

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) Total = 4
- Increased sodium chloride having more sodium and chloride molecules (ions) decreases water potential outside the seed, increases osmotic pressure, makes water potential more negative solution to be hypertonic to the cell sap in the seedling, makes the surrounding by osmosis are dehydrated, lose water molecules to the surrounding solution, reducing the (growth) enzyme activity; hence reduced growth rate. OWTTE
- (b) Apart from a ruler, state two other equipment one would need to determine the rate of growth in the roots. (2 marks) 3
- Thread; ^{acc}String; wire;
 - Dye accept (waterproof) ink; tissue paper or a piece of cloth;
 - Pen; (marker) (pen);
 - Book.
- (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) 2
- (Rate of growth/increase in length of) the shoot tip / apex;
- It is a region of (active) cell division/growth;
- acc. leaf;

- (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 highly dehydrated, lose water (hence) wither/die;

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 ($\times 10^4$)	4.8	5.3	6.7	7.6	8.47	9.82
White blood cells ($\times 10^4$)	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)

- The number of red blood cells count increase with the increase in altitude; to increase the oxygen carrying capacity (by the hemoglobin molecules in blood); since oxygen concentration is lower at higher altitudes; 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 or vulnerability of the body to microbial attack is not dependent on the altitude (to be countered by the white blood cells); hence the number of white blood cells count is constant at whatever altitude; OWTTE

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

(2 marks)

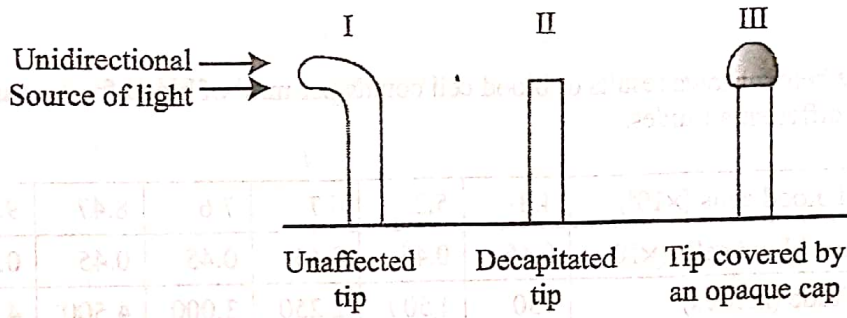
Atmospheric pressure decreases with the increase in altitude; the imbalance between the (outer) atmospheric pressure at high altitude and the internal blood pressure (generated by the heart) results in the nose bleeding at higher altitudes; internal blood pressure is higher than the outer atmospheric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

- Enables living organisms obtain access favourable environmental conditions (light, water, oxygen); anyone one.

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

- Enables living organisms to avoid dangerous / harmful harsh climatic conditions / environmental conditions; ✓
 or
 Enables 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 darker side; (of the shoot), resulting in faster division of cells / elongation / growth on the darker side / 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 / erect; seedling II does not have the tip, while in III the tip has been covered by an opaque material preventing light from causing uneven distribution of auxins. (Ref: didn't bend / remained upright.)

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

- Fitting an agar block treated with 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;

Punnett Square

Genotype $X^B X^G$; $X^B Y$;

X^B	X^G	
X^B	$X^B X^B$	$X^B X^G$
X^G	$X^B X^G$	$X^G X^G$

Gametes ;
 Anisiois / cross ;
 Genotype F_1 ;

