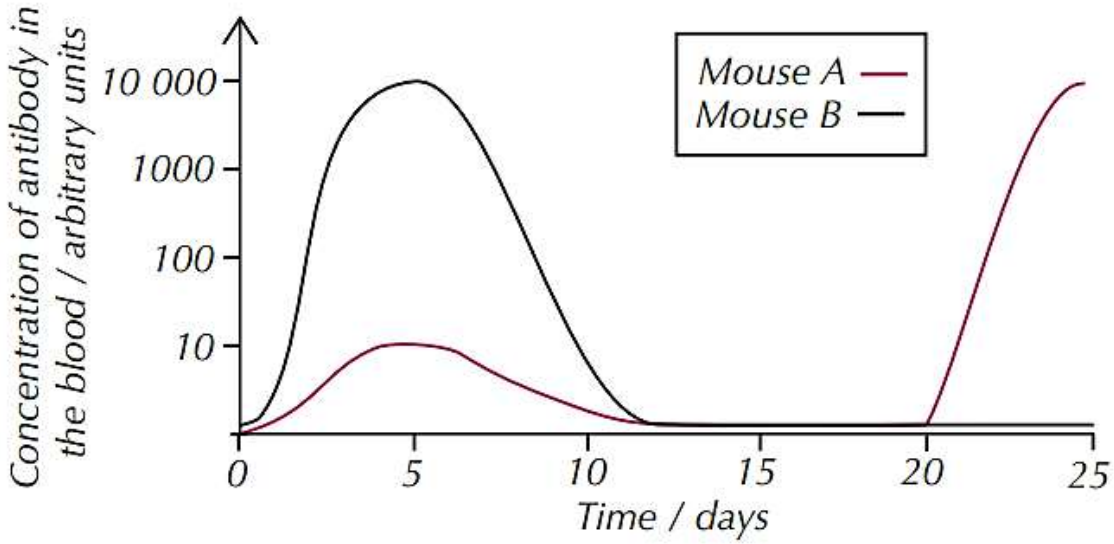
MARKING GUIDE FOR RESOURCEFUL MOCK PAPER II-2022.

The graph below shows the immune responses of two mice exposed to a pathogen. Both mice were exposed on day 0 of the experiment. Study the curves below to answer questions that follow.



a) Compare the antibody concentrations in the two mice after exposure to the pathogen. (05 marks)

Descriptions	Marks allotted	Comment
Similarities **(in both) concentration of antibodies in mouse A and B.** **Increases with time; (from day 0 to day 5)** **Decreases with time; (from day 5 to day 12)** **Initially/At day 0 antibody concentration was low;** **Attain peaks; Attain maximum level; Was equal from day 12 to day 20; Remained constant from day 12 to day 20;**	**Any 3 marks**	**"in Both" used.**

Differences in antibody concentration.		Accept from - to -	Accept statements clearly written by the students. Using "While" Whereas.
Mouse A	**Mouse B**		
Gradual/slow increase to peak	**Sharp/rapid/steep/drastic increase to peak;**		
Initially Zero/lower;	**Initially higher;**		
Higher maximum	**lower maximum;**		
Lower peak	**Higher peak;**		
From day 20 to day 25, rapid increase;	**Remained constant;**		
Short lag/latent period/ takes a while;	**longer lag period;**		
Gradual decrease from peak/maximum;	**Rapid decrease from peak/maximum;**		

(i) Account for the differences in the concentration of antibodies in the two mice for the first 20 days following exposure. (12 marks)

Initially antibody concentration in Mouse B was higher while that in Mouse A was zero because Mouse B had already B- memory cells; following previous attack/already immune/exposed before; which continued to circulate in blood and lymph and secreted little antibodies;
Antibody concentration in mouse B increased rapidly to peak, (higher maximum) and (higher peak) while that in mouse A increased gradually to peak, (lower maximum) and (lower peak) because mouse B had a larger population of B- and T-memory cells; rapidly activated or (recognized) on pathogen entry; T and B-memory cells divided by mitosis and differentiated; Memory B-cells into larger number of plasma cells; Memory T-helper cells into T-helper cells; T-helper cells secreted lymphokines which stimulated large population B-plasma cells to form antibodies;
Mouse A starts with fewer B-cells/One B-Cell with specific membrane receptors complementary to antigen shape; producing primary response; fewer clones of B-plasma cells and hence low antibody concentrations.
Mouse A has a shorter Lag phase while mouse B has longer lag phase because different types of mice have different genetic immune capacities; lag phase involves: antigen recognition, antigen presentation and clonal expansion in lymphocytes. longer the processes, the longer the lag phase.
Antibody concentration decreased rapidly in B while gradually in A because in presence of large quantities of antibodies in blood of mouse B; pathogen is rapidly cleared/destroyed/shorter time/mouse immune; then the spleen and liver destroys the antibodies after use.

