CANDIDATE'S NAME

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BIOLOGY (PRINCIPAL)

Paper 1

UACE
April/ May
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. Which of the following would cause an increase in capillary hydrostatic pressure?
A. Hypotension
B. Increased fluid volume
C. Decreased fluid volume
D. Increased diameter of the capillary

2. Without functioning parietal cells, which of the following would you expect for an individual?
A. Not to be able to initiate protein digestion in the stomach
B. Not to be able to initiate mechanical digestion in the stomach
C. Only to be able to digest fats in the stomach
D. Not to be able to produce pepsinogen

3. If a length of DNA comprises 10000 nucleotides of which 26% is adenine, what is the predicted number of cytosine bases?
A. 1200
B. 600
C. 4800
D. 2400

4. Which one of the following statements cannot be connected to predation?
A. It might lead to extinction of a species
B. Both interacting species are negatively impacted
C. It is necessitated by nature to maintain the ecological balance
D. It helps in maintaining species diversity in a community

5. Exoskeleton of arthropods is composed of:
A. Cellulose
B. Chitin
C. Glucosamine
D. Cutin

Turn Over

6. Which of the following occurs due to the presence of autosome linked dominant trait?

A. Myotonic dystrophy

B. Haemophilia

C. Thalassemia

D. Sickle cell anaemia

7. In a certain species of rat, fur colour is controlled by a single gene. Two alleles for this gene, black fur allele and white fur allele show incomplete dominance. This species of rat would most likely have?

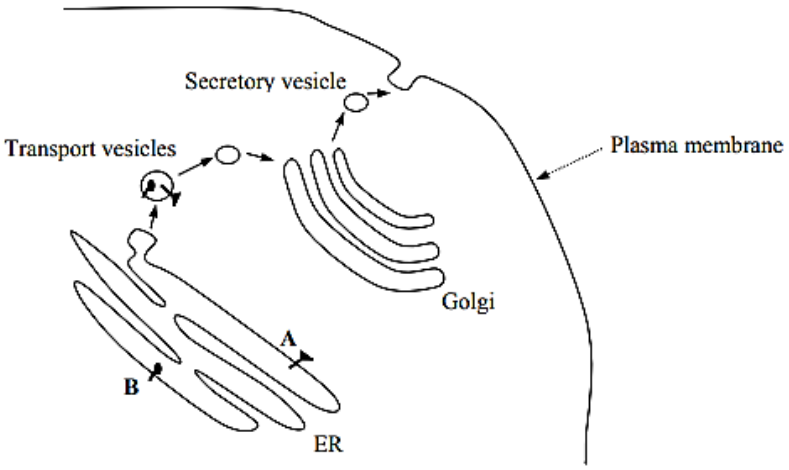
A. Only black fur

B. Only white fur

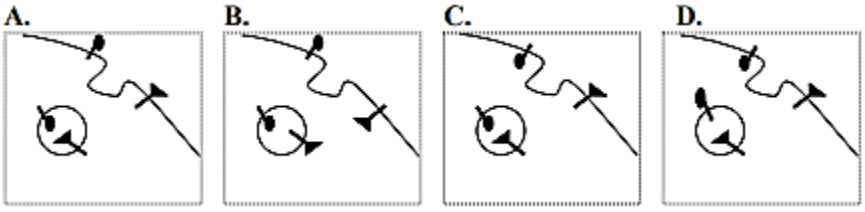
C. Two possible genotypes for fur colour

D. Three possible phenotypes for fur colour

8. Below is a diagram of a secretory pathway from the endoplasmic reticulum(ER), through the Golgi apparatus, to the plasma membrane.



Which of the following diagrams correctly represents the orientations of proteins A and B upon reaching the secretory vesicle and the plasma membrane?



B

9. What is the role of the large bundle sheath cells found around the vascular bundles in C4 plants?

A. To increase the number of chloroplasts for operation of Calvin cycle

B. To enable the plant to tolerate high temperature

C. To protect the vascular tissue from high light intensity

D. To provide the site for photorespiratory pathway.

10. Which of the following is NOT a connective tissue?

A. Adipose tissue

B. Cartilage

C. Neuroglia

Turn Over

D. Blood

11. Natural selection where more individuals acquire specific character value other than the mean character value, leads to;

