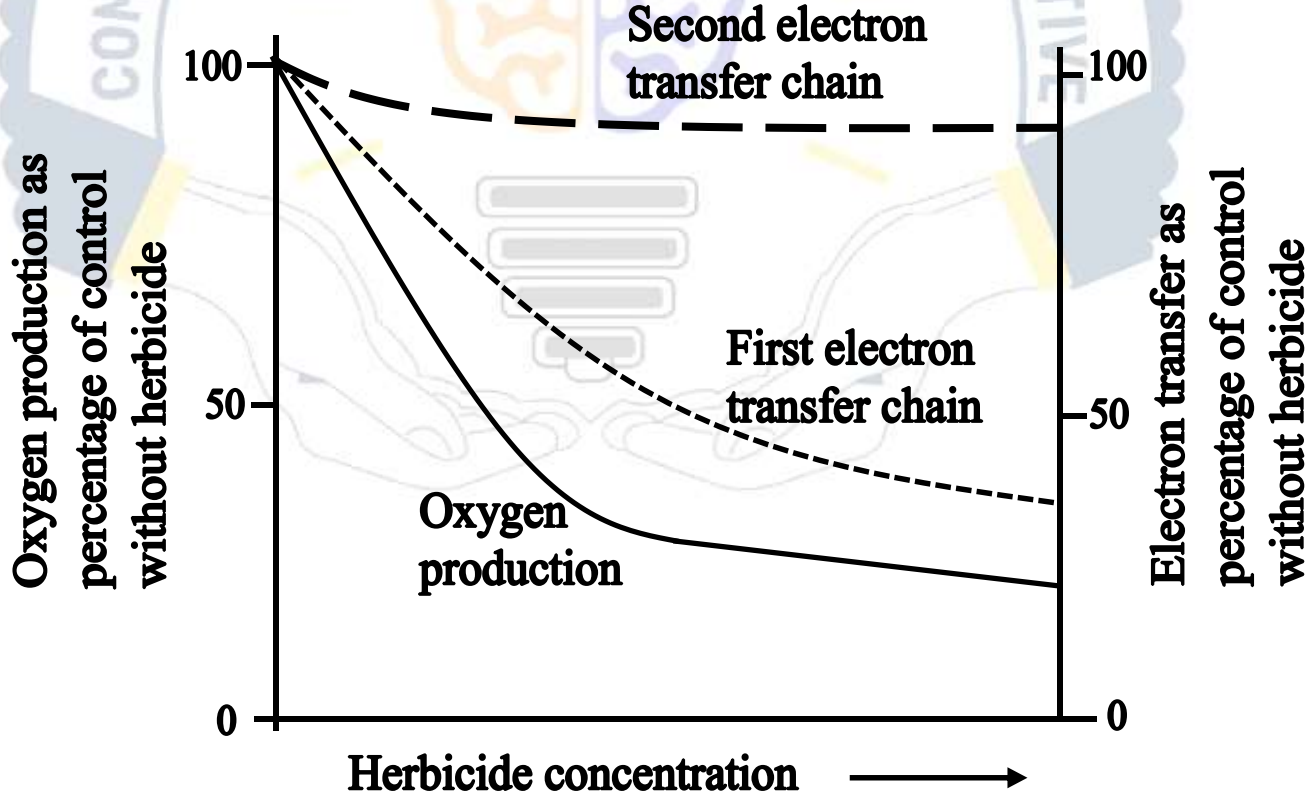
PROPOSED GUIDE FOR POST MOCK

N.B. THIS SECTION IS COMPULSORY TO ALL STUDENTS.

1. Scientists investigated the effect of herbicide on the light-dependent reaction in green micro-algae, *chlorella vulgaris*. Isolated chloroplasts were placed in well buffered and isotonic medium and exposed to sunlight. They measured the effects of different concentrations of herbicide on the production of Oxygen and on the electron transfer chains. The graph shows the results.



