1. Cell Structure and Organisation Content

- Plant and Animal Cells
- Cell Specialisation

Learning Outcomes

Candidates should be able to:

(a) identify and state the functions of the following cell structures (including organelles) of typical plant and animal cells from diagrams, light micrographs and as seen under the light microscope using prepared slides and fresh material treated with an appropriate temporary staining technique:

- cell wall - fully permeable; gives the cell its fixed shape and protects it from injury
- cell membrane - partially permeable; controls the substances going in and out of the cell
- cytoplasm - contains cell organelles and enzymes; where most cell activities occur
- nucleus - controlls cell activities such as cell growth and repair of worn-out parts; essential for cell division
- cell vacuoles (large, sap-filled in plant cells, small, temporary in animal cells) - stores dissolved substances
- chloroplasts - contains chlorophyll which absorbs light energy and converts it to chemical energy to manufacture glucose with carbon dioxide and water during photosynthesis. oxygen is produced.

(b) identify and state the functions of the following organelles from diagrams and electron micrographs:

- mitochondria - site for aerobic respiration where glucose is oxidised to release energy for cellular activities
- ribosomes - synthesis of proteins

(c) compare the structure of typical animal and plant cells

plant cell	animal cell
have cell wall	no cell wall
has a large central vacuole	have numerous small vacuoles
have chloroplasts (leaf cells)	no chloroplasts

(d) explain how the structures of specialised cells are adapted to their functions (e.g. muscle cell – many mitochondria to supply more energy, root hair cell – large surface area of cell membrane for greater absorption, red blood cell – lack of nucleus allowing it to transport more oxygen)

root hair cell
- long, narrow protrusion to increase surface area to volume ratio for increased rate of absorption of water and dissolved mineral salts
- uniformly thin cell wall to decrease diffusion distance to increase rate of absorption of water molecules and mineral ions

red blood cell
- circular biconcave shape to increase surface area to volume ratio for increased rate of transport of oxygen
- absence of nucleus to allow for packing of more haemoglobin to increase carrying capacity of oxygen molecules
- contains haemoglobin which binds irreversibly with oxygen to form oxyghaemiglobin to transport it around the body

muscle cell

- numerous mitochondria to release more energy via aerobic respiration for contraction of muscle cell

2. Movement of Substances Content

- Diffusion
- Osmosis

Learning Outcomes

Candidates should be able to:

(a) define *diffusion* and describe its role in nutrient uptake and gaseous exchange in plants and humans - net movement of particles from a region of higher concentration to a region of lower concentration down a concentration gradient

(b) define *osmosis*, investigate and describe the effects of osmosis on plant and animal tissues - net movement of water molecules from a region of higher water potential to a region of lower water potential across a partially permeable membrane

3. Biological Molecules Content

- Carbohydrates, Fats and Proteins
- Enzymes

Learning Outcomes

Candidates should be able to:

(a) state the main roles of carbohydrates, fats and proteins in living organisms:

- carbohydrates as an immediate source of energy
- fats for insulation and long-term storage of energy
- proteins for growth and repair of cells

(b) describe and carry out tests for:

- starch (using iodine in potassium iodide solution) - iodine remains brown: starch absent, iodine turns blue-black: starch present
- reducing sugars (using Benedict's solution) - remains blue: absent, blue to green ppt: traces, blue to yellow/orange ppt - moderate, blue to brick red ppt: large amount
- protein (using biuret solution) - blue to violet: present, remains blue: absent
- fats (using ethanol) - cloudy white emulsion: fats present, remains clear: absent

(c) state that large molecules are synthesised from smaller basic units:

- cellulose, glycogen and starch from glucose
- polypeptides and proteins from amino acids
- lipids such as fats from glycerol and fatty acids

(d) explain the mode of action of enzymes in terms of an active site, enzyme-substrate complex and enzyme specificity using the ‘lock and key’ hypothesis

enzyme is the lock, substrate is the key. substrate binds to the active site of the enzyme to form enzyme-substrate complex. while substrate is attached to the active site, chemical reactions take place, and substrate is converted into products, but enzyme remains chemically unchanged at the end of the reaction.

