THE KENYA NATIONAL EXAMINATIONS COUNCIL
Kenya Certificate of Secondary Education

231/2 — BIOLOGY — Paper 2

(THEORY)

Nov. 2019 – 2 hours

Name ..... Index Number .....

Candidate's Signature ..... Date .....

CO-ORDINATED MARKING SCHEME

Instructions to candidates

(a) *Write your name and index number in the spaces provided above.*
(b) *Sign and write the date of examination in the spaces provided above.*
(c) *This paper consists of **two** sections; **A** and **B**.*
(d) *Answer **all** the questions in section **A** in the spaces provided.*
(e) *In section **B** answer question **6 (compulsory)** and either question **7** or **8** in the spaces provided after question **8**.*
(f) ***This paper consists of 12 printed pages.***
(g) ***Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.***
(h) ***Candidates should answer all the questions in English.***

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Section	Question	Maximum Score	Candidate's Score
A	1	8	
	2	8	
	3	8	
	4	8	
	5	8	
B	6	20	
		20	
	Total Score	80	

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SECTION A (40 marks)

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

1. In an experiment to investigate the effect of sodium chloride on the growth rate in a spinach seedling, seeds were treated with different concentrations of sodium chloride. The results are as recorded in the table below.

Concentration of sodium chloride (mol/l)	Percentage of spinach seeds which started to grow roots	Mean root length (mm)
0.00	99.98	17.70
0.06	98.20	15.60
0.12	92.0	10.20
0.18	54.0	7.60

(a) From the results in the table above, explain the effect of increasing the concentration of sodium chloride. (3 marks)

Increased Nacl conc/having more Nacl ions decreases water potential/decrease osmotic Potential/increase osmotic pressure/ makes water potential more negative outside the seed/ seedling in the surrounding solution to be hypertonic to the cell sap in the seedling; seeds cells take in less water by osmosis/are dehydrated/lose water molecules to the surrounding solution; Reducing the growth enzyme activity; have reduced growth rate;

(b) Apart from a ruler, state two other equipment one would need to determine the rate of growth in the roots. (2 marks)

- Thread; (Wire/string)
- Book;
- Pen; Marker (Pen);

Acc. dye/Water Proof ink/blotting Paper/tissue paper/Tissue Paper/Piece of cloth

(c) With a reason, state one other part of the seedling the students would focus on to determine the effect of sodium chloride on growth. (2 marks)

Rate of growth/increase in length of shoot tip/apex (active)

It is a region of (active) cell division/growth

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(d) State the likely effect on the seedling of increasing the concentration of sodium chloride to 2.20 mol/l. (1 mark)

The seedling will be dehydrated // lose water (hence) withers / die / dry

01

08

2. The table below shows results of blood cell counts per mm^3 of blood from a sample of people living at different altitudes.

Red blood cells ($\times 10^6$)	4.8	5.3	6.7	7.6	8.47	9.82
White blood cells ($\times 10^6$)	0.45	0.45	0.45	0.45	0.45	0.45
Altitude (metres)	750	1,500	2,250	3,000	4,500	4,500

(a) Explain the relationship between:

(i) red blood cells count and the altitude; (3 marks)

No. of RBC increase with altitude; to increase oxygen carrying capacity (by haemoglobin molecules in blood); since oxygen concentration is lower at higher altitude;

OWTTE

(ii) white blood cells count and the altitude. (3 marks)

White blood cells serve to protect the body against harmful microorganisms / pathogens; the quantities of pathogens / vulnerability of the body to microbial attack is not dependent on the altitude (to be countered by the WBC); hence the No. of WBC count is constant at whatever altitude; 6

OWTTE

(b) Explain why chances of nose-bleeding increase with altitude in humans. (2 marks)

Atmospheric pressure decreases with the increase in altitude; the imbalance between the (outer) atmospheric pressure at high altitude and the internal blood pressure (generated by the heart) results in (one) nose bleeding at high altitudes / internal blood pressure is higher than the (outer) atmospheric pressure; (OWTTE)

