

BIOLOGY

Paper & Solution

Code: 57/2

Time: 3 Hrs.

Max. Marks: 100

SECTION A

1. List two advantages of the use of unleaded petrol in automobiles as fuel.

Solution:

Two advantages of unleaded petrol in automobiles as fuel are :-

(1) The use of lead-free petrol or diesel can reduce the pollutants they emit.

(2) It will increase the efficiency of the automobiles.

2. Retroviruses have no DNA. However, the DNA of the infected host cell does possess viral DNA. How is it possible ?

Solution:

Retroviruses have no DNA, however the DNA of the infected host cell does possess viral DNA because the retrovirus produces viral DNA by reverse transcription and which is incorporated into the host DNA.

3. State the cause of adenosine deaminase enzyme deficiency.

Solution:

This enzyme is important for immune system to function. This disorder is caused due to deletion of the gene for the enzyme adenosine deaminase.

4. What is a cistron ?

Solution:

Cistron is a segment of DNA that codes for a polypeptide. The structural gene in a transcription unit could be monocistronic (mostly in eukaryotes) or polycistronic (in bacteria).

5. How many chromosomes do drones of honeybee possess ? Name the type of cell division involved in the production of sperms by them.

Solution:

Drones of honey bee possess 16 chromosomes. They divide by mitosis.

SECTION B

6. What is mutualism ? Mention any two examples where the organisms involved are commercially exploited in agriculture.

OR

List any four techniques where the principle of conservation of biodiversity has been employed.

Solution:

When in an interaction both the species are benefited. Eg. 1. Mycorrhiza an association of fungi with roots of higher plants show resistance to root borne pathogen. Eg. 2. Rhizobium and leguminous plant also show symbiotic association can be used to increase the nitrogen content of the crops.

OR

four techniques where the principle of in-situ conservation of biodiversity has been employed are :-

1. Animals that have become extinct in the wild can be maintained in the zoological park.
2. Gametes of threatened species can be preserved in viable and fertile condition for long periods.
3. Egg can be fertilized in vitro, and plants can be propagated using tissue culture methods.
4. seeds of different genetic strains of commercially important plants can be kept for long periods in seed banks.

7. (a) Why are the plants raised through micropropagation termed as somaclones (13) Mention two advantages of this technique.

Solution:

(a) The plants raised through micro propagation termed as somaclones because these are the clones prepared by the fusion of somatic cells of the parent .Offspring formed are genetically identical to the parent.

- (b) (i) Large number of plants can be prepared in short time.
(ii) Recovery of healthy plants.

8. Explain the process of secondary treatment given to the primary effluent up to the point it shows significant change in the level of biological oxygen demand (BOD) in it.

Solution:

The primary effluent is passed into large aeration tanks where it is constantly agitated mechanically and air is pumped into it. This allows vigorous growth of useful aerobic microbes into flocs (masses of bacteria associated with fungal filaments to form mesh like structures). while growing, these microbes consume the major part of the organic matter in the effluent. Significantly reduces the BOD (biochemical oxygen demand).

9. (a) Select the analogous structures from the combinations given below :

- (i) Forelimbs of whales and bats
(ii) Eyes of octopus and mammals
(iii) Tuber of sweet potato and potato.
(iv) Thorns of *Bougainvillea* and tendrils of *Cucurbita*
(b) State the kind of evolution they represent.

Solution:

(a) Analogous structures are :-

- ⇒ Eyes of octopus and mammals
⇒ Tuber of sweet potato and potato.
(b) convergent evolution.

10. A moss plant is unable to complete its life-cycle in a dry environment. State two reasons.

Solution:

Two reasons why moss is unable to complete its life cycle are :-

- (1) They need water for fertilization.

(2) Lack of water vascular system for transport of water.

SECTION C

11. A heavily bleeding and bruised road accident victim was brought to a nursing home. The doctor immediately gave him an injection to protect him against a deadly disease.

- Write what did the doctor inject into the patient's body.
- How do you think this injection would protect the patient against the disease?
- Name the disease against which this injection was given and the kind of immunity it provides.

Solution:

- Vaccine against the disease called tetanus.
- The Vaccine contain deactivated tetanus toxins that will kill the tetanus causing bacteria
- Active immunity.

12. Explain the significance of satellite DNA in DNA fingerprinting technique.

Solution:

Satellite DNA are the repetitive DNA sequences which show high degree of polymorphism and form the basis of DNA fingerprinting since DNA from every tissue (such as blood, hair follicle, skin bone, saliva etc) from an individual show the same degree of polymorphism, they become very useful identification tool in forensic applications. As the polymorphisms are inheritable from parents to children DNA finger printing is the basis of paternity testing, in case of disputes.

