

KCSE 2024
BIOLOGY PAPER2

SECTION A (40 marks)

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

The following word equation represents a biological process that occurs in green plants.

Carbon (IV) oxide + water \longrightarrow Glucose + Product E

- (a) Name the cell organelle where the illustrated process takes place in green plants. (1 mark)

Chloroplast. Acc. Chloroplasts

- (b) (i) Give the likely identity of product E. (1 mark)

Oxygen. Acc. O_2

- (ii) Suggest ways in which the rate of production of E can be increased. (3 marks)

Optimum temperature. Acc. increase in temperature.

Optimum light intensity / light. Acc. Increase in light intensity / light

Increasing the concentration of Carbon(IV) oxide.

Increase availability / amount of water.

- (c) Suggest one possible source of carbon (IV) oxide if the above process was artificially conducted in a school laboratory. (1 mark)

Sodium Hydrogen Carbonate. Acc. Sodium bicarbonate

Burning candle / any hydrocarbon

- (d) Explain how the illustrated process is significant in nature. (2 marks)

+ Air purification / removes / reduces the concentration of Carbon(IV) oxide in the atmosphere / regulates the amount of Carbon(IV) oxide and O_2 in the atmosphere.

- Increases the concentration of Oxygen in the atmosphere used during respiration / production / provision of Oxygen for other organisms.

- provision of glucose / sugars / food; (Award any two)

2

In an experiment, the number of red blood cells present in three samples of blood labelled F, G and H was estimated. Different concentrations of salt solution were then separately added to the samples. After an hour, the number of red blood cells present in each sample was counted and recorded as shown in the table below.

Blood sample	Salt solution % concentration added	Number of red blood cells
F	1.0	Number remained the same
G	0.6	Fewer cells observed
H	0.4	No cells observed

- (a) Name the physiological process being investigated in the experiment. (1 mark)

Osmosis.

- (b) Account for the results made in blood sample F. (2 marks)

The concentration of cytoplasm was equal to that of 1.0% salt solution / the salt soln was isotonic to the cytoplasm, therefore no net movement of water molecules in/out of the cell (number of cells remained the same since) no cell haemolysed.

- (c) Account for the difference in appearance of red blood cells in samples F and G at the end of the experiment. Red blood cells in sample G appeared (2 marks)

swollen/bulging (outwards). Since the soln was hypotonic to the cytoplasm and there was net mov't of water into the cell (by osmosis); while those placed in sample F assumed the normal shape/size. Since the soln was isotonic to the cytoplasm hence no net movement of water molecules in and out of the cell (by osmosis); (before and after).

- (d) With a reason, predict the possible observation that would be made if blood sample F was treated with a salt concentration of 2.6%. (2 marks)
- Number of red blood cells would remain the same, the solution will be hypertonic to the cytoplasm; water molecules will be drawn from the cell, making the cells to shrink / appear crenated. Acc. Wrinkled for crenated.

- (e) State the importance of the process being investigated above during urine formation. (1 mark)