A. Directional change

B. Disruptive change

C. Random change

D. Stabilizing change

12. What is the net gain of ATP when each molecule of glucose is converted to two molecules of pyruvic acid?

A. 6

B. 2

C. 8

D. 4

13. Which of the following statements is correct during a cardiac cycle?

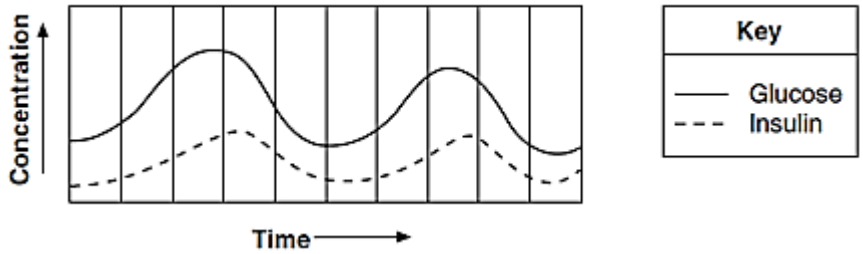
A. The tricuspid and bicuspid valves close due to the pressure exerted by the simultaneous contraction of atria

B. Blood moves freely from atria to the ventricles during joint diastole

C. Increased ventricular pressure causes closing of semilunar valves

D. The atrio-ventricular node generates action potential to stimulate atrial contraction.

14. The diagram below represents levels of glucose and insulin within the bloodstream of a healthy person throughout the course of the day.



The increase in insulin levels following an increase in glucose levels in the blood can best be explained by?

A. Insulin being released into the blood to digest glucose

B. A feedback mechanism that regulates blood glucose level

C. An excess of glucose-stimulating cells

D. A response of the immune system to lower excess blood glucose levels

15. Which of the following best explains why there are seldom more than five trophic levels in a food chain?

A. Most carnivores function at more than one trophic level

B. Top carnivores are too few to prey effectively

C. Ecosystem contains too much biomass

D. Energy is lost from each trophic level

16. The QRS complex in a standard electrocardiogram represents;

A. Depolarization of auricles

B. Repolarization of auricles

Turn Over

C. Depolarization of ventricles

D. Repolarization of ventricles

17. Which of the following genetic disorders is caused by the presence of an additional copy of X-chromosome resulting into XXY genotype?

A. Down's syndrome

B. Klinefelter's syndrome

C. Turner's syndrome

D. Haemophilia

18. During DNA replication, the synthesis of one strand is discontinuous because...

A. DNA molecule being synthesised is very long and only one strand needs to be synthesised continuously

B. DNA dependent DNA polymerase catalyses polymerization only in '5 ⟶ 3' direction

C. It is a more efficient process

D. RNA dependent DNA polymerase catalyses polymerization only in '5 ⟶ 3' direction

19. When tissue is damaged, mast cells release histamine which immediately results in;

A. An accumulation of phagocytes

B. Increased delivery of antimicrobial proteins and clotting factors

C. Increased localized blood vessel dilation and capillary permeability

D. Stimulation of a specific immune response by activating lymphocytes

20. Which of the following provides a correct sequence of events in origin of species according to Darwinism?

(i) Natural selection

(ii) Variations and their inheritance

(iii) Survival of the fittest

(iv) Struggle for existence

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

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

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

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

21. Which of the following layers of the ovum undergoes changes to prevent polyspermy when sperm contacts with it?

A. Corona radiate

B. Plasma membrane

C. Zona pellucida

D. Tunica albuginea

22. A 40g serving of a breakfast cereal contains 2mg of iron. Only 25% of this iron is absorbed into the bloodstream. If a pregnant woman requires a daily uptake of 6mg of iron, how much cereal would she have to eat to meet this requirement?

