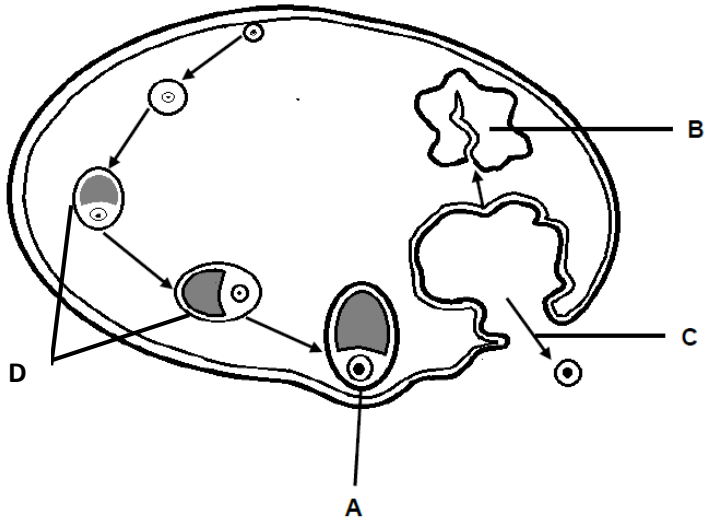
S.6 BIOLOGY (P530/1)
1Hour 30 Minutes

Instructions

*Attempt **all** questions in this paper.*

***Precise and sequential presentation of answers** is required of candidates*

1. The diagram below shows the sequence of events that takes place during the ovarian cycle of a human female.



(a) Identify structures labeled **A**, **B**, **D** and process **C**. (**2marks**)

A: ***Graafian follicle/Ovarian follicle***;✓
B: ***Corpus luteum;***✓ ***Acc Glandular mass of yellow tissue***
D: ***Growing follicle***;✓
Process **C**: ***Ovulation***;✓ ***@ ½ mark***

(b) State the main hormone secreted by structured labeled **B**, clearly giving its roles during this cycle. (**3marks**)

Progesterone;✓✓
Stimulates <u>further</u> growth of the uterine wall/endometrium and its blood supply for implantation of blastocyst (young embryo);✓✓
Inhibits secretion of Follicle stimulating hormone by anterior pituitary gland;✓ ***allowing only one follicle develop at a time***;✓
Award only if there is correct label in (a) ***@ ½ mark***

(c) Briefly explain what would happen if fertilization does not occur. (**3marks**)

Corpus luteum/B atrophies;✓ ***into corpus albicans;***✓ ***secretion of progesterone and oestrogen ceases/is reduced;***✓

In low levels of progesterone, inhibition of secretion of Follicle stimulating hormone ceases;✓ increasing concentration of Follicle stimulating hormone;✓ lining of the uterus is sloughed off, passed out via vagina together with blood;✓ **@ ½ mark**

(d) What is the role of hypothalamus in the ovarian cycle? (**2marks**)

Secretes Gonadotrophin releasing hormone;✓ that stimulates the anterior pituitary gland to secrete Follicle stimulating hormone;✓ triggering the development of follicles in the ovary;✓ and secretion of oestrogen by ovaries;✓ ***@ ½ mark***

2. (a) What is meant by the following ecological terms? (**3marks**)

(i) Indicator species

Are organisms that by their presence, abundance and absence signal a change in the biological conditions of a particular ecosystem;✓

(ii) Biotic index

Is a scale for showing the quality of an environment by indicating the types of organisms present in it;✓
OR
Is a numerical expression coded according to the presence of bio indicators differing in their sensitivity to environmental conditions;

(iii) Endangered species

Is a species very likely to become extinct; owing to its continued decrease in numbers;✓ ***@ 1mark***

(b) Explain the use of biotic indices in monitoring environmental changes. (**3marks**)

Biotic indices compare relative frequency of indicator species;✓ with their change over time marking a change in the environmental condition within an ecosystem;✓
<u>High biotic index</u>;✓ signals abundance of pollution sensitive organisms/unpolluted environment;✓
<u>Low biotic index</u>;✓ indicates absence of indicator species;✓ and abundance of pollution tolerant organisms /denotes a polluted environment;✓ ***@ ½ mark***

