GCSE Specification :

CCEA Science: **Double** Award (A and B)

Please check that you have chosen the correct specification.

The subject content is organised into 6 teaching and learning modules.
The content of these is set out below and for each module the major topics to be covered are listed, together with related guidance notes. The notes provide further detail of the content required but they are not intended to be exhaustive descriptions of the topics to which they relate.

The content should be read in conjunction with the relevant aims and assessment objectives set out in Section 1 of the full specification.

Specification content for the Foundation Tier is laid out in normal type.
Questions in Foundation Tier papers will be set only in this content.

Specification content for the ***Higher Tier only*** is laid out in ***bold italics.***
Questions in Higher Tier papers may be set on any content in the specification.

Living Organisms and Life Process	

The cell		**page numbers**
3.1.1	*The Cell*	
	Know that plants and animals are composed of cells:	pages 8-9
	use a microscope and slide to study the structure and function of a typical plant and animal cell including nucleus, cytoplasm, cell membrane, nuclear membrane, cell wall, chloroplast, permanent vacuole and chromosomes;	8-11
	know the similarities: cytoplasm, nucleus and membranes as features common to most cells;	8-9
	know the differences: cell wall and large vacuole as distinguishing features of most plant cells;	9
	understand that cancer is abnormal cell division.	285
	Specialisation	
	Understand that cells become specialised to carry out different functions to include the root hair, palisade mesophyll in plants; sperm cell, ciliated epithelium in animals.	12
Nutrition		
3.1.2	*Plants*	
	Know that photosynthesis is a key process which is essential to life including:	
	that oxygen and starch are produced by photosynthesis;	205-206, 209
	investigations which show that light, carbon dioxide, and chlorophyll are needed for photosynthesis to take place;	207-208
	the word equation for photosynthesis;	205
	factors affecting the rate of photosynthesis.	211-213
	that plants require specific minerals for healthy growth limited to calcium for cell walls, magnesium for chlorophyll formation and nitrogen as nitrates for amino acids and protein formation.	218

3.1.3	Explain how the products of photosynthesis are used by a plant.	page 209
3.1.4	***Describe the economic implications in crop production of enhancing environmental factors, for example, carbon dioxide, light intensity, temperature and fertiliser application.***	219-221
3.1.5	*Animals*	
	Diet	
	know the functions of food – energy, growth and protection;	44
	recall the main dietary sources and roles of carbohydrates, fats, proteins, fibre, vitamins (C and D only) minerals (calcium and iron only) and water in a balanced diet;	45-47, 52-53
	health dangers associated with obesity and lack of exercise;	47-50, 95-96
	use simple tests for each of the following, starch, (iodine), simple sugar, (Benedict's reagent), protein (Biuret test) and vitamin C (DCPIP test);	45-46, 52
	compare energy content of carbohydrates, fats and proteins in different foods;	47-48
	know about variation in energy required, with respect to age, gender, activity.	49-50
3.1.6	Digestive System	
	Know the basic function of the digestive system – where large molecules are broken down to simple soluble molecules which are absorbed into and transported by the blood.	57
	Know the structure and functions of the component parts of the digestive system in humans, including: buccal cavity, oesophagus, stomach, small intestine (ileum), large intestine (colon), rectum and anus.	58-61
	Identification of the parts of the human alimentary canal, in relation to ingestion, digestion and egestion, absorption and assimilation.	58-61
3.1.7	Describe the action of amylase, lipase and protease in saliva, gastric, pancreatic and intestinal juice, (specific names of enzymes not required).	31-32, 58-60
	the source and action of bile;	60
	the significance of a large surface area for absorption; folds and villi;	61
	the absorption of water in the colon;	61
	the role of the liver in the assimilation of glucose.	108
3.1.8	***understand the role of enzymes as biological catalysts in cellular activity involving both breaking down and building up of molecules (illustrated by reference to starch metabolism). The effects of temperature and pH on enzyme action. The principle of substrate specificity.***	29-37
Respiration		
3.1.9	*Plants*	
	Understand that plants respire, including:	
	the exchange of oxygen and carbon dioxide through the stomata of the leaf of a plant during the day and during the night.	71, 215-216
3.1.10	*Animals*	

	Know the function of the respiratory system as one of gas exchange (oxygen for carbon dioxide in the lungs).	page 71-73
	Understand the structure and function of the component parts of the respiratory system, including:	
	identification and function of the major organs of the respiratory system – nasal cavity, trachea, bronchus, bronchioles, lungs, alveolus, diaphragm and ribs and intercostal muscles;	74-77
	mechanism of breathing (the role of the intercostal muscles and diaphragm);	76
	investigation of the composition of inhaled and exhaled air; (gas analysis not required).	71-72
3.1.11	Understand that respiratory surfaces are adapted for their function in both plants and animals, including large surface area, thin, moist and permeable.	77
3.1.12	*Anaerobic*	
	Understand that respiration may be aerobic or anerobic depending on the availability of oxygen.	81-82
	Compare anaerobic respiration with aerobic respiration in terms of energy released and the production of ethanol by yeast (word equations only required).	81-82
3.1.13	*Smoking and Health*	
	Describe how cigarette smoke affects health, including:	
	tar as a trigger for lung cancer;	83-84
	nicotine contributing to heart disease, irregular and increasing heartbeat;	83-84
	carbon monoxide displacement of O_2 in red blood cells;	83
	passive smoking; arguments related to smoking in public places.	84
Transport		
3.1.14	Understand that substances pass into and out of cells in a number of ways, including:	
	diffusion – as the means by which gases move in and out of cells;	20
	osmosis – as a special case of diffusion where water passes through a partially permeable membrane (details of osmotic, water and pressure potential are not required). The role of the cell wall in limiting entry of water into a plant cell;	21-24
	active uptake – understand as a process involving the expenditure of energy and the transport of substances against a concentration gradient as exemplified by the absorption of ions by an epidermal cell of the root of a plant.	26
3.1.15	*Plants*	
	Know how substances are transported in plants, including:	
	water and mineral salts in xylem from root to all parts of plants;	224-225, 230
	food from leaves, in phloem to all parts of plants.	224-225, 230
3.1.16	Understand the role of water in plants, including transport, support and transpiration;	226-229
	know how to use the potometer to measure water uptake;	229

