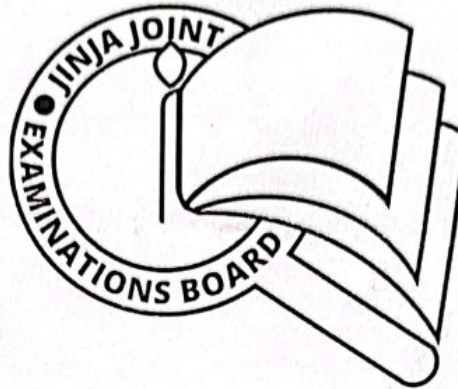


P530/2
BIOLOGY
(Theory)
Paper 2
AUGUST, 2023
2½ hours



JINJA JOINT EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

MOCK EXAMINATIONS – AUGUST, 2023

BIOLOGY

(THEORY)

Paper 2

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES

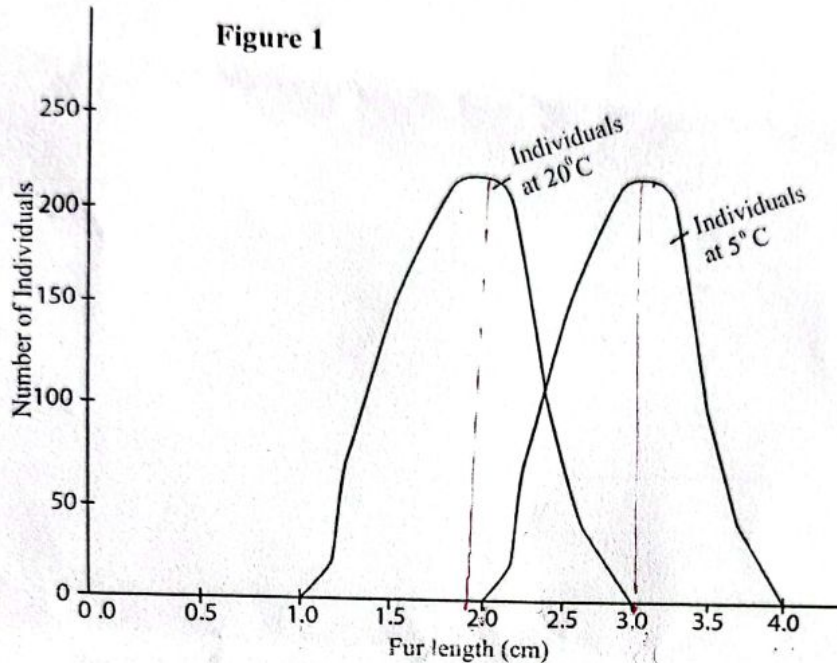
Answer question ONE in section A plus three others from section B.

Candidates are advised to read questions carefully, organize their answers and present them precisely and logically.

Illustrate, whenever necessary, with well labelled diagrams.

SECTION A (40MARKS)

