steady speed the resistive forces balance the driving force.	Stopping Distances
b) The greater the speed of a vehicle the greater the braking force needed to stop it in a certain distance.	Stopping Distances

c) The stopping distance of a vehicle is the sum of the distance the vehicle travels during the driver's reaction time (thinking distance) and the distance it travels under the braking force (braking distance).	Stopping Distances
d) A driver's reaction time can be affected by tiredness, drugs and alcohol.	Stopping Distances
e) When the brakes of a vehicle are applied, work done by the friction force between the brakes and the wheel reduces the kinetic energy of the vehicle and the temperature of the brakes increases.	Stopping Distances
f) A vehicle's braking distance can be affected by adverse road and weather conditions and poor condition of the vehicle.	Stopping Distances

P2.1.4 Forces and terminal velocity

a) The faster an object moves through a fluid the greater the frictional force that acts on it.	Falling Objects
b) An object falling through a fluid will initially accelerate due to the force of gravity. Eventually the resultant force will be zero and the object will move at its terminal velocity (steady speed).	Falling Objects
c) Draw and interpret velocity-time graphs for objects that reach terminal velocity, including a consideration of the forces acting on the object.	Falling Objects
d) Calculate the weight of an object using the force exerted on it by a gravitational force: $W = m \times g$	Falling Objects

P2.1.5 Forces and elasticity

a) A force acting on an object may cause a change in shape of the object.	Elasticity
b) A force applied to an elastic object such as a spring will result in the object stretching and storing elastic potential energy.	Elasticity
c) For an object that is able to recover its original shape, elastic potential energy is stored in the object when work is done on the object to change its shape.	Elasticity
d) The extension of an elastic object is directly proportional to the force applied, provided that the limit of proportionality is not exceeded: $F = k \times e$	Elasticity

P2.2 The kinetic energy of objects speeding up or slowing down

Candidates should use their skills, knowledge and understanding to: - evaluate the benefits of different types of braking system, such as regenerative braking.	Stopping Distances
Candidates should use their skills, knowledge and understanding to: - evaluate the benefits of air bags, crumple zones, seat belts and side impact bars in cars.	Car Safety

P2.2.1 Forces and energy

a) When a force causes an object to move through a distance work is done.	Work and Power
b) Work done, force and distance, are related by the equation: $W = F \times d$	Work and Power
c) Energy is transferred when work is done.	Work and Power
d) Work done against frictional forces.	Work and Power
e) Power is the work done or energy transferred in a given time. $P = E / t$	Work and Power

f) Gravitational potential energy is the energy that an object has by virtue of its position in a gravitational field. $E_p = m \times g \times h$	Potential and Kinetic Energy
g) The kinetic energy of an object depends on its mass and its speed. $E_k = 0.5 \times m \times v^2$	Potential and Kinetic Energy

P2.2.2 Momentum

a) Momentum is a property of moving objects. $p = m \times v$	Momentum and Collisions
b) In a closed system the total momentum before an event is equal to the total momentum after the event. This is called conservation of momentum.	Momentum and Collisions

P2.3 Currents in electrical circuits

Candidates should use their skills, knowledge and understanding to: - apply the principles of basic electrical circuits to practical situations	Circuit Components
Candidates should use their skills, knowledge and understanding to: - evaluate the use of different forms of lighting, in terms of cost and energy efficiency.	Circuit Components

P2.3.1 Static electricity

a) When certain insulating materials are rubbed against each other they become electrically charged. Negatively charged electrons are rubbed off one material and onto the other.	Static Electricity
b) The material that gains electrons becomes negatively charged. The material that loses electrons is left with an equal positive charge.	Static Electricity
c) When two electrically charged objects are brought together they exert a force on each other.	Static Electricity
d) Two objects that carry the same type of charge repel. Two objects that carry different types of charge attract.	Static Electricity
e) Electrical charges can move easily through some substances, eg metals.	Static Electricity

