

SYLLABUS FOR COMBINED SCIENCE (CHEMISTRY & BIOLOGY) ENTRANCE TEST

1. Cell Structure and Organisation

- (a) identify cell structures (including organelles) of typical plant and animal cells from diagrams, photomicrographs and as seen under the light microscope using prepared slides and fresh material treated with an appropriate temporary staining technique:
- chloroplasts
 - cell membrane
 - cell wall
 - cytoplasm
 - cell vacuoles (large, sap-filled in plant cells, small, temporary in animal cells)
 - nucleus
- (b) identify the following organelles from diagrams and electron micrographs:
- mitochondria
 - ribosomes
- (c) state the functions of the organelles identified above
- (d) compare the structure of typical animal and plant cells
- (e) state, in simple terms, the relationship between cell function and cell structure for the following:
- absorption – root hair cells
 - conduction and support – xylem vessels
 - transport of oxygen – red blood cells
- (f) differentiate cell, tissue, organ and organ system

2. Movement of Substances

- (a) define *diffusion* and describe its role in nutrient uptake and gaseous exchange in plants and humans
- (b) define *osmosis* and describe the effects of osmosis on plant and animal tissues

3. Biological Molecules

- (a) state the roles of water in living organisms
- (b) describe and carry out tests for
- starch (iodine in potassium iodide solution)
 - reducing sugars (Benedict's solution)
 - protein (biuret test)
 - fats (ethanol emulsion)
- (c) state that large molecules are synthesised from smaller basic units
- glycogen from glucose
 - polypeptides and proteins from amino acids
 - lipids such as fats from glycerol and fatty acids
- (d) explain enzyme action in terms of the 'lock and key' hypothesis (explain the mode of action of enzymes in terms of an active site, enzyme-substrate complex and enzyme specificity)

SYLLABUS FOR COMBINED SCIENCE (CHEMISTRY & BIOLOGY) ENTRANCE TEST

- (e) investigate and explain the effects of temperature and pH on the rate of enzyme catalysed reactions

4. Nutrition in Humans

- (a) describe the functions of main regions of the alimentary canal and the associated organs: mouth, salivary glands, oesophagus, stomach, duodenum, pancreas, gall bladder, liver, ileum, colon, rectum, anus, in relation to ingestion, digestion, absorption, assimilation and egestion of food, as appropriate
- (b) describe the functions of enzymes (e.g. amylase, maltase, protease, lipase) in digestion, listing the substrates and end-products
- (c) state the function of the hepatic portal vein as the transport of blood rich in absorbed nutrients from the small intestine to the liver
- (d) state the role of the liver in
- the metabolism of glucose
 - the metabolism of amino acids and the formation of urea
 - the breakdown of alcohol

5. Nutrition in Plants

- (a) identify the cellular and tissue structure of a dicotyledonous leaf, as seen in cross-section under the microscope and state their functions:
- distribution of chloroplasts - photosynthesis
 - stomata and mesophyll cells - gaseous exchange
 - vascular bundles - transport
- (b) state the equation, in words only, for photosynthesis
- (c) describe the intake of carbon dioxide and water by plants
- (d) state that chlorophyll traps light energy and converts it into chemical energy for the formation of carbohydrates and their subsequent storage
- (e) investigate and state the effect of varying light intensity, carbon dioxide concentration and temperature on the rate of photosynthesis (e.g. in submerged aquatic plants)
- (f) briefly explain why most forms of life are completely dependent on photosynthesis

6. Transport in Flowering Plants

- (a) identify the positions of xylem vessels and phloem in sections of a typical dicotyledonous stem and leaf, under the light microscope, and state their functions
- (b) relate the structure and functions of root hairs to their surface area, and to water and ion uptake
- (c) state that transpiration is the loss of water vapour from the stomata
- (d) briefly explain the movement of water through the stem in terms of transpiration pull
- (e) describe
- a. the effects of variation of air movement, temperature, humidity and light intensity on transpiration rate
 - b. how wilting occurs
- (f) define the term translocation as the transport of food in the phloem tissue

SYLLABUS FOR COMBINED SCIENCE (CHEMISTRY & BIOLOGY) ENTRANCE TEST

7. Transport in Humans

- (a) name the main blood vessels to and from the heart, lungs, liver and kidney
- (b) state the functions of blood
- red blood cells – haemoglobin and oxygen transport
 - plasma – transport of blood cells, ions, soluble food substances, hormones, carbon dioxide, urea, vitamins, plasma proteins
 - white blood cells – phagocytosis, antibody formation and tissue rejection
 - platelets – fibrinogen to fibrin, causing clotting
- (c) relate the structure of arteries, veins and capillaries to their functions
- (d) describe the structure and function of the heart in terms of muscular contraction and the working of valves (histology of the heart muscle, names of nerves and transmitter substances are **not** required)
- (e) describe coronary heart disease in terms of the occlusion of coronary arteries and list the possible causes, such as diet, stress and smoking, stating the possible preventative measures

