

Question Paper Code 57/4/2

SECTION – A

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

1. Name the pattern of inheritance where F_1 phenotype

- (a) resembles only one of the two parents.
- (b) does not resemble either of the two parents and is in between the two

Ans a) (Complete) dominance / Mendelian inheritance

b) Incomplete dominance = $\frac{1}{2} + \frac{1}{2}$

[1 Mark]

2. According to the Hardy-Weinberg principle, the allele frequency of a population remains constant. How do you interpret the change of frequency of alleles in a population ?

Ans i) Resulting in evolution / Speciation / original drifted population becomes founders

[1 Mark]

OR

***Coelacanth* was caught in South Africa. State the significance of discovery of *Coelacanth* in the evolutionary history of vertebrates.**

Evolved as first amphibian (lived on both land and water) / ancestor of modern day frogs and salamanders

[1 Mark]

3. State the functions of mast cells in allergy response.

Ans Release of chemicals like histamine, serotonin

= $\frac{1}{2} + \frac{1}{2}$

[1 Mark]

OR

State the function of interferons.

Ans Protects the non infected cells from viral infection(in the body)

[1 Mark]

4. State from where do the signals for parturition originate in human females.

Ans Fully developed foetus , the placenta = $\frac{1}{2} + \frac{1}{2}$
[1 Mark]

5. Write the specific point in the palindrome and the bond that is cut by EcoRI

Ans Between G and A , Phosphodiester bond = $\frac{1}{2} + \frac{1}{2}$
[1 Mark]

SECTION – B

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

6. Explain polygenic inheritance with the help of an example.

Ans Trait controlled by three or more genes = $\frac{1}{2}$

Skin colour is controlled by three genes (A, B, C), all dominant genes show darkest skin, and all recessive genes show lightest skin , the mix of dominant and recessive gene will show many variations of skin colour = $\frac{1}{2} \times 3$

[2 Marks]

7. Write the relationship between productivity, gross primary productivity, net primary productivity and secondary productivity.

Ans The rate of production of biomass is **productivity** , whereas rate of formation of organic matter during photosynthesis is **Gross primary productivity** , Gross primary productivity minus respiratory losses ($NPP = GPP - R$) is **net primary productivity**, formation of new organic matter by consumers is **secondary productivity**. = $\frac{1}{2} \times 4$

[2 Marks]

8. Write the scientific name of the source from where cocaine is obtained. How does its use affect the human body

Ans *Erythroxylum coca* = 1

Stimulating action on central nervous system / producing a sense of euphoria / interferes transport of dopamine / increased energy / hallucination (Any two) = $\frac{1}{2} + \frac{1}{2}$

[2 Marks]

9. Justify the need for signing of ‘Montreal Protocol’ by the participating nations in 1987.

Ans Control the emission of ozone depleting substances (which results in thinning of ozone layer), which allows the UV rays to penetrate the earths surface / causing deleterious effects (cataract / skin cancer / ageing of skin.) 1+1=2

[2 Marks]

OR

Write the effective remedy found by Ahmed Khan of Bengaluru for the efficient use of the plastic waste generated by big cities.

Ans He used plastic waste to produce polyblend, polyblend mixed with bitumen, enhanced the water repellent properties of bitumen, (laid on the roads) to increase the road life. = $\frac{1}{2} \times 4$

[2 Marks]

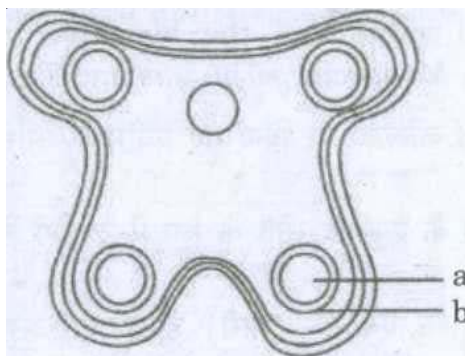
10. How is an alien species invasion considered as one of the causes of biodiversity loss? Support your answer with the help of example.

