

CHRISTIAN SOCIAL SERVICES COMMISSION (CSSC)
NORTHERN ZONE JOINT EXAMINATIONS SYNDICATE (NZ-JES)



FORM SIX PRE-NATIONAL EXAMINATIONS 2023

133/2

BIOLOGY 2

MARKING SCHEME

1. (a) Importance of fungi to man

- Some members of the kingdom Fungi such as Agaricus species are source of food to human being. For example, Agaricus bisporus are the most important edible mushroom commercially cultivated world-wide. They are rich source of nutrients such as proteins, carbohydrates, lipids, minerals, fibres, and vitamins.
- Yeasts are used in fermentation to produce alcohol in brewing industries.
- Fungi are important in production of organic acids and organic solvents such as acetic acid, lactic acid, amyl, isoamyl alcohol, and glycerol.
- Saprophytic fungal communities are important in the soil as they decompose dead organic matter and recycle nutrients locked in dead plants and animals thereby improving soil fertility.
- Some members of the kingdom Fungi are used in producing medicine (antibiotics) such as penicillin from Penicillium sp., and ephedrine extracted from yeast.
- They are sources of important hormones such as gibberellins obtained from Gibberella fujikuroi. This hormone regulates vegetative and fruit growth in plants

(10 marks @ 02 any five points)

(b) classes of the phylum arthropoda

(i) Class diplopoda

- Has cylindrical body.

- Has two pairs of legs per segment. (02 marks)

(ii) Class chilopoda

- Has flattened body.
- Has one pair of legs per segment. (02 marks)

(iii) class insecta

- Has three body parts. (02 marks)
- Has 3 pairs of jointed legs.

(iv) Class arachnida

- Has four pairs of legs. (02 marks)
- Has no antennae.

(v) Class crustacea

- Has carapace.
- Has gills for gaseous exchange. (02 marks)

2. (a) Organic evolution-is the gradual change in structure and physiology of organisms over a long period of time

OR

Is a slow change in genetic composition of organism in a population through successive generations leading to the formation of new species from pre-existing ones. (02 marks)

(b) processes

- Geneflow-when a population migrate from one place to another, causes the breeding in population which can lead to continual interchange of alleles between organisms. Random introduction of new alleles into the recipient population and their removal from donor populations that leads to increase of genetic variation that can lead to evolution at a given period of time. (04 marks)
- Mutation-is the sudden change in structure or number of chromosomes. Mutation can lead to introduction of new gene in a population that confers better adaptation of organism

bearing it. The mutant gene can then be passed from one generation to another and multiply generation to generation hence evolution. (04 marks)

iii) Natural selection-is the process by which environment act as natural check/play role in selecting favourable genes and maintaining it, and unfavourable genes are eliminated. Removal of certain gene or favouring of another gene causes change in gene frequency hence evolution. (04 marks)

iv) Genetic drift-is the variation of gene frequencies within the population which occurs by chance rather than by natural selection. It operates in small/isolated population. Genetic drift can lead to extinction of population or result into the population becoming better adapted to the environment and more widely different from parental population hence evolution. (04 marks)

(c) Weaknesses of special creation theory

i) It cannot be subjected to scientific proof. (01 marks)

ii) It is against law of biogenesis because according to it, organisms just arose by the word of God. (01 marks)

3. a). i. During the process of fertilisation only the nucleus is involved (02 Marks)

ii. During the process of meiosis. (02 Marks)

b. (i) Process of DNA replication.

Step 1: Replication Fork Formation

Before DNA can be replicated, the double stranded molecule must be “unzipped” into two single strands. DNA has four bases called adenine (A), thymine (T), cytosine (C) and guanine (G) that form pairs between the two strands. Adenine only pairs with thymine and cytosine only binds with guanine. In order to unwind DNA, these interactions between base pairs must be broken. This is performed by an enzyme known as DNA helicase. DNA helicase disrupts the hydrogen bonding between base pairs to separate the strands into a Y shape known as the replication fork. This area will be the template for replication to begin.

DNA is directional in both strands, signified by a 5' and 3' end. This notation signifies which side group is attached the DNA backbone. The 5' end has a phosphate (P) group attached, while the 3' end has a hydroxyl (OH) group attached. This directionality is important for replication as it only progresses in the 5' to 3' direction. However, the replication fork is bi-directional; one

strand is oriented in the 3' to 5' direction (leading strand) while the other is oriented 5' to 3' (lagging strand). The two sides are therefore replicated with two different processes to accommodate the directional difference. (05 Marks)

Step 2: Primer Binding

The leading strand is the simplest to replicate. Once the DNA strands have been separated, a short piece of RNA called a primer binds to the 3' end of the strand. The primer always binds as the starting point for replication. Primers are generated by the enzyme DNA primase.(03 marks)

Step 3: Elongation

Enzymes known as DNA polymerases are responsible creating the new strand by a process called elongation. There are five different known types of DNA polymerases in bacteria and human cells. In bacteria such as *E. coli*, polymerase III is the main replication enzyme, while polymerase I, II, IV and V are responsible for error checking and repair. DNA polymerase III binds to the strand at the site of the primer and begins adding new base pairs complementary to the strand during replication. In eukaryotic cells, polymerases alpha, delta, and epsilon are the primary polymerases involved in DNA replication. Because replication proceeds in the 5' to 3' direction on the leading strand, the newly formed strand is continuous.

