

Question Paper Code 57/1/3

SECTION – A

Q. Nos. 1 - 5 are of one mark each

1. Name the pathogen which causes Typhoid. Name the test that confirms the disease.

Ans. *Salmonella typhi* , widal test = $\frac{1}{2} + \frac{1}{2}$

[1 mark]

2. State Mendel's Law of Independent Assortment.

Ans. When two pairs of traits (characters) are combined in a hybrid segregation of one pair of characters is independent of the other pair of characters.

[1 mark]

3. What is female heterogamety ? Give one example .

Ans. Two different types of gametes (in terms of sex chromosomes) produced by female organism
e.g In some birds / any example of bird = $\frac{1}{2} + \frac{1}{2}$

[1 mark]

4. How does the human body respond when haemozoin produced by Plasmodium is released in its blood ?

Ans Chill and high fever occurs , in regular intervals / every 3 to 4 days = $\frac{1}{2} + \frac{1}{2}$

[1 mark]

OR

Write the role of interferons.

Ans. Virus infected cells secrete proteins called interferons, which protect non infected cells (from further viral infection) = $\frac{1}{2} + \frac{1}{2}$

[1 mark]

5. How do drones develop in honey bees ? Name the process.

Ans Drones develop from female gamete without fertilization, parthenogenesis = $\frac{1}{2} + \frac{1}{2}$

[1 mark]

OR

Some flowers, selected for artificial hybridization, do not require emasculation but bagging is essential for them. Give a reason

Ans As some flowers are unisexual , to prevent contamination of its stigma with unwanted pollen grains.
= $\frac{1}{2} + \frac{1}{2}$

[1 mark]



SECTION - B

Q. Nos. 6 - 12 are of two marks each

6. Write the functions of bone marrow as the primary lymphoid organ and lymph nodes as the secondary lymphoid organs.

Ans Bone Marrow-lymphocytes are produced here, develop and mature into antigen sensitive lymphocytes = $\frac{1}{2} + \frac{1}{2}$

Lymph nodes- trap the microorganism / antigens from the tissue fluid , the trapped antigens activate the lymphocytes (present in lymph nodes) to cause immune response = $\frac{1}{2} + \frac{1}{2}$

[2 marks]

OR

What is a vaccine ? State the type of immunity that it induces.

Ans. Vaccine is a weakened / inactivated pathogen or its antigenic protein , Active immunity = 1+1

[2 marks]

7. Write any two ways by which apomictic seeds may be developed in angiosperms.

Ans. (i) Develops from a diploid egg cell (formed without reduction division) which grows into an embryo without fertilization.

(ii) Develops from nucellar cell which divides and protrudes into the embryo sac and develops into an embryo = 1+1

[2 marks]

8. Explain the principle that helps in separation of DNA fragments in Gel electrophoresis.

Ans. Since DNA fragments are negatively charged molecules they can be separated by forcing them to move towards anode / +ve pole under an electric field through a medium (matrix) = 1 , DNA fragments separate according to their size , through sieving effect provided by agarose gel (matrix) = $\frac{1}{2} + \frac{1}{2}$

[2 marks]

9. Write the scientific name of the sugarcane variety that was originally grown in North India. Why was this variety hybridised with the tropical variety of sugarcane grown in South India

Ans *Saccharum barberi* = 1

Increase in yield / thicker stem / increase in sugar content (Any Two) = $\frac{1}{2} + \frac{1}{2}$

[2 marks]

10. Why is genus Nucleopolyhedrovirus considered an excellent biocontrol agent ?

Ans They are species specific , show narrow spectrum insecticidal effect , no negative impact on insects / mammals / plants / fish etc , desirable when beneficial insects are managed / Integrated Pest Management / IPM = $\frac{1}{2} \times 4$

[2 marks]



11. State the cause and the symptoms of a person suffering from Turner's Syndrome

Ans Cause - Due to the absence of one of the X chromosome in human female /22 pairs of autosomes+ X /44 +XO chromosomes = 1

Symptoms - Females are sterile /ovaries are rudimentary , lack of other secondary sex characters = 1/2 +1/2

[2 marks]

12. Name one toxin gene isolated from *B. thuringiensis* and its target pest.

Ans Toxin gene cryIAc / cryIIAb , targets pest-cotton Bollworms // cryIAb ,controls corn borer = 1+1

[2 marks]

OR

Why does the toxin produced by *B. thuringiensis* not kill the *Bacillus* ?

