ISB Grade 9 Programme of Study

for English, Mathematics, Physics, Chemistry and Biology

Version 1.0

The objectives detailed in this document have been compiled from IGSCE courses for English, Mathematics, Physics, Biology and Chemistry available at www.cie.org.uk
For a detailed list of key sage objectives for K through 9 out of which ISB teachers construct year plans, please consult the ISB Curriculum Framework for non-core subjects available at www.isob.cz.
For a list of objectives for English, Mathematics and Science for grades 1 through 8, please consult the Cambridge Framework documents available at www.cie.ork.uk

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English

Reading

Core

Students should be able to:

- Demonstrate understanding of words within extended texts
- Scan for and extract specific information
- Identify main and subordinate topics, summarise, paraphrase, re-express
- Show some sense of how writers achieve their effects
- Recognise and respond to simple linguistic devices including figurative language

Extended

Students should be able to:

- Show a more precise understanding of extended texts
- Recognise the relationship of ideas
- Draw inferences, evaluate effectiveness, compare, analyse, synthesise
- Show understanding of how writers achieve their effects
- Recognise and respond to more sophisticated linguistic devices

Writing

Core

Students should be able to:

- Express thoughts, feelings and opinions in order to interest, inform or convince the reader
- Show some sense of audience
- Demonstrate adequate control of vocabulary, syntax and grammar
- Exercise care over punctuation and spelling
- Write accurate simple sentences
- Attempt a variety of sentence structures
- Recognise the need for paragraphing
- Use appropriate vocabulary

Extended

Students should be able to:

- Show a wider and more varied sense of different styles to interest, inform or convince the reader
- Show a clear sense of audience
- Demonstrate a sophisticated use of vocabulary and structures
- Demonstrate accuracy in punctuation and spelling
- Write accurate complex sentences
- Employ varied sentence structures
- Write in well-constructed paragraphs
- Use imaginative and varied vocabulary

Speaking and Listening

Core

Students should be able to:

- Understand and convey both simple and detailed information
- Present facts, ideas and opinions in an orderly sequence
- Make relevant comments on what is heard, seen or read
- Describe experience in simple terms and express intelligibly what is thought and imagined
- Recognise and give statements of opinion and attitude
- Speak audibly and intelligibly with appropriate tone, intonation and pace

Extended

Students should be able to:

- Understand and convey more complex information in an interesting and authoritative way
- Consciously order and present facts, ideas and opinions for a particular audience
- Evaluate and reflect on what is heard, seen or read
- Describe and reflect on experience, and express effectively what is thought and imagined
- Discuss statements of opinion and attitude, discerning underlying assumptions and points of view

Mathematics

1. Number, set notation and language

Students should be able to:

- Identify and use natural numbers, integers (positive, negative and zero), prime numbers, square numbers, common factors and common multiples, rational and irrational numbers
  - (e.g. π , 2), real numbers; continue a given number sequence; recognise patterns in sequences and relationships between different sequences, generalise to simple algebraic statements (including expressions for the nth term) relating to such sequences.

2. Square and Cubes

Students should be able to:

- Calculate squares, square roots, cubes and cube roots of numbers.

3. Directed numbers

Students should be able to:

- Use directed numbers in practical situations (e.g. temperature change, flood levels).

4. Vulgar and decimal fractions and percentages

Students should be able to:

- Use the language and notation of simple vulgar and decimal fractions and percentages in appropriate contexts; recognise equivalence and convert between these forms.

5. Ordering

Students should be able to:

- Order quantities by magnitude and demonstrate familiarity with the symbols =, OE, K, I, [,Y

6. Standard form

Students should be able to:

- Use the standard form A × 10n where n is a positive or negative integer, and 1 Y A I=10

7. The four rules

Students should be able to:

- Use the four rules for calculations with whole numbers, decimal fractions and vulgar (and mixed) fractions, including correct ordering of operations and use of brackets.

8. Estimation

Students should be able to:

- Make estimates of numbers, quantities and lengths, give approximations to specified numbers of significant figures and decimal places and round off answers to reasonable accuracy in the context of a given problem.

9. Limits of accuracy

Students should be able to:

- Give appropriate upper and lower bounds for data given to a specified accuracy (e.g. measured lengths).

10. Ratio, proportion and rate

Students should be able to:

- Demonstrate an understanding of the elementary ideas and notation of ratio, direct and inverse proportion and common measures of rate; divide a quantity in a given ratio; use scales in practical situations; calculate average speed.

11. Percentages

Students should be able to:

- Calculate a given percentage of a quantity; express one quantity as a percentage of another; calculate percentage increase or decrease.

12. Use of an electronic calculator

Students should be able to:

- Use an electronic calculator efficiently; apply appropriate checks of accuracy.

13. Measures

Students should be able to:

- Use current units of mass, length, area, volume and capacity in practical situations and express quantities in terms of larger or smaller units.

14. Time

Students should be able to:

- Calculate times in terms of the 24-hour and 12-hour clock; read clocks, dials and timetables.

15. Money

Students should be able to:

- Calculate using money and convert from one currency to another.

16. Personal and household finance

Students should be able to:

- Use given data to solve problems on personal and household finance involving earnings, simple interest and compound interest (knowledge of compound interest formula is not required), discount, profit and loss; extract data from tables and charts.

17. Graphs in practical situations

Students should be able to:

- Demonstrate familiarity with Cartesian co-ordinates in two dimensions, interpret and use graphs in practical situations including travel graphs and conversion graphs, draw graphs from given data.

18. Graphs of functions

Students should be able to:

- Construct tables of values for functions of the form ax + b, ±x2 + ax + b, a/x (x OE 0) where a and b are integral constants; draw and interpret such graphs; find the gradient of a straight line graph; solve linear and quadratic equations approximately by graphical methods.

19. Straight line graphs

Students should be able to:

- Interpret and obtain the equation of a straight line graph in the form y = mx + c; determine the equation of a straight line parallel to a given line.

20. Algebraic representation and formulae

Students should be able to:

- Use letters to express generalised numbers and express basic arithmetic processes algebraically, substitute numbers for words and letters in formulae; transform simple formulae; construct simple expressions and set up simple equations.

21. Algebraic manipulation

Students should be able to:

- Manipulate directed numbers; use brackets and extract common factors.

22. Indices

Students should be able to:

- Use and interpret positive, negative and zero indices.

