

EDUZEDCO
231/2 BIOLOGY
Paper 2
Form 4 End Term Examination

Time: 2 ½ Hours

Name:

Adm No:

School:

Class:

Signature:

Date:

INSTRUCTIONS TO CANDIDATES

- (a) Write your name and index number in the spaces provided at the top of this page.
- (b) Write your school name, sign and write the date of the examination in the spaces provided above.
- (c) This paper consists of **Two** sections: **Section I** and **Section II**.
- (d) Answer all questions as instructed in each section.
- (e) Marks may be given for correct working, relevant points, and clear presentation.
- (f) Non-programmable silent electronic calculators may be used where necessary.
- (h) This paper consists of **4 printed pages**.
- (i) Candidates should check the question paper to ensure that all the pages are printed as indicated and no questions are missing.
- (j) Candidates should answer the questions in English.

For Examiner's Use Only

SECTION I

1	2	3	4	5	Total

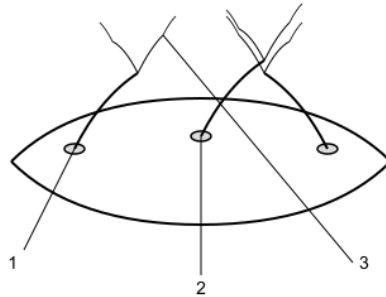
SECTION II

6	7	8	Total	Grand Total

SECTION I (50 Marks)

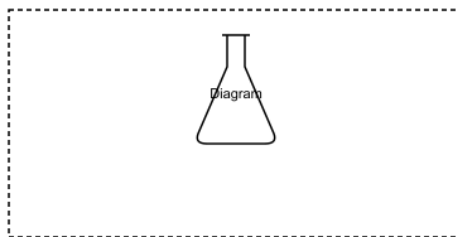
Answer **all** questions in this section in the spaces provided.

1. The diagram below shows part of the tracheal system of a grasshopper. Study it and answer the questions that follow. (8 mks)



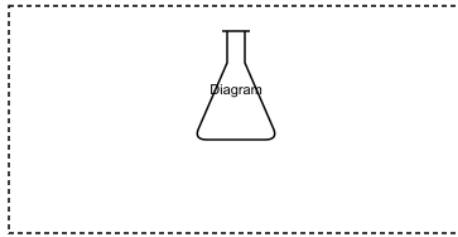
- (a) Label the parts numbered 1, 2, and 3. (3 marks)
(b) Explain how oxygen from the atmosphere reaches the body cells of the grasshopper. (2 marks)
(c) Describe three adaptations of the tracheal system that make it efficient for gaseous exchange in insects. (3 marks)

2. (8 mks)



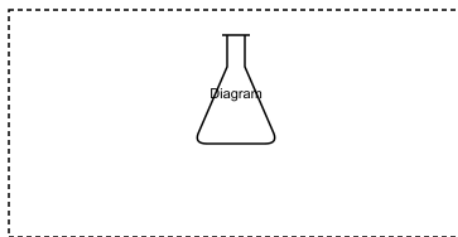
- (a) Draw a labeled diagram of a nephron showing the following parts: Bowman's capsule, proximal convoluted tubule, loop of Henle, distal convoluted tubule, and collecting duct. (3 marks)
(b) Describe the process of ultrafiltration in the glomerulus. (2 marks)
(c) Explain how the loop of Henle creates a concentration gradient in the medulla. (3 marks)

3. In a grassland ecosystem, the following organisms are found: grass, grasshopper, frog, hawk, snake, mouse, owl. (8 mks)



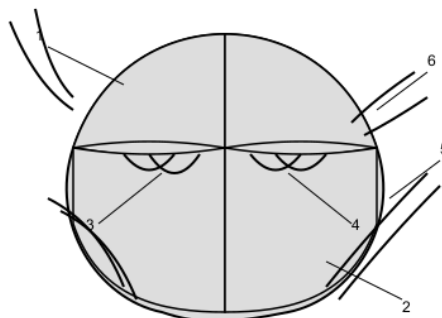
- (a) Construct a food web using these organisms. (3 marks)
- (b) Identify two trophic levels in your food web. Given that the grass contains 10,000 kJ of energy, and the primary consumers have 1,000 kJ, calculate the percentage of energy transferred from producers to primary consumers. (2 marks)
- (c) Predict and explain the likely effect on the food web if frogs were removed from the ecosystem. (3 marks)