	know the factors affecting the rate of transpiration;	
	temperature, wind speed, humidity and surface area.	228
3.1.17	*Animals*	
	Circulatory System	
	Understand the function of the circulatory system – transport of materials, protection and maintaining body temperature;	88, 110
	Know the structure and functions of the component parts of the circulatory system in humans, including:	
	structure of the blood: red blood cells (transport of oxygen), white blood cells (defence), plasma (transport of food, waste in solution), platelets (blood clotting);	97-110
	the heart, limited to names of the four chambers and the direction of blood flow; double circulation;	90, 92-93
	blood vessels – arteries carrying blood away from the heart and veins carrying blood to the heart;	89-91
	heart attack as reduced coronary circulation.	95-96
	The names of the main blood vessels entering and leaving the heart and the main organs of the body, limited to the lungs, kidney, liver and intestine.	93, 111
3.1.18	*Defence*	
	Understand that disease can be caused by viruses, e.g. AIDS (HIV), bacteria, e.g. Gonorrhoea, Salmonella, fungi, e.g. Athlete's foot;	171-172, 184
	Understand the defence mechanisms of the body including the role of the skin;	178
	Blood-clotting; antibodies and antigens; active and passive immunity;	100, 178-180
	Mucous membranes in the respiratory system;	74, 178
3.1.19	Know the work of Jenner limited to the development of smallpox vaccine;	181
	Know the work of Pasteur, limited to spontaneous generation and the Swan Neck experiment;	171
Excretion		
3.1.20	*Excretory System*	
	Know excretion as the elimination of metabolic waste products and toxic materials taken in from the environment;	111
	Recall the structure of the human urinary system to include: kidney, ureter, bladder, sphincter muscles, urethra, renal artery and vein;	111
	Know that excess amino acids break down to urea in the liver;	111
	Know how these toxic products of metabolism are removed by ultrafiltration from the blood at the kidneys (no detail of nephron required);	112
	Recall that the kidney has a role in maintaining the internal environment (homeostasis) in humans limited to osmoregulation (no detail of nephron or ADH required);	113
	Understand that dialysis is a life supporting mechanism using an artificial method of filtration in cases of kidney failure;	115

	Appreciate the advantages and disadvantage of dialysis and kidney transplants.	page 115
Sensitivity and response		
3.1.21	*Plants*	
	Understand the role of hormones in plants, including:	
	phototropism as a growth movement in the response to light.	243
3.1.22	*Animals*	
	Know that behaviour can be explained in terms of receptors, coordinators and effectors, including:	118
	receptors – the eye; structure and function of the conjunctiva, cornea, pupil, iris, lens, retina and optic nerve;	130-131
	skin, including temperature control; (details of skin structure not required);	109-110, 126
	coordinators – the simple function of the brain and spinal cord in coordinating responses; a reflex arc; voluntary and reflex actions; reflex arc in terms of sensory association and motor neurones;	119, 121, 123-124, 125
	effectors – the antagonistic action and function of muscles at a joint, limited to the elbow joint.	144
3.1.23	Understand the function and role of hormones in coordination in humans, including:	132
	insulin control of blood sugar levels; (diabetes as a condition in which this mechanism breaks down);	108
	adrenaline in preparation for flight or fight.	133
3.1.24	*Drugs*	
	Discuss the effects of alcohol, drug and solvent abuse including antibiotics, painkillers, stimulants, depressants and hallucinogens on individuals and the cost to society.	134, 185-189

3.2: Environment, Reproduction and Genetics

Environment, Reproduction and Genetics		**page numbers**
Habitat study		
3.2.1	Carry out fieldwork, including the use of sampling techniques, e.g. quadrats and pitfall traps, to investigate the physical factors affecting the distribution and type of living organism found in a local habitat, including:	334-335
	changes in seasonal temperature;	329, 334-335
	availability of light;	329, 334-335
	availability of water;	329, 334-335
	extent of cultivation.	330, 334-335
Food chains and webs		
3.2.2	Understand the components of food chains and food webs, including:	
	Sun as the primary source of energy;	335, 362
	producers;	355, 362
	consumers (primary, secondary and tertiary);	355, 363
	decomposers (the role of bacteria and fungi);	355, 370
	nature of energy flow;	362-363
	decomposers (the role of bacteria and fungi).	335, 370
3.2.3	Explain the meaning of the terms pyramid of numbers and pyramid of biomass;	358-359
Cycles		
3.2.4	Understand that materials are recycled to maintain the balance in the environment, including: carbon cycle; photosynthesis, respiration, combustion and fossilisation;	369-371
	Understand the nitrogen cycle – cycling of protein, to include decay and decomposition, nitrification, nitrogen fixation and denitrification (no specific name of bacteria required).	373
Pollution		
3.2.5	Describe ways that human activity can damage the environment and affect the plants and animals living there, including:	
	air - effects of pollution by soot and sulphur dioxide on plants;	347
	land - deforestation - waste management; (land fill versus incineration as a means of disposal); - biodegradable and non biodegradable materials;	346
	water - sewage treated and untreated, eutrophication; - effluent from water cooling processes.	349, 374
Conservation		

3.2.6	Describe ways of improving the environment including:	
	air – smokeless fuels, alternative fuels, catalytic converters;	347
	land – reafforestation;	346
	water – sewage disposal (detail of plant treatment not required).	349, 316-317
3.2.7	Explain how materials for growth and energy are transferred through an ecosystem, including assigning organisms to their trophic level;	355-363
	Energy losses between trophic levels;	360-361
	The advantages of short food chains in relation to the feeding of man.	341, 350, 361
3.2.8	***Understand how food production involves the management of ecosystems to improve the efficiency of energy transfer, including the management of fish stocks, e.g. herring stock in the North Sea.***	341, 350, 361
3.2.9	Understand how population growth and decline are related to environmental resources including the effects of birth rate, death rate, emigration, immigration, food supply, predation and diseases.	332-334, 344-345
3.2.10	*Animals*	
	Reproductive System	
	Know the structure and functions of the component parts of the reproductive systems in humans, including;	157-168
	the male system – testes, scrotum, sperm ducts, prostate gland, urethra and penis;	157
	the female system – ovaries, oviducts, uterus, cervix, vagina and vulva;	158
	fertilisation in the oviduct;	159
	development, by cell division, into a ball of cells which implants in the uterus lining;	160
	the placenta, umbilical cord, amnion and amniotic fluid;	160-161
	birth limited to contraction of the uterus, dilation of the cervix and rupture of the amniotic membrane.	161
3.2.11	Understand the need for a responsible attitude to sexual behaviour, including:	
	interpersonal relationship;	165-166
	prevention of sexually transmitted disease – the cause, transmission, treatment and prevention of AIDS and gonorrhoea;	184
	contraception – natural, mechanical, chemical and surgical methods.	164-165
Genetics		
3.2.12	Recall that genetic information is carried in the form of genes on chromosomes in the nucleus of cells, e.g. eye colour and tongue rolling;	272-273
	Know that genes are short lengths of DNA.	273
	Understand how genetic information is passed from cell to cell and generation to generation, including:	
	mitosis; outline in terms of the exact duplication of chromosomes (names of phases and details of DNA replication not required);	275-276