23. Solutions of equations and inequalities

Students should be able to:

- Solve simple linear equations in one unknown; solve simultaneous linear equations in two unknowns.

24. Geometrical terms and relationships

Students should be able to:

- Use and interpret the geometrical terms: point, line, parallel, bearing, right angle, acute, obtuse and reflex angles, perpendicular, similarity, congruence; use and interpret vocabulary of triangles, quadrilaterals, circles, polygons and simple solid figures including nets.

25. Geometrical constructions

Students should be able to:

- Measure lines and angles; construct a triangle given the three sides using ruler and pair of compasses only; construct other simple geometrical figures from given data using protractors and set squares as necessary; construct angle bisectors and perpendicular bisectors using straight edges and pair of compasses only; read and make scale drawings.

26. Symmetry

Students should be able to:

- Recognise rotational and line symmetry (including order of rotational symmetry) in two dimensions and properties of triangles, quadrilaterals and circles directly related to their symmetries.

27. Angle Properties

Students should be able to:

- Calculate unknown angles using the following geometrical properties:

- (a) angles at a point
- (b) angles at a point on a straight line and intersecting straight lines
- (c) angles formed within parallel lines
- (d) angle properties of triangles and quadrilaterals
- (e) angle properties of regular polygons
- (f) angle in a semi-circle
- (g) angle between tangent and radius of a circle.

Physics

General Physics

1.1 Length and time

- Use and describe the use of rules and measuring cylinders to calculate a length or a volume
- Use and describe the use of clocks and devices for measuring an interval of time

1.2 Speed, velocity and acceleration

- Define speed and calculate speed from total time over total distance
- Plot and interpret a speed/time graph or a distance/time graph
- Recognise from the shape of a speed/time graph
  - when a body is:
    - at rest
    - moving with constant speed
    - moving with changing speed
- Calculate the area under a speed/time graph to work out the distance travelled for motion with constant acceleration
- Demonstrate some understanding that acceleration is related to changing speed
- State that the acceleration of free fall for a body near to the Earth is constant

1.3 Mass and weight

- Show familiarity with the idea of the mass of a body
- State that weight is a force
- Demonstrate understanding that weights (and hence masses) may be compared using a balance

1.4 Density

- Describe an experiment to determine the density of a liquid and of a regularly shaped solid and make the necessary calculation

1.5 (a) Effects of forces

- State that a force may produce a change in size and shape of a body
- Plot extension/load graphs and describe the associated experimental procedure
- Describe the ways in which a force may change the motion of a body
- Find the resultant of two or more forces acting along the same line

1.5 (b) Turning effect

- Describe the moment of a force as a measure of its turning effect and give everyday examples
- Describe qualitatively the balancing of a beam about a pivot

1.5 (c) Conditions for equilibrium

- State that, when there is no resultant force and no resultant turning effect, a system is in equilibrium

1.5 (d) Centre of mass

- Perform and describe an experiment to determine the position of the centre of mass of a plane lamina

- Describe qualitatively the effect of the position of the centre of mass on the stability of simple objects

Energy work and power

1.6 (a) Energy

- Demonstrate an understanding that an object may have energy due to its motion or its position, and that energy may be transferred and stored
- Give examples of energy in different forms, including kinetic, gravitational, chemical, strain, nuclear, internal, electrical, light and sound
- Give examples of the conversion of energy from one form to another, and of its transfer from one place to another
- Apply the principle of energy conservation to simple examples

1.6 (b) Energy resources

- Distinguish between renewable and nonrenewable sources of energy
- Describe how electricity or other useful forms of energy may be obtained from:
  - chemical energy stored in fuel
  - water, including the energy stored in waves, in tides, and in water behind hydroelectric dams
  - geothermal resources
  - nuclear fission
  - heat and light from the Sun (solar cells and panels)
- Give advantages and disadvantages of each method in terms of cost, reliability, scale and environmental impact
- Show a qualitative understanding of efficiency

1.6 (c) Work

- Relate (without calculation) work done to the magnitude of a force and the distance moved

1.6 (d) Power

- Relate (without calculation) power to work done and time taken, using appropriate examples

1.7 Pressure

- Relate (without calculation) pressure to force and area, using appropriate examples
- Describe the simple mercury barometer and its use in measuring atmospheric pressure
- Relate (without calculation) the pressure beneath a liquid surface to depth and to density, using appropriate examples
- Use and describe the use of a manometer

Thermal physics

2.1 (a) States of matter

- State the distinguishing properties of solids, liquids and gases

2.1 (b) Molecular model

- Describe qualitatively the molecular structure of solids, liquids and gases
- Interpret the temperature of a gas in terms of the motion of its molecules
- Describe qualitatively the pressure of a gas in terms of the motion of its molecules
- Describe qualitatively the effect of a change of temperature on the pressure of a gas at constant volume
- Show an understanding of the random motion of particles in a suspension as evidence for the kinetic molecular model of matter
- Describe this motion (sometimes known as Brownian motion) in terms of random molecular bombardment

2.1 (c) Evaporation

- Describe evaporation in terms of the escape of more-energetic

molecules from the surface of a liquid
- Relate evaporation to the consequent cooling

2.1 (d) Pressure changes

- Relate the change in volume of a gas to change in pressure applied to the gas at constant temperature

2.2 (a) Thermal expansion of solids, liquids and gases

- Describe qualitatively the thermal expansion of solids, liquids and gases
- Identify and explain some of the everyday applications and consequences of thermal expansion
- Describe qualitatively the effect of a change of temperature on the volume of a gas at constant pressure

2.2 (b) Measurement of temperature

- Appreciate how a physical property that varies with temperature may be used for the measurement of temperature, and state examples of such properties
- Recognise the need for and identify fixed points
- Describe the structure and action of liquid-in-glass thermometers

2.2 (c) Thermal capacity

- Relate a rise in the temperature of a body to an increase in internal energy
- Show an understanding of the term thermal capacity

2.2 (d) Melting and boiling

- Describe melting and boiling in terms of energy input without a change in temperature
- State the meaning of melting point and boiling point
- Describe condensation and solidification

2.3 (a) Conduction

- Describe experiments to demonstrate the properties of good and bad conductors of heat

2.3 (b) Convection

- Relate convection in fluids to density changes and describe experiments to illustrate convection

2.3 (c) Radiation

- Identify infra-red radiation as part of the electromagnetic spectrum

2.3 (d) Consequences of energy transfer

- Identify and explain some of the everyday applications and consequences of conduction, convection and radiation

