CANDIDATE'S NAME

Proposed marking scheme by Lawrence Arum Bronsted (LAB)
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BIOLOGY (PRINCIPAL)

Paper 1

UACE
July/August
2Hours 30Minutes

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.*

SECTION A (40 MARKS)

1. What is the term that best describes the net movement of uncharged molecules from an area of high concentration to an area of low concentration?
   A. Diffusion
   B. Active transport
   C. Passive transport
   D. Osmosis
2. Which of the following is NOT a characteristic of the plasma membrane?
   A. It is selectively permeable
   B. Cholesterol helps to maintain membrane fluidity at low temperatures
   C. It is composed of phospholipid bilayer
   D. Peripheral proteins enable facilitated diffusion
3. Table below shows the mRNA codons for amino acids.

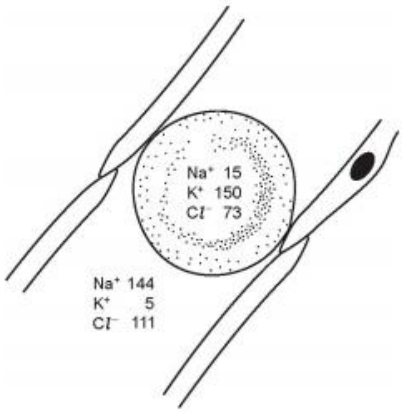
Amino acid	**mRNA codon**
Histidine	CAU
Arginine	CGU
Methionine	AUG
Alanine	GCA

On the basis of the data above, tRNA with the anti-codon GCA will carry….

   A. Histidine
   B. Arginine
   C. Methionine
   D. Alanine
4. A virus consists of a,
   A. Protein coat and a nucleic acid
   B. Protein coat and ribosomes

C. Cell wall and a nucleic acid
D. Cell wall and ribosomes

5. During DNA replication, the two new DNA strands are synthesised from the template strands at the same time. The two new strands are synthesised
   A. in the same direction
   B. in the opposite direction
   C. by RNA polymerase
   D. by DNA helicase
6. Energy can be stored in the body in different ways. Glucose and glycogen yield approximately 17KJ of energy per gram while lipids yield 37KJ per gram. If the average person has stored 5g of free glucose in their blood, 480g total glycogen in their muscles and liver, 15Kg of lipids in their adipose tissue and has a daily energy requirement of 8700KJ per day.
   Approximately how many days could they theoretically survive under starvation?
   A. 65 days
   B. 35 days
   C. 55 days
   D. 45 days
7. What is the primary function of large leaves found on seedlings growing on the forest floor?
   A. Provision of shade for their root systems
   B. Elimination of excess water that is entering via the roots
   C. To allow for leaf damage by insects
   D. Acquisition of as much sun light as possible for photosynthesis
8. If a length of DNA comprises of 10000 nucleotides of which 26% is adenine, what is the predicted number of cytosine bases?
   A. 48
   B. 4800
   C. 2400
   D. 1200
9. The diagram shows a red blood cell and the concentration of ions in $mmoldm^{-3}$, in plasma and out of cell.



Which ions are actively transported into and out of the cell respectively?

A. Cl^- and K^+

B. K^+ and Na^+

C. Na^+ and Cl^-

D. Na^+ and K^+

10. A sample of leg muscle from an Olympic 100 metre sprinter was analyzed. Which of the following is most likely to indicate the results of the analysis?

	Most common muscle fibre type	**Mitochondria per cell**
A	Fast-twitch	2000
B	Slow-twitch	2000
C	***Fast-twitch***	***500***
D	Slow-twitch	500

11. Atheroma can rupture, damaging the endothelium of an artery and triggering the following.

(i) A thrombus forms

(ii) Clotting factors are released

(iii) Fibrinogen is converted into fibrin

(iv) Prothrombin is converted into thrombin

Which of the following sequences shows the correct order in which these events occur?

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

B. (ii), (iv), (iii), (i)

C. (ii), (iii), (iv), (i)

D. (i), (ii), (iv), (iii)

12. At which stage in the cell cycle will a lack of availability of extracellular growth factors result in cells entering the Go phase?

