(05)

TAEB 2022

P530/2 BIOLOGY PAPER 2

MARKING GUIDE:

1. (a)

For Strain A: For the first two weeks of cold treatment there is a rapid decrease in the number of days required for flowering to start; for the next three weeks of cold treatment, there was a gradual decrease in number of days required for flowering to start; and for the remaining weeks of cold treatment, there was a very gradual decrease in number of days required for flowering to start;

(3 marks)

- For Strain B: The number of days required for onset of flowering decreased very gradually from start to end of cold treatment;

(2 marks)

- For Strain X: There was no effect of cold treatment on onset of flowering;

(1 mk)

For hybrid strain (AxB) There was a gradual decrease in number of days required for onset of flowering at first, then a very gradual decrease in number of days required for onset of flowering for the remaining periods of cold treatment;

(2 marks)

(b)(i) Vernalisation; (1 mk)

(ii) Lolium needs to go through periods of cold treatment in winter; So that they can flower in Spring when most organisms like insect pollinators; are active; and contribute to development of flowers into fruits; (5 marks).

(c)(i) Short day plant; (1mk)

(ii) - Flowering is triggered by the length of the night; This is because exposure to 16 hours of dark and 8 hours of light produced flowers;
- Also interruption of the 16 hours of darkness with a light flash inhibited flowering;
- Equal exposure to 16 hours light and 16 hours of darkness also led to flowering;
- Exposure to 8 hours of darkness and 16 hours of light led to inhibition of flowering;
- 16 hours of light and 8 hours of darkness with dark flash in the middle of the light period inhibited flowering;
- Equal hours of light and dark; (8 hours and 12 hours) also inhibited flowering since Lolium requires many hours of dark, at least 16;

(8 mks)

(d)(i) $P_{fr}$ is dominant during day time when red light is abundant; Because $P_r$ absorbs red light and is rapidly converted to $P_{fr}$; since long day plants require more hours of exposure to light, $P_{fr}$ therefore promotes flowering in long day plants;

On the other hand, $P_r$ dominates dark periods and $P_{fr}$ is less because $P_{fr}$ absorbs far red light which dominates dark periods; and is slowly converted to $P_r$; Since short day plants flower on exposure to day light hours below a critical level, $P_{fr}$ therefore inhibits flowering in short day plants;

(7 marks)

(ii) This is because red light dominates light periods and is absorbed by $P_r$ which is rapidly converted to $P_{fr}$; Presence of $P_{fr}$ interrupts flowering in short day plants; (2 mks)

Dark flash in the middle of the light period has no effect because conversion of $P_{fr}$ to $P_r$ is slow in darkness; A dark flash is not sufficient to remove more $P_{fr}$ in order to allow flowering in short day plants;

(2 mks)

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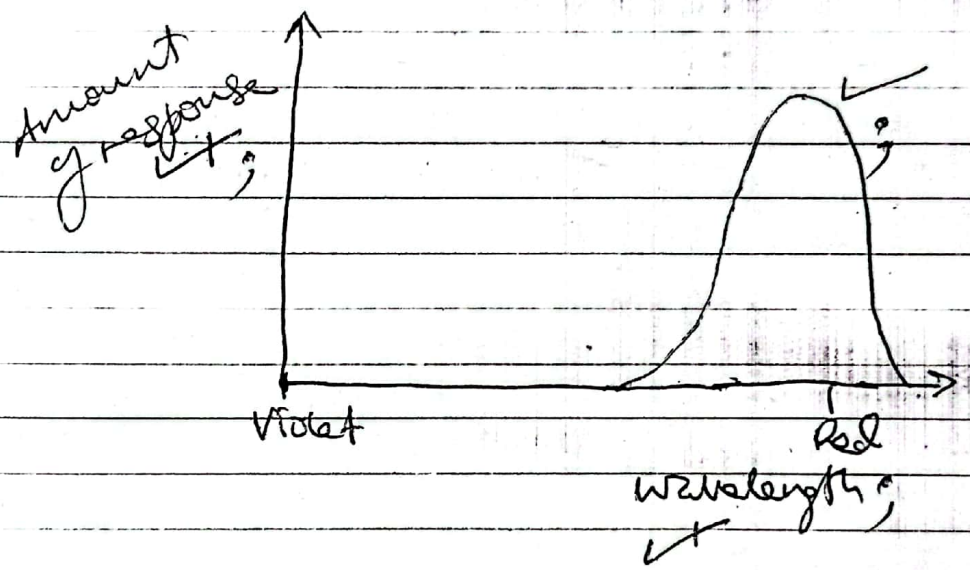
(iii) Yes ; (1 mk)