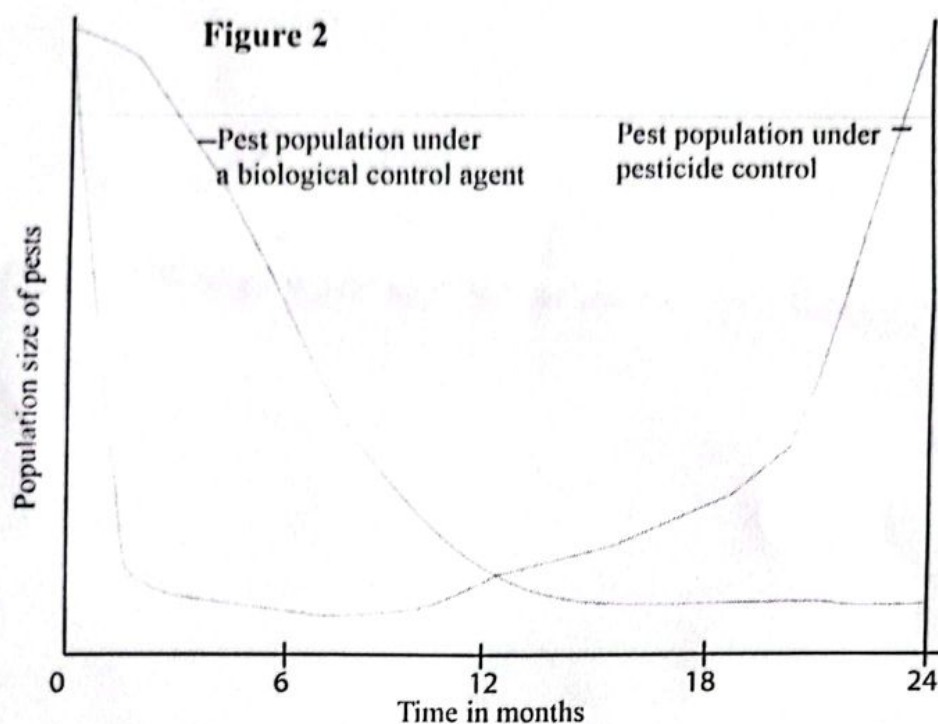
1. The graph in figure 1 below shows the relationship between fur length and the number of individuals of a mammalian species in each of the two different terrestrial habitats of different temperature conditions.



- (a). Describe the relationship between the fur length of the individuals and their number in each of the habitats. (03 marks)
- (b) Explain how
- the fur lengths affect the distribution of the individuals of a mammalian Species in the two habitats of different temperatures (08 marks)
 - the relationship between fur length and the number of individuals of a mammal in the habitats affects the evolutionary change of the organisms. (04marks)
- (c). Explain the importance of maintaining constant body temperature in mammals (05marks)

The graph in figure 2 below shows the variation in the population of the pest species of the fruit crops at two separate gardens both cultivated for same type of crop over a period of two years.

The necessity of two separate gardens was because some clients of the farmer wanted fruits and vegetables for their customers where no chemicals in form of pesticides and herbicides were not used in their production.



- (d). Describe the effects of using each type of control agent over the two-year period. (07marks)
- (e) (i). Suggest why some clients of the farmer were against fruits and vegetables for their customers from the gardens where pesticides, herbicides and other chemicals were applied in their production. (03marks)
- (ii). State the possible challenges which the farmer could have experienced in using the biological control agents to eliminate the arthropod pests. (03marks)
- (f) (i). What are the likely long term effects of using chemicals to control pests and diseases in crop plants. (03marks)
- (ii). Explain in evolutionary terms how change in the population of pests under control of pesticides could be of benefit in agricultural productivity. (04marks)

SECTION B (60 MARKS)

2. (a). Explain the importance of maintaining the pH of mammalian blood and tissue fluid within a narrow limit. (04marks)
- (b). How does the pH of blood regulate in mammals? (07marks)
- (c). State the form human bodies obtain protein and give the functions of the absorbed protein substances. (09marks)

3. (a). Explain the need for movement of substances across the plasma membranes. (04marks)
 (b). Describe the structure of the cell membrane according to fluid mosaic model. (08marks)
 (c). Describe the functions of various chemical components of the cell membrane. (08marks)
4. (a). Explain why asexual reproduction form offspring identical with the parents but sexually reproduced offspring show variation. (08marks)
 (b). Explain the significance of the following in crop production.
 (i) Inducing polyploidy. (03 marks)
 (ii) Using seeds in crop propagation. (04marks)
 (c). In what ways is light important in crop growth and development? (05marks)
5. Explain the following observations.
 (a). A very little component of the ingested plant food material is absorbed and incorporated into our body than when the ingested food is from animal body. (05marks)
 (b). The guts of herbivorous mammals are relatively larger, longer and complicated than guts of omnivorous mammal such as humans. (05marks)
 (c). Populated human settlement areas are advised to use crop items as maize, beans etc. as source of food and firewood, charcoal, e.t.c as source of energy but not items like skin, fresh and bones from mammals. (05marks)
 (d). A good supply nitrates is essential to photosynthesizing food crops. (05marks)
6. (a). What is meant by species extinction? (02marks)
 (b). Explain human activities that may lead
 (i) to formation of new species in nature (03marks)
 (ii) to extinction of species (04marks)
 (c). Describe how variation, natural selection and isolation may contribute to formation of new species (11marks)