13. What does the following equation represent ? Explain.

$$p^2 + 2pq + q^2 = 1$$

Solution:

It is Hardy - weinberg principle. According to this principle that allele frequencies in a population are stable and is constant from generation to generation. The gene pool (total genes and their alleles in a population) remains constant. This is genetic equilibrium - Sum total of all frequencies is 1

$$p^2 + 2pq + q^2 = 1$$

where p , q can be names of individual frequencies.

14. Two independent monohybrid crosses were carried out involving a tall pea plant with a dwarf pea plant In the first cross, the offspring population had equal number of tall and dwarf plants, whereas in the second cross it was different. Work out the crosses, and explain giving reasons for the difference in the offspring populations.

Solution:

First cross -

Tt × tt

50% - Tall

50% - Dwarf

	T	t
t	Tt	tt
t	Tt	tt

→ f1 generation

In this 1st cross one parent is heterozygous dominant, and another is homozygous recessive, so the half of the off-springs are tall and another half are Dwarf.

Second cross

Tt x Tt

	T	t
T	TT	Tt
t	Tt	tt

TT Tt tt
1 : 2 : 1

Here both the parents are heterozygous dominant hence the off springs are different.

15. State what is apomixis ? Comment on its significance. How can it be commercially used ?

Solution:

Apomixis is form of sexual reproduction that mimics sexual reproduction. significance - It is cost effective method and prevents the loss of specific character. It can be used in Hybrid seed industry.

16. State the medicinal value and the bioactive molecules produced by Streptococcus, Monascus and Trichoderma.

OR

What are methanogens ? How do they help to generate biogas ?

Solution:

organism . Medicinal value

1. Streptococcus clot bustes for removing clots in body.
2. Monascus produces blood cholesterol lowering agent.
3. Trichoderma Cyclosporin a immunosuppressive agent in organ transplant

17. Describe any three potential applications of genetically modified plants.

Solution:

Three applications of genetically modified plants- 1. Nutritional enhancement : higher vitamin content, more fatty acid profiles

2. Stress tolerance (cold, drought, salt, heat)
3. Disease resistance, to reduce post harvest losses.

18. How did an American Company, Eli Lilly use the knowledge of r-ENA technology to produce human insulin ?

Solution:

Eli Lilly, an American company, prepared two DNA sequences corresponding to A & B chains of human insulin and introduced them in plasmids of *E. coli* to produce insulin chains. Chains A & B were produced separately, extracted and combined by creating disulfide bonds to form insulin.

19. Explain co-evolution with reference to parasites and their hosts. Mention any four special adaptive features evolved in parasites for their parasitic mode of life.

Solution:

Parasites have evolved to be host-specific in such a way that both host and the parasite tend to co-evolve. That is, if the host evolves special mechanisms for rejecting or resisting the parasite, the parasite has to evolve mechanisms to counteract and neutralise them, in order to be successful with the same host species. The special adaptive features involved in parasites for parasitic mode of life are :-

1. loss of unnecessary sense organs.
2. loss of digestive system and high reproductive capacity.
3. presence of adhesive organs or suckers.
4. complex life cycle involving 2 hosts.

20. Rearrange the following in the correct sequence to accomplish an important biotechnological reaction :

- (a) *In vitro* synthesis of copies of DNA of interest
- (b) Chemically synthesized oligonucleotides
- (c) Enzyme DNA-polymerase
- (d) Complementary region of DNA
- (e) Genomic DNA template
- (f) Nucleotides provided
- (g) Primers
- (h) Thermostable DNA-polymerase (from *Thermus aquaticus*)
- (i) Denaturation of ds-DNA

Solution:

1. Genomic DNA template
2. Enzyme DNA - polymerase
3. Complementary region of DNA.
4. Denaturation of ds DNA.
5. Primers
6. Thermostable DNA-polymerase (from *Thermus aquaticus*)
7. Nucleotides provided
8. Chemically synthesized oligonucleotides.
9. *In vitro* synthesis of copies of DNA of interest.

21. With the help of a flowchart exhibit the events of eutrophication.

Solution:

nutrients (fertilizers) enter into water body from near by cropland



nutrients are utilized by the algae



Algae grow more and more by consuming the nutrients and oxygen.



the number of Aquatic plants and animals
decrease in number.



Algae grows on the surface of the water and do not allow sunlight to enter in the water body



All aquatic plants and animals die ultimately.

22. Enumerate any six essentials of good, effective Dairy Farm Management Practices.

Solution:

Six essentials of good, effective Dairy farm management are .

