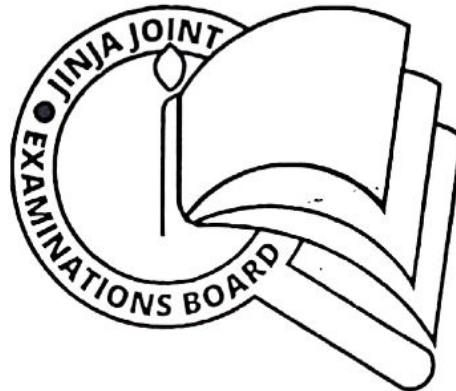


P530/2
BIOLOGY
(Theory)
Paper 2
AUGUST, 2022
2½ hours



JINJA JOINT EXAMINATIONS BOARD
Uganda Advanced Certificate of Education
MOCK EXAMINATIONS – AUGUST, 2022

BIOLOGY

(THEORY)

Paper 2

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES

Answer question ONE in section A plus three others from section B.

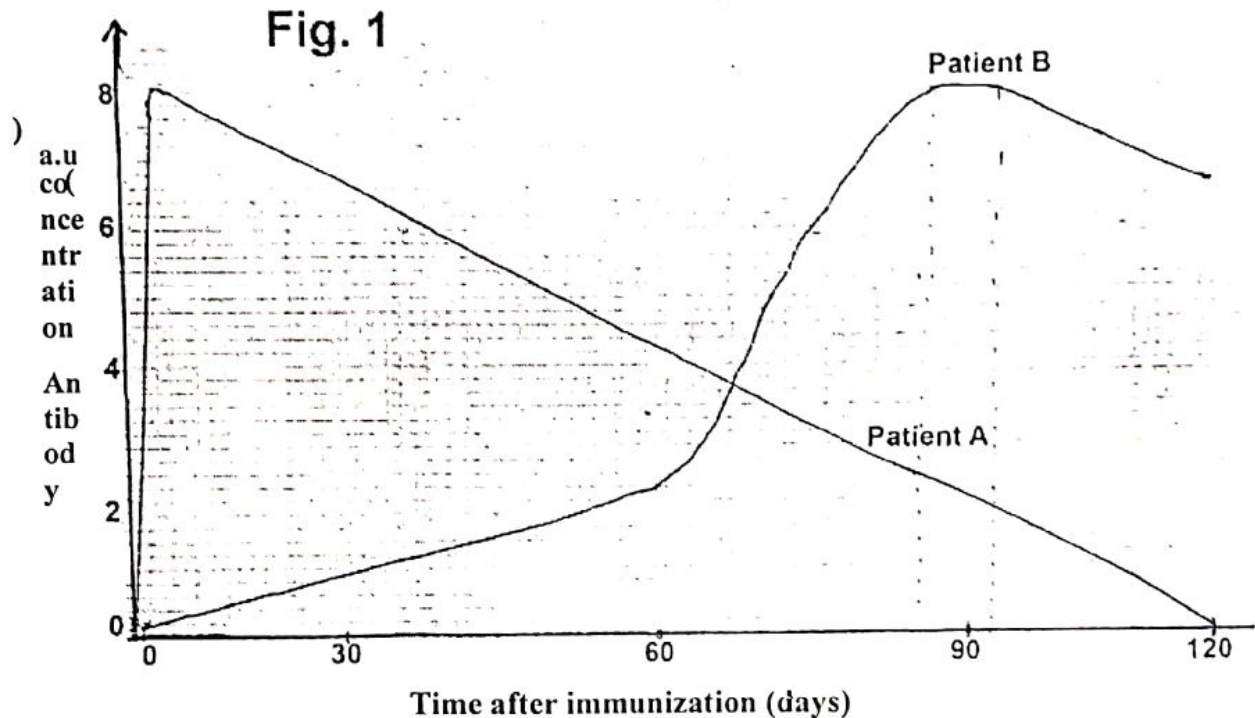
Candidates are advised to read questions carefully, organize their answers and present them precisely and logically.