(iv) A flash of red light would inhibit flowering in short day plants; but a flash of blue light would not ;
½ @ (1 mk).

(v)




(2 mks)

(e) Animal behaviour: Migration of birds and some butterfly species;
Migratory birds move ~~to~~ from temperate regions during winter to tropical regions; to avoid the harsh weather ; the signal to migrate is triggered by shortening of day lengths as winter nears ;
½ @ (2 mks).

2(a)(i) – Blood proteins; ✓
– Amino acids; ✓ (2mks)
– Haemoglobin

(ii) When the blood pH is low; the excess $H^+$ diffuse into distal tubule cells of the kidney; where they are combined to alkaline phosphate from the tubule lumen ($HPO_4^{2-}$); The product, acid phosphate; is secreted into the tubule lumen; in exchange for $HCO_3^-$; which is actively pumped into neighbouring capillaries; The result is more acidic urine is produced;

When the blood pH is high; The excess $OH^-$ ions diffuse into distal tubule cells; where they are combined with acid phosphate ($H_2PO_4^-$); to form alkaline phosphate ($HPO_4^{2-}$); which is secreted in urine; making urine more alkaline; The $HCO_3^-$ ions are actively secreted into the ~~secreted~~ into the lumen; in this way blood pH is maintained at about 7.4; ½e total (8 mks)

(b) The epithelium lining the inner wall of the proximal convoluted tubule has a brush border; which increases the surface area over which diffusion occurs; Glucose & molecules are actively pumped into the proximal tubule cells from the lumen of tubule cells; from where they

(2mks)

diffuse into the surrounding blood capillaries;
1 mk (5 mks)

(c) High blood pressure can rupture the delicate capillaries of the glomeruli, rendering the glomeruli ineffective in ultrafiltration; this ultimately leads to kidney failure; and subsequent accumulation of metabolic poisons in the blood system; and eventual death;
1 mk @ (5 mks)

3. (a) Water enters the roots by osmosis; and when in the ~~root~~ root, it takes three paths:
- The apoplast pathway; where water passes from cell to cell via the spaces within ~~cells~~ cell walls upto the xylem; About 90% of water uses the apoplast route;
- The Symplast pathway, where water passes from cell to cell via the protoplast; Water faces much resistance in this route;
- The vacuolar pathway; where water passes from cell to cell across vacuoles upto the xylem;

In the xylem, water is taken up to the aerial parts of the plant due to water potential gradient; created by evaporation of water

vapour from the leaves;
(1 mk e max. 8 mks)

(b) Soil water is at a higher water potential than the contents of the root hair vacuoles; so water enters the root hairs by osmosis; diluting their vacuoles; in turn, the vacuoles of root hair cells will gain higher water potential than neighbouring cortex cells which gain water by osmosis from the root hairs; the cortex cells gain a higher water potential than xylem vessels so that water enters the vessels by osmosis; Evaporation of water from the leaves as vapour; creates a water potential gradient; that has the effect of drawing the water upwards, from the root xylem; (1 mk e 8 mks)

(c) Water logged soils deprive plant roots of air and oxygen; oxygen is required for respiration of root cells; The cells soon die and rot/decompose; and lose their function of absorption of minerals and water required for photosynthesis; (1 mk e 4 mks)