Ans. Bt Toxin protein exists as inactive protoxins , the inactive toxin is converted into an active form of toxin only in the presence of the alkaline pH which is not available in the *Bacillus* = 1+1

[2 marks]

SECTION-C

Q. Nos. 13 - 24 are of three marks each

13. Explain the three different ways in which the natural selection operates.

Ans Natural Selection operated on different rates and can lead to

- Stabilisation , more individuals acquire mean character
- Directional change , where individuals acquire value other than mean characters.
- Disruptional , where individuals acquire peripheral character at both ends = 1/2 × 6

[3 marks]

14. Explain the role of regulatory gene in a lac operon. Why is regulation of lac operon called as negative regulation ?

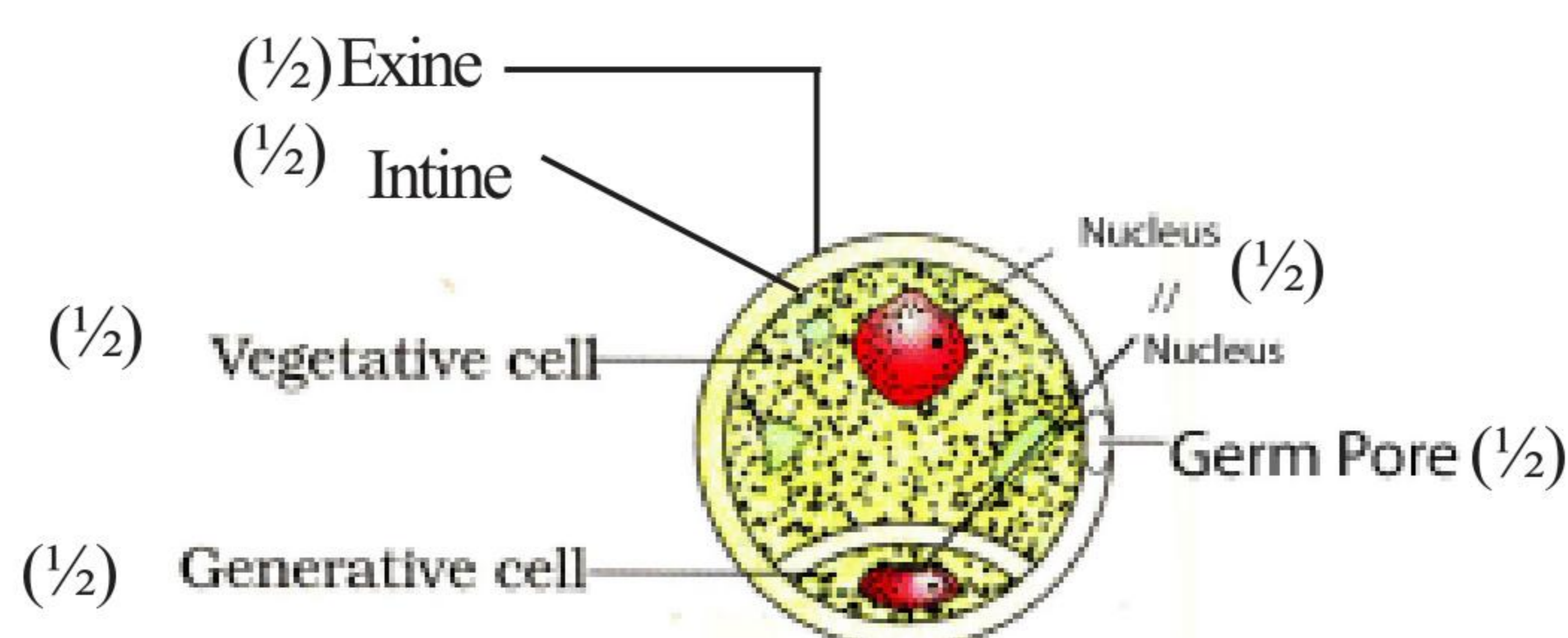
Ans. Regulatory gene / i gene codes for the repressor of the lac operon , the repressor protein (synthesised by i gene, binds to the operator site of the operon , and prevents the RNA polymerase from transcribing the operon = 1/2 × 3