Illustrate, whenever necessary, with well labelled diagrams.

SECTION A (40MARKS)

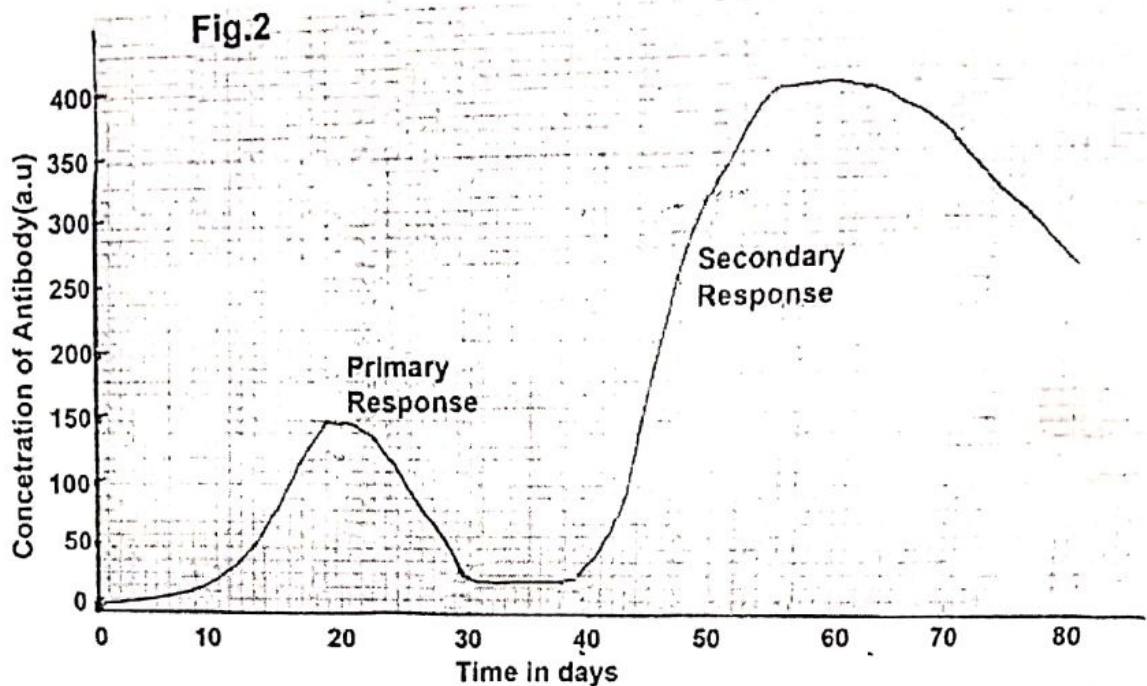
1. (a). The graph below in **Figure 1** below shows how the concentration of the antibody varied in each of the two patients after immunizing them with different vaccine against a pathogenic microbe.

Fig 1



- (i). Describe the variation of the antibody concentration with time in the patients immediately after their immunization. (07marks)
 - (ii). Explain the differences in the way antibody concentration changed immediately after the immunization of the patients. (12 marks)
 - (iii). Discuss the advantages of immunizing the infected individuals using the vaccines administered to each of patient A and patient B (07 marks)
- (b). The graph in **Figure 2** shows how the antibody concentration varies with time in

days in the first and second infections by the same pathogens.



- Explain the differences in the response to infections by the same pathogens indicated in fig 2. above. (06Mark)
- Describe how the antibodies produced in response to infections may destroy the pathogens. (04 marks)
- Suggest why it is advantageous to be exposed to mild infections of the pathogenic microbes such as corona virus. (04marks)

SECTIONB B (60MARKS)

- Explain the evolutionary significance of the processes that bring pollens and stigma together in terrestrial flowering plant species. (08marks)
 - Outline structural and physiological features of flowering plants that eliminate the disadvantages of inbreeding in crops. (06marks)
 - Suggest why farmers would prefer using seeds in crop propagation over other planting materials. (06marks)
- What is meant by
 - Species (02marks)
 - Species extinctions and (01Mark)
 - Pests resurgence? (01marks)

