

Syllabus Dot Points That Could be Covered in the G9 End of Semester 1 Examination

0654 Biology

B1 Characteristics of living organisms

Core

- 1 Describe the characteristics of living organisms by defining the terms:
 - *movement* as an action by an organism causing a change of position or place
 - *respiration* as the chemical reactions in cells that break down nutrient molecules and release energy
 - *sensitivity* as the ability to detect and respond to changes in the environment
 - *growth* as a permanent increase in size
 - *reproduction* as the processes that make more of the same kind of organism
 - *excretion* as removal from organisms of toxic materials and substances in excess of requirements
 - *nutrition* as taking in of materials for energy, growth and development

Supplement

- 2 Define the terms:
 - *movement* as an action by an organism or part of an organism causing a change of position or place
 - *respiration* as the chemical reactions in cells that break down nutrient molecules and release energy for metabolism
 - *sensitivity* as the ability to detect or sense stimuli in the internal or external environment and to make appropriate responses
 - *growth* as a permanent increase in size and dry mass by an increase in cell number or cell size or both
 - *excretion* as removal from organisms of the waste products of metabolism (chemical reactions in cells including respiration), toxic materials, and substances in excess of requirements
 - *nutrition* as taking in of materials for energy, growth and development; plants require light, carbon dioxide, water and ions; animals need organic compounds and ions and usually need water

B2 Cells**B2.1 Cell structure****Core**

- 1 State that living organisms are made of cells
- 2 Describe and compare the structure of a plant cell with an animal cell, as seen under a light microscope, limited to cell wall, nucleus, cytoplasm, chloroplasts, vacuoles and location of the cell membrane
- 3 State the functions of the structures seen under the light microscope in the plant cell and in the animal cell
- 5 Calculate magnification and size of biological specimens using millimetres as units

Supplement

- 4 Relate the structure of the following to their functions:
 - ciliated cells – movement of mucus in the trachea and bronchi
 - root hair cells – absorption
 - palisade mesophyll cells – photosynthesis
 - red blood cells – transport of oxygen
 - sperm and egg cells – reproduction

B2.2 Movement in and out of cells**Core**

- 1 Define *diffusion* as the net movement of particles 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
- 3 State that substances move into and out of cells by diffusion through the cell membrane
- 4 State that water diffuses through partially permeable membranes by osmosis
- 5 State that water moves in and out of cells by osmosis through the cell membrane
- 7 Investigate and describe the effects on plant tissues of immersing them in solutions of different concentrations

Supplement

- 2 Investigate the factors that influence diffusion, limited to surface area, temperature, concentration gradients and diffusion distance
- 6 Define *osmosis* as the net movement of water molecules from a region of higher water potential (dilute solution) to a region of lower water potential (concentrated solution), through a partially permeable membrane
- 8 Explain the effects on plant tissues of immersing them in solutions of different concentrations by using the terms turgid, turgor pressure, plasmolysis and flaccid
- 9 Explain the importance of water potential and osmosis in the uptake of water by plants
- 10 Explain the importance of water potential and osmosis on animal cells and tissues

B3 Biological molecules**Core**

- 1 List the chemical elements that make up:
 - carbohydrates
 - fats
 - proteins
- 2 State that large molecules are made from smaller molecules, limited to:
 - starch and glycogen from glucose
 - proteins from amino acids
 - fats and oils from fatty acids and glycerol
- 3 Describe the use of:
 - iodine solution to test for starch
 - Benedict's solution to test for reducing sugars
 - biuret test for proteins
 - ethanol emulsion test for fats and oils
- 4 State that water is important as a solvent

B4 Enzymes**Core**

- 1 Define *enzymes* as proteins that function as biological catalysts
- 3 Investigate and describe the effect of changes in temperature and pH on enzyme activity

Supplement

- 2 Explain enzyme action with reference to the complementary shape of the active site of an enzyme and its substrate and the formation of a product
- 4 Explain the effect of changes in temperature on enzyme activity, in terms of kinetic energy, shape and fit, frequency of effective collisions and denaturation
- 5 Explain the effect of changes in pH on enzyme activity in terms of shape and fit and denaturation

B5 Plant nutrition**Core**

- 1 Define *photosynthesis* as the process by which plants manufacture carbohydrates from raw materials using energy from light
- 2 State the word equation for photosynthesis: carbon dioxide + water → glucose + oxygen, in the presence of light and chlorophyll
- 6 Investigate the necessity for chlorophyll, light and carbon dioxide for photosynthesis, using appropriate controls
- 8 Identify chloroplasts, cuticle, guard cells and stomata, upper and lower epidermis, palisade mesophyll, spongy mesophyll, vascular bundles, xylem and phloem in leaves of a dicotyledonous plant
- 10 Describe the importance of:
 - nitrate ions for making amino acids
 - magnesium ions for making chlorophyll