The lagging strand begins replication by binding with multiple primers. Each primer is only several bases apart. DNA polymerase then adds pieces of DNA, called Okazaki fragments, to the strand between primers. This process of replication is discontinuous as the newly created fragments are disjointed. (03 marks)

Step 4: Termination

Once both the continuous and discontinuous strands are formed, an enzyme called exonuclease removes all RNA primers from the original strands. These primers are then replaced with appropriate bases. Another exonuclease “proofreads” the newly formed DNA to check, remove and replace any errors. Another enzyme called DNA ligase joins Okazaki fragments together forming a single unified strand. The ends of the linear DNA present a problem as DNA polymerase can only add nucleotides in the 5' to 3' direction. The ends of the parent strands consist of repeated DNA sequences called telomeres. Telomeres act as protective caps at the end of chromosomes to prevent nearby chromosomes from fusing. A special type of DNA polymerase enzyme called telomerase catalyses the synthesis of telomere sequences at the ends

of the DNA. Once completed, the parent strand and its complementary DNA strand coils into the familiar double helix shape. In the end, replication produces two DNA molecules, each with one strand from the parent molecule and one new strand. (03 marks)

(ii) Reason.

because the DNA polymerase must as well move in the 5' → 3' direction and away from the replication fork. Since enzyme polymerase moves away from the fork and the fork is uncovering the new DNA, then the DNA synthesis on the lagging strand is discontinuous.

(02 Marks)

4. (a) Features associated with secondary growth in dicot plants are;

i) Heartwood and sapwood-wood is formed as a result of deposition of secondary xylem. Heart wood is the wood at the centre that has ceased to play conductive role and is blocked by darkly staining deposits like tannis Sapwood is outer wetter, actively conducting wood.

(03 marks)

ii) Annual rings-are rings in the wood formed due to variation of seasons of the year. In the season of the year when water is adequate, the vessels formed are wide and thin walled with the vessels formed are wide and thin walled with light colour. In the period with inadequate supply of water vessels formed fewer vessels are formed, which are thick walled and dark in colour. The vessels formed in the next year where water is plant will differ markedly in appearance and seen as annual rings. (03marks)

iii) Cork and lenticels-cork are cells which are formed by cork cambium in order to replace raptured epidermis. As cork cells mature, their walls became deposited with fatly, impermeable materials called suberin and die. At random intervals, slit-like opening is left in the cork to allow gaseous exchange. These are called lenticels (03 marks)

iv) Bark-refers to all tissues outside the vascular cambium that covers the stem. (02 marks)

(a) explain why insects exhibit a unique growth curve

Arthropods such as cockroach exhibit a type of limited growth known as discontinuous or intermittent growth pattern. (01 mark)

Arthropods often moult periodically to grow because their hard inelastic exoskeleton does not expand, to allow growth. Moulting is the process of shedding exoskeleton in arthropods.

(01 mark)

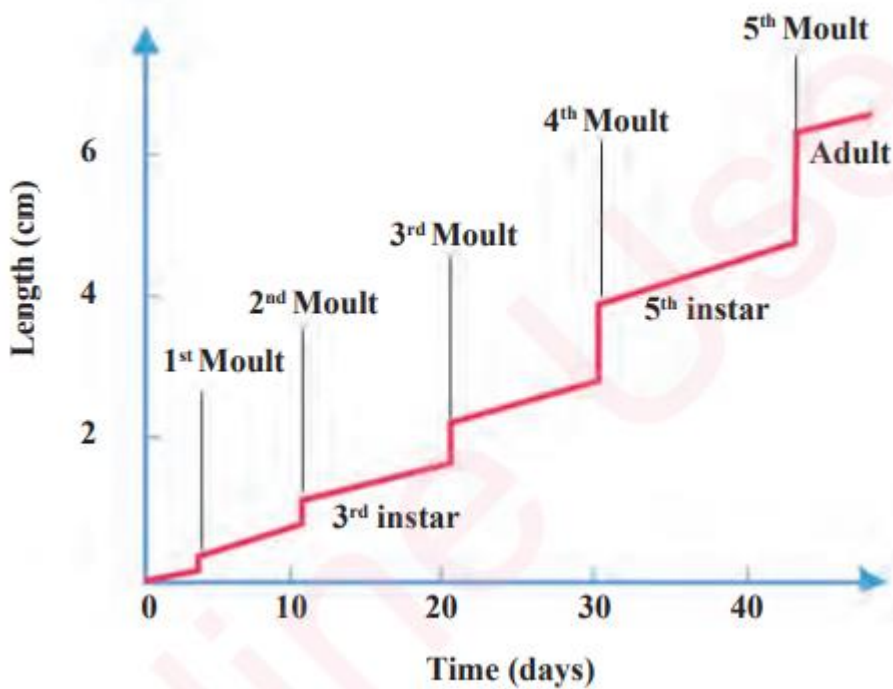
Two hormones known as a juvenile (neotonin) and ecdysone hormones control this process. Ecdysone hormone also called a moulting hormone is produced by glands found in the first thoracic segment called prothoracic gland. (01 mark)

