2009

## Part B - Essay

1. Write an account of the absorption and conduction of water by a plant, indicating paths, mechanisms and regulation.
2. Explain briefly how the human body defends itself against pathogenic microorganisms.
3. a) Describe the basic structure of the vertebrate motor neurone.
   b) Explain the process of chemical transmission at a synapse.
4. Write an account on mutations, describing how they arise, their consequences and the way they help in creating genetic diversity and evolution in natural populations.
5. Write an account on natural resources and their judicious use.
6. Write short notes on:
   a) Life cycle of Poganatum.
   b) Human erythrocytes.
   c) Agarose gel electrophoresis.

B i) a) murein/ peptidoglycan / mucopeptide
b) proteins / phospholipids c) chitin

ii) a) RNA b) DNA c) DNA

| Name of tissue | location | function |
|---|---|---|
| a) parenchyma | plant cortex/mesophyll pith/ground tissue | storage /photosynthesis for mesophyll |
| b) phloem | plant vascular bundle | transport sucrose(food) |
| c) pseudostratified columnar epithelium | trachea/bronchioles/ bronchi/lining of respiratory tract | secretion and sending mucus |
| d) areolar tissue | mucosa/submucosa/ skin/hypodermis | holding of tissues or organs/binding |

C i) The place or site of enzyme to which the substrate binds.

ii) Non-protein organic molecules which are needed for some enzyme reactions.

iii) a) cytoplasm/cytosol
b) stroma of chloroplast
c) mitochondrial matrix

D i) 1. $N_2$ fixation
2. denitrification
3. lightning/non biological $N_2$ fixation
4. nitrification
5. ammonification

ii) Rhizobium; Anabaena; Nostoc; Clostridium; Azotobactor

iii) Nitrobacter, Nitrosomonas/ Nitrococcus

### Answers to paper I

| | | | | | |
|---|---|---|---|---|---|
| 1 - 3/5 | 2 - 2 | 3 - 4 | 4 - 3 | 5 - 5 | 6 - 4 |
| 7 - 3 | 8 - 5 | 9 - 3 | 10 - 1 | 11 - 2 | 12 - all |
| 13 - 4 | 14. - 2 | 15 - 2 | 16 - 1 | 17 - 3 | 18 - 5 |
| 19 - 3 | 20 - 4 | 21 - 5 | 22 - 2 | 23 - 4 | 24 - 3 |
| 25 - 4 | 26 - 2 | 27 - 4 | 28 - 4 | 29 - 4 | 30 - 4/3 |
| 31 - 3 | 32 - 2 | 33 - 5 | 34 - 2 | 35 - 1/2 | 36 - 2 |
| 37 - 5 | 38 - 5 | 39 - 3 | 40 - 3 | 41 - 3 | 42 - 5 |
| 43 - 1 | 44 - 1 | 45 - 3/5 | 46 - 1 | 47 - 2 | 48 - 4 |
| 49 - 5 | 50 - 4 | 51 - 3 | 52 - 5 | 53 - 3 | 54 - 3 |
| 55 - 2 | 56 - 5 | 57 - 1 | 58 - 4 | 59 - 1 | 60 - 5 |

### Answers to Part II - Structured Essay

1. A i) Order and organisation; growth; development; metabolism; excretion; irritability (responding to stimuli); movement; adaptation; reproduction; heredity; evolution. (any 4)

ii) subatomic particles → atoms → molecules → organelles → cells → tissues → organs → organ systems → populations → communities → ecosystems → biosphere

(No marks even if one link is missing)

iii)

| Polymer | Monomer molecule |
|---|---|
| starch | glucose |
| cellulose | glucose |
| glycogen | glucose |
| inulin | fructose |

(Both parts should be correct)

2. A i) Production of a new generation of organisms/ individuals
of the same species.

ii) Maintains the same genotype/ produces genetically identical offspring.
Multiply rapidly.
Only one parent is required.

iii)

| | |
|---|---|
| Plasmodium | multiple fission |
| Planaria | fragmentation |
| Hydra | budding |

iv) An animal that produces both male and female gametes./ An animal that produces both sperms and ova (eggs)./ An animal having both male and female reproductive organs.