1. housed well
2. Adequate water
3. feeding in a scientific manner
4. Cleanliness and hygiene(both of the cattle and the handlers)
5. Regular inspection with proper record keeping
6. Regular visit by veterinary doctor.

SECTION D

23. Your school has been selected by the Department of Education to organize and host an interschool seminar on "Reproductive Health - Problems and Practices". However, many parents are reluctant to permit their wards to attend it. Their argument is that the topic is 'too embarrassing'. Put forth four arguments with appropriate reasons and explanation to justify the topic to be very essential and timely.

Solution:

Adolescents should be encouraged to provide right information to encourage children from believing in myths and having misconceptions about sex related aspects.

- (2) Proper information about reproductive organs, hygiene sexual practices, sexually transmitted disease to lead a reproductively healthy life.
- (3) Sex education will enable them to understand the problems related to uncontrolled population growth, social evils like sex abuse and sex related crimes.
- (4) Sex education will address the importance of bringing up socially conscious healthy families of desired size and thereby build up socially responsible and healthy society.

SECTION E

24. (a) List the different attributes that a population has and not an individual organism.

(b) What is population density? Explain any three different ways the population density can be measured, with the help of an example each.

OR

It is often said that the pyramid of energy is always upright. On the other hand, the pyramid of biomass can be both upright and inverted." Explain with the help of examples and sketches.

Solution:

(a)

(i) Natality refers to the number of births during a given period in the population that are added to the initial density.

(ii) Mortality is the number of deaths in the population during a given period.

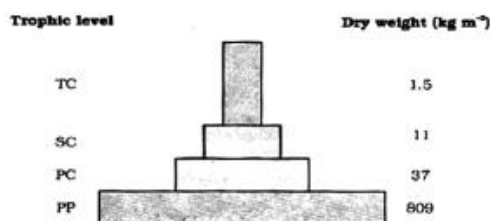
(iii) Immigration is the number of individuals of the same species that have come into the habitat from elsewhere during the period under consideration.

(iv) Emigration is the number of individuals of the population who left the habitat and gone elsewhere during the period under consideration.

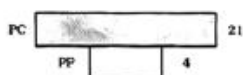
(b) Population size, more technically called population density (designated as N), need not necessarily be measured in numbers only. Although total number is generally the most appropriate measure of population density, it is in some cases either meaningless or difficult to determine. In an area, if there are 200 *Parthenium* plants but only a single huge banyan tree with a large canopy, stating that the population density of banyan is low relative to that of *Parthenium* amounts to underestimating the enormous role of the Banyan in that community. In such cases, the per cent cover or biomass is a more meaningful measure of the population size. Total number is again not an easily adoptable measure if the population is huge and counting is impossible or very time-consuming. Sometimes, for certain ecological investigations, there is no need to know the absolute population densities; relative densities serve the purpose equally well. For instance, the number of fish caught per trap is good enough measure of its total population density in the lake. We are mostly obliged to estimate population sizes indirectly. Without counting them or seeing them. The tiger census in our national parks and tiger reserves is often based on pug marks and faecal pellets.

OR

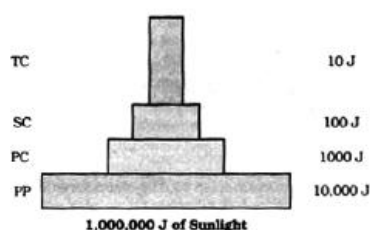
In most ecosystems, all the pyramids, of number, of energy and biomass are upright, i.e., producers are more in number and biomass than the herbivores, and herbivores are more in number and biomass than the carnivores. Also energy at a lower trophic level is always more than at a higher level. The pyramid of biomass in sea is also generally inverted because the biomass of fishes far exceeds far exceeds that of phytoplankton. Pyramid of energy is always upright, can never be inverted, because when energy flows from a particular trophic level to the next trophic level, some energy is always lost as heat at each step. Each bar in the energy pyramid indicates the amount of energy present at each trophic level in a given time or annually per unit area.



Pyramid of biomass shows a sharp decrease in biomass at higher trophic levels.



Inverted pyramid of biomass—small standing crop of phytoplankton supports large standing crop of zooplankton.



An ideal pyramid of energy. Observe that primary producers convert only 1% of the energy in the sunlight available to them into NPP

25. (a) Plan an experiment and prepare a flow chart of the steps that you would follow to ensure that the seeds are formed only from the desired sets of pollen grains. Name the type of experiment that you carried out.
- (b) Write the importance of such experiments.

OR

Describe the roles of pituitary and ovarian hormones during the menstrual cycle in a human female.