enzymes

- biological catalysts made up of proteins
- form an enzyme-substrate complex
- required in minute amounts as they can be reused over and over again
- remain chemically unchanged at the end of the reaction
- speed up or alter rate of reaction

(e) investigate and explain the effects of temperature and pH on the rate of enzyme catalysed reactions
increasing temperature: particle gain kinetic energy, enzyme is more active. beyond optimum pH and temperature - enzymes are denatured, active site of enzyme is lost

optimum pH and temperature - enzymes are most active, rate of reaction is highest

4. Nutrition in Humans Content

- Human Digestive System
- Physical and Chemical Digestion

5. Absorption and Assimilation

Learning Outcomes

Candidates should be able to:

(a) describe the functions of the various parts of the digestive system: 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

mouth: chewing to break food into smaller pieces for increased rate of digestion by salivary amylase

salivary glands; secrete saliva containing salivary amylase via salivary duct, softens food for faster digestion by salivary amylase

oesophagus: long narrow muscular tube made up of longitudinal and circular muscles

stomach: thick distenisble, peristalsis to churn, break up and mix with gastric juice, contains hydrochloride acid (pH 2), to kill harmful microorganisms in food, acidic to stop the action of salivary amylase. provide acidic medium for protease
small intestine (duodenum & ileum): peristalsis to churn and break up large pieces of food into smaller pieces, ileum - absorption, has villi (tiny finger-like protrusions) to increase surface area to volume ratio for faster rate of absorption of digested food. the small intestine is long to allow more time for absorption, richly supplied with blood capillaries to maintain a steep concentration gradient for faster rate of absorption.

large intestine: no digestion, absorb water and mineral salts from undigested food.

rectum: stores faeces temporarily

anus: where faeces are expelled through

(b) describe the functions of enzymes (e.g. amylase, maltase, protease, lipase) in digestion, listing the substrates and end-products
amylase digests starch into maltose (salivary amylase found in mouth and pancreatic amylase found in small intestine)
maltase digests maltose into glucose (found in small intestine)
stomach and pancreatic protease digests proteins into polypeptide, intestinal protease digests polypeptide into amino acids
lipase digests fats into fatty acids and glycerol (both intestinal & pancreatic lipase found in small intestine)

(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:

- conversion of glucose to glycogen and vice versa (regulate blood glucose concentration) - when BGC increases above or below normal, more insulin or glucagon is secreted by islets of Langerhans in the pancreas to regulate BGC
- fat digestion (production of bile) - bile emulsifies large fat globules into small fat droplets to increase surface area to volume ratio for icreased rate of digestion of fats by lipase into fatty acids and glycerol
- metabolism of amino acids and formation of urea (deamination of excess amino acids) - excess amino acids are brought to the liver for its amino groups to be removed, and converted to urea, removed via urine
- breakdown of alcohol - harmful substances are transported to the liver to be converted into harmless substances

- breakdown of hormones - once a hormone as served its function, it is brought to the liver to be broken down

(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

(f) outline how blood glucose concentration is regulated by insulin and glucagon

when BGC increases above normal (after a heavy meal), islets of Langerhans are stimulated to produce more insulin into the bloodstream, insulin is transported by blood to the liver where it stimulates the liver to convert excess glucose into glycogen for storage. BGC decreases back to normal.

when BGC decreases below normal (starving/fasting/after exercise), islets of Langerhans are stimulated to produce more glucagon into the bloodstream, glucagon is transported by blood to the liver where it stimulates the liver to convert excess glycogen into glucose. BGC increases back to normal.

(g) describe type 2 *diabetes mellitus* in terms of a persistently higher than normal blood glucose concentration due to the body's resistance to insulin or insufficient production of insulin - persistently high blood glucose levels, presence of glucose in urine after a meal

(h) identify the risk factors of (e.g. unhealthy diet and sedentary lifestyle) and ways to manage type 2 *diabetes mellitus*

risk factors:
- age
- genetic factor
- sedentary lifestyle
- unhealthy diet

ways to manage:
- healthy diet
- exercise regularly

6. Transport in Humans Content

- Parts and Functions of the Circulatory System
- Blood
- Coronary Heart Disease

Learning Outcomes

Candidates should be able to:

