

SECTION A (40 MARKS)

1. An experiment was conducted to investigate the uptake of nitrogen and the amount of nitrogen incorporated into organic compounds in groups of soya beans that belong to the family Papilionaceae (legumes). These plants possess root nodules containing Rhizobium bacteria. In this investigation, different groups of the soya bean seedlings were grown under green houses (Glass houses).

The first group of the soya bean seedlings were grown in a glass house enriched with carbon dioxide.

The second group of the soya bean seedlings (control plants) were grown in glass house in a normal atmosphere of carbon dioxide.

After 25 days, the total amount of nitrogen incorporated into compounds in these plants were measured at intervals of time until the plants were 100 days old.

The results of the experiment is shown in the figure 1 below. Study it and answer the questions.

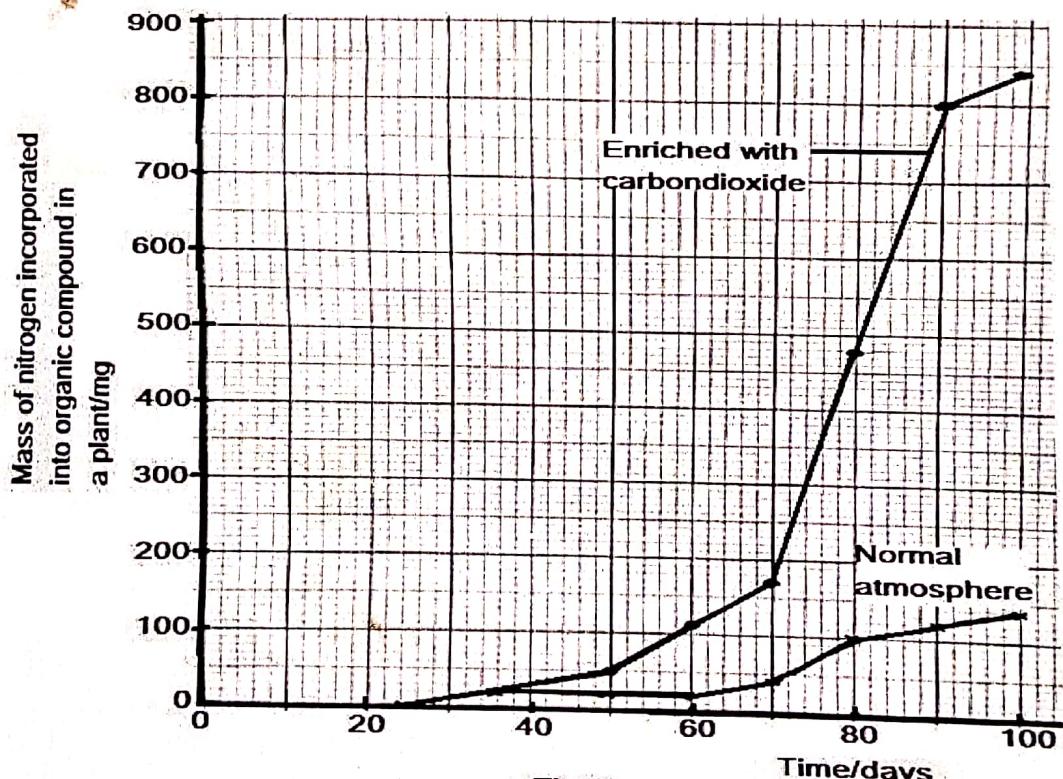


Fig.1

- (a) Compare the mass of nitrogen incorporated into compounds in the first and second groups of the soya bean seedlings. (09 marks)

SIMILARITIES,

- In both, first and second group of soya bean seedlings, the mass of nitrogen incorporated into compounds begins to increase from the same time of 22 days ;
- In both, first and second group of soya beans, the mass of nitrogen incorporated into compounds had same gradual increase from time of 22 days upto 39 days ;
- In both, first and second group of soya beans the mass of nitrogen incorporated into compounds increased from time of 60 days upto 100 days ;
- In both, first and second group of soya beans the mass of nitrogen incorporated into compounds reached a maximum ;
- In both, first and second group of soya beans the mass of nitrogen incorporated into compounds increased gradually to reach a maximum ;
- In both, first and second group of soya beans the mass of nitrogen incorporated into organic compounds initially at time of 22 days was zero/very low ;
- In both first and second groups attained their maximum at the same time.