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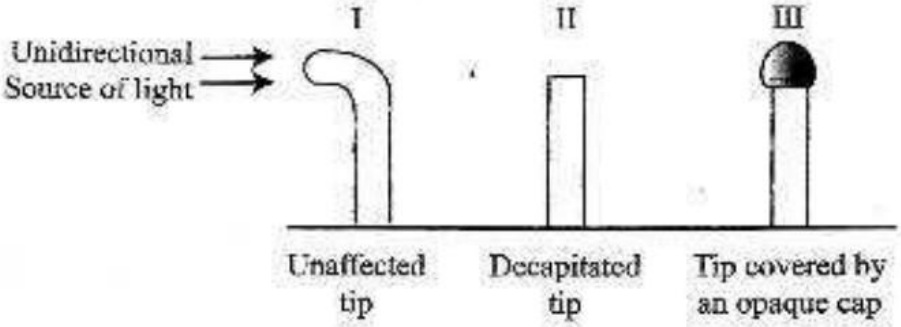
3. (a) State **one** importance of irritability to living organisms. (1 mark)

Enable living organisms to avoid dangerous/harmful/harsh climatic environmental conditions;
Enable living organisms obtain/access favourable environmental conditions (light, water, oxygen); any one

(b) In an experiment, students treated seedlings as illustrated below.



(i) Account for the observations made in seedling I. (3 marks)

Positive Phototropism/tip bends towards light;
Light causes migration of auxins (Produced at the tip) to the darker side; (of the shoot) Resulting in faster division of cells/elongation of cells on the darker/opposite side of the shoot hence bending towards light;

(ii) Explain the similarity in the end results made in seedlings II and III. (2 marks)

Both seedlings remain upright; (Acc. Erect/straight)
seedling II does not have tip while III the tip has been covered by opaque material preventing Light causing unequal distribution of auxins; (Acc. uniform/even distribution of auxins)

(iii) State the likely treatment that would make seedlings II and III respond like seedling I. (2 marks)

- Fitting an agar block treated with IAA auxins at the decapitated end of seedling II;
- Removing the opaque material covering the tip of seedling III/replacing the opaque cap with a transparent one;

07
08

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1. In cats, the gene for fur colour is sex-linked. Letter G represents the gene for ginger fur colour while letter B represents the gene for black fur colour in a given cat species. These genes are codominant. Heterozygous females have ginger and black patches of fur and their phenotype is described as tortoise-shell.

(a) With reference to the information given above, what is meant by the term codominance? (1 mark)

Both alleles are expressed /Shown equally in the Phenotype (of the offspring)/ **None suppresses the other** gene for ginger and black fur colour from expressing itself in the Phenotype (tortoise shell);

(b) Explain why male cats with a tortoise-shell phenotype do not usually occur. (2 marks)

The gene for coat colour contained on the **X-chromosome**; **Males only inherit one X-chromosome** from females/mothers/Y-chromosome does not carry the gene for colour coat

(c) A tortoise-shell female was crossed with a black male. Determine the genotypes and phenotypes of the offspring. (5 marks)

* Codominance
* Capital
* No penetration
* Lines touch O
Rej. Small letter
* C

Parental Phenotype: Tortoise fur female / Black fur male

Parental Genotype: X^BX^G × X^BY ;

Gametes: X^B X^G X^B Y ;

Crossing ;

F1 Genotypes: X^BX^B X^BX^G X^BY X^GY ;

F1 Phenotypes: Female Black fur / Female Tortoiseshell fur / Male Black fur / Male Ginger fur ;

OR ; (Parental Phenotype) (Parental Genotypes)

♀ \ ♂	X^B	Y
X^B	X^BX^B	X^BY
X^G	X^BX^G	X^GY

; (gametes)
; (boxes)
; (F1 genotypes)