(ii) Account for the variation in antibody concentration after the first 20days of exposure in mouse A (05 marks)

Antibody concentration increased very rapidly to maximum; large population immunological memory B and T-cells; pathogen rapidly recognized and presented; B-memory divide by mitosis forming large population of B-Plasma cells; T-memory into T-helper cells; B-plasma secreting large quantities of antibodies due to stimulation by lymphokines from T-helper cells;

b) From the graph above, suggest with reasons.
(i) Mouse that spreads the disease to other mice during first exposure with the pathogen. (05 marks)

Mouse A; because the maximum antibody concentration attained was lower on first exposure/gradual increase in antibody concentration; due to fewer B-cells/One B-Cell; pathogen not completely cleared/destroyed; completed life cycle; Spreads to body fluids eg saliva; very infectious.

(ii)Beyond 10days, why antibody concentration decreases for both mice. (03 marks)

Antibodies are cleared/removed from circulation; (blood and tissue fluid) by spleen and liver; after immune response completed/pathogen cleared;

b) Using the knowledge from the graph, explain how the above information can be employed by humans to increase their longevity. (07marks)

Vaccines contain antigens or attenuated (weakened) pathogen; stimulate body to produce specific T and B- memory cells; without the pathogen causing disease; (immune without symptoms) protect individuals that are vaccinated; and non-vaccinated; by reducing the occurrence of the disease; herd immunity; booster vaccines stimulate production of more B and T-memory cells and Stable IGg antibodies; long lasting immunity/life- long immunity.

c) Illustrate how mutations are basis for immunity defectiveness in human beings. (03 marks)

Mutations causes change in surface antigen/Antigenic variation; immune cells no-longer recognize the antigen for destruction/pathogen evades immune system; pathogen destroys immune cells/causes death;

SECTION **B**

2 a) Describe how the nephron performs the following functions during urine formation in Man.

(i) Selective reabsorption of Glucose. (05 marks)

Sodium ions are actively/use ATP; transported out of the cells lining the proximal convoluted tubule; into blood capillaries; by sodium-potassium ATPase pump; sodium ion concentration in cells lowered; Sodium ions diffuse; down a concentration gradient; from the lumen of the proximal convoluted tubule into the epithelial cells; via special carrier protein/symporter/co-transporter; transporting glucose along; glucose diffuse into blood;

(ii) Regulation of Blood Potential of hydrogen. (05 marks)

Fall in blood P^H below normal; distal convoluted cells secrete hydrogen ions into glomerular filtrate; and retain hydrogen carbonate ions; excreted protons react with disodium hydrogen phosphate; forming sodium dihydrogen phosphate; react with ammonia; forming ammonium salt;
Rise in P^H above the norm; distal convoluted tubule retains hydrogen ions; and excrete hydrogen carbonate ions;

b) Explain the attempts of the

(i) Ectotherms to regulate body temperature. (07 marks)

Basking in the sun; perpendicular allows heat gain; parallel to reduce heat gain; thermal-gaping; evaporation of heat from moist lining of the buccal cavities; Salivation over neck and front legs; moisture increases heat evaporation from the surfaces; Burrowing/hiding under stones during hot and cold times; Raising the body off the ground; to reduce gain by conduction; Move into water to cool; cold night to warm; Panting; to increase surface area for heat loss by evaporation; Elimination of hot urine from cloaca to cool; Slowing down heart beat/bradycardia reduce blood flow between skin surface and core tissues in cold waters; Change colour of skin; darker for heat gain; lighter to reduce gain; Thermal dancing; loss by convention; Curling to reduce heat gain surface area; shades to cool;

(ii) Mammals in Cold waters to conserve heat. (03 marks)

Counter current heat exchanger in appendages; close arterial and venous blood in vessels; heat flows along thermal gradient from arterial blood to venous blood;

3 a) What is meant by adaptive radiation? (03 marks)

Evolution of ancestral species into different species to fill different ecological niches; population introduced into new area with (vacant ecological) niches for colonization; homologous structures formed;

b) Describe the role of the following in speciation.

(i) Polyploidy (07 marks)

Possession of more than one set of chromosomes; polyploid individuals are genetically and reproductively isolated from original diploid individuals; Interbreeding doesnot occur/fails; but interbreed among themselves; polyploids are better adapted to different ecological niches; increasing chances of successful establishment through natural selection than diploid individuals; evolve into distinct species overtime;

(ii) Isolation (07 marks)

Reproductive; or geographical isolation; preventing gene flow/interbreeding among demes; populations experience slightly different conditions; selection pressures differ; natural selection influences the two population differently as they adapt independently to different conditions; allele frequency changes because different allele will be more advantageous in different demes; mutations and genetic drift occur independently causing further changes in allele frequency; accumulated differences cause genetic isolation; hence unable to interbreed successfully.

