Biology I - Solutions

	1	2	3	4	5
1.				X	
2.			X		
3.			X		
4.				X	
5.			X		
6.					X
7.	X				
8.					X
9.					X
10.			X		
11.				X	
12.		X			
13.		X			
14.	X				
15.	X				
16.			X		
17.	X				
18.		X			
19.				X	
20.		X			

	1	2	3	4	5
21.			X		
22.	X				
23.					X
24.					X
25.			X		
26.					X
27.			X		
28.			X		
29.					X
30.			X		
31.					X
32.	X	X	X	X	X
33.					X
34.					X
35.		X			
36.	X				
37.				X	
38.					X
39.		X			
40.			X		

	1	2	3	4	5
41.			X		
42.	X				
43.			X		
44.		X			
45.					X
46.			X		
47.	X				
48.		X			
49.		X			
50.					X
51.	X				
52.		X			
53.					X
54.	X				
55.			X		
56.	X				
57.				X	
58.			X		
59.				X	
60.	X				

Biology II - Model Answers

Part A- *Structured Essays*

1. A. (i) a. Thymine
b. Cytosine
c. Guanine
d. Adenine
x. Phosphate/Phosphoric acid
y. Deoxyribose

(ii) • Ability to store information
• Ability of self replication
• Ability of mutation

(iii) • Density gradient centrifugation
• Electrophoresis / Gel electrophoresis

(iv) H bonds break / two strands separate / becomes single stranded

B. (i) • Ribosome • Mitochondria • Chloroplast • Cytoplasm

(ii) Nucleus / Nucleolus

(iii)

DNA	RNA
• Double stranded	• Single stranded
• Contain Deoxyribose/ Deoxyribo nucleotides	• Contain Ribose/ Ribo nucleotides
• Contain thymine/ lacks uracil	• Contain uracil/ Lacks thymine

(iv) • Makes ribosomes
• Carries genetic information from DNA to ribosome
• Transport amino acids to ribosome
• Forms genetic material in some viruses.

C. (i) • Nitrogen base
• Phosphate/ Phosphoric acid
• Pentose sugar/ 5-Carbon sugar

(ii)

Nucleotide	Function
• ATP/ ADP/ AMP	• store/ transfer energy
• NAD/ NADP	• H carrier/ H acceptor / Reducing agent e acceptor/ e carrier
• FMN/ FAD	• H carrier/ Reducing agent e acceptor/ e carrier
• DNA	• Proteins (Histones)

(iii) • DNA

(iv) 23

D. (i) • Three adjoining bases/ nucleotides in a gene/ DNA/ RNA
(Three adjoining bases/ nucleotides in m-RNA is more appropriate)

(ii) Sequence of nucleotides/ bases in a gene determines the sequence of amino acids in a protein.

(iii) Organisms into which genes from a different species have been inserted.

(iv)
- Producing improved/ better crop plants/ live stock eg. Paddy/ wheat/ meat and milk
- Producing pharmaceuticals eg. Insulin, heparin, GH, interferon
- Producing industrially important enzymes eg. Amylase, Protease, Pectinase, Peptidase, Glucose oxydase

2. (A) (i) A group of individuals which can produce fertile offspring through inter breeding, having many common characteristics and differing from all other forms in one or more ways.

(ii) Arthropoda/ Insecta

(iii) A grouping used in the classification of individuals. Individuals with more or less similar characteristics are included in a taxon.

(iv) Species→Genus→Family → Order → Class → Phylum (Division)→Kingdom.

(B) (i) The process of elimination of a particular species from earth.

(ii)
- Provide room for new species
- Permits evolution

(iii)

Group of animals	Period of extinction
• Trilobites	• Permian
• Ammonites	• Cretaceous
• Dinosaurs	• Cretaceous

(iv) Collision of earth with an asteroid.