	meiosis as reduction division (diploid to haploid) and as a process which re-assorts the chromosomes (omitting crossing over and names of the phases);	p. 277
	fertilisation as a means of restoring the diploid number and combining different sets of chromosomes.	277
3.2.14	Understand the principles of a simple monohybrid cross (co-dominance not required). Use of Punnett squares to determine genotype frequencies. Distinction between genotype and phenotype; heterozygous and homozygous; dominant and recessive alleles. ***Use of backcross to determine genotype.***	279-284
3.2.15	Explain the way in which sex is determined in humans. (No detail of sex linked characters required).	278
3.2.16	Know that some diseases can be inherited, limited to cystic fibrosis and Down's syndrome: no details of symptoms required.	285-286
3.2.17	Know that radiation can cause genetic mutation to include the role of UV light and skin cancer.	285
3.2.18	***Understand how DNA controls protein synthesis, (limited to DNA as a double helix linked by base pairs and lengths of DNA which code for specific proteins).***	273-275
	Understand how proteins can be obtained from genetically engineered bacteria, e.g. human insulin.	289
	Discuss two approaches to discovery of DNA structure, e.g. Watson, Crick and R Franklin and Wilkins.	274
Selection		
3.2.19	Know that variation in living organisms has both a genetic and environmental basis, e.g. height in humans.	254-255
3.2.20	Understand that sexual reproduction is a source of genetic variation, while asexual reproduction produces clones.	233-234
3.2.21	***Know that cloning results in genetically identical offspring, for example, cuttings and runners in asexual reproduction in plants, tissue culture and splitting of early embryos in agricultural animals; (no details of experimental technique required).***	233-234, 291
3.2.22	Understand how variation and selection may lead to evolution or extinction;	296-306
	Natural selection as variation with phenotypes and competition for resources leading to differential survival.	298-301
3.2.23	***Understand the use of artificial selection in plant and animal breeding leading to increased yield, food value.***	290

3.3: Using Materials and Understanding Reactions

Chemistry for You

Using Materials and Understanding Reactions		page numbers
Hazard symbols		
3.3.1	Recognise and know the value of common hazard symbols on containers, i.e. flammable, toxic, corrosive, explosive, harmful/irritant (distinction between supply symbols, convenience labels and safety signs not required).	page 379
Man-made materials		
3.3.2	Relate knowledge of the properties of the different classes of man-made materials to everyday use.	Throughout
	Specific examples of man-made materials should include: metals – iron, aluminium, copper, lead and zinc; ceramics – pottery, tiles; glass – soda glass, heat resistant glass; plastics – thermosetting, e.g. melamine, bakelite, epoxy resins, thermo softening, e.g. polythene, PVC, polystyrene; fibres – nylon.	Throughout
	Structures and methods of manufacture are not required unless specifically mentioned elsewhere in the specification.	
Composite materials		
3.3.3	***Evaluate the relative advantages and disadvantages of composite materials, e.g. glass fibre (boats, car bodies), reinforced glass (windows), reinforced concrete (beams), glass-reinforced plastic and bone.***	
3.3.4	***Describe a composite material as one which combines the properties of more than one material to produce a more useful material for particular purposes.***	
Gases		
3.3.5	Recognise that gases have weight and that they spread out to fill the space available, e.g. diffusion of bromine.	6-9
3.3.6	Give examples which show that gases are compressible and how this characteristic is used in everyday life, e.g. fire extinguishers, aerosol sprays.	319, 65
Solubility		
3.3.7	Understand the terms: solvent, solute, solution, saturated, hydrated and dehydration.	20, 149, TSP
3.3.8	Recognise the factors affecting solution, i.e. heat, surface area, stirring, volume of solvent.	149
3.3.9	Understand the qualitative effect of temperature on the solubility of solids and gases in water.	149, 314
3.3.10	***Carry out simple quantitative determination of solubility of solids in water leading to an understanding of solubility curves.***	149

Particles and Bonds		
Kinetic theory		page numbers
3.3.11	Explain changes of state, including sublimation and energy changes associated with them, diffusion and dissolving, in terms of simple kinetic theory.	6-12, 267
3.3.12	Recognise that the volume of a gas depends upon pressure and temperature. (Qualitative treatment only).	
3.3.13	***Use the relationship between the volume of gas and its pressure and temperature to solve simple problems, i.e. PV/T = constant (conversion to STP not required). Quantitative practical details not required.***	
Atomic structure		
3.3.14	Understand the terms: elements, compounds, atoms, ions and molecules and their interrelation.	14-15, 71
3.3.15	Describe the structure of atoms and ions in terms of protons, electrons and neutrons limited to elements 1-20 in the Periodic Table.	70
3.3.16	State the relative charge and relative mass of a proton, an electron and a neutron.	29
3.3.17	Understand the terms atomic number and mass number.	31
3.3.18	Explain the existence of isotopes and distinguish between isotopes, e.g. ^{35}Cl and ^{37}Cl.	33
Elements, compounds and mixtures		
3.3.19	Classify substances as elements (metallic or non-metallic), compounds or and mixtures and distinguish between them according to their properties.	16-18, 44-5
Ionic bonding		
3.3.20	Describe the formation of an ionic bond in terms of electron transfer and recognise that bond formation is the result of attraction between ions of opposite charge and is typical of metal compounds. Examples should include MgO, NaCl and $CaCl_2$.	262-5
Covalent bonding		
3.3.21	Describe the formation of a covalent bond in terms of sharing electron pairs. ***Examples should include Cl_2, O_2, H_2O and CH_4.***	270-1
3.3.22	***Recognise covalent bonding as typical of non-metal elements and compounds.***	270
Bonding in metals		
3.3.23	***Describe in simple terms, the bonding in metals.***	280
Bonding and structure		
3.3.24	***Classify substances in terms of their properties as metallic; ionic; covalent molecular or giant covalent (including graphite, diamond and quartz).***	266-7, 272-7, 281, 286
3.3.25	***Explain the properties and uses of typical ionic, covalent (simple and giant) and metallic substances in terms of their chemical bonding and structures.***	266-7, 272-7, 281, 286
3.3.26	***Relate the properties of thermosoftening plastics, thermosetting plastics and fibres to simple models of their structures.***	170