B i) A = acrosome B = nucleus
C = centriole/centrosome
D = mitochondria E = tail /flagellum

ii) A--- Provides enzymes to dissolve /digest /penetrate egg-membrane.
B--- Provides paternal genes /chromosomes.
C--- Helps the sperm to move towards the ovum./Takes sperm to the egg.

iii) Corona radiata

iv) Zona pellucida

v) Secondary oocyte

C i) Stimulates /regulates the release of FSH and LH hormones from pitutary.

ii) LH

iii) Secretory phase

iv)a). Stimulates the development of female sexual organs.
Stimulstes the development of female secondary sexual characters.
Stimulates the development of mammary glands during pregnancy.
Stimulates the development of smooth muscles of uterus.
Stimulates maturation of oocytes.
Involved in ovulation.
Inhibits FSH production.
Regulates proliferative phase / growth of endomatrium.

iv) b) Regulates secretory phase of endomatrium.
Inhibits ovulation.
Stimulates development of mammary glands.
Inhibits contractions of uterus.
Maintains pregnancy / maintains corpus luteum.

v) Severe decline or, a lack of oestrogen and progesteron, the endometrial wall breaks down releasing tissue and blood.

D i) Chorion, allantois, or allantochorion. (If anything else is given with the above, no marks.)

ii) Hormone - hCG Function - Maintains corpus luteum (chorionic gonadotrophin)

(No marks for function if hormone is wrong.)

iii) Water, urea, $CO_2$, hormones.

iv) Second.

v) Prostaglandin.

3. A i) In the ocean /sea.

ii) Deforestation;
Burning of fossil fuels;
Lime industry/burning $CaCO_3$

iii) Bicarbonates dissolved in the water.

iv) Koyoto protocol.

B i) Graphical or diagrammatic representation of ecological relationships among different trophic levels in an ecosystem or community.
or,
Graphical or diagrammatic representation of quantification of feeding relationship among different trophic levels in an ecosystem or community.
or,
Graphical or diagrammatic representation of energy transfer through different trophic levels in an ecosystem or community.

ii) Pyramid of energy; pyramid of numbers; pyramid of biomass.

iii) Pyramid of biomass and pyramid of numbers.

iv) a) Sequence of feeding relationship through which the energy flows in the ecosystem / community.
b) Each step / level of a food chain through which energy of an ecosystem /commu nity is transferred.
c) A number of food chains in a community (or, an ecosystem) which are interconnected at different trophic levels. or,
A graphical /diagrammatic representation of the interconnected feeding relationships between various trophic levels in an ecosystem.

Diptera; Hemiptera; Lepidoptera; Coleoptera.

ii) Lepidoptera.

iii)

| Paddy | Coconut |
|---|---|
| Yellow stem borer | Coconut caterpillar |
| Swarming caterpillar | |
| Case bearer / Case worm | |

iv) Red weevil

v) . Using systemic insecticides.
. Destroying dead or affected plants / Cutting and burning the affected plants.

D i)

| Phylum | Examples |
|---|---|
| Platyhelminthes | Taenia / Tapeworm |
| | Fasciola / Liverfluke |
| Nematoda | Necator / Hook worm |
| | Ascaris / Round worm |
| | Wuchereria/Filarial worm |

(No marks for examples if phyla are wrong.)

D. ii) Entamoeba coli (E. coli not accepted)

iii) Apical meristem, apical buds, stem pieces, leaf parts, embryos, lateral meristem, lateral buds, axillary buds.

iv) Can propagate/obtain plants bearing seedless fruits.
Can propagate disease free plants.
Culturing is independent of climatic factors.
Faster rate of propagation / produces large numbers within a short period.
Produces identical progeny/ maintains the same genotype.

4.A i) a) Stimulus is received by the coleoptile apex / tip.
Coleoptile apex /tip is necessary for the response.
Region of response is below the apex/tip.

b) Darwin.

ii) a) A substance / signal moves from apex to the growing region.
This substance/ signal cannot be conducted across mica.
Signal /substance travels / is conducted, to the unilluminated
or shaded side.
This substance /signal stimulates growth.

b) Boysen /Jensen (any one)

B. i) Went.

ii) Apical dominance (not allowing easy growth of lateral buds) cell elongation /root (or stem) elongation/ induction of root initiation/parthenocarpy/initiate tropic movements/stimulate fruit development.

iii) Hard seed coat / immature embryo / seed coat impervious to water / unsuitable temperature (too cold or not cold enough)/ chemical inhibitors (ABA) present / need of light (or darkness).

