Uganda Teachers Education Consult UTEC 2024

BIOLOGY

P530/2

MAKING GUIDE

1.

(a)

(i) Population density of yeast

Between 0 and 6hours, population density of yeast cells **remained constant;**

Between 6 and 11 hours, population density of yeast cells **increased rapidly;**

Between 11 and 18 hours, population density of the yeast cells **increases gradually;**

Between 18 and 20 hours, population density of the yeast cells **decreases gradually/ slowly;**

@ = 1 mark

Award 4 marks

(ii) Glucose concentration

Between 0 and 5 hours, glucose concentration **decreases gradually;**

Between 5 and 12 ½ hours, glucose concentration **decreased rapidly;**

Between 12 ½ and 20 hours, glucose concentration **remained constant;**

@ = 1 mark

Award 3 marks

(b)

(i) 0and 6 hours

The population density of yeast remained constant; because the number of the yeast cells is low and the yeast cells are still synthesizing respiratory enzymes; thus there is no cell division of the yeast taking place; **@ = 1 Mark, award 4 marks only.**

(ii) 6 and 12 hours

Between 6 and 11 hours, the population density of the yeast cells increased rapidly; because enough respiratory enzymes were synthesized; causing rapid metabolism of glucose; producing a lot of ATP; for faster rate of cell division of yeast cells;

On the other hand, there was also enough glucose for yeast respiration; and enough living space to accommodate the increasing number of yeast cells; and few toxic wastes; / less intraspecific competition for resources/ conditions of yeast culture were favorable for yeast cell division

Between 11 and 12 hours, population density of yeast cells increased gradually; because the available yeast population was close to the mediums carrying capacity; causing environmental resistance to set in; / intraspecific competition for resources increased / toxic wastes/ alcohol accumulation became limiting for yeast cell division. This caused lowering of the yeast cell division while increased yeast death rate;

@ = 1 mark

Total 10 marks

(c) Between 0 and 6 hours, as the population density of the yeast cells remains constant, the glucose concentration decreases slowly; because of little/ gradual metabolism of glucose by yeast; causing no significant change in the rate of cell division of yeast cells;

Between 6 and 11 hours, as population density of the yeast cells increase rapidly, the glucose concentration also decrease rapidly; due to rapid respiration of glucose; by yeast cells causing a rapid increase in their cell division;

Between 11 and 20 hours, the population density of the yeast increases gradually to the peak and then decreases gradually whereas glucose concentration remains constant; because respiration of glucose in the fermenter yields alcohol which is toxic ; to yeast cells killing them; also depletion of glucose causes yeast cell division to slow down;

@ = 1 mark

Total = 10

Award maximum = 8 marks

(d)

(i)

$$\text{Percentage of glucose At end} = \frac{\text{concentration glucose at end}}{\text{Concentration of glucose at start}} \times 100;$$

$$= \frac{5}{45} \times 100;$$

$$= 11.1\%;$$

Award marks for: covered formulae, substitution of figures and correct % answer

@ 1 mark

(d)

(ii)

The respiration of glucose by yeast yields carbon dioxide and alcohol; which lower the pH of the culture; and this denatures yeast respiratory enzymes; causing their respiration to cease; thus glucose is not respired at the end. **@ = 1 mark**

Award 4 marks

(e) The respiration of glucose by yeast is controlled by enzymes; which are sensitive to changes in the pH of culture;

Thus 35^0C provides an optimum temperature; for yeast respiratory enzymes to metabolize glucose;

@ = 1 mark

Award 4 marks

Total 44

Max on whole question = 40

2

(a)

(i) Fresh water fish

The internal body fluids of fresh water fish are hypertonic to the surrounding waters; and experience considerable osmotic entry of water into their bodies and loss of ions by diffusion; through the highly permeable gill surface thus dilution of their tissues by excess water absorbed and loss of ions are counteracted by;

Possession of many large glomeruli; to increase the filtration rate for production of large volumes of dilute urine;

Excretion of nitrogenous wastes in form of ammonia; whose expulsion from the body requires large amount of water;

Active uptake of salts from surroundings by special cells in the gills; to replace the ions lost in urine;

Active reabsorption of ions from glomeruli filtrate as it passes down the tubule;