Solution:

The changes in the ovary and the uterus are induced by changes in the levels of pituitary and ovarian hormones. The secretion of gonadotropins (LH and FSH) increases gradually during the follicular phase, and stimulates follicular development as well as secretion of estrogens by the growing follicles. Both LH and FSH attain a peak level in the middle of cycle (about 14th day). Rapid secretion of LH leading to its maximum level during the mid-cycle called LH surge induces rupture of Graafian follicle and thereby the release of ovum (ovulation). The ovulation (ovulatory phase) is followed by the luteal phase during which the remaining parts of the Graafian follicle transform as the corpus luteum. The corpus luteum secretes large amounts of progesterone which is essential for maintenance of the endometrium. Such an endometrium is necessary for implantation of the fertilised ovum and other events of pregnancy.

OR

(a) Artificial hybridisation is one of the major approaches of crop improvement programme. In such crossing experiments it is important to make sure that only the desired pollen grains are used for pollination and the stigma is protected from contamination (from unwanted pollen). This is achieved by emasculation and bagging techniques. If the female parent bears bisexual flowers, removal of anthers from the flower bud before the anther dehisces using a pair of forceps is necessary.



This step is referred to as emasculation. Emasculated flowers must be covered with a bag of suitable size, generally made up of butter paper, to prevent contamination of its stigma with unwanted pollen. This process is called bagging.



When the stigma of bagged flower attains receptivity, mature pollen grains collected from anthers of the male parent are dusted on the stigma.



The flowers are rebagged, and the fruits allowed to develop.

(b) By this experiment breeders can combine desirable characters to produce commercially superior varieties.

26. (a) Why are colour-blindness and thalassemia categorised as Mendelian disorders? Write the symptoms of these diseases seen in people suffering from them.

(b) About 8% of human male population suffers from colour-blindness whereas only about 0.4% of human female population suffers from this disease. Write an explanation to show how it is possible.

OR

Explain the process of transcription in prokaryotes. How is the process different in eukaryotes?

Solution:

(a) Colour-blindness and Thalassemia are considered as Mendelian disorder because these occur due to mutation in single gene. Symptoms of colour-blindness:-

⇒ failure to differentiate between red and green colour

Symptoms of thalassemia:-

⇒ This causes formation of abnormal haemoglobin molecules resulting into an anaemia.

(b) It occurs in about 8% of males and only 0.4% of females. This is because the genes that lead to red-green colour blindness are on the X Chromosome. Males have only one X Chromosome and females have two. The son of a woman who carries the gene has a 50% chance of being colour blind. The mother is not herself colour blind because the gene is recessive.

OR

In bacteria, there are three major types of RNAs: mRNA (messenger RNA), tRNA (transfer RNA), and rRNA (ribosomal RNA). All three RNAs are needed to synthesise a protein in a cell. The mRNA provides the template, tRNA brings amino acids and reads the genetic code, and rRNAs play structural and catalytic role during translation. There is single DNA-dependent RNA polymerase that catalyses transcription of all type of RNA in bacteria. RNA polymerase binds to promoter and initiates transcription (Initiation). It uses nucleoside triphosphates as substrates and polymerises in a template dependent fashion following the rule of complementarity. It somehow also facilitates opening of the helix and continues elongation. Only a short stretch of RNA remains bound to the enzyme. Once the polymerase reaches the terminator region, the nascent RNA falls off, so also the RNA polymerase. This results in termination of transcription. The RNA polymerase is only capable of catalyzing the process of elongation. It associates transiently with initiation-factor and termination-factor to initiate and terminate the transcription, respectively. Association with these factors alter the specificity of the RNA polymerase to either initiate or terminate. In bacteria, since the mRNA does not require any processing to become active, and since transcription and translation take place in the same compartment (there is no separation of cytosol and nucleus in bacteria), many times the translation can begin much before the mRNA is fully transcribed. Consequently, the transcription and translation can be coupled in bacteria. **Prokaryotic Transcription :**

1. Coupled transcription-translation is the rule.
2. Occurs in the cytoplasm.
3. A single RNA polymerase synthesises all the three types of RNA (mRNA, tRNA, rRNA)
4. RNAs are released and processed in the cytoplasm.
5. Transcriptional unit has one or more genes (Polycistronic)
6. The 23S, 16S and 5S rRNAs are formed from a single primary transcript.

Eukaryotic Transcription:

1. Coupled transcription translation is not possible.

2. Occurs in the nucleus.
3. The RNA polymerases I, II and III synthesizes rRNA mRNA and tRNA respectively.
4. RNAs are released and processes in the nucleus.
5. Transcriptional unit has only one gene (Monocistronic)
6. The 28S, 18S, 5.8S and 5S rRNAs are formed from two primary transcripts.