

Question Paper Code 57/1/3

SECTION – A

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

1. At what state does the meiosis occur in an organism exhibiting haploidy life cycle and mention the fate of the products thus produced.

Ans. After zygote formation = $\frac{1}{2}$

haploid organism / haploid spores / (haploid) gametophyte = $\frac{1}{2}$

[1 mark]

2. Write the number of chromosomes body cells of honey bee workers and drone have.

Ans. Honey bee workers : 32 = $\frac{1}{2}$

Drones : 16 = $\frac{1}{2}$

[1 mark]

3. What are 'flocs', formed during secondary treatment of sewage ?

Ans. Masses of bacteria associated with fungal filament (to form mesh like structure)

[1 mark]

OR

Write any two places where methanogens can be found.

Ans. Anaerobic sludge (digester) , rumen of cattle / ruminants / stomach of cattle / gut of cattle , marshy area , flooded rice fields , biogas plant (*Any two*) = $\frac{1}{2} + \frac{1}{2}$

[1 mark]

4. Name the layer of the atmosphere that is associated with 'good ozone'.

Ans. Stratosphere

[1 mark]

OR

Mention the term used to describe a population interaction between an orchid growing on a forest tree.

Ans. Commensalism

[1 mark]

5. **British geneticist R.C. Punnett developed a graphical representation of a genetic cross called “Punnett Square”. Mention the possible result this representation predicts of the genetic cross carried.**

Ans. (Probability of) all genotypes / genotypic ratio

[1 mark]

SECTION-B

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

6. **It is said apomixes is a type of asexual reproduction. Justify.**

Ans. Apomixis is the formation of seeds or embryo without fusion of gametes / fertilization / Diploid egg cell is formed without reductional division and develops into the embryo without fertilization / Some cells of the nucellus start dividing and develop into embryo (*Any two*) = 1 + 1

[2 marks]

7. **Mention four significant services that a healthy forest ecosystem provide.**

Ans. Purify air / Production of O₂ / Purify water / Mitigate droughts and floods / Nutrient cycling / Generating fertile soils / Provide wildlife habitat / Maintain biodiversity / Pollinate crops / Provide site for carbon storage / Provide aesthetic - cultural - spiritual values / economic benefits / from nature food / industrial products / products of medicinal importance (*Any four*) = $\frac{1}{2} \times 4$

[2 marks]

OR

Substantiate with the help of one example that in an ecosystem mutualists (i) tend to co-evolve and (ii) are also one of the major causes of biodiversity loss.

Ans. Fig species is pollinated only by (its partner) wasp species where the female wasp uses the fruit of fig species as a site for egg laying and nourishing its larvae (mutualists tend to co-evolve / evolution of flower and its pollinated species are tightly linked) / Moth deposits its egg in the locule of the ovary of *Yucca* plant and the flower in turn gets pollinated by the moth (mutualists tend to co-evolve / evolution of flower and its pollinator species are tightly linked) (*Any other relevant example explained*) = 1

When any one of these two species become extinct - the other species associated with it in obligatory way also becomes extinct and leads to biodiversity loss = 1

[2 marks]

8. **Write the steps in sequence as carried in multiple ovulation embryo transfer technology.**

Ans. Cow is administered with FSH like hormone, to induce follicular maturation and super ovulation / produce 6 – 8 eggs instead of one egg, animal is mated with an elite bull or artificially inseminated, fertilized eggs at 8 – 32 cells stages recovered non-surgically and transferred to surrogate mothers = $\frac{1}{2} \times 4$

[2 marks]

9. What is an origin of replication in a chromosome ? State its function.

Ans. This is the point on DNA where replication originates / starts = 1

It controls the copy number of linked DNA = 1

[2 marks]

10. List any four ways by which GMO's have been useful for enhanced crop output.

Ans. Make crops more tolerant to abiotic / cold / heat / drought / salt stresses /

Reduces reliance on chemical pesticides (pest-resistant crops) / Reduce post harvest losses / Increased efficiency of mineral usage by plant (prevents early exhaustion of soil fertility) / Enhanced nutritional value of food (example vitamin A enriched rice / starch) / To create tailor-made plants for non food purposes (to supply alternative resources of fuels / pharmaceuticals to industries) = *(Any four)* = $\frac{1}{2} \times 4$

