MARKING GUIDE FOR PAPER II END OF TERM ONE

SECTION A (40 MARKS)

N.B QUESTION ONE IS COMPULSORY TO ALL CANDIDATES.

1.DCPIP is an artificial hydrogen acceptor that can be used to measure the rate of photosynthesis. When DCPIP is reduced it turns from blue to colourless. A scientist used DCPIP to investigate the rate of photosynthesis in plant chloroplasts at three different temperatures. DCPIP was incubated with liquid extracts of chloroplasts for 10 minutes. Every minute, the absorbance of the solution was measured. All conditions except the temperature were kept the same. The results are shown in Figure 1.

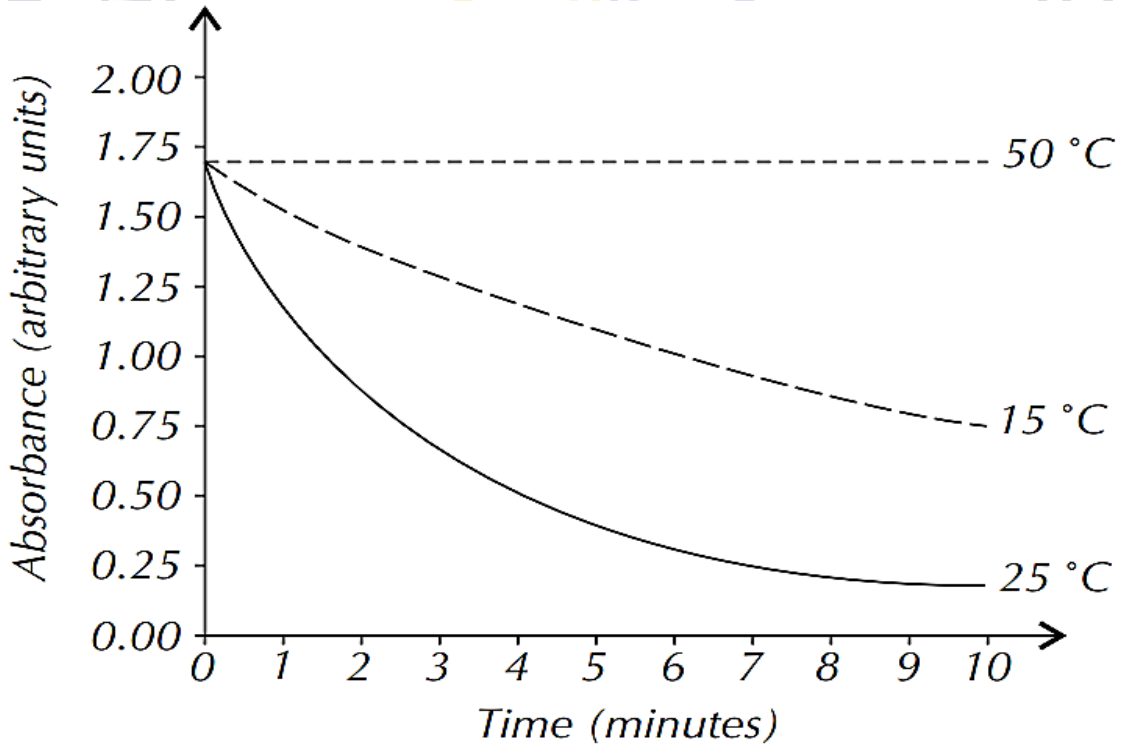


Fig -1.0

a) (i) Compare the absorbance of the solutions incubated at 15°c and 25°c. (05 marks)