A. M

B. G_1

C. G_2

D. S

13. Which of the following statements correctly describes the role of calcium ions during skeletal muscle contraction?

A. Binding of calcium ions to myosin heads repels tropomyosin, exposing myosin heads for cross-bridge formation

B. Binding of calcium ions to myosin heads repels troponin, exposing myosin heads for cross-bridge formation

C. Binding of a calcium ion to troponin causes attached tropomyosin to be pulled away from the myosin binding site

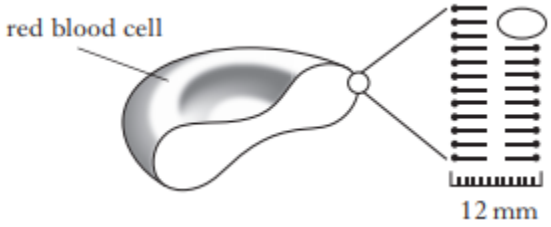
D. Binding of a calcium ion to tropomyosin causes a change in shape of the attached troponin, exposing myosin heads

14. Which is the correct statement concerning the light-dependent stage of photosynthesis in a C3 plant?
    A. Cyclic photophosphorylation involves the emission of excited electrons from photosystem 2
    B. In non-cyclic photophosphorylation, hydrogen ions are pumped into the stroma
    C. Photolysis of water must occur before ATP synthesis by chemiosmosis can proceed
    D. ***The production of reduced NADP is always coupled with the production of oxygen***.
15. Which of the following explains why cell membranes are described as having a 'fluid mosaic' structure?
    A. Different types of membranes have different sets of proteins, each with a specific pattern
    B. Phospholipids diffuse within their own monolayer, with many of the proteins also moving around
    C. The fluidity of membrane changes as temperature changes, with cholesterol molecules maintaining stability
    D. There are different kinds of transport protein scattered within the phospholipid bilayer, allowing facilitated diffusion and active transport
16. Different types of reactions occur in the sequence of chemical reactions known as the Calvin cycle. Which reactions of the Calvin cycle is correctly described?
    A. Carboxylation occurs in the conversion of triose phosphate to RUBP
    B. Decarboxylation occurs in the conversion of RUBP to GP
    C. Phosphorylation occurs in the conversion of RUBP to GP
    D. Reduction occurs in the conversion of GP to triose phosphate
17. Which feature shows that a substance is transported by facilitated diffusion rather than active transport?
    A. Respiratory inhibitors affect the rate of transport
    B. The substance is transported against the concentration gradient
    C. The transport protein involved has a specific binding site for the substance
    D. Transport across the membrane uses a membrane channel protein
18. Which of the following characteristics indicate that an organism is a prokaryote?
    (i) 80s ribosomes free in the cytoplasm
    (ii) Cell walls made of chitin
    (iii) Reproduces asexually by mitosis
    (iv) No Golgi apparatus
    A. (iv) only
    B. (i) and (ii) only
    C. (i) and (iii) only
    D. (iii) and (iv) only
19. Huntington's chorea is caused by a single dominant gene which is not sex linked. A woman's father is heterozygous for this condition and her mother is unaffected.

What are the chances this woman has the inherited condition?

A. 75%
B. 67%
C. 50%
D. 25%

20. The diagram below represents part of the plasma membrane of a red blood cell.



The membrane is shown magnified 2 million times. What is the width of the membrane? (1nm= 1×10^{-6}mm)

A. 0.6nm
B. 6nm
C. 24nm
D. 60nm

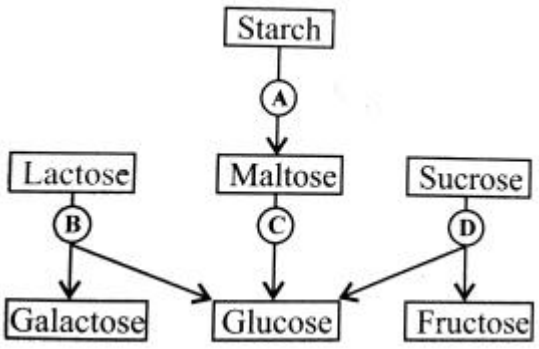
21. What is the similarity between gymnosperms and angiosperms?