Understanding Chemical Reactions		
Chemical nomenclature		page numbers
3.3.27	Recognise and use symbols for common elements.	14, 43
3.3.28	Use chemical names for simple compounds.	Throughout
3.3.29	Construct simple word equations to describe the range of reactions covered in this specification.	17, throughout
3.3.30	Give symbolic representations for some elements and deduce the formulae of simple compounds, limited to elements both of whose valencies in the compound can be established from their positions in the Periodic Table and those groups (hydroxide, sulphate, nitrate, carbonate, hydrogen carbonate, ammonium) whose symbols and valencies are given in a Data Leaflet provided for candidates.	265, 391
3.3.31	Use state symbols (s, l, g and aq).	26
3.3.32	Represent chemical reactions by balanced symbolic equations.	24-5, throughout
3.3.33	***Write ionic equations, e.g. to describe electrolysis processes.***	105, 151
Rusting		
3.3.34	***Understand rusting as the reaction of iron with a combination of water and air to produce hydrated iron(III) oxide. Sacrificial protection related to the reactivity series.***	92-3, 95
Redox		
3.3.35	Relate important oxidation and reduction reactions to everyday examples ***and manufacturing processes***, limited to rusting, combustion of fuels, ***aluminium and iron manufacture, Haber Process. (Iron manufacture, Haber Process in terminal papers only).***	92, 187, 107, 91, 241, 243
Hard water		
3.3.36	Identify a sample of water as being hard or soft.	302
3.3.38	Describe the effects of hard water on soap and detergents.	302, 307
3.3.39	Recognise characteristics of a hard water region including advantages associated with hard water.	303
3.3.40	Give examples of advantages and disadvantages associated with hard water.	302
3.3.41	Explain the differences between temporary and permanent hardness.	304
3.3.42	Recognise methods of water softening, i.e. by boiling, addition of washing soda and by ion exchange.	304-5
3.3.43	***Explain in terms of ions the causes and effects of water hardness.***	303
3.3.44	***Outline methods of softening water.***	304-5
3.3.45	***Explain precipitation in terms of ions and relate this to processes of separation and purification, e.g. use of washing soda to soften water.***	305

Acids and bases		page numbers
3.3.46	Recognise that acids dissolve in water, producing hydrogen ions (H^+), that alkalis dissolve in water producing hydroxide ions (OH^-) and that neutralisation is the combination of these ions to form water. ***This can be represented by the ionic equation:*** ***$H^+ (aq) + OH^- (aq) \rightarrow H_2O (l)$***	page 148
3.3.47	Recognise that a base is a metal oxide or hydroxide and that an alkali is a soluble base.	47
3.3.48	Recognise that metal oxides are basic and than non-metal oxides are acidic, but understand that there are limitations to different systems of classification, for example, oxide classification in terms of acid/base behaviour.	46-8
3.3.49	Give examples of reactions of acids with: metals, bases (including sodium hydroxide and copper(II) oxide) and metal carbonates to form salts. Examples limited to those reactions mentioned elsewhere in the syllabus.	144-6
Electrolysis		
3.3.50	Give a simple explanation of electrolysis and examples of its use, i.e. recognise that some substances can be broken down into simpler substances by an electric current. This is called electrolysis and can happen when the substance is molten or dissolved in water.	Chapter 9, 100-1
3.3.51	Understand the terms anode, cathode and electrolyte.	100, 103
3.3.52	***Predict the products of simple electrolytic reactions. Examples should include the molten halide salts LiCl and $PbBr_2$, and solutions limited to sulphuric acid (dilute) and sodium chloride (concentrated). (inert electrodes in all above).***	106, 110
3.3.53	Describe and explain the processes involved in the purification of copper by electrolysis of copper sulphate solution using copper electrodes and the extraction of aluminium from pure aluminium oxide. (Details of processes required but no details of plant).	113, 107
3.3.54	***Recognise that, in electrolysis, conduction occurs through the movement of ions, that positive ions are discharged at the cathode and that negative ions are discharged at the anode. The idea of preferential discharge is limited to the electrolysis of sulphuric acid (dilute) and sodium chloride (concentrated).***	101-2, 111
3.3.55	***Describe electrolysis in terms of ionic reactions. Any stoichiometrically correct equations for cathode and anode reactions will be accepted. Examples should be drawn from electrolytic processes specifically covered in the syllabus.***	105-7, 110

3.4: Patterns, Problems, Processes

Patterns, Problems, Processes	

Energetics		page numbers
3.4.1	Demonstrate a knowledge that materials can be decomposed by heat including the effect of heat on hydrated copper(II) sulphate, thermal decomposition of metal carbonates, decomposition of limestone and ***thermal cracking of hydrocarbons (details of plant not required).***	129, 134, 232, 165
3.4.2	Give and recognise examples of simple exothermic and endothermic reactions, e.g. combustion, photosynthesis, dissolving, displacement, hydration of $CuSO_4$, neutralisation.	190-1
3.4.3	***Recognise that the energy transferred in a chemical reaction is associated with breaking and making of chemical bonds. (Qualitative treatment only).***	194
Reactivity series		
3.4.4	Make predictions from the reactivity series of metals, i.e. K, Na, Ca, Mg, Al, Zn, Fe, Cu based on reactions with oxygen, water/steam, and dilute acids (hydrochloric and sulphuric) as appropriate, displacement reactions.	80-6
3.4.5	Predict where an unfamiliar element should be placed in the series based on comparative information.	86
Reaction rates		
3.4.6	Describe the qualitative effects of temperature, concentration, particle size, catalysis and, as appropriate, light on the rate of chemical reactions.	199-210
3.4.7	***Identify the significant factors which control the rates of reaction and, where appropriate, their quantitative effects. Quantitative effects limited to the interpretation of data, e.g. drawing graphs and making predictions about how the rate may change when the factors listed are altered. Give a simple explanation of how the factors identified above influence the rate in terms of collisions and the energies of the reacting particles.***	199-210
3.4.8	***Relate the factors which control rates of chemical reactions to practical problems associated with manufacturing processes in industry.***	240-1, 155, 245
Periodic Table		
3.4.9	Demonstrate a knowledge that the Periodic Table groups together elements with similar properties, e.g. the Alkali metals as a group of reactive metals, the Halogens as a group of reactive non-metals, the Noble gases as a group of unreactive non-metals.	43
3.4.10	Outline the work of Mendeleeve in the development of the Periodic Table.	42-3
3.4.11	Relate the position of selected elements in the Periodic Table and their properties to their electronic structure (limited to the first 20 elements).	70-1
3.4.12	Describe simple trends in the properties of elements within Groups (I, II, VII) and across Periods (2 and 3) of the Periodic Table.	50-1, 54-5, 62-3