@ = 1 mark, max 06 marks

(ii) Xerophytes are desert plants which are faced with a problem of water shortage in their habitat; and experience high evaporation rates of water due to high temperature; these problems have been solved in the following ways;

Have extremely deep roots to absorb water from deep soil layers;

Have tissues tolerant to desiccation;

Some store water in succulent tissues in leaves and stems;

Have reduced number of stomata; and leaves;

Reverse stomata rhythm especially in CAM plants;

Sunken stoma that creates humid conditions for preventing water loss;

Have small sized leaves to reduce surface area for water loss;

Have thick waxy cuticle which is impermeable to water;

Have hairy epidermis to trap moisture;

Some fold leaves to conceal stomata;

Shading off leaves to prevent water loss;

(b) Plants synthesise all their organic requirements according to demands; e.g. they manufacture only a certain amount of protein that is necessary to satisfy their immediate demands; so there is no excess protein limiting nitrogenous waste production;

The amino acids produced from breakdown of proteins can be recycled into new proteins;

The gaseous metabolic waste products in plants can be recycled / reused; e.g. carbon dioxide and water can be used as raw materials in photosynthesis; / oxygen can be used as a substrate in respiration.

The excess gaseous metabolic waste products can be excreted by diffusion; e.g. oxygen

Many organic waste products of plants are stored within dead permanent tissues eg wood and in leaves and bark;

Organic acids which might prove harmful to plants combine with excess cations to form precipitates/ crystals that are nontoxic;

Aquatic plants lose most of their metabolic wastes by diffusion directly into water;

3

(a) Energy stored in ATP is produced by cyclic and non-cyclic phosphorylation which requires energy from the sun/ solar energy;

Light strikes chlorophyll molecule/ photosystem; and an electron becomes excited; and moves to a higher energy level; where t is accepted by an electron acceptor;

The electron moves through a system of electron carriers; at a progressively decreasing energy levels / are arranged downhill in energy terms; while losing energy; which is used to combine inorganic phosphate with Adenosine di Phosphate (ADP) to form ATP/ Adenosine tri phosphate;

@ 1 mark total = 9

Award maximum 8 marks

(b) In the Calvin cycle; ATP provides a source of energy for reducing glycerate 3-phosphate to triose phosphate/ phosphoglyceraldehyde; from which hexose sugar is formed; that is polymerized to form starch;

The starch is stored in plant cells; which is later fed on the herbivores

In the herbivores, digestion of starch produces sugars/ glucose; which are absorbed; into blood stream and transported to the liver where the excess glucose is converted into glycogen/ fat; for storage; / oxidized to release energy for growth.

When the carnivores feeds on the herbivores; the fats and proteins are in flesh are digested; to produce fatty acids and glycerol together with the amino acids; which are assimilated; by the carnivores.

@ 1 mark Total = 14

Award max 12

4

(a) Numerous mitochondria in the sarcoplasm to provide ATP;

Numerous sarcoplasmic reticula for transport of substrates for energy synthesis/ storage of calcium ions that initiate muscle contraction;

Dense supply of capillaries to deliver oxygen and remove wastes products;

Have parallel fibres to provide maximum contractile effect;

Muscle fibres are elongated to allow considerable contractions;

Have much myoglobin for oxygen storage and release when oxygen levels fall;

Have myosin and actin filaments that slide over each other to bring about contraction and relaxation;

Many neuromuscular functions to produce quick and powerful contractions;

Presence of phosphocreatine it regenerate phosphates for ATP synthesis;

Have reciprocal muscles that allow antagonistic contractions;

Numerous myofibrils arranged parallel to each other to increase strength;

Has a supply of motor nerves to produce faster contractions when stimulated to effect movement in time;

@ = 1 mark

Total = 11 marks

Award max = 10 marks

(b) A muscle fibre shortens by the sliding of the actin filaments past the stationary myosin filaments; in the sarcomeres. The stimulation of the muscle fibres causes release of calcium ions from the sarcoplasmic reticulum and the T-system; into the sarcoplasm to bind with troponin; the binding causes change in shape of troponin; leading to the displacement of the regulatory protein called tropomyosin; from binding sites on the actin filaments;

This enables myosin heads to bridge with actin filaments; and change position causing the actin filaments to be pulled; and slide past the stationary myosin filaments;

Hydrolysis of ATP releases energy required for the movement of myosin heads;

Ceasation of stimulation of the muscle fibre causes tropomyosin to re- blocks the binding sites so that the muscle relaxes;

5.