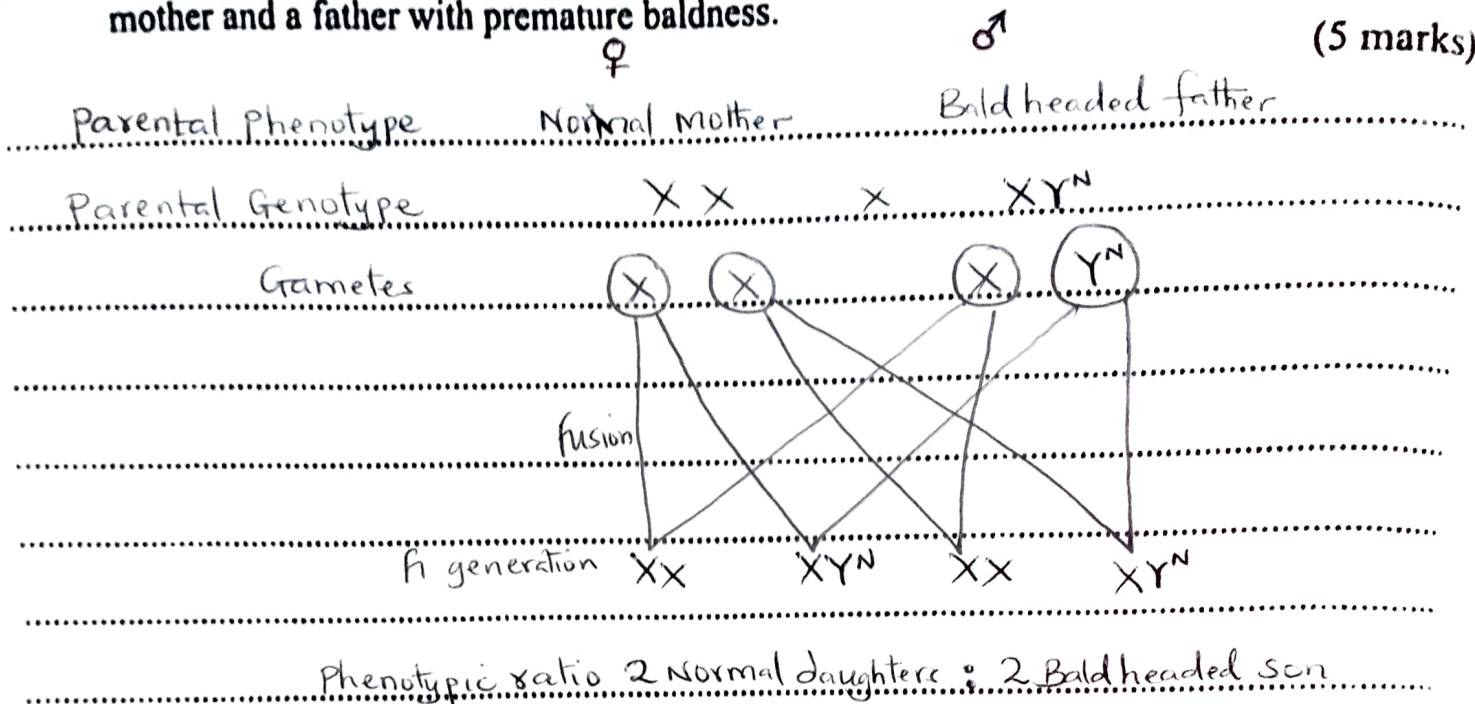
Reabsorption of water into the blood stream (from kidney tubules).

Conserves water / not much water is lost through urine.

- (b) OR. The concentration of the solution was hypertonic to the cell cytoplasm; hence there was net movement of water out of the cell / cells were crenated / shrink;

A genetic investigation on a certain population established that, in human beings, premature baldness is controlled by a dominant gene, N located on the Y chromosome.

- (a) Work out the phenotypic ratio of the offspring of a couple comprising of a normal mother and a father with premature baldness. (5 marks)



- (b) What is the probability that this couple would have a daughter with premature baldness? (1 mark)

Zero / 0 / no chances / none / 0% / Naught. Rej 1/2 or 1/4

- (c) Name two sex-linked traits in human beings associated with the X-chromosomes. (2 marks)

* Haemophilia; Acc. Hemophilia + Duchenne muscle/muscular dystrophy;
* Colour blindness; Acc. color blindness

Parental genotype $XX \times XY^N$;

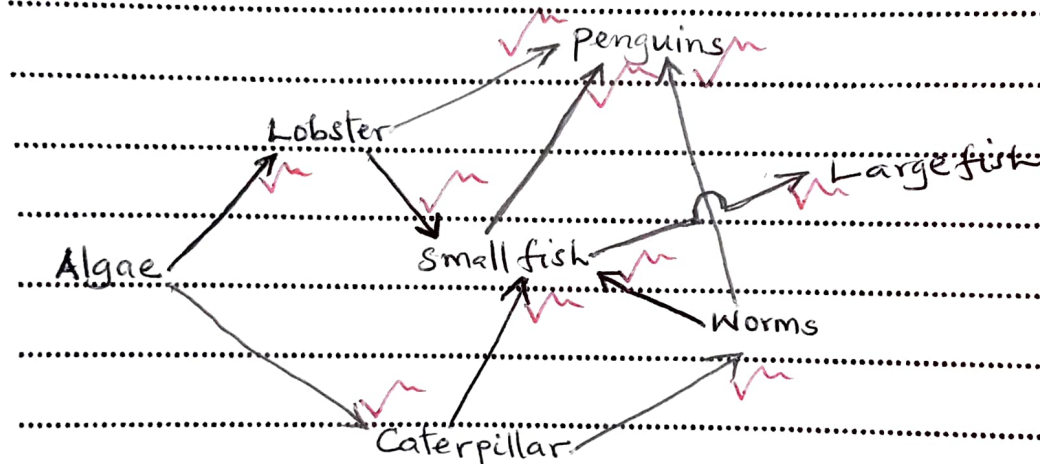
♀ \ ♂	X	Y^N
X	XX	XY^N
X	XX	XY^N

1 Normal daughter : 1 Bald headed son,

During an ecological study in a lake ecosystem, a group of students made the following observations on the feeding relationships among some organisms.

