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**PROPOSED GUIDE**

**Uganda Advanced Certificate of Education**

**BIOLOGY P530/2**

**TIME: 2½ HOURS**

**INSTRUCTIONS TO CANDIDATES**

*Question one in sections* ***A*** *is compulsory and any three questions in section* ***B***

**SECTION A**

The graph below shows changes in the standing crop biomass of producers, primary consumers and certain environmentalVariable in a lake during the course of one year. Study the curves and answer the questions that follow.



**(a).Describe the changes in the standing crop biomass of consumers and producers**

***(06 marks)***

**Standing crop biomass of consumers**

From January to February;the standing crop biomass increased gradually;

From March to May; the standing crop biomass increased rapidly; to a peak;

From June to July; standing crop biomass decreased rapidly;

From July to mid-September; the standing crop biomass remained constant;

From mid-September to mid-December, it decreased gradually; and then remained constant towards the end of December;

**Standing crop biomass of producers**

From January to mid-February; standing crop biomass of the producers increased gradually;

From February to March; standing crop biomass of the producers increased rapidly; to a peak;

From April to May; standing crop biomass decreased rapidly;

From May to June, the standing crop biomass of the producers decreased gradually;

From July to mid-august, the standing crop biomass of the producers increased gradually; to another peak;

From mid-August to mid-December; standing crop biomass decreased gradually and then remained constant towards the end of December;

**(b)(i).Explain the observed changes in the physical factors in the river? (10Marks)**

From January to July, light and temperature increased; to attain their peaks because it’s a sunny season; the sky is clear; quantity of light is high; there are also few organisms at the surface of the water; due to unfavorable temperatures for their cell metabolism; light energy from the sun is absorbed by water; rapidly warming up the water and the temperature of the water body increases; therefore an increase in light implies an increase in water temperature;

From July to mid-august Temperature remains constant when there is a balance between heat loss by evaporation; and heat gain from the sun’s light rays striking the water body;.

From mid-august to December, light and temperature decreases; because it’s the rainy season; cold rain water; mixes with the river water cooling it; clouds also cover-up the sky impeding some light rays from reaching the lake and therefore reducing on the amount of light received/light penetration and the temperature of the water body, also more organisms at the water surface reduces light penetration into the water body due to favorable temperature for their cell metabolism

**(b)(ii).What is the importance of increased light penetration into the water body to the ecosystem in the river? (04marks)**

• It increases the rate of photosynthesis; increasing productivity in the river;

• Increases the number of producers in the river ecosystem; availing energy to higher trophic levels;

• Light energy warms up the water; providing a suitable temperature for breeding of the organisms;

• Increased light penetration affecting the seasonal rhythms such as mating and migration of organisms;

• Warming up the water can decrease the amount of dissolved oxygen in the river water;

• Increases visibility in the river serving both the predator and prey to escape from being eaten or to find food, shelter, and mates.

**(c).Explain the relationship between producers and**

**(i).nutrients (05marks)**

From January to mid-march, as the amount of the nutrients decreased, the number of producers increased; because producers fed on nutrients for their survival;

From mid-April to mid-march, as the amount of nutrients decreased, the number of producers also decreased because of the many producers; which over fed on the nutrients, due to competition for the available nutrients, some producers were deprived off the nutrients and died.

From October to December, as the amount of the nutrients increase, the number of producers decreased; because it’s a rainy season; the sky is covered by the clouds; low light penetration; low light absorption by the water; low temperature and therefore unfavorable temperature for the metabolic activities in the producers resulting into death of some producers.

**(ii).primary consumers (05marks)**

From January to mid-April as the number of producers increase, primary consumers also increased ;because primary producers depend on producers for food and oxygen; Increase in producers produce more food and oxygen available for consumption by consumers ;.

