

**ISC SEMESTER 2 EXAMINATION
SPECIMEN QUESTION PAPER
BIOLOGY PAPER 1 (THEORY)**

Maximum Marks: 35

Time allowed: One and a half hour

Candidates are allowed an additional 10 minutes for only reading the paper.

They must NOT start writing during this time.

*Internal choices have been provided in one question in Section B
and one question in Section C.*

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

SECTION A – 7 MARKS

Question 1

- (i) Give the biological name of the causative agent of gonorrhoea. [1]
- (ii) Sonora – 64 is a variety of: [1]
- (a) Wheat
 - (b) Rice
 - (c) Maize
 - (d) Sugarcane
- (iii) **Assertion:** PAN is a secondary pollutant. [1]
Reason: The secondary pollutants are produced by the combination of primary emitted pollutants in the atmosphere.
- (a) Both assertion and reason are true, and reason is the correct explanation of assertion.
 - (b) Both assertion and reason are true, but reason is not the correct explanation of assertion.
 - (c) Assertion is true but reason is false.
 - (d) Both assertion and reason are false.

- (iv) Give one significant contribution of Prof. R. Mishra. [1]
- (v) Expand the term ADA. [1]
- (vi) A substance that stimulates the production of antibodies is called _____. [1]
- (vii) Why does a large ozone hole develop specifically over Antarctica? [1]

SECTION B (16 MARKS)

Question 2

Briefly explain the role of the following in providing defense against infections in human body:

- (i) B-cells [1]
- (ii) T-cells [1]

Question 3

[2]

What is the role of a probe in recombinant DNA technology?

Question 4

[2]

The level of air pollution is very high in a city. Suggest *any four* measures which should be taken by the government to control it.

Question 5

[2]

- (i) If 20000 K Cal energy is available at the level of producers, what will be the amount of energy available at the level of secondary consumers.

OR

- (ii) The number of mice in a laboratory was 100 on a particular day. After one year their number increased to 120. Calculate the growth rate in the population.

Question 6

[2]

Give *any four* advantages of *mutation breeding*.

Question 7

[2]

Name and describe the technique that helps in separation of DNA fragments.

Question 8

[2]

Which molecules are called *molecular scissors*? Why are they called so?

Question 9

[2]

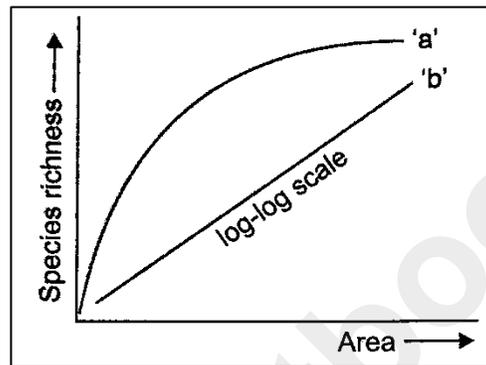
Differentiate between *primary succession* and *secondary succession* with appropriate examples.

SECTION C (12 MARKS)

Question 10

[3]

Study the graph given below and answer the following questions:



- (i) Explain the ecological principle represented by the graph and write a mathematical expression for the same.
- (ii) What will happen if the slope of the line 'b' becomes steeper?

Question 11

[3]

Explain the steps involved in the process of plant breeding.

Question 12

[3]

The rDNA technology has provided a method to control the nematode parasite *Meloidogyne incognita*. Explain the principle involved in this technique.

Question 13**[3]**

- (i) Consider the amount of organic matter at the different trophic levels in an ecosystem given below:

Trophic Level	Amount of organic matter (in Kg)
Tertiary consumers	250
Primary consumers	150
Primary producers	100
Secondary Consumers	200

On the basis of the data provided above, construct an ecological pyramid. Comment upon its nature giving at least one example of the type of organism occupying each of the above mentioned trophic levels.

OR

- (ii) On the basis of the demographic data of a country given below, construct an age pyramid and explain whether the population is stable, declining or growing.

Age group	No. of individuals
Pre-reproductive	20,000
Reproductive	15,000
Post-reproductive	10,000



Answers

Section-A

Answer 1.

- (i) *Neisseria gonorrhoea*
- (ii) (a) Wheat
- (iii) (a) Both assertion and reason are true, and reason is the correct explanation of assertion.

Explanation :

PAN are a secondary pollutants since they form in the atmosphere after the emission of primary pollutants. Sources of the pollutants required to create PAN include tobacco smoke, motor vehicles, etc.