As fur length increases from 0. to 1.0 cm, the number of individuals in both habitats remains constant at 0;
As fur length increases from 1.0 to 1.8 cm the number of individuals at 20°C increase rapidly to maximum while at 5°C remains constant at 0;
As fur length increases from 1.8 to 3.0 cm the number of individuals at 2°C decreases rapidly to 0 while at 5°C increases rapidly to a maximum;
As fur length increases from 3.0 to 4.0 cm, number of individuals at 5°C decreases rapidly to 0 while at 20°C remains constant at 0;

JINJA JOINT EXAMINATIONS BOARD

MOCK EXAMINATIONS 2023

P530/2 – BIOLOGY

MARKING GUIDE

max 03.

SECTION A

1. (a) In each habitat of a given permanent temperature, individuals of fur length within a certain range survive; Those individuals with intermediate range/ around the intermediate fur length in each habitat are more favoured to survive than those with extreme fur length;
In a habitat of 20°C individuals with shorter fur length (1.0cm to 3cm) survive better while in cold habitat of 5°C individuals are within a longer range of fur length are favoured to survive (2cm to 4.0cm); **1 mark @ 3 marks**

(b)(i) Mammals maintain their body temperatures constant or around 37°C irrespective of environmental temperatures using a range of anatomical /structural/physical, physiological and behavioural adaptations; fur length is a structural adaptation which provides insulation against heat losses and gains;

Individuals in a cold habitat of 5°C require efficient body adaptations to prevent heat losses; they possess thick, dense and long fur which may be raised by contraction of erector muscle, trapping a thick layer of warm air around the body to insulate against heat loss;

Individuals in a habitat of 20°C / of moderate temperature are adapted to reduce to the slight heat losses that may occur; They possess generally short fur which may lie flat on the body by relaxation of erector muscle, reducing thickness of warm air trapped around the body for moderate heat losses; In each habitat individuals with the intermediate ranges of fur length are more favoured to survive than the extremes; because the intermediate fur length correspond to the optimum temperature conditions favouring increased chances of survival of mammals with such fur length; **1 mark @ marks maximum.**

max 03

(ii) In each of the two habitats of different temperatures individual of the mammalian species with intermediate ranges of fur length are more favoured/ selected for / adapted to survive than those of extreme fur length; This is stabilizing selection which produces a more phenotypically homogenous population; This type of selection in each habitat with more homogenous individuals does not promote evolutionary change; However, if the population of a mammal in the two habitats are isolated each may evolve/ develop into a different species;

04.

(c) The characteristic of mammals to maintain their body temperature constant enables them to remain metabolically very active irrespective of external environmental temperatures; The metabolic reactions are enzyme controlled; and enzymes work within a narrow range of optimum temperature;

When the body temperatures are increased above the working temperature range enzymes are denatured and it may be fatal; similarly very low body temperature below the optimum temperature range enzymes are inactivated; - **1 mark @ 5 marks.**

max 05

- Excessively high or too low temp disorganizes structure & functioning of transport proteins surface membranes; affecting entry & exit of substances resulting into death of the organism;

(d) The effect of pesticides control on the population size of pests. The population size of pests decreased ~~very sharply/ rapidly~~ from 0 to about 2 months/ for ~~about~~ 2 months to a small population; ~~the remaining population of pests that remained oscillated around the lowest size~~ ^{from 2nd to 7th month population of pest decreased gradually} from 2nd to 10th month of the year; The population size of pests increased gradually from 10th to 20th month; and then rapidly increased from 20th to 24th month; The effect of biological control agent on the population size of pests. In the first two months, the pest population size decreased ~~very slightly/ very slowly~~ ^{gradually} from 2nd to around 10th month the population size decreased rapidly to lowest population size; which remained constant up to the 24th month;

1 mark @ 7 marks

(e) ~~All people know that~~ chemicals used to kill pests ~~and other arthropods~~ are poisonous/ toxic substances; and ~~some consumers are also aware that pesticides~~ are persistent/ non-biodegradable; and get incorporated and stored in plant structures such fruits; Therefore, ~~consumers know that~~ it is risky to consume such fruits as toxic and cancerous substances will be introduced into their bodies;

1 mark @ 3 marks.