(a) identify the main blood vessels to and from the heart, lungs, liver and kidney

heart - coronary
lungs - pulmonary
liver - hepatic
kidney - renal

(b) relate the structures of arteries, veins and capillaries to their functions (specific names of muscle layers in arteries and veins are **not** required)

artery (transport blood away from heart)
- thick and muscular to withstand high blood pressure
- elastic, can stretch and recoil, to help push the blood in spurts, to maintain high blood pressure, give rise to the pulse

veins (transport blood towards the heart)
- less thick and less muscular than artery
- less elastic
- presence of valves along their length to prevent back flow of blood (semi-lunar valves)

capillary (site of exchange of substances)
- one-cell-thick to decrease diffusion distance for increased rate of diffusion of substances
- partially permeable to allow only certain substances to pass through

(c) state the components of blood and their roles in transport and defence:

- red blood cells – haemoglobin for oxygen transport (binds to oxygen to form oxyhaemoglobin, transport oxygen around the body)

- plasma – transport of blood cells, ions, soluble food substances, hormones, carbon dioxide, urea, vitamins, plasma proteins

- white blood cells – (phagocytes) phagocytosis - engulf and destroy bacteria, (lymphocytes) antibody formation, cause bacteria to clump together for easier ingestion by phagocytes and tissue rejection (when transplanted organ is treated as foreign body, white blood cells produce antibodies.will not occur if transplanted organ is from the same body)

- platelets – thrombin(enzyme) converts soluble fibrinogen to insoluble fibrin threads, entangle RBCs, causing clotting, preventing excessive loss of blood or the entry of harmful microorganisms

(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)

- median septum: prevents mixing of oxygenated and deoxygenated blood (mixing decreases amount of oxygen transported
- ventricle has thicker, more muscular walls to generate more pressure as it pumps blood to a further distance (rest of body) compared to atrium (to lungs)
- presence of valves to prevent backflow of blood
- pathway of blood: oxygenated blood from the lungs are transported to the left atrium via the pulmonary vein. when left atrium contracts, it pushes blood into the left ventricle via the bicuspid valve. when the left ventricle contracts, it pushes blood out of the heart through the semi-lunar valve, via the aorta, to the rest of the body. deoxygenated blood from the rest of the body is transported via the vena cava, passes through the semi-lunar valve and enters the right atrium. when right atrium contracts, is pushed blood into the right ventricle via the tricuspid valve, when right ventricle contracts, it pushes blood out of the heart, through the semi-lunar valve and through the pulmonary artery, and it is transported back to the lungs.

(e) describe coronary heart disease in terms of the occlusion of coronary arteries and list the possible causes, such as unhealthy diet, sedentary lifestyle, and smoking, stating the possible preventative measures

coronary heart disease: fatty deposits stuck on the inner walls of the coronary arteries, narrowing lumen. when blood clot forms, less oxygen and glucose supplied to the heart muscles. heart muscles are unable to respire to release energy for muscular contractions. part of the heart muscle dies/heart attack

causes:

- smoking
- unhealhty diet (high in cholesterol and saturated fats)
- age
- sedentary lifestyle

preventive measures:

- healthy diet
- do not smoke
- exercise regularly

7. Respiration in Humans Content

- Human Gas Exchange
- Cellular Respiration

Learning Outcomes

Candidates should be able to:

(a) identify the larynx, trachea, bronchi(plural), bronchioles, alveoli and associated capillaries and state their functions in human gaseous exchange

(b) explain how the structure of an alveolus is suited for its function of gaseous exchange
- one-cell-thick to decrease diffusion distance for faster rate of diffusion of gasses
- richly supplied with blood capillaries to maintain steep concentration gradient for increased rate of diffusion of gasses
- thin film of moisture for oxygen to dissolve in and diffuse across alveolar wall

(c) state the major toxic components of tobacco smoke – nicotine, tar and carbon monoxide, and describe their effects on health

nicotine
- increases heart rate and pressure
- addictive
- increases risk of blood clot, leading to coronary heart disease

tar
- causes uncontrolled cell division, increasing risk of lung cancer
- paralyses cilia lining the epithelium, dust trapped mucus cannot be removed, increasing risk of emphysema and chronic bronchitis

carbon monoxide
- binds irreversibly with haemoglobin in blood, reduces the oxygen carrying capavity of haemoglobin
- increase rate of fatty deposits on inner arterial wall, increasing risk of coronary heart disease

