

You will not be allowed to write during the first 15 minutes. Read the paper and select questions from part II.

Answer all questions in Part I and *five* questions from Part II.

All working including rough work should be done on the same sheet as, and adjacent to, the rest of the answer.

The intended marks for questions or parts of questions are given in brackets [ ].

**Part II each point carries half mark.**

**NOTE: ATTACH THE QUESTION PAPER WITH THE ANSWERSHEET.**

**Part I (20 marks)**

Answer **all** questions

**Question 1**

**A. Mention two differences between each of the following:**

[5]

1. Differentiation and dedifferentiation
2. Quiescence and dormancy
3. 'I' band and 'A' band
4. Sympathetic and parasympathetic reflex
5. Osteoclast and osteoblast

**B. What would happen if**

[3]

1. The short day plant darkperiod cycle is interrupted by a brief flash of light.
2. Inorganic fertilizers are released into water bodies
3. Sarcoplasmic reticulum does not function

**C. Give the contribution of the given scientist/scientists**

[2]

1. Garner and Allard
2. Landsteiner

**D. Elaborate the following:**

[3]

1. 2,4 D
2. CCK
3. GFR

**E. Choose the correct option (copy and write the answer with the alphabet):**

[5]

1. Which statement explains why cell membranes are described as having a 'fluid mosaic' structure?
  - A. Different types of membrane have different sets of proteins, each with a specific pattern.
  - B. Phospholipids diffuse within their own monolayer, with many of the membrane proteins also moving around.

- C. The fluidity of membranes changes as temperature changes, with cholesterol molecules maintaining stability.
- D. There are different kinds of transport protein scattered within the phospholipid bilayer, allowing facilitated diffusion and active transport.
2. The enzymes that catalyse the reactions are listed below in alphabetic order. Isomerase enzymes catalyse structural changes within a molecule.
- fructose 1,6-bisphosphate aldolase
  - hexokinase
  - phosphofructokinase
  - phosphoglucose isomerase
  - pyruvate kinase
  - triosephosphate isomerase

Which is a correct match of enzymes to reactions?

A	2 = phosphofructokinase	5 = triosephosphate isomerase	6 = pyruvate kinase
B	1 = hexokinase	2 = phosphoglucose isomerase	5 = fructose 1,6-bisphosphate aldolase
C	3 = phosphofructokinase	4 = fructose 1,6-bisphosphate aldolase	5 = triosephosphate isomerase
D	1 = phosphoglucose isomerase	4 = hexokinase	6 = pyruvate kinase

3. An insect lives in and feeds on the tissue of oak tree leaves and is eaten by birds.

Which ecological terms are described in this information about the insect?

	habitat	niche	trophic level	
A	✓	✓	✓	key ✓ = can be described ✗ = cannot be described
B	✓	✓	✗	
C	✗	✓	✓	
D	✗	✗	✓	

4. A farmer grows a different crop in a field each year for three years. In the fourth year the farmer plants a leguminous crop and then ploughs this into the soil. The next year the rotation starts again.
- Which microorganisms will increase by the time the rotation starts again?

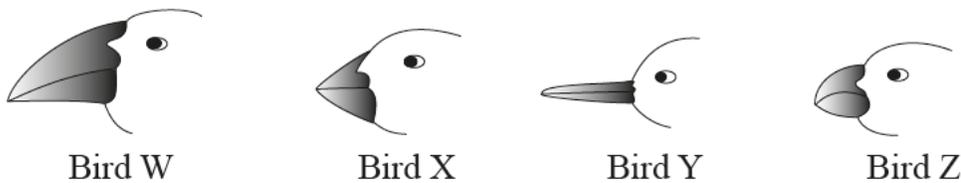
- 1 denitrifying bacteria
- 2 nitrifying bacteria
- 3 nitrogen-fixing bacteria
- 4 decomposing bacteria

- A. 1, 2 and 3
- B. 1, 2 and 4
- C. 1, 3 and 4
- D. 2, 3 and 4

5. Which is correct about the affinity between haemoglobin and the gases carbon dioxide, carbon monoxide and oxygen?

	highest affinity	—————▶	lowest affinity
<b>A</b>	carbon monoxide	carbon dioxide	oxygen
<b>B</b>	carbon monoxide	oxygen	carbon dioxide
<b>C</b>	oxygen	carbon dioxide	carbon monoxide
<b>D</b>	oxygen	carbon monoxide	carbon dioxide

