

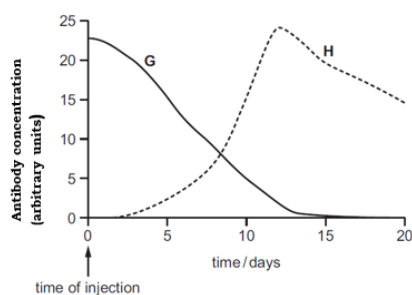
S.6 PRE-REGISTRATION EXAMINATIONS**BIOLOGY (P530/1)**

TIME 2Hours 30 Minutes

INSTRUCTIONS. Attempt **all** questions in both sections **A** and **B****SECTION A (40 MARKS)**

- Which of following is the correct information about amylose?
 - Branched, with both α -1,4 and α -1,6 glycosidic bonds
 - B. Helical with only α -1,4 glycosidic bond**
 - Branched with only α -1,6 glycosidic bond
 - Helical without α -1,4 and α -1,6 glycosidic bonds
- In a human population, approximately 5% of the humans have one amino acid of the β chain changed affecting the structure and stability of haemoglobin. Which of the following levels of protein could be changed in haemoglobin of these humans?
 - Primary only
 - Primary and quaternary only
 - C. Primary, secondary, tertiary and quaternary**
 - Secondary, tertiary and quaternary only
- The cell surface membrane structure is described as a '**fluid mosaic**'. Which statement describes the '**mosaic**' part of the cell surface membrane?
 - the different pattern that are obtained by the moving phospholipid molecule.
 - the random distribution of cholesterol molecules within the phospholipid layer
 - the regular pattern produced by the phospholipid heads and membrane proteins
 - D. the scattering of the different protein within the phospholipid bilayer**
- The graph in the figure below shows the concentration of the antibody against a particular pathogen in the blood of the two people, **G** and **H**, over a 20days period following injection.

One person was injected with antibodies while the other person was injected with a vaccine.



Which of the following describes the type of immunity shown by **G** and **H**?

	G	H
A	Artificial active immunity	Artificial passive immunity
B	Artificial passive immunity	Artificial active immunity
C	Natural active immunity	Natural passive immunity
D	Natural passive immunity	Artificial active immunity

5. Which of these statements could describe the effects of carbon monoxide in cigarette smoke?

- (i) It binds irreversibly to haemoglobin
- (ii) It causes mucus to accumulate in the bronchioles
- (iii) It results in more carbon dioxide being transported in the blood
- (iv) It temporarily increases the heart rate

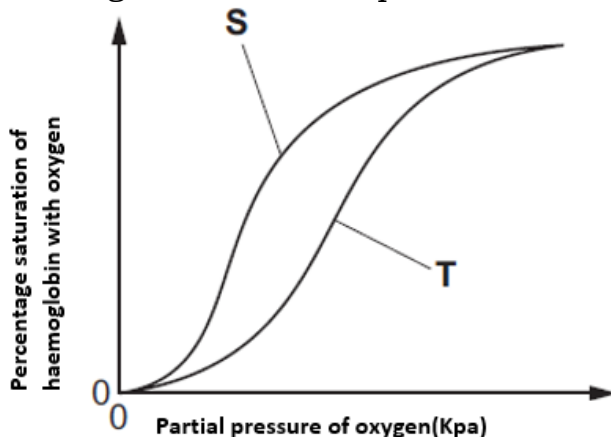
A. (i) and (ii)

B. (i) only

C. (ii) and (iii)

D. (iii) and (iv)

6. The graph in the figure below shows oxygen dissociation curves of haemoglobin from two species of mammals, **S** and **T**.



Which of the following statements explains the differences in the oxygen dissociation curves of species **S** and **T**?

- (i) Species **T** has a lower haemoglobin concentration in its red blood cells than species **S**.
- (ii) The haemoglobin in species **T** has a lower affinity for oxygen than haemoglobin in species **S**.

(iii). Species **T** lives at higher altitude than species **S**.