A. 60g

B. 120g

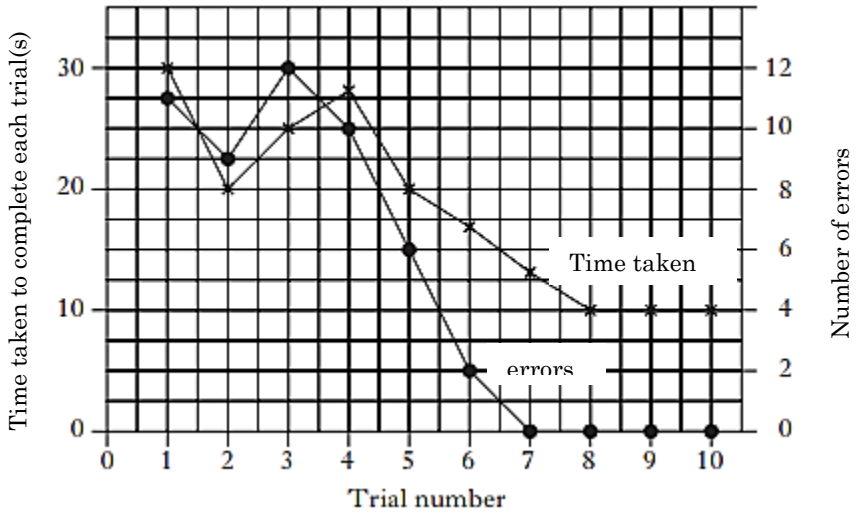
C. 240g

D. 480g

23. During a competition, a trained athlete can increase his cardiac output by 7times. If the athlete has a resting heart rate of 60beats/min and a resting stroke of 70cm^3/beat, his maximum cardiac output is?

A. 8.2 cm^3/min
B. 4200 cm^3/min
C. 29400 cm^3/min
D. 36000 cm^3/min

24. The graph below shows the time taken by a student to complete a finger maze, over a number of trials, and the number of errors at each trial.



Which of the following statements is correct?

A. The fastest time to complete the maze correctly is 4seconds
B. The time taken at trial 5 is 20seconds
C. The number of errors increased with each subsequent trial
D. The number of errors decreased with each subsequent trial.

25. In a lipid bilayer, the lipids have their;

A. Water repelling tails facing inwards
B. Water repelling heads facing inwards
C. Hydrogen bond forming heads facing inwards
D. Hydrogen bond forming tails facing inwards

26. Mutations that impact evolution must occur in,

A. the fossil record
B. somatic cells
C. sperm cells
D. germ-line cells

27. Which one of the following ways has seed formation greatly improved plants' adaptation to land?

A. Enabling offsprings to disperse further away from the parent plant.
B. Allowing survival during adverse conditions
C. Providing nourishment following germination
D. All the above

Turn Over

28. Which of the following stages of meiosis involves division of centromeres?

A. Metaphase I
B. Metaphase II
C. Anaphase II
D. Telophase II

29. The first stable product of carbon dioxide fixation in sorghum is….

A. Pyruvic acid
B. Oxaloacetic acid
C. Succinic acid
D. Phosphoglyceric acid

30. Inspite of interspecific competition in nature, which mechanism the competing species might have evolved for their survival?

A. Competitive release
B. Mutualism
C. Resource partitioning
D. Predation

31. Young goslings soon after birth are seen to follow and move around the first object they see. This behavior can best be described as,

A. Trial and error learning
B. Associative learning
C. Insight learning
D. Imprinting

32. Which of the following behavioral or physiological adaptations increase the survival of kangaroo rats in desert habitats?

A. Frequent drinking
B. Frequent urination
C. Nephrons with long loops of Henle
D. Nephrons with short loops of Henle

33. A body plan with radial symmetry is found in which of the following groups of organisms?

A. Hydrozoans and jelly fish
B. Flat worms
C. Sponges
D. Round worms

34. Which feature of the human gas exchange system helps to maintain a steep diffusion gradient?

A. Numerous alveoli in the lungs
B. Well ventilation
C. Endothelium of capillary wall is made up of flattened cells
D. Alveoli wall contains elastic fibres allowing expansion