8. Respiration in Humans

- (a) identify on diagrams and name the larynx, trachea, bronchi, bronchioles, alveoli and associated capillaries and state their functions in human gas exchange
- (b) state the characteristics of, and describe the role of, the exchange surface of the alveoli in gas exchange
- (c) describe the effect of tobacco smoke and its major toxic components – nicotine, tar and carbon monoxide, on health
- (d) define and state the equation, in words only, for aerobic respiration in humans
- (e) define and state the equation, in words only, for anaerobic respiration in humans
- (f) describe the effect of lactic acid in muscles during exercise

9. Co-ordination and Response in Humans

- (a) state the relationship between receptors, the central nervous system and the effectors
- (b) state the principal functions of component parts of the eye in producing a focused image of near and distant objects on the retina
- (c) describe the pupil reflex in response to bright and dim light
- (d) outline the functions of sensory neurones, relay neurones and motor neurones
- (e) 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
- (f) state what is meant by an endocrine gland, with reference to the islets of Langerhans in the pancreas
- (g) outline how the blood glucose level concentration is regulated by insulin and glucagon

10. Reproduction

- (a) define *asexual reproduction* as the process resulting in the production of genetically identical offspring from one parent
- (b) define *sexual reproduction* as the process involving the fusion of nuclei to form a zygote and the production of genetically dissimilar offspring

SYLLABUS FOR COMBINED SCIENCE (CHEMISTRY & BIOLOGY) ENTRANCE TEST

- (c) state the functions of the sepals, petals, anthers and carpels
- (d) outline the process of pollination
- (e) 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)
- (f) identify on diagrams, the male reproductive system and give the functions of: testes, scrotum, sperm ducts, prostate gland, urethra and penis
- (g) identify on diagrams, the female reproductive system and give the functions of: ovaries, oviducts, uterus, cervix and vagina
- (h) briefly describe the menstrual cycle with reference to the alternation of menstruation and ovulation, the natural variation in its length, and the fertile and infertile phases of the cycle, with reference to the roles of progesterone and estrogen only
- (i) briefly describe fertilisation and early development of the zygote simply in terms of the formation of a ball of cells which becomes implanted in the wall of the uterus
- (j) discuss the spread of human immunodeficiency virus (HIV) and methods by which it may be controlled

11. Molecular Genetics

- (a) outline the relationship between genes, chromosomes and DNA
- (b) state the structure of DNA in terms of the bases, sugar and phosphate groups found in each of their nucleotides
- (c) state the rule of complementary base pairing
- (d) state that DNA is used to carry the genetic code, (details of transcription and translation are **not** required)
- (e) state that each gene
 - is a sequence of nucleotides, as part of a DNA molecule
 - controls the production of one polypeptide

12. Inheritance

- (a) define a *gene* as a unit of inheritance and distinguish clearly between the terms *gene* and *allele*
- (b) describe the difference between continuous and discontinuous variation and give examples of each
- (c) explain the terms dominant, recessive, homozygous, heterozygous, phenotype and genotype
- (d) predict the results of simple crosses with expected ratios of 3:1 and 1:1, using the terms homozygous, heterozygous, F₁ generation and F₂ generation
- (e) state why observed ratios often differ from expected ratios, especially when there are small numbers of progeny
- (f) describe the determination of sex in humans – XX and XY chromosomes
- (g) describe mutation as a change in the structure of a gene such as in sickle cell anaemia, or in the chromosome number, such as the 47 chromosomes in the condition known as Down's syndrome
- (h) name radiation and chemicals as factors which may increase the rate of mutation

SYLLABUS FOR COMBINED SCIENCE (CHEMISTRY & BIOLOGY) ENTRANCE TEST

13. Organisms and their Environment

- (a) briefly describe the non-cyclical nature of energy flow
- (b) establish the relationship of the following in food webs: producer, consumer, herbivore, carnivore, decomposer, food chain, trophic level
- (c) describe how energy losses between trophic levels and infer the advantages of short food chains
- (d) interpret pyramids of numbers and biomass
- (e) explain the importance of the carbon cycle and outline the role of forests and oceans as carbon sinks
- (f) evaluate the effects of
 - water pollution by sewage
 - pollution due to insecticides including bioaccumulation up food chains and impact on top carnivores
- (g) outline the roles of microorganisms in sewage treatment as an example of environmental biotechnology
- (h) discuss reasons for conservation of species with reference to the maintenance of biodiversity and how this is done, e.g. management of fisheries and management of timber production

END