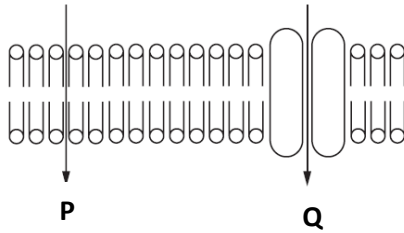
A. (i), (ii) and (iii)

B. (i) and (ii) only

C. (ii) only

D. (iii) only

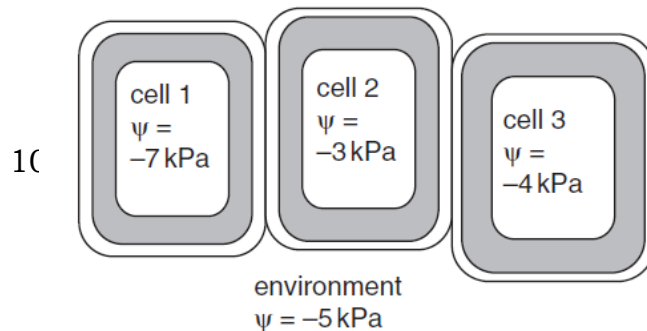
7. The diagram below shows two pathways, **P** and **Q**, through which molecules can diffuse across a cell surface membrane.



What is the correct possible pathway(s) for lipids, water and glucose?

	Lipids	water	glucose
A	P only	P and Q	Q only
B	P only	Q only	Q only
C	P and Q	P only	P and Q
D	P and Q	P and Q	P only

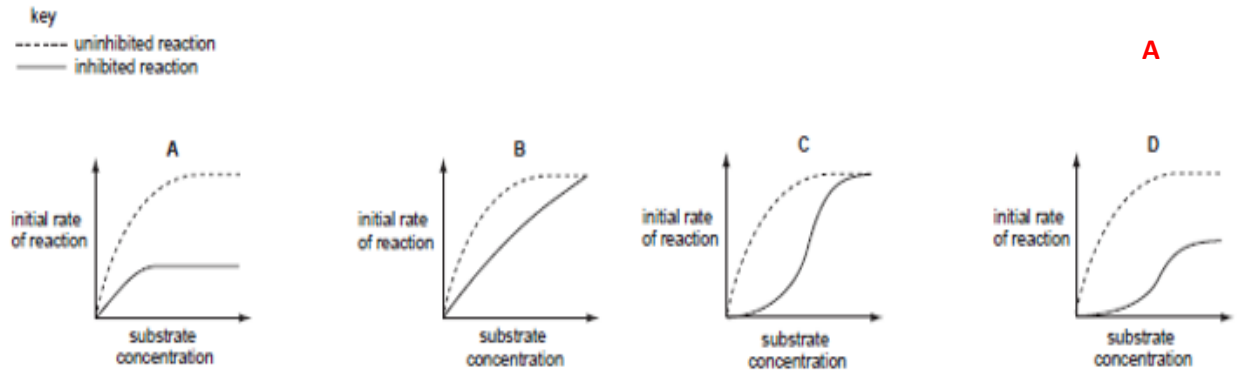
8. Which of the following statements explains why two species **cannot** permanently occupy the same ecological niche?
- The two species could not interbreed
 - The two species may be part of separate food web
 - C. The two species would compete for the same resources**
 - The two species would have different nutritional requirements
9. The diagram shows the water potential (ψ) in some plant cells and in their environment.



Which statement describes the movement of water between these cells and between them and their environment.

- All three cells are turgid, so no water moves
 - Water moves from cell 1, cell 3 and their environment into cell 2
 - C. Water moves from cell 3 to the environment, and from the environment to cell 1**
 - Specific heat capacity
11. The initial rate of a reaction catalyzed by an enzyme was measured at various substrate concentrations.

Which graph shows the effect of low concentration of non-competitive inhibitor on the reaction?



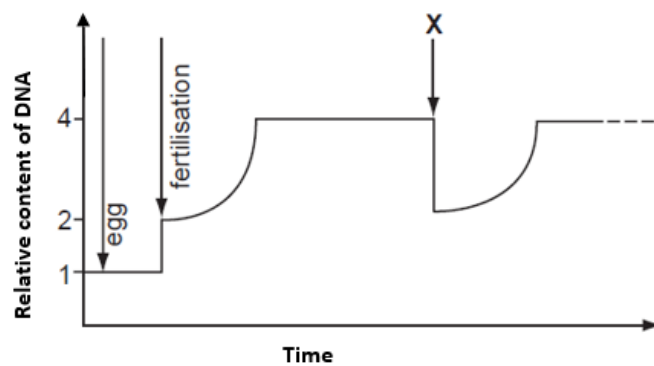
12. In a genetic engineering experiment, a piece of double-stranded DNA containing 6000 nucleotides is transcribed and translated. What is the total number of amino acids used?