- (iv) Prof. R.Misra started first the Bachelor Degree in Ecology in India and is known as the father of Indian Ecology.
- (v) Adenosine deaminase
- (vi) Antigen
- (vii) The uniqueness of atmospheric and chemical condition of the Antarctica region increase the effectiveness of ozone destruction by reactive halogen gases. In addition to an abundance of reactive gases, the formation of the Antarctica ozone holes requires temperatures lower enough to form polar stratospheric clouds, isolation from the air in other stratospheric regions and sunlight.

Section-B

Answer 2.

- (i) **B-cells:** B cells are activated when their B cell receptor (BCR) binds to either soluble or membrane-bound antigens. This activates the BCR to form microclusters and trigger downstream signalling cascades. The micro cluster eventually undergoes a contraction phase and forms an immunological synapse, this allows for a stable interaction between B and T cells to provide bidirectional activation signals. They produce an army of proteins in response to pathogens into our blood to fight with them.
- (ii) **T-cells:** T cells are generated in the thymus and are programmed to be specific for one particular foreign particle (antigen). Once they leave the thymus, they circulate throughout the body until they recognize their antigen on the surface of antigen-presenting cells (APCs). The T cell receptor (TCR) on both helper T cells and cytotoxic T cells binds to the antigen as it is held in a structure called the MHC complex, on the surface of the APC. This triggers the initial activation of the T cells. T cells themselves do not secrete antibodies but help B cells to produce them.

Answer 3.

A probe is a single-stranded sequence of DNA or RNA used to search for its complementary sequence in a sample genome. The probe is placed into contact with the sample under conditions that allow the probe sequence to hybridize with its complementary sequence.

Answer 4.

Following four measures could be taken by the government to control air pollution.

1. Public transport-buses and auto are to be switched to CNG.
2. Use odd-even methodology to control private vehicles mostly during the winter season.
3. Government should strictly implement the use of ESP in all plants and industries where gaseous pollutants generate more.
4. Industrial areas near the city should be phased out with time by providing a special economic zone at the outskirts of the city and closing down old highly polluting industries.

Answer 5.

- (i) According to 10% law of ecology, only 10% of the energy is transferred to each trophic level from the lower trophic level. So the amount of energy available at the secondary level is $20000\text{K Cal} \times 10\% = 2000\text{K Cal}$.

OR

(ii) Growth rate in population =
$$\frac{\text{Current population} - \text{previous population}}{\text{previous population}} \times 100\%$$
$$= \left[\frac{120 - 100}{100} \right] \times 100\% = 20\%$$

Answer 6.

Four advantages of mutation breeding are as follows:

1. Mutation breeding can effective to disseminate an undesirable characters from a crop variety.
2. It improves the morphological and psychological characters of cultivated crops.
3. Mutation breeding can improve the disease resistance of crop plants.
4. Mutation breeding can be used to improve the specific characters of a well-adapted high yielding variety.

Answer 7.

The fragments can be separated by a technique called gel electrophoresis.

Steps are as follows:

Step: 1. The DNA fragments are loaded on a gel or matrix and an electric current is applied. The most commonly used matrix is agarose which is a natural polymer extracted from seaweeds.

Step: 2. Since DNA fragments are negatively charged they move towards the positive charge i.e. anode under an electric field through a gel.

Step: 3. The DNA fragments move through the gel and separate according to their size. The bigger ones move slowly and the smaller ones move faster.

Step: 4. The separated fragments can be visualized after staining the DNA with Ethidium bromide followed by exposure to UV radiation. The DNA fragments can be seen as bright orange coloured bands in UV light.

Step: 5. The separated bands are cut from the agarose gel and extracted from the gel piece.

Step: 6. DNA fragments purified in this way are used for constructing rDNA after joining them with cloning vectors.

Answer 8.

Restriction enzymes are called molecular scissors.

Restriction enzymes cleave DNA at or near specific recognition sequences known as restriction sites. These enzymes make one incision on each of the two strands of DNA and are also called restriction endonucleases.

Answer 9.

S. No.	Primary Succession	Secondary Succession
1.	It occurs in an area where no community had existed before.	It occurs in the area where a community had existed before.
2.	Lichens are the first organism to appear.	Grasses, shrubs and weeds are the first organisms to appear.
3.	It may take a long time to reach the climax community.	It takes a very short time compared to primary succession to reach the climax community.
4.	Example: It begins on bare rocks, dunes, volcanic islands, lava flows etc.	Example: It begins in an area devastated by fire, drought, floods, deforestation, overgrazing etc.