From mid-September to mid-December as the number of producers decrease, the number of primary consumers also decrease; due to death of some consumers ;as a result of competition for few producers;

**(d).Suggest the**

**(i).probable sources of nutrients in the lake *(02 marks)***

• Decomposition of dead organisms in the lake

• Drainage of nutrients into the lake by the feeding river

• Nutrient falling in with rain eg nitrates

• Dissolution of the underlying lakes

• Fertilizer washout from farms into lakes

**(ii).reasons for the rapid rise in the nutrients up to the end of the year *(02 marks)***

* Death of producers adds nutrients after decomposition;
* Decrease in producers which would have consumed the nutrients.
* Death of primary producers adds nutrients after their decomposition.
* A low temperature reduces respiration resulting in a decrease in nutrient consumption.
* Low light intensity lowers the photosynthetic rate; resulting in a decrease in nutrient consumption.

**(e)(i).Predict what would happen to the ecosystem if the prevailing conditions continue for yet another year. (02marks)**

Nutrients will decrease gradually ten fluctuate around a constant; Light intensity will decrease gradually and fluctuate around a constant; Producers and consumers will increase gradually; and fluctuate around a constant.

**(e)(ii).Explain your answer *(03 marks)***

Phytoplanktons and so the consumers increase gradually; Increase in producers might shield the submerged photosynthetic phytoplankton; reducing light infiltration; and oxygen dissolution from the atmosphere into the lake;

Consumers will be deprived of oxygen; leading to their death and decay;. Decrease in light penetration reduces temperature too; causing decay of producers hence resulting in an increase in level of toxins in the water body; which may render the ecosystem unfavorable for life.

**SECTIONB**

5. (a) **Comparison of structure of cardiac and skeletal muscle**

**Similarities**

* Both are covered by a sarcolemma;
* Both have cross striations/stripped;
* Both are made up of fine fibres/myofibrils;
* In both each myofibril is made up filaments; of actin and myosin filaments;
* Both have **numerous** mitochondria;
* Both are supplied with **numerous** blood vessels/highly vascularized;
* Both are cylindrical;

b. Differences

|  |  |
| --- | --- |
| Cardiac muscle | Skelental muscle |
| Has one/two nuclei | Many nuclei |
| Nucleus is central in each muscle fibre | Nucleus is periphery in muscle fibre |
| Has intercalated discs | No intercalated discs |
| Fibres branch and cross connect with each other forming a complex net-like arrangement | Fibres are not branched |
| Innervated from within the heart muscle(SAN) | Innervated by the voluntary part of the nervous system |
| Muscle cells are shorter | Muscle cells are longer |

(b) **Adaptations of muscles**

(i) **Cardiac muscles**

* Has many mitochondria that release energy for continuous contraction;
* Cardiac muscle has SAN in the heart muscle which enables the heart contract rhythmically;
* It is richly supplied with blood capillaries to supply enough oxygen and nutrients for muscles continuous contraction;
* It has interconnections by intercalated discs which makes the muscle fibres a network for quick impulse transmission throughout the heart muscle to cause rhythmic contractions;
* It has slow contractibility than other muscles to prevent muscle fatigue/long refractory periods avoid muscle fatigue;
* Muscle fibres are arranged in such a way to allow rapid diffusion of action

Potentials/excitations from one fibre to another;

* There is the SAN in heart walls so that the cardiac impulses are myogenic/self-generated within the heart itself;

(ii) **Skeletal muscle**

* The sarcoplasm contains numerous mitochondria for supply of ATP; and numerous sarcoplasmic reticula for transportation of substrates needed for supply of energy/for storage of calcium ions that initiates muscle contraction;
* Has a rich network of blood vessels/capillaries for supply of nutrients/oxygen/removal of waste products;
* A muscle fibre is made up of myosin and actin filaments which slide over other to bring about contractions/relaxation of the whole muscle affecting movement;
* Supplied by voluntary nervous system via motor nerves from the brain and spinal cord to convey impulses from central nervous system to muscles; when stimulated it quickly contracts to effect movement in time;
* Numerous myofibrils arranged parallel to another; to increase strength;
* Many neuromuscular junctions throughout muscles; to make contractions more rapid and powerful as fibrils contract simultaneously;
* Have several myoglobin molecules for oxygen storage and release when oxygen levels drop;
* Phosphocreatine to regenerate phosphates required for ATP production;
* Elongated muscle fibres for considerable contraction;
* Parallel fibres for maximum contractile effect;
* Reciprocal muscles to allow antagonistic contraction;