(C) (i)
- Tundra
- Coniferous forests/Taiga
- Temperate deciduous forests
- Tropical deciduous forests
- Tropical rain forests
- Grasslands / Savannahs
- Desserts
- Temperate evergreen forests/ Chapparal

(ii) Tundra

(iii)
- Low land grass forests/ wet evergreen forests
- Dry mixed evergreen forests/ Monsoon forests
- Scrub jungle/ thorn forests
- Savannah/grasslands/ Patana/ Damana

(iv)
- Rivers/ streams
- Reservoirs/ ponds/lakes
- Villus
- Marshes/ swamps

(D) (i) Conservation of adequate areas of each ecosystem

(ii) ***Ex-situ* conservation :** Species is removed from natural habitat and its survival and reproduction is ensured in a specially created environment.

***In-situ* conservation:** Species is protected and its reproduction is facilitated in the natural habitat.

(iii) Gene banks/ Genetic resource centers/ Seed banks/ Botanical gardens/ Zoological gardens/ Orphanages/ Captive breeding centers/ Turtle hatcheries/ Herbal Gardens

(iv) Strict nature reserve/ sanctuaries/ nature reserve/ protected area re-introduction/ national parks

3. (A) (i) Removal of catabolic products (waste) resulting from metabolic activity of the body

(ii) **Defaecation:** Removal of undigested food
Excretion : Removal of waste produced in body

(iii) CO_2 and urea

(iv) • insects/ Insecta • reptiles/Reptilia • birds/ Aves

(v) Nephridia

(vi) • Habitat of the animal / the amount of water available for the animal
• Degree of regulation of water loss
• Presence / absence of certain enzymes

(B) (i) In the abdominal cavity closer to its posterior wall retro peritoneally on either side of the vertebral column in the region between thoracic and lumbar vertebrae

(ii) • Regulation of blood pH
• Regulation of blood pressure
• Regulation of blood glucose level
• Production of hormones/function as an endocrine organ/ production of rennin and erythropoitene
• Regulation of chemical composition of blood
• Regulation of amount of water in body
• Removal of nitrogenous waste
(any three of above)

(iii) • By the diameter of the efferent arteriole being smaller than that of the afferent arteriole in the glomerulus.

(iv) In the distal convoluted tubule.

(v) Increase of osmotic pressure of blood/ increase in the salt concentration of blood reduction of water content in blood

(C) (i) Resorption of water in the nephron, irrespective of water content of the body.

(ii) In the proximal convoluted tubule.

(iii) H^+, NH_4^+, K^+

(iv)
- Secretion/ production of rennin
- Control of blood sodium level
- Regulation of blood pressure/ blood volume (mention any two)

(v) To prevent precipitation of Calcium oxalate and Calcium phosphate

(D) (i) Introduction of a known weight of germinating seeds into the flask. Introduce a small tube/ container with KOH/ NaOH into the flask. Open the tap and equalize the liquid level in columns A and B. After a known period of time, note the position of the liquid column. Volume change= volume of O_2 used. Calculate reduced volume/(time x weight). This will give the amount of oxygen used or the rate of oxygen used by a unit weight of germinating seeds during a unit time.

(ii) Carry out the procedure given under (i). Remove KOH/ NaOH container. Repeat same procedure. Volume change in absence of KOH = volume of O_2 – Volume of CO_2.
Volume of CO_2 = Volume change with KOH – Volume change without KOH.

Calculate $\frac{\text{volume of } CO_2}{\text{Time} \times \text{weight}}$. This will give the rate of CO_2 release.

(iii) Define, Respiratory quotient = Volume of CO_2 output/ Volume of O_2 used.
Calculate volume of O_2 used and CO_2 released by the same seed sample at a given period of time. Use above formula to calculate RQ.

(iv) RQ = 1. When carbohydrates (eg. Green gram) are used in respiration, volume of O_2 used is equal to volume of CO_2 released.