**diseases caused by tobacco smoke
- emphysema: partition walls in alveoli broken down due to persistent and violent coughing. decreased surface area for gaseous exchange
- chronic broncitis: epithelium lining inflamed, excessive mucus, cilia paralysed. mucus and dust particles cannot be removed, air passages blocked, persistent and violent coughing to clear air passages to breath, increasing risk of lung infections

(d) define *aerobic respiration* in human cells as the release of energy by the breakdown of glucose in the presence of oxygen and state the word equation

oxygen + glucose -> carbon dioxide + water + large amount of energy

(e) define *anaerobic respiration* in human cells as the release of energy by the breakdown of glucose in the absence of oxygen and state the word equation

glucose -> lactic acid + water + small amount of energy

(f) explain why cells respire anaerobically during vigorous exercise resulting in an oxygen debt that is removed by rapid, deep breathing after exercise

- during vigorous muscular contractions, energy demand increases
- breathing rate and heart rate increases to supply oxygen and glucose to muscles at a faster rate; and carbon dioxide to be removed at a faster rate
- when maximum aerobic respiration cannot produce oxygen fast enough to meet oxygen demand, oxygen debt is incurred anaerobic respiration occurs to release a small amount of energy to meet energy demand
- lactic acid is produced and accumulated in the muscles, causing fatigue and muscular pain
- breathing rate remains high after exercise to repay oxygen debt. lactic acid is gradually removed from muscles and transported to liver
- in the liver, lactic acid is oxidised to release energy to convert remaining lactic acid into glucose and tranported back to the muscles

8. Infectious Diseases in Humans Content

- Organisms affecting Human Health
- Influenza and Pneumococcal Disease
- Prevention and Treatment of Infectious Diseases

Learning Outcomes

Candidates should be able to:

(a) state that infectious diseases can be spread from person to person (e.g. influenza, pneumococcal, COVID-19, HIV) whereas non-infectious diseases cannot (e.g. diabetes, coronary heart disease) and identify examples of each

spread through: body fluids, direct contact, contaminated food and water

(b) explain that infectious diseases are caused by pathogens such as bacteria and viruses and can be spread from person to person through body fluids, food and water (knowledge of the structure of bacteria and viruses is **not** required)

(c) state the signs and symptoms of:

- influenza – caused by the influenza virus (cough fever headache, sore throat, runny nose, fatigue)
- pneumococcal disease – caused by the bacteria, pneumococcus (cough fever headache, shortness of breath, fatigue)

influenza	**pneumococcal**
fever, cough, headache	
sore throat, runny nose, fatigue	vomiting, shortness of breath

(d) describe the transmission and methods to reduce the transmission of:

- influenza virus - droplets in air; touching contaminated surfaces then touching eyes, nose, mouth
- pneumococcus - respiratory droplets

methods to reduce transmission

- influenza: wear a mask when coughing, vaccine, wash hands with soap and water
- pneumococcus: same + antibiotics

signs vs symptoms

- symptom can be felt and described by the pateint (nausea, headache)
- sign can be observed of measured (fever, cough, vomiting)

(e) state that vaccines contain an agent that resembles a pathogen (bacteria and virus) and prevent infectious diseases by stimulating white blood cells to quickly produce antibodies when the pathogen invades

(f) state that antibiotics kill bacteria and are ineffective against viruses

(g) explain that the misuse and overuse of antibiotics may accelerate the emergence of antibiotic-resistant bacteria

9. Nutrition and Transport in Flowering Plants Content

- Plant Structure
- Photosynthesis
- Transpiration
- Translocation

Learning Outcomes

Candidates should be able to:

(a) identify the cellular and tissue structure of a dicotyledonous leaf, as seen in transverse section using the light microscope and describe the significance of these features in terms of their functions, such as the