A. Phloem of both have companion cells
B. Endosperm is formed before fertilization in both
C. Origin of ovule and seed is similar in both
D. Both have leaves, stem and roots

22. Which one of the following is the major constituent of proteins, nucleic acids, vitamins and hormones?

A. Phosphorus
B. Nitrogen
C. Potassium
D. Sulphur

23. Diagram shows the fate of carbohydrates during digestion in the human alimentary canal.



What is the correct identity of enzymes acting at stages indicated A, B, C and D?

A. A=Amylase, B=Maltase, C=Lactase, D=Invertase
B. A=Amylase, B=maltase, C=Invertase, D=Lactase
C. A=Amylase, B=Invertase, C=Maltase, D= Lactase
D. A=Amylase, B=Lactase, C=Maltase, D= Invertase

24. A bacterium divides every 35minutes. If a culture containing 10^5 cells/ml is grown for 175minutes. What will be the cell concentration/ml after 175minutes?
A. 5×10^5
B. 35×10^5
C. 32×10^5
D. 175×10^5

25. Which of the following is true of a turgid plant cell?
A. Water potential is equal to solute potential
B. Pressure potential is greater than solute potential
C. Pressure potential is equal to solute potential
D. Pressure potential is less than solute potential

26. The correct sequence of cell organelles during photorespiration is….
A. Chloroplast ⟶ Golgi apparatus ⟶ Mitochondria
B. Chloroplast ⟶ Rough endoplasmic reticulum ⟶ Dictyosomes
C. Chloroplast ⟶ Peroxisomes ⟶ Mitochondria
D. Chloroplast ⟶ Vacuole ⟶ Peroxisomes

27. The presence of diversity at the junction of territories of two different habitats is known as….
A. Bottle neck effect
B. Edge effect
C. Junction effect
D. Pasteur effect

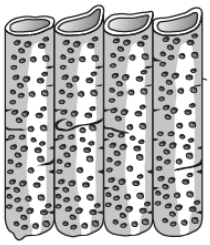
28. Which of the following enzymes catalyse the breaking of hydrogen bonds between bases during transcription?
A. RNA ligase
B. DNA dependent RNA polymerase
C. DNA helicase
D. DNA polymerase

29. The most abundant cartilage at the extremities of long bones is…
A. calcified cartilage
B. fibrous cartilage
C. elastic cartilage
D. hyaline cartilage

30. Which of the following terms describes lack of relaxation between successive stimuli in striated muscle contraction?
A. Fatigue
B. Tetanus
C. Tonus

D. Spasm

31. What name is given to the plant cell represented in the figure below.

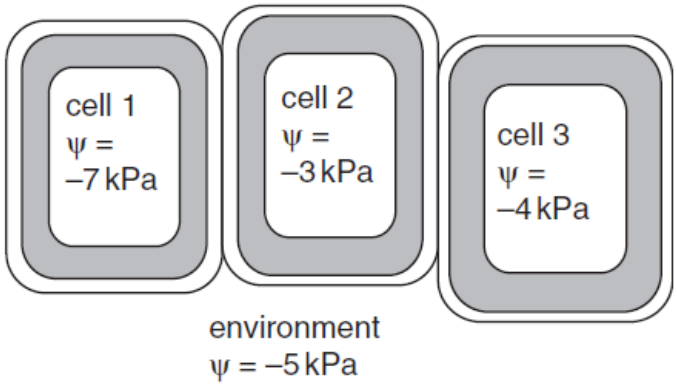


A. Xylem vessel
B. Tracheid
C. Sieve tube
D. Fibre

32. 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 synthesise proteins

33. Which of the following statements explains why two species **cannot** permanently occupy the same ecological niche?
    A. The two species could not interbreed
    B. The two species may be part of separate food web
    C. The two species would compete for the same resources
    D. The two species would have different nutritional requirements

34. 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.
    A. All three cells are turgid, so no water moves
    B. 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
    D. Water moves from the environment into cells 1, 2 and 3.