(v) Less than 1, about 0.7. Castor seeds contain oil/lipids as stored food. When oil (a protein) us used as the respiratory substrate, volume of CO_2 released is less than the volume of O_2 used.

4. (A) (i) (a) **Pathogenecity:** The ability of organisms to cause disease in the host on infection
(b) **Invasiveness** : Ability to invade host tissue and to multiply therein.
(c) **Toxigenicity** : Ability of microorganisms to produce toxins that disrupt the normal function of cells.

(ii)

Enzyme	Function
• Phospholipase	• destroy phopholipid component of animal cell membranes
• Hyluronidase	• Destroy body tissue by attacking the hyluronic acid/ cementing substance between cells
• Lecithinase	• destroy the lecithin component of the lipid in the cell membrane

(iii) chemical compounds produced by microorganisms that are inhibitory to other microorganisms

(iv)

Name of antibiotic	Mode of action
• Tetracyclin	Inhibit bacterial protein synthesis
• Erythromycin	Inhibit bacterial protein synthesis
• Penicillin	Inhibit bacterial cell wall synthesis
• Polymixin	Damage bacterial cell membrane
• Friseofulvin	damages cell membranes

*(write any **two** of above)*

(B) (i)
- Lifecycle of the pest
- Behaviour/ habitat of the pest
- Cost/ economics
- Time of highest abundance
- Environmental conditions
- Toxicity/ damage to the environment/ Degree of pollution

*(any **four** of above)*

(ii)

Method	Example
• Traditional methods	• Rotation of crops/ use of trap crops/ manipulation of water level/ hand picking/ cleanliness/ pruning/ ploughing.
• Chemical methods	• Use of insecticides.
• Biological methods	• Use of natural enemies/ predators/ parasites/ pathogens/ attractants/ repellents/ use of resistant varieties/ genetic engineering technologies.

(iii) Control of pests using an appropriate combination of two or more methods of pest control

(C) (i) • shark • gray mullet • tilapia • common carp • trenched sardine

(ii)

Column A Natural food items of adult	Column B Fish species
• detritus, zooplankton, small animals	• *Cirrhinus merigala*
• detritus, aquatic macrophytes	• *Labeo rohita/ Catla catla*
• detritus, aquatic macrophytes, small animals	• *Orechromis mossambicus*
• small animals, plankton	• *Orechromis niloticus*

(iii) SEMBV and MBV

(iv)
- Induced breeding/ induced egg laying/ ablation of eye stalk
- Fertilization
- Rearing of young

(f) (i) Culturing tissue in sterilized nutrient media

(ii)
- hormones/ auxins/ cytokinins
- sugars/ sucrose
- vitamins
- agar

(*any two*)

(iii)
- Can propagate plants faster
- Maintain identical progeny without genetic variation
- Can produce large numbers in small space
- Independent of climatic conditions
- Can propagate disease free plants

(iv)

Method	Crop plant
• Rooting stem cuttings	• Tea/ lime
• Budding	• Mango/ orange/ rambuttan
• Rhizome	• Banana
• Corms	• Colocasia
• Bulbs	• Onion
• Tubers	• Potato
• Runners	• Centella
• Adventitious buds/roots	• Bread fruit
• Bulb	• Pineapple