A. 500
B. 1000
 C. 2000
 D. 3000

13. Which of the following cell structure(s) would be present in a giant bacterium, *Epulopiscium fishelsoni*, enabling biologists to classify it as prokaryotic?

A. A cellulose cell wall outside the plasma membrane
 B. A pair of centrioles close to the nuclear area
 C. Circular DNA lying free in the cytoplasm
 D. Smooth endoplasmic reticulum throughout the cytoplasm

14. The graph in the figure below represents the changes in the quantity of DNA present in one nucleus at different stages in the life cycle.



Which stage takes place at **X**?

A. Interphase
 B. Metaphase
 C. Prophase
D. Telophase

15. Which statement describes the vital capacity of a human being?
- A. The additional volume of air that can be exhaled after breathing out normally
 - B. The additional volume of air that can be inhaled after breathing in normally
 - C. The volume of air inhaled and then exhaled during a single breath**
 - D. The volume of air that can be exhaled following a maximum inhalation
16. Cells which do not have nucleoli die because they do not have?
- A. Centrioles and thus cannot divide
 - B. Mitochondria and cannot release energy
 - C. mRNA and cannot transcribe DNA
 - D. Ribosomes and cannot synthesize proteins**
17. Why is it necessary for a person with a bacterial infection to be told to take antibiotics at evenly spaced time intervals?
- A. to increase the concentration of antibiotics slowly to a level lethal to bacteria.
 - B. to maintain concentration of antibiotics in the body which is lethal to the bacteria**
 - C. to prevent the development of resistant strains of bacteria
 - D. to select and kill the resistant strains of bacteria
18. In the DNA sequence for sickle cell anaemia, adenine replaces the central thymine in a CTT triplet. During synthesis of the sickle cell haemoglobin molecule, the amino acid valine is incorporated instead of glutamic acid.
- What is the anticodon in the transfer RNA molecule carrying this valine?
- A. CAU**
 - B. CUA
 - C. GAU
 - D. GUA
19. In separate experiments, an actively photosynthesizing plant was supplied with one of two reactants, carbon dioxide containing radioactive

oxygen, ^{17}O and water containing radioactive oxygen, ^{18}O . In which of the following products of photosynthesis would these isotopes be found?

	^{18}O	^{17}O
A	oxygen produced by chloroplast grana	carbohydrate produced by chloroplast stroma
B	oxygen produced by chloroplast stroma	carbohydrate produced by chloroplast grana
C	carbohydrate produced by chloroplast grana	oxygen produced by chloroplast stroma
D	carbohydrate produced by chloroplast stroma	oxygen produced by chloroplast grana

20. Which of the following is responsible for saltatory conduction in myelinated neurons?

A. Axon membrane
B. Nodes of Ranvier
 C. Schwann cells
 D. Voltage-gated channels

21. Below are causes of variation in a population.

(I) crossing over, and independent assortment during meiosis
 (II) differential environmental conditions
 (III) random mating and fertilization
 (IV) mutation

Which of the following gives rise to genetic variation?

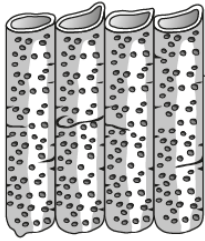
A. (I), (II), (III) and (IV)
 B. (I), (II), and (III)
C. (I), (III) and (IV)
 D. (II), (III) and (IV)

22. A species of finch living on an isolated island shows variation in beak size. Birds with larger beaks can eat larger seeds. After a period of drought on the island, large seeds were more plentiful than small seeds and the average size of the finches' beaks increased.

What explains this increase in size of beak?

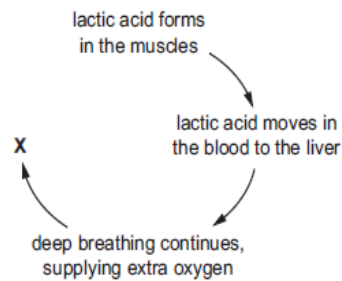
A. Artificial selection against finches with small beaks
B. Directional selection acting against finches with small beaks
 C. Increased rate of mutation resulting in finches with larger beaks
 D. Stabilizing selection acting against finches with smallest and larger beaks

23. What name is given to the plant tissue represented in the figure below?



- A. Xylem vessel**
 B. Tracheid
 C. Sieve tube
 D. Fibre

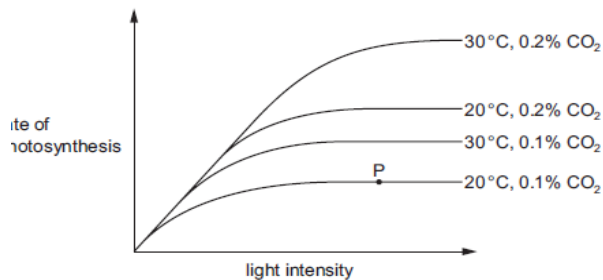
24. After a race, athletes experience oxygen debt. The diagram below shows how the oxygen debt is removed.