Properties of waves

3.1 General wave properties

- Describe what is meant by wave motion as illustrated by vibration in ropes and springs and by experiments using water waves
- Use the term wavefront
- Give the meaning of speed, frequency, wavelength and amplitude
- Distinguish between transverse and longitudinal waves and give suitable examples
- Describe the use of water waves to show:
  - reflection at a plane surface
  - refraction due to a change of speed
  - diffraction produced by wide and narrow gaps

3.2 (a) Reflection of light

- Describe the formation of an optical image by a plane mirror, and give its characteristics
- Use the law angle of incidence = angle of reflection

3.2 (b) Refraction of light

- Describe an experimental demonstration of the refraction of light
- Use the terminology for the angle of incidence i and angle of refraction r and describe the passage of light through parallel-sided transparent material
- Give the meaning of critical angle
- Describe internal and total internal reflection

3.2 (c) Thin converging lens

- Describe the action of a thin converging lens on a beam of light
- Use the term principal focus and focal length
- Draw ray diagrams to illustrate the formation of a real image by a single lens

3.2 (d) Dispersion of light

- Give a qualitative account of the dispersion of light as shown by the action on light of a glass prism

3.2 (e) Electromagnetic spectrum

- Describe the main features of the electromagnetic spectrum and state that all e.m. waves travel with the same high speed in vacuo
- Describe the role of electromagnetic waves in:
  - radio and television communications (radio waves)
  - satellite television and telephones (microwaves)
  - electrical appliances, remote controllers for televisions and intruder alarms (infrared)
  - medicine and security (X-rays)
- Demonstrate an awareness of safety issues regarding the use of microwaves and X-rays

3.3 Sound

- Describe the production of sound by vibrating sources
- Describe the longitudinal nature of sound waves
- State the approximate range of audible frequencies
- Show an understanding that a medium is needed to transmit sound waves
- Describe an experiment to determine the speed of sound in air
- Relate the loudness and pitch of sound waves to amplitude and frequency
- Describe how the reflection of sound may produce an echo

Electricity and magnetism

4.1 Simple phenomena of magnetism

- State the properties of magnets
- Give an account of induced magnetism
- Distinguish between ferrous and non-ferrous materials
- Describe methods of magnetisation and of demagnetisation
- Describe an experiment to identify the pattern of field lines round a bar magnet
- Distinguish between the magnetic properties of iron and steel
- Distinguish between the design and use of permanent magnets and electromagnets

4.2 (a) Electric charge

- Describe simple experiments to show the production and detection of electrostatic charges
- State that there are positive and negative charges
- State that unlike charges attract and that like charges repel
- Describe an electric field as a region in which an electric charge experiences a force
- Distinguish between electrical conductors and insulators and give typical examples

4.2 (b) Current

- State that current is related to the flow of charge
- Use and describe the use of an ammeter

4.2 (c) Electro-motive force

- State that the e.m.f. of a source of electrical energy is measured in volts

4.2 (d) Potential difference

- State that the potential difference across a circuit component is measured in volts
- Use and describe the use of a voltmeter

4.3 (b) Series and parallel circuits

- Understand that the current at every point in a series circuit is the same
- Give the combined resistance of two or more resistors in series
- State that, for a parallel circuit, the current from the source is larger than the current in each branch
- State that the combined resistance of two resistors in parallel is less than that of either resistor by itself
- State the advantages of connecting lamps in parallel in a lighting circuit

4.3 (c) Action and use of circuit components

- Describe the action of a variable potential divider (potentiometer)
- Describe the action of thermistors and lightdependent resistors and show understanding of their use as input transducers
- Describe the action of a capacitor as an energy store and show understanding of its use in timedelay circuits
- Describe the action of a relay and show understanding of its use in switching circuits

4.4 Dangers of electricity

- state the hazards of
  - damaged insulation
  - overheating of cables
  - damp conditions
  - Show an understanding of the use of fuses and circuit-breakers

4.5 (a) Electromagnetic induction

- Describe an experiment that shows that a changing magnetic field can induce an e.m.f. in a circuit

4.5 (b) a.c. generator

- Describe a rotating-coil generator and the use of slip rings
- Sketch a graph of voltage output against time for a simple a.c. Generator

4.5 (c) Transformer

- Describe the construction of a basic iron-d transformer as used for voltage transformations
- Recall and use the equation (Vp /Vs) = (Np /Ns)
- Describe the use of the transformer in highvoltage transmission of electricity
- Give the advantages of high-voltage transmission

4.5 (d) The magnetic effect of a current

- Describe the pattern of the magnetic field due to currents in straight wires and in solenoids
- Describe applications of the magnetic effect of current, including the action of a relay

4.5 (e) Force on a current-carrying conductor

- Describe an experiment to show that a force acts on a current-carrying conductor in a magnetic field, including the effect of reversing:
  - (i) the current
  - (ii) the direction of the field

4.5 (f) d.c. motor

- State that a current-carrying coil in a magnetic field experiences a turning effect and that the effect is increased by increasing the number of turns on the coil
- Relate this turning effect to the action of an electric motor

4.6 (a) Cathode rays

- Describe the production and detection of cathode rays
- Describe their deflection in electric fields
- State that the particles emitted in thermionic emission are electrons

Atomic Physics

5.1 (a) Detection of radioactivity

- Show awareness of the existence of background radiation
- Describe the detection of α -particles, β -particles and γ -rays (β + are not included: β - particles will be taken to refer to β –)

5.1 (b) Characteristics of the three kinds of emission

- State that radioactive emissions occur randomly over space and time
- State, for radioactive emissions:
  - their nature
  - their relative ionising effects
  - their relative penetrating abilities

5.1 (c) Radioactive decay

- State the meaning of radioactive decay, using equations (involving words or symbols) to represent changes in the composition of the nucleus when particles are emitted

5.1 (d) Half-life

- Use the term half-life in simple calculations, which might involve information in tables or decay curves

5.1 (e) Safety precautions

- Describe how radioactive materials are handled, used and stored in a safe way

5.2 (a) Atomic model

- Describe the structure of an atom in terms of a nucleus and electrons

5.2 (b) Nucleus

- Describe the composition of the nucleus in terms of protons and neutrons
- Use the term proton number Z
- Use the term nucleon number A
- Use the term nuclide and use the nuclide notation (A over Z)X