E. The following shows a dichotomous key.



Dichotomous key to represent birds	
1. a.	The beak is relatively long and slender ..... <i>Certhidea</i>
b.	The beak is relatively stout and heavy ..... go to 2
2. a.	The bottom surface of the lower beak is flat and straight ..... <i>Geospiza</i>
b.	The bottom surface of the lower beak is curved ..... go to 3
3. a.	The lower edge of the upper beak has a distinct bend ..... <i>Camarhynchus</i>
b.	The lower edge of the upper beak is mostly flat ..... <i>Platyspiza</i>

[Source: <http://uoitbio2013.wordpress.com/taxonomy/dichotomous-keys/>]

- 1. Using the dichotomous key above, identify the genus of bird W and bird Z. [1]
- 2. What is binomial nomenclature? What is its importance? [1]

## Part II (50 marks)

Answer any **five** questions.

1. The blood is not only the river of life; it is also the river through which the cells and organs dispose of their garbage and dead material. Enzymes improve circulation by eating the excess fibrin that causes blood to sometimes get as thick as catsup or yogurt, creating the perfect environment for the formation of clots. All of this material is supposed to be cleared by the liver on its "first pass", or the first time it goes through but given the sluggish and near toxic or toxic states of everyone's liver these days that seldom happens. So the sludge remains in the blood waiting for the liver to have enough free working space and enough enzymes to clean the trash out of the blood. This can take days, and in some cases, weeks!
- a) What type of enzymes act on fibrin? Give examples of these enzymes present in the digestive system. [2]
- b) Discuss the mechanism of action of an enzyme mentioned in the previous question. [2]
- c) Discuss the role of blood in disposing the garbage and dead materials of tissues and organs. [2]
- d) Liver helps in detoxification. Describe two other functions of the liver. [2]
- e) Excess fibrins in the blood can create problems. Discuss the affect of excess fibrins on the heart. [2]
2. Fig. 2.1 shows a drawing made from an electron micrograph of two adjacent cells in a leaf.

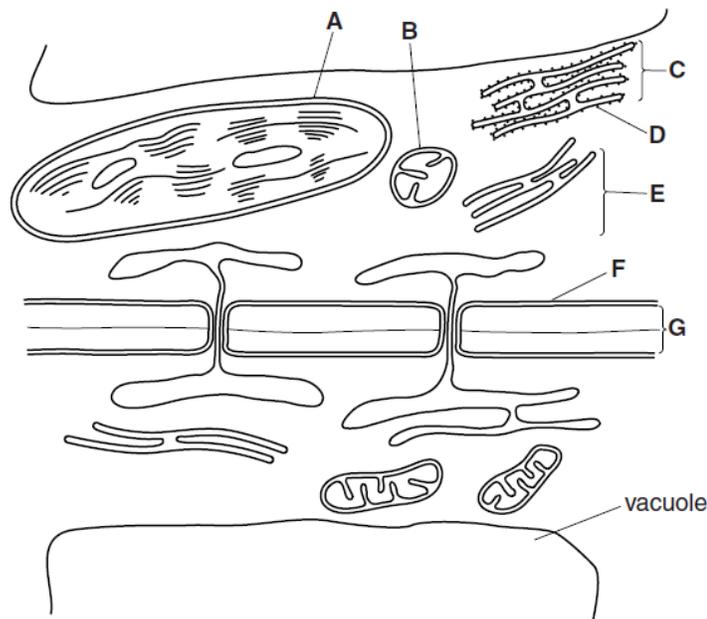


Fig. 2.1

- a) Structures F and G have very different permeability properties. Explain how the composition of structures F and G determines the permeability properties of these structures. [3]