Juvenile hormone is produced in the region behind the brain known as corpus allatum. If the juvenile hormone is present in high concentration, larval moult occurs but if its concentration is low, pupal moult occurs. (01 mark)

In the complete absence of juvenile hormone, the pupa metamorphoses into an adult (imago).

(01 mark)

Moulting is followed by a sharp increase in body size often before exoskeleton hardens and limit growth. Thus, in arthropods growth occurs in spurts resulting in a step-like growth curve as shown below. (01 mark)



Growth curve of insects.

04 marks.

5. (a) Modifications of the renal corpuscles for ultra-filtration:

- Has thick afferent arteriole in order to bring blood under high pressure.
- Have endothelial cells with pores so that materials can be leak.

- Have podocytes in the inner layer of Bowman's capsule which have many infoldings to allow materials to enter the Bowman's capsule.
- Have squamous epithelial cells for easy passage of glomeruli filtrate into the tubule.
- The endothelial cells place against basement membrane to allow rapid diffusion.
- Have special podocyte cells and filtration slits to increase surface area for filtration.

(Any five points@02marks = 10 marks).

(b) This is because in cold weather, there is constriction of blood vessels on the skin in order to reduce heat loss by radiation and conduction. This leads to less sweating and retains more water in the blood.

This leads to low blood osmotic pressure which inhibit ADH secretion which in turn makes the walls of the collecting duct and distal convoluted tubule impermeable into water and urea, hence less water is reabsorbed hence humans produce more dilute urine. (02 Marks).

(c) Advantages of using urea as nitrogenous waste products to mammals:

- Urea is easily washed away, since it doesn't require much water to get rid of it, hence favouring mammals even during times of water shortage.
- Urea doesn't harm other cells when it is carried around the body through the blood from the liver where it is produced to the kidneys where it is excreted,
- Urea is very soluble in water. This means urea it dissolves easily in water and then removed easily.
- Urea has smaller molecule so it is easily filtered by the kidneys.

(4points@02 marks = 08Marks).

6. (a) Factors for growth and decrease in population in any area are

(i) Birth rate

Reproductive capacity of the population leads to an increase in population

(ii) Migration

Movement of organism out/into the population can cause rise/decrease in population in the area of destination and origin respectively

(iii)Emigration

Movement of people/organism out of the population. This cause decrease in population in the area of origin but increase in the area of destination

(iv)Mortality

Death rate of organisms in a population can cause decrease in population

(08 marks @ 02)

(b) advantages and limitations

Simple random sampling

Advantages.

- This method helps to avoid an introduction of any personal biasness.
 - It needs only a minimum knowledge of the study group of the population in advance.
 - It ensures a high degree of representativeness of the population, and it is a fair way of selecting a sample from a given population since every member is given an equal opportunity to be included in the sample.
- (02 marks @ 01)

Limitations:

- The method cannot be applied where the population units are heterogeneous in nature.
 - It is tedious and time consuming particularly, when dealing with large samples.
- (02 marks @ 01)

Systematic random sampling

- It is simple to use. This property allows addition of the degree of systems or processes into the randomly selected subjects.
 - The method also ensures an even sampling of the population.
- (02 marks @ 01)

Limitation:

- If the sampling technique coincides with the periodicity of the trait, the sampling technique will no longer be random and the representativeness of the sample is compromised.
 - The technique is more biased because not all members or points have an equal chance of being selected.
- (02 marks @ 01)

Stratified random sampling

- Process of stratification reduces sampling errors and ensures the greater level of representation.

- An adequate representation of all subgroups is ensured. When there is homogeneity within the strata and heterogeneity between the strata, the estimates can be as precise as compared with the simple random sampling.

Limitations.

- The application of this method requires the knowledge of members of the strata and ability to distinguish between strata in the sample frame at initial stages, which in practice, may create difficulties.
- The method takes a long time and therefore, it becomes more expensive due to an extra stage in the sampling procedure.