MARKING GUIDE FOR UNEB UACE BIOLOGY P2 2023

SECTION A. (40 MARKS)

1. (a) (i) **Description of rate of photosynthesis**

From 8 to 20^{O}C, the rate photosynthesis increases gradually; and then rapidly from 20 to 30^{o}C; it increases gradually to the peak at 37^{o}C; and falls/decreases rapidly from 40 to 46^{o}C; and then gradually decreases from 46 to 58^{o}C; max 04 marks

ACC. Any description award increase and decrease twice for gradual and rapid

(ii) **Explanation of rate of respiration**

The rate of respiration gradually increases with increase in temperature; because respiration is an enzyme controlled reaction; since increase in temperatures kinetic energy/frequency of collision for enzyme and substrate molecules; the rate reaches a peak at 45^{o}C because enzyme activity is at its optimum;

The rate then gradually decreases as temperature rises above 45^{o}C; due to denaturation;

06 marks

(iii) **Explanation for the difference in rate of photosynthesis and respiration**

From 40-47^{o}C, there is a rapid drop/decrease in photosynthetic rate as rate of respiration increases gradually to a peak; because at high temperature stomata close; there is reduced carbon dioxide uptake/photosynthetic enzymes are denatured at lower temperatures;

From 47 to 58^{o}C photosynthesis continues to decrease rapidly as respiration increases gradually; due to little oxygen still remaining in cells which continues to be used in aerobic respiration;

Beyond 58^{o}C no photosynthesis takes place but respiration continues to decrease gradually to zero; because of anaerobic respiration; until when respiratory enzymes are all denatured;

08 marks

(iv) **Explanation for the relationship between respiration and photosynthesis**

The rate of respiration increases as rate of photosynthesis increases; because the by-products of photosynthesis (oxygen/glucose) are used during respiration; at 47^{o}C rate of photosynthesis equals rate of respiration; and this point there is no net gas exchange between plant and environment; as all oxygen from photosynthesis is used by respiration and also all carbon dioxide from respiration is used up for photosynthesis; beyond 58^{o}C, there is anaerobic respiration; max 06 marks

(b) **Comparison of carbon dioxide uptake by plant A and plant B**

Similarities

- In both amount of carbon/dioxide uptake increases with increase in temperature from 10 to 25^{o}C;

- Both rates of uptake attain maximum/peak;
- From 40 to 45^0C, both show decrease in amount of carbon dioxide absorbed;
- At 30ºC they have same amount of carbon dioxide absorbed; Max 04 marks

Differences

- Photosynthesis in B attains a higher peak/maximum than in plant A;
- Plat A reaches peak at a lower temperature of 25ºC while plant B reaches peak at a higher temperature of 40OºC
- At 10ºC plant A absorbs more carbon dioxide than plant B/ from 10 to 30ºC amount of carbon dioxide absorbed in plant A is higher than that in plant B;
- Beyond 30ºC plant B absorbs more carbon dioxide than plant A;
- From 25 to 40ºC absorption by plant A decreases while that of plant B decreases;
- Beyond 40ºC absorption in A decreases gradually while for plant B decreases rapidly;

Max 04 marks

(c) Plant B /C4/CAM plant; rate of photosynthesis is highest at temperature of 40Oc; at same temperature plant B absorbs the highest amount of carbon dioxide; which implies increased rate of carbon dioxide; 04 marks

(d) **Factors affecting rate of photosynthesis**

- Carbon dioxide concentration; insufficient carbon dioxide limits rate of photosynthesis/high carbon dioxide concentration increases rate of photosynthesis;
- Amount of water available; water stress reduces rate of photosynthesis;
- Type/concentration of photosynthetic pigments; low concentration of pigments reduces rate of photosynthesis;
- Mineral nutrients;
- Wind velocity/speed;
- Wavelength of light;
- Leaf structure and positions;
- Oxygen partial pressures in C4; increases photorespiration lowering photosynthetic rate;

Any 4, max 08 marks

(e) the carbon dioxide from atmosphere diffuses into mesophyll cells; and fixed into malate; the malate is then shunted into the bundle sheath cells; where it breaks down into pyruvate and carbon dioxide; carbon dioxide may be directly absorbed by bundle sheath cells and fixed by RuBP into sugars; 5X 1mark, max 4 marks

SECTION B: (60 MARKS)

2. (a) **Ecological significance of instinct behaviors.**

(i) **Territoriality**

- Reduces (intra/inter-specific) aggression;
- Reduces (intra-specific) competition;
- Avails enough resources to organisms;