(ii) ~~Its introductions at gardens required skilled personnel and it is expensive to hire the services of these agriculturalists;~~

- At first after the introduction of biological agent the pest population decreased very slowly and become effective later after damages have been done; ^{slow in action}

- Specific pest control agents required re-introduction every time they completely eliminated pests/ their source of food which were laborious; Non-specific control agents/ predators of pests feed on all types of arthropod insects in the gardens including useful insects such as pollinating agents which greatly affected fruit formation;

1 mark @ for any 3 marks

(f)(i) Resistant forms of parasites and pests emerge e.g. pest resurgence in pest species;

- Crop yield becomes less and less as a result of pesticides destroying decomposers which would increase soil fertility;

- Many pesticides being persistent get incorporated into food chains in nature which result into harmful effects in mammals and birds at higher trophic levels; ^{acc. bioaccumulation & biomagnification}

- Chemicals destroy a wide range of living organisms including natural predators of many potential pests causing the outbreak of other pests; 1 mark @ 3 marks max.

(ii) Pesticides decreased the size of pest population rapidly to every small population of pests which later increased; The small population of pests that remained / survived emerged as a result of mutation; or were selected for because had natural resistance to toxic pesticide; some pests surviving after application of pesticides is a case of directional/ progressive selection which is the basis of artificial selection;

- Identifying crops that are resistant to pesticides;

- Identifying new pesticides that can eliminate the pests;

In artificial selection, man/farmers rather than environmental factors determine which crops and domesticated animals which survive and propagated through future generations; 1 mark @ 4 marks

Total = 40 marks maximum.

SECTION B

2. (a) Blood and tissue fluid in mammalian bodies both surround the body cells, affecting their internal composition including the intracellular pH; The cells are site of the vital life processes which are controlled by pH such as metabolic reactions that are enzyme controlled; and enzymes controlling the metabolic processes work under a small particular pH range which is around a neutral pH of 7.0; Any sudden change in the pH of the medium of the metabolic reactions, adversely affects the working of enzymes involved in the processes; due to the denaturation of the shape of enzyme; 1 mark @ 4 marks.

(b) The pH of blood in mammals is maintained at 7.4 by chemicals buffers in the plasma; These include plasma proteins, phosphates and carbonates in blood plasma; These combine with either hydrogen ions (H^+) or hydroxyl ions ($-OH^-$) added to blood resisting the pH changes due to moderate additions of acids or bases;

The distal convoluted tubule cells combine water and carbon dioxide forming carbonic acid which dissociates into HCO_3^- and H^+ ions. The hydrogen carbonate ions are absorbed into blood where they play a buffering role. Hydrogen ions (H^+) together with Ammonium ion (NH_4^+) and potassium ions (K^+) are pumped into urine or glomerulus filtrate in the distal convoluted tubules as a means of controlling blood pH around 7.4 by tubule secretion;