Which of the following is the correct description of what happens at X?

- A. Aerobic respiration of glucose
B. Aerobic respiration of lactic acid
 C. Anaerobic respiration of glucose
 D. Anaerobic respiration of lactic acid

25. The graph in the figure below shows the effect of light intensity on rate of photosynthesis at different conditions of temperature and carbon dioxide concentration.



What limits the rate of photosynthesis at point P?

- A. Light intensity, and carbon dioxide concentration.
 B. Light intensity
C. Carbon dioxide concentration and temperature
 D. Temperature

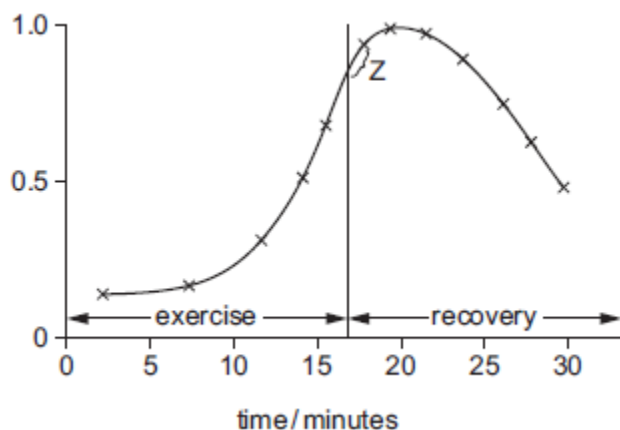
26. *Vibrio cholerae* produces toxins that cause chloride ions to be secreted into the small intestine. Which of the following best describes the changes in the water potential of blood in the intestinal capillaries and the intestinal contents?

- A. Water potentials of blood in the intestinal capillaries and the intestinal contents are lowered.
 B. Water potential of blood in the intestinal capillaries is lowered and that of the intestinal contents raised.

C. Water potential of blood in the intestinal capillaries is raised and that of the intestinal contents lowered.

- D. Water potentials of blood in the intestinal capillaries and the intestinal contents are raised.

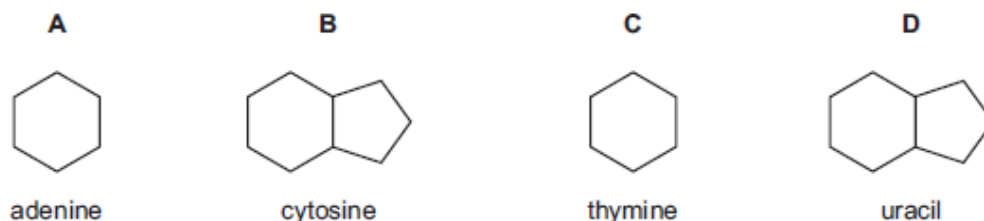
27. The graph in the figure below shows the lactic acid concentration in blood during and after exercise.



The continuation of the which process accounts for the shape of the graph at **Z**?

- A. Deep breathing
- B. High heart rate
- C. High rate of breathing
- D. Movement of lactic acid from muscles**

28. Which diagram shows a correct ring structure and named nucleic acid base?



C

29. What is the correct order in which organelles functions to make and secrete an enzyme?

- A. Nucleolus → ribosome → Golgi body → vesicle
- B. Nucleolus → smooth endoplasmic reticulum → lysosome → vesicle**
- C. Nucleus → rough endoplasmic reticulum → Golgi body → vesicle
- D. Nucleus → smooth endoplasmic reticulum → lysosome → vesicle