Adapt to the 21st Century pedagogical skills- 2023.

a) Compare the oxygen production and the first electron transfer chain. **(05 marks)**

<table>
<tr><th>Descriptions</th><th>Advice</th></tr>
<tr><td>
<u>Similarities</u>.
(Both) Oxygen production and first electron transfer chain.
Initially are same/equivalent/equal;
Decrease with increase in herbicide concentrations;
Attain minimum value;
<u>Differences.</u>
<table>
<tr><th>oxygen production</th><th>First electron transfer chain.</th></tr>
<tr><td>Lower throughout;</td><td>Higher throughout;</td></tr>
<tr><td>Rapid decrease at low concentrations of herbicides;</td><td>Gradual decrease at low concentrations of herbicides;</td></tr>
<tr><td>Lower minimum attained;</td><td>Higher minimum attained;</td></tr>
</table>
</td><td>
Any (02 marks) Heed to the use of “Both”

Any (03 marks) -Accept complete statements with while/whereas.
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</table>

b) Describe the effect of the herbicide concentration on the following measurable variables.

(i) Oxygen production. **(03 marks)**

Increased concentration of herbicide caused rapid decrease in oxygen production; and finally gradual decrease; to minimum;

(ii) First electron transfer chain. **(02 marks)**

Increased herbicide concentration caused gradual decrease; in electron transfer chain to minimum;

(iii) Second electron transfer chain. **(02 marks)**

Increased herbicide concentration caused slight/gradual decrease in electron transfer chain; and finally remained almost constant;

c) Explain the effect of herbicides above in (a) on the following.

(i) Oxygen production. (07 marks)

Increased concentration of herbicide caused decrease in oxygen production because herbicides combine with chlorophyll-a-P680/reaction centre chlorophyll; damages/destroys chla/chlorophyll-a; prevents photo-ionisation/chlorophyll-a doesnot release electrons; no electrons flow from chla to Plastoquinone/primary electron acceptor; no positive hole/positively charged chlorophyll ion/oxidized chlorophyll; photolysis/photo-oxidation of water reduces; AVP herbicide inhibit water splitting/oxidizing enzyme; oxygen evolved decreases.

(ii) Electron transfer chains. (10 marks)

Herbicide was specific to chlorophyll a of (PSII) Photosystem II; with little or no effect on chlorophyll a of (PSI) Photosystem I; no photo-ionisation of Chla in PSII/inactive photosystem II;
Stops flow of electrons though the Z-scheme; preventing formation of reduced NADP; inhibits enzymes such as ATP synthetase; affecting ATP formation; damages the chlorophyll membranes where electron transport chains exists; inactivates primary electron acceptors; and electron carriers;

d) Suggest explanation for the following observations.

(i) Herbicides cause death of plants. (05 marks)

Herbicides work by blocking the flow of electrons; through the Z-scheme/non-cyclic photophosphorylation/electron transport chain/light reaction/light dependent stage; which converts the light energy into the chemical energy of ATP and reduced NADP; Calvin/dark stage/light independent stage fails to occur; plant dies from no energy for maintenance and growth;
Respiration higher than photosynthesis causing starvation;
AVP- Herbicides inhibits the $NADP^+$-reductase enzyme which catalyze formation of Reduced NADP;

(ii) Isolated chloroplast placed in well buffered and isotonic solution. (05 marks)

Buffered to resist changes in P^H; which may cause denaturation of photosynthetic enzymes; or change in the structure of the chloroplast by affecting chemical nature of membrane components; Isotonic to prevent osmotic shocks/lysis; or crenation/shrinking;

SECTION B (60 MARKS)

CHOOSE THREE QUESTIONS OF YOUR CHOICE.

2a) Describe the feedback control of the heart rate following sensory input from.