@ 1 mark = 05 marks.

DIFFERENCES IN THE MEAN MASS OF NITROGEN INCORPORATED INTO COMPOUNDS BETWEEN FIRST AND SECOND GROUP OF SOYA BEAN SEEDLINGS.

- The mass of nitrogen incorporated into organic compounds in the first group of soya bean seedlings is higher while the mean mass of nitrogen incorporated into compounds is lower in the second group of soya beans from time of 39 days upto 100 days ;
- The mass of nitrogen incorporated into organic compounds in the first group of soya bean seedlings increased gradually while the mean mass of nitrogen incorporated into compounds in the second group of soya bean seedlings remained constant from time of 39 days upto 60 days ;
- The mass of nitrogen incorporated into compounds in the first group of soya beans increased rapidly/steeplly/drastically while the mean mass of nitrogen incorporated into compounds in the second group of soya beans increased gradually from time of 70 days upto 100 days ;
- The mass of nitrogen incorporated into organic compounds in the first group of soya beans reached a higher maximum while the mean mass of nitrogen incorporated into organic compounds in the second group of soya beans reached a lower maximum ;
- The mass of nitrogen incorporated into organic compounds in the first group of soya beans increased slowly while the mean mass of nitrogen incorporated into organic compounds in the second group of soya beans remained constant from time of 39 days upto 60 days ;

@ 1 mark , max = 04 days.

(b) Explain,

- (i) The trend of the mass of nitrogen incorporated into organic compounds in the first group of the soya bean seedlings beyond 70 days. (07 marks)
- (ii) The difference in the mass of nitrogen incorporated into organic compounds in the first and second group of soya bean seedlings. (10 marks)

b (i)

From time of 70 days upto 90 days, the mass of nitrogen incorporated into organic compounds in the first group of soya bean seedlings increased rapidly/dramatically/steadily ; this is because of greater nitrogen fixation ^(due to formation of more nodules) to form more nitrates ; by aerobic nitrogen fixing bacteria/Rhizobium bacteria in the soil ; the nitrates are converted into amino groups ; carbondioxide is also reduced to form more Phosphoglyceraldehyde (PGAL)/triose phosphate molecules in the process of photosynthesis ; triose phosphate molecules and amino groups undergo series of biochemical reactions to form more amino acids ; which can be condensed to form various protein molecules.

From time of 90 days upto 100 days, the mass of nitrogen incorporated into organic compounds in the first group of soya bean seedlings increases slowly/gradually ; this is because ~~factor due to amount of carbondioxide such as amount of triose phosphate/PGAL~~ becomes the limiting factor so, the amount ^{of amino acids/proteins synthesized} reduce ;

@ 1 mark , max = 08 marks.

(ii)

The mass of nitrogen incorporated into organic compounds in the first group of soya bean plants is higher ; while the mass of nitrogen incorporated into organic compounds in the second group of soya bean plants is lower ; from time of 39 days upto 100 days. This is because, ^{(36-39) Note: any difference identified can be used to explain.}

Where the first group of soya bean seedlings grow there is higher concentration of carbondioxide ; rate of photosynthesis increase/becomes higher ; this results into formation of more carbohydrate units , triose phosphate/phosphoglyceraldehyde molecules ; and more sugars are formed from photosynthesis ; which is respiration to form more adenosine triphosphate (ATP) which provide sufficient energy ;

More nitrates are formed from the process of nitrogen fixation by the rhizobium bacteria in the soil ; the nitrates are converted into amino groups ;

Plenty of carbohydrate units triose phosphate/PGAL and nitrates which are converted into amino groups undergo series of biochemical reactions ; to form more amino acids/proteins ; But, where the second group of soya bean plants are grown, amount of carbondioxide is limited ; rate of photosynthesis is lower/decreases ; less carbohydrate units, triose phosphate and less sugars formed results into less ATP molecules ; this lowers the amount of aminoacids/proteins formed in plants ;

@ 1 mark , max = 10 marks.