35. Which organelle is present in large quantities in ciliated epithelial cells?

A. Golgi body
B. Lysosomes
C. Mitochondria

Turn Over

D. Rough endoplasmic reticulum

36. Which one of the following describes the induced fit mode of action of an enzyme?

A. Binding of a substrate to the active site causes the enzyme to change shape

B. Substrate and active site have complementary shapes that form temporary bonds

C. Substrate causes a change in enzyme shape so the active site can bind

D. Substrate changes shape so it can bind to active site

37. Which of the following pairs of organelles does not contain DNA?

A. Mitochondria and lysosomes

B. Chloroplasts and vacuoles

C. Lysosomes and vacuoles

D. Nuclear envelope and mitochondria

38. Conversion of glucose to glucose-6-phosphate, the reversible reaction of glycolysis is catalyzed by;

A. Aldolase

B. Hexokinase

C. Enolase

D. Phosphofructokinase

39. In some plants, the female gamete develops into embryo without fertilisation. This phenomenon is known as;

A. Autogamy

B. Parthenocarpy

C. Syngamy

D. Parthenogenesis

40. Which part of the brain is responsible for thermoregulation?

A. Cerebrum

B. Hypothalamus

C. Corpus callosum

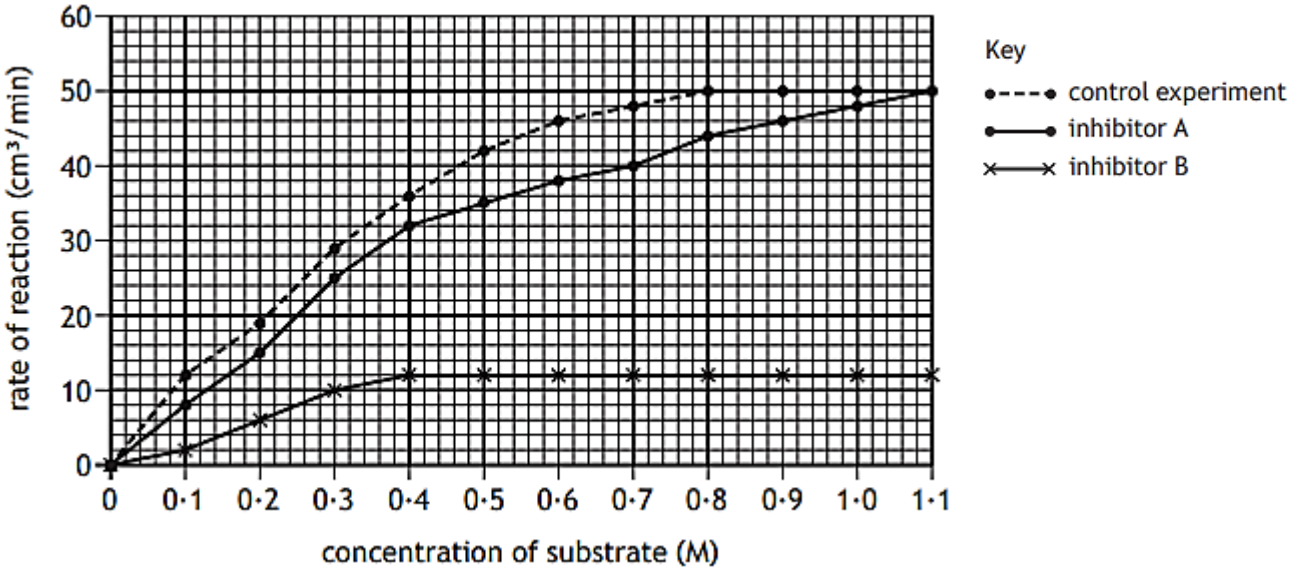
D. Medulla oblongata

Turn Over

SECTION B (60 MARKS)

Write answers in the spaces provided.

41. The graph in the figure below shows the results of an investigation into the effect of two different inhibitors on an enzyme-controlled reaction over a range of substrate concentrations.



(a) Using information in the figure, state the type of inhibitor, **A** and **B**, giving a reason for your answer. (*03 marks*)

Inhibitor A:

Competitive inhibitor /active-site directed inhibitor; ✓increasing the substrate concentration decreases the inhibition / increases the rate of reaction; ✓✓

Inhibitor B:

***Non-competitive inhibitor / non active-site directed inhibitor; ✓increasing the substrate concentration does not reverse the inhibition* / have no effect on the rate of reaction; ✓✓**

Acc. does not increase the rate of reaction. ***@ ½ mark***

(b) Explain the difference in the rates of reaction between the control experiment and in presence of inhibitor **A**. (*04 marks)*

Rate of reaction in presence of inhibitor A is lower than in control experiment;✓ because inhibitor A molecules with <u>similar structure/shape</u> to those of substrate molecules;✓fit into active site of enzyme;✓preventing substrate molecules from fitting; ✓no enzyme-substrate complex formed;✓decreasing reaction rate;
@ 1 mark max 4

(c) Suggest why antibiotic drugs with similar properties to inhibitor **A** are often used to combat bacterial infections. (*03 marks*)

Antibiotic drugs with similar structure/shape to substrate molecules;✓fit into active site of bacterial enzymes essential for bacterial metabolism/synthesis of cell walls and folic acid;✓inhibiting bacterial reproduction and growth in the host's body;✓ @ 1 mark

Turn Over

42. (a) State **two**

(i) similarities between binary fission and mitosis. (*02 marks*)

Both produce genetically identical cells/ mechanisms of asexual reproduction; ✓
Both produce two (daughter) cells; ✓
Both involve division of cells; ✓
Both involve DNA replication, segregation of genetic material and cytokinesis/division of cytoplasm;✓
Any first two correct @ 1 mark; Penalize for any additional wrong answer.