- Lobsters feed on algae
- Small fish feed on lobsters, worms and caterpillars
- Caterpillars feed on algae
- Worms feed on caterpillar
- Large fish feed on small fish
- Penguins feed on small fish, lobsters and worms.

(a) From the students' observations, construct a food web for the ecosystem. (5 marks)



(b) From the food web constructed in 4(a), extract a food chain with the penguin as a secondary consumer. (1 mark)

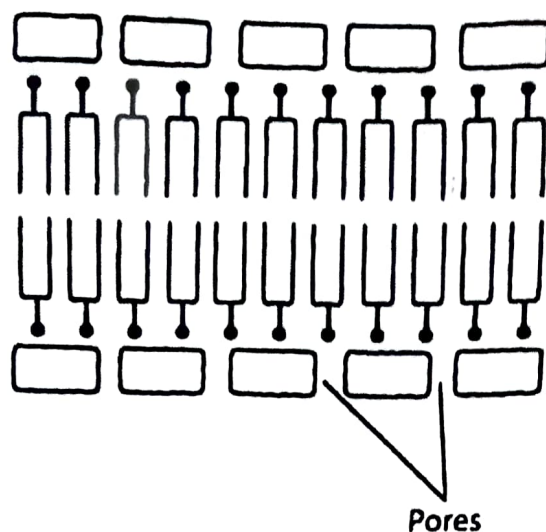
Algae → Lobsters → Penguins;

(c) Explain how spillage of oil from water vessels is likely to affect this lake ecosystem.

- prevents exit of air / Carbon(IV) oxide; cause suffocation / death of (living) organisms; OR
- prevents entry / diffusion of Carbon(IV) oxide / air; limiting / preventing photosynthesis; OR
- prevents entry / diffusion of oxygen / air; causing suffocation / death of (living) organisms; OR
- Reducing penetration of light; limiting / stopping / preventing photosynthesis; acc. prevents / blocks for reducing penetration of light.
- clogs respiratory surfaces; causing suffocation / death / limiting gaseous exchange; OR

5

The following diagram represents part of a cell structure as seen under an electron microscope.



(a) (i) Identify the structure represented.

(1 mark)

Cell membrane / Plasmalemma / Plasma membrane.

(ii) State two functions of the structure.

(2 marks)

Enclosing cell contents / protection of the inner cell inclusions / organelles.
Selective mov't of the materials in / out of the cell. Acc. Regulating / controlling movement of substances in and out of the cell.

(iii) Suggest two ways in which the functioning of the structure can be impaired.

(2 marks)

In the extremes of pH / strong acid / strong base.
Extremes in temperatures / (too) low / high temperature.

(b) Name two structures found in plant cells but not in animal cells.

(2 marks)

Chloroplast / Plastids; Sap vacuole;
Cell wall; Tonoplast;

(c) What is the purpose of staining cells before observing them under a light microscope?

For clarity during observation / makes structures more distinct / clear; Acc. more visible / more distinct.