- (c) Briefly describe how cells of the soya bean plants can obtain nitrogen that ^{is} incorporated into the organic compounds, from the,
- (i) Soil. (04 marks)
 - (ii) Atmosphere. (03 marks)

C (i)

Nitrogen in form of nitrates ; is actively absorbed ; from the soil by the root hair cells ; the nitrates pass into epidermal cells and parenchyma cells in the cortex ; and then pass into endodermis ; by both diffusion and active transport ; endodermis actively secrete nitrates ; into the xylem vessels of the roots ; where the mineral ions are transported in solution form up the xylem vessels ; by the root pressure and transpiration pull up to the leaf cells ;

@ 1/2 mark , max = 04 marks.

(ii)

Nitrogen fixing bacteria (Rhizobium bacteria) in the root nodules ; oxidize atmospheric nitrogen into nitrates ; which are actively absorbed by the root hair cells and transported via xylem vessels into the leaf cells ;

@ 1 mark = 03 marks.

(d) Suggest why, it was necessary to,

- (i) Grow the soya bean seedlings in green houses. (03 marks)
- (ii) Conduct the investigation with the second group of soya bean seedlings. (02 marks)

d (i)

To enable certain required conditions to be controlled ; like concentration of carbondioxide/light intensity/nutrient content in the soil/temperature ; some factors can be varied while others kept constant ; so that actual effect of a particular condition on certain plant activity such as growth rate/photosynthesis can accurately be investigated/analyzed ;

@ 1 mark = 04 marks.

(ii)

To enable comparison between the effects of different conditions on the mass of nitrogen incorporated into organic compounds ; accurate conclusions and explanations about the factors under study is arrived at ;

@ 1 mark = 02 marks.

- (e) In what ways are activities in a green houses (Glass houses) similar to the global green house effect. (03 marks)

In both the radiations from the sun penetrate through the system , either as in through the transparent glass or the ozone layer ; which hit the soil surface and reflected ; the reflected sun radiations are prevented to easily escape and instead trapped within the system ; which may cause rise in temperatures/warming effect ;

@ 1 mark , max = 03 marks.

TOTAL = 40 MARKS.

SECTION B (60 MARKS)

2. (a) State the significance of excretion in mammals.

(04 marks)

- To remove from the body waste products of metabolism like carbon dioxide when allowed to accumulate become harmful to the body tissues ;
- To eliminate out of the body toxic nitrogenous waste products of metabolism such as urea/ammonia which can destroy body tissues ;
- Promotes constant production of useful Bi-products in enzyme controlled reactions which occurs whenever certain Bi-products and waste products of metabolism are removed ;
- Ensures maximum activity of some enzymes where bi-products that act as enzyme inhibitors are removed ;
- Regulates pH of blood and tissue fluids through excretion of excess hydrogen ions and hydrogen carbonate ions in urine ;

@ 1 mark, max = 04 marks

(b) Describe physiological differences that exist in osmo-regulation between fresh water fish and marine bony fish. (07 marks)

Physiological differences in osmo-regulation between ;

Fresh water Bony fish	Marine Bony fish
<ul style="list-style-type: none">- Higher filtration rate,- Excretes nitrogenous wastes in form of very toxic compound, like ammonia ;- Chloride secretory cells actively pumps salts from the surrounding into the body tissues,- Much water is used during excretion of nitrogenous wastes ,- Decreased reabsorption of water from renal fluids in the kidney tubules,- Large volume of hypotonic/very dilute urine is formed and passed out,	<ul style="list-style-type: none">- Lower filtration rate ;- Excretes nitrogenous waste in form of less toxic compounds ; like Trimethylamine oxide ;- Chloride secretory cells actively pumps salts from the body fluids into the surrounding ;- Less water is used during excretion of nitrogenous wastes ;- Increased reabsorption of water from the renal fluids in the kidney tubules ;- Small volume of hypertonic/very concentrated urine is passed out ;