[2 marks]

11. How is a continuous culture system maintained in bioreactors and why ?

Ans. Used medium is drained out from one side of the bioreactor and fresh medium is added from the other side = 1

This type of culturing method produces a larger biomass leading to higher yields (of desired protein)=1

[2 marks]

12. How would the gene flow or genetic drift affect the population in which either of them happen to take place ?

Ans. Results in changed frequency of genes (or alleles) in both populations , causing variation , leading to evolution / speciation / founder effect = 1 + 1

(Any two)

[2 marks]

SECTION-C

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

13. How does a bisexual flowering plant ensures cross pollination ? Explain.

Ans. - Pollen release and stigma receptivity are non synchronized , either the pollen is released before the stigma becomes receptive / stigma becomes receptive before the release of pollen = $\frac{1}{2} \times 2$

- Anther and stigma are placed at different positions , pollen cannot come in contact with stigma of the same flower = $\frac{1}{2} \times 2$

- Self incompatibility , prevents self pollen from fertilising the ovules = $\frac{1}{2} \times 2$

[3 marks]

14. Bee keeping practice is a good income generating industry. Write the different points to be kept in mind for successful bee keeping. Write the scientific name of the most common Indian species used for the purpose.

Knowledge of the nature and habits of bees / Selection of suitable location for keeping the beehive / Catching and hiving of swarms (group of bees) / Management of beehives during different seasons / handling and collection of honey and bee wax (*Any four*) = $\frac{1}{2} \times 4$

- *Apis indica* = 1

[3 marks]

15. Explain the mechanism of DNA replication with the help of a replication fork. What role does the enzyme DNA-ligase play in a DNA replication fork ?

OR

Construct and label a transcription unit from which the RNA segment given below has been transcribed. Write the complete name of the enzyme that transcribed this RNA.



Ans. *Non evaluative , because the choice question is faulty , full marks to be awarded to all examinees who attempt either of the choice questions.*

16. (a) Write two differences between *Homo erectus* and *Homo habilis*.
(b) Rearrange the following from early to late geologic periods: Carboniferous, Silurian, Jurassic.

Ans. (a) *Homo erectus* *Homo habilis*
(i) Brain capacity 900 cc Brain capacity 650 – 800 cc = 1
(ii) (Probably) ate meat (Probably) did not eat meat = 1
(b) Silurian → Carboniferous → Jurassic = 1

(No mark to be awarded if all the three are not in proper sequence)

[2 +1 = 3 marks]

17. List six advantages of “ex-situ” approach to conservation of biodiversity.

An endangered / threatened species can be conserved / genetic strains of commercially important plants can be preserved for a long time (seed banks) / biodiversity loss is reduced / gametes of threatened species can be preserved in a viable and fertile condition for long periods (using

cryopreservation) / eggs can be fertilized in -vitro / plants can be propagated using tissue culture / economically beneficial / conserve large number of species / aesthetic value

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

[3 marks]

- 18. Effluent from the primary treatment of sewage is passed for secondary treatment. Explain the process till the water is ready to be released into natural water bodies.**

Ans. During treatment (after adding small amount of inoculum) primary effluent is constantly agitated mechanically in (large) aeration tanks 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]

- 19. Two children, A and B aged 4 and 5 years respectively visited a hospital with a similar genetic disorder. The girl A was provided enzyme-replacement therapy and was advised to revisit periodically for further treatment. The girl, B was, however, given a therapy that did not require revisit for further treatment.**