<table>
<tr><th>Descriptions.</th><th>Mark allocated.</th><th>Examiners advice.</th></tr>
<tr><td>Similarities.
(In both) solutions incubated at 15°c and 25°c, absorbance:
-Starts at 0-minute;
-At 0-minute, was (very) high;
-Decrease; (Gradual/slow decrease)
-Attain minimum level/value;</td><td>Any 02</td><td>“Both” used.</td></tr>
<tr><td>Differences.
<table>
<tr><th>Absorbance at 15°c</th><th>Absorbance at 25°c</th></tr>
<tr><td>Absorbance was higher throughout;</td><td>Lower throughout;</td></tr>
<tr><td>From 0-minute to 3-minutes, absorbance decreased gradually;</td><td>Absorbance decreased rapidly;</td></tr>
<tr><td>From 3 minutes to 8.5 minutes, absorbance decreased more gradually;</td><td>Absorbance decreased less gradually;</td></tr>
<tr><td>Beyond 8.5 minutes, absorbance decreased gradually;</td><td>Absorbance remained almost/Fairly constant;</td></tr>
</table></td><td>Any 03</td><td>Accept clear and complete statements with while/where as used.
Accept Tabulation.</td></tr>
</table>

b)(i) Describe the change in the absorbance with time for each solution. (05 marks)

At 50°c
Absorbance remained high and constant throughout;
At 25°c
From 0 minute to 3 minutes, absorbance decreased rapidly/Sharply/Steeply/Drastically/Fastly;
From 3 minutes to 8.5 minutes absorbance decreased gradually/slowly;
Beyond 8.5 minutes, absorbance remained fairly/almost constant;
At 15°c
Absorbance decreased gradually throughout;

(ii) Explain the rate of change in the absorbance with time for each test tube in b(i) (17 marks)

At 50°c
Absorbance remained high and constant throughout because (very) high temperature beyond optimum; Damage of thylakoids/thylakoid membranes/grana; causes the following:
-Destruction of photosystems/photosynthetic pigments/damage/deterioration of chlorophyll; stops/prevents light capture/light-dependent stage/photosynthetic electron transfer reaction; photo-ionisation/oxidation of chlorophyll-a fails; photolysis/photo-oxidation of water fails; no/zero hydrogen atoms formed;
-Prevents/stops the electron transport chain/electron carrier chain; which transports electrons to hydrogen ions forming hydrogen atoms;
-Denaturation of water-splitting/oxidizing enzyme; denaturation of electron-carriers and electron carrying enzymes;
At 25°c
From 0 minute to 3 minutes, absorbance decreased rapidly/Sharply/Steeply/Drastically/Fastly because of faster/rapid light dependent stage/photo-chemical reactions; forming much/high/a lot of Hydrogen atoms; accepted by DCPIP.
Favourable/ideal temperature for water-splitting/oxidizing enzyme/enzymes are highly/more activated; electrons have higher kinetic energy/move faster along carriers;
From 3 minutes to 8.5 minutes absorbance decreased gradually/slowly because most of the DCPIP reduced by hydrogen atoms;
Beyond 8.5 minutes, absorbance remained fairly/almost constant because dark-blue of DCPIP completely disappears; leaving green solution of chloroplasts; (green solution causes absorbance not to fall to zero)
At 15°c
Absorbance decreased gradually throughout; low temperature; water splitting enzyme slowly/lowly activated; fewer hydrogen atoms formed; electrons and hydrogen ions have low mobility;

C(i) suggest

(i) what would happen to absorbance in each of the solution if the experiment was continued for more 15 minutes.

(05 marks)

At 50°c
Absorbance remains the same/doesn't change;
At 15°c
Absorbance continues to decrease gradually; until it remained constant;
At 25°c
Absorbance remained constant;

(ii) How absorbance of the solution was measured.