Chemistry

1. The particulate nature of matter

- Describe the states of matter and explain their interconversion in terms of the kinetic particle theory
- Describe and explain diffusion
- Describe evidence for the movement of particles in gases and liquids

2. Experimental techniques

2.1 Measurement

- Name appropriate apparatus for the measurement of time, temperature, mass and volume, including burettes, pipettes and measuring cylinders

2.2 (a) Criteria of purity

- Describe paper chromatography
- Interpret simple chromatograms
- Identify substances and assess their purity from melting point and boiling point information
- Understand the importance of purity in substances in everyday life, e.g. foodstuffs and drugs

2.2 (b) Methods of purification

- Describe methods of purification by the use of a suitable solvent, filtration, crystallisation, distillation (including use of fractionating column). (Refer to the fractional distillation of crude oil in section 14.2 and products of fermentation in section 14.6.)
- Suggest suitable purification techniques, given information about the substances involved

3. Atoms, elements and compounds

3.1 Atomic structure and the Periodic Table

- State the relative charges and approximate relative masses of protons, neutrons and electrons
- Define proton number and nucleon number
- Use proton number and the simple structure of atoms to explain the basis of the Periodic Table (see section 9), with special reference to the elements of proton number 1 to 20
- Define isotopes
- State the two types of isotopes as being radioactive and non-radioactive
- State one medical and one industrial use of radioactive isotopes
- Describe the build-up of electrons in ‘shells’ and understand the significance of the noble gas electronic structures and of valency electrons

3.2 Bonding: the structure of matter

- Describe the differences between elements, mixtures and compounds, and between metals and non- metals
- Describe an alloy, such as brass, as a mixture of a metal with other elements

3.2 (a) Ions and ionic bonds

- Describe the formation of ions by electron loss or gain
- Describe the formation of ionic bonds between elements from Groups I and VII

3.2 (b) Molecules and covalent bonds

- Describe the formation of single covalent bonds in H_2 , Cl_2 , H_2O, CH_4 and HCl as the sharing of pairs of electrons leading to the noble gas configuration
- Describe the differences in volatility, solubility and electrical conductivity between ionic and covalent compounds

3.2 (c) Macromolecules

- Describe the giant covalent structures of graphite and diamond
- Relate their structures to the use of graphite as a lubricant and of diamond in cutting

4. Stoichiometry

- Use the symbols of the elements and write the formulae of simple compounds
- Deduce the formula of a simple compound from the relative numbers of atoms present
- Deduce the formula of a simple compound from a model or a diagrammatic representation
- Construct word equations and simple balanced chemical equations
- Define relative atomic mass, Ar
- Define relative molecular mass, Mr , as the sum of the relative atomic masses

5. Electricity and Chemistry

- Describe the electrode products in the electrolysis of:
  - molten lead(II) bromide
  - concentrated hydrochloric acid
  - concentrated aqueous sodium chloride between inert electrodes (platinum or carbon)
- State the general principle that metals or hydrogen are formed at the negative electrode (cathode), and that non-metals (other than hydrogen) are formed at the positive electrode (anode)
- Predict the products of the electrolysis of a specified binary compound in the molten state
- Describe the electroplating of metals
- Name the uses of electroplating
- Describe the reasons for the use of copper and (steel-d) aluminium in cables, and why plastics and ceramics are used as insulators

6. Chemical Energetics

6.1 Energetics of a reaction

- Describe the meaning of exothermic and endothermic reactions

6.2 Production of energy

- Describe the production of heat energy by burning fuels
- Describe hydrogen as a fuel
- Describe radioactive isotopes, such as 235 U, as a source of energy

7. Chemical Reactions

7.1 Speed of reaction

- Describe the effect of concentration, particle size, catalysts (including enzymes) and temperature on the speeds of reactions
- Describe a practical method for investigating the speed of a reaction involving gas evolution
- Describe the application of the above factors to the danger of explosive combustion with fine powders (e.g. flour mills) and gases (e.g. mines)

7.2 Reversible reactions

- Describe the idea that some chemical reactions can be reversed by changing the reaction conditions (Limited to the effects of heat on hydrated salts. Concept of equilibrium is not required.)

7.3 Redox

- Define oxidation and reduction in terms of oxygen loss/gain. (Oxidation state limited to its use to name ions, e.g. iron(II), iron(III), copper(II), manganate(VII), dichromate(VI).)

8. Acids, bases and salts

8.1 The characteristic properties of acids and bases

- Describe the characteristic properties of acids as reactions with metals, bases, carbonates and effect on litmus
- Describe the characteristic properties of bases as reactions with acids and with ammonium salts and effect on litmus
- Describe neutrality and relative acidity and alkalinity in terms of pH (whole numbers only) measured using Universal Indicator paper
- Describe and explain the importance of controlling acidity in soil

8.2 Types of oxides

- Classify oxides as either acidic or basic, related to metallic and non-metallic character

8.3 Preparation of salts

- Describe the preparation, separation and purification of salts as examples of some of the techniques specified in section 2.2(b) and the reactions specified in section 8.1

8.4 Identification of ions and gases

- Describe the following tests to identify:
  - aqueous cations: aluminium, ammonium, calcium, copper(II), iron(II), iron(III) and zinc (using aqueous sodium hydroxide and aqueous ammonia as appropriate)
  - anions: carbonate (by reaction with dilute acid and then limewater), chloride (by reaction under acidic conditions with aqueous silver nitrate), iodide (by reaction under acidic conditions with aqueous silver nitrate), nitrate (by reduction with aluminium), sulfate (by reaction under acidic conditions with aqueous barium ions)
  - gases: ammonia (using damp red litmus paper), carbon dioxide (using limewater), chlorine (using damp litmus paper), hydrogen (using lighted splint), oxygen (using a glowing splint).