Ans They become invasive, cause decline / extinction of indigenous species = $\frac{1}{2} + \frac{1}{2}$

E.g Nile perch / Lantana / Carrot grass / water hyacinth / African catfish (*Clarias gariepinus*) = 1

[2 Marks]

11. In the T.S. of a mature anther given below, identify “a” and “b” and mention their functions.



Ans a- Sporogenous tissue / Microspore mother cells / Pollen Mother cells = $\frac{1}{2}$

give rise to microspores or pollen grains = $\frac{1}{2}$

b-Tapetum = $\frac{1}{2}$

provides nourishment to developing pollen grains. = $\frac{1}{2}$

[2 Marks]

OR

What is cleistogamy? Write one advantage and one disadvantage of it, to the plant.

Ans Pollination occurring in closed flowers =1

Advantage : Ensures self pollination / Assured seed set formation in absence of pollinators = ½

Disadvantage : does not allow cross pollination / genetic variation / can cause inbreeding depression = ½

[2 Marks]

12. **“Artificial insemination helps overcome several problems of normal mating in cattle”. Do you agree ? Support your answer with any three reasons.**

Ans Ans Yes =½

desirable mating can be carried , semen can be used immediately , can be frozen for later use, can be transported in frozen form where female is housed (**Any Three reasons**) =½×3

[2 Marks]

SECTION – C

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

13. **Describe the roles of (a) high temperature, (b) primers, and (c) bacterium *Thermus aquaticus* in carrying the process of polymerase chain reaction.**

Ans (a) High temperature- denaturation of double stranded DNA. = 1

(b) Primers -Initiates the process of polymerization =1

(c) Bacterium *Thermus aquaticus*- source of thermo stable DNA polymerase /Taq polymerase which remain active during the high temperature =½+½

[3 Marks]

OR

How does β -galactosidase coding sequence act as a selectable marker ?

Why is it a preferred selectable marker to antibiotic resistance genes ? Explain.

Ans When a recombinant DNA is inserted within the coding sequence of the enzyme β -galactosidase, it results into insertional inactivation / inactivation of the enzyme formation , the presence of chromogenic substrate gives blue coloured colonies if plasmid does not have an insert (non recombinant) , in the presence of insert no colour is produced (recombinant) . =½×4

selection of recombinant due to inactivation of antibiotic is a cumbersome procedure ,because it requires simultaneous plating having different antibiotics . =½×2

[3 Marks]

14. **State the medicinal value and the bioactive molecules produced by *Penicillium***

notatum, *Monascus purpureus* and *Trichoderma polysporum*.

Ans *Penicillium notatum*: Penicillin, effective antibiotic = $\frac{1}{2}+\frac{1}{2}$

Monascus purpureus: Statins, blood cholesterol lowering agents. = $\frac{1}{2}+\frac{1}{2}$

Trichoderma polysporum: Cyclosporin A, immunosuppressive agent = $\frac{1}{2}+\frac{1}{2}$

[3 Marks]

15. Answer the following questions 'based on Meselson and Stahl's experiment on *E. coli* :

- Write the name of the chemical substance used as the only source of nitrogen in the experiment.
- Why did they allow the synthesis of the light and the heavy DNA molecules in the organism ?
- How did they distinguish the heavy DNA molecules from the light DNA molecules ? Explain.
- Write the conclusion the scientists arrived at, at the end of the experiment.

Ans a) $\text{NH}_4\text{Cl} = \frac{1}{2}$

b) To distinguish between the hybrid / newly synthesized and the parent DNA = 1

c) the heavy and the light DNA molecules formed different bands on centrifugation in a cesium chloride density gradient. = 1

c) DNA replication is semi conservative = $\frac{1}{2}$

[3 Marks]

16. "A very small sample of tissue or even a drop of blood can help determine paternity." Provide a scientific explanation to substantiate how it is possible.

Ans DNA from all cells of an organism show the same degree of polymorphism, which is inheritable, thus DNA finger printing of the given sample can be useful for determining paternity. =1+1+1

[3 Marks]

17. Name the technique and the property of plant cells that can help to grow somaclones of certain desired variety of apple. Explain how somaclones of apple can be obtained in the lab so as to get the desired variety on a large scale.