3.4.13	***Use the Periodic Table to predict the properties of certain unfamiliar elements, limited to Groups I, II, VII and properties to relative atomic mass, atomic size, metallic and non-metallic characteristics, valency and chemical reactivity with oxygen, water and dilute acids, as appropriate.***	
Chemical calculations		
3.4.14	Understand the term relative atomic mass and use this to determine relative formula masses (relative molecular masses).	34-5
3.4.15	***Understand that one mole of different substances contains equal numbers of specified particles.***	352
3.4.16	***Use relative formula mass to determine the number of moles present in a given mass of material.***	353
3.4.17	***Carry out calculations involving reaction masses from given balanced equations. Calculations relating to moles will be limited to use of the relationship: mass(m) = number of moles(n) x relative molecular (atomic) mass (RMM or RAM).***	362-3
3.4.18	***Understand the term concentration of a solution expressed in moles per litre (mol/dm^3). Questions on titrations will not be asked. Calculations on molarity will not be asked but concentrations of chemicals in solution may be given in moles per litre if this is appropriate, e.g. in work relating to rates of reaction.***	356-7
Metals, Non-Metals and their Compounds		
Metals		
Physical properties of metals		
3.4.19	Describe the important physical properties of a range of metals: sodium, calcium, magnesium, iron and copper. Physical properties of metals to include electrical and thermal conductivity, malleability, ductility, lustre, strength, melting point (qualitative treatment).	45
Chemical properties of metals		
3.4.20	Describe the important chemical properties of a range of metals: sodium, calcium, magnesium, iron and copper. Limited to their reactions with oxygen, water/steam, dilute hydrochloric and sulphuric acids as appropriate.	80-1, 86, 51, 54-5, 56-7
Physical properties of metal compounds		
3.4.21	Describe the typical properties of ionic solids, i.e. hard, brittle, high melting, crystalline solids which conduct electricity when molten or in solution, to include solubilities of chlorides, nitrates, sulphates, carbonates, hydroxides and oxides as provided in the data leaflet supplied to candidates.	266-7
Chemical properties of metal compounds		
3.4.22	Recognise oxides and hydroxides as bases (NaOH, CaO, $Ca(OH)_2$, CuO and describe their reactions with water and with dilute hydrochloric and sulphuric acids as appropriate.	144-6
3.4.23	Describe the reactions of carbonates ($CaCO_3$, Na_2, CO_3) with acid and the thermal composition of carbonates ($CaCO_3$, $CuCO_3$).	147, 128-9

Uses of metals		page numbers
3.4.24	Recall important uses of metals including:	
	magnesium: high strength alloys for aircraft, flares;	58
	aluminium: electrical wiring, saucepans, alloys;	107
	zinc: galvanising, brass;	93, 285
	iron: steel manufacture, steel structures, ornamental gates, cookers, nails;	94, 59
	copper: electrical wiring, plumbing, brass, coinage;	56, 59, 284-5
	lead: roofing, batteries, solder, anti-knock.	285
Non-Metals		
Gases		
3.4.25	Describe tests to identify the gases hydrogen, oxygen and carbon dioxide and recognise the diatomicity of hydrogen, oxygen, nitrogen and chlorine gases.	125, 271, 208, 315-6, 62, 318
Hydrogen		
3.4.26	Describe the physical properties and reactions of hydrogen with oxygen forming water, as a reducing agent, e.g. with copper(II) oxide ***and with nitrogen forming ammonia.***	125, 96, 368, 241, 243
Carbon		
3.4.27	Describe the combustion of carbon to CO and CO_2 and recognise in simple terms the toxic effects of incomplete combustion of fuels.	187
Nitrogen		
3.4.28	Describe the physical properties and lack of reactivity of nitrogen ***and its reaction with hydrogen in the manufacture of ammonia (Haber-Bosch Process), i.e. name of catalyst, approximate temperature and pressure. Equilibrium aspects will not be examined.***	315, 240-1, 243
Oxygen		
3.4.29	Describe the physical properties of oxygen and recognise its importance in combustion and respiration.	316-7, 186-7
Sulphur		
3.4.30	Describe the physical properties of sulphur, its combustion to form SO_2 and the reaction of sulphur with iron. Causes and effects of SO_2 pollution (acid rain) and its control.	277, 17, 188
Noble gases		
3.4.31	Recognise that helium, neon and argon are chemically inert gases.	66
Chlorine		
3.4.32	Describe the physical properties and poisonous nature of chlorine. Describe displacement reactions of chlorine with bromides and iodides (and recognise aqueous bromine and iodine solutions by their colour).	62-3