iv) Abiscisic acid / ABA

C. i) a----pollen chamber b----archegonial chamber
c----archegonia d----micropyle
e----female gametophyte f----nucellus
g----integument

ii)

| | Cycas ovule | Angiosperm ovule |
|---|---|---|
| Female gametophyte | large/lots of cells | small/ few cells |
| Size | large | (very) small |
| Egg cells | many | one |
| Stalk | absent | present |
| Pollen chamber | present | absent |
| Archegonial chamber | present | absent |
| Archegonia | present | absent |

iii) Spore mother cells/sporogenous tissue / microsporangium. (any four)

iv) Male gametophyte.

v)

| Cycas | Angiosperm |
|---|---|
| Cilliated | Non cilliated |
| Large | Small |
| Gamete is a cell | Gamete is a nucleus |

D. i) Oryza

ii) Cocos

iii) Fertilization of angiosperm ovule by two male nuclei, one with the egg nucleus to form the zygote and the other with the secondary nucleus to form the endosperm nucleus.

iv) a) integument of ovule
b) wall of ovary
c) funiculus
d) diploid nucleus / (fused) secondary nucleus

## Part B - Essay

1. . Water is absorbed from the soil solution
. mainly by root hairs
. of plant roots.
. Water moves along a water potential gradient
. by osmosis / diffusion.
. There are three paths along which water moves.
They are,
. apoplast,
. symplast, and
. vacuolar pathway.

Soil solution has a higher water potential than root hair cells.
Apoplast is the interconnected network of spaces within the cell walls and intercellular spaces.
In this apoplast, water moves by mass flow and diffusion.
Symplast is the interconnected network of cytoplasm through plasmodesmata
in which water moves by diffusion / osmosis, along a water potential gradient.
In the vacuolar path, water moves from vacuole to vacuole,
by osmosis (crossing membranes)
Suberised
casparian strips
in the radial walls of the endodermal cells, act as a barrier
to the apoplast path.
Water can pass through the endodermis only by symplast path and vacuolar path.
Xylem vessels form a network of tubes/channels for movement of water from roots ,through stem into leaves.
In the xylem, water is drawn up by the transpiration pull,
aided by adhesion
cohesion
and capillary action
maintaining an unbroken/continuous column of water.
Water entering the mesophyll cells from the xylem
will evaporate
into the intercellular spaces of the leaf.
This vapour will then move out into the atmosphere
by transpiration.
A continuous gradient of water potential exists from soil solution through the plant into the atmosphere.
Transpiration can also take place through cuticle
and lenticels in stems.
Regulation of (stomatal) transpiration is done by
guard cells
which border the stomata.
This will stop water-deficit in the plant. (any 38)

2. Defence mechanisms of the body can be either specific, or,
non-specific.
Specific defence mechanism starts only when a microorganism enters the body.
Non-specific defence mechanisms protect the body, from any pathogen (regardless of species), at any time without forming antibodies.
Specific immunity is the development of immunity
due to the production of antibodies
which are specific proteins / immunoglobulins
produced in the blood / lymph / by lymphocytes
in response to antigens
which are foreign molecules (in microbes).
Antibodies combine with antigens
and destroy (invaded) microbes.
This is naturally acquired active immunity.
Immunity can also be due to antibodies received from mother
during pregnancy / through placenta
and breast feeding / colestrum of milk.
This is naturally acquired passive immunity .

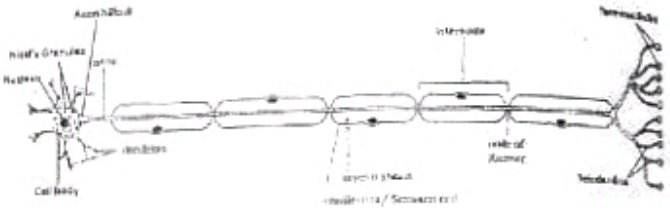
Non-specific defence systems/ mechanisms include--
(i) Skin,
which acts as a physical barrier/ preventing entry of microorganisms
as the keratin layer is not easily degradable by microbial enzymes.

(ii) Mucus membranes
secreting saline sweat
and sebum
and antimicrobial substances,
prevent the growth and establishment of microbes.
Nasal hair filter air and remove microbes.
Constant removal of the outer epidermal layer removes microorganisms.
Mucus secreted by the mucus membrane of the respiratory tract,
traps microorganisms
and removes them by ciliary action.