(ii) differences between binary fission and mitosis. (*02 marks*)

Binary fission occurs in prokaryotic cells while mitosis occurs in eukaryotic cells;✓
Binary fission is faster/involves fewer stages while mitosis is slower/involves many stages; ✓
No spindle fibre formation in binary fission while mitosis involves formation of spindle; ✓
Binary fission is a means of reproduction and population growth in unicellular organisms while mitosis is a means of growth and tissue repair in multicellular organisms;✓
Any first two correct @ 1 mark; Penalize for any additional wrong answer.

(b) Explain the role of fertilisation in sexual reproduction. (*04 marks*

<u>Random</u> fusion of <u>haploid</u> gametes (produced by meiosis);✓***results into mixing of parental characteristics;***✓***creating genetic variation;***✓***and restoration of diploid chromosome number/zygote formed has two copies of each chromosome type***;✓ ***@ 1 mark***

(c) Why does gene reshuffling play only a limited role in evolution? (*02 marks*)

New genetic combinations formed by independent segregation of chromosomes and crossing over;✓ ***in one generation are undone in later generations;***✓***thus non- persistent for many generations;***✓***giving no chance for natural selection to act on them;***✓ ***@ ½ mark***

43. (a) What is meant by **gross primary productivity**? (*02 marks*)

Total solar energy stored as organic matter by autotrophs/producers; per unit area per unit time;✓✓ ***reject without units***

(b) Table below shows energy flow in a temperate forest and a tropical rain forest.

Process	**Energy ($KJm^{-2}year^{-1}$)**	
	Temperate forest	**Tropical rain forest**
Gross primary productivity	48800	180000
Net primary productivity	30000	52000

(i) Determine the respiration that occurs in each type of forest. (*02 marks*)

Respiration = GPP – NPP;
Temperate forest: Respiration= 48800-30000;✓ 18800 KJm^{-2}year^{-1};✓
Tropical forest: Respiration= 180000-52000;✓ 128000 KJm^{-2}year^{-1};✓
@ ½ mark

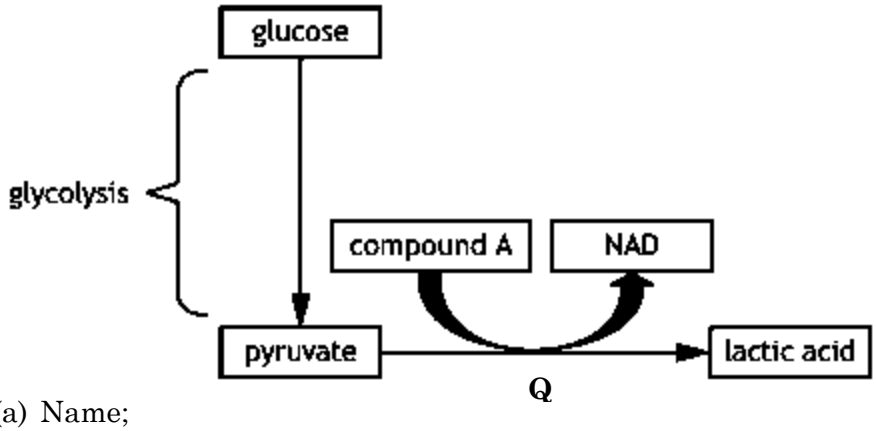
(ii) Suggest explanations for the difference in gross primary productivity between the two forest types. (*04 marks*)

Gross primary productivity of a tropical forest is higher than that of temperate forest;✓✓ because the higher/ more consistent temperatures;✓ higher rainfall all year;✓ greater light intensity;✓ higher plant density thus better exploitation of available resources;✓ and more evergreen plants/fewer deciduous plants;✓ all increase photosynthetic rate; ✓ Also faster nutrient recycling rates;✓ due to warm temperatures and high moisture; ✓ increase nutrient availability for plant growth;✓
@ ½ mark max 4 marks.