Water		page numbers
3.4.33	Describe the physical properties of water, its use as a common solvent, the use of anhydrous copper(II) sulphate to test for the presence of water and understand the term "water of crystallisation" and its removal by action of heat.	267, 232, TSP
3.4.34	Recognise the pollution of water by detergents (phosphates) and fertilisers (nitrates and phosphates). Describe the role of filtration and chlorination in water treatment.	250, 308, 300-1
Carbon dioxide		
3.4.35	Describe the physical properties of carbon dioxide, the causes and effects of carbon dioxide pollution (green house effect), its reactions with water ***and sodium hydroxide.***	318, 189, 303
Uses of non-metals		
3.4.36	Recall important uses of non-metals and their compounds to include:	
	hydrogen: meteorological balloons, rocket engines, potential as a clean fuel;	125
	carbon: as a fuel, electrodes in aluminium manufacture;	107
	nitrogen: coolant, food packaging;	315
	oxygen: hospitals – breathing, welding, steel making;	317
	sulphur: vulcanising of rubber, fungicide; chlorine: PVC manufacture, water, sterilisation;	64
	carbon dioxide: fire extinguishers, carbonated drinks, dry ice;	319
	ammonia: fertilisers, nitric acid manufacture, nylon;	243, 245
	sulphuric acid: car batteries, manufacture of detergents, fibres; pigments.	154
Organic Chemistry		
Sources of organic chemicals		
3.4.37	Recall that fossil fuels and biological substances are carbon-based compounds. Recall that oil is the major source of organic chemicals and that chemicals obtained from oil are hydrocarbons.	159, 178
3.4.38	Give examples of fossil fuels: natural gas, LPG, petrol, diesel, paraffin, candle wax, peat, lignite, coal, coke. Recognise that fossil fuels are non-renewable resources and describe the combustion of fossil fuels as: fossil fuel + oxygen → carbon dioxide + water + heat energy.	160, 187, 164
3.4.39	Explain how chemicals are obtained from oil by fractional distillation.	162-4
3.4.40	***Recall the conditions used to crack fractions obtained from crude oil and understand that cracking involves breaking large hydrocarbon chains into smaller ones, some of which have C=C bonds.***	165
Homologous series		
3.4.41	***Recognise an homologous series as one in which the chemicals have: the same general formula, similar chemical properties and a gradation their physical properties.***	178

Alkanes		page numbers
3.4.42	Recall the names, molecular and structural formulae, and physical state of first four alkanes. Describe the complete combustion of alkanes and recognise their use as fuels.	159-60, 187
Alkenes		
3.4.43	**Recall the names, molecular and structural formulae, and physical state of first two alkenes. Describe the complete combustion of alkenes and the manufacture of ethanol from ethene and steam.**	167, 180
3.4.44	**Describe the use of bromine water to distinguish alkanes/alkenes (equations not required). Understand that alkanes are saturated and that alkenes are unsaturated.**	167
3.4.45	**Recognise examples of the use of alkenes in the manufacture of commercially important addition polymers, (specific conditions not required) and to the social, cultural, economic, environmental, health and safety factors involved, limited to polythene, PVC, polypropene. Give uses of these polymers. Represent addition polymerisation as:** $n(C=C) \rightarrow -(C-C)_n-$	166, 168-73
Ethanol		
3.4.46	***Recall the molecular and structural formula and physical state of ethanol. Describe the complete combustion of ethanol and its formation by fermentation (equation not required). Give uses for ethanol as a fuel, in alcoholic beverages and as a solvent.***	178-81
Ethanoic acid		
3.4.47	***Recall the molecular and structural formula of ethanoic acid. Give examples of reaction of ethanoic acid as a typical dilute acid, i.e. with metals, bases and carbonates. Reaction with ethanol to form an ester. (Test-tube scale). Formula and structure of ethyl ethanoate.***	183
Science at Work		
Human influences		
3.4.48	Identify the positive and negative effects of the exploitation of raw materials, including the harmful effects on the physical and living environments. Limited to limestone quarrying, peat cutting, lignite mining and solution mining of salt.	127, 121, 107
3.4.49	Explain how the impact of human activity on the Earth is related to economic factors and industrial requirements and recognise pollution control as a national and international responsibility.	172, 297, 188-9
Industrial processes		
3.4.50	***Use scientific knowledge and information to evaluate the social, economic and environmental facts associated with the manufacturing processes involved in cracking oil, the chlor-alkali industry, the production of plastics and fertilisers and the manufacture of aluminium and iron. Specific chemistry limited to that given elsewhere in the syllabus.***	165, 121, 172-3, 249, 107, 91

Manufacture of iron		page numbers
3.4.51	***Describe the production of iron in the blast furnace. Outline the essential chemistry and conditions of the process and demonstrate an understanding of the energy factors involved. Details of plant not required.***	91

Radioactivity		in **Physics for You**
3.4.52	Describe the properties of different types of ionising radiation and relate these to their uses. Alpha decay illustrated by uranium-238 and beta decay illustrated by carbon-14. Properties of alpha and beta particles and gamma rays to include their charge, mass and relative penetrating power in air.	pages 350-1, 356-7
3.4.53	***Describe radioactivity and nuclear fission in terms of the atomic model, e.g. recognise the products formed on alpha or beta decay of given radioactive isotopes and write simple nuclear equations to illustrate alpha and beta decay.***	p. 352-3, 355, 358
3.4.54	***Demonstrate an understanding of half-life including simple calculations.***	p. 354, 362 worksheet

3.5: Forces and Energy

page numbers in **Physics for You**

Forces and Energy	

Forces of energy		**page numbers**
3.5.1	Describe energy transfers involving the following forms of energy; chemical, heat, electrical, sound, light, magnetic, nuclear, kinetic and potential (gravitational and strain).	pages 8-9, 108-112, worksheet
Energy resources		
3.5.2	Recall that there is a variety of energy resources, to include: oil, gas, coal, nuclear, biomass, wind, wave, solar, geothermal, tidal and hydroelectric, and distinguish between renewable and non-renewable resources.	p. 11-13, 111-113, worksheet
3.5.3	Explain how energy sources, such as wind and fossil fuels, are ultimately dependent on the sun's energy.	p. 111
3.5.4	Describe the environmental implications of the use of energy resources, limited to generation of electricity by fossil fuels, nuclear fuel, wind farms, waves and tides. Appreciate the effect on the environment of the use of these energy resources limited to the contribution of burning fossil fuels to the greenhouse effect, nuclear waste, effect on the use of land and sea.	p. 113-5, worksheet
3.5.5	***Evaluate the advantages and disadvantages of using various energy resources to generate electricity. This should take into consideration: reliability, how quickly the different types of power station can respond to changes in demand, the costs of building, operating and decommissioning power stations and any additional information, including quantitative information with which they are provided.***	p. 114-5, worksheet
Work and power		
3.5.6	Recall and use the relationship; work = force x distance moved in the same direction as the force, and that work is measured in joules.	p. 107 worksheet
3.5.7	Recall and use the formula; power = work done/time taken.	p. 118-9, worksheet
Conservation of energy		
3.5.8	Understand that energy is conserved and describe energy changes in terms of the principle of conservation of energy.	p. 108-9, 112
3.5.9	Understand that energy may be dissipated and become less useful and appreciate the role that friction plays in this.	p. 112-3, 92-3
3.5.10	***Recall and use the quantitative relationships for kinetic energy (½ mv^2), gravitational potential energy (mgh) and power, in the context of the conservation of energy.***	p. 116-9, worksheets
3.5.11	Recall that efficiency is a measure of how much energy is transferred in an intended way and calculate as the ratio of useful output energy to input energy.	p. 112-3, 122, worksheet