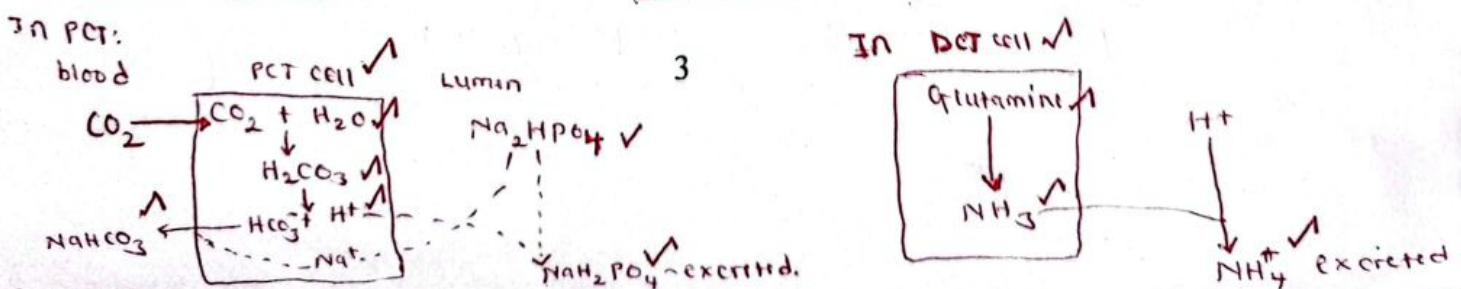
In normal mammals the blood pH is maintained constant around 7.4 and its change depends mainly on carbon dioxide concentration from respiration; During strenuous exercise the concentration of carbon dioxide released into blood increases as a result of increased rate of respiration lowering the pH of blood; Cells sensitive to changes in the acidity or alkalinity of blood send messages to centres in brain causing the centres to trigger increased rate of heartbeat and speeding up the breathing rate which lead to lowering of carbon dioxide concentration in blood;

1 mark @ 7 marks maximum

(c) Humans ingest food materials containing proteins; The protein food in the ingested material is digested by enzymes released in different parts of the gut forming amino acids as final product of protein digestion; In the ileum amino acids are absorbed into the blood or the body and hence, the human body obtain proteins in form of amino acids;

Amino acids absorbed into human body are used to synthesize enzymes;

Hormones; Antibodies; blood pigments such haemoglobin;



Amino acids/proteins can be respired during starvation to produce ATP; Some globular proteins from amino acids form structures like cell membranes; and fibrous proteins from amino acids form structures such as hair/fur; nail/ and muscle fibres; max 04,
As components of body fluids control osmotic pressure; and the pH because they are amphoteric;

1 mark @ 9 marks maximum Total = 20 marks
maximum.

3. (a) The plasma membranes surround cytoplasm in cells which is the site for metabolic reactions/ processes; / The cytoplasm surrounded by the plasma membranes holds organelles which are specialised sites of biochemical reactions; These biochemical reactions require supply of raw materials from within and outside the cells; The reactions also produce both useful products and excretory wastes that must be removed or eliminated; Vital substances essential for biochemical reactions gain entry into cells and respiratory wastes exit cells via plasma membrane which is selectively permeable; 1 mark @ 04 marks; To obtain nutrients/raw materials
To maintain electro-neutrality; To generate ionic gradients essential for neurons & muscular activity/stomatal movements; To obtain suitable pH;
- (b) The cell membrane consists of phospholipid molecules; which form a bimolecular layer/bilayer; The main structure component in fluid mosaic cell membrane structure; Each phospholipid molecule consists of hydrophilic head, and a hydrocarbon hydrophobic tail; In the formation of the bilayer phospholipid molecules are arranged in such a way that the hydrophilic heads face outward, and hydrocarbon tails inwards; which constantly drifts laterally giving peripheral a fluid nature
phosphate fatty acid
- The cell membrane is also made up of globular proteins of different size; The extrinsic globular proteins are restricted to surface of the bilayer; the integral/ intrinsic globular proteins penetrate to some extent into the bilayer; and other globular proteins transverse across the phospholipid bilayer and these are transmembranous globular proteins; Some transmembranous have hydrophilic pores; The different globular proteins are arranged or distributed randomly / unevenly/ here and there in the phospholipid bilayer; giving it a mosaic pattern;
- The cell membrane consists of glycolipids, glycoproteins, found on the outer side of the cell membrane; and the cholesterol; in between the phospholipid molecules;
- ½ mark @ 08 marks. (c) The phospholipid bilayer constitutes the main structure of the cell membrane according to fluid mosaic model;
- The bilayer allows simple diffusion/ passage of lipid soluble substances into and out of cells;
- The globular proteins of the cell membrane some form structural skeletons of membrane; enzymes; and receptors in the membranes;
- Transmembranous globular protein may be carriers being involved in active transport; and facilitated diffusion of substances across the cell membrane; and those with the hydrophilic pores allow passage of small ionic particles and water soluble substances;
- The glycoproteins / glycolipids on the outer side of the cell membrane are for recognition; and can be respired to produce ATP for active uptake across the cell membrane;

The cholesterol molecules in between the phospholipid molecules prevent their close packing enabling flexibility ^{stability} fluidity of the cell membrane; 1 mark @ 08 marks maximum.