4. In pea plants, tall stem (T) is dominant over short stem (t). (8 mks)



- (a) Complete a Punnett square for a cross between a heterozygous tall plant (Tt) and a homozygous short plant (tt). State the phenotypic ratio of the offspring. (3 marks)
- (b) Explain the difference between genotype and phenotype. (2 marks)
- (c) A farmer has a tall pea plant but does not know its genotype. Describe how the farmer can determine whether the plant is homozygous tall (TT) or heterozygous tall (Tt) using a test cross. (3 marks)

5. The diagram below shows a frontal section of the human heart. Study it and answer the questions that follow. (8 mks)



- (a) Label the parts numbered 1 to 6. (3 marks)
- (b) Describe the pathway of blood through the heart starting from the vena cava. (2 marks)
- (c) Explain the role of the coronary artery and state the likely effect if it becomes blocked. (3 marks)

SECTION II (50 Marks)

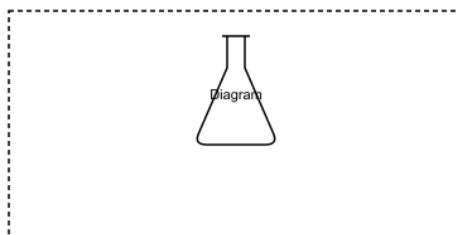
Answer any **five** questions from this section in the spaces provided.

6. A biologist studied a lizard population in a rocky outcrop using capture-recapture. The data for five sampling sessions are given below. The number of lizards captured is the total caught in that session; the number marked is the total previously marked lizards caught in that session. (20 mks)

Session	Number captured	Number marked (recaptured)
1	20	0
2	30	5
3	25	8
4	35	10
5	40	12

- (a) On the grid provided, plot a graph of the number captured and number marked against sampling session. Use different symbols or lines. (5 marks)
- (b) Using the data from session 2, calculate the estimated population size using the Lincoln-Petersen index: $N = (M \times C) / R$, where M = number marked in first sample, C = total captured in second sample, R = number marked in second sample. State one assumption of this method. (5 marks)
- (c) Analyze two sources of error that could affect the accuracy of this estimate. (5 marks)
- (d) Suggest two improvements to the method to increase reliability of the population estimate. (5 marks)

7. (20 mks)



- (a) Draw a labeled diagram of the human eye in transverse section showing the following parts: cornea, iris, lens, retina, optic nerve, choroid, sclera, and vitreous humour. (5 marks)
- (b) Describe how the eye accommodates to focus on a near object. (5 marks)
- (c) Explain the pathway of a light impulse from the retina to the brain. (5 marks)
- (d) Discuss the effects of cataract on vision and explain how it can be treated. (5 marks)

8.

(20 mks)

- (a) Explain how multiple alleles and codominance are involved in the inheritance of ABO blood groups. (5 marks)
- (b) A man with blood group A (genotype $I^A i$) and a woman with blood group B (genotype $I^B i$) have children. Work out the possible blood groups of their offspring. (5 marks)
- (c) Discuss the medical importance of blood group compatibility in blood transfusions. (5 marks)
- (d) Describe how the Rhesus factor can cause hemolytic disease of the newborn. (5 marks)

231/2 BIOLOGY MARKING SCHEME

Form 4 Paper 2

SECTION I (50 marks)

1. The diagram below shows part of the tracheal system of a grasshopper. Study it and answer the questions that follow. (8 marks)

- (a) Label parts 1, 2, 3 (3 marks) - 1: Spiracle (1 mark) - 2: Trachea (1 mark) - 3: Tracheole (1 mark) [3]
(b) Explain how oxygen reaches body cells (2 marks) - Oxygen enters through spiracles (1 mark) - Diffuses through tracheae and tracheoles directly to cells (1 mark) [2]
(c) Three adaptations of tracheal system (3 marks) - Extensive branching increases surface area for gas exchange (1 mark) - Thin walls of tracheoles allow rapid diffusion (1 mark) - Spiracles can open/close to reduce water loss (1 mark) [3]

Alternative method/answer:

Accept 'tracheal tubes' for trachea; 'air sacs' if mentioned as part of system (but not in diagram). For adaptations: accept 'moist inner lining' or 'no circulatory system needed' if correctly explained.