Heat transfer		
3.5.12	Describe the thermal conduction in good conductors and in insulators in terms of the movement of electrons and vibrational movement of atoms/molecules.	p. 43
3.5.13	Describe convection in liquids and gases in terms of the movement of the molecules of the liquid or gas.	p. 46-7
3.5.14	Describe the effect that the nature of a surface has on the emission and absorption of radiant heat, including some applications.	p. 48-53
3.5.15	Describe methods of reducing heat loss from the home.	p. 44-5
Effects of a force		
3.5.16	Understand Newton's first law, i.e. that change in movement or direction results from unbalanced forces and that balanced forces produce no change.	p. 77-8
3.5.17	Appreciate that friction is a force that opposes motion.	p. 92-3, 98-9
Mass and weight		
3.5.18	Distinguish between mass and weight, in that, mass is an unchanging property of an object whereas weight is a force that depends on how strong gravity is.	p. 75, 76, 139
3.5.19	Recall that, on the Earth, gravity exerts a force of 10N on every kilogram of mass and be able to carry out simple calculations involving mass and weight.	p. 75, 139
Hooke's Law		
3.5.20	Investigate experimentally the relationship between force and the extension of a helical spring.	p. 74, worksheet
3.5.21	State and use Hooke's Law and use it to solve simple problems.	p. 74
3.5.22	Understand the meaning of elastic limit.	p. 74
Moments		
3.5.23	Calculate the moment of a force as force times perpendicular distance from the pivot.	p. 100
3.5.24	Describe some practical applications of levers.	p. 100, 123
3.5.25	***State the principle of moments and use it to solve simple problems. Calculations limited to two forces other than acting at the pivot. Perpendicular distances only will be given.***	p. 101, worksheet
Centre of mass		
3.5.26	Understand the term centre of mass and how the stability of an object depends on the position of the centre of mass and the width of its base.	p. 102-5
Pressure		
3.5.27	Recall and use the quantitative relationships between pressure, force and area; recall that pressure is measured in Pascals. (Problems may be set in which N/cm^2 and N/mm^2 are used. There will be no interchange of units).	p. 85, worksheet

Displacement		
3.5.28	Recall and use the quantitative relationships between average speed, distance and time, including the calculation of average speed from linear distance-time graphs.	p. 130, 134, worksheet
3.5.29	Distinguish between distance and displacement, speed and velocity.	p. 134, 130
3.5.30	Recall and use the quantitative relationships between: ***(i) displacement, time and average velocity;*** ***(ii) initial velocity, final velocity, acceleration and time. (Problems will only be set on motion in one direction. Equations of motion will not be examined).***	p. 130-4
3.5.31	Use graphical methods to determine velocity, acceleration and displacement; recall that the slope of a displacement-time graph is the velocity and that the slope of a velocity-time graph is the acceleration and that the area under the graph is the displacement.	p. 132-4
Newton's 2nd Law		
3.5.32	***Recall and use the quantitative relationships between force, mass and acceleration in the form F = ma, where F is the resultant force.***	p. 138-9
3.5.33	***Appreciate that, in the absence of all other forces, objects near the surface of the earth fall with the same acceleration and recall that this acceleration is known as the acceleration of free fall.***	p. 136-7, 99
3.5.34	***Recognise and use the equation : weight = mass x acceleration of free fall. Experimental determination of acceleration of free fall is not required.***	p. 75, 139
Momentum		
3.5.35	Recall that momentum is the product of mass and velocity. Conservation of momentum is **not** required.	p. 144
Circular motion		
3.5.36	Describe some examples of circular motion.	p. 78, 158-160, 162, 168, 352
3.5.37	Recall that an object moving in a circle requires a force and that this force acts towards the centre of the circle.	p. 78
3.5.38	Recall that if this force is removed the object will fly off at a tangent to the circle.	p. 78

3.6: Waves, Light and Sound, Electricity and Magnetism, Earth in Space

page numbers in **Physics for You**

Waves, Light and Sound, Electricity and Magnetism, Earth In Space	

Waves		page numbers
3.6.1	Understand that waves transfer energy from one point to another.	p. 174
3.6.2	Distinguish between transverse and longitudinal waves in terms of the motion of the particles of the medium.	p. 174
3.6.3	Recall examples of transverse and longitudinal waves.	p. 174 (p. 154)
3.6.4	Describe, using simple wavefront diagrams, how waves are reflected and refracted, restricted to plane wavefronts, plane barriers and plane boundaries. (Geometrical constructions **not** required).	p. 175-7, worksheets
3.6.5	Recall the meaning of frequency, wavelength and amplitude of a wave.	p. 175
3.6.6	Recall and use the quantitative relationship between frequency, wavelength and speed of a wave.	p. 175
Sound		
3.6.7	Describe experiments to demonstrate that sound can travel through different materials at different speeds but cannot travel through a vacuum.	p. 231. 229
3.6.8	Relate pitch and loudness of sound to its waveform displayed on a CRO.	p. 234
3.6.9	Recall that the range of human hearing is 20 Hz to 20 kHz and that the upper limit decreases with age.	p. 232
3.6.10	Recall that frequencies greater than 20 kHz are called ultrasound.	p. 232, 230
3.6.11	Describe damaging effects of loud sounds on the ear and understand the need to control noise levels in the environment.	p. 238
3.6.12	Recall that sound is reflected so that the angle of incidence = the angle of reflection.	p. 176, 230
3.6.13	Describe some application of echoes and carry out simple calculations on the echo principle.	p. 230, 240, worksheet
3.6.14	Describe some applications of ultrasound in industry and medicine.	p. 240-1
Light		
3.6.15	Recall that luminous objects are seen by the light they emit and that all other objects are seen by the light they reflect.	p. 179
3.6.16	Explain with the help of ray diagrams the formation of shadows by point and extended sources of light.	p. 180-1
3.6.17	Understand that light is reflected from plane surfaces so that the angle of incidence = the angle of reflection and apply in practical situations.	p. 184-7, (190), worksheet
3.6.18	Understand that a change of speed causes light to be refracted at air/glass, glass/air, air/water, and water/air boundaries.	p. 192-3, 176