Xylem vessels;

4. (a)(i) - Composed of xylem elements which are joined end to end; to form long open-ended tubes; The walls of the elements are heavily deposited with lignin; and have lost their cross-walls; so that the xylem vessel has an empty lumen; also due to loss of protoplast of the xylem elements;

Xylem tracheids;

The tracheids have elongated; tapering cells; that interlock with each other; Their walls are also heavily deposited with lignin; and they have also lost their protoplasts;

(½ @ Total 6 mks)

(ii) Compact bone is made of concentric cylinders; called Haversian systems; held together by connective tissue; Each Haversian System is made of a central Haversian canal; that contains the main artery supplying the system; and vein draining blood away; Surrounding the Haversian Canal are rings of Lacunae; and canaliculi; that contain osteoblasts; and blood capillaries respectively; The rings of lacunae and canaliculi form layers called lamellae;

Lacunae and canaliculi are embedded within bony matrix; made of calcium carbonate and calcium phosphate; This makes up 70% of structure of compact bone; (½@ Total 07 mks)

Xylem:

(b) - Xylem vessels and tracheids have walls heavily deposited with lignin. Lignin has high tensile strength and gives mechanical support to the stem; prevent the plant from landing over due to wind;
- Lignin is also impermeable to water, this makes xylem suitable for water transportation as water is kept within the vessels;
- The loss of protoplast and end walls allows for free flow of water through the vessels;
- The presence of bordered pits on the walls also allows for horizontal flow of water between vessels;

Compact bone

- The heavy deposits of calcium salts in the matrix makes the bone to withstand tensional and compressional forces; so that it can offer mechanical support to organisms;

Mk @ 7 mks

5 (a) - The germinal epithelium in the ovary has cells which divide by mitosis to produce numerous cells called oogonia;
- Each oogonium grows and increases in size to form a primary oocyte;
- Each primary oocyte is capable of a meiotic division to form a secondary oocyte and the first polar body;
- The secondary oocyte is the functional egg or ovum which is released into the fallopian tube during ovulation;
- The secondary oocyte is triggered to complete the second meiotic division during penetration of the sperm cell; and produces the mature egg and a second polar body;

(1 mark 8 mks)

(b) - The spermatozoon loses its tail;
- The secondary oocyte undergoes the second meiotic division; producing the egg nucleus; and a second polar body;
- The haploid egg nucleus then fuses with the sperm nucleus; producing a zygote (diploid);

(1 mk 6 mks)

(c) Rising levels of oestrogen; secreted by the Graafian follicle; reach a peak; which triggers a sudden surge in production of both FSH and LH; This triggers rupture of the mature Graafian follicle; to release the egg; (1 mk e bmks)

6 (a) - Loss of a large number of trees leads to loss of the canopy layer; that usually protects the soil from running water and soil erosion; Loss of large amounts of top soil leads to loss of habitats of soil organisms like earthworms; This also causes loss of soil fertility; and low support of producer organisms;
- Forests contribute a lot as carbon sinks, i.e a lot of atmospheric carbon dioxide is absorbed by young forest trees during photosynthesis; This reduces the atmospheric carbon dioxide; and prevents the green house effect;
- The large surface area provided by the collection of leaves gives off large quantities of water vapour; that aid in the water cycle; Deforestation

Therefore interfering with the normal functioning of the water cycle and disrupts natural rainfall patterns; and affects growth and distribution of producers;

(1 mk @ 12 mks)

(b) Raw sewage often contains large amounts of organic waste; and mineral salts like nitrates and phosphates; These cause rapid growth of algae leading to algal blooms; which cover the lake surface and interfere with dissolution of oxygen; The BOD of the lake increases; causing death of aquatic life; decomposition further causes accelerated increase of BOD and further deaths;

(1 mk @ 8 mks)