- (b). (i). Outline human activities that may lead to extinction of the species. (04marks)
 (ii). Explain how man has contributed to the formation of new species. (06marks)
 (c). Describe the evolutionary effects of the following.
 (i). Predation (03 marks)
 (ii). Migration (03 marks)

4. (a). Describe how the epithelial tissue is suited for the function of.
 (i). Protection (04marks)
 (ii). Gaseous exchanged and absorption of food. (08marks)
 (b). How are the requirements for efficient gaseous exchange fulfilled in the mammalian lungs and gills in fish? (08marks)

5(a) Explain what is meant by genetic disorder. (02marks)

- (b) Explain how a small difference in the base sequence of DNA can lead to a large difference in the structure of a protein produced such as hemoglobin (06marks)
 (c). (i). If two people with sickle cell trait marry, what are the chances that their first child will have sickle cell anaemia? (06marks)
 (ii). Explain why despite of strong selection pressure against people with sickle cell anaemia, the sickle allele is not easily eliminated in human populations. (06marks)

6. (a). State the functions of water absorbed into plants. (04marks)
 (b). Explain
 (i). the ways in which the soil temperature and humidity of air surrounding leaves affect absorption by the roots. (05marks)
 (ii). how the leaf structure is suited for transpiration? (06marks)
 (c). Compare transpiration and sweating in mammals. (05marks)



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MARKING GUIDE P530/2 2022

SECTION A

1.(a)(i) For patient A; the antibody concentration increased/accumulated/raised ^{rapidly} to the peak/highest concentration; immediately/at the time of vaccination; the antibody concentration in the body then decreased gradually/slowly with time; to zero/completion; at 120 days;

For patient B, after immunisation the concentration of the antibody increased slowly/slightly/gradually; from 0 to 60 days; it then increased rapidly; to a maximum concentration; from 60 days to 80 days; from 80 days to 120 days; the concentration of ~~remained at the peak for a few days~~; and then decreased very slightly; remained constant; from 95 days to 120 days; the antibody concentration decreased gradually;

07mk

e2

1/2 mark for any 14 07 marks

(ii) In patient A there was an immediate rapid accumulation/increase in concentration of the antibody while antibody was absent in patient B; immediately after the vaccination; This is because patient A was directly vaccinated by the antibody; while patient B received an Antigen vaccine;

Over the 120 days the antibody concentration in patient A decreased slowly to zero while that of Patient B increased slowly up to 60 days; then increased rapidly to peak at 85 days; and after wards from 85 to 120 days it decreased very slowly/gradually;

12.

This is because in patient A the antibody being a protein is broken down over time; in patient B, the introduction of antigen vaccine stimulates the lymphocytes to start producing antibodies slowly for the first 60 days; since some time is taken for lymphocytes to recognise the antigen/vaccine; The rapid increase from 60 to 90 days may be due to the infection; which results in secondary response; if the individual is attacked by the pathogen in the vaccine;

1 mark @ 12 marks

(iii) Vaccine to patient A is an antibody; which is given /administered in enough amounts/concentrations that can suppress the effects of the pathogen/parasites in case of infection; in early days after immunisation; immediate protection; However it is used up completely over time; and this leaves the body unprotected; in case of future attack/infection by the parasite immunised against; Vaccine to patient B is an antigen; which stimulates the lymphocytes to start producing the antibodies; At the beginning days after immunisation the concentration of the antibody is small or accumulate very slowly; and in case if infection at that time; the development of a disease may not be prevented; However, any infection causes rapid production of antibody; and

@1mk

max 07mk

the body has its own defence system to fight the pathogens/ parasites immunised/ vaccinated against;

1 mark @ 7 marks

(b) In primary response which occurred after first infection with pathogen/antigen the antibody concentration increased ~~very slightly~~ and then increased gradually to a lower peak; and decreased rapidly to a lower concentration in blood; while in secondary response which occurred after second infection/challenge with the pathogen/parasites/antigen; the antibody concentration increased ~~very steeply~~ rapidly; immediately after the infection to a higher peak/maximum concentration and it then decreased slowly/ gradually/slightly in the remaining period of time.