9. The Periodic Table

- Describe the Periodic Table as a method of classifying elements and its use to predict properties of elements

9.1 Periodic trends

- Describe the change from metallic to non-metallic character across a period

9.2 Group properties

- Describe lithium, sodium and potassium in Group I as a collection of relatively soft metals showing a trend in melting point, density and reaction with water
- Predict the properties of other elements in Group I, given data, where appropriate
- Describe chlorine, bromine and iodine in Group VII as a collection of diatomic non-metals showing a trend in colour, and state their reaction with other halide ions
- Predict the properties of other elements in Group VII, given data where appropriate

9.3 Transition elements

- Describe the transition elements as a collection of metals having high densities, high melting points and forming coloured compounds, and which, as elements and compounds, often act as catalysts

9.4 Noble gases

- Describe the noble gases as being unreactive
- Describe the uses of the noble gases in providing an inert atmosphere, i.e. argon in lamps, helium for filling balloons

10. Metals

10.1 Properties of metals

- Describe the general physical and chemical properties of metals
- Explain why metals are often used in the form of alloys
- Identify representations of alloys from diagrams of structure

10.2 Reactivity series

- Place in order of reactivity: potassium, sodium, calcium, magnesium, zinc, iron, (hydrogen) and copper, by reference to the reactions, if any, of the metals with
  - water or steam
  - dilute hydrochloric acid and the reduction of their oxides with carbon
- Deduce an order of reactivity from a given set of experimental results

10.3 (a) Extraction of metals

- Describe the ease in obtaining metals from their ores by relating the elements to the reactivity series
- Describe the essential reactions in the extraction of iron from hematite
- Describe the conversion of iron into steel using basic oxides and oxygen

10.3 (b) Uses of metals

- Name the uses of aluminium:
  - in the manufacture of aircraft because of its strength and low density
  - in food containers because of its resistance to corrosion
- Describe the idea of changing the properties of iron by the controlled use of additives to form steel alloys
- Name the uses of mild steel (car bodies and machinery) and stainless steel (chemical plant and cutlery)

11. Air and Water

- Describe a chemical test for water
- Describe, in outline, the treatment of the water supply in terms of filtration and chlorination
- Name some of the uses of water in industry and in the home
- Describe the composition of clean air as being approximately 79% nitrogen, 20% oxygen and the remainder as being a mixture of noble gases, water vapour and carbon dioxide
- Name the common pollutants in the air as being carbon monoxide, sulfur dioxide, oxides of nitrogen and lead compounds
- State the source of each of these pollutants:
  - carbon monoxide from the incomplete combustion of carbon-containing substances
  - sulfur dioxide from the combustion of fossil fuels which contain sulfur compounds (leading to 'acid rain' – see section 13)
  - – oxides of nitrogen from car exhausts
- State the adverse effect of common pollutants on buildings and on health
- Describe methods of rust prevention, specifically paint and other coatings to exclude oxygen
- Describe the need for nitrogen-, phosphorus- and potassium-containing fertilisers
- Describe the displacement of ammonia from its salts
- State that carbon dioxide and methane are greenhouse gases and may contribute to climate change
- Describe the formation of carbon dioxide:
  - as a product of complete combustion of carboncontaining substances
  - as a product of respiration
  - as a product of the reaction between an acid and a carbonate
- State the sources of methane, including decomposition of vegetation and waste gases from digestion in animals

12. Carbonates

- Describe the manufacture of lime (calcium oxide) from calcium carbonate (limestone) in terms of the chemical reactions involved
- Name some uses of lime and slaked lime as in treating acidic soil and neutralising acidic industrial waste products, e.g. flue gas desulfurisation
- Name the uses of calcium carbonate in the manufacture of iron and of cement

13. Organic Chemistry

13.1 Names of compounds

- Name and draw the structures of methane, ethane, ethene, ethanol, ethanoic acid and the products of the reactions stated in sections 14.4–14.6
- State the type of compound present, given a chemical name ending in -ane, -ene, -ol, or -oic acid , or a molecular structure

13.2 Fuels

- Name the fuels coal, natural gas and petroleum
- Name methane as the main constituent of natural gas
- Describe petroleum as a mixture of hydrocarbons and its separation into useful fractions by fractional distillation
- Name the uses of the fractions as:
  - refinery gas for bottled gas for heating and cooking
  - gasoline fraction for fuel (petrol) in cars
  - naphtha fraction for making chemicals
  - kerosene/paraffin fraction for jet fuel

  - diesel oil/gas oil for fuel in diesel engines
  - fuel oil fraction for fuel for ships and home heating systems
- lubricating fraction for lubricants, waxes and polishes
- bitumen for making roads

13.3 Homologous series

- Describe the concept of homologous series as a 'family' of similar compounds with similar properties due to the presence of the same functional group

13.4 Alkanes

- Describe the properties of alkanes (exemplified by methane) as being generally unreactive, except in terms of burning
- Describe the bonding in alkanes

13.5 Alkenes

- Describe the manufacture of alkenes and of hydrogen by cracking
- Distinguish between saturated and unsaturated hydrocarbons from molecular structures by reaction with aqueous bromine
- Describe the formation of poly(ethene) as an example of addition polymerisation of monomer units

13.6 Alcohols

- Describe the formation of ethanol by fermentation and by the catalytic addition of steam to ethene
- Describe the properties of ethanol in terms of burning
- Name the uses of ethanol as a solvent and as a fuel

Biology

Section 1

1. Characteristics of Living Oranisms

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

2. Classification of Living Organisms

2.1 Concept and use of a classificatory system

- Define and describe the binomial system of naming species as a system in which the scientific name of an organism is made up of two parts showing the genus and species
- List the main features of the following vertebrates: bony fish, amphibians, reptiles, birds and mammals

2.2 Adaptations of organisms to their environment

(to be illustrated by examples wherever possible)

- List the main features used in the classification of the following groups: flowering plants (monocotyledons and eudicotyledons (dicotyledons)), arthropods (insects, crustaceans, arachnids and myriapods), annelids, nematodes and molluscs

Simple Keys

- Use simple dichotomous keys based on easily identifiable features

Section 2

1. Cell Structure and organisation

- State that living organisms are made of cells
- Identify and describe the structure of a plant cell (palisade cell) and an animal cell (liver cell), as seen under a light microscope
- Describe the differences in structure between typical animal and plant cells

2. Levels of Organisation

- Relate the structure of the following to their functions:
  - ciliated cells – in respiratory tract
  - root hair cells – absorption
  - xylem vessels – conduction and support
  - muscle cells – contraction
  - red blood cells – transport
- Define:
- tissue as a group of cells with similar structures, working together to perform a shared function
- organ as a structure made up of a group of tissues, working together to perform specific functions
- organ system as a group of organs with related functions, working together to perform body functions using examples covered in Sections II and III

3. Size of Specimens

- Calculate magnification and size of biological specimens using millimetres as units

4. Movement in and out of cells

4.1 Diffusion

- Define diffusion as the net movement of molecules from a region of their higher concentration to a region of their lower concentration down a concentration gradient, as a result of their random movement
- Describe the importance of diffusion of gases and solutes and of water as a solvent