35. A protease is added to a cloudy suspension of protein in a test tube and kept in a water bath at 37℃ for eight minutes. After eight minutes, the suspension changes from cloudy to transparent. Which product or products, will now be present in the test tube?
    A. Amino acids
    B. Fatty acids

C. Glycerol
D. Simple sugars

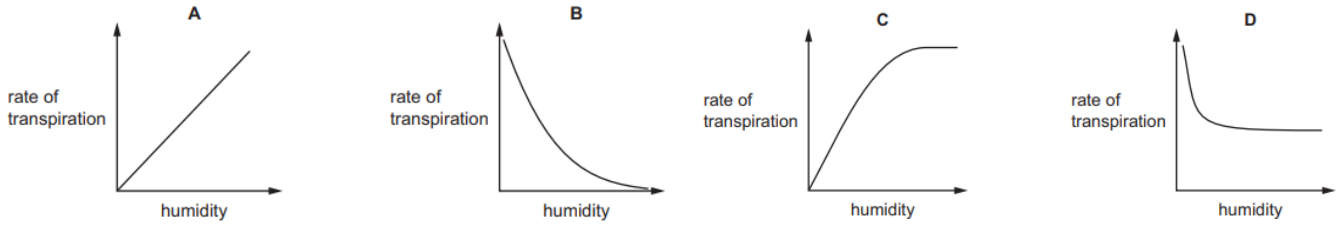
36. An electron micrograph of a cell shows large quantities of rough endoplasmic reticulum and many Golgi bodies. What type of cell is being viewed?
A. Bacterium
B. Guard cell
C. Lymphocyte
D. Mesophyll

37. Colchicine, an alkaloid chemical stops chromatids from separating during mitosis. Which stage of mitosis will a cell reach but stop when treated with colchicine?
A. Anaphase
B. Metaphase
C. Prophase
D. Telophase

38. Which of the following statements correctly describes endocytosis?
(i) It is part of phagocytosis
(ii) It is a passive process
(iii) Materials are taken into the cell
(iv) Vesicles form within the cytoplasm
A. (i), (ii) and (iii) only
B. (i), (ii) and (iv) only
C. (iii) and (iv) only
D. (ii), (iii) and (iv) only