(c) What are the advantages of in situ conservation of endangered species? (**4marks**)

Allows species live in an environment to which they are highly adapted; thus occupying their natural positions in the food chains;✓
Prevents environmental loss of natural habitats; thus availing for other endangered species;✓
Larger populations are protected and maintained simultaneously;✓
Increased chances of population recovery;✓
Costs of conservation efforts are low;✓
Species are provided with chance to adjust to the prevailing environmental conditions such as drought, pathogens, temperature fluctuations, thus evolve into a better adapted life form;✓
Maintains animal's normal behavior (offsprings usually acquire skills from parents and peers around;✓
Any correct four @ 1mark

3. (a) Cells in the lining of the stomach secrete pepsinogen, an inactive form of pepsin.

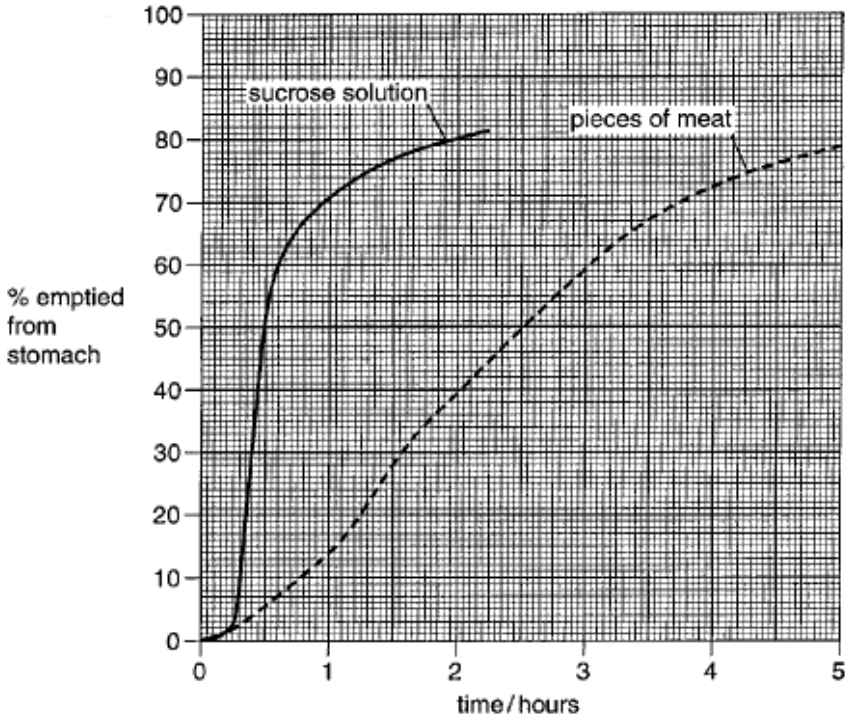
(i) Explain why cells in the stomach secrete pepsinogen rather than pepsin. (**2marks**)

Pepsin a protease/protein digesting enzyme;✓ would digest/break down the stomach cells (chief/zymogen/peptic cells);✓ protein in nature, that secrete it;✓✓ @ ½ mark
OR
Inactive pepsinogen prevents auto digestion;✓ allowing it to be converted to active pepsin, only when protein food and/or hydrochloric acid is present in the stomach;✓ @ 1mark

(ii) Suggest how pepsinogen is converted to pepsin. (**2marks**)

Longer Pepsinogen molecule is cleaved/part of molecule (44 amino acids from N-terminal end) removed;✓✓ by action of hydrochloric acid/ in acidic medium;✓ autocatalysed by pepsin;✓ @ ½ mark

(b) An investigation was carried out to determine the rate at which the contents of the stomach are emptied into the duodenum in response to types of food, sucrose solution and pieces of meat.
The results of this investigation are shown in the figure below. Study it carefully and answer the questions that follow.