(iii) Antimicrobial substances in body fluids include lysozyme
found in saliva/ tears
which break down bacterial cell walls,
and lactoferrin
found in tears,
semen / breast milk / bile
that binds with iron
and limits growth of microbes.
Acid in stomach / HCl / gastric juice
provides a chemical barrier(to prevent microbial invasion).
Interferon
produced in the blood,
provides protection from viral infections.
Phagocytosis
is carried out by cells like WBCs /monocytes / neutrophills
found in the blood / lymph.
Inflammatory responses.
are generalized responses to infections
which result in increased blood circulation to infected areas
and swellings/ to areas of accumulated fluid.
This destroys microbes,
and prevents their spread.

3. a). Motor neurone consists of a cell body
. and several processes.
. The star shaped cell body
. has a large nucleus
. and a prominent nucleolus.
. Typical organelles, eg. ER, mitochondria, lysosomes, ribosomes, golgi bodies are present.
. There is no centriole.
. Cytoplasm has several Nissl's granules.
. Microtubules / neurofilaments / microfilaments / neurofiblils / neurotubules present.
. Cell is multipolar/ several dendrites arise from the cell body.
. Dendrites are short,
. branched,
. tapering and
. do not have mylin sheathes.
. Typical organelles (excepr nucleus) are present in dendrites.
. Motor neurone has only one axon
. which is long
. and cylindrical / with uniform diameter.
. The axon arises from the cone shaped structure in the cell body (called axon hillock).
. The axon is surrounded by a myelin sheath
. which is interrupted at certain points
. called nodes of Ranvier.
. Region between two nodes is internode.
. Myelin sheath is lined by neurilemma / Schwann cell or sheath.
. Axon does not have Nissl's granules.
. No myelin at the terminal end of the axon.
. End of axon is divided into branches or telodendria
. each of which is swollen and has terminal buds / synaptic bulbs / terminal buttons.
. Each terminal bulb contains many mitochondria
. and several vesicles
. each of which contains a neurotransmitter
. called acetylcholine.

3. b). In chemical transmission, an impulse / action potential reaches the terminal bulb.
. $Ca^{2+}$ permeability of pre-synapuc membrane of terminal bulb increases / $Ca^{2+}$ channels open,
. causing an influx of $Ca^{2+}$ from synaptic cleft to terminal bulb.
. Vesicles (containing acetylcholine) move / are attracted towards the pre-synaptic membrane
. fuse with the pre-synaptic membrane,
. and rupture.
. Acetylcholin,which is then released into the synaptic cleft,
. diffuses towards the post-synaptic membrane,
. and combines (reversibly) with post-synaptic (acetylcholin) receptors (in the membrane) to form acetylcholin-receptor complex.
. Localised permeability to $Na^{+}$ increases.
. Depolarization of post synaptic membrane
. results in an action potential.
. In the mean time, acetylcholin gets hydrolysed by
. acetylcholine esterase and
. transmission stops. (any 46)
(Fully or partially labelled, or unlabelled diagram gets additional marks.)



4. . Mutations are (sudden) changes in DNA / hereditary material
. which are transmitted into subsequent generations
. at reproduction or at cell division.
. Mutations occurring in somatic cells(somatic mutations) are not transmitted into progeny.
. Spontaneous mutations are naturally occurring and
. are due to errors in DNA replication,
. and at meiosis (due to segregation errors).
. Replication errors are point mutations (gene mutations)
. caused by base substitution,
. base deletion,
. or, addition of bases.
. Mutations occurring at meiosis involve parts of chromosomes,
. and numbers of chromosomes,
. resulting in polyploids
. and aneuploids.
. Mutations can also occur due to external factors / UV / X rays / mustard gas / chemicals.
. These are called induced mutations.
. Examples of point mutations in man are --albinism, haemophilia
. sickle cell anemia, colour blindness, thalesemia. (any 2)
. Examples of chromosomal mutations are – Down's syndrome,
. Kleinefelter syndrome, Turner syndrome (any 2)
. Most mutations are harmful,
. and bring recessive characters
. which can stay unexpressed for many generations.
. Some mutations are useful,
. and bring dominant characters.
. Mutations affect one or many genes,
. produce new characters/ phenotypes
. and new combinations of characters,

. in sexual reproduction
. that occurs in natural populations.
. Mutations that are beneficial give advantages
. in competition, and,
. mutations that are harmful give disadvantages,
. leading to natural selection,
. and changes in allele frequencies.
. These lead to evolution
. and origin of new species.