4.2 Osmosis

- Define osmosis as the diffusion of water molecules from a region of their higher concentration (dilute solution) to a region of their lower concentration (concentrated solution), through a partially permeable membrane
- Describe the importance of osmosis in the uptake of water by plants, and its effects on plant and animal tissues

5. Enzymes

- Define the term catalyst as a substance that speeds up a chemical reaction and is not changed by the reaction
- Define enzymes as proteins that function as biological catalysts
- Investigate and describe the effect of changes in temperature and pH on enzyme activity

6. Nutrition

- Define nutrition as taking in of nutrients which are organic substances and mineral ions, containing raw materials or energy for growth and tissue

6.1 Nutrients

- List the chemical elements that make up:
  - carbohydrates
  - fats
  - proteins
- Describe the synthesis of large molecules from smaller basic units, i.e.
  - simple sugars to starch and glycogen
  - amino acids to proteins
  - fatty acids and glycerol to fats and oils
- Describe tests for:
  - starch (iodine solution)
  - reducing sugars (Benedict's solution)
  - protein (biuret test)
  - fats (ethanol)
- List the principal sources of, and describe the importance of:
  - carbohydrates
  - fats
  - proteins
  - vitamins (C and D only)
  - mineral salts (calcium and iron only)
  - fibre (roughage)
  - water
- Describe the deficiency symptoms for:
  - vitamins (C and D only)
  - mineral salts (calcium and iron only)

6.2 Plant Nutrition

6.2.1 Photosynthesis

- Define photosynthesis as the fundamental process by which plants manufacture carbohydrates from raw materials using energy from light
- State the word equation for the production of simple sugars and oxygen
- Investigate the necessity for chlorophyll, light and carbon dioxide for photosynthesis, using appropriate controls
- Describe the intake of carbon dioxide and water by plants
- Explain that chlorophyll traps light energy and converts it into chemical energy for the formation of carbohydrates and their subsequent storage

6.2.2 Leaf structure

- Identify and label the cuticle, cellular and tissue structure of a dicotyledonous leaf, as seen in cross-section under the light microscope, and describe the significance of these features in terms of functions, to include:
  - distribution of chloroplasts – photosynthesis
  - stomata and mesophyll cells – gas exchange
  - vascular bundles (xylem and phloem) – transport and support

6.2.3 Mineral requirements

- Describe the importance of:
  - nitrate ions for protein synthesis
  - magnesium ions for chlorophyll synthesis
  - Describe the uses, and the dangers of overuse, of nitrogen fertilisers

6.3 Animal Nutrition

6.3.1 Diet

- State what is meant by the term balanced diet and describe a balanced diet related to age, sex and activity of an individual
- Describe the effects of malnutrition in relation to starvation, coronary heart disease, constipation and obesity

6.3.2 Food supply

- Discuss ways in which the use of modern technology has resulted in increased food production (to include modern agricultural machinery, chemical fertilisers, pesticides and herbicides, artificial selection)

6.3.3 Human alimentary canal

- Define ingestion as taking substances (e.g. food, drink) into the body through the mouth
- Define egestion as passing out of food that has not been digested, as faeces, through the anus
- Identify the main regions of the alimentary canal and associated organs including mouth, salivary glands, oesophagus, stomach, small intestine: duodenum and ileum, pancreas, liver, gall bladder, large intestine: colon and rectum, anus
- Describe the functions of the regions of the alimentary canal listed above, in relation to ingestion, digestion, absorption, assimilation and egestion of food (cross reference 6.3.4, 6.3.5, 6.3.6 and 6.3.7)

6.3.4 Mechanical and physical digestion

- Define digestion as the break-down of large, insoluble food molecules into small, watersoluble molecules using mechanical and chemical processes
- Identify the types of human teeth and describe their structure and functions
- State the causes of dental decay and describe the proper care of teeth
- Describe the process of chewing
- Describe the role of longitudinal and circular muscles in peristalsis
- Outline the role of bile in emulsifying fats, to increase the surface area for the action of enzymes

6.3.5 Chemical digestion

- State the significance of chemical digestion in the alimentary canal in producing small, soluble molecules that can be absorbed
- State where, in the alimentary canal, amylase, protease and lipase enzymes are secreted
- State the functions of a typical amylase, a protease and a lipase, listing the substrate and end-products

6.3.6 Absorption

- Define absorption as movement of digested food molecules through the wall of the intestine into the blood or lymph
- Identify the small intestine as the region for the absorption of digested food
- Describe the significance of villi in increasing the internal surface area of the small intestine

6.3.7 Assimilation

- Define assimilation as movement of digested food molecules into the cells of the body where they are used, becoming part of the cells
- Describe the role of the liver in the metabolism of glucose (glucose → glycogen) and amino acids (amino acids → proteins and destruction of excess amino acids)
- Describe the role of fat as an energy storage substance

7. Transportation

7.1 Transport in plants

- State the functions of xylem and phloem
- Identify the positions of xylem and phloem tissues as seen in transverse sections of unthickened, herbaceous, dicotyledonous roots, stems and leaves

7.1.1 Water uptake

- Identify root hair cells, as seen under the light microscope, and state their functions
- State the pathway taken by water through root, stem and leaf (root hair, root cortex cells, xylem, mesophyll cells)
- Investigate, using a suitable stain, the pathway of water through the above-ground parts of a plant

7.1.2 Transpiration

- Define transpiration as evaporation of water at the surfaces of the

mesophyll cells followed by loss of water vapour from plant leaves, through the stomata
- Describe how water vapour loss is related to cell surfaces, air spaces and stomata
- Describe the effects of variation of temperature, humidity and light intensity on transpiration rate
- Describe how wilting occurs

7.1.3 Translocation

- Define translocation in terms of the movement of sucrose and amino acids in phloem;
  - from regions of production
  - to regions of storage OR to regions of utilisation in respiration or growth

7.2 Transport in humans

- Describe the circulatory system as a system of tubes with a pump and valves to ensure one-way flow of blood
- Describe the double circulation in terms of a low pressure circulation to the lungs and a high pressure circulation to the body tissues and relate these differences to the different functions of the two circuits