(iii) Mutations. (03 marks)

Mutations introduces new alleles/genes; leading to genetic or reproductive isolation; fertilsation of gametes unsuccessful; or favourable mutations are selected for by the environment; and unfavourable are eliminated; perpetuation of favourable mutations; due to increased adaptability;

4a) Explain the Functions of the following in photosynthesis.

(i) Lamellae

Lamellae, intergranal/unstacked thylakoids; and stacked thylakoids/grana; folded membranes provide large surface area for attachment of photosynthetic pigments; chlorophyll and carotenoids; electron carriers and enzymes of dark reaction; form photosystems; for harvesting light; Membranes with ATPase/ATP synthase for catalysis of ATP formation during photophosphorylation;

(ii) Photophosphorylation

Cyclic photophosphorylation/Z-scheme; forms much ATP; and much reduced NADP for dark reaction;

(iii) Water (07 marks)

Donate electrons to chlorophyll a in PSII; sources of hydrogen ions in formation of reduced Nicotinamide adenine dinucleotide phosphate/photophosphorylation;

Maintains cells turgid for photosynthesis; source of Oxygen as bi-product;

b) Describe the following evidences that show photosynthesis is a double stage reaction.

(i) Intermittent light supply

Intermittent/flashes of light/discontinuous light yields more photosynthetic products than continuous light supply; continuous light produces much ATP and NADPH+H$^+$; accumulate and slow down the process; dark periods allow dark stage to use up the much ATP and NADPH+H$^+$ completely;

(ii) Temperature Co-efficient. (07 marks)

Light stage show unity temperature co-efficient (Q_{10}=1.0); no increase in rate of reaction with increase in temperature; but for dark reaction, temperature co-efficient (Q_{10}=2/3); reaction affected by temperature increase/temperature sensitive; controlled by enzymes;

c) Outline the significance of leaf Unfolding in relation to photosynthesis. (06 marks)

Unfolding causes phytochrome controlled reactions/photo-morphogenesis to occur; chlorophyll development; from etioplasts; greening; due to conversion of proto-chlorophyll to chlorophyll; increased surface area for photosynthesis;

5a) How does photoperiods play role in the following

(i) Flowering (07 marks)

Long light periods cause flowering in LDPs; red light converts Phytochrome red to far red; Short light periods cause flowering in SDPs; far red light converts phytochrome far red to red; in both florigen precursor; converted to florigen; travels to shoot apex causing flowering;

(ii) Dormancy in plants (05 marks)

Shortening days; photoperiodic stimulus received by leaves; stimulating increase in ABA levels; moves to meristem inhibiting growth; cause formation of buds and tubers which lie dormant;

(iii) Breeding behaviour in animals? (05 marks)

Increasing light and lengthening of the day; increases the size of gonads/maturation of gonads; due to secretion of gonadal/reproductive hormones; such as testosterone; controlling mating through change in plumage/mating calls/postural displays;

b) Explain role of gibberellins in germination of seeds. (03 marks)

stimulates synthesis of alpha amylase; enzyme for breakdown of starch to sugar products; for synthesis of new cell walls/respiration to form energy;

6a) Describe the classification of covering epithelia basing on.

(i) Cell arrangement (03 marks)

Simple epithelia; one cell thick;
Stratified epithelium/compound epithelia; many cells thick;
Pseudostratified epithelium; appear as more than one cell thick; with all cells resting on basement membrane;

(ii) Cell shapes (07 marks)

Squamous epithelium/pavement epithelia; flattened cells shaped like paving stones; smooth surface; shallow cells; projecting nucleus;
Cubical epithelia; cells are cube-like/isodiametric;
Columnar epithelia; cells are taller than they are wide;
Transitional epithelia; cells change shape when stretched;

b)(i) Explain the adaptations of the xylem to the diurnal changes in diameter. (05 marks)

Heavily lignified; for high tensile strength; Dead tissue; not strained by pressure surges; flexibility; prevents breaking during stretching/bending;

(ii)Suggest the role of secondary growth in the plant life (05 marks)

Highly lignified secondary Xylem/Wood; provides high mechanical strength to land plants; Cork Cambium forms cork cells; loosely packed forming lenticels; for gaseous exchange; Cork cells in the bark impregnated with suberin; reduce desiccation/water loss/underlying tissues from weathering/infections; trees reach great/maximum size and age as they expand laterally/sideways; vascular cambium forms Secondary phloem for food conduction; secondary xylem for conduction of water and mineral salts; medullary rays; allow horizontal movement of water and mineral salts/storage; increases thickness and strength of the stem; enabling it to grow to much greater height;