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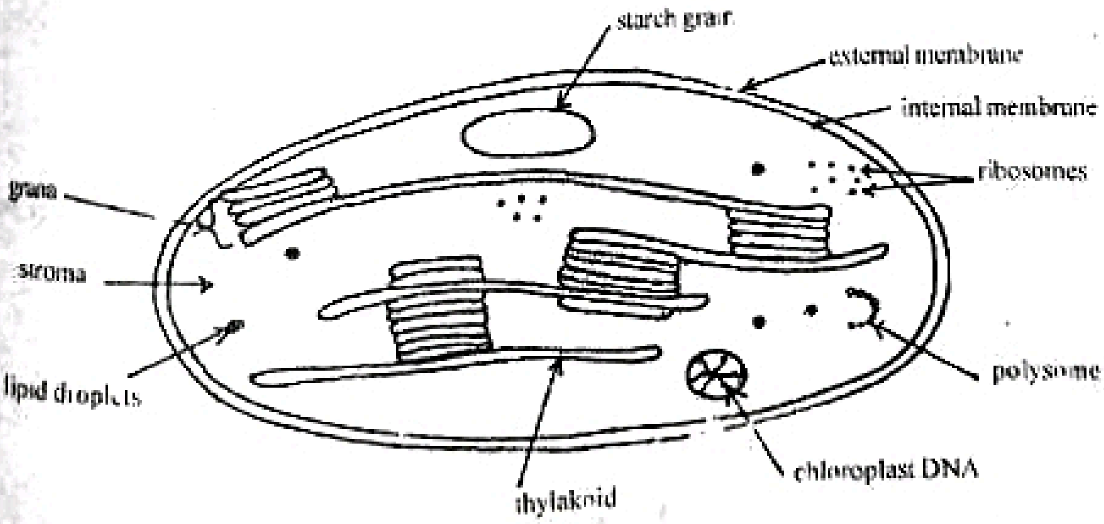
Part B - Essays

(a) Chloroplast is a cell organelle, covered by two membranes (in the stroma); it has internal membranes forming thylakoids. Thylakoids are stacked to form grana. In addition to thylakoids, stroma has starch grains, ribosomes and DNA/RNA. Chlorophylls and carotinoids are embedded as pigments in the internal membrane.



(b) Pigment molecules absorb light energy. In the presence of red and blue light this energy is transferred to a P_{680} chlorophyll a molecule in the reaction center of photo-system II. When this energy is absorbed, its electrons are excited to a high energy level and are transferred. These are transferred through a series of acceptor molecules and finally to Photo-system I. When electrons are transferred through electron carriers, some of the energy is released. This energy is used in the synthesis of ATP. This process is known as photophosphorylation.

Water molecules are split in a process called photolysis. These provide electrons missing from P_{680} chlorophyll a molecule of photo-system II. This liberates oxygen from water.
($4H_2O \rightarrow 2H_2O + O_2 + 4H^+ + 4e$)

When a P_{700} chlorophyll a molecule of Photo-system I is excited, its electrons are picked up by primary electron acceptor, and through acceptor molecules, finally transferred to NADP. Then $NADP \rightarrow NADPH_2$.

Protons (H^+) produced in photolysis are used in this reaction. ATP and $NADPH_2$ molecules carry the energy in the form of chemical energy.

2. (a) **Primary/ basic treatment stage**

Here, large floating materials are screened out, sand is removed, oil and grease removed and solid matter settles in sedimentation tanks. In addition, sludge is removed. No biochemical activity is used here. Primary treatment removes 25-35% organic matter.

The water/liquid flowing out of primary treatment is subjected to secondary treatment. Waste water is aerated to facilitate growth of aerobic bacteria and for rapid microbial oxidation. Two systems are used in this stage:

(1) Activated sludge system (2) Trickling filter method

In the first system vigorous aeration is carried out mechanically. In the second system, waste water is sprayed over a bed of rocky material and allowed to filter. Here, microorganisms will grow on the filter bed and oxidize the organic matter. In the secondary treatment 75-95% organic matter is oxidized.

The final liquid coming from secondary stage is disinfected (by adding chlorine) and released into natural waters. Sludge removed from both treatments enter in to anaerobic sludge digester, and the resulting anaerobic decomposition release bio gas (methane + CO_2).
(the remaining sludge after decomposition is used as fertilizer).