- Ensures safe, undisturbed mating/pair formation;
- Ensures protection of vulnerable/sick/elderly members of species;
- Control diseases spread from outside the territory;
- Encourages inbreeding reducing variation/hybrid vigour; 06 marks

(ii) **Courtship**

- Minimises breeding between closely related species;
- Synchronises time of producing offsprings with availability of food;
- Allows pair bonding leading to successful mating;
- Provides protection to courting individuals;
- Stimulates mating of individuals;
- Provides parental care to offspring increasing chances of survival;
- Limits mating to sexually mature individuals;; 07 marks

(b) **How organisms avoid predation**

- Group protection; e.g. school of fish/buffalo herds;
- Chemical defence/venoms; e.g. snakes/birds/wasps;
- Alarm; e.g. rattle of snakes/puff adder/insects/birds/elephants;
- Distraction displays/flash colourations; e.g. lizards/millipedes/pangolin;
- Mechanical protection/mandibles/teeth/horns/scales/spines/shells; e.g. cows/ porcupines/crocodiles;
- Visual protection/mimicry/camouflage; e.g. caterpillars/chameleon;
- Antibiosis/strong odour chemicals repel or worn other individuals against danger; e.g. in insects/molluscs;
- Electrical signals e.g. electric fish;
- Autotomy, where organisms run and leave behind body parts e.g. lizards leave behind tails;
- Sham death; e.g. tortoises;
- Faster locomotion/running away and migrations e.g. antelopes/rats;
- Hiding/burrowing/nocturnal e.g. rats/owls;
- Keen eye sight to easily detect predators; e.g. insects; @$^1/_2$ mark, max 07 marks

3. (a) **Structure of vascular tissues**

Consists of xylem; and phloem;
The xylem is made of tracheids; and vessels; tracheids are single celled; elongated; with tapering end walls;
The vessels are very long; and tubular structures of several cells; fused end to end in a row;
Tracheids and vessels are made up of dead empty lumen; with lignified walls/patterns of lignification; and have pits;
The phloem consists of sieve tubes; companion cells; phloem parenchyma; fibres; and sclereids; and are living;

The sieve tubes are long; tube-like; fused sieve elements/cells/end-to-end; but with nucleus; the elements have sieve plates; adjoining neighbouring cells; with sieve pores; and cytoplasmic filaments;
The companion cells have dense cytoplasm; has plasmodesma; in between sieve tubes and companion cells; in between sieve tubes and companion cells;

26 x $^1/_2$ mark, max 10 marks

ACC. Appropriate diagrams for phloem and xylem and mark accordingly

(b) **How movement of water from the soil provides support**

The soil water surrounding the root hair cells has a lower osmotic pressure/higher water potential/higher osmotic/solute potential; than the cell sap in the vacuoles of root hair cells; this creates a concentration gradient; which allows water to move from the soil into root hair cells by osmosis;
The entry of water into root hair cells lowers their osmotic pressure/increases the water/osmotic/solute potential;; than the neighbouring cells in the cortex of roots; which causes outflow of water by osmosis from the root hair cells to cortex cells; this builds a water potential gradient through the plant cells; until all cells of plant absorb water by osmosis; this leads to turgidity of the cells; and this turgidity provides support;

12 x1 mark, max 10 marks

4. (a) (i) **Adaptations of placenta for exchange of materials**

- Placenta has numerous microvilli to increase surface area for exchange of materials;
- Chorionic villi has a thin membrane to reduce diffusion distance;
- Trophoblastic cells produce anticoagulants this prevents this prevents blood clotting;
- Highly vascularised/numerous blood capillary supply for transport of metabolites and metabolic wastes;
- Material in foetus and mother flow in close proximity/counter-current flow for faster diffusion;
- Numerous mitochondria for ATP production for active transport;
- Trophoblastic cells contain numerous carrier/channel proteins which allows facilitated diffusion for transport of glucose from the maternal to foetal blood;

05 marks

(b) **Advantages of internal embryo development**

- The embryo is protected; against predation; and harsh weather conditions;
- The embryo receives constant supply of nutrients; gains immunity from the maternal antibodies; all of which increases its chances of survival; 06 marks

(c) **Exchange mechanisms between foetus and the mother**

- Simple diffusion; allows movement of oxygen and nutrients; from maternal into foetal blood; and removal of carbon dioxide/wastes from foetal blood to maternal blood; oxygen and nutrients are transported in umbilical vein; while wastes in umbilical artery; the rate of simple diffusion is increased by presence of numerous blood capillaries in placental veins and microvilli which further increases surface area;