(03 marks)

Sample of solution placed in a standard coloured-tube/Cuvette; and put in a calorimeter; (Blue) filter used;

(iii) Why measuring the change in absorbance of solutions overtime is a suitable way of measuring the rate of photosynthesis? (03 marks)

As DCPIP is reduced/loses blue colour, absorbance decreases; when photosynthesis occurs at faster rate; DCPIP reduced at a faster rate and absorbance reduces faster;

(ii) Calculate the rate of photosynthesis of the solution incubated at 250c for the first 3minutes of the experiment. (02 marks)

$$\text{Rate} = \frac{1.73-0.73}{3-0};$$

$$= \frac{1.0}{3.0};$$

$$= 0.333 \text{ arbitrary units/minutes};$$

Accept + (01) or – (01)

SECTION B

2a) Starch is a mixture of Amylose and Amylopectin. Explain why Amylose is more difficult to digest than amylopectin. (07 marks)

Amylose is a straight/unbranched chain; of 1,4-glycosidic bonds between alpha glucose molecules; Glycosidic bonds cause coiling/helical/cylindrical structure; hydroxyl groups of alpha-glucose molecules allow hydrogen bond formation; causing a Closed/compact and stable structure; hydrolytic enzyme/amylase doesn't easily/readily access the glycosidic bonds; due to fewer terminal glucose residues/units; (fewer ends, so few points to begin hydrolysis by amylase)

amylose

;

Amylopectin α- glucose chain of α-1,4 and α-1,6-glycosidic linkages; with a brush-like structure; More open molecular structure than amylose due to no intermolecular hydrogen bonds; many terminal glucose residues/units; hydrolytic enzymes rapidly/easily digest the terminal glucose units and gets to glycosidic bonds easily/more ends" hence broken down easily by amylase enzyme;

amylopectin

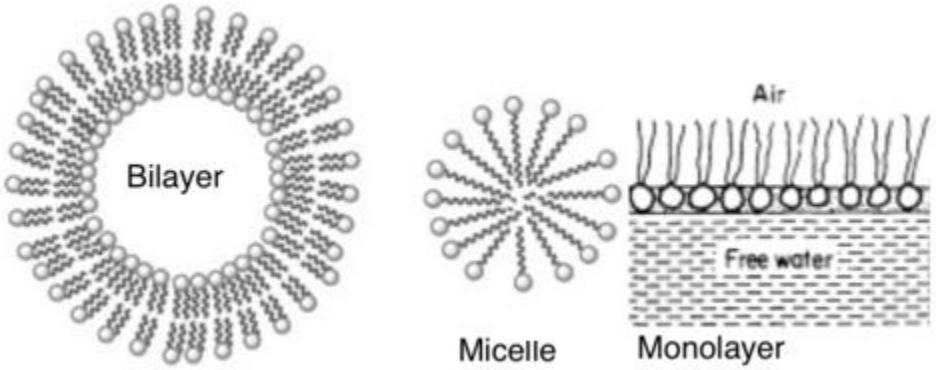
;

b) Describe the common arrangements that result from the behaviour of phospholipids in water. (07 marks)

Monomolecular layer; non-polar tails project out of water and polar heads lie in the surface of water; tails slightly bent or parallel and closely packed;

Micelle; sphere of phospholipids with tails project at the centre and heads point out;

Bilayer; two layers of phospholipid with tails projecting inside due to hydrophobic interactions and heads form hydrogen bonds with water; forming a bilayered vesicle/sphere;



(ii) Explain why the phospholipid bilayer is fluid in nature.
(06 marks)

Phospholipids with unsaturated hydrocarbon tails/carbon atoms have double bonds; chains become bent/kinked; preventing close packing; due to weak attraction between molecules;

Cholesterol; disturbs close packing of lipids at low temperature preventing crystallization of the cell membrane;

Alternatively Accept

Short hydrocarbon/fatty acid tails; reduces surface area for Vandarwaals' forces of attraction/mutual attraction/hydrophobic interaction;

3a) Explain why babies born with immature lungs fail to survive.
(07 marks)

Lungs have not accumulated enough surfactant; that keeps the alveoli open; alveolar sac are lined with moisture/water with higher surface tension/greater cohesive forces; air-sacs liable to collapse/stick together after exhalation;

Efforts needed to inhale and inflate collapsed alveoli are too great; die from exhaustion and suffocation; respiratory distress syndrome;

b(i) Describe how the accumulation of lactic acid cause fall in P^H and influence the rate of ventilation. (09 marks)

lactic acid dissociates into lactate ions and hydrogen ions/protons; causing fall in P^H.