(i) Baroreceptors. (05 marks)

Baroreceptors detect high pressure and send impulses to the Cardio-Inhibitory centre/medulla oblongata via sensory neurone; medulla sends impulses via Vagus/parasympathetic nerve/inhibitor nerve to SAN/Sino-atrial node; Vagus nerve terminals reduce heart rate by secreting acetylcholine which binds to SAN receptors;

Baroreceptors detect fall in/low blood pressure and send impulses to cardio-accelerator centre/pressor/medulla oblongata via sensory nerve; medulla sends impulses via sympathetic nerve/accelerator nerves to SAN; sympathetic nerve terminals secrete noradrenaline/norepinephrine or adrenaline/epinephrine secreted which binds with SAN receptor increasing the heart rate;

Ignore location of baroreceptors (Aorta ,carotid and venacava)

(ii) Chemoreceptors. (05 marks)

Chemoreceptor detects high O2 and Low Co2 concentration and sends impulses along sensory neurone to medulla; which sends impulses via parasympathetic/Vagus/inhibitory neurone to the SAN; nerve terminals secrete acetylcholine which reduces heart rate;

Chemoreceptors detect low o2 and high Co2 concentration and send impulses via sensory neurone to medulla; which responds via sympathetic/accelerator nerve to SAN; nerve terminals secrete noradrenaline which increases heart rate;

Ignore location of chemoreceptors.

Ignore categorization of central and peripheral chemoreceptors.

b) Explain how adrenaline secretion from adrenal gland prepares the body to vigorous activity. (10 marks)

Muscles break down glycogen to glucose to be used in aerobic respiration;

Liver break down glycogen to glucose which is released into the blood stream for energy production;

Bronchi and bronchioles dilate due to relaxation of smooth muscles; air ways are wider and ventilation easier;

Ventilation rate increases; larger volume of air breathed in and out per-minute;

Sino-atrial node speeds up the heart rate; cardiac out-put increases;

Arterioles carrying blood to muscles and the liver widen due to relaxation of smooth muscles; so more blood flow to them carrying O2 and nutrients/metabolites;

Arterioles that carry blood to the gut, kidneys, skin and extremities become narrower; due to contraction of smooth;

muscles so less blood flows there/diverted/channeled to key organs;

Blood from storage areas like spleen is released into circulation; to increase oxygen and nutrient carrying capacity of blood;

3a) Describe the role of proteins in the functioning of the nerve fibre. (10 marks)

Sodium-voltage gated channels; open on threshold/liminal stimulation causing rapid influx/flooding in of sodium ions along the electro-chemical gradient leading to depolarization; and generation of action potential;

Potassium voltage gated channels; open during repolarization to allow efflux of potassium ions to restore of the resting potential/polarity;

Sodium-potassium exchange pump; carrier protein that actively transports three sodium ions outside and two potassium ions inside to restore membrane polarity/resting potential;

Neuro-transmitter substances; proteins essential in transmission of impulses across the synapse/depolarization of post-synaptic membrane generating post-synaptic potential;

Receptors; on post-synaptic neurons for binding of neuro-transmitter substances;
Calcium voltage gated channel; open on stimulation causing entry of calcium ions which leads to exocytosis of neuro-transmitter substance;
b) Explain the effect of drugs on the synaptic transmission. (10 marks)
Inhibitory drugs; stops synaptic transmissions; prevent release of synaptic transmitters; Block functioning of the transmitter substances at receptor molecules on the post synaptic neurone;
Excitatory drug; amplify the synaptic transmission by mimicking the normal transmitters;
Stimulating the release of more neuro-transmitter substances;
Preventing or slowing down the normal beak down of neurotransmitter substances causing continuous stimulation of post synaptic neurone;
Reducing the threshold/liminal for stimulation of the post synaptic membranes, resulting in facilitation;
4a) Describe the role of reproductive isolation and differential selection in increasing species diversity. (10marks)
Reproductive isolation prevents interbreeding between two demes/sub-populations; preventing gene flow; climate and ecology differ in the two demes/experience slightly different conditions; selection pressures differ; natural selection influences two sub-populations differently; and each adapts differently to different environmental conditions; allele frequencies change because different alleles will be more advantageous in different population; mutations and genetic drift cause gene pools diverge further; Accumulation of differences in the populations; individuals have changed much and wont interbreed to give rise to fertile offspring/progeny or offspring given off is sterile/hybrid barrier;

b) Explain the following observations.