Section-C

Answer 10.

- (i) German naturalist and geographer Alexander Von Humboldt observed that within a region, species richness increases with increasing explored area but only up to a limit.

The relation between species richness and area for a wide variety of taxa turns out to be a rectangular hyperbola. On a logarithmic scale, the relationship is a straight line described by the equation:

$$\log S = \log C + Z \log A$$

Where S = species richness, A = area, Z = slope of the line [regression coefficient] C = Y-axis intercept.

- (ii) The slope of the line 'b' becomes steeper when very large areas such as continents are considered for species-area relationship.

[here Z value is in the range of 0.6 to 1.2]

Answer 11.

The main steps of the plant breeding process are as follows:

- Collection of variability:** Wild varieties species and relatives of the cultivated species having desired traits should be collected and preserved. The entire collection having all the diverse alleles for all genes in a given crop is called germplasm collection and can be done by either in-situ conservation method or ex-situ conservation method.
- Evaluation and selection of parents:** The germplasm collected is evaluated to identify the plants with desirable characters. It is made sure that only the pure lines are selected. The selected plants are multiplied and used in the process of hybridization.
- Hybridization:** The pollen grain from one desired parent plant selected as a male parent is collected and dusted over another plant which is considered as the female parent.
- Selection and testing of superior recombinants:** Progeny obtained after crossing are evaluated for the desired combination of characters. These are self-pollinated for several generations till there is a state uniformity that the characters will not segregate further.
- Testing, release and commercialization of new cultivars:** The selected plants are evaluated by growing the plants in an experimental field and the performance is recorded. This is done for at least 3 growing seasons at different locations.

Answer 12.

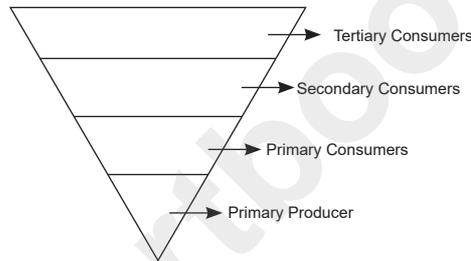
RNA interference (RNAi) is a gene silencing process that blocks the expression of genes in the parasite when it enters the host's body. This method is used to prevent infestation of roots of tobacco plants by a nematode *Meloidogyne incognita*. In RNAi, a complementary RNA binds to mRNA to form a dsRNA that cannot translate and hence its expression is blocked. Synthetic neurotransmitants mixed with dsRNA solutions are used for in vitro RNAi in plant-parasitic nematodes with significant success. This introduced DNA which forms both sense and anti-sense RNA. These two strands being complementary

to each other bend and form dsRNA leading to RNA interference. mRNA of nematodes is thus silenced and the parasite cannot survive in the transgenic host. Thus through this method tobacco plants can be protected from nematode attacks.

Answer 13.

(i) The given data has resembled the marine ecosystem. Almost all aquatic environments will have inverted biomass pyramids. This is because the primary producers are always located at the base of the pyramid and in an aquatic environment, plankton organisms occupy this space. The lower level organisms bloom or reproduce at a faster rate than the trophic level above them. Therefore they can still sustain that level in terms of food even though their biomass at a given time is smaller. This chain effect is vital to these organisms survival because low mass does not mean an imbalance in the system. For example: on an average killer whales consumes at about 100-300 pounds of food a day but take between 6-13 years to reach maturity. On the other end of this spectrum, given proper conditions, phytoplanktons can double their number in only one day and generally grow up to 100 times faster than plants on land. Therefore, phytoplankton is the primary producer of most marine biomass pyramids.

1. (TOP) Tertiary Consumers (Secondary Carnivores or Apex Predators): orcas
2. Secondary Consumers (Primary Carnivores or Predators): dolphins
3. Primary Consumers (Herbivores): copepods
4. (BOTTOM) Primary producers: phytoplankton



OR

(ii) In the given data, the number of pre-reproductive individuals is very large, the number of reproductive individuals is moderate, while post-reproductive individuals are fewer. This type of age pyramid shows that the population is "growing". The rate of growth depends on the size of the pre-reproductive population. This type of population growth is observed in developing countries like India, Bangladesh.