Hydrogen ions are sensed/detected by peripheral; and central/medullary chemoreceptors; which fire nerve impulses to the respiratory centre/Inspiratory centre; inspiratory centre responds by sending impulse via phrenic nerve; to the diaphragm; and thoracic/intercostal nerve; to the external intercostal muscles; these contracts increasing rate of ventilation to supply enough oxygen needed;

(ii) Explain the disadvantages of oxygen levels falling without Carbondioxide levels increasing. (04 marks)

Chemoreceptors are relatively insensitive to falling oxygen levels but much sensitive to increasing partial pressures of Carbondioxide;

Ventilation will not increase to immediately supply oxygen; tissues deprived with oxygen/oxygen starvation/hypoxia/anoxia; death occurs;

4a) Describe the complex forces that caused original ancestral stock of Darwin's' finches to diverge along different paths. (08 marks)

Geographical isolation; between islands by water body/Pacific Ocean/tides/water currents; preventing interbreeding/gene flow/reproductive isolation;
Natural selection; found few competitors on different sparsely colonized islands/relaxed selection pressures/plenty of food; flourished/reproduced many offspring/over-population; caused competition for limited foods; variation in beak shape and size occurred; different islands had different local food/vacant niches; finches with adaptive beak shape and size were out-competed those with non-adaptive beak shape; Mutations; introduces new alleles different from already existing ones; increased genetic variation; favourable mutations selected for while unfavourable mutations selected against; Genetic drift; change in allele frequency by pure chance; some alleles are under-presented while others are over-presented; Halves awarded for a right point.

(b) Explain the significance of

(i) Heterozygotes and (05 marks)

Heterozygote superiority/advantage; preserves multiple alleles/polymorphisms is population; increased genetic variation/heterozygosity; Sickle cell anaemia in areas where malaria is endemic; heterozygotes are more- fitter/selected for/selective advantage over both homozygotes due to ability to resist malaria; Survive more and reproduce more-offspring/progenies and their allele frequency increases/micro-evolution;

(ii) Dehydration of organisms in the process of evolution. (07 marks)

Dehydration is a survival strategy of organisms; during extreme conditions of climate/weather/conditions; eg during hot climate/water scarcity; small organisms and reproductive structures such as seed, eggs and pollen grains; dehydrate and lie dormant; Periods of cold conditions; organisms dehydrate to avoid freezing of body tissues; low water content allows easy dispersal to areas of optimum conditions due to low weight/light;

N.B Anything which increases survival, increases chances of evolution.

5a) Describe the structure of the xylem. (07 marks)

Key components	Structural aspects
Xylem parenchyma;	Spherical; large vacuole; thin walls; closely packed; Any 03.
Tracheids;	Long; thin; tapering; pitted; narrow lumen; heavily lignified/thick walled; spindle shaped; polygonal in cross-section; closed/unbroken end walls; arranged in rows; overlapping cells; Any 03
Xylem vessel;	short; thickened wall/lignified; end walls broken; tubular/cylindrical; pitted; arranged end to end; wide lumen/cavity; Any 03
Xylem fibres;	Elongated; narrow lumen; pitted; closely fitted; overlapping ends; lignified; thick walled; Halves awarded. Any 03
Accept description of Collenchyma cells.	

b) Explain the adaptations of the following tissues to their roles.

(i) Bones.