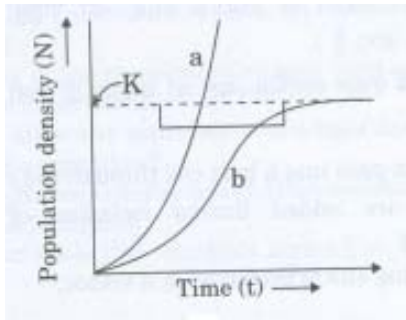
Ans Tissue Culture /Micropropagation, = $\frac{1}{2}$

Totipotency = $\frac{1}{2}$

Explants of apple plant (any small part), taken grown in a test tube under sterile conditions , in (special) nutrient media (Containing sucrose , inorganic salts , amino acids and vitamins) , with growth regulators =1/2×4

[3 Marks]

18. Study the graph given below and answer the questions that follow :



(i) The curve 'b' is described by the following equation :

$$\frac{dN}{dt} = rN \left(\frac{K - N}{K} \right)$$

What does 'K' stand for in this equation ? Mention its significance.

- (ii) Which one of the two curves is considered a more realistic one for most of the animal populations ?
- (iii) Which curve would depict the population of a species of deer if there are no predators in the habitat ? Why is it so ?

Ans i) K- Carrying capacity = 1/2

Any habitat having enough resources can support a maximum number of organisms, = 1

ii) Curve 'b' = 1/2

iii) Curve 'a', deer population will reach enormous numbers. = 1/2+1/2

[1 1/2+1/2+1=3 Marks]

19. Effluent from the primary treatment of the sewage is passed through large aeration tanks for biological treatment. Explain the complete process that follows till the water is ready to be released into the natural water bodies.

- Ans. - During treatment (after adding small amount of inoculum) primary effluent is constantly agitated mechanically and air is pumped into it
- This allows the vigorous growth of useful microbes into flocs
 - The microbes consume the major part of the organic matter in the effluent
 - It reduces the BOD of the effluent
 - The effluent is then passed into settling tank where the bacterial flocs are allowed to sediment
 - Major part of the activated sludge is pumped into aerobic sludge digester (and remaining water is released into natural water bodies)

[$\frac{1}{2} \times 6 = 3$ marks]

20. Expand 'BAC' and YAC'. What are they and what is the purpose for which they are used ?

Ans BAC- Bacterial Artificial Chromosomes =1

YAC- Yeast Artificial Chromosomes =1

They are commonly used as host , act as vectors for sequencing the DNA = $\frac{1}{2} + \frac{1}{2}$

[3 Marks]

21. (a) Mention the importance of gel-electrophoresis in biotechnology .

(b) Explain the process of this technique .

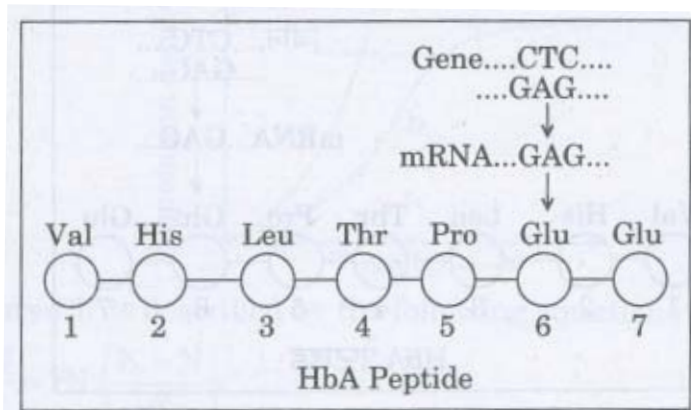
Ans a) It helps in cutting of (desired) DNA / seperation of DNA fragments for biotechnology experiments, = $\frac{1}{2}$

b) DNA being negatively charged moves towards anode, under electric field through a matrix / agarose medium , DNA fragments separate according to their size (smaller the size farther they move), separated DNA fragments stained with ethidium bromide , and visualised by exposing them to UV radiation and are cut. = $\frac{1}{2} \times 5$

[3 Marks]

22. Given below is the representation of a relevant part of amino acid composition of the

(3-chain of haemoglobin, related to the shape of human red blood cells.