(a) Mechanisms of fruit and seed dispersal; reduces competition among off springs;

Develop seeds which may remain dormant; until favorable conditions set in;

Some have vegetative organs with food reserves; to withstand adverse conditions; double fertilization produces food store/ endosperm in seeds; to sustain new plant following seed germination;

Cross pollination mechanisms lead to variation; which promotes survival in the changing environment;

Have a sporophyte resistant to harsh conditions; and protects the delicate gametophyte;

Display features like scent/ brightly coloured petals; to attract insect pollinators;

Female gametes are protected within the ovary; and develop style through which pollen tube grows;

@ = 1 mark, award max =7

(b) (i) light acts as a limiting factor; in plan growth by influencing photosynthesis; since it provides energy required to drive the light reactions; and consequently the synthesis of carbohydrates in the dark stage which are needed for plant growth/ synthesis of biological molecules required for plant growth;

Directional light causes unequal distribution of auxin; in plant shoots resulting into a growth curvature towards the source of light;

Red and far red light affects flowering; and seed germination; both of which are growth processes.

On the other hand light of low intensity/ dim light stimulates etiolation; / causes internode elongation and affects leaf expansion/ limits size of the leaf

@ = 1 mark total =

Award max 08 marks

(ii) water acts as a limiting factor; in plant growth by influencing photosynthesis; sine it is a raw material for the process; and germination; since it activates hydrolytic enzymes/ promotes synthesis of growth hormones; thus adequate amounts of water stimulate growth;/ limited amounts of water inhibits growth.

@ = 1 mark, award max = 06 marks

6

(a)

Gene mutation	Chromosomal mutation
Involve changes in the structure of DNA/ amount of genes/ nucleotide sequence of DNA	Involves changes in structure and number of chromosomes;
Affect a single gene locus	Affects several gene loci;
Have les profound effect on phenotype	Have a more profound effect on phenotype;
Detected by DNA sequencing	Detected by karyotyping;

(b) Gene mutations cause a change in the structure of DNA at a single locus; on a chromosome which may be transcribed to produce a mutant messenger RNA; which directs the translation of a wrong sequence of amino acids in a polypeptide chain; that forms an abnormal protein which may be an enzyme un able to catalyse a particular chemical reaction; these changes in the DNA structure may involve;

Deletion, where a portion of a nucleotide chain is removed from the sequence;

Duplication, where a portion of a nucleotide chain is repeated;

Addition/ insertion, where an extra nucleotide sequence becomes inserted into the chain;

Inversion, where a nucleotide sequence separates from the chain and rejoins in its original position when inverted;

Substitution, where one of the nucleotide is replaced by another with a different organic base;

(c) Mutation causes change in the structure of DNA which leads to variability; some of which are advantageous while others are disadvantageous;

Organisms with advantageous variations are selected for; which survive to reproductive age; and pass on their characteristics to future/subsequent generations/ offspring;

Organisms with disadvantageous variations are selected against; and so do not contribute their genes to offspring/ next generation; when this process of selection is repeated for successive generations; the advantageous variations accumulate; and cause the population to diverge from the original one; consequently a new species has emerged/ evolved;

@ = 1 mark total = 11 marks

Award only 10 marks

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BIOLOGY

P530/1

MAKING GUIDE

SECTION A

1 A	11 B	21 A	31 B
2 A	12 C	22 C	32 A
3 D	13 A	23 A	33 A
4 C	14 C	24 D	34 A
5 A	15 D	25 B	35 A
6 C	16 D	26 A	36 C
7 A	17 C	27 B	37 B
8 A	18 D	28 C	38 B
9 C	19 C	29 B	39 D
10 B	20 C	30 D	40 A

SECTION B

41 (a)

(i) The oxidation of chemical compounds/ divalent iron salts/ hydrogen sulphide;