Supplement

- 3 State the balanced equation for photosynthesis

$$6\text{CO}_2 + 6\text{H}_2\text{O} \xrightarrow[\text{chlorophyll}]{\text{light}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$$
- 4 Explain that chlorophyll transfers light energy into chemical energy in molecules, for the synthesis of carbohydrates
- 5 Outline the subsequent use and storage of the carbohydrates made in photosynthesis
- 7 Investigate and describe the effect of varying light intensity and temperature on the rate of photosynthesis (e.g. in submerged aquatic plants)
- 9 Describe the significance of the features of a leaf in terms of functions, to include:
 - palisade mesophyll and distribution of chloroplasts – photosynthesis
 - stomata, spongy mesophyll cells and guard cells – gas exchange
 - xylem for transport and support
 - phloem for transport
- 11 Explain the effects of nitrate ion and magnesium ion deficiency on plant growth

B6 Animal nutrition**B6.1 Diet****Core**

- 1 State what is meant by the term *balanced diet* for humans
- 2 List the principal sources of, and describe the dietary importance of:
 - carbohydrates
 - fats
 - proteins
 - vitamins, limited to C and D
 - mineral salts, limited to calcium and iron
 - fibre (roughage)
 - water

Supplement

- 3 Explain how age, gender and activity affect the dietary needs of humans including during pregnancy and whilst breast-feeding
- 4 Describe the effects of malnutrition in relation to starvation, constipation, coronary heart disease, obesity and scurvy
- 5 Explain the causes and effects of vitamin D and iron deficiencies
- 6 Explain the causes and effects of protein-energy malnutrition, e.g. kwashiorkor and marasmus

B6.2 Alimentary canal**Core**

- 1 Define *ingestion* as the taking of substances, e.g. food and drink, into the body through the mouth
- 2 Define *digestion* as the breakdown of large, insoluble food molecules into small, water-soluble molecules using mechanical and chemical processes
- 5 Define *absorption* as movement of digested food molecules through the wall of the intestine into the blood
- 6 Define *assimilation* as the movement of digested food molecules into the cells of the body where they are used, becoming part of the cells
- 7 Define *egestion* as passing out of food that has not been digested, as faeces, through the anus
- 8 Identify the main regions of the alimentary canal and associated organs, including mouth, salivary glands, oesophagus, stomach, small intestine, pancreas, liver, gall bladder, large intestine and anus
- 9 Describe the functions of the regions of the alimentary canal listed above, in relation to ingestion, digestion, absorption, assimilation and egestion of food

Supplement

- 3 Define *mechanical digestion* as the breakdown of food into smaller pieces without chemical change to the food molecules
- 4 Define *chemical digestion* as the breakdown of large, insoluble molecules into small, soluble molecules

B6.3 Digestion**Core**

- 1 Identify the types of human teeth (incisors, canines, premolars and molars)
- 2 Describe the structure of human teeth, limited to enamel, dentine, pulp, nerves and cement, as well as the gums
- 3 Describe the functions of the types of human teeth in mechanical digestion of food
- 4 Describe the proper care of teeth in terms of diet and regular brushing

- 6 State the significance of chemical digestion in the alimentary canal in producing small, soluble molecules that can be absorbed

Supplement

- 5 State the causes of dental decay in terms of a coating of bacteria and food on teeth, the bacteria respiring sugars in the food, producing acid which dissolves the enamel and dentine
- 7 State the functions of enzymes as follows:
 - amylase breaks down starch to simpler sugars
 - protease breaks down protein to amino acids
 - lipase breaks down fats to fatty acids and glycerol
- 8 State where, in the alimentary canal, amylase, protease and lipase are secreted
- 9 State the functions of the hydrochloric acid in gastric juice, limited to killing bacteria in food and giving an acid pH for enzymes
- 10 Explain the functions of the hydrochloric acid in gastric juice, limited to the low pH:
 - denaturing enzymes in harmful microorganisms in food
 - giving the optimum pH for protease activity
- 11 Outline the role of bile in neutralising the acidic mixture of food and gastric juices entering the duodenum from the stomach, to provide a suitable pH for enzyme action
- 12 Outline the role of bile in emulsifying fats to increase the surface area for the chemical digestion of fat to fatty acids and glycerol by lipase
- 13 Explain the significance of villi in increasing the internal surface area of the small intestine
- 14 Describe the structure of a villus
- 15 Describe the roles of capillaries and lacteals in villi