30. What maintains the steep concentration gradients needed for successful gas exchange in the lungs?

1. Air flow in the alveoli is in the opposite direction to blood flow in the capillaries

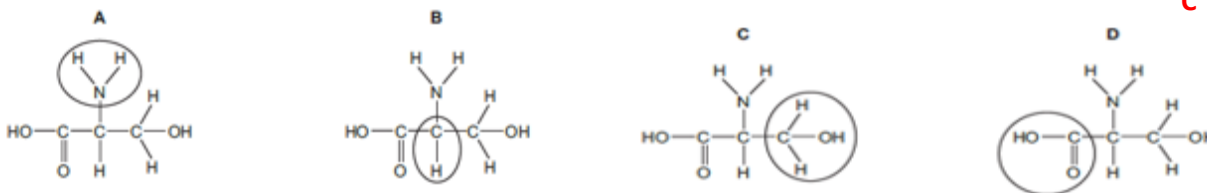
2. Blood arrives in the lungs with a lower oxygen concentration and a higher carbon dioxide concentration than the air in the alveoli
3. Blood is constantly flowing through and out of the lungs bringing fresh supply of red blood cells
- A. 1, 2 and 3
- B. 1 and 2 only
- C. 1 and 3 only
- D. 2 and 3 only**

31. Which row correctly shows the behavior of the nuclear envelope, the centrioles and spindle during a stage of mitosis.

	stage of mitosis	Behaviour of organelles		
		nuclear envelope	centrioles	spindle
A	Prophase	disappears	replicates	spindle microtubules begin to form
B	Metaphase	not present	begins to move to poles of the cell	spindle microtubules fully form
C	Anaphase	begins to form	at opposite poles of the cell	some spindle microtubules shorten
D	Telophase	reforms	one besides each nucleus	spindle microtubules breakdown

32. Which one of the following features make cones to have better visual acuity than rods?
- A. Each cone is connected to a single optic nerve**
- B. Cones are more sensitive to light
- C. Cones are connected to more than one optic nerve
- D. Cones have high retinal convergence
33. Which of these is a sex influenced trait?
- A. Down's syndrome
- B. Colour blindness
- C. Male pattern baldness**
- D. Skin colour

34. Which circled area in the amino acid serine below is different in all other amino acids?



35. Chemiosmotic theory describes how Adenosine triphosphate, ATP is generated from Adenosine diphosphate, ADP. All of the following statements conform to the principles of the theory except...
- A. Protons accumulate in the intermembrane space
 - B. Electrons flowing through the ATP synthetase channel proteins provide energy to phosphorylate ADP to ATP.**
 - C. Voltage gradient is created across the cristae membranes
 - D. pH gradient is created across the cristae membranes
36. Fish oils are thought to have beneficial effects on the conduction of electrical excitation through the ventricle of the heart. What could the fish oils influence?
- A. Atrio-ventricular node
 - B. Purkinje tissue
 - C. Sino atrial node**
 - D. Vagus nerve
37. Even though marsupial mammals give birth to live young, an egg shell forms briefly early in their development. This is evidence that
- A. Marsupials share a common ancestor with some egg laying species**
 - B. Marsupials are not really mammals
 - C. All animals arose from a common ancestor
 - D. Marsupial mammals were separately created by God
38. An individual with the genotypic constitution BBTt could produce the gametes
- A. BB and Tt only
 - B. BT and Bt only**

- C. BB, Tt, Bt and BT only
 D. BBT, BBt, and BTt only
39. Chemiosmotic theory describes how ATP is generated from adenosine diphosphate, ADP in the mitochondria. All of the following statements confirm to the principles of the theory except?
- A. Electrons flowing through the ATP synthase channels provide the energy to phosphorylate adenosine diphosphate to ATP**
- B. Protons accumulate in the area between the membrane of the cristae and the outer membrane of the mitochondria
 C. A voltage gradient is created across cristae membrane
 D. pH gradient is created cristae membrane
40. Which one of the following statements is not true about test cross?
- A. It is carried out on an organism showing a dominant phenotype
 B. The off springs from the cross may all have dominant phenotype
C. The organism of the unknown genotype is crossed with a homozygous dominant individual
 D. The offspring of the cross may have the ration of 1 dominant phenotype: 1 recessive phenotype

SECTION B(60MARKS)

41. (a) Outline an area in plants where a **named** modified parenchyma tissues is found. (02marks)

Mesophyll tissue; ✓ between the upper and lower epidermis of leaf cells; ✓ Endodermis; ✓ around central vascular tissue/ inner most layer of cortex of roots; ✓

Pericycle; ✓ between central vascular tissue and endodermis in roots; ✓ Companion cells; ✓ adjacent to phloem sieve tubes; ✓ Epidermis; ✓ covering the whole primary plant body; ✓ i.e. roots, leaves, stems.

Award 1 mark for correct identity of modified parenchyma tissue and 1 mark for location; site and name of parenchyma tissue tied

(b.) Explain the importance of the collenchyma tissue in leaves and young stems.