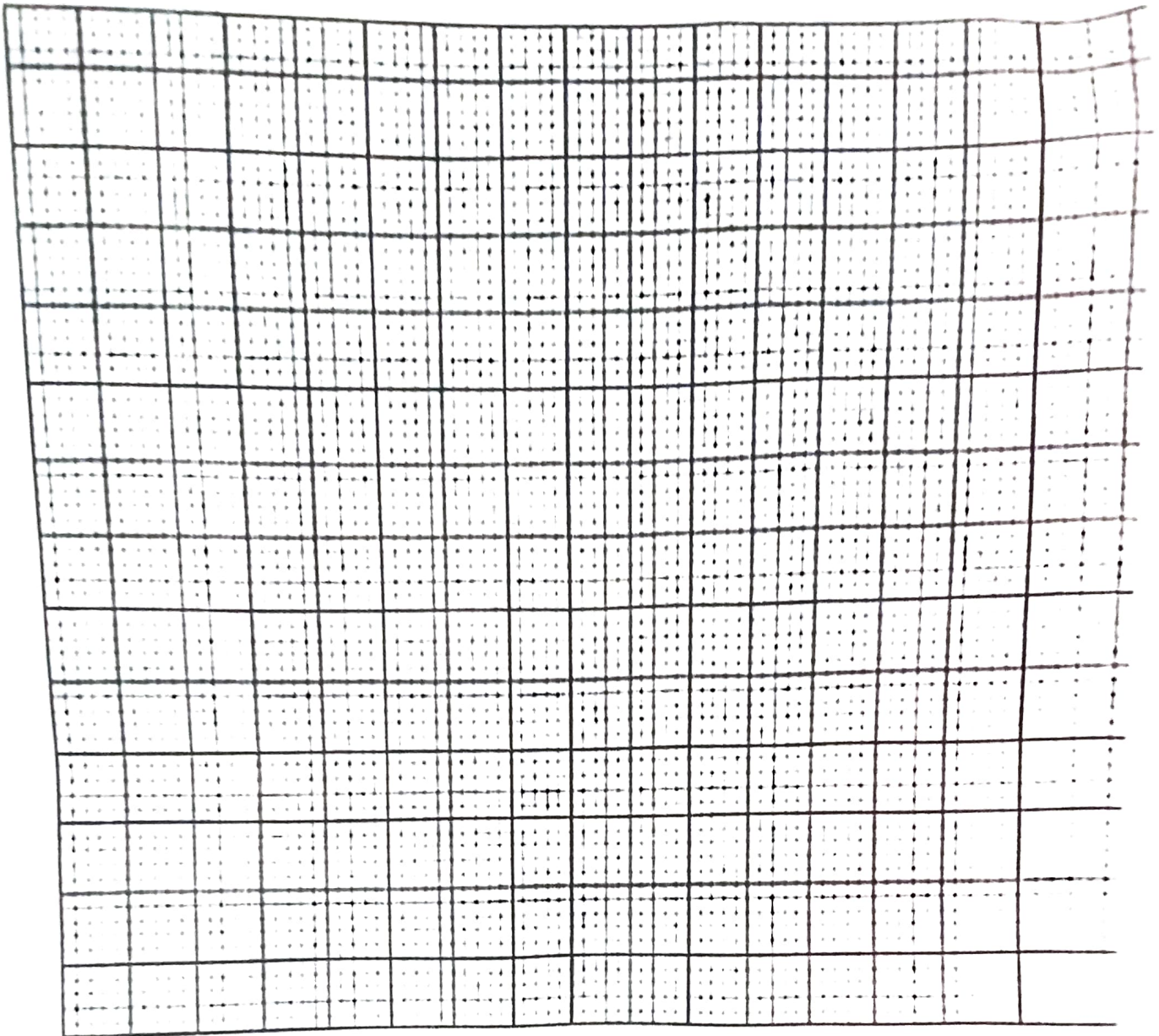
SECTION B (40 marks)

Answer question 6 (compulsory) and either question 7 or 8 in the spaces provided after question 8.

- 6 An investigation was carried out to monitor trends of growth in a group of boys and girls for a period of 20 years. Their average weights were recorded at two years' intervals as shown in the table.

Age (Years)	Average weights (kg)	
	Boys	Girls
0	2.4	2.4
2	11.0	11.4
4	14.5	15.5
6	18.2	19.6
8	21.7	26.8
10	25.2	27.4
12	27.7	31.5
14	37.2	35.4
16	44.5	44.5
18	46.8	52.6
20	48.6	55.6

- (a) On the same axes, draw line graphs of average weights of girls and boys against their ages. (8 marks)



(b) From the graph, determine the:

(i) weight of boys at the age of 13 years;

(1 mark)

$$32 \pm 1 \text{ (Kg)} \quad (31 - 33)$$

(ii) growth rate in girls between the 13th and 15th year.