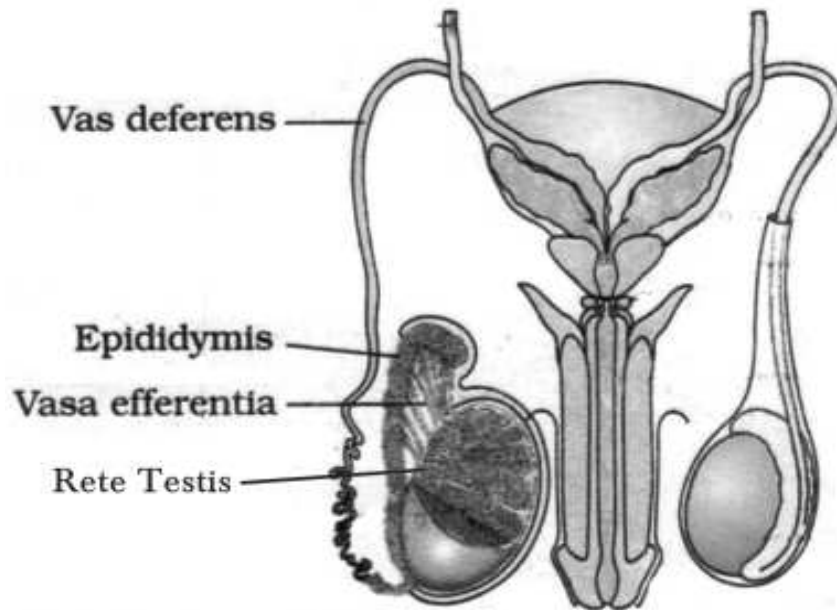
- (a) Name the ailments the two girls were suffering from ?
- (b) Why did the treatment provided to girl A required repeated visits ?
- (c) How was the girl B cured permanently ?

Ans. (a) Adenosine deaminase (ADA) deficiency = 1

- (b) (In Enzyme Replacement Therapy) functional ADA is introduced to the patient (by injection), this therapy is not completely curative / enzyme can act only for a limited time period = 1 + 1
- (c) [As there is no permanent cure at the age of five hence 1 mark of this answer allocated to part (b)]

[2 + 1 = 3 marks]

- 20. Draw a labelled diagram to show interrelationship of four accessory ducts in a human male reproductive system.**

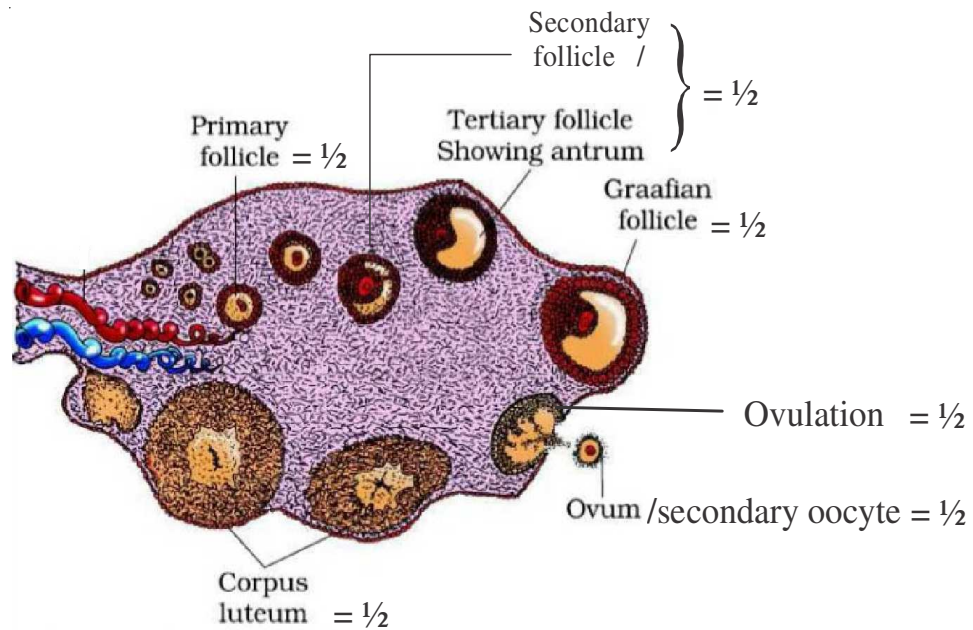


Correct diagram with : 1 labelling = $\frac{1}{2}$, 2 labellings = 1, 3 labellings = 2, 4 labellings = 3
[3 marks]

OR

Draw a sectional view of the human ovary showing the different stages of developing follicles, corpus luteum and ovulation.