(02marks)

Are living; can grow; and stretch; ✓ without imposing limitations on the growth of cells of leaves and young stems; ✓

@ 1mark

(c.) (i) Describe the structural adaptations of the sclerenchyma fibres for their function. (03marks)

Primary cellulose cell walls heavily thickened; ✓ with deposits of lignin; ✓ with great tensile strength; ✓ and compressional strength; ✓ for support; ✓ Ends of fibre cells are tapered; ✓ and interlocked with another; ✓ increasing their combined strength; ✓ @ ½ mark

(ii) Outline **three** structural differences between tracheid and xylem vessel

(03marks)

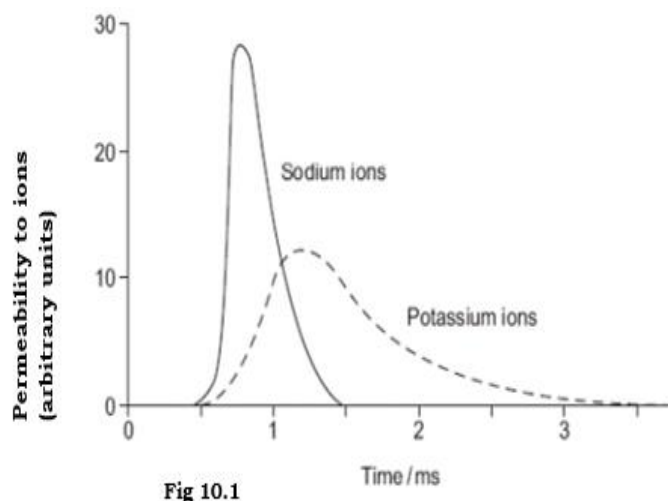
Tracheid		Xylem vessel
Tapering end walls	✓	End walls do not taper
End walls closed usually with perforation	✓	End walls broken down to form continuous tubes
Smaller lumen	✓	Larger lumen
Smaller in diameter	✓	Larger in diameter
Bordered pit with torus	✓	Bordered pits rarely have torus
Polygonal	✓	Circular

Any three, @ 1mark

42. (a). (i) What is an action potential? (02marks)

Is a short lasting effect in which the electrical membrane potential of the cell rapidly rises and falls following a threshold stimulus; ✓✓ OR A localised rapid change in the electrical membrane potential from negative value of -70mV to a positive value of +40mV on initiation of an impulse; ✓✓

(b) During an action potential, the permeability of the cell-surface membrane of an axon changes. The graph in figure below shows changes in permeability of the membrane to sodium ions (Na⁺) and to potassium ions (K⁺) during a single action potential.



(i) Explain the shape of the curve for sodium ions between 0.5ms and 0.7ms. (04marks)

Permeability of the membrane to sodium ions increases rapidly; ✓ to a peak; ✓ because on stimulation of the axon membrane, sodium ion gates open rapidly; ✓ sodium ions diffuse; ✓ into the membrane; ✓ making inside of the axon less negative/more positive/depolarisation occurs; ✓ subsequently causing more and more sodium ion gates to open; ✓ allowing more inward diffusion of sodium ions; ✓ @ ½ mark

(ii) During an action potential, the membrane potential rises to +40Mv and then falls. Using information from the graph, explain the fall in the membrane potential. (02marks)

Potassium ion gates open; ✓ sodium ion gates close; ✓ potassium ions diffuse out of the axon; ✓✓ @ ½ mark

(c). Explain how the resting potential is re-established during exercise. (02marks)

(Three) sodium ions are actively transported/ pumped out of the axon; ✓ while (two) potassium ions are pumped in; ✓

43. (a) Distinguish between **sex limited traits** and **sex influenced traits**. (02marks)

Sex limited traits are characteristics whose phenotypic expressions are limited to only one sex; while sex influenced traits are characteristics whose phenotypic expressions differ in males and females; (Are expressed in both sexes but more frequently in one than the other sex); ✓✓

(b) In maize, there are two alleles for seed shape and two for seed colour. In a breeding experiment, all F1 phenotype produced from a cross between coloured smooth seeds and colourless shrunken seed parents had coloured smooth seeds.

Test crossing F1 plants, gave the following results.