The repressor of lac operon is synthesised constitutively / all the time , and thus the operon is in 'switched off' position generally , it is switched on only when lactose is present in the culture medium of the *E.coli* when the operon gets ' switched on' = 1/2 × 3

[3 marks]

15. Draw a labelled diagram of a mature male gametophyte of an angiosperm.

Ans



=1/2 × 6

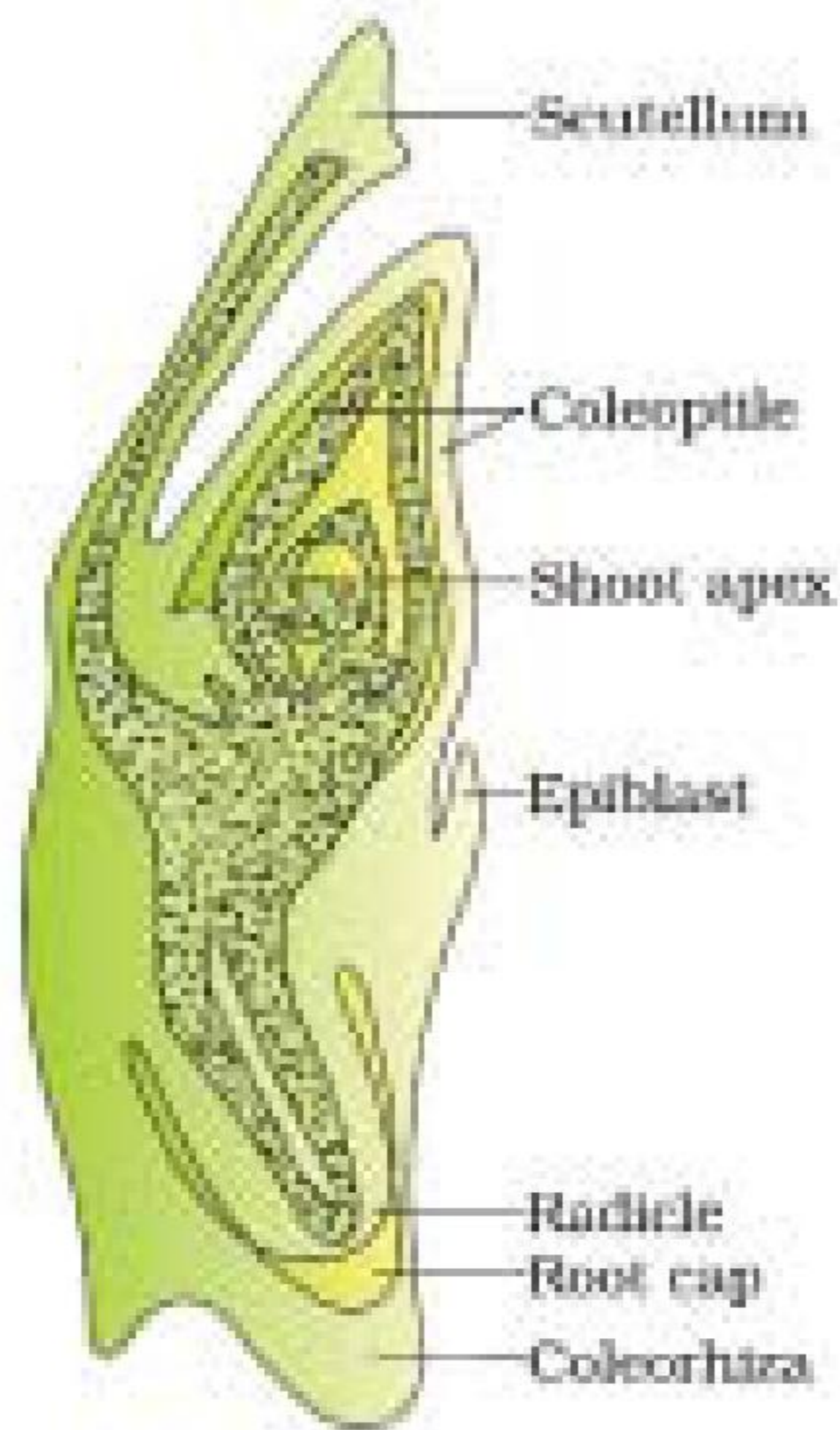
[3 marks]

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OR

Draw a diagram of L.S. of an embryo of grass and label any six parts.