F1 Phenotypes – ; correct Phenotypes

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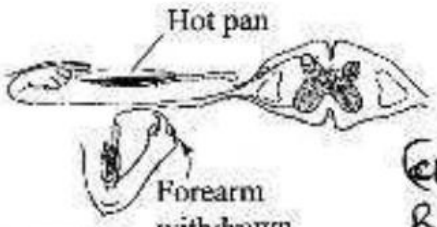
5. A person accidentally touches a hot pan and responds as illustrated in the diagram below.



stimulus/pain/temp. → detector → Receptor (thermoreceptor) → Impulse → Sensory Neurone → synapse → (CNS) Relay Neurone → synapse → Motor Neurone → synapse → Bicep (effector)

(a) Explain how the response illustrated above occurs. (6 marks)

The stimulus/heat/pain is detected by temperature/Pain receptors (also; thermoreceptors) in the skin/dermis; An impulse is generated; Impulse is transmitted along a sensory neurone to the CNS/spinal cord; (Chemical) transmission across Synapse to relay neurone; Across a Synapse to motor neurone; across a Synapse to Biceps muscles/effector via motor neurone; muscles/effectors contract; (hand moves away). This is known as (simple reflex action;

(b) Explain how auxins are utilised as selective weed killers in agriculture. (2 marks)

Selective weed Killers contain auxins which are absorbed by the weeds (than desired/beneficial Plants); Making the weeds to grow abnormally/accelerated/rapid/more die out; (ahead of the beneficial Plants);

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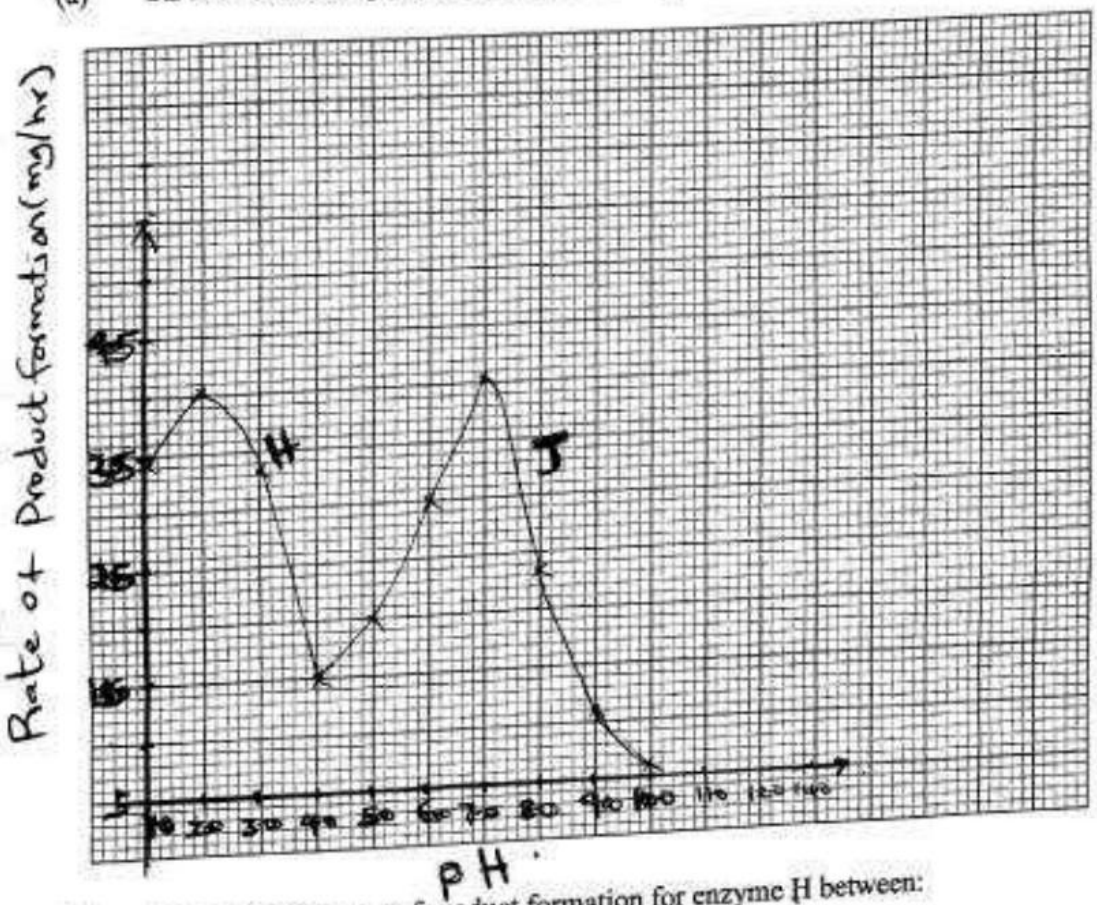
SECTION B (40 marks)