Coloured seeds with smooth kernels **4032**

Colourless seeds with shrunken kernels **4035**

Coloured seeds with shrunken kernels **149**

Colourless seeds with smooth kernels **152**

(i) Account for the appearance and numbers of the phenotypes shown above. Show your working. (06marks)

Higher proportions of coloured smooth and colourless shrunken kernels; ✓ implies these genes are carried on the same chromosome/linked; ✓ thus transmitted together in the same gametes to the offspring; ✓

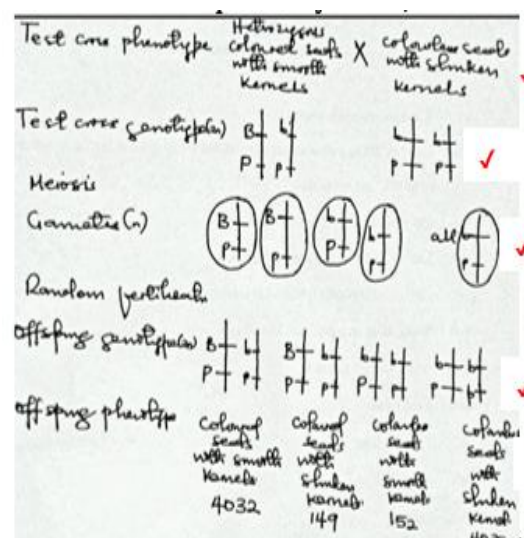
Smaller proportions of coloured shrunken and colourless smooth; ✓ crossing over occurred on the alleles of these genes; ✓ separating these alleles which were previously linked; ✓

Let allele for coloured seeds be B;

Let allele for colourless seeds be b;

Let allele for smooth seeds be P;

Let allele for shrunken seeds be p;

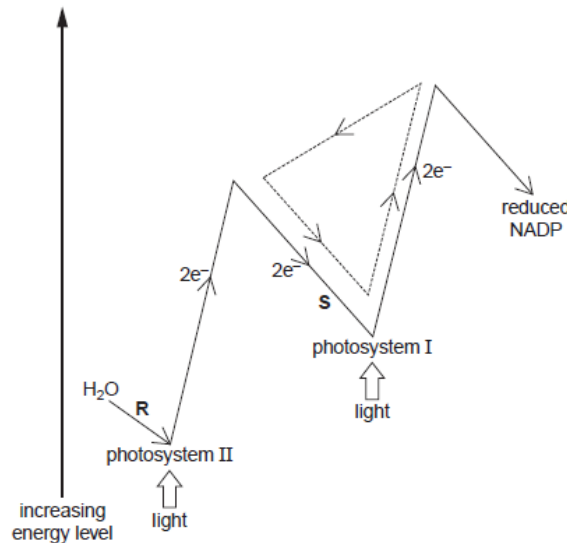


(c). Calculate the recombination frequency.

(02marks)

$$\begin{aligned}\text{Recombination frequency} &= \frac{\text{total number of recombinants}}{\text{total number of offsprings}} \times 100; \checkmark \\ &= \frac{(149+152)}{(4032+4035+149+152)} \times 100; \checkmark \\ &= 3.6 \%; \checkmark\end{aligned}$$

44. Figure below shows the main reactions in the light-dependent stage of photosynthesis.



(a) (i) Where in the chloroplast does the light-dependent reaction take place? (01mark)

Thylakoid membrane of the chloroplast's grana; ✓
Rej Thylakoid alone; grana

(ii) Name the process shown by the dotted arrows.

(01mark)

Cyclic photophosphorylation; ✓

(iii) Describe what happens to water at R? (02marks)

Photolysis of water/water splits; ✓ **into hydrogen ions(protons);** ✓
electrons; ✓ **releasing oxygen gas;** ✓ **in presence of / catalyzed**
by an enzyme; @ ½ mark

(iv) What product is formed as electrons flow along **S**?

(01mark)

Adenosine Triphosphate; ✓

Acc ATP, Rej energy;

(b) Explain briefly the role of reduced NADP in the light-independent stage.

(02marks)

Hydrogen carrier; ✓ providing hydrogen that reduces; ✓ glycerate-3-phosphate to glyceraldehyde-3-phosphate (triose phosphate); ✓ in presence of adenosine triphosphate; ✓ @ ½ mark

(c) How is the chloroplast suited for photosynthesis? (03marks)

Stroma contains necessary enzymes for light independent reactions; ✓

Internal membrane has electron systems that synthesize ATP; ✓ Chlorophyll and carotenoids that trap different wave lengths of light; ✓

Thylakoids that increases surface area for holding chlorophyll molecules in best positions for trapping sunlight; ✓

Permeable surface membrane for exchange of gases; ✓

Stroma contains circular DNA and numerous ribosomes for protein synthesis reducing on importation of the proteins from the cytoplasm; ✓

Double membrane isolates the chloroplast from interference by the processes in the cytoplasm; ✓

Narrow thylakoid space/lumen allow rapid establishment of proton gradient between thylakoid lumen and stroma for chemiosmosis to occur; ✓

DNA to act as genetic material for synthesis of some proteins; ✓

Any three correct adaptations; @ 1mark

45. (a) (i) Distinguish between **water potential** and **solute potential**.