(b) 1. Water pollution

2. Dissemination of pathogenic microorganisms

3. Accumulation of biological/ carbonic material and decomposed material in water bodies.

4. Decomposition of these require large amounts of O_2

5. As a result, the biological oxygen demand (BOD) in water increases

6. The low oxygen in water affects aquatic organisms

7. Anaerobic decomposition in water ways leads to bad odour (smell).

3. **Estuarine ecosystem**

Structural features: Consists of abiotic and biotic components. Main abiotic component is water. Water is brackish and salinity is highly variable (0-40 ppt). This is due to mixing of sea water and fresh water. High nutrient content due to nutrient input from sea and river. Light usually penetrates to the shallow bottom.

Considering biotic components, there is a high biological diversity. There are marine organisms as well as fresh water organisms. Permanent brackish water organisms also exist. Organisms consist of primary producers, primary consumers, secondary consumers, tertiary consumers (top predator carnivores) and decomposers.

Primary producers: Phytoplankton, rooted emergent plants, (e.g. mangroves), rooted submerged plants, (e.g. sea grass).

Primary consumers: Zooplanktons, fish and crustaceans. Secondary consumers are predatory fish and aquatic birds.

There are many habitats.

- Surface of water, e.g. some insects
- Water column e.g. fish/crustaceans/ zooplanktons
- At the bottom e.g. some fish and mollusks
- In the substratum e.g. annelids and some mollusks
- Surface of plants *i.e.* attached to plants e.g. mollusks and coelentarates

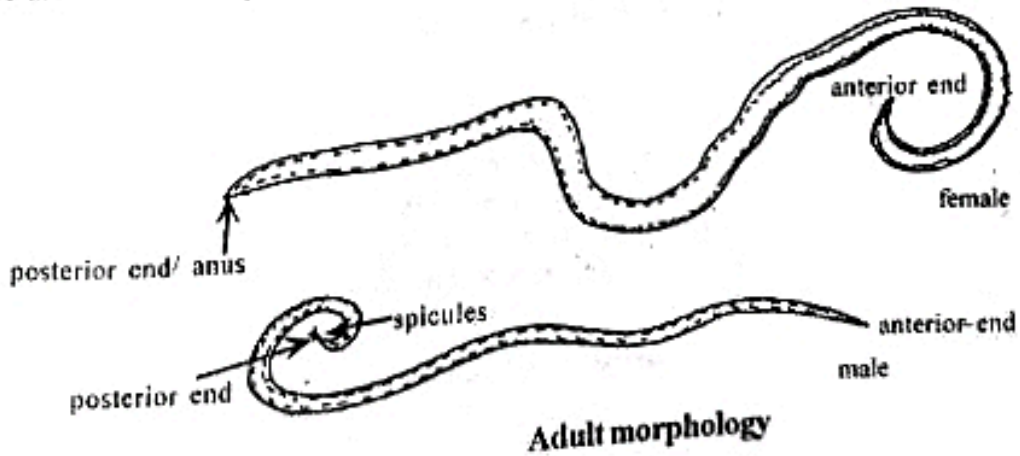
Functional features

High productivity. High amount of nutrients exist. Efficient nutrient cycling. Energy flows through food chains. Unidirectional organisms present. Interaction between organisms, and organisms and abiotic environment is seen. Predator prey relationships and symbiotic relationships can be detected.

4. (a) **External morphology of *Ascaris lumbricoides***

Cylindrical body.Both ends pointed, unsegmented with thick cuticle. Female larger than male. Posterior end of the male is curved. Spicules are present at the posterior end of males. Mouth at the anterior end, surrounded by three lips. Excretory pore closer to the anterior end. Anus present in females while cloaca is seen in males.

