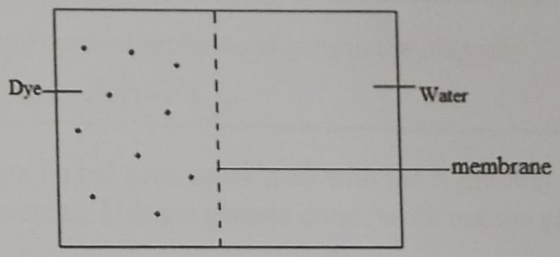
SECTION A (40 marks)

Answer all the questions in this section in the spaces provided

1. a) What is the meaning of the term concentration gradient? (1 mark)

Difference in the no of molecules/particles between two adjacent regions;

b) The set-up below was used to investigate a certain physiological process.



i)Name the physiological process being investigated. (1 mark)

Diffusion;

ii) How can the process be made to occur faster? (2 marks)

- Reduce the size of dye molecules;
- Reduce thickness of membrane;
- Increasing temperature of dye molecules;
- Reducing volume occupied by dye molecules;

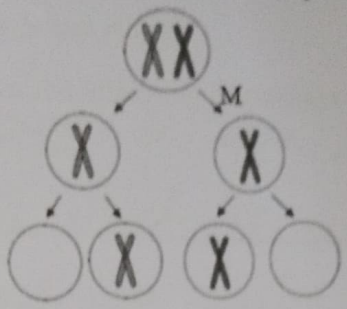
c) State the importance of the process in **(b)(i)** above in human beings. (2 marks)

- Gaseous exchange;
- Absorption of soluble products of digestion in the alimentary canal;

d) Highlight **two** factors necessary for active transport to take place. (2 marks)

- Energy/adenosine Triphosphate;
- protein carriers;

2. Study the diagram below and use it to answer questions that follows:



a) Name the stage of cell division represented by M. (1 mark)

Anaphase I;

b) Name the type of chromosomal mutation shown in the diagram. (1 mark)

Non-disjunction;

c)(i) Haemophilia is a sex linked gene associated with the X chromosome. A normal man marries a haemophilic woman. Using a genetic cross, work out the genotypes of the offspring. (4 marks)

Parental genotypes X^HY x X^hX^h;

Gametes X^H Y X^h X^h;

;

F genotypes X^HX^h X^HX^h X^hY X^hY;

(ii) What is the probability of the couple giving birth to a haemophilic son? (1 mark)

Haemophilic son – ½

Getting a son ½ $1 \times ½ = 0.5 / ½ / 50\%$;

c) Define the term linkage as used in genetics. (1 mark)

Location of genes on the same chromosome hence transmitted together in the same gamete;

3. A fresh water lake surrounded by an agricultural farm has the following organisms;

Fish, Hippopotamus, Reeds and Algae

a) State the role of each of the following organisms in the lake ecosystem:

i) Hippopotamus - Dung is also fed on by dungs; (2 marks)

- Exhale CO_2 which is used by algae/reeds;

- Dung released into water enriches it with nutrients favouring growth of phytoplanktons/reeds/algae;

ii) Algae - Are primary producers; (2 marks)

- purifies the ecosystem by using up CO_2;

- Regulates the pH of water by using up CO_2;

- provides breeding grounds for fish; fed on by algae & hippopotamus;

b) Explain the likely positive and negative effects of the surrounding agricultural farms on the lake region.

i) Negative effects - excess run off/soil erosion and (2 marks)

deposition into lake clogs gaseous exchange surfaces of aquatic life; - Excessive use of fertilizers/organic manure results to overgrowth of phytoplanktons/eutrophication;

- Some agrochemicals may be toxic/kills aquatic organisms

ii) Positive effects - Increases turbidity/reduces visibility/penetration of light; (2 marks)

- Fertilizers/organic manure applied on the farm find themselves deposited in the lake hence enriching the ~~lake~~ Lake ecosystem with nutrients; favouring growth of phytoplanktons/algae/producers/plants;

4. The diagrams below show feet of different birds.

* 4 (i) Vestigial — structures that have in the course of evolution ceased to function hence have become rudimentary / reduced in size;

a)(i) State the evidence of organic evolution illustrated by the diagrams. (1 mark)

Comparative anatomy;

(ii) Give a reason for your answer in (a)(ii) above. (1 mark)

The feet perform different functions;

b)(i) Distinguish between analogous and vestigial structures. (2 marks)

Analogous – structures with different embryonic origin but have been modified to perform ~~different~~ same function due to exploitation of same environment;

ii) Name the type of evolution shown by the organisms that possses analogous structures. (1 mark)

Convergent evolution;

c) Give a reason why Lamarck's theory of evolution is unacceptable. (1 mark)

Phenotypically acquired characteristics which don't affect the genotype of an individual cannot be inherited;

d) Define the term Natural Selection as used in evolution. (2 marks)

Nature selects organisms with desirable characteristics and allows them to survive, grow to maturity, reproduce and pass on these characteristics to the next generation while those with ~~their~~ undesirable characteristics die young;