0.5 marks

Award for any correct difference & explanation given full marks

This is because in secondary response there are memory B cells; which produce antibodies immediately the pathogen /antigen gains entry into the body; and antibodies produced are stronger and last for a longer time than the antibodies produced in the primary response;

1 mark @ 06 marks

(ii) ^{Acc. Agglutination} The agglutinins bind to the pathogens causing them to clump together which lead to their death;

• The lysins bind to the pathogens causing them to disintegrate and die in a process called lysis;

^{Acc. Opsonisation}
• The opsonins bind to the pathogens making it easier for phagocytes to engulf them;

0.5 marks

^{Acc. Neutralisation}
• The Antitoxins bind to pathogens and neutralise toxins they produce or from other sources;

• Precipitation bind pathogens making them immobile;

1 mark @ 4 marks

(c) Mild infections introduce the antigens/pathogens for the disease into our body but the disease may not develop to serious condition; However, pathogen ^{stimulates} the body/ lymphocyte to start producing antibodies; and memory B cells/ primary response to infections; Therefore in case of future infections/attack by the same pathogens; the antibodies are immediately and rapidly produced by the memory cells/secondary response occurs/ to counter the effects of the pathogens;

0.5 marks

1 mark @ 4 marks

Total = 40 marks

SECTION B

2(a) Self pollination; maintains the characteristics of the parental plants; but the reduced genetic variation; causes reduced fertility; and reduced resistance to diseases; and all members may be wiped out in case an epidemic, e.t.c;

Cross pollination; results in formation of hybrids that may show variation superior to those of the parents/ show hybrid vigour such as increased growth rate and size; resistance to pests and harsh climatic condition such as long periods of dryness; increasing the chances of survival of organisations/plants produced by cross pollination.

1 mark for any 8 08 marks

- ✓ (b) Dioecism/plant species with flowers of opposite sex developing on different plants. Pollination is only by cross pollination;
- Self incompatibility/Growth of pollen/growth of pollen tubes cannot occur on stigma of same flowers or flowers of the same plants;
- Protogyny or protandry/maturation of stigma before pollen grains by the same plant/maturation of pollen grains before maturation of stigma of flowers on the same plant;
- Stigma being above anthers hanging down wards;
- Presence of brightly coloured petals which attract external insect pollinators;
- Secretion of sweet smelling substances that attract insects' pollinators;
- ~~Strictly pollen grains attracting on insect pollinating agents;~~
- monocious; having separate male & female flowers on the same plant reduces likelihood of self pollination;

1 mark @ 06 marks

(c) Seeds can be preserved and stored for a long period of time; This is because the conditions for their germination are known and can be controlled so that planting is done when crop growth is assured;

Seeds are small and easily distributed in large quantities from one place to another with no or very minimum spoilage;

Seeds are formed by fertilization; and plants developed from seeds may show ^{variation} hybrid vigour characteristics by advantageous features of crops such as increased growth rate; high yield/large fruit size; and high resistance to pests, and droughts;

1 mark, @ for any 6 6 marks

Total 20 marks max

3(a)(i) A species is a group of organisms with similar characteristics/with similar morphological features; and interbreed among themselves to form fertile or viable offspring;

02 marks

(ii) Species extinction refers to when all the existing members of a species become completely wiped out such that there is not any surviving members;

(iii) Pest resurgence refers to when the residual population of pests increases rapidly without check to worse levels than before after the natural predators as well as other pests had been killed by the non-specific pesticides;

1 mark

(b) (i) Land reclamation/ Deforestation;

- ✓ Application of pesticides;
- ✓ Over fishing;
- ✓ Poaching; ^{hunting}
- ✓ Disposal of wastes into water bodies;
- ✓ Land fragmentation by road construction;

- Industrialisation producing poisonous gases
- Swamp reclamation for agriculture & settlement.