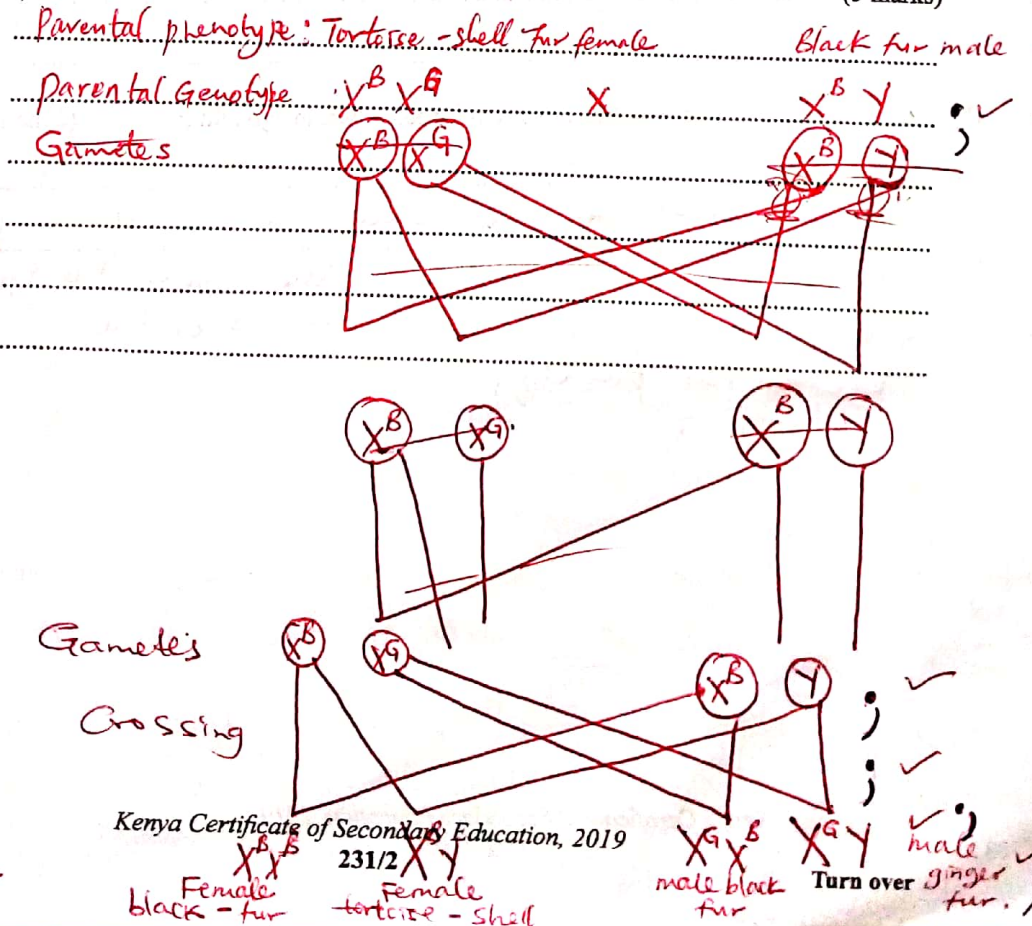
$X^B X^B$ female black fur
 $X^G X^G$ female ginger
 $X^B X^G$ female tortoise shell
 $X^B Y$ male black fur
 $X^G Y$ male ginger fur

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.

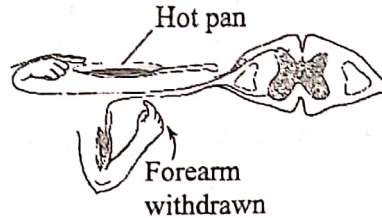
(a) With reference to the information given above, what is meant by the term codominance? (1 mark)
 - Both alleles are expressed / shown equally in the phenotype (of the offspring) / none suppresses the other gene for ginger and black fur from colour expressing itself in the phenotype (tortoise shell);

(b) Explain why male cats with a tortoise-shell phenotype do not usually occur. (2 marks)
 The gene for coat colour is contained on the X-chromosome; males have only one X chromosome (from female / mothers) / Y-chromosome does not carry the gene;

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



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



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

The stimulus (heat/pain) is detected by temperature/pain receptors (in the skin dermis); impulse is generated; transmitted sensory neurone to the central Nervous system/spinal cord. (chemical) transmission across synapse to relay neurone; ^{across a synapse} to motor neurone; ^{across} a synapse to muscle/effectors via motor neurone; motor/effectors contract; This is known as 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/die out (ahead of the beneficial plants);

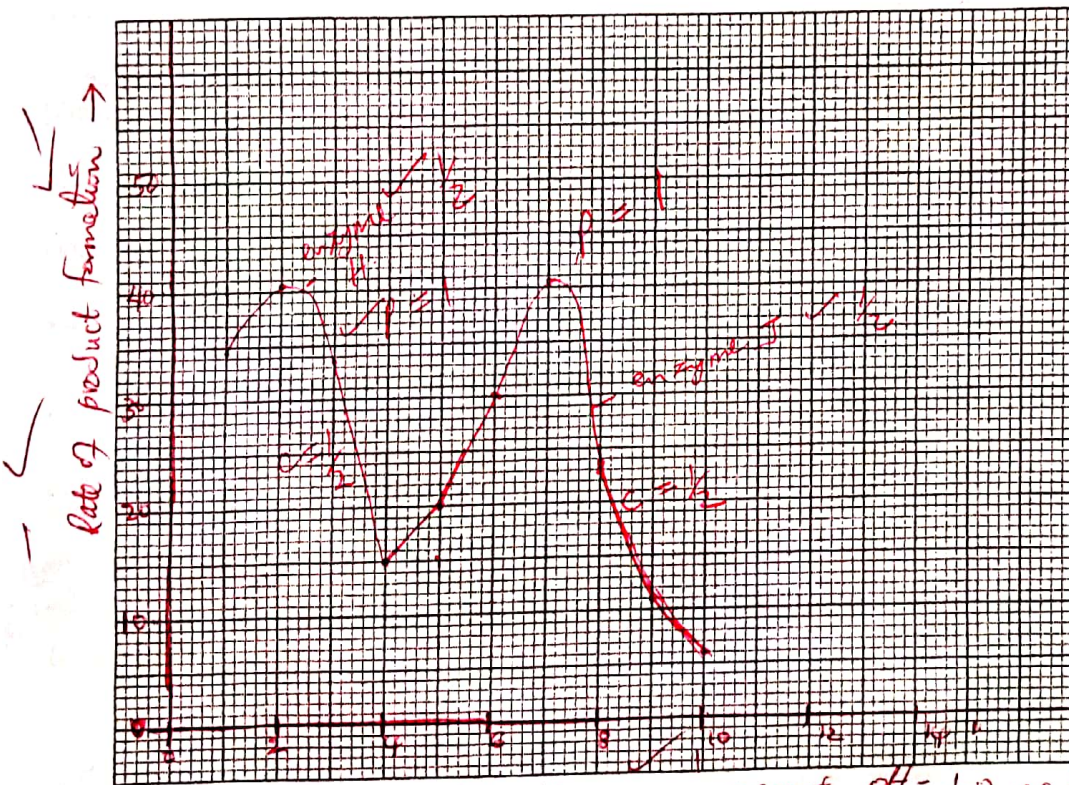
SECTION B (40 marks)