Ans.



(Any six labels) = $\frac{1}{2} \times 6$

[3 marks]

16. Explain the logistic growth pattern of a population. Why do population growth patterns of all organisms ultimately follow it ?

Ans. A population growing in a habitat with limited resources, shows a lag phase, followed by phases of acceleration and deceleration and finally an asymptote when the population density reaches the carrying capacity, a plot of population density in relation to time results in sigmoid curve = $\frac{1}{2} \times 4$

Since resources for growth of most organisms are finite, and become limiting sooner or later the logistic growth pattern is ultimately followed = $\frac{1}{2} \times 2$

[3 marks]

17. How is polygenic inheritance different from pleiotropy ? Give one example of each.

Polygenic inheritance

Pleiotropy

Ans

a) A single trait influenced by many genes

a) A single gene can exhibit multiple phenotypic expression = 2

b) e.g height/ skin colour in humans controlled by three or more genes.

b) e.g phenylketonuria, characterised by mental retardation / reduction in hairs and / skin pigmentation / or any other correct example = $\frac{1}{2} + \frac{1}{2}$

[3 marks]

OR

Explain the Hardy-Weinberg principle with the help of an algebraic equation.

Ans • The Principle says that allele frequency in a population are stable and is constant from generation to generation, the gene pool remains constant = $\frac{1}{2} + \frac{1}{2} = 1$

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expressed as $p^2 + 2pq + q^2 = 1 / (p+q)^2 = 1$ = $\frac{1}{2}$

- Where p^2 = frequency of individuals with AA genotype
- Where q^2 = frequency of individuals with aa genotype
- Where $2pq$ = frequency of individuals with Aa genotype = $\frac{1}{2} \times 3$

[3 marks]

18. It is observed that plant-animal interactions often involve co-evolution. Explain with the help of a suitable example.

Ans Fig tree and wasp, Fig species are pollinated by wasp only, female wasp uses the fruit for laying its eggs, seed in the fruit for nourishing the larvae, the wasps pollinate fig and in florescence, thus if one partner evolves other partner also needs to co-evolve = $\frac{1}{2} \times 6$

//

Mediterranean orchid Ophrys and a species of bee, one petal of the orchid flower bears a close resemblance to the female bee (shape, size and colour), male bee is attracted to this petal (mistaking it to be a female bee), gets dusted with the pollen of the flower, when the same bee pseudocopulates with another flower it gets pollinated, thus one partner evolves other partner also needs to co-evolve = $\frac{1}{2} \times 6$

19. A doctor after conducting certain tests on a pregnant woman advised her to undergo M.T.P., as the foetus she was carrying showed trisomy of 21st chromosome.

- (a) State the cause of trisomy of the 21st chromosome.**
- (b) Why was the pregnant woman advised to undergo M.T.P. and not to complete the full term of her pregnancy? Explain**

Ans. a) Cause - non-disjunction / failure of segregation of chromatids of 21st chromosome during gamete formation, leading to gain of a chromosome = 1+1

b) Mother was advised to undergo MTP because Trisomy of 21st Chromosome would lead to Down's syndrome / an individual is short statured with furrowed tongue / broad palm with characteristic palm crease / retarded physical / mental and psychomotor development (any two) = 1

[3 marks]

20. Explain the impact of human activities on carbon cycle in nature and list its harmful effects.

Ans. Human activities like deforestation for timber / land / other purposes / massive burning of fossil fuels for energy and transport, have significantly increased rate of release of CO₂ into the atmosphere which results in disturbing the carbon cycle = $\frac{1}{2} + \frac{1}{2}$

Increase in the level of CO₂ along with other greenhouse gases has led to considerable heating of earth leading to global warming, and deleterious changes in the environment resulting in odd climatic changes or El Nino Effect, increased melting of polar ice caps, submerging the coastal areas = $\frac{1}{2} \times 4$

OR

Explain the cause and effect of biomagnification in an aquatic food chain

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Ans. It refers to increase in concentration of toxic substances such as mercury / DDT at successive trophic levels , because the accumulated toxic substances cannot be metabolised or excreted by the organism , and is thus passed on to the next higher trophic level , and concentration of these toxic substances increases to an alarming level in the top carnivore / fish eating bird = $\frac{1}{2} \times 4$

Effect- High conc. of DDT disturbs calcium metabolism in birds causing thinning of egg shells and their premature breaking , leading to decline in bird population = $\frac{1}{2} \times 2$

[3 marks]

21. (a) Name the most commonly used bioreactor. Why are these bioreactors used ?
(b) How is the operation in a bioreactor carried out so as to achieve the desired end product ?

