

Candidate's Name: A DRAFT GUIDE

Signature:

Random No.					Personal No.		

(Do not write your School/Centre Name or Number anywhere on this booklet.)

P530/1

BIOLOGY

(Theory)

Paper 1

Nov./Dec. 2022

2½ hours



UGANDA NATIONAL EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

BIOLOGY
(THEORY)

Paper 1

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

This paper consists of sections; A and B.

Answer all questions in both sections.

Write answers to section A in the boxes provided and answers to section B in the spaces provided.

No additional sheets of paper should be inserted in this booklet.

For Examiners' Use Only			
Section	Question	Marks	Examiner's Signature and No.
A	1 - 40	40	Ramya SUSAN NO 2022
B	41	10	
	42	10	
	43	10	
	44	10	
	45	10	
	46	10	
Total		100	

SECTION A (40 MARKS)

Write the letter corresponding to the right answer in the box provided. Each question in this section carries one mark.

1. In bacterial and fungal cells, food is stored in form of

- A. starch. X
- B. lipids.
- C. proteins.
- D. glycogen.

 D ✓

2. Which one of the following is the possible genotype of the parent in a dihybrid test cross where an offspring shows up with all recessive traits?

- A. RRGG.
- B. RrGG.
- C. RRGg.
- D. RrGg.

 D ✓

3. Which one of the following is controlled by the combined actions of nervous and hormonal systems?

- A. Temperature. — only nervous
- B. Blood pressure. — nervous and hormonal \rightarrow (febrile)
- C. Glucose levels. — only hormonal
- D. Solute potential. — ~~both~~ hormonal and nervous

 B ✓

4. Which one of these explains why the respiratory quotient normally falls when the seed coat is shed during germination?

- \downarrow Red_{ox} CO₂
- A. Shedding of the seed coat reduces the rate of respiration.
 - B. Removing the seed coat increases surface area for enzyme action.
 - C. Removal of seed coat leads to less carbon dioxide released.
 - D. Removal of the seed coat allows entry of oxygen.

 D ✓

5. Which one of the following is an adaptation of the loose connective tissue?

Possession of feature + function:

- A. a matrix which contains flexible fibres for strength and resilience.
- B. an underlying tissue to protect against dehydration. X
- C. a germ layer in the early growth and development of the organs. X
- D. a basement membrane composed of non elastic collagen fibres. ?

loose conn. tissue \rightarrow Adipose - fatty.
 \rightarrow Areolar

 A ✓

- Marine aquatic*
6. Figure 1 is a pyramid of biomass.

Candidates should explain the terrestrial pyramid of biomass too.

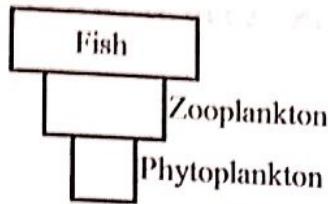
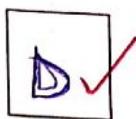


Fig. 1

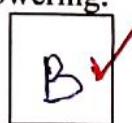


The pyramid shows that the

- A. zooplankton have a higher reproductive rate than phytoplankton. ✗ (reverse)
- B. number of fish outnumber that of zooplankton and phytoplankton. ✗
- C. zooplankton have a short life span. ✗ Not reason enough
- D. phytoplankton have a rapid turnover rate. ✗ First concern

7. Short day plants usually delay to flower when the nights are interrupted with red light because

- A. the light period is shorter than the critical length in the 24 hour cycle ✗
- B. red light inhibits the release of the chemical which initiates flowering. ✗
- C. the light period is longer than the critical length. ✗
- D. the dark period is longer than the critical length. ✗



8. Table 1 shows the results obtained in the capture-recapture method of estimating the population of grasshoppers in an ecosystem.

Table 1

marked and released on day 1	marked captured on day 3	un marked captured on day 3
180	30	120

What was the estimated population size?

- A. 900.
- B. 720.
- C. 330.
- D. 270.

$$\frac{180 \times 120}{30}$$

$$\frac{180 \times 120}{30} = 720$$



9. Figure 2 shows the inheritance of a recessive sex-linked trait in a family. The circles indicate females while the shading indicates the occurrence of the defect.

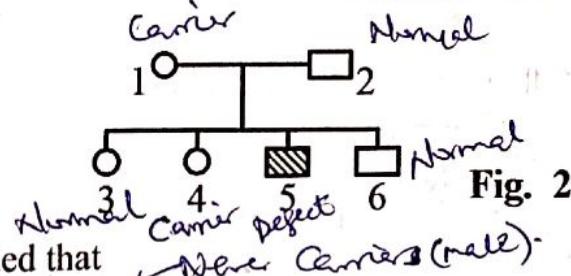


Fig. 2

It can be concluded that

- A. individuals 1 and 2 were carriers. ✗
- B. each family member had at least one recessive allele ✗
- C. individuals 1, 3 and 4 were carriers. ✗
- D. individuals 2 and 6 had no recessive allele.



Turn Over

10. The pitch of sound is determined by the
- number of receptor cells stimulated.
 - position of receptor cells stimulated.
 - threshold value of receptor cells stimulated.
 - summation in the receptor cells.

A ✓

11. Figure 3 shows the population growth curve of rats in a cage.

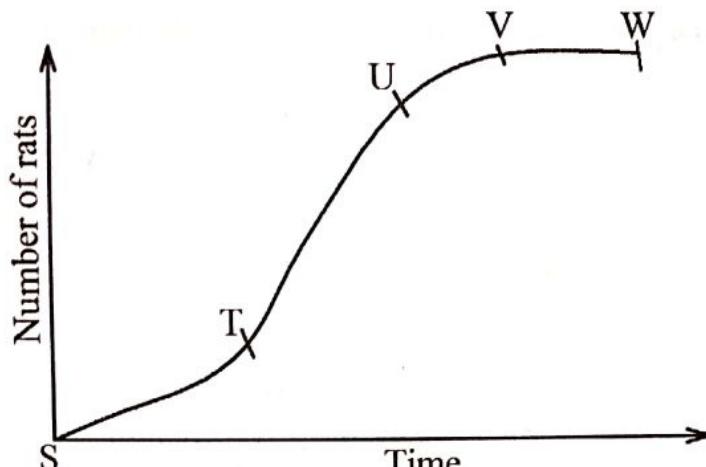


Fig. 3

In which region of the growth curve is the struggle for existence highest?

- ST
- TU
- UV
- VW

B ✓

12. The spore of a fern species has y number of chromosomes. What is the number of chromosomes in its leaf?

- $\frac{y}{2}$
- y
- $2y$
- $4y$

C ✓

13. Which of the following features of sclerenchyma tissue enables it to contribute towards toughness and rigidity of stems?

- Very long fibres.
- Unevenly thickened walls.
- Uniformly thick lignified walls.
- Presence of plasmodesmata.

C ✓

14. Which of the following hormones stimulates seed germination?

Both

- auxins and ethene.
- cytokinins and auxins.
- gibberellins and cytokinins.
- gibberellins and ethene.

C - most correct
alternative; Reason:
synergistic effect is
documented.
Objective D:

C ✓

4. Ethene too breaks seed dormancy hence stimulating germination.

- BASIC**
ESSENTIALS
OF A LEVEL
BIOLOGY
Pg. 230 &
243
15. The tidal volume of an athlete whose number of breaths per minute is 100 and ventilation rate of 250 dm^3 per minute is
- $25,000 \text{ dm}^3$.
 - 25 dm^3 .
 - 2.5 dm^3 .
 - 0.4 dm^3 .
- B ✓
16. Which one of the following sub stages of photosynthesis is unlikely to be slowed down by decrease in temperature?
- Photolysis of water. — light dependent
 - Fixing of carbon dioxide by RuBP.
 - Regeneration of RuBP.
 - Conversion of PGAL to glucose. } enzyme controlled.
- A ✓
17. The following are advantages of excreting uric acid by flying organisms, except attention
- it is insoluble in water and non-toxic. ✓
 - it requires very little water for its removal! ✓
 - it requires less energy for its formation. X
 - its storage does not have osmoregulatory effects X
- C B ✓
18. The behaviour in which a snail ceases to withdraw its tentacles in response to repeated mechanical stimulation is
- associative learning. *Originality of such -*
 - exploratory learning. *Concepts suggest*
Candidates show
understand, not cram
 - imprinting.
 - habituation. *Concepts*
- D ✓
19. Which of the organisms in table 2 require the most specialised respiratory system?
- Table 2**
- | Organism | A | B | C | D |
|--------------------------------|-----|-----|-----|--------|
| Surface area (cm^2) | 1 | 6 | 2 | 8 |
| Volume (cm^3) | 0.5 | 2 | 0.5 | 3 |
| | 2:1 | 3:1 | 4:1 | 2.67:1 |
- A ✓
20. Sprinters usually take off at an angle rather than upright position in order to increase crouch.
- effective length of the limb X
 - the speed of movement. X
 - the forward force.
 - the upward force. X
- C ✓

21. Which one of the following pairs of plant tissues contain living cells at maturity?

- A. Cork and xylem tissue.
- B. Parenchyma and phloem tissue.
- C. Sclerenchyma and collenchyma.
- D. Sclerenchyma and phloem tissue.