@ 1 mark, max = 07 marks

(c) Account for the production of small quantities of hypertonic urine in mammals.
(09 marks)

Rise in osmotic pressure/salt concentration of the blood ; due to excessive water loss from the body/ over sweating/large intake of salts ; is detected by osmo-receptors in the hypothalamus ; they are stimulated and transmit impulses to the posterior lobe of pituitary gland ; which secretes into blood stream Antidiuretic hormone/vasopressin ; which circulates in blood until it reaches the kidney.

In the Kidney , Antidiuretic hormone stimulates the walls of the distal convoluted tubule and collecting duct ; to become more permeable to water and urea ; urea diffuse rapidly from the collecting duct into the surrounding tissues of the medulla ; the concentration in the surrounding tissues of the medulla become higher ; causing more water to be reabsorbed from the distal convoluted tubule and collecting ducts into the surrounding tissues ; causing small volume of hypertonic urine to be excreted.

@ 1 mark, max = 09 marks

TOTAL = 20 MARKS

3. (a) Describe the roles played by different organelles in synthesis of glyco-proteins in the cell of living organisms.
(07 marks)

Ribosomes lining surfaces of ; Rough Endoplasmic reticulum ; provide site for synthesis of primary proteins ; where amino acids are condensed together to form long polypeptide chains(primary proteins) ; the polypeptides bind onto receptor molecules on the membrane of Rough Endoplasmic Reticulum and enter inside ; while inside, they are transformed into other protein molecules/secondary protein/tertiary proteins/quaternary proteins ; the protein molecules are transported as ends of the rough endoplasmic reticulum pinched off to form vesicles ; these vesicles move into the cytoplasm and unite ; to form Golgi-body ; Golgi-body adds carbohydrates into the protein molecules ; to form Glyco-proteins.

@ 1 mark = 07 marks

(b) Discuss about the cell membrane, the existence of each of the following, its

- (i) Fluid mosaic nature.**
- (ii) Bilayer.**

09 marks)

(04 marks)

b (i) Fluid mosaic nature of the plasma membrane,

Unsaturated fatty acid tails of the phospholipids ; are bent and fit together more loosely ; they disturb close packing of the phospholipids ; increasing flexibility of the membrane ; making them more fluid.

The presence of the cholesterol within the phospholipid Bilayer ; also disturb the close packing of the phospholipids ; keeping membrane more fluidly.

The membrane proteins are scattered within the phospholipid Bilayer ; some membrane proteins are on the surface/Extrinsic ^{Peripheral} membrane proteins ; while other proteins are inside/intrinsic ^{Integral} proteins ; while some membrane proteins span completely across the phospholipid/transmembrane proteins ; providing the mosaic appearance/nature of the cell membrane ;

@ 1 mark, max = 09 marks

(ii) Bi-layer nature of the plasma membrane,

The phospholipids ; are arranged in two layers ; in such a way that, the hydrophilic heads of the phospholipids face outwards ; towards the aqueous solutions ; while the hydrophobic tails of the phospholipids face inwards facing one another ; forming a Bi-layer.

@ 1 mark, max = 04 marks

TOTAL = 20 MARKS

4. (a) Give physiological events which will occur in menstrual cycle when fertilization does not succeed. (06 marks)

- The released ovum dies off/ degenerates ;
- The levels of Luteinizing Hormone begins to fall from the peak ;
- Corpus luteum secretes large amounts of progesterone ; and small amounts of oestrogen ;
- Secretion of mucus that maintains lining of the uterus ;
- Constriction of the spiral arterioles, reducing blood supply to the arterioles supplying the uterus ; uterine blood pressure reduces ;
- Secretion of luteinizing and Follicle stimulating Hormones from the anterior pituitary gland is inhibited/Levels of Luteinising hormone and Follicle stimulating hormone falls rapidly ;
- Corpus luteum starts to degenerate ;