P2.3.2 Electrical circuits

a) Electric current is a flow of electric charge. The size of the electric current is the rate of flow of electric charge. The size of the current is given by the equation: $I = Q / t$	Electrical Circuits
b) The potential difference (voltage) between two points in an electric circuit is the work done (energy transferred) per coulomb of charge that passes between the points. $V = W / Q$	Electrical Circuits
c) Circuit diagrams using standard symbols. The following standard symbols should be known: (see specification)	Electrical Circuits
d) Current–potential difference graphs are used to show how the current through a component varies with the potential difference across it.	Current, Voltage and Resistance
e) The current–potential difference graphs for a resistor at constant temperature. As the current increase, the potential difference increases at the same rate (see specification)	Current, Voltage and Resistance
f) The resistance of a component can be found by measuring the current through, and potential difference across, the component.	Current, Voltage and Resistance

g) The current through a resistor (at a constant temperature) is directly proportional to the potential difference across the resistor.	Current, Voltage and Resistance
h) Calculate current, potential difference or resistance using the equation: $V = I \times R$	Current, Voltage and Resistance
i) The current through a component depends on its resistance. The greater the resistance the smaller the current for a given potential difference across the component.	Current, Voltage and Resistance
j) The potential difference provided by cells connected in series is the sum of the potential difference of each cell (depending on the direction in which they are connected).	Series and Parallel Circuits
k) For components connected in series: - the total resistance is the sum of the resistance of each component - there is the same current through each component - the total potential difference of the supply is shared between the components.	Series and Parallel Circuits
l) For components connected in parallel: - the potential difference across each component is the same - the total current through the whole circuit is the sum of the currents through the separate components.	Series and Parallel Circuits
m) (HT) The resistance of a filament bulb increases as the temperature of the filament increases. (see specification for graph)	Circuit Components
n) The current through a diode flows in one direction only. The diode has a very high resistance in the reverse direction. (see specification for graph)	Circuit Components
o) An LED emits light when a current flows through it in the forward direction.	Circuit Components
p) The resistance of a light-dependent resistor (LDR) decreases as light intensity increases.	Circuit Components
q) The resistance of a thermistor decreases as the temperature increases.	Circuit Components

P2.4 Using mains electricity safely and the power of electrical appliances

Candidates should use their skills, knowledge and understanding to: - understand the principles of safe practice and recognise dangerous practice in the use of mains electricity	Electrical Safety and Wiring
Candidates should use their skills, knowledge and understanding to: - compare the uses of fuses and circuit breakers	Electrical Safety and Wiring
Candidates should use their skills, knowledge and understanding to: - evaluate and explain the need to use different cables for different appliances	Electrical Safety and Wiring
Candidates should use their skills, knowledge and understanding to: - consider the factors involved when making a choice of electrical appliances.	Electrical Power

P2.4.1 Household electricity

a) Cells and batteries supply current that always passes in the same direction. This is called direct current (d.c.).	Electrical Supply
b) An alternating current (a.c.) is one that is constantly changing direction. (HT) Determine the period and hence the frequency of a supply from diagrams of oscilloscope traces.	Electrical Supply
c) Mains electricity is an a.c. supply. In the UK it has a frequency of 50 cycles per second (50 hertz) and is about 230 V.	Electrical Supply
d) Most electrical appliances are connected to the mains using cable and a three-pin plug.	Electrical Safety and Wiring
e) The structure of electrical cable.	Electrical Safety and Wiring

f) The structure and wiring of a three-pin plug.	Electical Safety and Wiring
g) If an electrical fault causes too great a current, the circuit is disconnected by a fuse or a circuit breaker in the live wire.	Electical Safety and Wiring
h) When the current in a fuse wire exceeds the rating of the fuse it will melt, breaking the circuit.	Electical Safety and Wiring
i) Some circuits are protected by Residual Current Circuit Breakers (RCCBs).	Electical Safety and Wiring
j) Appliances with metal cases are usually earthed.	Electical Safety and Wiring
k) The earth wire and fuse together protect the wiring of the circuit.	Electical Safety and Wiring

P2.4.2 Current, charge and power

a) When an electrical charge flows through a resistor, the resistor gets hot.	Electrical Power
b) The rate at which energy is transferred by an appliance is called the power. $P = E / t$	Electrical Power
c) Power, potential difference and current are related by the equation: $P = I \times V$	Electrical Power
d) (HT) Energy transferred, potential difference and charge are related by the equation: $E = V \times Q$	Electrical Power

P2.5 What happens when radioactive substances decay, and the uses and dangers of their emissions