 A

22. Which one of the following statements explains why DDT increases in birds during food shortage? *in soluble | poorly soluble*

- A. dissolves in water and then diffuses into blood.
- B. increases the insulation capacity of the birds.
- C. metabolises to release metabolic water.
- D. is released when fat is metabolised.

 B

23. Which one of the following shows the correct coding sequence during the synthesis of polypeptide chain?

- A. DNA → mRNA → tRNA → rRNA.
- B. DNA → mRNA → rRNA → tRNA.
- C. rRNA → DNA → tRNA → mRNA.
- D. RNA → tRNA → mRNA → rRNA.

 B

24. Which one of the following is correct about the life cycle of mosses?

The

- A. diploid sporophyte produces spores by mitosis.
- B. haploid sporophyte produces spores by meiosis.
- C. haploid gametophyte produces gametes by mitosis.
- D. diploid gametophyte produces gametes by meiosis.

 C

25. Which of the following events take place during metaphase II of meiosis?

- A. Crossing over of the genetic materials occurs. → Prophase I
- B. Homologous chromosomes align on the equator of spindle as tetrads. → Metaphase I
- C. Homologous chromosomes align singly on the equator of the spindle.
- D. Chromatids migrate to opposite poles. → Anaphase II / II

 C

26. Hydrogencarbonates are actively reabsorbed into the haemocoel because they

- A. combine with potassium ions.
- B. lower the osmotic pressure of the malpighian tubules.
- C. increase the pH and lower the concentration of uric acid.
- D. cause further reabsorption of water through the rectal epithelium.

 D

27. Which of the following is **not** affected by the stimulation of the vagus nerve on the heart?

- A. Force of ventricular contraction.
- B. Rate of heart beat.
- C. Atrio-ventricular node.
- D. Sino-atrial node.

 C ✓

28. The amount of phosphoglyceric acid increases after a photosynthesising plant has been in darkness for a short time because

- A. ribulose biphosphate becomes more unstable.
- B. the concentration of RuBP carboxylase reduces.
- C. the available ATP and NADPH are not sufficient.
- D. all the formed triose phosphate converts back to phosphoglyceric acid.

 C ✓

29. Ovulation in human menstrual cycle occurs following an increase in

- A. progesterone hormone only.
- B. luteinising hormone only.
- C. both oestrogen hormone and follicle stimulating hormones.
- D. both luteinising and gonadotrophin releasing hormones.

 D ✓

30. Which one of the following occurs during the recovery phase in an axon?

Active pumping of

- A. Na⁺ ions into the axon.
- B. K⁺ ions out of the axon.
- C. Na⁺ ions out of the axon.
- D. organic ions into the axon.

 C ✓

31. Which one of the following fins may perform the same function as a swim bladder of a teleost fish?

- A. Vertical dorsal fins.
- B. Pectoral fins.
- C. Caudal fins.
- D. Ventral fins.

 B ✓

32. In which of the following parts does spermatogenesis take place?

- A. Vas efferens.
- B. Seminiferous tubules.
- C. Vas deferens.
- D. Epididymis.

 B ✓

33. Which one of the following statements is correct about the metabolic rate?

- A. Small animals require the same energy to maintain each gram of body mass as large animals.
- B. Large animals require less energy to maintain each gram of body mass than small animals.
- C. The overall metabolic rate is inversely proportional to the body mass of an animal.
- D. The overall relationship between metabolic rate and the body mass of animals is constant.

34. During flight in birds, the air pressure is greater on the lower surface of the wings in order to

- A. keep the bird soaring.
- B. make the bird less dense than air,
- C. enable the bird overcome resistance.
- D. generate lift and move forward.

35. The movement of photosynthetic products into ~~phloem~~ from the companion cells occurs by ~~sieve tubes element~~

- A. active transport across cell membrane.
- B. mass flows through plasmodesmata.
- C. diffusion along apoplast and symplast routes.
- D. diffusion through the plasmodesmata.

36. The sodium ion concentration is higher in the descending limb than in the ascending limb of the loop of Henle due to

- A. active pumping of sodium ions out of the ascending limb.
- B. increased permeability of ascending limb to water.
- C. descending limb being impermeable to sodium ions resisting outflow.
- D. renal fluid in the descending limb lying in the medulla with high ion concentration.

37. The catalytic action of enzymes is attributed to

- A. their specificity to respond to one substrate at a time.
- B. faster disintegration of substrate to products.
- C. ability to properly fit the substrate molecule.
- D. ability to reduce activation energy of substrate.

38. Which one of the following would occur in guard cells when a potted plant is shifted from a well lit room to a totally dark place?

- A. Potassium ions are pumped into guard cells.
- B. Inner walls of guard cells bulge inwards.
- C. Pressure potential of guard cells increases.
- D. Water potential of guard cells becomes less negative.

 B

39. Which one of the following factors can determine the existence of recessive alleles in successive generations of a small population? - *genetic drift*

- A. Natural selection.
- B. Mutation.
- C. Chance.
- D. Random mating.

 C

40. Which one of the following factors is responsible for the faster rate of secondary succession than primary succession?

- A. Presence of soil.
- B. Availability of water.
- C. Optimum temperature.
- D. Suitable light intensity.

 A

SECTION B (60 MARKS)

Write answers in the spaces provided.

OR When two or more genes occurring on same chromosome singly
of individual parents result into new gene combinations occurring less frequently than parental phenotypes.

41. (a) What is gene linkage? (02 marks)
more than a single gene | many different genes | occurring on the same single chromosome; result into same gamete and inherited together.

(b) How does codominance influence monohybrid phenotype expression
in

(i) F_1 generation?

(All) F_1 generation are phenotypic intermediates of the two parental phenotypes.

(ii) F_2 generation?

(02 marks)

In F_2 generation, 25% offspring have phenotype of one parent (male) & 25% offspring phenotypically resemble other parent (female); 50% pheno offsprings are intermediates of parental phenotypes.

Award: Use of ratio of 1:2:1, well described

- (c) Explain the effect of gene linkage on F_2 dihybrid phenotypes.

(05 marks)

Gene linkage results into ratio of 3:1 ✓

Where 3 offspring phenotypically resemble the homozygous pure dominant parent and 1 offspring phenotypically expresses at the homozygous recessive parent. ✓

The ratio 3:1 is different from the expected 9:3:3:1 phenotypic expression in F_2 .

~~Mendelian dihybrid inheritance / phenotypes~~, ✓

because, the linked genes don't separate. ✓

Segregate remain attached and inherited together, mat

Opposing Mendel's law of independent assortment. ✓

Accept - Explanation using genetic crosses that are well defined.

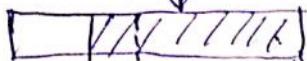
42. (a) State the difference between short day plants and long day plants.

(02 marks)

~~Acceptable differences~~ Short day plants only flower when the period of day light is shorter than critical maximum day length while long day plants only flower when period of day light exceeds a critical minimum day length. ✓

OR: Short day plants require long night periods to flower while long day plants require short night periods to flower. ✓

Florigen $P_R \rightarrow P_{FR}$



(b) With reference to long day plants, explain

(i) how flowering is controlled. $P_R \rightarrow P_{FR}$. (03 marks)

Flowering is stimulated by phytochrome farred but inhibited by phytochrome red. In presence of red light phytochrome red is rapidly converted to active phytochrome for red which on accumulation stimulates conversion of inactive florigen to active florigen demonstrated from leaves to shoot apex flower buds stimulate flowering; ✓
 (ii) the effect of flashing red light in a long night, (02 marks)

Flashing red light further stimulates flowering.

long day plants ✓ as red light is absorbed by P_R .

and rapidly converted to P_{FR} also phytochrome red decreases length of light to short favorable for flowering. ✓ 02

(c) With reference to flowering, explain the significance of photoperiod in plants. (03 marks)

Ensure members of the same species to flower at the same time; enabling cross pollination and cross fertilization; increasing genetic variability ✓ 03

Synchronizes reproductive behavior of plants with environments; ensuring reproduction at favourable times of the year such as when pollinators are abundant; ✓ 03

43. Table 3 shows the percentage composition of blood plasma and urine in g/100 cm³ of fluid for a selection of substances. Study the table and answer questions that follow.