5 . Material and
. energy
. found naturally
. and which are used in daily life,
. as well as for economic development, are natural resources.
. Natural resources can be either living
. or non living.
. living natural resources are mostly renewable.
. Eg. fisheries
. forests.
. Non living natural resources are not renewable,
. unless recycled.
. Eg. soil, fresh water, air (any 2)
. Some non living natural resources cannot be recycled.
. Eg. Coal/petroleum/ gems/ calcite/ dolomite/ limestone / apatite / bauxite / graphite (any 3)
. Some natural resources are inexhaustible.
. Eg. wind/ waves/ sunlight/ sea water (any 3)
. Quantity of exhaustible natural resources are limited.
. Renewable natural resources / forests/ fisheries, have to be used at a slower rate than their production.
. This allows them to remain at levels which allow exploitation.
. If natural resources are not used in a rational manner,
. they get depleted.
. Soil should not be allowed to get eroded
. because it degrades land,
. leading to a reduction in productivity.
. Use of water should be done properly/ wisely
. to avoid water scarcity,
. water logging,
. sanitation problems
. spread of diseases
. and salination of agricultural land.
. Fisheries should not be over-exploited or over used
. as it will reduce the yield (in the long run)
. and thus,reduce biodiversity.
. Forests should not be over exploited /overused
. as it would reduce local rainfall,
. increase soil erosion/cause nutrient loss / lose water retaining capacity of soil,
. and also will reduce biodiversity.
. Inexhaustible resources/wind/solar power,should be used more.
. Other alternative energy sources should also be used, to generat power / electricity,
. so,use of non-renewable resources / fossil fuel, can be reduced.
. Recycling of non-renewable resources (metals like iron, copper etc), must be encouraged.
. School children (public) should be made aware (educated) on judicious use of natural resources.
. Rules should be imposed,
. and violators must be penalised /punished.

6 a). Life cycle of Poganatum shows alternation of generations,
. between a diploid sporophyte
. and a haploid gametophyte.
. Prominent or dominant generation is the gametophyte
. which is autotrophic / independent
. and dioecious.
. The plant consists of a pseudo-stem, pseudo-leaves and rhizoids.
. Female plant produces archegonia
. each of which contains a single egg cell.
. Male plant produces antheridia
. each of which contain a number of biflagellate male gametes.
. Both gametangia are covered by sterile cell layers / paraphyses.
. Male gametes need water for fertilisation / to swim towards archegonia for fertilisation.
. Zygote develops into an embryo,
. which is embedded in the female gametophyte.
. Embryo develops into the sporophyte, consisting of a capsule, stalk and a foot.
. Meiosis occurs within the capsule /sporogenous tissue
. producing haploid spores
. which are dispersed by wind.
. Spore germinates to form a protonema,
. that gives rise to the gametophyte.

6 b). Human erythrocyte is a type of blood cell
. which is circular / disc shaped,
. biconcave
. and flexible.
. Lack of a nucleus (leaves more space for haemoglobin).
. Large surface area to volume ratio
. facilitates better gas exchange.
. Lack of mitochondria helps,
. so that it does not use oxygen in the cell.(respires anaerobically).
. Cytoplasm contains haemoglobin
. which contains iron,
. and this transports oxygen
. as oxyhaemoglobin.
. Cell contains carbonic anhydrase(in large amounts)

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. and transports $CO_2$ as carbaminohaemoglobin.
. Erythrocytes are produced in the liver/spleen in foetus,
. and in the red bone marrow in adults.
. There are about 4.5 - 5 million erythrocytes per $mm^3$ of blood in a healthy adult.
. Vitamin $B_6$ /$B_{12}$ /Folic acid are required for their production,
. while erythroprotein stimulates their production.
. Their life-span is 120 days / four months.
. They are destroyed in the liver / spleen.
. Low erythrocyte counts are an indication of anaemia.

c) . Agarose gel electrophoresis is a technique used to isolate or
. separate DNA molecules / fragments of DNA.
. The mixture of DNA molecules are placed
. in a gel prepared with agarose.
. A DC electrical field is applied.
. DNA is negatively charged
. and moves towards the anode (+ve end).
. Small molecules move faster,
. therefore, separate into bands of different sizes.
. This technique is used for identifying DNA with probes,
. and in DNA finger printing (DNA typing).