Ans.



$$= \frac{1}{2} \times 6$$

[3 marks]

21. Compare in any three ways the chromosomal theory of inheritance as proposed by Sutton and Boveri with that of experimental results on pea plant presented by Mendel.

Sutton and Boveri	Mendel
1. Chromosomes occur in pairs	1. Factors occur in pairs
2. Chromosomes segregate at the time of gamete formation such that only one of each pair is transmitted to a gamete	2. Factors segregate at gamete formation stage and only one of each pair is transmitted to a gamete
3. Independent pairs of chromosomes segregate independently of each other	3. One pair of factors segregate independently of another pairs

= 1×3

[3 marks]

OR

- (a) Explain linkage and recombination as put forth by T.H. Morgan based on his observations with *Drosophila melanogaster* crossing experiment.
- (b) Write the basis on which Alfred Sturtevant explained gene mapping.

Ans. (a) Linkage :- Physical association of genes on a chromosome ,

- Two genes did not segregate independently of each other

- F₂ (phenotypic) ratio deviates (significantly) from 9:3:3:1 (**Any two**) = $\frac{1}{2} \times 2$

Recombination: -Tightly linked genes tend to show fewer recombinant frequency / 1.3% = $\frac{1}{2}$

-Loosely linked genes show higher percentage of recombinant frequency /37.2% = $\frac{1}{2}$

- (b) He used the frequency of recombination between gene pairs on the same chromosome as a measure of distance between genes and mapped their position on the chromosome = 1

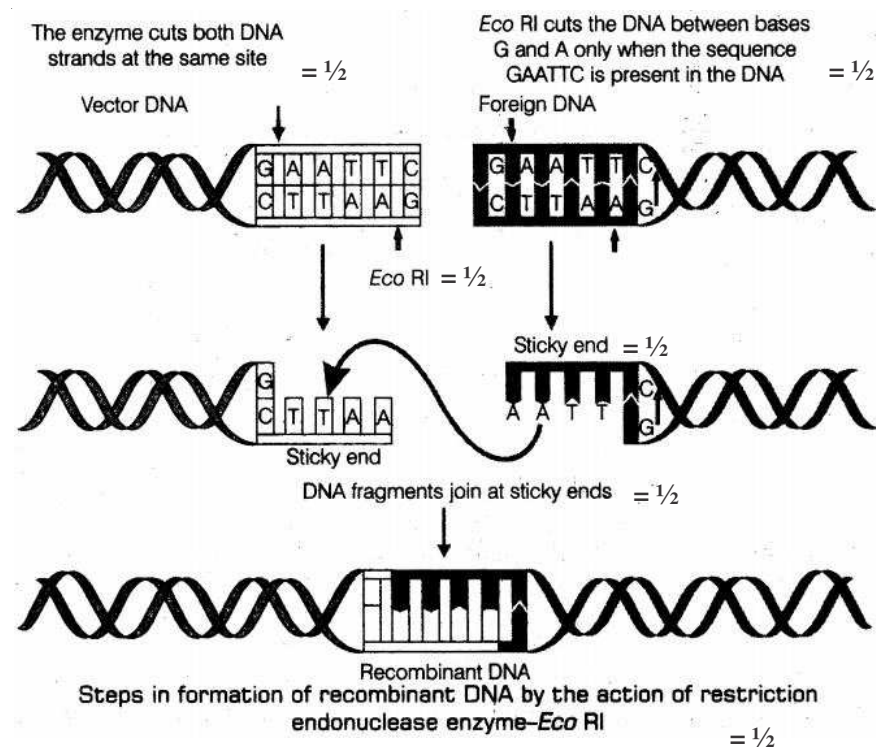
[2 + 1 = 3 marks]

22. Describe the formation of recombinant DNA by the action of EcoRI.

Ans. EcoRI identifies its palindromic sequence on both vector DNA and foreign DNA/ 5' GAATTC3', cuts strands of DNA little away from the centre of palindromic sites , but between same two bases (G and A) , this leaves single stranded portion at the end (sticky ends) on each strand , for recombination both vector DNA and foreign DNA , with similar sticky ends are joined by the enzyme DNA ligase = $\frac{1}{2} \times 6$