Table 3

Substance	Percentage composition of	
	Blood plasma	Urine
Water	90	96. (16 times by 6g/100cm ³)
Plasma proteins	8	0. Decreased absent
Glucose	0.1	0. Different amount
Urea	0.03	2. (67 times) increased
Chloride ions	0.37	0.6. (2 times) increased
Hormones	Traces	Traces. No difference Turn Over on sex

- Ques (a) Explain any four significant differences in the composition of urine and that of blood plasma. (04 marks)
- Ans - Plasma proteins are present and high in blood plasma and absent in urine because they are too large to pass through glomerulus hence absent in capsular fluid / glomerular filtrate / urine.
- Glucose present in blood plasma and absent in urine, because all glucose is absorbed in the proximal convoluted tubule, hence absent in urine.
- Concentration of urea in urine is twice that in plasma, because it is actively secreted at PCT and large amount of water is reabsorbed into capillaries.

- (b) Give an explanation for the expected change in the composition of urine

(i) during strenuous exercise. (02 marks)

Concentration of urea increases because of increased protein catabolism; and chloride ion concentration that follows increased reabsorption of sodium ions; Percentage composition of water increases due to increase in metabolism.

(ii) after a high protein meal. (02 marks)

Concentration of urea increases because metabolism deamination of amino acids that make up proteins (excess) results into high production of ammonia which is quickly converted into urea for excretion increasing its concentration in urine.

- (c) Explain how the epithelial cells of the proximal convoluted tubule are adapted to perform their function. (02 marks)

- thin, single layer of cells; to ease reabsorption of substances;
- numerous mitochondria; forming ATP; providing energy for active secretion, reabsorption of substances.
- Cells have numerous microvilli to increase surface area for reabsorption of substances.
- numerous pinocytic vesicles, to endote digestion of any protein molecule from renal filtrate.

Ans 02

Accept other adaptations.
Correct

44. Figure 4 shows the control of gastric juice secretion in a mammalian stomach with increasing time after ingestion of food. Study the figure and answer the questions that follow.

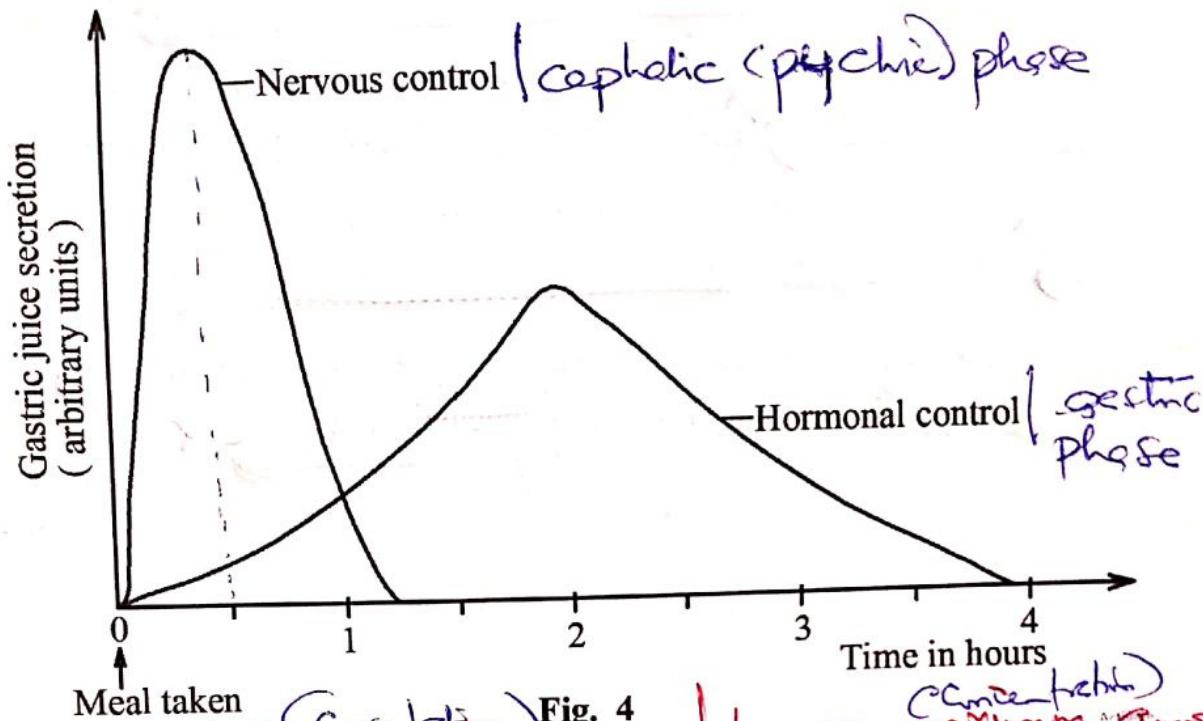


Fig. 4

- (a) Comment on the effects of nervous control on the secretion of gastric juice. (03 marks)

~~Explain~~ Nervous control causes immediate and short lived secretion of gastric juice. Gastric juice secretion increased rapidly to a peak from 0 hours to $\frac{1}{2}$ hours (30 minutes). Gastric juice secretion decreased rapidly from $\frac{1}{2}$ hours to 1 hrs and stops.

- (b) (i) State the differences in the effect of nervous and hormonal control of gastric juice secretion. (03 marks)

Nervous control of gastric juice secretion	Hormonal control of gastric juice secretion
1. Cessation starts earlier / shorter lived ; testing	cessation / stops later / longer lived
2. attained higher peak ;	attained lower peak ;
3. secretion decreased rapidly after the peak ;	secretion decreased gradually after the peak ;
4. Secretion increased rapidly to attain a peak when meal taken	secretion increased gradually to attain a peak after taking the meal

Award - differences in statements Any correct with emphasis to correct use of comparative words such as white, or wheeler.

Turn Over

- Nervous control lasts for a shorter period because impulse transmission is faster and short lived, while hormonal control lasts for a longer period because hormonal action is slower and long lived.
- (ii) Give reason(s) for your answer in (b)(i). (04 marks)
- Nervous control requires impulses, thus faster quicker and rapid stimulation of gastric glands to secrete a higher amount of gastric juice before food arrives in the stomach, preparing food stomach to receive food; while hormonal control requires secretion of gastric juice; therefore gradual secretion of gastric juice occurs only when food enters the stomach and due to increase in products of protein digestion.

OR

45. (a) State the difference between photosynthetic bacteria and chemosynthetic bacteria. (02 marks)

Photosynthetic bacteria synthesise organic compounds using light energy, while chemosynthetic bacteria synthesise organic compounds using energy obtained from oxidation of inorganic chemicals.

Q2

- (b) How is photosynthetic bacteria adapted to carrying out photosynthesis? (04 marks)

- bacteriochlorophyll, for trapping sunlight energy for photosynthesis.
- bacteriochlorophyll absorbs light of both long and short wavelength increasing rate of photosynthesis.

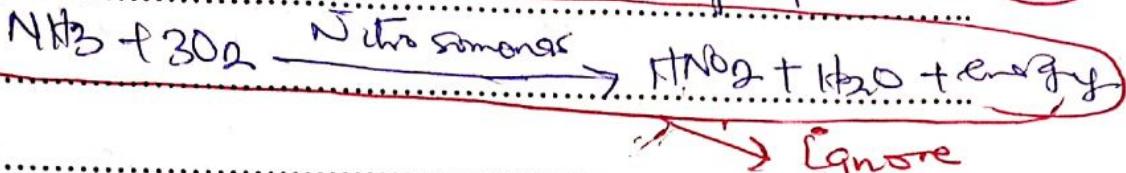
Q4

- (c) Using an example, explain the significance of chemosynthetic bacteria in an ecosystem. (04 marks)

Chemosynthetic bacteria such as nitrosomonas bacteria, recycle nutrients in the ecosystem.

or bacteria

Convert ammonia compounds into nitrates which can be further oxidized to nitrates that can easily be absorbed by plants



Ignore

46. (a) How is the body protected from pathogen reinvasion through active natural immunity? (02 marks)

(Ans) Memory cells; rapidly recognise pathogen, divide mitotically; produce a large clone of anti-bodies. Producing cells; producing a high concentration of antibodies in a short time; quickly destroying the pathogen before it exerts its effect.

- (b) Describe how the following protect the human body from the entry of pathogens.

(i) Ear. - wax secreted in the ear has antiseptic properties. (01 mark)

Secrete mucus; which traps pathogens, preventing them from entering physical barrier.

(ii) Anus. (01 mark)

tightly closed and often deeply covered by buttocks; preventing pathogen from squeezing between to enter the body through anal opening. (01 mark)

- (c) What is the role of the lymph nodes in the prevention of diseases in animals? (02 marks)

Organs where lymphocytes encounter pathogen; become activated; undergo rapid mitotic division and differentiation into effector cells; that eliminate/destroy the pathogens. (02 marks)

Also

gums contains non-harmful bacteria / commensals that outcompete harmful bacteria that may enter. (02 marks)

- Commensals in gums produce antibiotics to harmful bacteria.

mark 10
(d) State four roles played by the body's immune system. (04 marks)

- Produces antibodies; ✓

- Recognizes | detects pathogens; ✓

- destroys pathogens | foreign bodies; ✓

- stores information about previous pathogen

Memory invasion | memory establishment; ✓ Q4

Recruits effector | immune cells to sites

of infection;

- Selection of immune cells enabling

self and non self recognition; | train immune cells to recognize self (own body cells) and non self (foreign bodies) preventing own attack

Signature
2022
Date 16/09/2022

SECTION A

Qn. 1

(a)

- UNEB 2022 PS3 Q2

A DRAFT GUIDE~~STUDY MATERIALS~~
~~SUSTAINABILITY~~
2022(i) Lignin

Initially, at the start (at time when leaves fell), there is no lignin broken down / rate is lowest.