(i) Abrupt speciation occurs as a result of Polyploidy and hybridization. (05 marks)

Polyploidy occurs when organism has more than two sets of homologous chromosomes; due to duplication of chromosomes in a same species/auto-polyploidy or different species/allopolyploidy; without subsequent cell division; polyploids are genetically isolated from diploids because they cannot successfully interbreed; Hybridization occurs when two different species are crossed; Offspring are sterile and made fertile by chromosomal mutation/allopolyploidy;

(ii) Relationship between niche and convergent evolution. (05 marks)

Organisms living in different regions/continents; with same environmental conditions evolve similar adaptations; natural selection causes organisms to adapt to the similar conditions by developing the analogous structures; which look similar but have different basic plans; increasing survival of individual organism and other organisms in the different niches;

5a) With examples of plant hormones, explain how the following mechanisms are shown.

(i) Synergism. (05 marks)

Occurs when two or more growth regulators work together to reinforce an effect; overall influence on growth is greater than the sum of the effect of each individual regulator; eg auxins and gibberellins; work together to increase cell elongation; Auxins interact with cytokinins; to promote cell division and differentiation in meristems;

(ii) Antagonism. (05 marks)

Two or more growth regulators have opposite effects on the processes; interact to reduce each other's effect; one regulator promotes while the other inhibits; eg ABA and gibberellins; ABA induces dormancy while GA breaks dormancy;

b) How does photoperiodism affect the following.

(i) Dormancy in plants. (05 marks)

Shortening days; photoperiodic stimulus received by leaves; stimulating increase in ABA levels; moves to meristem inhibiting growth; cause buds to lie dormant/Bud dormancy;

(ii) Breeding behaviour in animals? (05 marks)

Increasing light and lengthening of the day; causes secretion of testosterone and oestrogen hormone; (reproductive hormones) which increases the size of gonads/maturation of gonads; produces changes in secondary sexual characteristics; such as changes in plumage/mating calls/postural displays/chemical sex attracts/size of body parts increase;

6a) Describe the integration of the following organic molecules into the respiratory pathway.

(i) Protein. (05 marks)

Proteins hydrolyzed amino acids by proteolytic enzymes; amino acids are deaminated in the liver; enzymes in liver separate amine group from the rest of the molecule leaving organic acids/keto-acid converted to acetyl-CoA and respired via gluconic/carbohydrate pathway;

Transamination; transaminase/amino-tranferase enzyme transfers amino group from one amino-acid to keto-acid/organic acid forming a new Keto-acid which enters respiratory pathway;

(ii) Lipids. (05 marks)

Lipids hydrolyzed to fatty acid and glycerol; fatty acids broken down into 2-carbon acetyl fragments; (Beta-oxidation) which are converted to acetyl-CoA that enter Krebs cycle;

Glycerol is phosphorylated by ATP to glycerol phosphate; dehydrogenated by oxidized NAD to dihydroxyacetone phosphate; Converted into glyceraldehyde-3-phosphate used as a fuel in glycolysis and Krebs cycle;

b) (i) Explain the significance of Co-enzymes in respiration.
(05 marks)

NAD and FAD; carry electrons from electron donors in glycolysis, pyruvate oxidation and Krebs cycle to electron acceptors in the electron transport chain; which produce large quantities of ATP;
Work as carriers of the electrons in the electron transport chain;
Coenzyme A; combines with pyruvate forming acetyl CoA which transfers acetyl group into Krebs cycle;
Co-enzyme-Q; splitting hydrogen atoms into hydrogen ions and electrons used to harness ATP;

(ii) Describe the process of alcoholic fermentation in plants.
(05 marks)

Pyruvate loses one molecule of C02/decarboxylation; to form ethanal/acetaldehyde; catalyzed by pyruvate decarboxylase;
ethanal accepts hydrogen atoms from reduced NAD to form ethanol; catalyzed by Ethanal/alcohol dehydrogenase;