39. Which diagram represents the effect of atmospheric humidity on the rate of transpiration?

B

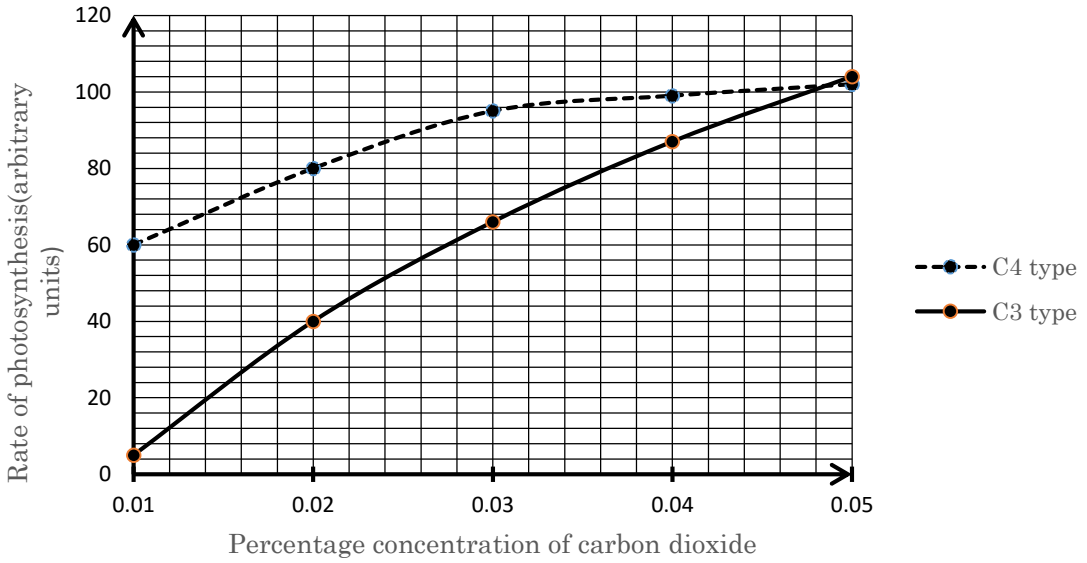


40. What occurs when active immunity is artificially induced?
A. Non-self antibodies attack self antigens
B. Non-self antigens attack self antibodies
C. Self antibodies attack non-self antigens
D. Self antigens attack non-self antibodies

SECTION B (60 MARKS)

Write answers in the spaces provided

41. An experiment was carried out in which a group of two distinct types of grass species, *Alloteropsis semialata* with different photosynthetic pathways was exposed to high intensity artificial sun light and a temperature of 30℃, at different carbon dioxide concentrations. All other factors are kept constant. The rate of photosynthesis (per unit area of leaf) was measured over 30-minute period.
Results are shown on the graph in the figure below.



(a) Describe variation in the rate of photosynthesis of C4 type with carbon dioxide concentration. **(02 marks)**

From 0.01% to 0.03% carbon dioxide concentration, rate of photosynthesis increases rapidly; ✓
From 0.03% to 0.05% carbon dioxide concentration, rate of photosynthesis increases gradually/slowly; ✓

(b) Compare the variation in rate of photosynthesis for the C3 and C4 types of *A. semialata* species. **(05 marks)**

Similarities
In both, rate of photosynthesis increases rapidly from 0.01% to 0.03% carbon dioxide concentration; ✓
Both have same rate of photosynthesis at 0.049% carbon dioxide concentration; ✓
In both, rate of photosynthesis increases with increase in carbon dioxide concentration; ✓ ***Any two @ 1mark***

Differences
Rate of photosynthesis for C4 type is higher than for C3 type from 0.01% to 0.049% carbon dioxide concentration; ✓

Rate of photosynthesis for C4 type is lower than for C3 type from 0.049% to 0.05% carbon dioxide concentration;✓
Rate of photosynthesis for C3 type increases rapidly while that of C4 type increases gradually from 0.03% to 0.05% carbon dioxide concentration;✓
@ 1 mark

(c) Explain the differences between the rates of photosynthesis for the C3 and C4 types of *A. semialata*. **(03 marks)**

At lower carbon dioxide concentration, rate of photosynthesis for C4 type is higher than that of C3 type;✓carbon dioxide fixing enzyme, PEP carboxylase of C4 type has a higher affinity for carbon dioxide than RuBP carboxylase of C3 type;✓and does not combine with oxygen;✓thus photorespiration does not occur;✓
***At higher carbon dioxide concentration, rate of photosynthesis for C3 type increases rapidly while for C4 type increases gradually/remains almost constant;✓because in C3 type, carbon dioxide outcompetes oxygen for active site of RUBP carboxylase-oxygenase;✓thus no photorespiration;✓and in C4 type, other factors other than carbon dioxide concentration limits the photosynthetic rate*;✓**
@ ½ mark
Max 03 marks

42. The genetic code contains punctuation codons to mark the start and end of synthesis of polypeptide chains on ribosomes.