Total = 20 marks maximum.

4. (a) Asexual reproduction involves mitosis as a basis of cell division; ^{cells pr} Mitotic division involves a single cycle of division stages where during metaphase chromosomes each with a pair of chromatids arrange singly at the equator and the sister chromatids are separated at anaphase and each chromatid becoming a new chromosome and the number of chromosome number is doubled in the dividing cell;

The separated sister chromatids move to the opposite poles/sides of the dividing cell which splits/cleavages across the middle forming two daughter cells; The two daughter cells formed at the end of telophase have the same genetic material/ number of chromosomes as the original parent cell and these multiply and develop to form functioning organisms;

Sexual reproduction involves formation of male and female gametic haploid cells by meiosis; During meiosis crossing over/ exchange of genes/ alleles between homologous chromosomes may occur producing new gene combinations; and there is also independent assortment or random segregation of maternal and paternal chromosomes to each of the respective gametes formed which also results in ^{new} meiotic genetic recombination; The genetic recombination and the mixing of maternal and paternal gametes by random fusion bring about genetic variation in sexually reproduced organisms;

1 mark @ 8 marks

- (b) The polyploids formed by inducing polyploidy contain multiples sets of chromosomes in their somatic/ body cells; These polyploids such as triploid tetraploids show advantageous/ ^{hybrid vigour} beneficial characteristics; such as increased growth rate; High yields / increase in size; resistant to pests and diseases; and harsh climatic factors like long drought; ^{max 3}

1 mark @ 03 marks maximum.

- (ii) Formation of seeds involves pollination ^{sexual reproduction} and double fertilization which may result in plants developed having advantageous variation;

Seeds contain stored food reserves and this enables their storage for a long time until it is convenient to be propagated;

Seeds are small ^{and dormant propagules} which can be easily distributed from one place to another;

Each seed develops into a single and these plants can be regularly / uniformly distributed in gardens in such a way ensuring high yields and least competition for soil resources;

- Planting/ propagation of seeds is only synchronised by the availability of suitable growth factors; ^{seed dormancy allows seeds survive adverse env'tal conditions}

1 mark @ 4 marks maximum

(C)- Light is essential for synthesis of chlorophyll pigment which trap the light energy for photosynthesis/ organic food production in crops; - High light intensity under suitable conditions of temperatures and water availability in soil results in increased crop size and high yield;

- It stimulates and enables vision of useful insects to our crops;
- Brightly coloured petaled flowers become very conspicuous in presence of light attracting pollinating agents which is essential for fruit formation; - In some crops flowers close in darkness/ at night and open up for pollination under presence of light and conditions of day time; - Light is essential and control flowering of short and long day crops; - Light is a necessary factor for germination of many very small seeded photoblastic crops;

1 mark @ 5 marks maximum.

Total = 20 marks maximum.

5. (a) Plant food materials ingested are largely composed of cellulose; and cellulose is an indigestible material in humans and they do not produce an enzyme for cellulose digestion or have no mutualistic bacteria in their gut that secrete cellulase for hydrolysis of cellulose; So the small digestible components of ingested plant food materials which may include starch, lipids and proteins are broken down and final soluble products absorbed and become utilized by our body;

Food materials from animal bodies are mainly fats and proteins; which are easily digested by enzymes released in the human gut and the digested end products are absorbed and utilized by the body;

1 mark @ 5 marks.

- (b) The diet of herbivorous mammals is largely vegetable materials which consists of cellulose; and cellulose is very difficult to digest; Therefore large volumes of vegetable materials are consumed to compensate for their poor nutrient content; The guts of herbivorous mammals are large to accommodate large volumes of grass and other plant materials consumed; the human gut is concerned with mainly the digestion of plant and animal food materials which are always processed before consumption;

1 mark @ 5 marks.