7.2.1 Heart

- Describe the structure of the heart including the muscular wall and septum, chambers, valves and associated blood vessels
- Describe the function of the heart in terms of muscular contraction and the working of the valves
- Investigate, state and explain the effect of physical activity on pulse rate
- Describe coronary heart disease in terms of the blockage of coronary arteries and state the possible causes (diet, stress and smoking) and preventive measures

7.2.2 Arteries, veins and capillaries

- Name the main blood vessels to and from the heart, lungs, liver and kidney
- Describe the structure and functions of arteries, veins and capillaries

7.2.3 Blood

- Identify red and white blood cells as seen under the light microscope on prepared slides, and in diagrams and photomicrographs
- List the components of blood as red blood cells, white blood cells, platelets and plasma
- State the functions of blood:
  - red blood cells – haemoglobin and oxygen transport
  - white blood cells – phagocytosis and antibody formation
  - platelets – causing clotting (no details)
  - plasma – transport of blood cells, ions, soluble nutrients, hormones, carbon dioxide, urea and plasma proteins

8. Respiration

- Define respiration as the chemical reactions that break down nutrient molecules in living cells to release energy
- State the uses of energy in the body of humans: muscle contraction, protein synthesis, cell division, active transport, growth, the passage of nerve impulses and the maintenance of a constant body temperature

8.1 Aerobic respiration

- Define aerobic respiration as the release of a relatively large amount of energy in cells by the breakdown of food substances in the presence of oxygen
- State the word equation for aerobic respiration

8.2 Anaerobic respiration

- Define anaerobic respiration as the release of a relatively small amount of energy by the breakdown of food substances in the absence of oxygen
- State the word equation for anaerobic respiration in muscles during hard exercise (glucose → lactic acid) and the microorganism yeast (glucose → alcohol + carbon dioxide)
- Describe the role of anaerobic respiration in yeast during brewing and

bread-making
- Compare aerobic respiration and anaerobic respiration in terms of relative amounts of energy released

8.3 Gas exchange

- List the features of gas exchange surfaces in animals
- Identify on diagrams and name the larynx, trachea, bronchi, bronchioles, alveoli and associated capillaries
- State the differences in composition between inspired and expired air
- Use lime water as a test for carbon dioxide to investigate the differences in composition between inspired and expired air
- Investigate and describe the effects of physical activity on rate and depth of breathing

9. Excretion in humans

- Define excretion as the removal from organisms of toxic materials, the waste products of metabolism (chemical reactions in cells including respiration) and substances in excess of requirements. Substances should include carbon dioxide, urea and salts
- Describe the function of the kidney in terms of the removal of urea and excess water and the reabsorption of glucose and some salts
- State the relative positions of ureters, bladder and urethra in the body
- State that urea is formed in the liver from excess amino acids
- State that alcohol, drugs and hormones are broken down in the liver

10. Coordination and response

10.1 Nervous control in humans

- Describe the human nervous system in terms of the central nervous system (brain and spinal cord as areas of coordination) and the peripheral nervous system which together serve to coordinate and regulate body functions
- Identify motor (effector), relay (connector) and sensory neurones from diagrams
- Describe a simple reflex arc in terms of sensory, relay and motor neurones, and a reflex action as a means of automatically and rapidly integrating and coordinating stimuli with responses
- State that muscles and glands can act as effectors
- Describe the action of antagonistic muscles to include the biceps and triceps at the elbow joint
- Define sense organs as groups of receptor cells responding to specific stimuli: light, sound, touch, temperature and chemicals
- Describe the structure and function of the eye, including accommodation and pupil reflex

10.2 Hormones

- Define a hormone as a chemical substance, produced by a gland, carried by the blood, which alters the activity of one or more specific target organs and is then destroyed by the liver • State the role of the hormone adrenaline in chemical control of metabolic activity, including increasing the blood glucose concentration and pulse rate
- Give examples of situations in which adrenaline secretion increases
- Compare nervous and hormonal control systems

10.3 Tropic responses

- Define and investigate geotropism (as a response in which a plant grows towards or away from gravity) and phototropism (as a response in which a plant grows towards or away from the direction from which light is coming)

10.4 Homeostasis

- Define homeostasis as the maintenance of a constant internal environment
- Identify, on a diagram of the skin: hairs, sweat glands, temperature receptors, blood vessels and fatty tissue
- Describe the maintenance of a constant body temperature in humans in terms of insulation and the role of temperature receptors in the skin, sweating, shivering, vasodilation and vasoconstriction of arterioles supplying skinsurface capillaries and the coordinating role of the brain

10.5 Drugs

- Define a drug as any substance taken into the body that modifies or affects chemical reactions in the body
- Describe the medicinal use of antibiotics for the treatment of bacterial infection
- Describe the effects of the abuse of heroin: a powerful depressant, problems of addiction,severe withdrawal symptoms and associated problems such as crime and infection e.g. HIV/AIDS
- Describe the effects of excessive consumption of alcohol: reduced self-control, depressant, effect on reaction times, damage to liver and social implications
- Describe the effects of tobacco smoke and its major toxic components (tar, nicotine, carbon monoxide, smoke particles) on the gas exchange system

Section 3

1. Reproduction

1.1 Asexual reproduction

- Define asexual reproduction as the process resulting in the production of genetically identical offspring from one parent
- Describe asexual reproduction in bacteria, spore production in fungi and tuber formation in potatoes

1.2 Sexual reproduction

- Define sexual reproduction as the process involving the fusion of haploid nuclei to form a diploid zygote and the production of genetically dissimilar offspring

1.2.1 Sexual reproduction in plants

- Identify and draw, using a hand lens if necessary, the sepals, petals, stamens, anthers, carpels, ovaries and stigmas of one, locally available, named, insect-pollinated, dicotyledonous flower, and examine the pollen grains under a light microscope or in photomicrographs
- State the functions of the sepals, petals, anthers, stigmas and ovaries
- Use a hand lens to identify and describe the anthers and stigmas of one, locally available, named, wind-pollinated flower, and examine the pollen grains under a light microscope or in photomicrographs
- Candidates should expect to apply their understanding of the flowers they have studied to unfamiliar flowers
- Define pollination as the transfer of pollen grains from the male part of the plant (anther of stamen) to the female part of the plant (stigma)
- Name the agents of pollination
- Compare the different structural adaptations of insect-pollinated and wind-pollinated flowers
- Describe the growth of the pollen tube and its entry into the ovule followed by fertilisation (production of endosperm and details of development are not required)
- Investigate and describe the structure of a non-endospermic seed in terms of the embryo (radicle, plumule and cotyledons) and testa, protected by the fruit
- Outline the formation of a seed (limited to embryo, cotyledons, testa and role of mitosis) and fruit (produced from the ovary wall)
- State that seed and fruit dispersal by wind and by animals provides a means of colonising new areas
- Describe, using named examples, seed and fruit dispersal by wind and by animals