Ans. a) Stirred tank bioreactor , to obtain large quantities of desired products from the culture medium containing cloned organisms with genes of interest = $\frac{1}{2} + \frac{1}{2}$

b) By providing optimum growth conditions for the living materials such as temperature / pH / substrate / salts/ vitamins/ oxygen (any four conditions) = $\frac{1}{2} \times 4$

[3 marks]

OR

Explain the process of amplification of genes of interest using PCR technique.

Ans. PCR - technique

a) Denaturation , - The two strands of the gene of interest are separated as DNA templates under high temperature = $\frac{1}{2} + \frac{1}{2}$

b) Annealing , - The two DNA primers attached to the two separated DNA template strands = $\frac{1}{2} + \frac{1}{2}$

c) Extension , - Taq polymerase extends the primers (in 5' → 3' using deoxynucleotides provided in the medium) = $\frac{1}{2} + \frac{1}{2}$

The Cycle is repeated to get the multiple copies of gene of interest.

[3 marks]

22. Explain the strategy used for herd improvement in cattle.

Ans Multiple Ovulation Embryo Transfer Technology /MOET , A high milk yielding cow is administered hormones with FSH like activities , to induce follicular maturation and super ovulation and instead of one egg per cycle they produce 6-8 eggs , the cow is mated with an elite bull or artificially inseminated , the fertilised eggs at 8-32 cell stage are retrieved (non-surgically) and transferred to surrogate mothers, the genetic mother is available for another round of super ovulation and mating with an elite bull improving herd size in a short time = $\frac{1}{2} \times 6$

[3 marks]

- 23 Name the disease and its cause for which the first gene therapy was given. Write the steps carried out for the gene therapy given to the patients suffering from such a disease.

Ans Adenosine deaminase deficiency / ADA deficiency = $\frac{1}{2}$

Cause : Due to deletion of gene for adenosine deaminase = $\frac{1}{2}$

Steps for gene therapy : Lymphocytes from the blood of the patient are grown in a culture outside the body, functional ADA cDNA (using retroviral vector) is then introduced into these



lymphocytes, then the lymphocytes are subsequently returned to the patient, as these lymphocytes are not immortal the patient requires periodic infusion of such genetically altered lymphocytes = $\frac{1}{2} \times 4$

[3 marks]

24. Explain with the help of an example each any three ways the ecologists use to measure population density of different organisms rather than by calculating their absolute number.

- Ans. (a) By measuring the percent cover or biomass which may be more meaningful, in cases like in an area where large number of *Parthenium* are there but only one banyan tree / densities of micro organisms in a culture medium = $\frac{1}{2} \times 2$
- (b) By measuring relative densities instead of absolute densities of organism, e.g the number of fish caught per trap in a lake is good enough to estimate population size = $\frac{1}{2} \times 2$
- (c) By estimating the population size indirectly without actually seeing or counting them, e.g counting tiger population in national parks is based on their pug marks or faecal pellets = $\frac{1}{2} \times 2$