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

6. The table below shows the rate of product formation for two enzymes, H and J over a range of pH values.

pH	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
Rate of product formation for enzyme H (mg/hr)	34.5	40.5	33.5	15.0	–	–	–	–	–	–
Rate of product formation for enzyme J (mg/hr)	–	–	–	15.0	20.0	30.0	40.5	23.5	11.0	6.0

(a) On the same axis, plot graphs of the rate of product formation against pH. (8 marks)



Scale – 2mks
Axes – 2mks
Plotting – 2mks
Curves – 1mk
Identity – 1mk

8

(b) Account for the rate of product formation for enzyme H between: (3 marks)

(i) pH 1.0 and 3.0

Rate of Product formation increases with the increase in pH to the optimum then decreases;
pH 2 is the optimum pH value for activity of enzyme H;
Btn pH 1 and 2 enzyme H/enzyme molecules are activated;
Btn pH 2 and 3 enzyme H (enzyme molecule) are denatured destroyed;
(Acc. enzyme is inactivated / Less active for denatured)

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(ii) pH 3.0 and 7.0. (3 marks)

Rate of Product formation (sharply) decreases with increase in pH; Enzyme H is (not favoured by increase in pH hence is) denatured; No Product forms above pH 4.0 to 7.0 because all enzymes (enzyme molecule) are denatured; 6

(c) From the graph, determine:

(i) the pH value at which the rate of product formation of the two enzymes was the same (1 mark)

4.0

(ii) the value of the rate of product formation for enzymes H and J at the pH value stated in (c)(i) above (1 mark)

15.0 mg/hr

(iii) the optimum pH value for enzyme J (1 mark)

7.0 3

(d) State **one** variable that may lead to the change in the optimum rate of product-formation of the two enzymes. (1 mark)

- Temperature; - Cofactors
- Substrate concentration; - coenzymes
- Enzyme concentration; - (Enzyme) inhibitors

(e) Suggest with a reason, the likely part of the human alimentary canal where enzyme H would be found. (2 marks)

Stomach;

Acidic Medium/Low pH

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7. Giving examples, describe the following interactions among organisms: (20 marks)

(a) predator-prey
(b) symbiosis
(c) parasitism.

8. Explain the effect of increased physical activity on the following organ systems: (20 marks)

(a) heart
(b) lungs
(c) kidneys
(d) skin.

7 a) **Predator - Prey**

A Predator is an animal that hunts / kills another / other animals (Prey) for food;

eg. - A dog and a hare; (Acc other correct example)

Preys device survival mechanisms in their habitats not to be eaten / killed; to survive and reproduce / propagate their lineage; to this end (Preys) (Adaptations)

Adaptations

- They run faster (Stronger hind muscles);
- Camouflage with environments;
- Mimic the Predators; (Acc Some have a wider field of vision;)
- Some emit some chemicals / smell that turn of Predators;
- Other like Porcupine use quills / spikey spines to fight off Predators;
- Some have good sense of smell to detect Predators;