Ans (a) Normal human , because at 6th position of the chain Glutamic Acid is present. =1+1

(b) Alteration / mutation occurs in a single gene , at 6th position Valine replaces Glutamic acid.= $\frac{1}{2}+\frac{1}{2}$

[3 Marks]

OR

Name the kind of diseases/disorders and any two symptoms that are likely to occur in humans if

(a) Mutation in the gene that codes for an enzyme phenylalanine hydroxylase occurs.

(b) The karyotype is XXY.

Ans (a) Phenylketonuria = $\frac{1}{2}$

Accumulation of phenyl pyruvic acid in brain results in mental retardation / phenyl pyruvic acid is excreted through urine / skin pigmentation / reduction in hair (any two) = $\frac{1}{2}+\frac{1}{2}$

(b) Klinefelter's Syndrome = $\frac{1}{2}$,

Deveopment of breast in male / Gynaecomastia , Individuals are sterile $\frac{1}{2}+\frac{1}{2}$

[$1\frac{1}{2}+1\frac{1}{2}=3$ Marks]

23 Emasculation and bagging are the two important steps carried during artificial hybridisation to obtain superior varieties of desired plants. Explain giving reasons, in which types of flowers and at what stages are the two processes carried out.

Ans Emasculation is carried out only in bisexual flowers , bagging is done in unisexual female flower as well as bisexual flowers , emasculation is done before the anther dehisces / matures , bagging is done before the stigma becomes receptive , it is done to prevent contamination of stigma with unwanted pollen , to allow the pollination to occur with desired pollens. $=\frac{1}{2}\times 6$

[3 Marks]

OR

State what is apomixis. Write its significance. How can it be commercially used ?

Ans It is a special mechanism of asexual reproduction that mimics sexual reproduction (to produce seeds without fertilization) , there is no segregation of characters in the progeny , farmers can develop apomicts of hybrids and use them year after year to cut the cost. $1+1+1=3$

[3 Marks]

24. (a) **Draw a sectional view of human ovary. Label the following parts :**

(i) **Primary follicle**

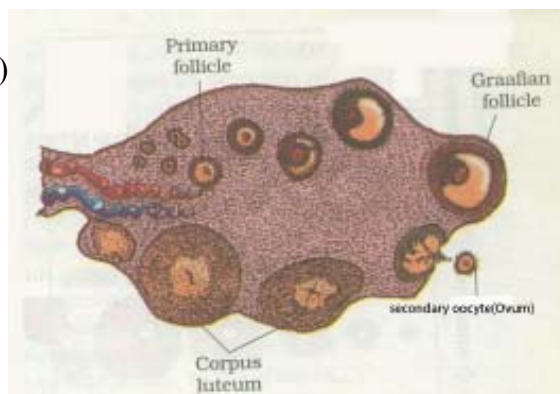
(ii) **Secondary oocyte**

(iii) **Graafian follicle**

(iv) **Corpus luteum**

(b) **Name the hormones influencing follicular development of corpus luteum.**

Ans (a)



$=\frac{1}{2}\times 4$

(b) LH/ Luteinising hormone & FSH/Follicle stimulating hormone

$=\frac{1}{2}+\frac{1}{2}$

[3 Marks]

OR

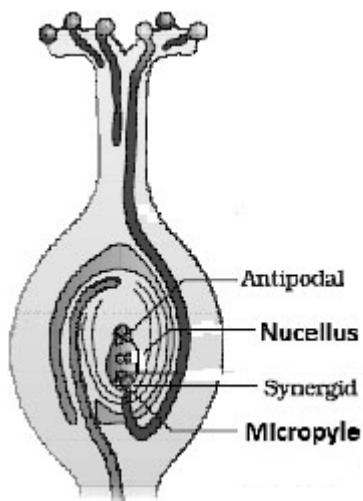
(a) Draw an L.S. of pistil showing pollen tube entering into the embryo sac. Label the following :