(a) State the codes for the;

(i) Start codon. **(½mark)**

AUG;✓

(ii) Stop codons. **(1½ marks)**

UAG;✓ UAA;✓ UGA;✓ ***@ ½ mark***

(b) Briefly outline the process of the formation of mRNA from DNA. **(03marks)**

Double helix unwinds/uncoils

Award for the first two @ 1 mark

(d) Explain the role of mRNA in protein synthesis. **(02marks)**

Transfers the encoded information in DNA to the ribosomes in the cytoplasm;✓ owing to its smaller size than DNA that could not pass through the tiny nuclear pore;✓
Involvement of mRNA as a mediator allows synthesis of only the required proteins/consists of triplet codes/codons on which sequence of amino acids to build specific polypeptide will be based;✓✓
@ 1 mark

(e) What is the fate of the proteins made in a cell? **(01mark)**

Used in formation of hormones;✓ enzymes;✓ and structures of membranes;✓
@ ½ mark

43. (a) State **two** structural features of protoctists that are;

(i) Absent in bacteria. **(02 marks)**

True nucleus; ✓
Membrane bound organelles such as mitochondria; ✓
Cell walls when present are made up of cellulose not peptidoglycan;✓
Often have cilia e.g. the protozoans;✓
Award for any first two @ 1 mark

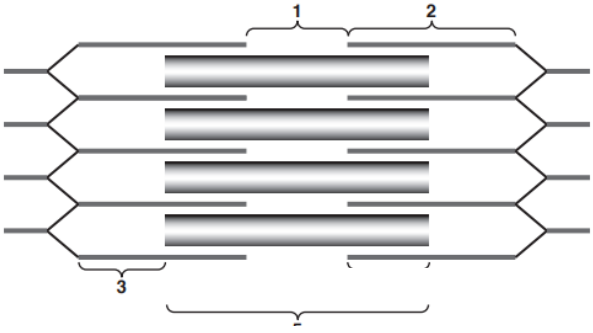
(ii) Absent in fungi. **(02 marks)**

Cell walls when present are made of cellulose not chitin;✓
Often have flagella or cilia;✓
Some have chloroplasts e.g. photosynthetic protoctists;✓
Award for any first two @ 1 mark

(b) Explain the ecological importance of protoctists in nature. **(06 marks)**

Photosynthetic protoctists such as algae photosynthesize/act as producers;✓ providing nourishment/food for a range of organisms in food chains;✓ and oxygen released for other aerobic organisms;✓
Decay/decompose dead organisms;✓ recycling nutrients;✓
Form symbiotic relationship with termites e.g. flagellated protozoa in the gut;✓ digests cellulose in wood, releasing nutrients for the benefit of the termite;✓
@ 1 mark

44. Diagram below represents one complete sarcomere of a striated muscle during muscle relaxation.



(a) Name the

(i) Parts labeled **1-4**. **(02 marks)**

1. ***H zone;***✓
2. ***Actin filament length;***✓
3. ***Isotropic band/I- band;***✓
4. ***Anisotropic band/ A- band;***✓ ***@ ½ mark***

(ii) Proteins that make up part labeled **3**. **(1½ marks)**

Actin;✓ ***Troponin;***✓***Tropomyosin***;✓ ***@ ½ mark***

(b) Complete the table by placing a tick (✓) in the appropriate box for the changes that will occur in the different parts of the sarcomere in (a) when the muscle contracts.

Region of sarcomere	**Change occurring during muscle contraction**		
	Increases	**Decreases**	**Stays the same**
1		✓	
2			✓
3		✓	
4			✓

Award only when a(i) is correctly labeled.

(c) Explain how prolonged strenuous exercise results in a reduction in the force of contraction of a skeletal muscle. **(4½ marks)**

Oxygen supply by ventilation and gaseous exchange is not sufficient enough to meet energy demands;✓ ***skeletal muscle resorts to anaerobic respiration;***✓ ***lactic acid accumulates;***✓ ***which on dissociation, high concentrations of hydrogen ions are produced/low pH/acidosis;***✓ ***decreasing release of calcium ions by sarcoplasmic reticulum;***✓***less binding of calcium ions to troponin/decreased sensitivity of troponin to calcium ions;***✓ ***less/no conformational change in tropomyosin occurs;***✓ ***binding sites on actin filaments not exposed;***✓ ***no binding of myosin head onto actin filaments;***✓***interfering with cross –bridge formation and cycling;***✓ ***@ ½ mark***