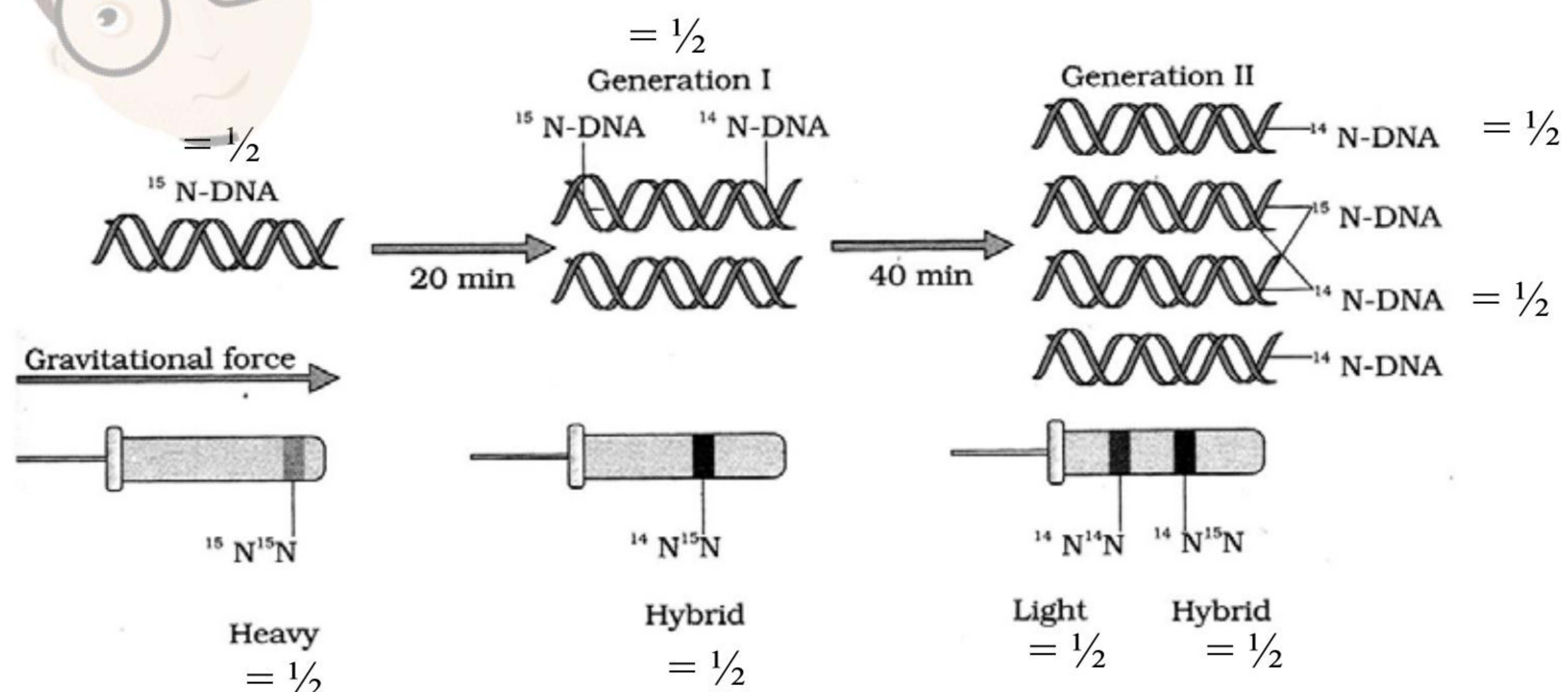
[3 marks]

SECTION -D

Q. Nos. 25 - 27 are of five marks each

25. Explain Meselson and Stahl's experiment and write the conclusion they arrived at.

Ans They grew *E.coli*, in $^{15}\text{NH}_4\text{Cl}$ for many generations to get ^{15}N incorporated into DNA, Then the cells are transferred into $^{14}\text{NH}_4\text{Cl}$, The extracted DNA are centrifuged in CsCl and measured to get their densities, DNA extracted from the culture after one generation (20 minutes), showed intermediate hybrid density, DNA extracted after two generations (40 minutes) showed light DNA, and hybrid DNA = $\frac{1}{2} \times 8 = 4 //$



A correctly labelled diagrammatic representation in lieu of the explanation of experiment = 4

They concluded that DNA replication is semi conservative = 1

[5 marks]

OR

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- (a) Describe the structure of a polymer of de-oxyribonucleotides.
 (b) How is an RNA polymer different from it ?