- Facilitated diffusion; that transports glucose into foetal circulation; due to presence of carrier proteins in surface membrane of foetus;
- Active transport; that transports ions and amino acids; across from maternal; to foetus; the energy is provided by mitochondria; in the chorionic villi;
- Osmosis; of water; from maternal into foetal blood;
- Pinocytosis; of amino acids/proteins/antibodies; from mother to foetus; due to presence of pinocytic vesicles in chorionic villi;

@$^1/_2$ mark, max 09 marks

5. (a) **Functions of proteins**
    - Hydrolysis of food in the gut; e.g. trypsin enzyme;
    - Storage of food in milk; e.g. casein;
    - Transportation of oxygen; e.g. haemoglobin;
    - Storage of oxygen in muscles; e.g. myoglobin;
    - Blood clotting; e.g. fibrinogen;
    - Defence against invasion of microorganisms; e.g. antibodies;
    - Control of growth and metabolism; e.g. thyroxine;
    - Catalyses reactions in ornithine cycle; e.g. urease/arginase;
    - Structural support/strength/protection; e.g. ossein in bone/elastin in ligaments/ lipoproteins in cell membrane/chromo-proteins in chromosomes;
    - Control of body activity; e.g. ACTH;
    - Allows sensitivity to light by visual pigments in retina; e.g. rhodopsin;
    - Induces milk production; e.g. prolactin;
    - Buffers; e.g. plasma proteins;
    - Protection against UV rays; e.g. melanin;
    - Transport proteins; e.g. carrier and channel proteins in active transport and facilitated diffusion;
    - Energy source during times of starvation; e.g. storage proteins;
    - Receptors sites; e.g. proteins in cell membrane;
    - Transport of lipids in plasma; e.g. lipoproteins;

    @$^1/_2$ mark, max 10 marks

    (b) **Causes of protein denaturation**
    - Heat breaks hydrogen and ionic bonds;
    - Acid additional hydrogen ions combine with COO^- group of amino acids breaking ionic bonds;
    - Alkalis addition of hydroxide ions/decrease in hydrogen ion concentration causes NH_3^+ group of amino acids to lose hydrogen ions hence breaking ionic bonds;
    - Inorganic chemicals/highly electropositive ions combine with COO^- group and break ionic bonds/highly electronegative ions combine with NH_3^+ group and break ionic bonds;
    - Organic chemicals alter hydrogen bonding within a protein;
    - Mechanical force break hydrogen bonds; 6x @1mark

6. (a) **Distinguishing features of gaseous exchange in fish and terrestrial insects**

- Respiratory medium in fish is water while in insects is air;
- Respiratory organ in fish are gills/with gill filaments while in insects it is tracheal system/with tracheoles as a respiratory surface;
- Respiratory pigment in fish is haemoglobin while in insects there is no respiratory pigment/haemoglobin oxygen diffuses directly into tissues;
- Ventilation in insects is achieved by contraction and relaxation of buccal and opercular/hypobranchial muscles while in insects is achieved by contraction and relaxation of abdominal muscles;
- In fish flow of air/water is unidirectional while in insects it is bidirectional/tidal flow; max 03 marks

(b) **Differences between gas exchange in bony and cartilaginous fish**

Bony fish	**Cartilaginous fish**
• Counter-current exchange mechanism • Maintains a concentration gradient across gill plate • Achieves a high exchange efficiency of up to 80% • Water enter via mouth only • The gas exchange surface/ gill filament enclosed with operculum; • Ventilation due to adjustments in buccal, opercular and pharynx	• Parallel flow exchange mechanism; • Concentration gradient not maintained across gill plate; • Lower exchange efficiency of about 50%; • Water enters via mouth and spiracles; • Gas exchange surface is open to the atmosphere via gill slits; • Ventilation due to adjustments in buccal cavity and pharynx only;

Max 04 marks

(c) **Control of ventilation in man**

Ventilation movement is initiated by arise in carbon dioxide levels/low PH/high hydrogen in blood; which is detected by chemoreceptors located in carotid; aortic bodies; and in the medulla oblongata; in the respiratory centre; these send impulses to the phrenic; and (external) intercostal/thoracic nerves; which relay impulses to diaphragm muscles; and (external) intercostal muscles respectively; which contracts; and causes faster inspiration;

The lungs stretch and become inflated with air and expand; and impulses are sent to the expiratory centre in the medulla; via vagus nerve; which automatically switches off the inspiratory centre; and sends messages to the (external) internal and diaphragm muscles to relax; causing expiration; 16 X 1mark@, max 13 marks

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