(c) Suggest why productivity of an ecosystem is measured in units of energy rather than biomass. (*02 marks*)

Productivity in energy units is true reflection of energy capture by producers;✓ accounting for losses at each trophic level;✓ while water content of biomass varies;✓ biomass incudes inorganic components;✓ @ ½ mark

44. The diagram represents glycolysis and the metabolic pathway which synthesizes lactic acid in the mammalian cell.



(a) Name;

(i) compound **A.** (*01 mark*)
Reduced NAD/NADH$_2$;✓

(ii) enzyme **Q.** (*01 mark*)
Lactate dehydrogenase enzyme;✓

(b) State the part of cell where glucose is converted to pyruvate. (*01 mark*)

Cytoplasm/cytosol;✓

(c) Describe what happens during the energy investment phase of glycolysis. (*04 marks*)

Turn Over

Two ATP molecules are used;✓✓inorganic phosphate from their hydrolysis/breakdown;✓✓used to phosphorylate glucose;✓forming glucose-6-phosphate;✓ and fructose-6-phosphate;✓ to fructose 1,6-Bisphosphate;✓ @ ½ mark.

(d) Explain the importance of converting pyruvate to lactic acid. (*03 marks*)

Regeneration of NAD;✓a hydrogen carrier in glycolysis;✓allowing continued ATP production via glycolytic pathway;✓ @ 1 mark

45. (a) State any **two** factors which must be kept constant in the internal environment of an organism. (*01 mark*)

<u>Blood</u> sugar level;✓pH of blood and tissue fluid;✓<u>Body core</u> temperature; Osmotic pressure of body fluids; Concentration of ions such as sodium, calcium etc.
Level of respiratory gases (oxygen and carbon dioxide) in blood; <u>Blood</u> pressure;
Any first two correct @ ½ mark; Penalize for any additional wrong answer.

(b) Of what significance is maintenance of a constant internal environment to living organisms? (*03 marks*)

Body cells are maintained at optimum conditions e.g. pH and temperature;✓ thus enzyme controlled reactions proceed efficiently;✓at a rate suitable for an organism's survival;✓
Provides organisms with degree of independence of the external environment;✓ thus able to exploit a wider range of environments and habitats;✓

(c) Explain how the following adaptations might assist in maintenance of a constant internal environment.

(i) an elongated loop of Henle in a desert mammal. (*02 marks*)

Increases surface area for reabsorption of water;✓decreasing amount of water lost in urine/ increasing concentration of urine;✓

(ii) the thick fur pelt in an artic mammal. (*02 marks*)

Traps a layer of air;✓a poor conductor of heat;✓ insulates the body against heat loss in cold conditions;✓✓ @ ½ mark

(iii) the subcutaneous fat in a marine mammal. (*02 marks*)

Fat, a poor conductor of heat;✓insulates the body against heat loss to the water;✓

46. Plants and animals are multicellular organisms.

(a) State **two** benefits and **two** disadvantages of being multicellular. (*04 marks*)

Benefits

Cell specialization/division of labour, making organisms more efficient;✓
Improved acquisition of resources e.g. in plants;✓

Exploits a wide range of habitats/greater control of the internal environment due to reduced heat and water loss;✓
More mobility, easier to catch food/prey, better defense due to increased size;✓
Protection from predation;✓

Disadvantages

Increased complexity; so need for a well-developed transport system, excretory system and respiratory system for adequate supply of oxygen, nutrients and removal of wastes;✓
Slower rate of reproduction/fewer offsprings produced; ✓
Increased problem of support for terrestrial organisms; ✓
More prone to predation; ✓
Increased vulnerability to wind e.g. plants; ✓
Increased consumption of food to meet the high metabolic rate; ✓
Increased dependence of cells on each other thus need for better coordination system;✓
Any first two correct @ ½ mark; Penalize for any additional wrong answer.

(b) Explain the need for mass flow systems in animals. (*04 marks*)

Most are large in size;✓with small surface area to volume ratio;✓diffusion is too slow to adequately supply metabolic needs (oxygen & nutrients);✓
Increased distance that materials (oxygen & nutrients) travel within the body;✓ thus diffusion alone cannot suffice;✓
@ 1 mark max 4

(c) How is the venous return of blood to the heart maintained? (*02 marks*)

- ***Contraction of skeletal muscles of the limbs (arms and legs) during locomotion, squeezes the thin walled veins forcing blood through them under high pressure;✓***
- ***Semi lunar valves along their length prevent backflow of blood; ensuring that blood flows in one direction towards the heart; ✓***
- ***Large diameter minimizes resistance to blood flow; ✓***
- ***Negative pressure developed in the thorax during breathing in draws blood towards the heart; ✓***
- ***Gravity allows return of blood from regions above the heart; ✓***
- ***Residual pressure in the heart; ✓***

Any correct two @ 1 mark

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