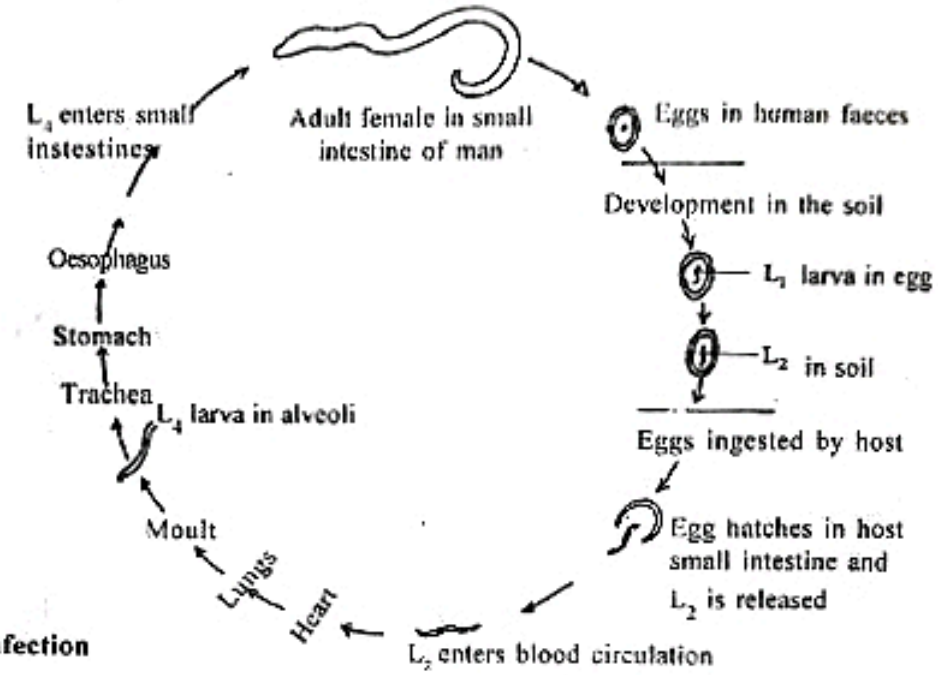
These are found in the posterior end of the respective organism.



Adult morphology

Life cycle:

Adult lives in the small intestines of humans. Female lays eggs in the small intestines. Eggs are voided with host faeces. L_1 Larva develops within the egg. L_1 larva is the infective stage. Eggs are ingested by the host with food and/or drinking water. Eggs hatch in the small intestines and the L_2 larva burrows into the intestine wall and enters in to the blood vessles/veins. The larva then passes through the heart and the pulmonary arteries in to the lungs. It moults twice in the lungs and turns into the L_4 larva. The L_4 larva penetrates the alveoli epidemis, enters the alveoli lumen, travels through trachea into the pharynx and enters in to alimentary canal by swallowing. It passes through the oesophagus and the stomach, reaches the small intestines and becomes an adult.



(b) Cotrol of infection

Passing of eggs into the environment can be prevented by treatment of infected persons. This can also be achieved by sanitary methods as well as infecting other people; us of water sealed toilets, drinking boiled, cooled water, covering food to protect from flies, washing of hands with soap after defaecating, washing of hands with soap before meals, washing of leafy vegetables – specially those that are eaten raw (eg. Salad leaves, green leaves such as gotukola).

Human maintains a constant body temperature despite fluctuations in the external environment. Man is a homeotherm. This constant temperature is approximately 37°C (98.6°F). This requires thermo receptors, heat generating mechanisms, heat dissipating mechanisms, a thermo regulatory center. Operates through a negative feedback mechanism.

When the body temperature rises, ruffini corpuscles get stimulated and nervous impulses pass to heat loss center/thermoregulatory center of the hypothalamus. Stimulation of heat loss center stimulates the sweat glands to increase sweat production. Evaporation of sweat by absorbing latent heat from the body results in decrease of body temperature. In addition, increase in blood supply to skin occurs by vaso-dilation. This increases the loss of heat by radiation. Also decreases metabolic rate by reducing secretion of adrenalin and thyroxin, thereby reducing rate of metabolic activity that causes less heat production.

These result in drop of body temperature back to normal and operation of feed back mechanism will stop the above mechanisms.