1.2.2 Sexual reproduction in humans

- Identify on diagrams of the male reproductive system, the testes, scrotum, sperm ducts, prostate gland, urethra and penis, and state the functions of these parts
- Identify on diagrams of the female reproductive system, the ovaries, oviducts, uterus, cervix and vagina, and state the functions of these parts
- Describe the menstrual cycle in terms of changes in the uterus and ovaries
- Outline sexual intercourse and describe fertilisation in terms of the joining of the nuclei of male gamete (sperm) and the female gamete

(egg)
- Outline early development of the zygote simply in terms of the formation of a ball of cells that becomes implanted in the wall of the uterus
- Outline the development of the fetus
- Describe the function of the placenta and umbilical cord in relation to exchange of dissolved nutrients, gases and excretory products (no structural details are required)
- Describe the ante-natal care of pregnant women including special dietary needs and maintaining good health
- Outline the processes involved in labour and birth

1.3 Sex hormones

- Describe the roles of testosterone and oestrogen in the development and regulation of secondary sexual characteristics at puberty

1.4 Methods of birth control

- Outline the following methods of birth control:
  - natural (abstinence, rhythm method)
  - chemical (contraceptive pill, spermicide)
  - mechanical (condom, diaphragm, femidom,IUD)
  - surgical (vasectomy, female sterilisation)

1.5 Sexually transmissible diseases

- Describe the symptoms, signs, effects and treatment of gonorrhoea
- Describe the methods of transmission of human immunodeficiency virus (HIV), and the ways in which HIV/AIDS can be prevented from spreading

2. Growth and development

- Define growth in terms of a permanent increase in size and dry mass by an increase in cell number or cell size or both
- Define development in terms of increase in complexity
- Investigate and state the environmental conditions that affect germination of seeds: requirement for water and oxygen, suitable temperature

3. Inheritance

- Define inheritance as the transmission of genetic information from generation to generation

3.1 Chromosomes

- Define the terms:
  - chromosome as a thread of DNA, made up of a string of genes
  - gene as a length of DNA that is the unit of heredity and codes for a specific protein. A gene may be copied and passed on to the next generation
  - allele as any of two or more alternative forms of a gene
  - haploid nucleus as a nucleus containing a single set of unpaired chromosomes (e.g. sperm and egg)
  - diploid nucleus as a nucleus containing two sets of chromosomes (e.g. in body cells)
  - Describe the inheritance of sex in humans (XX and XY chromosomes)

3.2 Mitosis

- Define mitosis as nuclear division giving rise to genetically identical cells in which the chromosome number is maintained by the exact duplication of chromosomes
- State the role of mitosis in growth, repair of damaged tissues, replacement of worn out cells and asexual reproduction

3.3 Meiosis

- Define meiosis as reduction division in which the chromosome number is halved from diploid to haploid
- State that gametes are the result of meiosis
- State that meiosis results in genetic variation so the cells produced are not all genetically identical

3.4 Monohybrid inheritance

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

3.5 Variation

- State that continuous variation is influenced by genes and environment, resulting in a range of phenotypes between two extremes, e.g. height in humans
- State that discontinuous variation is caused by genes alone and results in a limited number of distinct phenotypes with no intermediates e.g. A, B, AB and O blood groups in humans
- Define mutation as a change in a gene or chromosome
- Describe mutation as a source of variation, as shown by Down's syndrome
- Outline the effects of ionising radiation and chemicals on the rate of mutation

3.6 Selection

- Describe the role of artificial selection in the production of varieties of animals and plants with increased economic importance
- Define natural selection as the greater chance of passing on of genes by the best adapted organisms

3.7 Genetic Engineering

- Define genetic engineering as taking a gene from one species and putting it into another species

Section 4

1. Energy flow

- State that the Sun is the principal source of energy input to biological systems
- Describe the non-cyclical nature of energy flow

2. Food chains and food webs

- Define the terms:
  - food chain as a chart showing the flow of energy (food) from one organism to the next beginning with a producer (e.g. mahogany tree → caterpillar → song bird → hawk)
  - food web as a network of interconnected food chains showing the energy flow through part of an ecosystem
  - producer as an organism that makes its own organic nutrients, usually using energy from sunlight, through photosynthesis
  - consumer as an organism that gets its energy by feeding on other organisms
  - herbivore as an animal that gets its energy by eating plants
  - carnivore as an animal that gets its energy by eating other animals
  - decomposer as an organism that gets its energy from dead or waste organic matter
  - ecosystem as a unit containing all of the organisms and their environment, interacting together, in a given area e.g. decomposing log or a lake
  - trophic level as the position of an organism in a food chain, food web or pyramid of biomass, numbers or energy
  - Describe energy losses between trophic levels
  - Draw, describe and interpret pyramids of biomass and numbers

3. Nutrient cycles

- Describe the carbon and the water cycles

4. Population size

- Define population as a group of organisms of one species, living in the same area at the same time
- State the factors affecting the rate of population growth for a population of an organism (limited to food supply, predation and disease), and describe their importance
- Identify the lag, exponential (log), stationary and death phases in the sigmoid population growth curve for a population growing in an environment with limited resources
- Describe the increase in human population size and its social implications
- Interpret graphs and diagrams of human population growth

5. Human influences on the ecosystem

- Outline the effects of humans on ecosystems, with emphasis on examples of international importance (tropical rain forests, oceans and important rivers)

5.1 Agriculture

- List the undesirable effects of deforestation (to include extinction, loss of soil, flooding, carbon dioxide build up)
- Describe the undesirable effects of overuse of fertilisers (to include eutrophication of lakes and rivers)

5.2 Pollution

- Describe the undesirable effects of pollution to include:
  - water pollution by sewage and chemical waste
  - air pollution by sulfur dioxide
  - air pollution by greenhouse gases (carbon dioxide and methane) contributing to global warming
  - pollution due to pesticides including insecticides and herbicides
  - pollution due to nuclear fall-out

5.3 Conservation

- Describe the need for conservation of:
  - species and their habitats
  - natural resources (limited to water and nonrenewable materials including fossil fuels)