From time when leaves fell to 24 weeks, rate of decomposition of lignin increased slightly and linearly; ✓

Complex Organic Compound
must be clearly stated in description

From time when leaves fell initially, there is no cellulose breakdown / rate is lowest.

From time when leaves fell to 4 weeks, rate of breakdown of cellulose increased gradually; ✓

From 4 weeks to 12 weeks, rate of breakdown of cellulose increased rapidly; ✓

From 12 weeks to 24 weeks, rate of breakdown of cellulose increased gradually. ✓

Pectin

rate of breakdown is lowest

Initially, there was no pectin breakdown.

From time when leaves fell to 4 weeks, rate at which pectin is broken down increased gradually; ✓

From 4 weeks to 12 weeks, rate at which pectin is broken down increased rapidly; ✓

From 12 weeks to 20 weeks, rate at which pectin is broken down increased gradually; ✓

From 20 weeks to 24 weeks, rate at which pectin is broken down remained constant; ✓

~~OB~~

Answer description alternatively if percentage of substrate remaining is correctly described with time after leaves fell.

ALTERNATIVELY.

Lignin
Initially, percentage of lignin remaining was highest at 100%.
From time when leaves fell, throughout the 24 weeks, percentage of lignin remaining decreased slightly.

Cellulose

Initially, at time when leaves fell, percentage of cellulose remaining was highest.
From time when leaves fell to 4 weeks / After 4 weeks from time when leaves fell, percentage of cellulose remaining decreased gradually.
From 4 weeks to 12 weeks, rate of percentage of cellulose remaining decreased rapidly.
From 12 weeks to 24 weeks, percentage of cellulose remaining decreased gradually.

Pectin

At the time when leaves fell, percentage of pectin remaining was highest.
From time when leaves fell to 4 weeks / 4 weeks after leaves fell, percentage of pectin remaining decreased gradually.
From 4 weeks to 12 weeks after leaves fell, percentage of pectin remaining decreased rapidly.
From 12 weeks to 20 weeks, percentage of pectin remaining decreased gradually,
From 20 weeks to 24 weeks, percentage of pectin remaining remained constant.

(a) (ii)

Lignin

Throughout the 24 weeks, percentage of lignin decreased slightly because lignin is a very hard and rigid ^{most} complex polymer; highly insoluble;

and a non carb hydrate source; hence very difficult to be broken down; and least utilised by organisms feeding on decaying matter; / resistant to break down by organisms
Cellose feeding on decaying matter

Percentage of cellose remaining decreased gradually | rate of breakdown of cellose increased gradually for the first 2 weeks because plant leaves contain substantial / considerable quantities or amount of cellose; and higher rate of decomposition is also due to a relatively simpler structure; more easily broken down action of organisms feeding on decaying matter; simpler structure of cellose and being carbon source for most organisms using cellulase enzyme gradually increased its rate of breakdown;

Pectin

Percentage of pectin remaining decreased rapidly | rate of breakdown of pectin increased rapidly | was highest / fastest; because for the first 20 weeks and then remained constant in the last 4 weeks; because pectin less organised; shorted simple structure; and highly soluble; therefore easiest to decompose break down; and highly utilised by the organisms feeding on decaying organic matter, by secretion of pectinase to hydrolyse / digest it to easily absorbable simple sugars; in the last 4 weeks, reduced amount of pectin decreased activity of the feeding organisms;

next 14

- (b)
- Break down of plant material enables recycling of energy/ matter that can easily used by other organisms such plants; and as nutrients to living decomposers;
 - Cleans the environment by reducing amount of litter / wastes;

(c)

Fungi carries out extracellular digestion; by secretions - digestive enzymes to outside cell onto the plant materials; which are broken down chemically into smaller absorbable components; by the digestive system species; Specific enzymes are secreted for digestion of specific substrates; for example cellulase to digest cellulose.

05

(d) (i)

- barrier to entry of pathogens, hence protection;
- cements and anchors cellulose fiber, providing cell wall with extra tensile and compressional strength; to individual cells;
- increases mechanical strength and skeletal support to plants or trees;
- provides reinforcement to mature protoxylem for elongation;
- provide high tensile strength to mature xylem vessel walls, preventing tubes from collapsing when conducting water under tension;

05

a(ii)

- Lignin is a very hard and rigid matrix; cements and anchors cellulose fibres together; giving wood good quality for construction;
- used in synthesis of fibre glass; and carbon fibres.

03

QUESTION 2.

2 (a)

Blood clotting mechanism; ✓ (BS Page 482-483)

When tissue / part of human body is wounded blood flows out of the skin wound is exposed to air; ✓ damaged cells and ruptured platelets release thromboplastin; ✓ calcium ions and coagulatory factors X clotting factors VII and X. Enzymes found in plasma; which catalyse the conversion of prothrombin which inactive protein; to an active protein enzyme, thrombin; ✓

Thrombin catalyses the conversion hydrolysis of soluble protein fibrinogen in plasma; to insoluble and fibrous fibrin; ✓

Fibrin very tangled needle like fibres; blood cells become trapped in the meshwork; forming a blood clot; ✓

The clot dries up forming a scab; which prevents further blood loss from the human body

Platelet plug mechanism; | Platelet aggregation | Ignore

When blood vessel is damaged, free circulating platelets adhere to damaged endothelium; activated to recruit more platelets to adhere on the vessel wall; platelets aggregate together to seal the break in the endothelium preventing blood loss.

Vasoconstriction; ✓

Impacts narrowing of the damaged blood vessels; ✓ reducing blood flow to the damaged area; preventing blood loss. ✓

Vasoconstriction is caused by serotonin; secreted by platelets; ✓

(2b)

Sodium-potassium pump is a membrane carrier protein that spans across the cell membrane and continuously pumps sodium ions out to establish a chemical gradient.

Na⁺-K⁺ pump moves glucose from extracellular fluid into the cell along the sodium ion gradient since there is a high concentration of sodium ions outside the cell than inside. Water passively enters the cell following sodium ions; this causes osmosis. To restore osmotic balance,

Na⁺-K⁺ pump actively transfers sodium ions back to extracellular fluid which is followed by passive movement of water by osmosis.

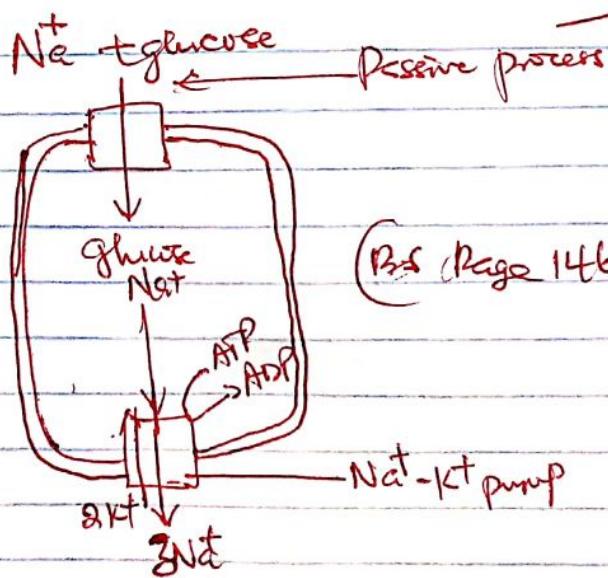
For every cycle of sodium-potassium pump,主动 movement of 3 Na⁺ out of the cell is in exchange of 2 K⁺ into the cell and one molecule of ATP is used.

This maintains water distribution between the extracellular and intracellular fluid in balance (equilibrium) constant.

(Bd Page 14b)

1 MARK @

92



(Bd Page 14b Fig 5-22)

(a)

mRNA is formed by process known as transcription from a specific region of DNA molecule as a template.

RNA Polymerase binds to the DNA strand of a promoter section of DNA unwinds the two strands breaking hydrogen bonds between base pairs in the DNA double helix by helicase exposing single strands of DNA. One of the two strands is selected as template. RNA Polymerase reads the antisense strand of DNA from 3' to 5' and matches free nucleotides with their complements on DNA strand such as G with C, A with T, in the 5' to 3' direction.

N₁ base

RNA polymerase joins the new mRNA nucleotides to form a complementary copy of DNA, called the mRNA. As DNA double helix reforms behind the RNA polymerase, when sufficient number of mRNA molecules have been formed, mRNA.