(ii) Decay of organic matter by anaerobic bacteria/ metabolism of anaerobic decay bacteria;

(b)

Purple sulphur bacteria	Cyano bacteria
Uses bacteria chlorophyll to trap sunlight	Uses chlorophyll to trap sunlight;
Produces sulphur as a bi product	Produces oxygen as a bi- product;
Source of hydrogen is hydrogen sulphide	Source of hydrogen is water;

(c) The nitrifying bacteria **oxidise;** ammonia into nitrates; releasing energy; which is used for synthesis of carbohydrates;

(d) Saprophytic bacteria cause the decay and recycling of nutrients;

Mutualistic bacteria enrich the soil with nitrogen;

42.

(a)

(i) No action potential; evoked because stimulus A is weak; thus membrane potential was unable to reach threshold; at which an action potential is generated.

(ii) Action potential is generated; because stimulus B is stronger; thus membrane potential exceeded the threshold; required to evoke an action potential

(b) The sodium ions diffuse into the axon; making the inside positive relative to the outside; when the positive charge builds to reach the threshold, an action potential is generated; **accept depolarizes**

(c) Axon is still repolarizing/ restoring its resting potential/excitability;

43

(a) Alimentary canal/ gut;

Respiratory tract/ pathway;

(b) Contains **lysozyme enzyme;** that dissolves bacterial cell wall; making it vulnerable to bursting;

(c) In the thymus gland, stem cells develop into **thymocytes;** which destroy cells that recognize self-antigens/ body's own cells;

In embryo, lymphocytes whose receptors fit those of body cells die or are suppressed; preventing an attack on body's own cells;

(d) Stimulates B cells to make antibodies/ produce plasma cells;

Produce chemicals which activate other white blood cells;

Assist T- killer cells to destroy pathogens; / stimulates T cells to multiply.

Promote inflammation;

44

(a) Both have a large surface area;

Both are thin walled;

(b) Have a loose mass of cells/ lenticels; in their bark through which respiratory gasses readily diffuse into and out;

(c)

(i) Gaseous exchange reduces; because respiration and photosynthesis are enzyme controlled; thus a decrease in temperature would reduce the activity of respiratory and photosynthetic enzymes;

(ii) Gaseous exchange increases; because small mammals have a higher metabolic rate; due to large surface area to volume ratio; thus their oxygen intake and carbon dioxide production are high;

45

(a) Removal of metabolic waste products;/ excretion

Regulation of the water content of body fluids; / osmoregulation

Regulation of the pH of the body fluids;

Regulation of chemical composition of the body fluids; / removal of substances in excess of body's requirements

(b) salt is actively removed from the ascending limb and deposited into interstitial fluid; from where it diffuses into the descending limb as water moves out of it by osmosis; this makes the filtrate in the descending limb concentrated; thus as the length of the loop increases/ descends deep into the medulla, the effect becomes multiplied;

(c) As the medulla thickness increases, the urine concentration also increase; because thicker medulla contains many loops of Henle; that form a counter current system which concentrates urine;

46

(a) No solid substratum to support body weight;

Forward force is exerted against a medium which slips away/ doesn't offer grip;

Involves high energy expenditure;

There is a tendency to sink;

Water offers more drag due to viscosity/ resistance of medium to propulsion;

(b)

(i) provides lift force; counteract the instabilities due to pitching; and rolling;

(ii) Counteracts instabilities due to pitching; / tendency of the nose to plunge vertically downwards

Minimizes water resistance / reduces drag during locomotion;

(c)

Locomotion in water	Locomotion in birds
Expend less energy	Expends more energy;
No need to overcome gravity	Need to overcome gravity;
Propulsion and lift brought about by side to side tail movement	Propulsion and lift occurs by flapping of wings in air;
Medium of locomotion is water	Medium of locomotion is air;
Side to side movement caused by alternate contraction and relaxation of myotomes	Flapping of wings caused by pectoral muscles; (major and minor)
Drag is reduced by overlapping nature of scales/ slimy wating on scales	Drag is reduced by cover of body with smooth feathers; and streamlines
Fish's position in water is maintained by swim bladder in bony fishes/ swimming in dog fishes	Birds position in air is maintained by gliding/ soaring;