- (i) Nucellus
- (ii) Antipodals
- (iii) Synergids
- (iv) Micropyle

(b) Write the functions of the following :

- (i) Synergids
- (ii) Micropyle

Ans (a)



= $\frac{1}{2}$ ×4

(b) (i) Synergids have Filiform apparatus which guides the entry of pollen tube to the embryo sac = $\frac{1}{2}$

(ii) Micropyle allows the entry of pollen tube to embryo sacs. = $\frac{1}{2}$ =2+1

[3 Marks]

SECTION – D

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

25. (a) Why and how must the ozone layer in the stratosphere be protected ? Explain .

(b) How do deforestation and green house gases negatively affect our environment ? Explain

Ans (a) Ozone layer acts as shield , absorbs ultraviolet radiation from the sun , UV rays being highly injurious to living organism , causing skin cancer / aging / snow blindness / cataract / damaging DNA and proteins (Any One) = $\frac{1}{2} \times 4$

Ozone layer can be protected by reducing the use / emission of chloroflurocarbons (CFCs) =1

(b) Deforestation leads to increase in carbon dioxide concentration in the atmosphere / loss of biodiversity due to habitat destruction / disturbs hydrological cycle / causes soil erosion / leads to desertification in extreme cases. (any two) = $\frac{1}{2} + \frac{1}{2}$

Increase in the level of green house gases leads to the increase in earth's temperature leading to global warming = $\frac{1}{2}$

/deleterious changes in the environment resulting in odd climatic changes (El Nino effect) / Increased melting of polar ice cap/Himalayan snow caps/ rise in sea level/ submerge many coastal areas = $\frac{1}{2}$

[5 Marks]

OR

Biomagnification and accelerated eutrophication are both caused due to indiscriminate use of chemicals and irresponsible human activities. Do you agree ? Support your answer with explanation and an example of each .

Ans Yes = $\frac{1}{2}$

Biomagnification is the increase in concentration of toxic substance *at successive trophic* levels , e.g In the aquatic food chain the concentration of DDT increases at each trophic level (starts at 0.003 ppb and reaches to 25 ppm) in fish eating birds , causing thinning of egg shell , premature breaking of egg shell -decline in bird population = $\frac{1}{2} \times 4$

Accelerated eutrophication is caused due to accumulation of industrial and domestic waste into water bodies , prime contaminants are nitrates and phosphates which act as plant nutrients , overstimulate the growth of algae causing scum / unpleasant odour , reducing dissolved oxygen in water bodies , leading to fish mortality / death of the lake . = $\frac{1}{2} \times 5$

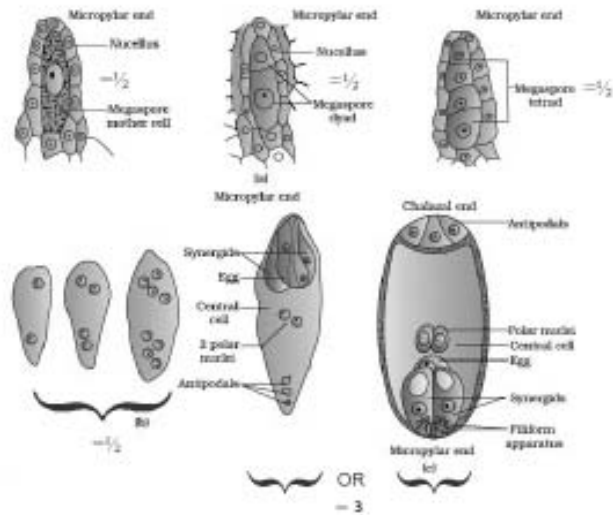
[5 Marks]

26. Describe the process of megasporogenesis upto fully developed embryo sac

Ans A single large cell of nucellus with dense cytoplasm and prominent nucleus differentiated as megaspore mother cell (MMC) , in the micropylar region, the megaspore mother cell undergoes meiosis to form 4 megaspores, 3 cells degenerates and one is functional, functional megaspore undergoes three successive mitotic divisions , to develop 8 nucleated (7 celled) embryo sac, with 3 antipodals, one egg cell (female gamete) , 2 synergids , two polar nuclei = $\frac{1}{2} \times 10$