@ 1 mark = 06 marks

(b) Discuss series of processes that occur in menstrual cycle leading into the development of,

- (i) Graafian follicle. (06 marks)
(ii) Corpus luteum. (08 marks)

b (i) Slight decrease in levels of oestrogen in blood ; stimulates hypothalamus ; to secrete Gonadotrophin releasing hormone into blood stream ; this stimulates Anterior lobe of pituitary gland ; to secrete Follicle stimulating Hormone (FSH) ; which stimulates developing of the ovarian follicles and Graafian follicle ;

| @ 1 mark = 06 marks

(middle)
(ii) In the ~~middle~~ cycle of the menstrual cycle, the levels of oestrogen reach its peak in blood stream ; this stimulates Hypothalamus ; to secrete Gonadotrophin releasing hormone ; which stimulates Anterior lobe of pituitary gland ; to secrete large amounts of Luteinizing hormone (LH) into blood ; high levels of LH in blood causes developed graafian follicle to rupture ; releasing the secondary oocyte into the oviduct ; in a process called ovulation ; and stimulates the remains of the Graafian follicle to transform into a yellow body called corpus luteum within the ovary ;

@ 1 mark = 08 marks

TOTAL = 20 MARKS.

5. (a) Compare directional and disruptive selections. (08 marks)

SIMILARITIES BETWEEN DIRECTIONAL AND DISRUPTIVE SELECTION.

- In both environmental conditions exert the selection pressure ;
 - In both variation is the basis for selection ;
 - both lead to evolution of new species ;
 - In both individuals that adapt better to new environmental conditions are selected for while those that become less adapted are selected against ; /both are forms of natural selection ;
- * In both, better adapted individuals evolve into new species/favour increase in frequency of new alleles that determine better features in a population ;
- In both, selection pressure shifts the mean phenotype towards an extreme/intermediates are not favoured ;
 - Both are slow processes which occur progressively over a long period of time ;
 - In both evolution can be by adaptive radiation ;

@ 1 mark, max = 05 marks.

Differences between,

Directional selection	Disruptive selection
<ul style="list-style-type: none"> ▪ Occurs when environmental conditions gradually change towards one extreme , ▪ Leads to formation of a single distinct new species , <p>* ▪ Leads to sympatric speciation where speciation occur when individuals occupy the same habitat or area ,</p> <ul style="list-style-type: none"> ▪ Selection pressure can be an environmental condition or human influence like <u>in breeding</u>, ▪ Intermediate phenotypes are not completely eliminated , 	<ul style="list-style-type: none"> ▪ occurs when environmental conditions fluctuate between two extreme conditions ; ▪ Can lead to formation of two or more new distinct species ; <p>* ▪ Leads to allopatric speciation where speciation arises when individuals occupy different habitats or area ;</p> <ul style="list-style-type: none"> ▪ Selection pressure is mainly environmental conditions ; ▪ Intermediate phenotypes are completely eliminated ;

@ 1 mark , max = 03 marks.

AAGTCTGATCA

(b) Explain ,

- (i) How comparative biochemistry provides evidence that support organic evolution. (05 marks)
- (ii) The effect of base deletion mutation on the overall nature of protein molecules synthesized. (07 marks)

b (i)

In comparative biochemistry, different species or groups of organisms like plants and animals/different vertebrates such as birds, reptiles, fish, humans/vertebrates and invertebrates ; posses chemical organic compounds with similar structure and function ;

For example, the body of different species or groups of organisms possess hormones or enzymes which have similar chemical structure and same mode of action ; haemoglobin among different animals have similar structure and perform same role of transport of oxygen/sequence of amino acids in polypeptide chains of cytochrome C is similar among different mammals ;

Similarity in structure and function of organic chemical compounds among different species or groups of organisms indicate common ancestral origin ;

The difference in chemical composition ~~that is due to different evolution;~~
@ 1 mark = 05 marks

(ii)