10 marks

(b)

mRNA which is a complementary copy of a specific region of DNA molecule which codes for a protein/polypeptide leaves the nucleus through the nuclear pores to the cytoplasm and attracted to the ribosomes and translated into synthesis of polypeptide.

Each ribosome is composed of small and a large subunit, the first two codons of mRNA enter the ribosome, (usually AUG) ignore the first codon binds the amino acyl-tRNA

Molecule having the complementary anticodon; ~~and carrying the first amino acid; (usually methionine) — ignore~~

the second codon; then attracts an amino acyl-tRNA sharing the corresponding anticodon carrying the second amino acid;

ribosome binds mRNA and tRNA-amino acid complex together; until the two amino acids form a peptide bond between each other.

The ribosome moves one codon along mRNA, holding the codon-anticodon complex together; until third amino acid is fixed to the second amino acid by a peptide bond,

ribosomal sequence reading and translating the mRNA code continues while the polypeptide chain grows; until a stop codon is reached; stop codons terminate translation.

Polypeptide then leaves the ribosome; and can now be assembled into a specific required protein/enzyme; and transported through the endoplasmic reticulum; max 200meters

QUESTION 4

(iv)

Reduction of the male gametophyte to pollen tube, with complete elimination of sterile sperm (male gamete).

Reduction of the female gametophyte to a seven-celled embryo sac, and enclosed within the ovary; protecting it from mechanical damage or adverse conditions.

Development of an ovary, stigma and style; the latter providing a pathway to guide male nuclei of the pollen tube to the embryo sac, and providing nourishment to the growing pollen tube.

• Double fertilization; resulting in the embryo, and endosperm which nourishes provides nutrients to the young embryo.

Development of seed and fruit, helping in their dispersal.

Development of stamens leading to various highly successful systems of pollination.

Brightly coloured floral parts | corolla to promote insect pollination.

Separate male and female flowers on different plants ensures cross pollination.

Some plants have a short life span, Cycles, thus form seeds in a short period when conditions are favourable.

Produce seeds which can remain dormant and survive adverse conditions, and germinate to reproduce when conditions are favourable.

TOMATOES

(d)

- Meiotic division^x of a large, diploid sporangium mother cell | - embryo^{sac} mother cell / megasporangium mother cell inside the parenchyma tissue^x
- nucleus[✓] forms four haploid megasporangium cells^x; three of which degenerate^x
- only one develops to form an embryo sac^x; whose nucleus divides mitotically^x to form two nuclei^x
- the two nuclei migrate to opposite poles^x; from where each divides mitotically twice^x; to form four haploid nuclei at each pole^x
- One of the nucleus from either end of the sac moves to the centre^x; fuse to form a diploid primary endosperm nucleus^x
- the remaining six^x; each gets enclosed by a thin cell wall^x
- One of the three nuclei near the micropyle forms the egg nucleus | egg cell^x
- the remaining two cells near the micropyle | synergids^x; degenerate^x; the other three nuclei at opposite end of the micropyle^x; form the antipodal cells^x

Tomato

QUESTION 5

(a)

Similarities

Both cardiac and skeletal muscles:-

- have mitochondria;
- elongated cylindrical fibres
- have a sarcolemma
- have striations → are striated

Differences

Structure of cardiac muscle

- branched muscle fibres
- inter connected to form a network
- arranged in bundles

- has intercalated discs
- has faint regular striations

Structure of skeletal muscle

- unbranched muscle fibres
- arranged in bundles

- lacks intercalated discs
- striations of light and dark bands

Award another correct

Structural similarity and difference.

(b)

(i)

- numerous mitochondria and glycogen granules to rapidly supply adequate amounts of energy, for rapid contraction without fatigue;
- branched muscle fibres; for increased surface area for rapid spread of waves of electrical excitations for continuous contraction
- dense network of capillaries, for adequate supply of oxygen and nutrients, for rapid production of adequate energy, and (or) rapid removal of metabolic wastes;
- striations provide mechanical support, to support fast and continuous contractions;
- a well developed T-system for rapid transmission of impulses, increasing speed of contraction and relaxation;

- highly branched terminally connected to each other by intercalated discs, to form a network that allows rapid spread of waves of electrical excitations, allowing rapid rhythmical and simultaneous contractions for fast heartbeats;

(Q3)

(ii)

- rich blood supply to provide adequate supply of oxygen and nutrients;
- muscle cells have myoglobin to store oxygen, and release it when blood oxygen tensions are low.
- have motor endplates, allowing nerve stimulation and control of the muscle;
- numerous mitochondria, to provide large amounts of ATP for muscle contraction;
- elongated fibres, allowing greater maximum contractile length;
- free calcium ions in its sarcoplasm which activate process of muscle contraction;
- respiration anaerobically in anaerobic conditions for continued supply of energy;
- ability to generate ATP using phosphocreatine, during anaerobic conditions for constant supply of energy for contraction / muscular activity;

Ans correct (Q2)

(a)

- are means of producing; and maintaining; reproductive isolation within a population of closely related species ✓

02

OR - are sets of mechanisms that prevent species or members of the same group from breeding or mating with each other.

OR - are means of preventing gene-flow between populations of closely related organisms.

(b)

Isolating mechanisms are majorly classified into categories, that presyngotic isolating mechanisms and postzygotic isolating mechanisms.

Prezygotic barriers mechanisms; these are barriers that prevent fertilization of eggs or barriers to formation of hybrids; they include geographical isolation; are physical barrier that occur to keep two closely related species from mating; splitting population into demes; preventing gene flow between them; species get adapted to new conditions; occurrence of genetic drift in the small populations; independent mutation in the subpopulations, result in change in allele frequencies making species genetically different / isolated even if brought together can not breed hence speciation;

Behavioral / ethological isolation; occurs where many species perform different courtship / mating rituals; preventing gametes of different populations from meeting

Mechanical / chemical isolation; caused by structures or chemical barriers that keep species isolated from one another; such as incompatible and/or anatomic structures of the genitalia; prevents mating; or failure of male gamete to survive in the female reproductive tract; or (plants) pollen of one species usually don't germinate on stigma of another species;

Seasonal / temporal isolation; occurs when species that are closely related; and could interbreed don't, because the different species breed at different times; of the year such as different times of the day / year; creating reproductively isolated populations that are genetically isolated hence speciation

Ecological / habitat isolation; occurs when two species of similar region could interbreed but don't because they live in different habitats; therefore will not encounter one another; due to isolation and don't mate; over time, adapt to different habitat, becoming genetically isolated in respective subpopulations; hence speciation

Postzygotic mechanisms; are isolating mechanisms / barriers preventing formation of a viable / fertile offspring; that include:- the zygote produced after successful fertilization is incapable of sustaining life; this includes

Hybrid inviability; occurs when hybrids produced fail to develop to maturity; or genetic incompatibility of interbred species hinders development of the

hybrid zygote; preventing normal mitosis
after fusion of gametes;

Hybrid sterility; occurs when two species mate and produce a viable hybrid; but the hybrid cannot reproduce; Since meiosis in such individuals fail to produce normal gametes | functional gametes; for example male from mating of female horse and ~~male~~ male donkey. Hence hybrids are genetically different; -

Hybrid breakdown | F₂ breakdown; occurs when first generation hybrids are viable and fertile; but when they mate ^{with} each other or ^{with} from original species; produce sterile | infertile ^{individual} hybrids or weak hybrids which die even before maturity; for example different cotton species.

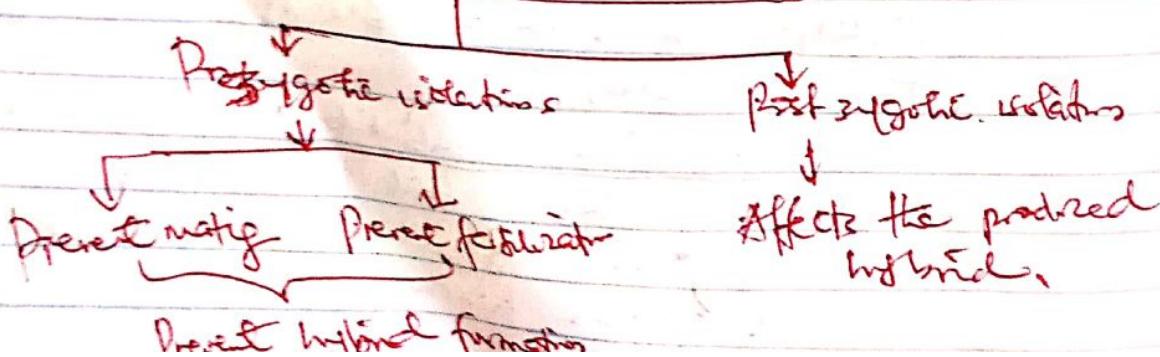
(B.S.Pg 925)
(Table 27.3)

REFERENCE BOOKS

~~BIOLOGICAL SCIENCE~~

1. D.T. TAYLOR, N.P.O. Green, G.W. Short and R. Super, Biological science, 3rd edition, Cambridge University Press.
2. Glenn and Susan Tooze, NEW UNDERSTANDING BIOLOGY for advanced level, 2nd Edition, Nelson Thomas
3. M.B.V. Roberts, Biology a functional approach, 4th Edition, Nelson.