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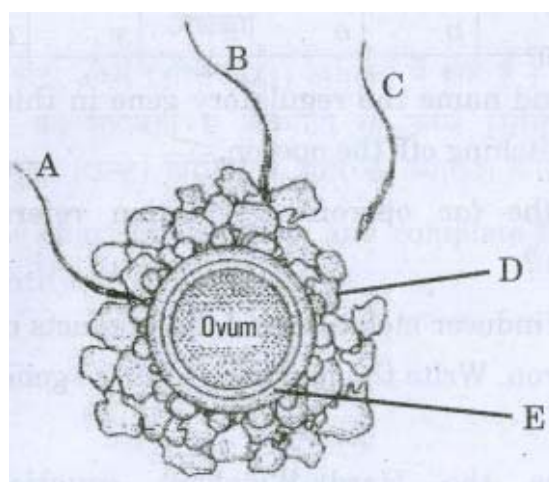
In lieu of above explanation the following diagram can be considered



[5 Marks]

OR

Given below is the diagram of a human ovum surrounded by a few sperms. Study the diagram and answer the following questions :



(a) Which one of the sperms would reach the ovum earlier ?

(b) Identify 'D' and 'E'. Mention the role of E

- (c) **Mention what helps the entry of sperm into the ovum and write the changes occurring in the ovum during the process.**
- (d) **Name the specific region in the female reproductive system where the event represented in the diagram takes place.**

Ans a) Sperm 'A' = $\frac{1}{2}$

b) D= Cells of corona radiata = $\frac{1}{2}$

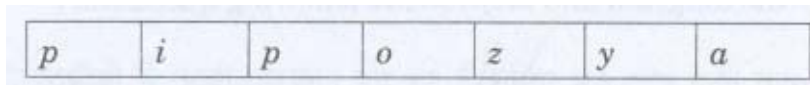
E= zona pellucida , undergoes changes (when comes in contact with sperm) and ensures that only one sperm can fertilize the ovum = $\frac{1}{2} + \frac{1}{2}$

c) the secretion of acrosome (enzymes) helps the entry of sperm into the ovum , induces the completion of meiotic division of secondary oocyte = 1+1

d) Ampulla /ampullary - isthmic junction of the fallopian tube = 1

[5 Marks]

27. **Study the schematic representation of the genes involved in the *lac* operon given below and answer the questions that follow :**



- (a) **Identify and name the regulatory gene in this operon. Explain its role in 'switching off the operon.'**
- (b) **Why is the *lac* operon's regulation referred to as negative regulation ?**
- (c) **Name the inducer molecule and the products of the genes 'z' and 'y' of the operon. Write the functions of these gene products.**

Ans a) 'i' gene , produces repressor that binds to the operator , prevents RNA polymerase from transcribing the operon = $\frac{1}{2} + \frac{1}{2} + \frac{1}{2}$

b) repressor binds to the operator , to switch off the operon = $\frac{1}{2} + \frac{1}{2}$

c) Lactose / Allolactose , z= β -galactosidase, β -gal hydrolyses lactose / disaccharide into glucose and galactose , y = permease , increases the permeability of the cell to lactose / beta galactosides = $\frac{1}{2} \times 5$

[5 Marks]

OR

- (a) **How does the Hardy-Wienberg equation explain genetic equilibrium ?**

(b) Describe how this equilibrium is disturbed that may lead to founder effect.

- Ans a) Allelic frequencies in a population are stable and remains constant from generation to generation / the sum total of all the allelic frequencies is one. =1
- b) gene migration / gene flow / genetic drift / mutation / gene recombination / natural selection leads to disturbance in equilibrium , when changes in allelic frequencies occur many times in a population , leads to the formation of a new species , original drifted population becomes the founders and the effect is called founders effect . = 1 × 4

[5 Marks]