The following diagram can be considered in lieu of the explanation

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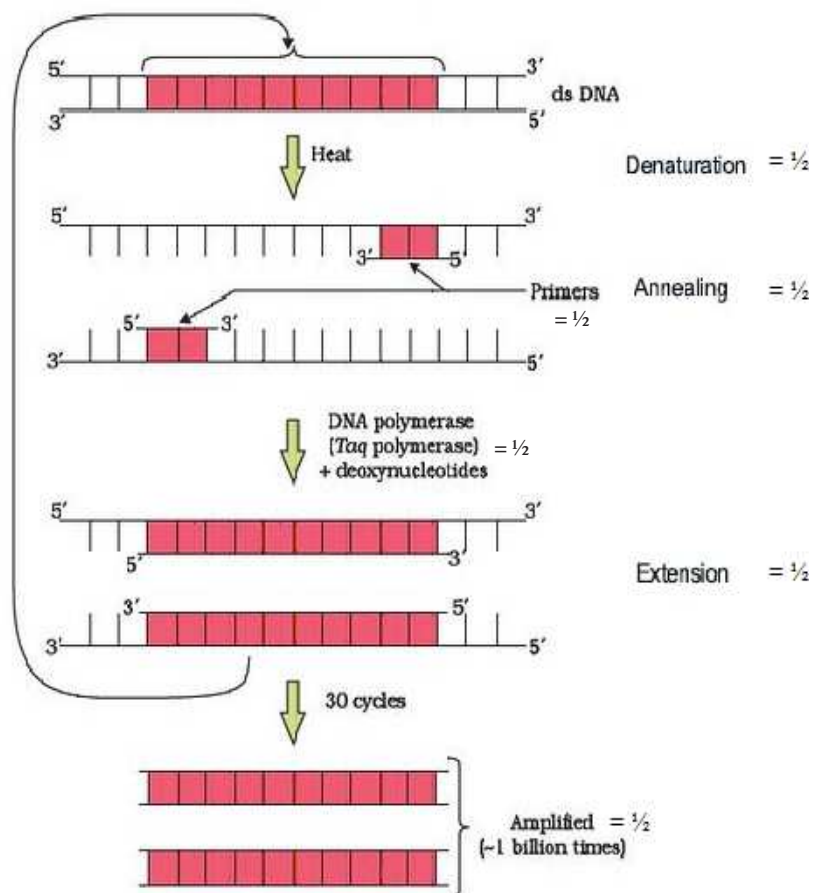
OR

Describe the process of amplification of “gene of interest” using PCR technique.

Ans. Denaturation of desired DNA into two strands, each acting as a template, for each strand separate set of primer (two sets of primer) used, with the help of deoxy(ribo)nucleotides and Taq polymerase (DNA polymerase isolated from *Thermus aquaticus*), extension of DNA template occurs, resulting in replication of desired DNA (amplification) $= \frac{1}{2} \times 6$

The following diagram can be considered in lieu of the explanation

//



[3 marks]

23. (a) Match the microbes listed under Column-A with the products mentioned under Column-B.

Column - A	Column - B
(H) <i>Penicillium notatum</i>	(i) Statin
(I) <i>Trichoderma polysporum</i>	(ii) ethanol
(J) <i>Monascus purpurea</i>	(iii) antibiotic
(K) <i>Saccharomyces cerevisiae</i>	(iv) Cyclosporin-A

- (b) Why does 'Swiss Cheese' develop large holes ?

- | | |
|------------------------------------|--------------------|
| (a) (H) <i>Penicillium notatum</i> | (iii) antibiotic |
| (I) <i>Trichoderma polysporum</i> | (iv) Cyclosporin-A |

(J) *Monascus purpureus*

(i) Statin

(K) *Saccharomyces cerevisiae*

(ii) ethanol

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

(b) Due to production of large amount of CO₂ (by *Propionibacterium sharmanii*) = 1

[3 marks]

24. Explain any two most important levels of biological organisation showing biodiversity with the help of an example each.