- distribution of chloroplasts for photosynthesis
- stomata and mesophyll cells for gaseous exchange
- vascular bundles for transport

upper epidermal layer

- waxy cuticle to prevent excessive loss of blood, transparent to allow sunlight to pass through to reach mesophyll cells
- no chloroplasts

palisade mesophyll layer

- numerous chloroplasts as it is closer to the upper surface of the leaf so it can absorb more sunlight

spongy mesophyll layer

- thin film of moisture for carbon dioxide to dissolve in before dissolving into the cells
- intercellular air spaces to allow for rapid diffusion of carbon dioxide and oxygen into and out of the mesophyll cells
- xylem and phloem

lower epidermal layer

- presence of stomata that opens in the presence of light to allow exchange of gases

guard cells

- controls the size of stomata
- contains chloroplasts for photoysnthesis

(b) identify the positions of and state the functions of xylem vessels and phloem in sections of a herbaceous dicotyledonous leaf and stem, under the light microscope

in stem: xylem inside phloem outside

in leaf: xylem on top phloem below

xylem: conduct water and mineral salts from roots to stem and leave; provide mechanical support (thickened with lignin)

phloem: conduct manufactured food substances (sucrose and amino acids) from leaves to other parts of the plant

(c) explain how the structure of a root hair cell is suited for its function of water and ion uptake

long, narrow protrusion to increase surface area to volume ratio for increased rate of absorption of water and mineral ions

uniformly thin cell wall to decrease diffusion distance for increased rate of absorption of water and mineral ions

numerous mitochondria to release energy more energy via aerobic respiration

(d) state that chlorophyll absorbs light energy and converts it into chemical energy for the formation of carbohydrates and their subsequent uses

(e) briefly explain why most forms of life are completely dependent on photosynthesis
- photosynthesis is the primary process which absorbs light energy and converts it to chemical energy to manufacture glucose
- produces oxygen which is essential for aerobic respiration of organisms

(f) state the word equation for photosynthesis (details of light-dependent and light-independent stages are **not** required)

$$\text{carbon dioxide + water} \xrightarrow[\text{chlorophyll}]{\text{light}} \text{oxygen + glucose}$$

(g) describe how carbon dioxide reaches mesophyll cells in a leaf

during photosynthesis, carbon dioxide in the lead is used up. carbon dioxide diffuses into the leaf through the stomata, down a concentration. carbon dioxide diffuses into the thin film of moisture before diffusing into the cells.

(h) investigate and describe the effects of varying light intensity, carbon dioxide concentration and temperature on the rate of photosynthesis (e.g. in submerged aquatic plants)

as light intensity increases, rate of photosynthesis increases
as carbon dioxide concentration increases, rate of photosynthesis increases
as temperature increases to optimum, rate of photosynthesis increases. beyond optimum, enzymes are denatured, rate of photosynthesis decreases

(i) state that *transpiration* is the loss of water vapour from the stomata

(j) briefly explain the movement of water through the stem in terms of transpiration pull

soil solution has higher water potential than cell sap. net movement of water molecules soil solution into cell sap across partially permeable cell membrane via osmosis. water potential of cell is higher than adjacent cell. net movement of water molecules into adjacent cell via osmosis across PPCM. repeats until reach xylem. water moves up the stem by transpiration pull. in leaf, water molecules move cell to cell via osmosis until it reaches mesophyll cells

(k) investigate and explain:

- the effects of variation of air movement, temperature, humidity and light intensity on transpiration rate
  - wind blows away the water vapour concentration surrounding the leaf. this maintains steep water vapour concentration, increase rate of diffusion
  - as temperature increases, rate of evaporation of thin film of moisture increases, steep water vapour concentration, increase rate of diffusion
  - as humidity increases, water vapour concentration around cell increases, less steep concentration, rate of diffusion decreases
- how wilting occurs - when rate of water loss via transpiration is higher than rate of absorption of water by; leaves droop down, fold up to decrease surface area to decrease water loss

(l) define the term *translocation* as the transport of food (mainly sucrose) in the phloem tissue

10. Organisms and their Environment Content

- Energy Flow
- Food Chains and Food Webs
- Carbon Cycle and Global Warming
- Effects of Man on the Ecosystem

Learning Outcomes

Candidates should be able to:

(a) describe the non-cyclical nature of energy flow
- sun: primary source of energy
- producers: absorb light energy and converts it to chemical energy during photosynthesis to manufacture glucose
- primary consumers (herbivores): feed on producers
- secondary consusmers (carnivores): feed on primary consumers

(b) describe the roles of producers, consumers and decomposers in food chains and food webs