5. (a) State **three** reasons why plants lack complex excretory organs. (3 marks)

- Some waste products are removed by simple diffusion; Some wastes eg CO_2 are reused;
- Waste products are formed slowly hence little accumulation; Waste products are mainly from carbohydrates hence less toxic;

b) Name **one** way through which solid wastes are excreted by the plants. (1 mark)

Deposition;

c) Give reasons why food has to pass through the liver first after absorption from the alimentary canal. (2 marks)

For - detoxification;

- Deamination/removal of excess amino acids;

d) State **two** physiological processes in the human body which helps in correcting temperatures above normal. (2 marks)

- Increased sweating;
- Vasodilation;
- Reduced metabolism;
- Relaxation of erector pili muscles;

SECTION B (40 marks)

Answer question 6 (compulsory) and either 7 or 8 in the spaces provided after question 8.

6. An experiment was carried out to investigate the effect of hormones on growth of lateral buds of three pea plants.

The shoots were treated as follows:

Shoot A-Apical bud was removed

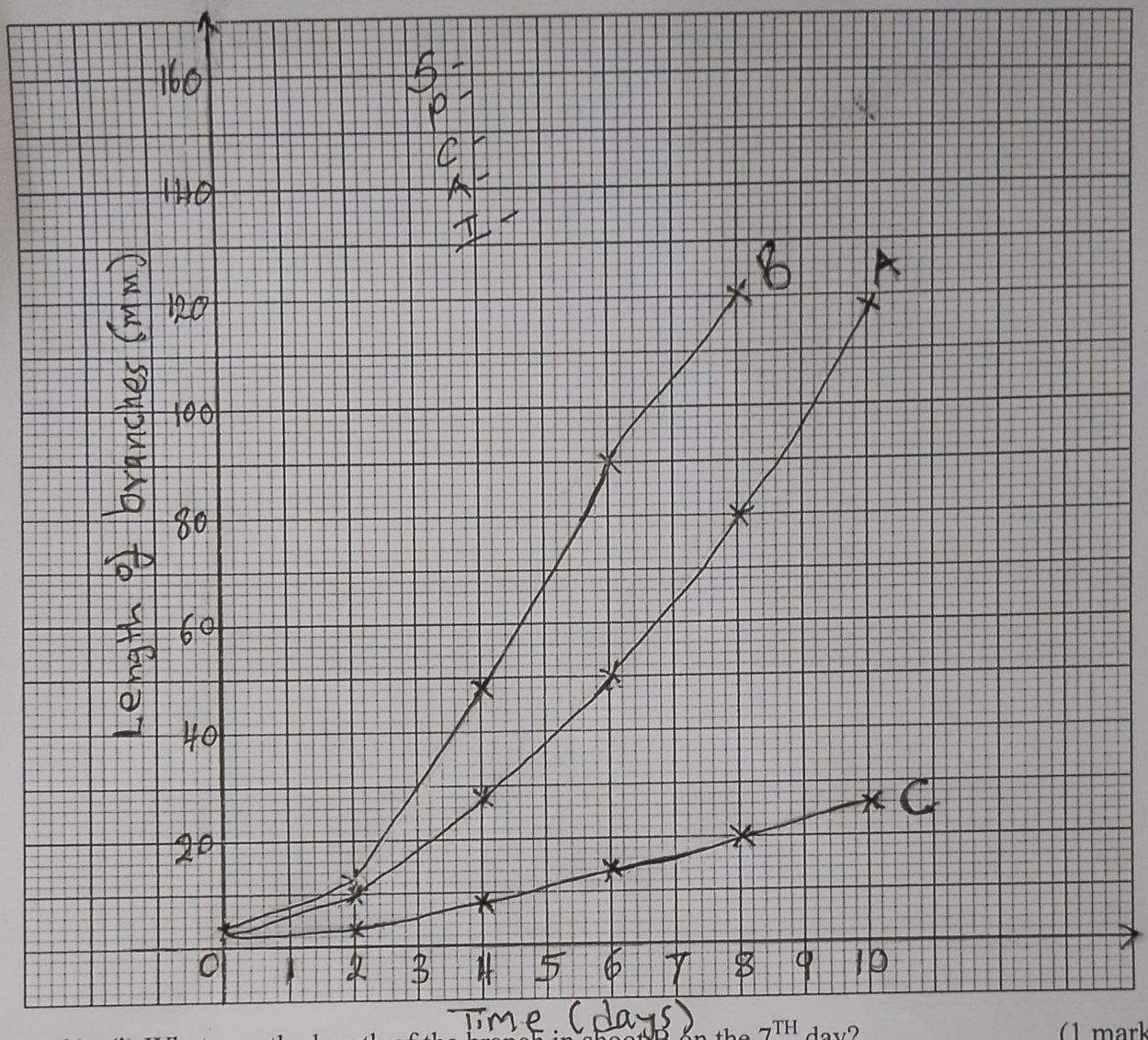
Shoot B-Apical bud was removed and gibberellic acid placed on the cut shoot