This arises when several nucleotide bases on the Deoxyribonucleic acid (DNA) molecule become deleted ; the normal correct nucleotide base sequence on the DNA coding strand that codes for a particular usual protein is altered ; messenger ribonucleic acid (mRNA) copies this new nucleotide base sequence into complementary codons during transcription ; the mRNA codons will be translated into wrong polypeptide containing completely different sequence of amino acids ; the polypeptides will be transformed into protein molecules which are defective/non functional ; or become toxins that may cause serious abnormalities in body functions including death ; the proteins may form wrong enzymes and hormones ; which are non-functional or fail to catalyze the usual biochemical reactions ; resulting into genetic diseases ;

For example deletion of three nucleotide bases in a gene is the cause of cystic fibrosis ;

@ 1 mark , max = 07 marks

TOTAL = 20 MARKS.

6. (a) How does structural arrangements of tissues in higher plants permit transport of materials.

(08 marks)

In xylem,

- xylem vessels/tracheids possess bordered pits on the side walls to allow horizontal or lateral flow of water ;
 - Xylem vessels/tracheids have narrow lumen, increasing upward transport of water and mineral salts by capillarity ;
 - Walls of vessels and tracheids are lignified to increase adhesion for upward flow water and mineral salts in long continuous column ;
 - Xylem vessels and the tracheids are hollow which allows easy passage of water and mineral salts ;
 - The cells in the vessels are arranged end to end for continuous flow of water and mineral salts ;
- Vessels/tracheids are lignified to prevent breaking under negative pressure in the system due to transpiration pull.* @ 1 mark , max = 3/4 marks.

In phloem,

- Sieve elements are arranged end to end to allow continuous flow of sugars or organic materials from one cell to the next ;
- Sieve plates in the sieve tube are perforated with sieve pores to allow easy passage of sugars/organic materials ;
- Sieve tube tubes contain fine numerous cytoplasmic filaments that run through the sieve pores which increase surface area for movement of sugars by cytoplasmic streaming ;/allows bidirectional movement of sugars and other organic substances ;
- Thin cytoplasm in the sieve tube lack nucleus and pushed more on the sides to create more space for passage of sucrose/other organic materials ;
- Plasmodesmata connect sieve tube to the companion cells for exchange of essential materials ; *During loading and unloading.*
- Companion cells contain numerous mitochondria for production of large amount of energy in form of ATP ;
- Thin cytoplasm in the sieve tube contain few mitochondria for production of energy in form of Adenosine triphosphate (ATP) ;

@ 1 mark , max = 4/5 marks.

(b) Explain how each of the following play roles in transport of water in plants,

- (i) Particular plant tissues. (08 marks)
(ii) Environmental temperatures. (04 marks)

b (i)

Root hair cells absorb water from the soil by osmosis ; and permit passage of water into the epidermis by osmosis ; epidermis permits passage of water into the cortex ;

In the cortex water passes through parenchyma cells ; via any of the pathways, their cellulose cell walls (apoplast)/across the cytoplasm (symplast)/through the sap vacuole (vacuolar pathway) ; until water reaches the endodermis ;

1111

Endodermis actively secrete salts into the vessels of the root to raise high concentrations in the vessels of the roots ; causing water to be drawn into the vessels of the root from the surrounding tissues by osmosis ; creating a high root pressure which pushes water into xylem vessels of the stem and upwards ;

The xylem tissue in the stem contain xylem vessels with highly lignified walls ; this increases adhesion that promote upward movement of water in long continuous column ; the vessels are narrow hollow tubes through ~~out~~ which allows easy passage of water which is transported upwards by capillarity ;

@ 1 mark , max = 08 marks.

(ii)

High temperatures increase evaporation of water from the surface of the mesophyll cells ; increasing the rate of transpiration ; causing more water to be drawn from the narrow surrounding xylem vessels in the leaves into the mesophyll cells to replace the water lost ; a high tension develops in these xylem vessels, increasing adhesion and cohesion ; this leads ~~to~~ water being transported upwards in the xylem vessels ; in long continuous column without breaking in between ;

@ 1 mark , max = 05 marks

TOTAL = 21 MARKS.
MAXIMUM = 20 MARKS.

END.