(c) explain how energy losses occur along food chains, and discuss the efficiency of energy transfer between trophic levels
- at every trophic level, 90% of energy is lost through heat during respiration, excreted materials and when consumers do not eat all parts of the organism

(d) interpret pyramids of numbers and biomass
reasons for pyramid of biomass: consider size and mass of organism
limitatons of pyramid of biomass: only at a particular time, all organisms have a to be killed

exception for pyramid of biomass: phytoplankton;zooplankton
exception of pyramid of numbers: parasites, trees

(e) describe how carbon is cycled within an ecosystem and outline the role of forests and oceans as carbon sinks

processes that remove carbon dioxide from the atmosphere: photosynthesis

processes that supply carbon dioxide to the atmosphere: respiration, combustion, decomposition

carbon sink: stores carbon from the atmosphere for a long period of time, stores more than it releases

forests: trees and plants absorb carbon dioxide when they photosynthesise, remains of dead trees form coal (fossil fuel)

oceans: carbon dioxide dissolves into the sea water and is absorbed by algae or phytoplankton during photosynthesis. a portion of carbon is buried in sea bed in the form of natural gas and oil (fossil fuels)

(f) describe how human activities, such as deforestation and use of fossil fuels, cause an increase in atmospheric carbon dioxide concentration, leading to global warming

deforestation: reduced carbon sink; less trees to absorb carbon dioxide, stored carbon dioxide is released back into the atmosphere as carbon dioxide
use of fossil fuels: combustion of fossil fuels; industrial activities

(g) discuss how human actions can reduce the effects of global warming

- improve energy efficiency (e.g. in transportation) to reduce greenhouse gas emissions
- conserving and restoring ecosystems; reforestation, protecting forests
- low-carbon transportation; encourage the use of public transportation,electric vehicles etc.
- reduce deforestation
- implement policies and regulations
- raising awareness and education; lifestyle changes

11. Molecular Genetics Content

- The Structure of DNA
- From DNA to Proteins

Learning Outcomes

Candidates should be able to:

(a) outline the relationships among DNA, genes and chromosomes'

gene is a small segment of DNA made up of a sequence of nucleotides that codes for the synthesis of a specific polypeptide

DNA is the condensed structure of DNA, only visible during cell division

a chromosome contains many genes

(b) state that DNA is a double helix comprising two strands of nucleotides (twisted around each other to form a double-helix structure), each nucleotide formed of a deoxyribone sugar, a phosphate group and one of four different nitrogenous bases (adenine, thymine, cytosine, guanine)

(c) state the rule of complementary base pairing - adenine pairs with thymine, cytosine pairs with guanine (% of A = % of T, % of C= % of G)

(d) state that each gene:

- is a sequence of nucleotides, as part of a DNA molecule
- codes for one polypeptide
- is a unit of inheritance

(e) state that DNA is used to carry the genetic code, which is used to synthesise specific polypeptides (details of transcription and translation are **not** required)

each specific order of bases code for a particular polypeptide. different order of bases results in different codons which codes for different amino acids resulting in different polypeptides formed

3 bases = codon

12. Reproduction in Humans Content

- Sexual Reproduction in Humans
- Sexually Transmitted Diseases

Learning Outcomes

Candidates should be able to:

(a) define *sexual reproduction* as the process involving the fusion of nuclei of male and female gametes to form a zygote and the production of genetically dissimilar offspring

(b) identify the male reproductive system and state the functions of: testes, scrotum, sperm ducts, prostate gland, urethra and penis

testes: produce sperms and male sex hormones such as testosterone

scrotum: keeps testes outside the main body cavity to ensure that it is at a slightly lower temperature than body temperature to ensue sperms develop properly

sperm ducts: transport sperms from testes to urethra

prostate gland: stores sperm temporarily

urethra: passes semen and urine out of the body

penis: deposit semen, containing sperms in the vagina

(c) identify the female reproductive system and state the functions of: ovaries, oviducts, uterus, cervix and vagina

ovaries: produce eggs and female sex hormones such as oestrogen and progesterone

oviduct: where egg is fertilised; transports eggs to uterus

uterus: site of implantation of embryo; where foetus develops during pregnancy

cervix: lower portion of uterus where it joins the valine; allow menstrual blood to flow through during menstruation

vagina: where semen is deposited during sexual intercouse

(d) outline 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 effects of progesterone and oestrogen only

fertile period is day 10-15
egg can survive for 1-2 days
sperm can survive for 5 days

During menstruation (Day 1 to 5)
- Both oestrogen and progesterone levels are low, menstruation occurs.
- During menstruation, the uterine lining breaks down and is shed.
- Blood and the unfertilised egg flows out through the vagina as well.