Structure	Function
Hollow;	Less weight, for locomotion;
Compact bone at periphery;	Bone resistant to stress;
Spongy bone at epiphyses;	Moderate strength and conserve weight;
Inorganic salt/hydroxyapatite;	Strength and support/maximum strength to bone;
Organic materials/collagen and osteonectin proteins;	Flexibility and strength during locomotion;
Sharpy-shafer fibres;	Holds periosteum to bone; gives strength where tendons are attached;
Volkmann and Harversian canal/Osteon;	Allow nutrient into bone and waste out;
Osteoblasts;	Allow bone growth to meet varying stress put on it/lay down organic and inorganic component of the bone/synthesize the Osteoid matrix;
Osteocytes;	Stores glycogen/nutrition of bones; Activated again into osteoblasts to secrete the organic and inorganic matrix;
Canaliculi;	Allow nutrients to osteocytes;
Osteoclasts;	Remodeling of bones to meet varying stress; Bone resorption and reconstruction;
Lamellae;	Cylindrical/concentric to resist compressional forces upon the bone;

(ii) Collagen. **(13 marks)**

Long parallel polypeptide/unbranched/straight to increase surface area for hydrogen bond formation for stability;

Very large unable to dissolve in water/insoluble provides support in synovial joints;

Triple helix/Tropocollagen/three polypeptide chains wind around held by hydrogen bonds gives strength/high tensile strength;

Three helical polypeptides are supercoiled forming a loop-like structure for great strength;

Small size of individual molecules/polypeptides allows close packing/compactness causing high strength;

Weak hydrogen bonds give flexibility/ability to stretch on pulling; - Tropocollagen is thick and tough giving high tensile strength;
Fibres formed due to interaction of fibrils via hydrogen bonds give strength
Cross linkages between amino-acids of polypeptides prevents each polypeptide sliding past each other hence functioning as a single unit;

6a) Distinguish between primary and Secondary immune response
(05 marks)

Primary immune response	Secondary immune response.
Fewer antibodies produced;	More antibodies produced;
Longer lag/latent phase;	Shorter lag/ phase;
No immunological memory cells;	Immunological memory cells are produced;
Takes longer time to establish;	Takes shorter time to establish;
Naïve B and T-cells respond;	Memory B and T-cells respond;
Occur on first encounter of pathogen;	Occur on second and subsequent encounter with the same pathogen;
Antibody concentration decline after peaking;	Antibody concentration remain high for a long time;
Antibodies concentration takes longer to reach maximum;	Antibodies concentration takes shorter time to reach maximum;
Symptoms and signs may show up;	Symptoms and signs don't show up;

b) (i) Describe factors that modify the heart rate of an organism.
(10marks)

Hormones; adrenaline; and thyroxine; increase discharge of cardiac impulses from the SAN/Pace maker to myocardium;
Autonomic neurones; Vagus nerve/parasympathetic/decelerator nerve release acetylcholine/Synapse at the end secretes Ach slows down heart rate;
Sympathetic nerve/Cardiac-accelerator nerve releases noradrenaline speeds up the heart rate;
Movement of limbs during exercise; stretch receptors in muscles and tendons relay information to the brain which stimulates increased breathing rate;
Low P^H due to lactic acid or high C02 partial pressures; detected by chemoreceptors which relay information to the Cardio-vascular centre;
Blood pressure; when blood pressure is high, fail-safe mechanism reduces heart rate;

Skeletal muscle contraction increases venous return; stretch receptors in venaecavae stimulates increased heart rate; Stretch receptors in the Aorta reduce heart rate; cardiac muscles respond automatically due to increased pressure of blood reaching it; (Frank Starling relationship)

(ii) explain the significance of coordination of the heartbeat.

(05 marks)

Delay of ventricular systole slightly (0.2s); atria completely emptied with blood; ventricles completely fill blood before contraction; Atrial and ventricular systoles involve combined activity of larger number of muscle cells form maximum pumping effect; long refractory period prevents tetany (tetanus); or fatigue; Normal heart beats because systoles are separated; prevents oxygen debt;

Any 05

END

Contributions made by MUGWE MARTIN.

Kampala-Uganda

Cc -initiative for Biology transformation.

Transforming Biology pedagogy