On the other hand Predators also evolve / devise means to be able to survive in such an ecosystem for instance (Adapt)

Adaptations

- Running faster; Strong jaws / long / sharp canines / talons;
- Camouflaging with the environment;
- Mimicking Prey; - Produce venom / poison that paralyse / kill Prey;
- Sharp eyesight;
- Strong sense of smell;

Total 18

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b) **Symbiosis**

Correct dfn (1mk) - Benefits - (2mks)
Correct example (1mk) Max 4

A close (long term) association between two organisms of different species where the two mutually benefit from each other;

Example 1. The bacteria in the rumen/gut of herbivores;
which help herbivores digest Cellulose;
as they are sheltered by the herbivores;

Example 2. The bacteria found in the human digestive system/gut/colon
The bacteria are sheltered by humans;
The bacteria aid humans in synthesis of vitamin K/Biz 1
ensure microbial balance;

Example 3. The Nitrogen fixing bacteria on the root Nodules of legumes;
NFB benefit from shelter offered by the plants.
NFB facilitate conversion of free atmospheric Nitrogen
into forms that can be readily by the plants;

Example
Lichen
Fungi & Algae

Example
Mycorrhiza
& Coniferous trees

c) **Parasitism** -
(- Dfn - 1mk, correct example - 1mk - Possible gains - 1mk - Host loses - 1mk - Type of Relationship)
Total 10 Max 4
- A kind of (inter-specific) relationship / Association where one member / organism, the Parasite, benefits while the other, the host is harmed / loses; Also called antagonistic / Anti Pathetic Symbiosis)

Example.
A tick (Parasite) sucking blood / Nutrients from a cow (host);
Making the cow to be anaemic / skin destroyed / Malnourished /
Transmission of diseases;

Parasite can be external / Ecto-Parasite; as
internal / Endo-Parasite; eg Liverfluke

Example 2: Liverfluke sucks blood / Nutrients from host
and can cause death / bodily harm on the internal
organs of the host including blocking blood vessels

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8a) **Heart**

Increased heart beat/rate/cardiac frequency; increase blood **pressure**; Pumping **More blood** to the muscles/peripheral blood vessels; at a faster rate; supplying **oxygen**; **Nutrients**; for continued oxidation/**respiration**; to yield energy needed to sustain the (vigorous) **contraction**/relaxation of muscles during the physical activity); Carbon(IV) oxide/Lactic acid/other Nitrogenous wastes/Metabolic wastes produced during the process are also eliminated/transported to the relevant excretory organs for elimination; the wastes, if left to accumulate can also intoxicate/poison cells/cause muscle cramps/pain/fatigue;

Total 10

b) **Lungs**

~~Panting~~/increased ~~breathing~~ **rate**; Cause the lungs to **expand**/increase in volume to take in **more** air/**oxygen**; and **deflate** to **expel More** Carbon (IV) oxide; More oxygen is taken in (during exercise) to Sustain the Process of muscle respiration/to Produce the required energy (for Constant muscle contraction and relaxation);

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c) Kidneys

Kidneys also maintain the blood Plasma pH; and osmotic balance; by eliminating excess Hydrogen ions(H^+) that accumulate due to Production of Lactic acid/ CO_2 during the exercise;

To maintain the osmotic balance Kidneys conserve Sodium ions (Na^+); and reabsorb water (in the kidney tubule); Leading to reduction in the volume of urine produced; During exercise the Kidneys tend to filter out more urea releasing more in the urine;

d) Skin.

Due to increased muscle activity during Physical exercise one sweats (more); Eliminating Nitrogenous wastes/ excess water; through the skin/sweat pores) cooling the body; After (water in) sweat evaporates; the increased internal body temperature also leads to dilation of superficial blood vessels (vasodilation) /blood flowing near the skin; leading to loss of excess heat (to the atmosphere) by radiation/ convection; the hair on the skin surface also lie flat to allow for loss of heat (to the environment) by radiation/ convection;

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