(3 marks)

$$\begin{array}{l} 13^{\text{th}} - 33.5 \pm 1 \quad (32.5 - 34.5) \quad \frac{41 - 32.5}{15 - 13} = \frac{8.5}{2} = 4.25 \text{ Kg/year higher} \\ 15^{\text{th}} - 40 \pm 1 \quad (39 - 41) \quad \frac{39 - 34.5}{15 - 13} = \frac{4.5}{2} = 2.25 \text{ Kg/year lower} \end{array}$$

(2.25 - 4.25 Kg/year)
accepted

(c) Account for the trend in the growth of girls between the 14th and 18th year.

(2 marks)

Faster (rapid trend in) growth / Exponential; it is the puberty stage / development of secondary characteristic / development of wide hips / broadening of hips / breasts; (Acc specific indicators of growth during the stage)

- (d) Apart from sex and age, state three other factors that affect the rate of growth in humans. (3 marks)

(Effect of) hormones; Basal metabolic Rate; Acc. BMR;

State of one's health/diseases;

Genetic/heritable factors/genes;

One's diet/feeding habits/environmental factors/food/emotions/stress;

- (e) Other than weight, state a parameter that can be used to establish growth in humans. (1 mark)

Height;

- (f) Why do girls above 12 years require more iron in their diet than boys of the same age? (2 marks)

Girls Menstruate (therefore lose blood); they require Iron to compensate for the blood lost;

- 7 (a) Explain the effects of hypothyroidism in adults. (4 marks)

- (b) Describe the hearing process in humans. (16 marks)

- 8 (a) Describe how urea is formed in humans. (5 marks)

- (b) Describe the path followed by urea from the site of formation until it is eliminated from the body. (15 marks)

7(a) Myxoedema/Myxedema/swollen thyroid gland/goiter; due to underproduction of the thyroid hormone/thyroxine; reduced production of thyroxine hormone leads to the overworking of the thyroid gland; in an attempt to produce more thyroxine hormone (causing the swelling); this further leads to low metabolic rate/reduced body temperature/reduced breathing rate/heart rate; causes mental/physical sluggishness; Obesity/increased body weight; and retention of body fluid/Oedema/swollen feet/puffy face;

(Total 8, Max: 4)

Process of Hearing in humans

7.(b) The (funnel-shaped) pinna; collects / concentrates / directs sound waves; into the (external) auditory meatus / canal; Sound waves strike the eardrum / tympanum / tympanic membrane; causing it to vibrate; and transforms sound waves into vibrations; the vibrations are transmitted to the ear ossicles / malleus, incus and stapes; (the ossicles are suspended by muscles tensor tympani and stapedius; the muscles prevent excessive vibrations which could damage the inner / delicate membranous labyrinth) the ossicles (further form a system of levers that) amplifies; and transmits vibrations; to the oval window / fenestra ovalis; the oval window vibrates; and transmits the vibrations to the fluids / perilymph and endolymph; in the inner ear / cochlea; the fluids conduct vibrations; (in the cochlea) The vibrations (in the cochlea) stimulate the sensory cell hairs / hair cells; to generate nerve impulses; which are transmitted to the brain; through the auditory nerve; for interpretation; the intensity of the stimulus transmitted to the brain enables the brain to interpret the impulses as sound of specific pitch / loudness; vibrations / are dissipated / exit / released through ^{the} round window; to the middle ear; (Total 22. Max. 16)

8.(a) How urea is formed

Urea is formed in the liver; where excess amino acids are deaminated / amino group is removed; the amino group reacts with hydrogen atom / hydrogen ion; to form ammonia; which is toxic; ammonia combines with carbon (iv) oxide (in the Ornithine cycle); to form urea (which is less toxic);

8. (b) Path followed by urea till it is eliminated

(Urea that is formed in the liver) is carried in blood; through the hepatic vein; into the vena cava; blood containing the urea then enters the heart / right auricle / right auricle and ^{right} Ventricle; leaves the heart through the pulmonary artery; into the lungs; (and out of the lungs through) the pulmonary vein; to the heart / left auricle / left auricle and left Ventricle; (leaves through) the aorta; into the kidney; via the renal artery; to afferent arteriole; glomerulus; where ultra-filtration occurs; resulting in the formation of the (glomerular) filtrate; which enters the Bowman's Capsule; into the proximal convoluted tubule; loop of Henle / descending and ascending loop of Henle; Distal convoluted tubule; urea enters the collecting tubule / collecting duct in urine; into pelvis; into the ureter; then into urinary bladder (for temporary storage); from where it ~~exits~~ exits the body through the urethra;

(Total 24. Max. 15)

OR