2. (8 marks)

- (a) Draw labeled nephron (3 marks) - Correct shape and labels: Bowman's capsule, proximal convoluted tubule, loop of Henle, distal convoluted tubule, collecting duct (1 mark each for any 3 correct labels; max 3 marks) [3]
(b) Describe ultrafiltration (2 marks) - High blood pressure in glomerulus forces fluid through capillary walls (1 mark) - Small molecules pass into Bowman's capsule; large proteins retained (1 mark) [2]
(c) Explain loop of Henle creating concentration gradient (3 marks) - Descending limb permeable to water, water leaves by osmosis (1 mark) - Ascending limb impermeable to water, actively transports NaCl out (1 mark) - This creates hypertonic medulla (countercurrent multiplier) (1 mark) [3]

Alternative method/answer:

Accept 'filtration slits' or 'podocytes' in ultrafiltration. For loop: accept 'countercurrent multiplier' or 'hairpin loop'.

3. In a grassland ecosystem, the following organisms are found: grass, grasshopper, frog, hawk, snake, mouse, owl. (8 marks)

- (a) Construct food web (3 marks) - Correct arrows: grass → grasshopper, grass → mouse (1 mark) - grasshopper → frog, frog → snake, frog → hawk (1 mark) - snake → hawk, mouse → owl, mouse → hawk (1 mark) (Any correct web with at least 5 arrows: 3 marks; 3-4 arrows: 2 marks; 1-2 arrows: 1 mark) [3]
(b) Identify two trophic levels and calculate energy transfer (2 marks) - Producers (grass) and primary consumers (grasshopper, mouse) (1 mark) - Efficiency = $(1000/10000) \times 100 = 10\%$ (1 mark) [2]
(c) Predict effect of removing frogs (3 marks) - Grasshopper population increases (1 mark) - Grass decreases due to overgrazing (1 mark) - Snakes and hawks lose food source, may decline (1 mark) [3]

Alternative method/answer:

Accept 'herbivores' for primary consumers. For (c): accept 'owl unaffected if eats mice' or 'ecosystem imbalance'.

4. In pea plants, tall stem (T) is dominant over short stem (t). (8 marks)

- (a) Punnett square and phenotypic ratio (3 marks) - Correct gametes: T,t and t,t (1 mark) - Correct offspring: Tt, Tt, tt, tt (1 mark) - Phenotypic ratio: 1 tall : 1 short (1 mark) [3]
(b) Difference between genotype and phenotype (2 marks) - Genotype: genetic makeup (1 mark) - Phenotype: observable traits (1 mark) [2]
(c) Test cross description (3 marks) - Cross tall plant with homozygous short (tt) (1 mark) - If all offspring tall → parent is TT (1 mark) - If half tall, half short → parent is Tt (1 mark) [3]

Alternative method/answer:

Accept 'backcross' for test cross. For (b): accept 'genetic constitution' and 'physical appearance'.

5. The diagram below shows a frontal section of the human heart. Study it and answer the questions that follow. (8 marks)

- (a) Label parts 1 to 6 (3 marks) - 1: Right atrium (0.5 mark) - 2: Left ventricle (0.5 mark) - 3: Tricuspid valve (0.5 mark) - 4: Bicuspid valve (0.5 mark) - 5: Aorta (0.5 mark) - 6: Pulmonary vein (0.5 mark) [3]
- (b) Pathway of blood from vena cava (2 marks) - Vena cava → right atrium → tricuspid valve → right ventricle → pulmonary artery (1 mark) - Lungs → pulmonary vein → left atrium → bicuspid valve → left ventricle → aorta (1 mark) [2]
- (c) Role of coronary artery and effect of blockage (3 marks) - Supplies oxygenated blood to heart muscle (1 mark) - Blockage leads to ischemia (1 mark) - Causes heart attack (myocardial infarction) (1 mark) [3]

Alternative method/answer:

Accept 'mitral valve' for bicuspid valve. For (c): accept 'angina' or 'chest pain'.

SECTION II (50 marks)

6. A biologist studied a lizard population in a rocky outcrop using capture-recapture. (20 marks)
The data for five sampling sessions are given below. The number of lizards captured is the total caught in that session; the number marked is the total previously marked lizards caught in that session.