Candidates should use their skills, knowledge and understanding to: - evaluate the effect of occupation and/or location on the level of background radiation and radiation dose	Ionizing Radiation
Candidates should use their skills, knowledge and understanding to: - evaluate the possible hazards associated with the use of different types of nuclear radiation	Ionizing Radiation
Candidates should use their skills, knowledge and understanding to: - evaluate measures that can be taken to reduce exposure to nuclear radiations	Ionizing Radiation
Candidates should use their skills, knowledge and understanding to: - evaluate the appropriateness of radioactive sources for particular uses, including as tracers, in terms of the type(s) of radiation emitted and their half-lives	Half-life
Candidates should use their skills, knowledge and understanding to: - explain how results from the Rutherford and Marsden scattering experiments led to the 'plum pudding' model being replaced by the nuclear model.	Atoms and Isotopes

P2.5.1 Atomic structure

a) The basic structure of an atom is a small central nucleus composed of protons and neutrons surrounded by electrons.	Atoms and Isotopes
b) The relative masses and relative electric charges of protons, neutrons and electrons.	Atoms and Isotopes
c) In an atom the number of electrons is equal to the number of protons in the nucleus. The atom has no overall electrical charge.	Atoms and Isotopes
d) Atoms may lose or gain electrons to form charged particles called ions.	Atoms and Isotopes
isotope. The total number of protons in an atom is called its atomic number. The total number of protons and neutrons in an atom is called its mass number.	Atoms and Isotopes

P2.5.2 Atoms and radiation

a) Some substances give out radiation from the nuclei of their atoms all the time, whatever happens to them. These substances are said to be radioactive.	Radioactive Substances
b) The origins of background radiation.	Radioactive Substances
c) Identification of an alpha particle as two neutrons and two protons, the same as a helium nucleus, a beta particle as an electron from the nucleus and gamma radiation as electromagnetic radiation.	Radioactive Decay
d) (HT) Nuclear equations to show single alpha and beta decay.	Radioactive Decay
e) Properties of the alpha, beta and gamma radiations limited to their relative ionising power, their penetration through materials and their range in air.	Ionizing Radiation
f) Alpha and beta radiations are deflected by both electric and magnetic fields but gamma radiation is not. (HT) Explain this in terms of the relative mass and charge of each particle.	Ionizing Radiation
g) The uses of and the dangers associated with each type of nuclear radiation.	Ionizing Radiation
h) The half-life of a radioactive isotope is the average time it takes for the number of nuclei of the isotope in a sample to halve, or the time it takes for the count rate from a sample containing the isotope to fall to half its initial level.	Half-life

P2.6 Nuclear fission and nuclear fusion

Candidates should use their skills, knowledge and understanding to: - compare the uses of nuclear fusion and nuclear fission.	Nuclear Fuels and Fission Nuclear Fusion
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P2.6.1 Nuclear fission

a) There are two fissionable substances in common use in nuclear reactors: uranium-235 and plutonium-239.	Nuclear Fuels and Fission
b) Nuclear fission is the splitting of an atomic nucleus.	Nuclear Fuels and Fission
c) For fission to occur, the uranium-235 or plutonium-239 nucleus must first absorb a neutron.	Nuclear Fuels and Fission
d) The nucleus undergoing fission splits into two smaller nuclei and two or three neutrons and energy is released.	Nuclear Fuels and Fission
e) The neutrons may go on to start a chain reaction.	Nuclear Fuels and Fission

P2.6.2 Nuclear fusion

a) Nuclear fusion is the joining of two atomic nuclei to form a larger one.	Nuclear Fusion
b) Nuclear fusion is the process by which energy is released in stars.	Nuclear Fusion
c) Stars form when enough dust and gas from space is pulled together by gravitational attraction. Smaller masses may also form and be attracted by a larger mass to become planets.	Stars
d) During the 'main sequence' period of its life cycle a star is stable because the forces within it are balanced.	Stars
e) A star goes through a life cycle. This life cycle is determined by the size of the star. (see specification for diagram)	Stars
f) Fusion processes in stars produce all of the naturally occurring elements. These elements may be distributed throughout the Universe by the explosion of a massive star (supernova) at the end of its life.	Stars