Reproductive Isolating Mechanisms



SECTION A (40 MARKS)

Question 1 is compulsory.

1. Studies were carried out to show how some of the complex organic compounds such as lignin, cellulose and pectin present in leaves are broken down by the action of organisms feeding on decaying organic matter over time. The results were plotted on the graph as shown in figure 1. Study the figure and answer questions that follow.

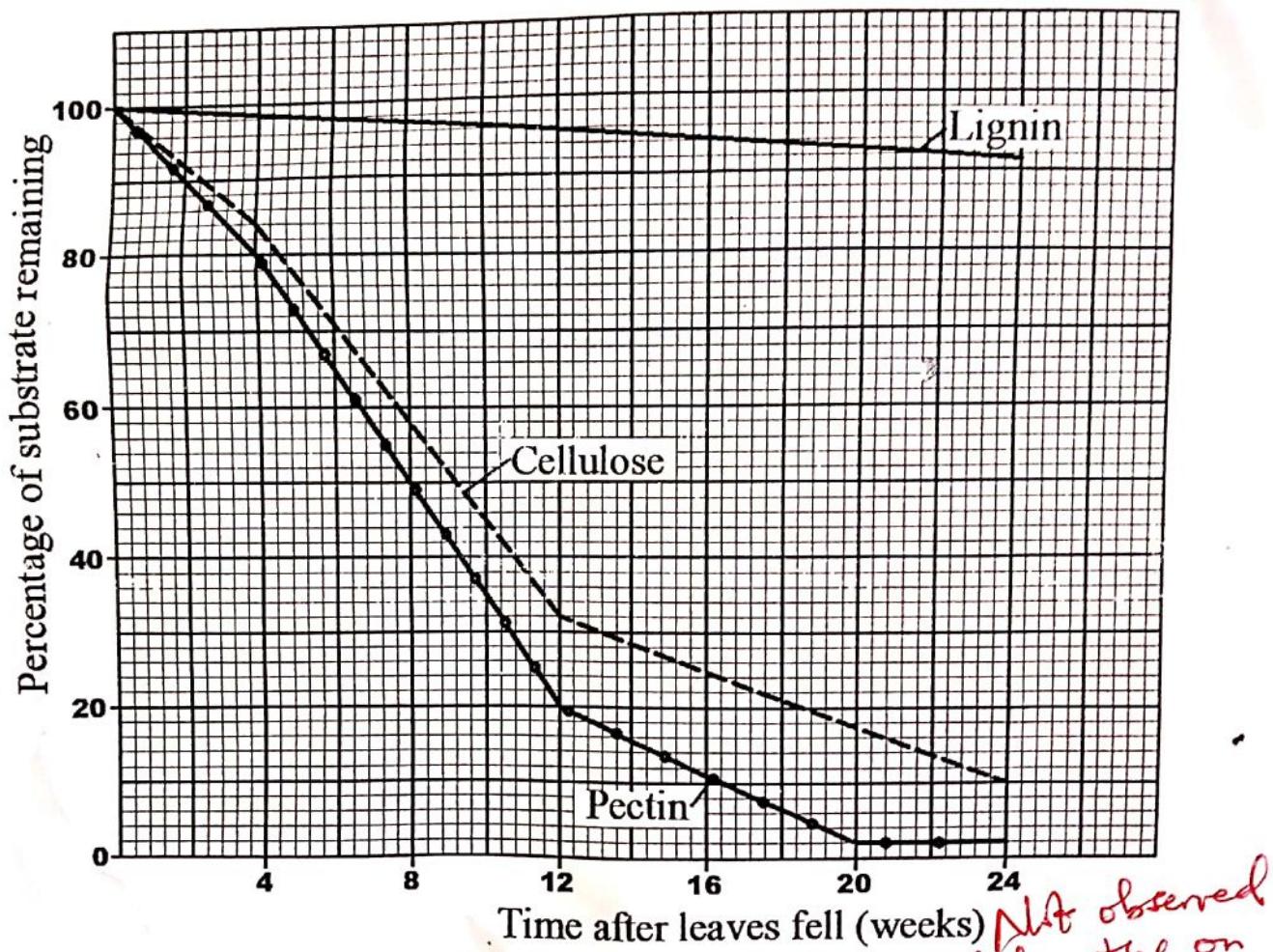


Fig. 1

- (a) (i) Describe the rate at which each of the complex organic compounds is broken down. (08 marks)
- (ii) Explain your descriptions in (a) (i). (14 marks)
- (b) Explain the ecological significance of the process of breakdown of plant materials shown in figure 1. (05 marks)
- (c) Explain how fungi are able to breakdown plant materials. (05 marks)
- Not observed during the graph*

- (d) How is lignin
(i) important in plants? (05 marks)
(ii) useful to man? (03 marks)

SECTION B (60 MARKS)

Answer any three questions from this section.

Any additional question(s) answered will not be marked.

2. (a) Describe the different mechanisms by which the human body prevents loss of blood. (08 marks)
- (b) Explain how the sodium-potassium pump mechanism brings about osmotic balance in a human body cell. (12 marks)
3. (a) How is mRNA formed from DNA in a cell? (10 marks)
- (b) Describe how the information on mRNA is used in the synthesis of an enzyme. (10 marks)
4. (a) How are flowering plants adapted for reproduction on land? (10 marks)
- (b) Describe the process of development of an embryo sac in flowering plants.
Logical flow of events (10 marks)
5. (a) Compare the structure of the cardiac and skeletal muscles. (06 marks)
- (b) Explain how each of the following is suited to its function:
- (i) Cardiac muscle. (07 marks)
- (ii) Skeletal muscle. (07 marks)
6. (a) What are isolating mechanisms? (02 marks)
- (b) Explain how each of the isolating mechanisms lead to emergence of new species in a population. (18 marks)

Candidate's Name:

Signature:

Random No.				Personal No.	

(Do not write your School/Centre Name or Number anywhere on this booklet.)

P530/3
BIOLOGY
(Practical)
Paper 3
Nov. / Dec. 2022
3½ hours



UGANDA NATIONAL EXAMINATIONS BOARD
Uganda Advanced Certificate of Education

BIOLOGY
(PRACTICAL)

Paper 3

3 hours 15 minutes

INSTRUCTIONS TO CANDIDATES:

This paper consists of three questions.

Answer all the questions.

Write the answers in the spaces provided. No additional sheets of paper should be inserted in this booklet.

You are not allowed to start working within the first 15 minutes. You are advised to use this time to read through the paper and ensure that you have all the apparatus, chemicals and specimens you require.

My humble appeal
to all P530/3 teachers
is to always
encourage students
carefully follow instruction
when dissecting.

A must dissect!
A must
student
interaction
with the
specimens

Should be
highly
encouraged.
for instance
during
Measurements

For Examiners' Use Only		
Question	Marks	Examiner's Signature & No
1	41	
2	35	
3	24	
Total	100%	

- Cat road*
1. You are provided with specimen Z, which is freshly killed. Examine the external features using a hand lens where necessary.

- (a) Giving reasons, state the order to which specimen Z belongs. (05 marks) - ink

Order Dictyoptera, ✓ Reject wrong spelling

Reasons: Because specimen Z has:

Pair of segmented anal cerci, ✓

dorso-ventrally flattened body, ✓

long segmented and tapering antennae; ✓

02

- (b) Measure the width of the widest region of the head, thorax, abdomen and then measure the width of the last abdominal segment of specimen Z in millimeters. Record your measurements in table 1. State the significance of the measurements obtained in relation to the life of the specimen.

Table 1

Range

(04 marks)

Part	Width (mm)	Significance of the measurements
Head	4.0-5.0	Provide the specimen with a streamlined shape to reduce air resistance during forward movement
Thorax	9.0-12.0	
Abdomen	10-11.0	
Last abdominal segment	5.0-6.5	

- (c) (i) Detach one fore limb and one hind limb from specimen Z. Stretch them out and measure the length of each limb in millimeters. Record your measurements in table 2 and determine the ratio of the fore limb to hind limb.