After menstruation (Day 6 to 13)
- Oestrogen is released by the ovary for the repair and growth of the uterine lining.
- High ostrogen levels lead to ovulation .

Ovulation (Day 14)
- Ovulation occurs whereby a mature egg is released from the ovary.

After ovulation (Day 15 onwards)
- Ovary produces progesterone
- It prevents ovulation and further development of eggs.
- It also causes the uterine lining to thicken further to prepare for implantation of embryo

- Oestrogen production decreases
- If there is no fertilisation, progesterone level decreases, uterine lining breaks down and the cycle repeats.

(e) 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

haploid loud sperm nucleus fuses with haploid egg nucleus and a diploid zygote is formed. zygotes divide to form a ball of cells called the embryo

(f) discuss the transmission of human immunodeficiency virus (HIV) and methods to reduce transmission transmitted by the sharing of hypodermic needles; sharing of intruments that may break the skin e.g. razor, toothbrush, from pregnant mother to fetus; sexual intercouse

methods to reduce: do not share hypodermic needles, do not share intruments that may break the skin; abstain from sex/wear condom (males)

13. Inheritance Content

- The Passage of Genetic Information from Parent to Offspring
- Monohybrid Crosses
- Variation

Learning Outcomes

Candidates should be able to:

(a) distinguish between the terms *gene* and *allele*
gene is a small segment of DNA that is made up of a sequence of nucleotides and codes for the synthesis of a specific polypeptide. unit of inheritance.

allele is different forms of the same gene that occupies the same relative positions on a pair of homologous chromosomes

(b) distinguish between continuous and discontinuous variation and give examples of each

continuous	discontinuous
range of phenotypes	a few clear cut and distinct phenotypes
genes show additive effect	genes do not show additive effect
affected by environmental conditions	not affected by environmental conditions
e.g. height	e.g. attached or detatched earlobe

(c) explain the terms *dominant, recessive, homozygous, heterozygous, phenotype* and *genotype*
dominant: trait that expresses itself in heterozygous condition
recessive: trait that does not express itself in heterozygous condition, only in homozygous recessive condition
homozygous: identical alleles for a particular gene
heterozygous: different alleles for a particular gene
phenotype: expressed trait of an organism
genetype: genetic makeup of an organism

(d) predict the results of simple crosses with expected ratios of 3:1 and 1:1, using the terms homozygous, heterozygous, F_1 generation and F_2 generation
3:1 ratio

gametes	A	a
A	AA	Aa
a	Aa	aa

1:1 ratio

gametes	a	a
A	Aa	Aa
a	aa	aa

(e) explain why observed ratios often differ from expected ratios, especially when there are small numbers of progeny
1. fertilisation is random
2. sample size is small

(f) use genetic diagrams to solve problems involving monohybrid inheritance - punnet square or test cross
Parental phenotype
Parental genotype
Gametes
Random fertilisation
Offspring genotype
Offspring phenotype

(g) describe the determination of sex in humans – XX (female) and XY (male) chromosomes

(h) describe mutation as a change in the sequence 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 syndrome

mutation: sudden random change in gene structure or chromosome number

sickle cell anemia: recessive gene mutation, production of abnormal haemoglobin causes it to clump together, causing RBC to be sickle-shaped, decrease in SAVR, decreasing its ability to transport oxygen. heterozygous - survive in malaria prone areas. homozygous recessive - die young

albinism: recessive gene mutation, absence of pigments in eyes, skin, hair. reddish white skin, white hair. eyes appear red due to blood vessels, easily sunburnt

(i) name ionising radiation (e.g. X-ray) and chemical mutagens as factors which may increase the rate of mutation

radiation e,g, Ultraviolet light, alpha, beta, gamma rays
chemicals in certain concentrations e.g. tar, formadelhyde