(02marks)

Water potential is the tendency of water molecules to enter or leave a system (solution/cell) by osmosis; Measure of the free kinetic energy of water molecules in a system; while solute potential is the negative component of the water potential of a system due to the presence of solutes; ✓✓

- (ii) Explain why the water potential of plant cells is negative.

(02marks)

**Highest water potential of pure water (distilled water) is 0Kpa; ✓
cell sap in vacuoles of plant cells have solutes; ✓ that attract
water molecules forming hydration shells; ✓ restricting/limiting
free flow of water molecules; ✓ lowering the water potential to a
negative value; ✓**

@ ½ mark

- (b) Describe how the;

- (i) root pressure contributes to the transport of water in plants.

(03marks)

**Active secretion of salts into the xylem by endodermal cells; ✓
lowers the water potential/solute potential of xylem below the
cortex cells; ✓ water is drawn into the xylem by osmosis; ✓ positive
hydrostatic pressure is created in the root that pushes water up
the xylem;**

@ 1mark

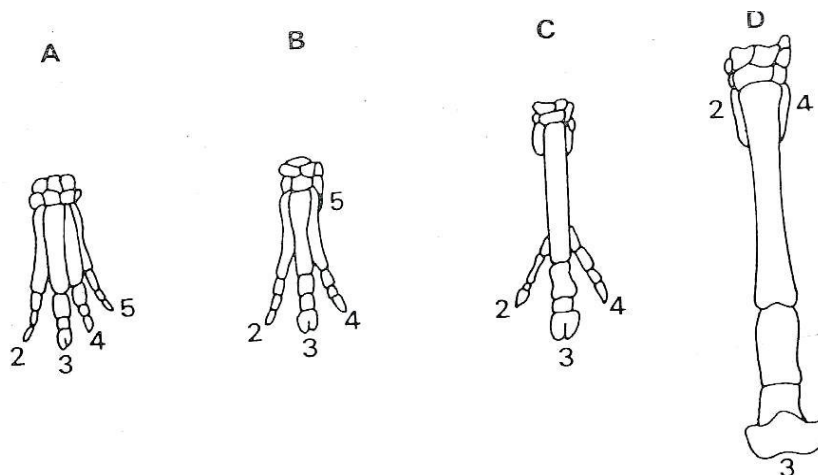
- (ii) structure of the cells of endodermis is adapted for their role of transport of water in a plant.

(03marks)

**Numerous mitochondria providing sufficient energy for active
secretion of salts into the xylem; ✓
Infolding /invagination of the cell wall; increase surface area of
the membrane for transfer of solutes; ✓
Numerous starch grains, whose starch on oxidation provides
energy; ✓
Presence of casparian strip of suberin that control passage of
water into the xylem / prevents water from passing across its
radial and horizontal walls (apoplast pathway), allowing water to
pass to xylem from cortex via symplast pathway; ✓**

Any correct three, @ 1mark

46. Figure below shows the chronological sequence from **A** to **D** of fossils of the fore limb skeletons of four related mammals.



a) State the (i) type of evolution that resulted in the changes shown (01 mark)

Divergent evolution; ✓

(ii) term used to refer to such structures (01 mark)

Homologous structures; ✓

b) Describe briefly the structural changes seen in the fossils sequence. (04 marks)

Loss of the 5th digit; ✓

Reduction of the length of 2nd and 4th digit; ✓

Appearance of a two hoof; ✓

Increase in length; and prominence of the 3rd digit; ✓

c) What were the possible adaptive advantages of these structural changes

(04 marks)

Increased sized of limbs increases their strength for support; ✓

Larger legs raised the body off the ground for better view of their predators; and food; ✓

Larger legs increased leverage for fast running; escaping easily from danger; ✓

Development of a hoof reduced the surface area of the foot in contact with ground for fast running on a hard ground; ✓

Award if (b) is correctly answered.

END