Table 2

(02 marks)

Limb	Length (mm)	Ratio
Fore limb	25	1:2
Hind limb	55	

261

61

- (ii) Explain the significance of the ratio in table 2 to the life of the specimen Z. (3% marks)

Explain the forelimbs is half the length of the hind limbs

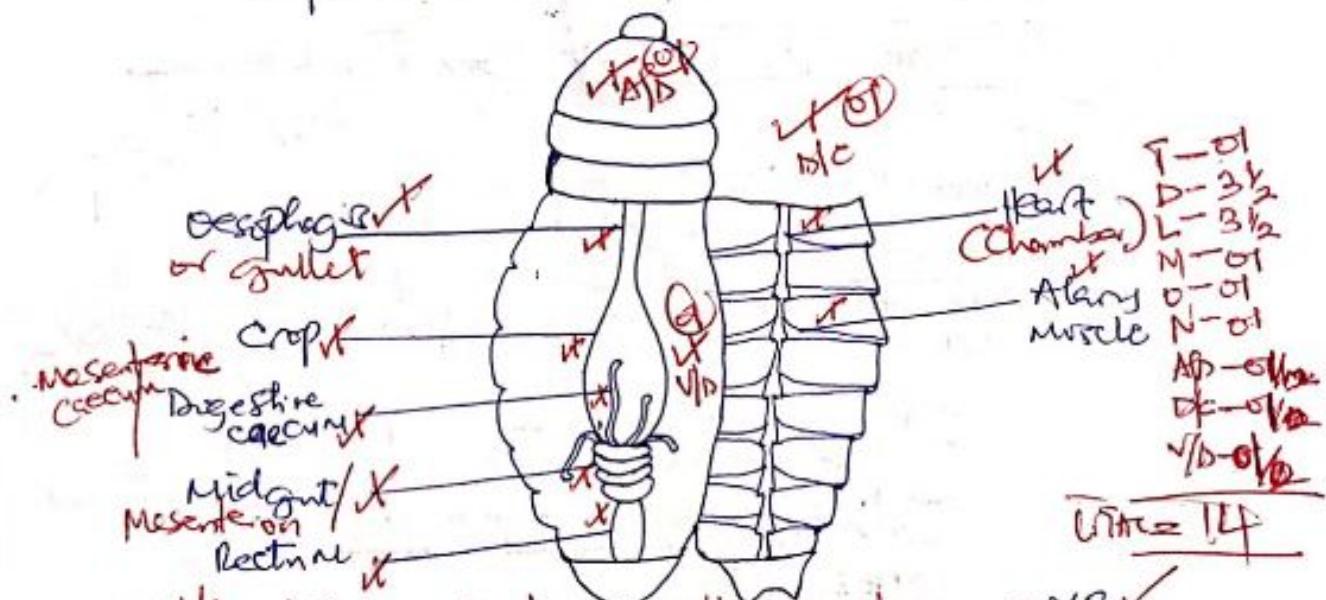
Shorter than hind limbs to absorb shock during locomotion. 02

the hind limb is twice length of the forelimbs

longer than forelimbs to generate strong propulsive force during locomotion. 1/2

- (d) Dissect specimen Z along the left lateral line to display the viscera in the abdomen of the specimen. Remove any pieces of odd fatty tissue present. Draw and label the structures displayed excluding the reproductive structures. (14 marks)

Drawing showing structures displayed in the viscera in the abdomen and excluding the reproductive structures of specimen Z



N/A - If any structures in thorax abdomen and $\times 3$ ✓

- labelled
- If the gut is displaced to opposite side and labelled nervous system

- If the dorsal article is displaced to the left side

Ignore - dorsal article and ventral article when labelled Turn Over
- any external features digested and labelled
- all reproductive structures digested and labelled

Reproductive
in (cm)

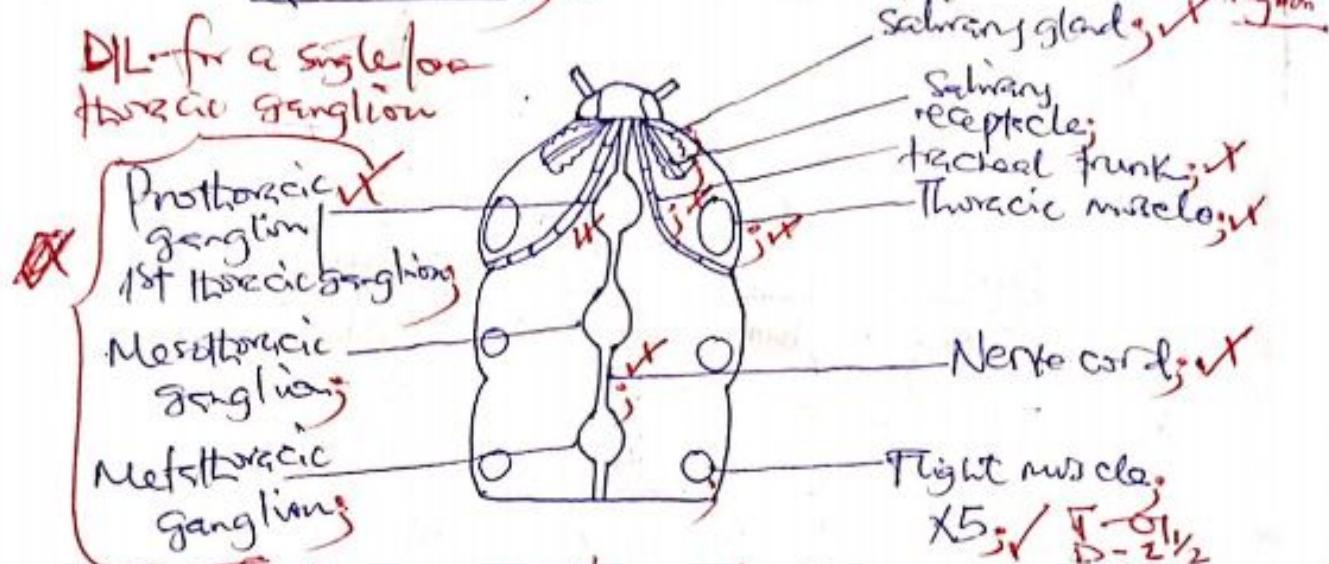
- (c) Dissect further into the thorax to display the internal structures within the thorax on the ventral cuticle. Cut off the alimentary canal.

- (i) Measure and record the length of the ventral cuticle.

..... 23 ✓ 9 mm (01 mark)

- (ii) Draw and label all the internal structures that remain attached in the anterior half of the ventral cuticle. (8½ marks)

Drawing showing internal structures that remain attached in anterior half of ventral cuticle of specimen Z ✓
Salivary gland must be in prothoracic region



NR If structures within the abdominal region of the ventral cuticle drawn & labelled → If structures on dorsal cuticle drawn & labelled → Ignore: Any external features of D.L.

- (iii) Explain the significance of the structures observed in (c) (ii) in the survival of specimen Z. (03 marks)

Salivary gland secretes saliva for softening food and contains digestive enzymes for chemical digestion. ✓