3.6.19	Recall that when light slows it is bent towards the normal, and the converse. A knowledge of Snell's law or total internal reflection is **not** expected.	p. 193, 176
3.6.20	***Use a wave model to explain refraction of light at a plane surface using simple plane wavefront diagrams. (See also 3.6.4.)***	p. 176
3.6.21	Describe how light is dispersed by prisms and understand that a spectrum can be produced because different colours of light are refracted by different amounts.	p. 216-7
The electromagnetic spectrum		
3.6.22	Recall that the electromagnetic spectrum includes radio waves, microwaves, infrared, visible light ultraviolet waves, X-rays and gamma-rays and be able to arrange them in order of wavelength.	p. 218-221, worksheet
3.6.23	Describe some uses and dangers of microwaves, infrared and ultraviolet waves in domestic situations.	p. 218-221, 227, worksheet
3.6.24	Describe some uses of X-rays and gamma-rays in medicine. (Excluding detection of various regions of the spectrum).	p. 218, 220, 318, 356

Electricity and Magnetism		page numbers in **Physics for You**
Static charge		
3.6.26	Recall that insulating materials can be charged by friction and explain this in terms of transfer of charge.	p. 247-8
3.6.27	Understand that positively charged objects have a deficiency of electrons and negatively charged objects have a surplus of electrons.	p. 248
3.6.28	Describe the dangers and use of electrostatic charge generated in everyday contexts.	p. 252, 251, 321
Charge flow		
3.6.29	Understand that an electric current is a flow of electrons and that it is in the opposite direction to that of a conventional current.	p. 242-5
3.6.30	***Recall that charge is measured in coulombs.***	p. 251, 266
3.6.31	***Recall and use the quantitative relationship between current, charge and time.***	p. 266
Electric circuits		
3.6.32	Understand the role of conductors, insulators and switches in simple series and parallel circuits.	p. 254-7
3.6.33	Describe the effects of varying the current on bulb brightness, motor speed and heater output.	p. 260-1
3.6.34	Describe and record diagrammatically simple electric circuits.	p. 254-261
3.6.35	Measure current and voltage in series and parallel circuits.	p. 256, 258
3.6.36	Recall that in a series circuit the current is the same everywhere.	p. 256
3.6.37	Recall that in a series circuit the sum of the voltages is equal to the voltage across the whole circuit.	p. 262

3.6.38	Recall that in a parallel circuit the sum of the currents in the branches is equal to the current entering the parallel section.	p. 257
3.6.39	Recall that voltages across components in parallel are equal.	p. 263
3.6.40	Calculate the total resistance of resistors in series.	p. 262, 267
3.6.41	Calculate the resistance of two equal resistors in parallel.	p. 263, 267
3.6.42	***Calculate simple combinations of resistors (no more than three resistors which may include two equal resistors in parallel).***	p. 262-3, 267, worksheet
Ohm's Law		
3.6.43	Plot and interpret voltage – current graphs for metallic conductors at constant temperature.	p. 265, worksheet
3.6.44	State and use Ohm's Law in the form V/I = R, where R is the resistance.	p. 259
3.6.45	Plot and interpret voltage-current graphs for a filament bulb.	p. 265
3.6.46	Recall how the resistance of a thermistor (n.t.c.) varies with temperature.	p. 265
3.6.47	***Understand that voltage is the energy transferred per unit charge.***	p. 267
3.6.48	***Recall and use the quantitative relationships between power, energy, current, voltage and time.***	p. 267, 272-3
Using electricity		
3.6.49	Understand one-way and two-way switching.	p. 254, 271
3.6.50	Describe how to wire a fused three-pin plug.	p. 275
3.6.51	Understand the functions of live and neutral wires and how the earth wire and fuse protect the user from electric shock.	p. 274-5, worksheet
3.6.52	Describe how double insulation protects the user.	p. 275
3.6.53	Describe how circuit breakers protect the user.	p. 270, 301, 312, 345
3.6.54	Understand the positioning of switches and fuses on the live side of appliances.	p. 271, 275
3.6.55	Calculate the costs of using electricity from meter readings.	p. 273
3.6.56	Understand the meaning of the kilowatt-hour and calculate the cost of using electrical appliances using their power rating.	p. 273
Electromagnetic induction		
3.6.57	***Understand that current may be induced in a conductor by its motion relative to a magnet, and by changing the current in a neighbouring conductor.***	p. 302-3, 307-8
3.6.58	Know the difference between a.c. and d.c.	p. 254, 274, 304-5
Generation and transmission of electricity		
3.6.59	Recall that a.c. generators are used in the generation of electricity. (Details of construction **not** required).	p. 113, 306
3.6.60	***Describe how step-up and step-down transformers are used in the transmission of electricity, including the relationship between the number of turns and voltage across the coils.***	p. 308-9, worksheet
3.6.61	***Understand that stepping up the voltage reduces energy losses in the grid.***	p. 309

Earth in Space		page numbers in **Physics for You**
Seasons		
3.6.62	Explain changes in day length, seasonal changes and changes in the elevation of the sun in terms of the tilt of the Earth's axis and its movement around the Sun.	p. 158
Solar system		
3.6.63	Recall the position of the Sun and planets within the solar system and how they move relative to each other. Recall, evaluate and discuss the historical evidence for the heliocentric solar system as opposed to the geocentric.	p. 160, 369, 372, worksheet
Gravitation		
3.6.64	***Understand that gravitational force acts towards the centre of every astronomical object and that this force determines the motion of the planets and comets round the Sun and satellites round the planets.***	p. 162-3, 168
3.6.65	***Understand that gravitational forces act between all masses and know that the magnitude diminishes with distance and increases with mass.***	p. 162
3.6.66	***Describe the nebular (gas cloud) model for the formation of the solar system.***	p. 163
Galaxy Universe		
3.6.67	Recall that the Universe is made up of innumerable galaxies. A galaxy is a vast number of star systems held by gravitational forces. The Milky Way is the galaxy which contains our solar systems.	p. 165-6
Big Bang and steady state		
3.6.68	Describe the Big Bang and steady state model for the formation of the universe.	p. 166, 369
3.6.69	Consider the possibilities and limitations of space exploration in terms of distances and speed of travel. Recall, evaluate and discuss evidence for life and planets outside our solar system.	p. 167
Stars		
3.6.70	Describe how stars are formed (the life cycle of stars is not required).	p. 163 (165)
3.6.71	Recall that stars are powered by nuclear fusion processes.	p. 164

end of subject content