Ans. (i) Genetic diversity : High diversity at the genetic level over its distributional range = 1

Example : *Rauwolfia vomitoria* growing in different himalayan ranges might be in terms of the potency and concentration of the active chemical that the plant produce / India has more than 50,000 genetically different strains of rice / 1,000 varieties of mango = $\frac{1}{2}$

(ii) Species diversity : Diversity at the species level = 1

Example : The Western Ghats have a greater amphibian species diversity than Eastern Ghats = $\frac{1}{2}$

(iii) Ecological diversity : At the ecosystem level = 1

Example : India for instance with its deserts / rain forests / mangroves / coral reefs / wetlands / estuaries / alpine meadows have a greater ecosystem diversity than a Scandinavian country like Norway (**Any two examples of ecological diversity**) = $\frac{1}{2}$

(**Any two levels of diversity**) = $1\frac{1}{2} + 1\frac{1}{2}$

[3 marks]

SECTION D

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

25. Differentiate between spermatogenesis and Oogenesis on the basis of

(i) Time of initiation of the process

(ii) Site of completion of the process

(iii) Nature of meiotic division undergone by gamete mother cells

(b) Name the hormones and state their role involved in controlling spermatogenesis in humans.

Ans. (a)

	Spermatogenesis	Oogenesis
Time of initiation	At puberty	During foetal stage / embryonic stage
Site of completion	Seminiferous tubule	Fallopian tube / Ampullary - isthmic junction / Ampullary region
Nature of meiotic division	Equal cell division/	Unequal cell division /
	Continuous cell division/	Suspended/ arrested at early embryonic stage/
	Formation of four daughter cells / spermatids	Formation of one egg / Ovum

$$= \frac{1}{2} \times 6$$

- (b) GnRH acts on anterior pituitary to secrete LH and FSH, LH acts on Leydig cell and stimulates synthesis and secretion of androgens, androgen stimulates spermatogenesis, FSH acts on Sertoli cells which stimulate secretion of some factors which helps in the process of spermiogenesis = $\frac{1}{2} \times 4$

[3 + 2 = 5 marks]

OR

- (a) Explain the process of double fertilization in angiosperms.
- (b) Why does the development of endosperm precedes that of embryo?
- (c) List the parts of a typical dicot embryo.

- Ans.** (a) (i) One male gamete fuses with egg cell in the embryo sac to form zygote (2n), called syngamy = $\frac{1}{2} + \frac{1}{2}$
- (ii) Other male gamete fuses with two polar nuclei to form PEN (primary endosperm nucleus) (3n), triple fusion = $\frac{1}{2} + \frac{1}{2}$
- (iii) Both syngamy and triple fusion together called as double fertilisation = $\frac{1}{2}$
- (b) Endosperm contains the reserve food material which is used for the nutrition of developing embryo = 1
- (c) Radicle, Plumule, Cotyledons = $\frac{1}{2} \times 3$

[2½ + 1 + 1½ = 5 marks]

26. (a) What is “population” according to you as a biology student ?
- (b) “The size of a population for any species is not a static parameter.” Justify the statement with specific reference to fluctuations in the population density of a region in a given period of time.

- Ans. (a) Total number of organisms of a species in a particular area at a particular time = 1
- (b) The size of a population for any species is not a static parameter because of the factors like :-
- Birth rate/ Natality = $\frac{1}{2}$, number of births during a given period = $\frac{1}{2}$
- Death rate/ Mortality = $\frac{1}{2}$, number of deaths during a given period = $\frac{1}{2}$
- Immigration = $\frac{1}{2}$, number of individuals of the same species that have come into the habitat from elsewhere during the time period under consideration = $\frac{1}{2}$
- Emigration = $\frac{1}{2}$, number of individuals of the population who left the habitat and gone elsewhere during the time period under consideration = $\frac{1}{2}$

[1 + 4 = 5 marks]

OR

- (a) What is hydrarch succession ?
- (b) Compare the pioneer species and climax communities of hydrarch and xerarch succession respectively.
- (c) List the factors upon which the type of invading pioneer species depend in secondary hydrarch succession. Why is the rate of this succession faster than that of primary succession ?