Tubular hollow tracheal trunk for passage of air for respiration. ✓

2. You are provided with specimen P, solution Q and distilled water.

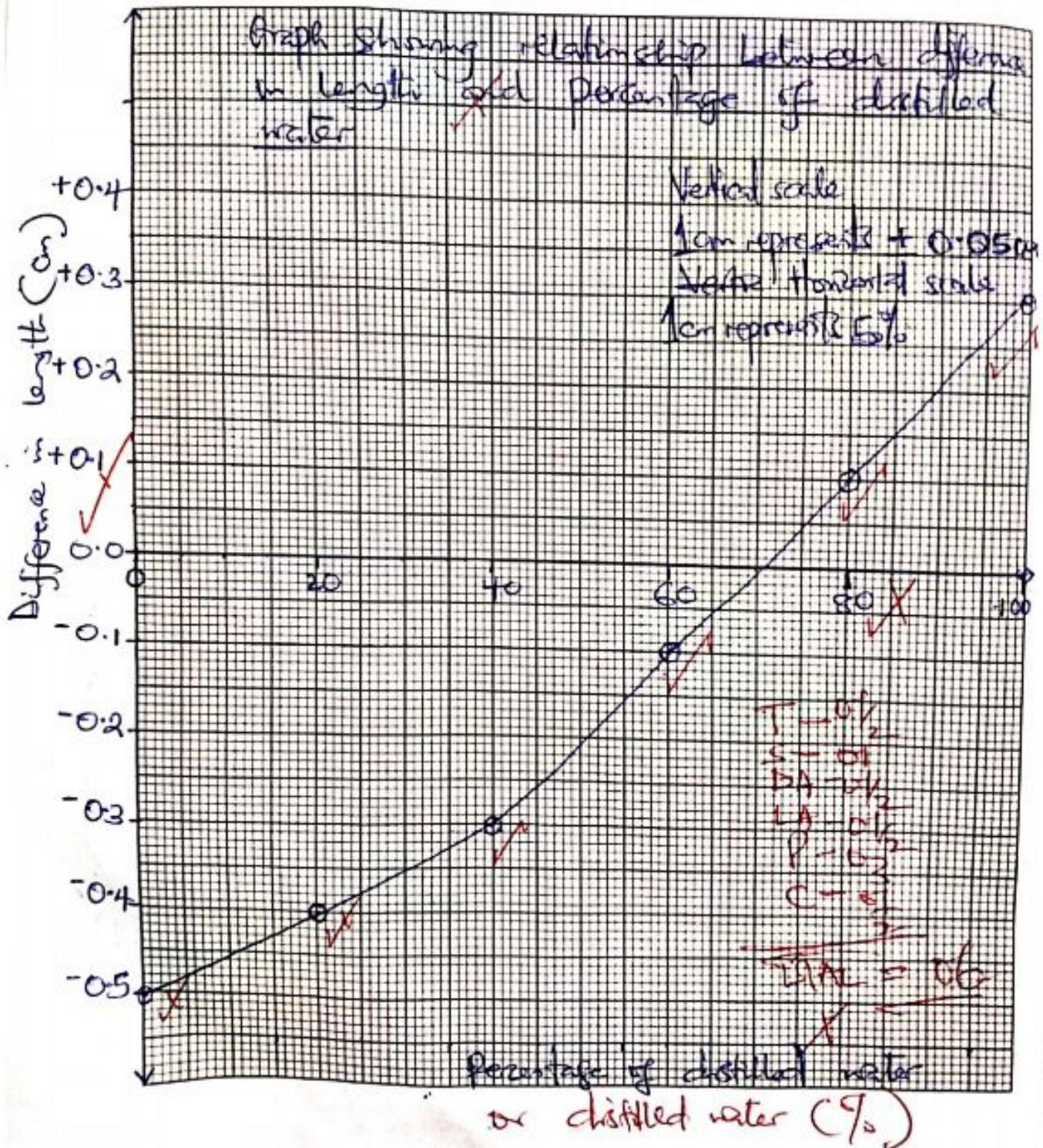
- I. Using a cork borer provided, prepare six solid cylinders from specimen P, each with an initial length (IL) of 5 cm long.
- II. Label six test tubes A, B, C, D, E and F and in each, pour a mixture of distilled water and solution Q in proportions shown in table 3.
- III. Place one cylinder obtained from specimen P in each of the test tubes, ensuring that it is immersed into the solution.
- IV. Leave the test tubes to stand for one hour (*meanwhile you may continue with other work*).
- V. After one hour, remove each of the cylinders from the solutions, one at a time and place each on a filter paper. Quickly measure and record the new length (NL) of each cylinder in table 3 and complete the table.

(a) **Table 3**

(09 marks)

Test tube	Volume of distilled water added (cm ³)	Volume of solution Q added (cm ³)	Length after one hour (NL) (cm)	Difference in length $\Delta L = NL - IL$ (cm)	Percentage of distilled water added
A	10	0	5.3 ✓	+0.3 ✓	100% ✓
B	8	2	5.1 ✓	+0.1 ✓	80% ✓
C	6	4	4.9 ✓	-0.1 ✓	60% ✓
D	4	6	4.7 ✓	-0.3 ✓	40% ✓
E	2	8	4.6 ✓	-0.4 ✓	20% ✓
F	0	10	4.5 ✓	-0.5 ✓	0% ✓

- (b) (i) Plot a suitable graph to show the relationship between the difference in length with percentage of distilled water added.
 (06 marks)



- (ii) Using the graph, determine the percentage of solution Q by volume, with the same concentration as the cell sap of specimen P. Explain your answer. (05 marks)

Percentage of distilled water that gave no change in length = 71% ✓ 7.1 cm³ by volume, therefore 2.9 cm³ of solution Q was added. Percentage is 29%, because 29% concentration of Q corresponds with 71% of distilled water which had no change in length. Therefore, in a mixture of 29% Q and 71% distilled water, there was ~~not~~ net gain or loss of water.

- (iii) Explain your graph in (b) (i). by the plant (06 marks)

At 0% distilled water, ~~was~~ most negative change in length; because solution Q is highly hyperonic (has lowest (most) negative) solute potential / lowest water potential / lowest (most negative) osmotic potential, thus ~~much~~ water was lost from the cell sap of the specimen into solution by osmosis. (Exosmosis)

Answr:
Correct
description
from either
side of the
graph +
correct
explanation

Between 0% and 71% distilled water, change in length becomes more positive/less negative, as solution progressively becomes less hyperonic with increase in water molecules; decreasing amount of water lost from cells of specimen.

At 71% distilled water, no change in length; because solution of 71% distilled water and 29% solution S is hypotonic to cell sap of specimen P (thus no net loss or gain of water). Between cell sap of specimen and solution, there's ~~less~~ difference of specimen P take in water by osmosis increasing in length, resulting into an increasingly more positive change in length.

At 100% distilled water, there was highest positive change in length, because distilled water has the highest water potential. Compared to cell sap of specimen P, hence much water (highest amount of water) is absorbed into the cells of specimen P by osmosis.

Turn Over
(Endorsement) Next = 06

- (c) (i) Explain why the new length of the cylinder in test tube A could not go beyond the length you have recorded in table 3.
(1 hour is sufficient for the physiological process being investigated in this experiment.) (05 marks)

In tube A with 100% distilled (pure) water, with highest water potential compared to cell sap of specimen P; thus cells absorb water by endosmosis; increasing the turgor pressure against the cell wall by the cell membrane; the cell wall produces an equal and opposite wall pressure to counteract the turgor pressure; maintaining cell shape and size on fully turgid. 05

- (ii) Explain the ecological significance of the experimental results in the plant from which specimen P was obtained, if the soil solution is 37% water. (04 marks)

According to experimental results, soil solution with 37% water has lower water potential and a higher solute concentration compared to cell sap of specimen P; therefore, soils from which P was obtained must be highly watered, to at least above 71% water; to increase the water potential and, to lower solute concentration of soil; to enable plant cells / cells of specimen P to absorb water; (and avoid wilting).
Therefore plant cells lose water resulting to, wilting; and closure of stomata; reducing surface area for water loss / transpiration.

3. You are provided with specimens; H, I and J.

(a) Using a hand lens, describe the

(i) arrangement of the florets of specimen J. (02 marks)

Numerous florets; closely packed and sessile.

(02 marks)

Florets surrounded by an involucel of bracts. Attached on top of expanded peduncle, in two conformations at different positions in a circular pattern; young florets surrounded by older florets.

(ii) structure of the essential parts of a floret of specimen I. (05 marks)

Stamens: eight, free bilobed anthers; thin and long filamentous smooth filaments; (2+2)

stamens of varying height;

Pistil: stigma is club-shaped, elongated; hairy; (2+2)

Style is short; thin; and hairy; Superior; No nectarine cavity;

(b) (i) Explain the significance of the arrangement of florets of specimen J. (04 marks)

Florets are at tip of peduncle to expose them for easy pollination; ✓

Award full mark for Nature of arrangement and significance increase chance for pollination; ✓

Closely packed florets for firm attachment

making them difficult to pluck off; ✓ (02)

Peripheral older florets surround inner/central younger florets for protection; ✓

Florets surrounded by an involucel of

bracts for support/firm attachment Turn Over

of florets/protection; ✓

- (ii) State the differences between the gynoecium of the florets of specimen J and specimen I. (03 marks)

Gynoecium of J	Gynoecium of I
Synocarpous	Non synocarpous ✓
bilobed stigma	club shaped stigma ✓
longer style	shorter style ✓
Smooth stigma	hairy stigma ✓
shorter ovary	elongated ovary ✓ Any correct longer ovary (03)

- (c) (i) Rub the anther of specimen I on the glass slide and observe the slide under medium power of a light microscope. Describe what you have observed. (1½ marks)

Many round shaped, large sized, spiny pollen grains that are clumped stuck together, brightly colored,

- (ii) From your observation in (c) (i), state the mode of pollination of the florets of specimen I. Give reasons for your answer.

Insect

Cross pollination ✓ Density of attachment

Spiky or spiny surface of pollen grains

for sticking or firm attachment on insects

body or stigma; ✓

Pollen grains are large to increase

surface area for firm attachment on the insect's body; ✓

- (d) Using a sharp blade, cut off the peduncle of specimen H. Cut the remaining part longitudinally. Slice a thin section longitudinally along the same plane from one half. Observe the slice under low power of a light microscope. Draw and label. (5½ marks)

Drawing showing longitudinal section of one half of specimen H as observed under low power of light microscope with Peduncle cut off;

Recommendation out N/T

1. Award Student for the longitudinal section of the ray floret, and allocate all marks

2. Alternatively → Shift marks to other question (Qn. 2(b)(iii)) $\times 10 - \times 20$ ~~N/T~~



3. the cluster of florets will separate on cutting off the peduncle; the question failed to state out exactly what to slice

Comment on 3(d)

1. the instructions were quite unclear on whether the candidates should slice a single floret (disc/ray floret).
2. the remaining part after cutting off the peduncle are in a cluster of florets, therefore what exactly to slice was not indicated.