Any 4 marks

(ii) Throughout ^{cross breeding} breeding / selective controlled reproduction between genetically distant related individuals of a species or closely related species; new forms of plants species have produced ^{hybrids};

Through inducing polyploidy in crops ^{eg application colchicine chemical}; new forms of plants/crops species are produced e.g. in wheat plants;

Through excess use/application of pests and drugs / chemicals; resistant forms due to random mutation have emerged;

1 mark @ 06 marks

(c) (i) Predation may cause evolution / emergence of preys with features that enable them to survive predation; These are selected for / survive better / at selective advantage and are perpetuated future generation; over time such preys may only exist after complete wiping out of the vulnerable preys; thereby creating vacant niches which can be exploited by other organisms; (1 mark @ 3 marks)

(ii) This inborn behaviour in some animals / birds enables them to avoid the likely unfavourable condition in a given habitat; and they move places with suitable factors for survival increasing their chances of survival through generations; Change in gene frequency due to emigration and immigration of populations is the basis of evolutionary process that may bring about formation of new species;

3 marks

4. (a) (i) The skin on the body surfaces in animals is an example of epithelial tissue for protection. It is thick / has several layers; to protect the inner structures from the penetration of pathogens; The outer layer / epidermis is keratinised dead; and this reduces evaporation, hence desiccation is prevented; The

Cells are continuously replaced by mitotic division of germinal layers; to allow it withstand the forces of tear & wear;

melanocytes in the skin on the body surface produce melanin; which protects inner cells from mutagenic ultra violet rays;

1/2 mark @ 4 marks

(ii) Gaseous exchange occurs at the alveoli in lungs/outlet and buccal skin in loads/amphibians; The tissue consists of numerous cells to provide a large surface for absorption; and a single layer of flattened cells; to reduce the distance for diffusion of gases;

The ileum part of the gut has epithelial tissue for absorption of food; it is one cell layer thick; for easy diffusion/reduce the diffusion distances; cells have microvilli on the free surface; this increases the surface area over which absorption occurs; The ileum is long; which increases the surface for absorption; and being coiled makes food move slowly to allow maximum absorption; The cells in the epithelial layer have numerous mitochondria; which produce ATP; for active absorption of glucose and amino acids;

e1mk.

max 08

(b) In the lungs gaseous exchange occurs at the alveoli. The alveolus is one cell layer thick; of flattened cells; to reduce diffusion distance of gases; The squamous cells are numerous; providing large surface area over which exchange occurs; The alveoli are supplied with capillaries; the absorbed oxygen is carried away while carbon dioxide is brought into the lungs; which maintains the diffusion gradient; for oxygen into blood and carbon dioxide out of blood to alveolar space;

05

The free surface of alveolus is uncutinised; and this allows permeability of the respiratory surface; The free surface is moist; for dissolving oxygen which diffuses faster in dissolved form;

02

Award once
- thinness
- vascularised
- Numerous

The gill plates provide the surface for gaseous exchange; They are numerous; providing the large surface area over which gases are exchanged; highly vascularised with capillaries; for carriage of oxygen away; and carbon dioxide to the gills; which maintain a diffusion gradient; Thin layer of epithelial cells; for easy diffusion of gases; counter-current flow of water and blood in capillaries; maintains diffusion gradient; The red blood cells have very high affinity for oxygen; picks oxygen from low concentrated water;

06 1/2

1/2 mark for any 16, 08 marks

5. (a) Genetic disorder refers to an abnormal body condition/disease/unfavourable condition; caused by inheritance of a mutant gene/s; which are not normal cell anaemia caused and expressed in recessive homozygous individuals;