Shoot C-Apical bud was left intact

The length of the braches developing from the lateral buds were determined at regular intervals. The results obtained are shown in the table below:

Time in days	**Length of branches in millimeters**		
	Shoot A	**Shoot B**	**Shoot C**
0	3	3	3
2	10	12	3
4	28	48	8
6	50	90	14
8	80	120	20
10	118	152	26

a) Using the same axes, draw graphs to show the lengths of branches against time. (8mks)



b) (i) What was the length of the branch in shoot B on the 7TH day? (1 mark)

105 ± 1;

(ii) What would be the expected length of the branch developing from shoot A on the 11TH day? (1 mark)

134 – 140 mm;

c) Account for the results obtained in the experiment. (6 marks)

Graph A :- Shoot tip which was removed contains auxins (IAA); that causes apical dominance; hence lateral buds sprouted/grew; (max 2)

Graph B :- Gibberellic acid promotes formation of lateral branches; hence faster growth of branches;

d) Why was shoot C included in the experiment? (1 mark)

Control experiment;

e) What is the importance of prunning in agriculture? (1 mark)

- Increase in yields;
- Formation of desired plucking table in crops like tea

f) State **two** physiological processes that are brought about by application of gibberellic acid on plants. (2 marks)

Stimulates cell division;

Stimulates cell elongation;

Shoot C :- The shoot tip which remained intact contains IAA (auxins) which inhibit growth/development of lateral buds; hence little growth of lateral branches;

7. (a) State **three** structural characteristics of skeletal muscles. (3 marks)
b) Describe the adaptations of the following bones of the mammalian skeleton to their functions. (17 marks)
i) Atlas
ii) Humerus
iii)Scapula
iv) Pelvic girdle

8. (a) Briefly describe how desert plants conserve water (12 marks)
(b) Describe how hydrophytic plants are adapted to living in areas with abundant water (8 marks)

7(a) - Are striated/have stripes;
- Muscle cells are cylindrical in shape;
- Muscle cells have many nuclei;

b) Atlas
- Wing like/ broad transverse processes to increase S.A for attachment of muscles;
- Vertebrateral canals for passage of vertebral arteries/blood vessels;
- Broad articular facets on the anterior to articulate with occipital condyles;
- Wide neural canal for passage of large spinal cord in the neck region;

Humerus:
- (Broad) head for articulation with glenoid cavity of scapula;
- Bicipital groove for passage of tendons of biceps muscles;
- Greater & lesser tuberosities provide surface for muscle attachment;

- Trochlea for articulation with trigonal notch of ulna;

Scapula

- Glenoid cavity for articulation with head of humerus;
- Broad/flat shape to increase S.A for muscle attachment;
- Spine provides increases S.A for muscle attachment
- Coracoid process provides surface for muscle attachment;
- Acromion & metachromion provide surface for muscle attachment;
- Supra scapula reduces friction and pressure during articulation with the ribs;

pelvic girdle

- Pubis symphysis has a flexible cartilage to permit widening of female's girdle during birth;
- Acetabulum which articulates with head of femur (to form ball & socket joint);
- Obturator foramen for passage of blood vessels, nerves & muscles; // reduce the weight of pelvic girdle hence lighten the load to be supported by hind limbs

- Has broad/flat/long ilium to provide a large SA for attachment of thigh muscles; // Ilium has sacral facets for articulation with sacrum

8(a) - Leaves reduced in size to reduce SA for water loss;

- Some shed their leaves during drought to reduce SA exposed to sun's rays;

- Some have leaves with thick waxy cuticle to minimise water loss;

- Some have sunken stomata that form deep pits/depressions which accumulate water vapour hence reducing saturation deficit/diffusion gradient hence reducing water loss;

- Some experience reversed stomatal rhythm to reduce water loss;

- Some have deep roots to absorb water from deeper water tables;

- Some store water in large parenchyma cells contained in succulent stems;

- Some are drought evaders i.e. have short life cycle where they grow, flower & produce seeds before drought sets in;

b)- Most emergent/floating types have broad leaves; with numerous stomata on the upper surface of the leaf; to provide a large S.A for ~~gaseous exchange~~ water loss;

- Some submerged hydrophytes have leaves which are deeply dissected into thread-like straws to increase S.A for maximum absorption of light;

- Submerged types have leaves with numerous and sensitive chloroplasts enabling them photosynthesise under low light intensities;

- They have ~~large vitted~~ aerenchyma tissue with large air spaces that store air for gaseous exchange; and for buoyancy;

- Have poorly developed roots that lack root hairs to reduce water absorption;

- Submerged plants lack cuticle and therefore epidermal cells are capable of absorbing water, dissolved nutrients and gases;

Emergent ~~&~~ Floating types have flowers raised above the water to allow for pollination;

- Leaf laming is thin for faster diffusion of gases;

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