(i) How long does it take for 50% of each food to be emptied from the stomach? **(2marks)**

Sucrose solution: ***30minutes/ ½ hour;***✓

Pieces of meat: ***2hours 30minutes/ 2½ hours;***✓ ***@ 1mark***

(ii) Explain the significance in the difference in the time taken by sucrose solution and pieces of meat to be emptied from the stomach. **(4marks)**

Sucrose solution took a shorter time in the stomach/emptied faster from the stomach than pieces of meat;✓ because no sucrose digesting enzyme/sucrase/carbohydrate digesting enzyme;✓ thus it passes straight through the stomach into the duodenum;✓ unlike pieces of meat whose chemical digestion starts in the stomach by pepsin;✓

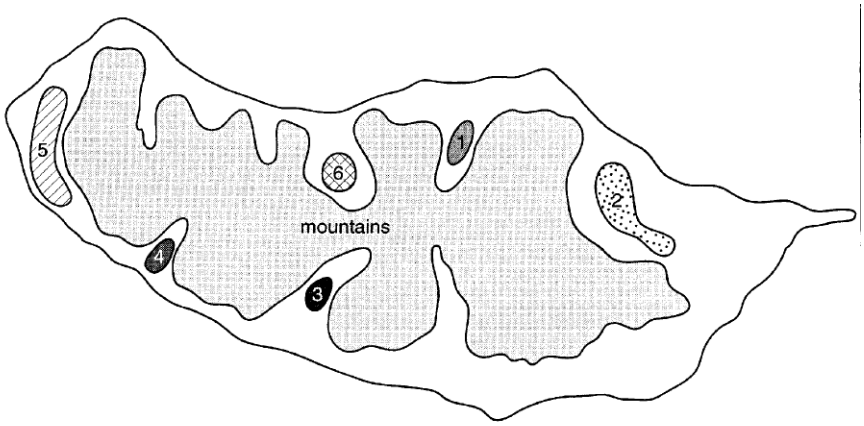
OR

Pieces of meat took a longer time in the stomach/emptied slower from the stomach than sucrose solution;✓ because solid protein;✓ (pieces of meat) avail a smaller surface area for pepsin/ enzyme action;✓ and also requires more mechanical digestion;✓ ***@ 1mark***

4. Below is a schematic representation of an island showing the distribution of six distinct populations of a house mouse, *Mus musculus*.

   After some time, it was observed that each population had different diploid chromosome numbers.

   Study it carefully and answer the questions that follow.



(a) State the likely isolating mechanism, giving a reason and the type of speciation taking place. (**2marks**)

(i) Isolating mechanism

Geographical isolation;✓

Reason

Each population located in a valley is separated/isolated by (steep) mountains;✓

(ii) Type of speciation

Allopatric;✓ ***Rej Intraspecific speciation.***

(b) Explain how the above mentioned isolating mechanism can lead to speciation. (**5marks**)

Sub populations of sexually reproducing organisms(demes) are created;✓✓ no breeding/gene flow;✓ each deme adapts differently to new environmental conditions;✓ mutation occurs independently in each deme;✓✓ allele and genotype frequency is altered;✓✓ which over time, each sub population evolve along separate lines;✓ subsequently forming distinct species;✓ @ ½ mark

(c) Account for the likely outcome of individuals from two separate populations being mated in captivity. (**3marks**)

Unsuccessful breeding/infertile offsprings are produced;✓ due to different parental chromosome numbers;✓ normal homologous pairing does not occur;✓ affecting normal gamete formation by offsprings;✓ @ 1mark

5. Covid-19 is an ongoing worldwide epidemic caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). The disease was first identified in Wuhan, China in December 2019. The number of cases in china was considered to be of epidemic proportions.

(a) State the

(i) meaning of the term **epidemic?** **(1mark)**

An infectious disease that spreads rapidly in a large number of individuals within a region/a group over a short period of time;✓

(ii) term used to describe a 'worldwide epidemic'. (**1mark**)

***Pandemic*;✓**

(b) Globally, lots of research are being carried out by scientists to produce a vaccine for Covid-19.