1 mark @ 2 marks

(b) A single base substitution that occurs in the sense strand of DNA results in an abnormal haemoglobin; In DNA the base A (adenine) substitutes/replaces base T (thymine) so that a triplet codon in a mutant strand is CAT instead of CTT in the normal DNA; when the mRNA is formed GUA is transcribed instead of GAA; During translation mutant mRNA incorporate the amino acid valine, which is coded for by GUA instead of glutamic acid; in the same position of a forming normal haemoglobin; the abnormal haemoglobin contains valine in position 6 of β -chain while the normal haemoglobin A has glutamic acid in the equivalent position; *which is deficient in carrying oxygen;*

1 mark @ 06 marks

(c) (i) When both parents are carriers;

Parental phenotype: Normal but carrier (♂) x Normal but carrier (♀) ✓
 Parental genotype: $Hb^A Hb^S$ x $Hb^A Hb^S$ ✓

Gametes formed by meiosis: Hb^A Hb^S Hb^A Hb^S ✓

Offspring genotype: $Hb^A Hb^A$, $Hb^A Hb^S$, $Hb^S Hb^A$, $Hb^S Hb^S$ ✓
 Offspring phenotype: completely Normal but sickler ✓
 Phenotypic ratio: 3 Normal : 1 sickler ✓
 Therefore, the chances that the first child has sickle cell anaemia are 1 in 4 children $\frac{1}{4}$ or 0.25 / 25% ✓

Accept also, a mating between a carrier female and sickler male parents. The chances of producing the first child with sickle cell anaemia from such a couple are 1 in 2 children.

1 mark @ 06 marks

(ii) The sickle cell allele is not easily eliminated because of heterozygous advantage/ balanced polymorphism;

Individuals who are $Hb^A Hb^A$ and $Hb^A Hb^S$ are both phenotypically normal but the heterozygotes / carriers are resistant to malaria; Therefore in an environment where malaria is the selection pressure; completely normal

Individuals are selected against, while the carrier Hb^AHb^S are selected for as survival better. The recessive allele for sickle cell anaemia (Hb^S) are harboured by carriers and these are capable of giving rise to offspring with sickle cell anaemia.

1 mark @ 06 marks

6.(a) - Reactant in photosynthesis ✓

- Provide support to non-woody parts when epidermal cells take up water by osmosis and become turgid ✓
- Medium of translocation and transport ✓
- Cooling of plants when evaporated during transpiration ✓

1 mark @ 4 marks

(b)(i) When soil temperature is warm there is increased uptake of water by active transport ✓
and at very low temperature water absorption is reduced in plants ✓
by diffusion ✓

Humidity of surrounding air of the leaves affects the rate of transpiration ✓
which in turn affects the rate of water absorption by the roots. water
absorption is rapid when the humidity is low during dry days and windy days ✓
and transpiration is very high. The rate of absorption reduces during humid
days when transpiration rate is low ✓

@ 1/2 mk.

1/2 mark @ 5 marks

(ii) The leaf has intercellular spaces especially in the spongy mesophyll cells ✓
in which vapour accumulates from the wet cells in the leaf. The leaf has
numerous pores/stomata through which accumulated vapour in the leaf
escapes by diffusion/evaporation ✓

The leaf lamina is thin ✓ this reduces the diffusion distance of vapour escape
from intercellular spaces through stomata to the outside of the leaf ✓

1 mark @ 06 marks

(c) Similarities between sweating and transpiration

- ✓ Both involves evaporation of water vapour from the body ✓
- ✓ In both cooling effect to organism occurs ✓
- ✓ Both are affected by environment factors such as temperature ✓

Differences between sweating and transpiration

Sweating	Transpiration
<ul style="list-style-type: none"> ✓ Secretion of sweat glands in response to increased temperature as a control ✓ Evaporation occurs from the external body surface. ✓ Escape in fluid form from the sweat pores. 	<ul style="list-style-type: none"> ✓ Occurs as result of stomatal opening in presence of light for carbon dioxide up take ✓ ✓ Evaporation occurs from cells inside the leaf ✓ ✓ Lost as water vapour through the stomata/cuticle/stomata ✓

1 mark : for an 5 marks

TOTAL = 20 MARKS