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)



$A = 1 \times 2$
 $S = 1 \times 2$
 $P = 1$
 $P = 1$
 $C = \frac{1}{2}$
 $C = \frac{1}{2}$
 $I = \frac{1}{2}$
 $I = \frac{1}{2}$
 If scale is correct,
 If origin is missing, penalise one scale - and combine marking the plot and the curve.

(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 up to the optimum then decreases; pH 2.0 is the optimum pH value for the activity of enzyme H; between pH 1.0 and 2.0 pH enzyme (molecules) are activated; between pH 2.0 and 3.0 pH enzyme (molecules) are denatured, destroyed; are inactivation, less active, for destroyed;

(ii) pH 3.0 and 7.0. - Rate of product formation (sharply) decreases with the increase in pH; enzyme H (is not favoured by the increase in pH, hence) is denatured; no product forms above pH 4.0 (to 7.0); because all enzyme molecules are denatured; (3 marks)

(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)

(pH) 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/hour rej if units are omitted

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

(pH) 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 (increasing beyond 40°C or lowering

extremely lowering it);
- (varying) substrate concentration; acc enzyme cofactors, (co-enzymes); enzyme concentration, 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;

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.

PREDATOR-PREY RELATIONSHIP.

A predator is an animal that hunts / kills another / other animals (prey) for food; example, a dog and a hare; preys devise survival mechanisms in their habitats not to be eaten / killed; to survive and reproduce / propagate their lineage; to this end, they run faster (strong hind muscles), camouflage with environment; mimic the predators; or some emit some chemicals / smell that turn off the predators; while others, like porcupines use quills / thorns / spines / ^{spikes} 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, running faster; camouflaging with the environment; mimicking preys; sharp eyesight; strong sense of smell; venom / poison; strong jaws / canines / talons / frontal eye sight; sharp curved claws (talons)



Symbiosis

Is a close, (long-term) association between two organisms of different species where the two mutually benefit from each other; for example, the bacteria in the rumen/gut of herbivores; which help the herbivores digest cellulose; as they are sheltered by the herbivores; the bacteria found in the human digestive system / gut / colon are also sheltered by humans; as they aid in the synthesis of vitamin K, B₁₂ / ensure microbial balance; the nitrogen-fixing bacteria on the root nodules of leguminous plants; benefit from the shelter and food nutrients the plants; as they facilitate conversion of free atmospheric ~~pressur~~ nitrogen into forms that can be readily absorbed by the plants;

Acc any symbiotic relationships

Examples: Mycorrhizal fungi, lichen - - -

Parasitism

Is a kind of interspecific relationship / association where one member / organism, the parasite, benefits while the other, the host is harmed / loses; (also called antagonistic / antipathetic symbiosis) for example a tick (parasite) sucking blood from a cow (host); making the cow to be anaemic / skin destroyed / malnourished / transmission of diseases; parasites can be external ecto-parasites; or internal / (endoparasite; for instance, liver fluke, suck blood / nutrients from the host and can cause death / bodily harm on the internal organs of the host, including blocking blood vessels)

for prey - wider field of view.

8. Heart

Increased physical activity results in increased heart beat rate | cardiac frequency; 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 the cells | cause muscle clamps | pain | fatigue. The panting | increased breathing rate; causes lungs to expand | increase in volume to take in more air | oxygen; and deflate to expel more carbon (IV) oxide; ~~and~~ More oxygen is taken in (during exercise) to sustain the process of muscle respiration | to produce the required energy | for the constant muscle contraction and relaxation;

Kidneys

Kidneys also maintain the blood plasma pH; and osmotic balance; by eliminating excess hydrogen ions that accumulated due to production of lactic acid | carbon (IV) oxide during exercise; to maintain the osmotic ~~pro~~ balance, the kidneys conserve sodium ions; and reabsorb water (in the kidney tubules); leading to reduction in the volume of urine produced; during

exercises, the kidneys tend to filter out more urea, releasing more in the urine,

Skin

Due to the increased muscle activity during physical exercises, one sweats, eliminating nitrogenous wastes / excess water; (through the skin) (sweat pores) cooling the body; after sweat evaporates, the increased internal body temperature leads to the dilation of superficial blood vessels (Vasodilation) (blood flowing under 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 by radiation / convection;

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