- b) Enzyme molecules in cells eventually stop working and are broken down. Outline (four stages only) how cells replace the enzymes that are broken down. [2]
- c) *Penicillium* is a parasitic fungus on leaves of cereals plants. Describe any four specific features of the class to which *Penicillium* belongs. [2]
- d) Structure **A** contains pigments responsible for photo morphogenesis process. Name these and explain in brief about their role. [2]
- e) Mention any two prokaryotic features of structure **A** and **B**. [1]

3. ***Agrobacterium tumefaciens* is a rod-shaped, Gram-negative soil bacterium that has been very closely studied for its importance as a plant pathogen and as a tool for genetic engineering.**

**Fig. 3.1 is a scanning electron micrograph of *A. tumefaciens***



Fig: 3.1

- a) How is this bacterium different from cyanobacteria? [2]
- b) Fig. 3.2 shows a crown gall caused by infection with *A. tumefaciens*. The crown gall is a tumorous growth produced as a result of higher than normal plant hormone levels. One of the hormones is indole-3-acetic acid (IAA), an auxin. Write any four common functions of Auxin hormone in plants. [2]



Fig: 3.2

- c) If the plant infected with the bacterium *A. tumefaciens* has 3 pairs of chromosome in root hair cells. Draw a labeled diagram of anaphase I of cell division occurring in anther to form male gamete. [2]
- d) One student observed that the infected plant shows some hunger sign. To know this he decided to analyze the minerals composition of soil of that area. During soil analysis what three criterions will he keep in mind that decides essentiality of particular mineral element? Mention the list of all essential mineral elements required by plants to grow healthy. [2]

- e) How is the life cycle of infected plant, different from mosses with reference to following points? [2]
- Main plant body
  - Vascular tissues
  - Type of meiosis
  - Male and female reproductive organ

**4. Neonicotinoids are a new class of insecticides chemically related to nicotine. The name literally means “new nicotine-like insecticides”. Like nicotine, the neonicotinoids act on certain kinds of receptors in the nerve synapse. They are much more toxic to invertebrates, like insects, than they are to mammals, birds and other higher organisms.**

**One thing that has made neonicotinoid insecticides popular in pest control is their water solubility, which allows them to be applied to soil and be taken up by plants. Soil insecticide applications reduce the risks for insecticide drift from the target site, and for at least some beneficial insects on plants. New research points to potential toxicity to bees and other beneficial insects through low-level contamination of nectar and pollen with neonicotinoid insecticides used in agriculture. Although these low level exposures do not normally kill bees directly, they may impact some bees’ ability to foraging for nectar, learn and remember where flowers are located, and possibly impair their ability to find their way home to the nest or hive. Despite the controlled studies completed to date, the actual impact of neonicotinoid insecticides on honey bees in the field are difficult to measure. It is still not known whether these effects explain bee colony collapse disorder, or have had any effect in agriculture or, especially, in urban areas.**

<http://citybugs.tamu.edu/factsheets/ipm/what-is-a-neonicotinoid/>

- Neonicotinoids acts on synapse. Draw a synapse and explain the possible ways it can affect the synaptic transmission. [3]
- Neonicotinoids are known to create a continuous state of depolarization in the synapse. Explain how depolarization happens in the neuron. [1]
- How can its water solubility and applying to soil harm the environment? [1]
- Though these do not have any affect on humans, if it enters the human body it will be excreted out. Describe the process of elimination of metabolic wastes in the human body. [3]
- These insecticides drift from the target site and affect other insects. Discuss what change in ecological balance would result if this happens. (Mention in terms of the example given in the paragraph) [2]

**5. *Azolla filiculoides* is an aquatic fern that floats on the surface of lakes. The nitrogen-fixing microorganism, *Anabaena azollae*, lives within the leaves of the fern.**

**The beetle, *Stenopelmus rufinasus*, feeds on *A. filiculoides*.**

- a) State the ecological terms applied to each of the following descriptions of these species. [2]
- All the members of the species *A. filiculoides* floating on a lake
  - All the organisms, including *A. filiculoides*, *A. azollae* and *S. rufinasus*, found living in and on the lake
  - Organisms, such as *A. filiculoides*, that absorb light energy, fix carbon dioxide and make organic compounds available to animals that eat them
  - The role of species, such as *A. filiculoides*, *A. azollae* and *S. rufinasus*, in the lake ecosystem
- b) *Rhizobium*, *Nitrosomonas*, *Nitrobacter* and *Pseudomonas* etc. are some soil bacteria, which help in the process of nitrogen cycling. With a suitable flow chart explain the role of these microorganisms in the process of nitrogen cycling. [3]
- c) Nitrogenase is an enzyme which essential for the process of nitrogen fixation. Describe the level of protein present in this enzyme. [2]
- d) In legumes root, *Rhizobium* can fix nitrogen in anaerobic condition only. Describe all the stages through which one molecule of glucose can be metabolized in anaerobic process. [3]