45. (a) Structurally distinguish between a

(i) **Hyaline cartilage** and **elastic cartilage**. **(02 marks)**

- ***Matrix of hyaline cartilage is semi-transparent/glassy while that of elastic cartilage is semi-opaque;*** ✓
- ***Hyaline cartilage is less elastic and flexible while elastic cartilage is more elastic and flexible;*** ✓
- ***Hyaline cartilage consists of only collagen fibres while elastic cartilage consists of both collagen fibres and elastic fibres (heavily laden with elastic fibres);***✓
- ***Matrix of hyaline cartilage consists of smaller sized chondrocytes while that of elastic cartilage consists of larger sized chondrocytes;***✓

Award for any two @ 1 mark;
Acc Hyaline consists of few fibres while elastic cartilage consists of more fibres;

(ii) **Bone** and **cartilage.** **(03marks)**

- ***Bone organic matrix is osteoid while that of cartilage is chondrin;***✓
- ***Bone is surrounded by periosteum while cartilage is surrounded by perichondrium;***✓
- ***Bone matrix contains Haversian canal while cartilage matrix does not;***✓
- ***Bone matrix contains inorganic material while cartilage matrix lacks;*** ✓
- ***Bone has blood vessels and nerves (vascular and neural) while cartilage does not (avascular and aneural);***✓
- ***Bone cells are osteocytes while cartilage cells are chondrocytes;***✓
- ***Bone matrix contains protein, ossein while cartilage matrix contains core protein, aggrecan;***✓
- ***In bone, osteoblasts are arranged in concentric layers while in cartilage, chondroblasts are randomly distributed in the matrix;***✓
- ***In bone, lacunae have canaliculi while in cartilage lacunae lack canaliculi;***✓
  Award for any three differences @ 1mark

(iii) **Neutrophils** and **Basophils.** **(01mark)**

- ***Neutrophils have irregularly lobed nucleus while Basophils have s-shaped nucleus;***✓
- ***Neutrophils have smaller dimeter while Basophils have larger diameter;***✓
  Any one @ 1 mark

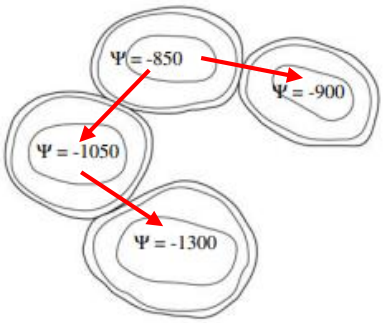
(b) Outline **four** roles of bones in the human body. **(04 marks)**

- ***Framework of support e.g. backbone;***✓
- ***Protection of vital organs e.g. by the skull;***✓
- ***Site of blood cell production in the marrow;***✓
- ***System of levers for locomotion;***✓
- ***Storage site of minerals/metabolic function; thus release calcium ions and phosphate ions into blood when their blood levels fall;***✓
  Award for any first four @ 1 mark

46. (a) Distinguish between **water potential** and **solute potential**. **(02 marks)**

Water potential is the tendency of water molecules to enter or leave a system by osmosis; while solute potential is the measure of the change in the water potential of a system due to the presence of solutes;✓✓ **@ 1 mark**

(b) Figure below shows the water potential (Kpa) of four neighboring spongy mesophyll cells from the leaf of a daffodil plant.



(i) Draw arrows on the figure to show the net flow of water between the cells.

(ii) Explain why the net flow of water in the cells is as you have indicated in (i). **(03 marks)**

Water moves from a region of higher water potential to a region of lower water potential;✓***water moves from cell with higher water potential, -850kpa to adjacent cells with lower water potentials, -900 and -1050kpa;***✓***and moves from cell with higher water potential, -1050kpa to one with lower water potential, -1300kpa;***✓ ***@ 1 mark***

(c) Explain why the water potentials of plant cells above are negative. **(3½ marks)**

Highest water potential value of pure water is 0kpa;✓plant cells have vacuoles with cell sap;✓containing solutes ;✓which attract water molecules;✓restricting their free flow;✓lowering the water potential to a negative value; ✓ ***@ ½ mark***

END

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