a). **Water.**

* It is a liquid for living things**;** and for the chemistry of life**;** because it is liquid at room temperature**;**
* Aquatic environments are slow to change temperature where temperatures of the environment fluctuates because water has a high specific heat capacity**;**
* Water has a high latent heat of fusion**;** contents of cells and aquatic environments are slow to freeze in cold weather**;** ice forms on the surface of water insulating the water below and when surface water freezes, aquatic life can survive below the ice because water has maximum density at 40c**;**
* Due to high surface tension of water; it forms droplets on surfaces and runs off**;** certain animals exploit surface tension to land on and moves over surface of water**;** Water flows readily through narrow capillaries because water molecules slide over each other very easily i.e. has low viscosity**;**
* Water is a medium for chemical reactions of life because it is a universal solvent**;** plants can photosynthesize at a depth in water because water is colourless**;**
* Due to high latent of vaporization, water cools organisms as it vaporizes**;**
* Water is incompressible that is, gives support to, for example, hydrostatic skeleton, and turgidity**;**
* Water has a high density for support**;**
* Water has a high cohesion so that it can be lifted by properties so that with low viscosity, capillarity becomes possible**;** and also moves through extremely narrow spaces e.g. soil particle**;**

b). Lipids are compact for a given quantity of energy than carbohydrates**;** this makes them a preferable store where an organism or part of it is to move from place to place**;** Lipids are insoluble in water hence can’t dissolve out of storage structures**;** They can release much more energy for same mass when oxidized in respiration**;** and release more metabolic water**;** due to more C-H bonds; compared to an equivalent mass of carbohydrates, their breakdown produces more hydrogen atoms ;for the electron transport chain ;hence liberate more energy and water, Lipids can also serve other functions such as, insulation against heat loss**;**

store Vitamins A, D, E and K**;** Used in water proofing; Formation of cell membrane**;** contributes to buoyancy in aquatic animals**;** Cautioning / shock absorbers (protecting delicate parts)**;**

4. a) cell organelle is a separate structure within a cell which performs specific functions ;eg mitochondrion, ;chloroplast,lysosome while cytoplasmic inclusion is an insoluble, non-living substance suspended in the cytosol of a cell not capable of any metabolic activity ;eg glycogen granules; lipid droplets,;water filled vacuoles,;calcium oxalate crystals in plant cells;.

b) Cell membrane is made up two layers of phospholipids(phospholipid bilayer) ;whose lipid tails face inwards of the membrane; and phosphate heads face outward;. Phosphate heads are polar,;hydrophilic ;and form hydrogen bonds with water;. Lipid tails are nonpolar,; hydrophobic ; and are attracted to each other by hydrophobic interactions ;and van-der-Waals forces of attraction.; Extrinsic(periphery) proteins are found at the inner and outer surfaces,; some intrinsic proteins are partly embedded in anyone of the phospholipid layers ;while others span across the two phospholipid layers(trans-membrane proteins) ;some trans-membrane proteins are porous,; some proteins conjugate with short branched carbohydrates forming glycoproteins, ;some phospholipids conjugate with short branched carbohydrates forming glycolipids,; in animals cells, cholesterol squeeze between the phospholipid molecules;

c) Ribosomes are non-membranous organelles lining surfaces of the membranous rough endoplasmic reticulum; ribosomes provide the site where amino acids are condensed together to form a polypeptide chains/ primary proteins; which bind on the receptor molecule of the RER that provides a channel through which the polypeptide chains enter the cisterna of the RER ;where they are transformed into other protein molecules/ secondary/tertiary/quaternary proteins ,;which are then transported in a pinched off transport vesicle to cis-end of another membranous vesicle ‘Golgi-body’,;transport vesicle then fuses with the end of the cis-Golgi,; a short branched carbohydrate is then added to the transformed protein; forming a glycoprotein.