**6. A team of researchers led by London based Imperial College has been working on a way to introduce a strain of infertility into female *Anopheles gambiae* mosquitoes that can be passed from one generation to the next to significantly cut, if not eradicate, local populations of the malaria-carrying insect.**

**The scientists in a way have genetically modified the species of *Anopheles gambiae* mosquito so that they carry a modified gene disrupting egg production in female mosquitoes. A technology called 'gene drive' has been used for this. The technology uses the technique of recessive genes, so that many mosquitoes will inherit only one copy of the gene.**

**Usually, two copies in female *Anopheles gambiae* mosquitoes are needed for fertility. But only one copy of the gene makes female infertile by disrupting the egg production.**

***Anopheles gambiae* is one of the best-known species of *Anopheles* genus of mosquito, because of its predominant role in the transmission of the most dangerous malaria parasite species to humans - *Plasmodium falciparum*.**

<http://indiatoday.intoday.in/education/story/scientists-genetically-modify-the-malaria-causing-mosquito-species-to-fight-disease/1/543459.html>

- a) Give the complete classification of the mosquito mentioned above. [3]
- b) Type of egg was one of the main parameters that influenced the evolution of animals from water to land. Explain the statement and give examples of first oviparous land animal. [2]

- c) Cockroaches are included in the same phylum as mosquitoes. Comment on the reproduction of cockroaches and whether the same genetic modification can be applied to them. [2]
- d) Mosquito has piercing and sucking type of mouthparts. Compare this with the mouthparts of cockroach. [1]
- e) Mention the kingdom to which the malarial belongs. Give two other examples and mention a unique feature of the kingdom. [2]

**7. The secret to losing fat without losing muscle starts with not being too aggressive or extreme with your reduction of carbohydrates. You need carbohydrate management, not carbohydrate elimination. You never drastically deplete the glycogen stores in the muscle so athletic performance is not affected like on a low carbohydrate diet.**

**Exercise 1.5 to 2 hours after eating when blood sugar levels and insulin levels are slowly declining. As insulin levels increase in response to a rise in blood sugar after a meal, the cells are in an anabolic state (receiving nutrients). Insulin is the hormone that feeds our cells.**

**As blood sugar levels drop, insulin levels drop and the pancreas produces the hormone glucagon and nutrients stored in the fat cells are released to the blood and used for energy. The management of this blood sugar rise and drop is important. It is important to never exercise without having at least one meal left in your day so that muscles can recuperate from exercise.**

**Long-term success managing weight starts with the right approach. If you are overweight, the real problem is that you have too much body fat for how much muscle you possess. Your goal should be to lose fat without losing muscle or sacrificing your health in the process.**

Author: Charles Remington is a Nutritionist from Connecticut, U.S.A. and in 1992 discovered a way to influence hormonal change so our bodies would lose fat without losing muscle or reducing metabolism.(<http://www.brianmac.co.uk/articles/scni22a4.htm>)

- a) Why is it specified to have carbohydrate management and not carbohydrate elimination? [1]
- b) Exercise is not possible without joints. Explain the types of joints involved in relation to any particular type of exercise. [1]
- c) Exercise leads to increase in breathing rate. Discuss how CO<sub>2</sub> is transported to the lungs during a breathing cycle. [2]
- d) What happens to muscles when you exercise? Explain the theory behind this. [3]
- e) Explain the statement- “Insulin is the hormone that feeds our cells”. [1]
- f) State how insulin works antagonistically. [1]
- g) “Your goal should be to lose fat without losing muscle”. Why is the author laying stress on muscle nutrition? [1]