(i) Describe how an effective vaccine to be produced may provide 'active immunity' to the disease. (**5marks**)

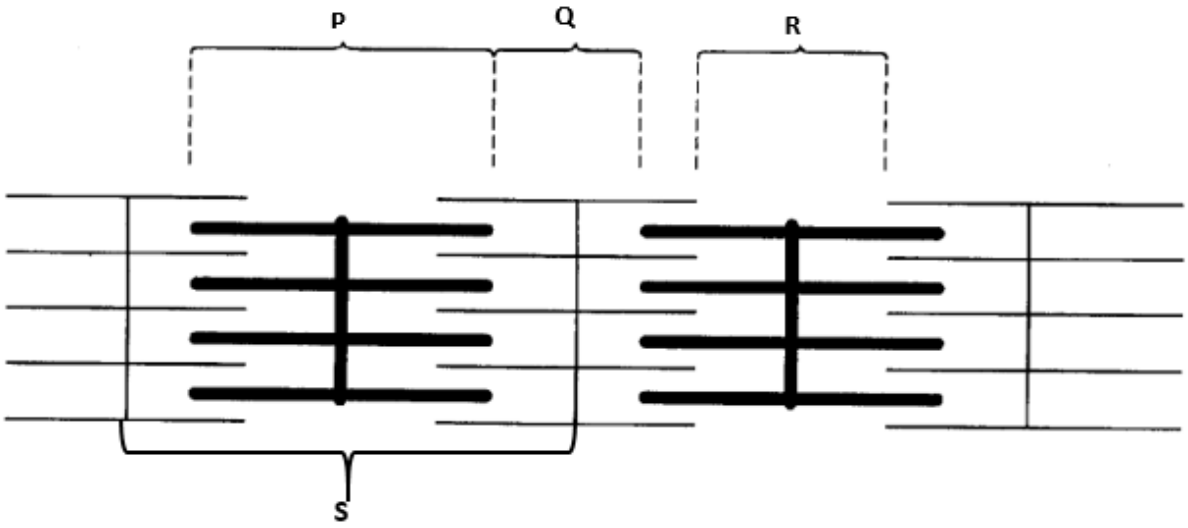
Injection of the vaccine activates T lymphocytes/Helper T cells;✓ to secrete cytokines;✓ which stimulate the B cells to rapidly divide by mitosis;✓ forming a clone of cells;✓ which differentiate into plasma cells that secrete antibodies;✓ and memory cells;✓ that retain the ability to recognize Covid-19/with immunological memory;✓

On reinfection by Covid-19;✓ memory cells divide faster than Covid-19;✓ producing large quantities of antibodies that destroy the virus before exerting its effects;✓ @ ½ mark

(ii) Explain how vaccination may be used as part of eradication programs of Covid-19. (**3marks**)

Herd vaccination/vaccinating large number of people at the same time;✓ provides a general immunity in the population/herd immunity;✓ stopping the spread of Covid-19 within the population;✓
Ring vaccination/vaccinating and monitoring all people around each infected individual;✓ forming a buffer of immune individuals;✓ stopping the spread of Covid-19 within the population;✓ ***@ ½ mark***

6. Figure below represents part of a myofibril.



(a) Name the

(i) parts labeled **P**, **Q, R** and **S.** (**2marks**)

P: ***Anisotropic/ A band;***✓

Q: ***Isotropic /I band;***✓

R: ***H zone;***✓

S: ***Sarcomere***;✓ ***@ ½ mark***

(ii) **two** proteins that make up part labeled **Q** **(1mark)**

Actin;✓
Troponin;✓
Tropomyosin;✓
Any two correct @ ½ mark

(b) State **two** pieces of evidence shown on the figure, which indicate that the myofibril is shown in a relaxed state. (**2marks**)

Little overlap of filaments/long sarcomere;✓
Wide H zone;✓
Wide I band;✓
Any correct two @ 1mark

(c) Explain how prolonged strenuous exercise results in a reduction in the force of contraction of a skeletal muscle. (**5marks**)

Oxygen supply by ventilation and gaseous exchange is not sufficient enough to meet energy demands;✓ skeletal muscle resorts to anaerobic respiration;✓ lactic acid accumulates;✓ which on dissociation, high concentrations of hydrogen ions are produced/low pH/acidosis;✓ decreasing release of calcium ions by sarcoplasmic reticulum;✓ less binding of calcium ions to troponin/decreased sensitivity of troponin to calcium ions;✓ less/no conformational change in tropomyosin occurs;✓ binding sites on actin filaments not exposed;✓ no binding of myosin head onto actin filaments;✓interfering with cross –bridge formation and cycling;✓ @ ½ mark

END