C1 The particulate nature of matter**Core**

- 1 State the distinguishing properties of solids, liquids and gases
- 2 Describe the structure of solids, liquids and gases in terms of particle separation, arrangement and types of motion
- 3 Describe the changes of state in terms of melting, boiling, evaporation, freezing and condensation
- 4 Demonstrate understanding of the terms *atom*, *molecule* and *ion*
- 6 Describe and explain diffusion in terms of the movement of particles (atoms, molecules or ions)

Supplement

- 5 Explain changes of state in terms of particle theory and the energy changes involved
- 7 Describe and explain dependence of rate of diffusion on molecular mass

C2 Experimental techniques**C2.1 Measurement****Core**

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

C2.2 Criteria of purity**Core**

- 1 Demonstrate knowledge and understanding of paper chromatography
- 2 Interpret simple chromatograms
- 4 Understand the importance of purity in substances for use in everyday life, e.g. in the manufacture of compounds to use in drugs and food additives
- 5 Recognise that mixtures melt and boil over a range of temperatures

Supplement

- 3 Interpret simple chromatograms, including the use of R_f values
- 6 Identify substances and assess their purity from melting point and boiling point information

C2.3 Methods of purification**Core**

- 1 Describe and explain methods of separation and purification by the use of a suitable solvent, filtration, crystallisation, distillation, fractional distillation and paper chromatography
- 2 Suggest suitable separation and purification techniques, given information about the substances involved

C3 Atoms, elements and compounds**C3.1 Physical and chemical changes****Core**

- 1 Identify physical and chemical changes, and understand the differences between them

Supplement

- 2 Understand that some chemical reactions can be reversed by changing the reaction conditions (Limited to the effects of heat and water on hydrated and anhydrous copper(II) sulfate and cobalt(II) chloride.) (Concept of equilibrium is **not** required.)

C3.2 Elements, compounds and mixtures**Core**

- 1 Describe the differences between elements, mixtures and compounds, and between metals and non-metals
- 2 Define the terms *solvent*, *solute*, *solution* and *concentration*

C3.3 Atomic structure and the Periodic Table**Core**

- 1 Describe the structure of an atom in terms of a central nucleus, containing protons and neutrons, and 'shells' of electrons
- 2 Describe the build-up of electrons in 'shells' and understand the significance of the noble gas electronic structures and of the outer shell electrons
(The ideas of the distribution of electrons in s and p orbitals and in d block elements are **not** required.)
- 3 State the charges and approximate relative masses of protons, neutrons and electrons
- 4 Define and use *proton number* (atomic number) as the number of protons in the nucleus of an atom
- 5 Define and use *nucleon number* (mass number) as the total number of protons and neutrons in the nucleus of an atom
- 6 Use proton number and the simple structure of atoms to explain the basis of the Periodic Table, with special reference to the elements of proton numbers 1 to 20
- 7 Define *isotopes* as atoms of the same element which have the same proton number but a different nucleon number

Supplement

- 8 Understand that isotopes have the same properties because they have the same number of electrons in their outer shell

Note: a copy of the Periodic Table, as shown in the Appendix, will be provided in Papers 1, 2, 3 and 4.

C3.4 Ions and ionic bonds**Core**

- 1 Describe the formation of ions by electron loss or gain
- 2 Use dot-and-cross diagrams to describe the formation of ionic bonds between Group I and Group VII

Supplement

- 3 Describe the formation of ionic bonds between metallic and non-metallic elements to include the strong attraction between ions because of their opposite electrical charges
- 4 Describe the lattice structure of ionic compounds as a regular arrangement of alternating positive and negative ions, exemplified by the sodium chloride structure

C3.5 Molecules and covalent bonds**Core**

- 1 State that non-metallic elements form simple molecules with covalent bonds between atoms
- 2 Describe the formation of single covalent bonds in H_2 , Cl_2 , H_2O , CH_4 , NH_3 and HCl as the sharing of pairs of electrons leading to the noble gas configuration including the use of dot-and-cross diagrams
- 4 Describe the differences in volatility, solubility and electrical conductivity between ionic and covalent compounds

Supplement

- 3 Use and draw dot-and-cross diagrams to represent the bonding in the more complex covalent molecules such as N_2 , C_2H_4 , CH_3OH , and CO_2
- 5 Explain the differences in melting point and boiling point of ionic and covalent compounds in terms of attractive forces

C3.6 Macromolecules**Core**

- 1 State that there are several different forms of carbon, including diamond and graphite
- 2 Describe the giant covalent structures of graphite and diamond

Supplement

- 3 Relate the structures of diamond and graphite to their uses, e.g. graphite as a lubricant and a conductor and diamond in cutting tools
- 4 Describe the macromolecular structure of silicon(IV) oxide (silicon dioxide, SiO_2)