- Ans a) A deoxyribonucleotide has three components- a nitrogen base and a deoxyribose sugar and a phosphate group, there are two types of nitrogenous bases - purine (adenine and guanine), pyrimidines (cytosine and thymine), a nitrogenous base is linked to the OH of 1'C of deoxyribose sugar, through N- glycosidic bond to form a nucleoside, when a phosphate group is linked to OH of 5' C of a nucleoside through phosphodiester linkages a deoxynucleotide is formed, two deoxynucleotides are linked through 3'-5' phosphodiester linkage to form a dinucleotide, more deoxynucleotides can be joined in such a manner to form a deoxypolynucleotide chain having at one end a free phosphate moiety at 5' end or sugar referred to as 5' end of polynucleotide chain and at the other end of the polymer the sugar has a free OH of 3'C which is referred to as 3' end of the chain = $\frac{1}{2} \times 8$
- b) i) the nitrogenous base in RNA polymer is uracil instead of thymine in DNA polymer
 ii) RNA has pentose sugar instead of deoxyribose sugar as in a DNA polymer
 iii) In a RNA polymer every nucleotide residue has an additional- OH group at 2' position in ribose sugar (Any Two) = $\frac{1}{2} \times 2$

[5 Marks]

26. While studying pollution of water, a group of students observed mortality of fish in the river flowing through the city and also in the pond which was away from the city but was adjacent to the crop fields. They further found that drains of the city discharged sewage into the river and the water from farms flowed into the pond. Explain how these could be the cause of fish mortality.

Ans. Following discharge of sewage into a river micro-organisms involved in biodegradation of organic matter flourish in the water body , consuming a lot of oxygen , and as a result there is a sharp decline in dissolved oxygen downstream / rise in BOD from the point of sewage discharge. This causes mortality of fish and other aquatic creatures = 1×3

Presence of large amounts of nutrients (coming from farm fields) in waters , also causes excessive growth of planktonic free-floating) algae, called an algal bloom which imparts unpleasant colour to the water bodies , Algal blooms cause depletion of dissolved oxygen leads to fish mortality = $\frac{1}{2} \times 4$

[3 + 2 = 5 marks]

OR

- (a) Identify the features of a stable biological community.
 (b) How did David Tilman's findings link stability of a biological community to its species richness ?

- Ans a) • A stable community should not show too much variation in productivity from year to year
 • it must be either resistant or resilient to occasional disturbances (natural or man-made)
 • and it must also be resistant to invasions by alien species = 1×3
- b) • plots with more species showed less year-to-year variation in total biomass.
 • increased diversity contributed to higher productivity. $1 \times 2 = 2$

[5 marks]

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27. Compare the processes of DNA replication and transcription in prokaryotes.

Ans Similarities -

Both the processes involve -

- i. Unwinding of the helix and separating the two DNA strands
- ii. Breaking the hydrogen bonds between the bases / pairs
- iii. Follow complimentary base pair rule
- iv. Polymerization occurs in 5' → 3' direction
- v. Linking / Polymerization of nucleotides

(Any other correct similarity)

(Any Five) = $\frac{1}{2} \times 5 = 2\frac{1}{2}$

Disimilarities

DNA replication	Transcription
1. DNA nucleotides added are ATP, GTP, CTP, TTP	RNA nucleotides added are ATP, GTP, CTP, UTP
2. Deoxyribose sugar is the part of nucleotide	Ribose sugar is the part of nucleotide
3. Adenine pairs with Thymine	Adenine with Uracil
4. Both strands copied	Only one strand copied.
5. Resulting into two DNA molecules	Resulting in formation of an RNA molecule

(Any other correct disimilarity)

(Any Five) = $\frac{1}{2} \times 5 = 2\frac{1}{2}$
[5 marks]

OR

(a) Explain Griffith's 'transforming principle' experiment.

(b) In the above experiment, "heat which killed one type of bacteria, did not destroy the properties of genetic material." Justify

Ans a) When *Streptococcus pneumoniae* (*pneumococcus*) bacteria are grown on a culture plate produced smooth shiny colonies (S) because the S strain bacteria have a mucus (polysaccharide) coat, Mice infected with the S strain (virulent) die from pneumonia infection while others produce rough colonies (R), but mice infected with the R strain do not develop pneumonia, Griffith observed that heat-killed S strain bacteria when injected into mice did not kill them, When he injected a mixture of heat-killed S and live R bacteria, the mice died. Moreover, he recovered living S bacteria from the dead mice
 $= \frac{1}{2} \times 6 = 3$

b) the two DNA strands complementary get separated by heating come together, when appropriate conditions are provided heat did not destroy the genetic properties = 1+1

[5 marks]

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