- (c) Storage plant materials like maize grains and bean seeds rich in complex organic food such as starch, proteins and lipids from photosynthesis; and the structural complex organic materials such as cellulose and lignin from photosynthesis constitute the wooden plant parts;

Since plants/ crops are primary producers and metabolically less active a lot of energy is stored in their parts such as seeds and wooden parts;

When the primary consumers such as cattle, goats and sheep feed on plant food materials, energy stored is transferred and incorporated into the bodies of these animals. However the energy transferred from plant food materials to primary consumers and stored in their bodies is small due to many parts

of plants being unpalatable, indigestible and large amount of the absorbed food being utilized by actively metabolic bodies of mammals. 1 mark @ 5 marks.

(d) Food crops such as legumes through photosynthesis utilise inorganic nitrates containing nitrogen to synthesise amino acids;

The amino acids combine/polymerise by condensation reactions to form proteins in crops. Some of the synthesized proteins are enzymes / growth substances/ used to form structures which are all essential for high growth rate and high yield of crops. Some proteins are stored in storage structures of crops such as seeds, tubers and fruits; and when these food materials are ingested and digested in humans our bodies are supplied with amino acids essential for growth and repair;

1 mark @ 5 marks.

Total = 20 marks.

6. (a) Species extinction refers to when all the existing members or individuals or organisms of a given species become completely wiped out/ eliminated due to either a sudden occurrence of an unfavourable condition or due to an unfavourable condition that has occurred and not prevented for a long time;

02 marks

(b) (i) By excessive use / application of chemicals e.g. drugs, pesticides, fungicides and herbicides; new resistant forms or varieties of a species may arise by random mutation;

- By inducing polyploidy, polyploids with multiple sets of chromosomes are formed from diploids; Application of colchicine chemical on dividing cells preventing spindle fibre formation;
- By outbreeding/ crossbreeding/ hybridisation hybrids that show superior characteristics to either of their parents are formed; 1 mark @ 3 marks *whole individuals which when isolated overtime evolve into different species.*

(ii)- Deforestation destroys habitats;

- *Award once any activity that destroys habitats.*
- Over fishing eliminates productive potential of fish populations in a lake as all stages are fished;
- Pouching or hunting eliminates animals like the males or females sexes which prevent productions;
- Disposal of organic wastes into a river or a lake eliminates completely aerobic inhabitants;
- Excessive use of chemicals may wipe out completely all the given type of pest species;

1 mark @ 4 marks maximum.

(c) Members of a given species possess variation which are either advantageous/ beneficial / favourable or variation that are unfavourable/~~disadvantageous~~;
advantageous;

Those with advantageous variation/ characteristics are better suited to survive than members with unfavourable variation/ characteristics; The more suited members to survive reach reproduce stage and reproduce becoming more represented in the subsequent generations while the less adapted reduce in their numbers;

Over several generations the less adapted become completely eliminated, leaving only those members of a species which showed advantageous characteristics/ variation;

Natural selection involves natural environmental factors rather than man determining members of a given population/ species that are perpetuated to successive generations; Individuals of a population that are structurally / physically, physiologically and behaviourally better adapted are selected for or survive; and reproduce to form offspring with similar features; and those members of the species with opposite characteristics/ less adapted structurally, physiologically and behaviourally are selected against or fail to survive; The net effect of natural selection which is through reproductive potential and differential mortality is that only the fit individual of the population are more perpetuated to future generations until all the non- fit are completely eliminated;

Isolation allows genetic changes such as mutation which may cause new variation; and selection that determines members of a species that survive to occur independently in each of the sub-populations/ demes; The independent genetical changes and selection that occur over a time in each deme/ sub-population may lead to new individuals which even when members of the deme are merged cannot reproduce viable/ fertile offspring and therefore these belong to different species; 1 mark @ 11 marks.

Total = 20 marks maximum.

-END -