- (a) Plot graph (5 marks) - Correct axes: x-axis session (1-5), y-axis number (1 mark) - Correct scale and labels (1 mark) - Plot captured data (20,30,25,35,40) (1 mark) - Plot marked data (0,5,8,10,12) (1 mark) - Different symbols/lines and key (1 mark) [5]
- (b) Calculate population size using session 2 (5 marks) - $M = 20$ (marked in session 1) (1 mark) - $C = 30$ (captured in session 2) (1 mark) - $R = 5$ (marked in session 2) (1 mark) - $N = (20 \times 30) / 5 = 120$ (1 mark) - Assumption: marked individuals mix randomly and are equally catchable (1 mark) [5]
- (c) Two sources of error (5 marks) - Trap shyness: marked individuals avoid traps, reducing R, overestimating N (2.5 marks) - Mortality/emigration: marked individuals die or leave, reducing R, overestimating N (2.5 marks) [5]
- (d) Two improvements (5 marks) - Use multiple capture sessions (Schnabel method) to average estimates (2.5 marks) - Use harmless marking that does not alter behavior (e.g., toe clipping, paint) (2.5 marks) [5]

Alternative method/answer:

For (b): accept 'Lincoln index' or 'Petersen method'. Assumption: accept 'no birth, death, immigration, emigration between samples' or 'marks not lost'. For (c): accept 'trap addiction' or 'learning to enter traps'. For (d): accept 'increase sample size' or 'use different capture methods'.

7. (20 marks)

- (a) Draw labeled eye diagram (5 marks) - Correct shape and labels: cornea, iris, lens, retina, optic nerve, choroid, sclera, vitreous humour (1 mark each for any 5 correct; max 5 marks) [5]
- (b) Accommodation for near object (5 marks) - Ciliary muscles contract (1 mark) - Suspensory ligaments slacken (1 mark) - Lens becomes more convex (1 mark) - Increased refractive power (1 mark) - Image focuses on retina (1 mark) [5]
- (c) Pathway of light impulse (5 marks) - Photoreceptors (rods/cones) generate impulses (1 mark) - Bipolar cells (1 mark) - Ganglion cells (1 mark) - Optic nerve → optic chiasma → optic tract (1 mark) - Thalamus → visual cortex (1 mark) [5]
- (d) Cataract effects and treatment (5 marks) - Lens becomes cloudy (1 mark) - Blurs vision, can cause blindness (1 mark) - Treated by surgical removal of cloudy lens (1 mark) - Replacement with artificial intraocular lens (1 mark) - Restores vision (1 mark) [5]

Alternative method/answer:

For (a): accept 'aqueous humour' if included. For (c): accept 'lateral geniculate nucleus' for thalamus. For (d): accept 'phacoemulsification' as surgical method.

8. (20 marks)

(a) Multiple alleles and codominance (5 marks) - Three alleles: IA, IB, i (1 mark) - IA and IB are codominant (1 mark) - Both expressed when together (1 mark) - i is recessive to both (1 mark) - This gives four blood groups: A, B, AB, O (1 mark) [5]

(b) Cross IAi × IBi (5 marks) - Gametes: IA, i and IB, i (1 mark) - Offspring genotypes: IAIB, IAi, IBi, ii (2 marks) - Blood groups: AB, A, B, O (1 mark) - Ratio 1:1:1:1 (1 mark) [5]

(c) Medical importance of blood group compatibility (5 marks) - Incompatible transfusion causes agglutination (1 mark) - Type O is universal donor (no antigens) (1 mark) - Type AB is universal recipient (no antibodies) (1 mark) - Cross-matching required before transfusion (1 mark) - Incompatibility can cause hemolysis and death (1 mark) [5]

(d) Rhesus factor and hemolytic disease of newborn (5 marks) - Rh- mother carries Rh+ fetus (1 mark) - Fetal blood enters maternal circulation at delivery (1 mark) - Mother produces anti-Rh antibodies (1 mark) - In second Rh+ pregnancy, antibodies cross placenta (1 mark) - Destroy fetal RBCs, causing HDN (1 mark) [5]

Alternative method/answer:

For (a): accept 'multiple allelism' for multiple alleles. For (c): accept 'blood typing' for cross-matching. For (d): accept 'erythroblastosis fetalis' for HDN; accept 'anti-D immunoglobulin' as prevention.