- Ans. (a) The gradual and fairly predictable changes in the species composition in a water body / wetter areas = 1
- (b) Hydrarch : Pioneer species – Phytoplanktons = $\frac{1}{2}$
- Climax community – Forest / trees = $\frac{1}{2}$
- Xerarch : Pioneer species – Lichens = $\frac{1}{2}$
- Climax community – Forest / trees = $\frac{1}{2}$
- (c) Condition of soil, availability of water, seeds or other propagules = 1
- Because (some) soil / sediment is already there, the rate of secondary succession is much faster than primary succession = 1

[1 + 2 + 1 + 1 = 5 marks]

27. Differentiate between incomplete dominance and co-dominance. Substantiate your answer with one example of each.

Ans. **Incomplete Dominance**

Co-dominance

F1 generation does not resemble either of the parent but show an intermediate trait

Both dominant alleles express themselves F1

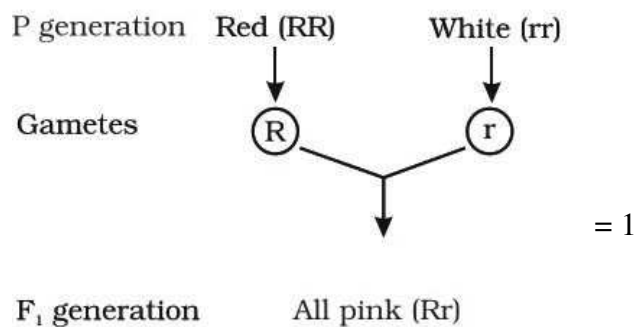
$$= \frac{1}{2} + \frac{1}{2}$$

Example : Snapdragon / *Antirrhinum* sp /
dog flower / *Mirabilis jalapa* /
Four O'clock plant = 1

Example AB blood group in human = 1

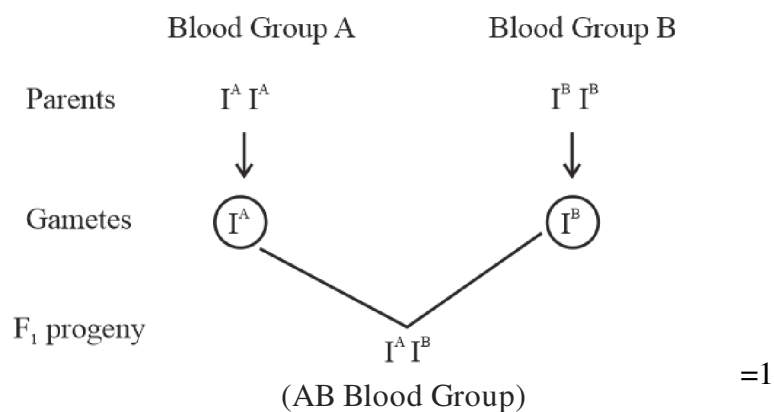
Incomplete dominance - When homozygous dominant and homozygous recessive parents are crossed all members of F1 progeny will show intermediate trait = 1

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Co dominance - When I^A and I^B are present together they both produce their own sugar / antigen = 1

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// (Any other suitable cross showing occurrence of I^A & I^B together in offsprings)

With $I^A i$ & $I^B i$ / $I^A I^A$ & $I^B i$ / $I^A i$ & $I^B I^B$ / $I^A I^B$ & $I^A I^B$ / $I^A I^B$ & $I^B i$ / $I^A I^B$ & $I^A i$

[5 marks]

OR

(a) Write the contributions of the following scientists in deciphering the genetic code.

George Gamow; Hargobind Khorana ; Marshall Nirenberg ; Severo Ochoa

(b) State the importance of a Genetic code in protein biosynthesis.

Ans. (a) George Gamow : Proposed that the Genetic code is constituted of 3 nucleotides / provided proof that the codon is a triplet = 1

Hargobind Khorana : Synthesized RNA molecule with a defined combination of bases (homopolymers and copolymers) = 1

Marshall Nirenberg : Cell free system for protein synthesis / helped the genetic code to be deciphered = 1

Severo Ochoa : Described enzyme (Polynucleotide phosphorylase) which polymerises RNA with defined sequence in a template independent manner (enzymatic synthesis of RNA) = 1

(b) Genetic code - Codes for a specific amino acid which is required for protein synthesis / provides information about the specific amino acid that form a particular protein / polypeptide = 1

[4 + 1 = 5 marks]