Senior School Certificate Examination

March 2010

Marking Scheme - Biology (Theory) [57|1|1, 2, 3]

Expected Answers/Value Points

General Instructions :

The Marking Scheme and mechanics of marking

1. In the marking scheme the marking points are separated by commas, one oblique line (/) indicates acceptable alternative, two obliques (//) indicate complete acceptable alternative set of marking points.

2. Any words/phrases given within brackets do not have marks.

3. Allow spelling mistakes unless the misspelt word has another biological meaning. Ignore plurals unless otherwise stated in the marking scheme.

4. In any question exclusively on diagram no marks on any description. But in questions on descriptions, same value points may be marked on the diagrams as a subsitute.

5. All awarded marks are to be written in the left hand margin at the end of the question or its part.

6. Place a tick (✓) in red directly on the key/operative term or idea provided it is in correct context. Place "Half-tick" ½ wherever there is ½ mark in the marking scheme. (Do not place tick indiscriminately just to show that you have read the answer).

7. If no marks are awarded to any part or question put a cross (×) at incorrect value portion and mark it zero (in words only).

8. Add up ticks or the half ticks for a part of the question, do the calculation if any, and write the part total or the question total in the left hand margin.

9. Add part totals of the question and write the question total at the end. Count all the ticks for the entire question as a recheck and draw a circle around the question total to confirm correct addition.

10. If parts have been attempted at different places do the totalling at the end of the part attempted last.

11. If any extra part is attempted or any question is reattempted, score out the last one and write "extra".

12. In questions where only a certain number of items are asked evaluate only that many numbers in sequence as is asked ignoring all the extra ones even if otherwise correct.

13. Transcribe the marks on the cover page. Add up question totals. Recheck the script total by adding up circled marks in the script.

14. Points/answer given in brackets in marking scheme are not so important and may be ignored for marking.

SECTION – A

Q. Nos. 1 - 8 are of one marks each

1. **A bilobed, dithecous anther has 100 microspore mother cells per microsporangium. How many male gametophytes this anther can produce ?**

Ans. 1600

[1 mark]

2. **Mention two functions of the codon AUG.**

Ans. Initiator Codon, codes for Methionine = ½ + ½

[1 mark]

3. **Name the scientist who disproved spontaneous generation theory.**

Ans. Louis Pasteur (If only Pasteur = ½)

[1 mark]

4. **What is it that prevents a child to suffer from a disease he/she is vaccinated against ? Give one reason.**

Ans. Antibodies produced , kills pathogen / destroys antigen
// provides immunity against pathogen = ½ + ½

[1 mark]

5. **Why is the enzyme cellulase used for isolating genetic material from plant cells but not for animal cells ?**

Ans. Animal cells do not have cellulose cell walls; (hence do not need the enzyme), plant cell have cellulose in their cell wall; (hence need enzyme to break it down) = ½ + ½

[1 mark]

6. **Name a molecular diagnostic technique to detect the presence of a pathogen in its early stage of infection.**

Ans. Recombinant DNA technology / Polymerase Chain Reaction (PCR) / ELISA *Any one* = 1

[1 mark]

7. **If 8 individuals in a laboratory population of 80 fruitflies died in a week, then what would be the death rate for population for the said period ?**

Ans. 0.1 , individuals per fruitfly per week = ½ + ½

[1 mark]

8. **Mention one positive and one negative application of amniocentesis .**

Ans. To detect genetic disorder, may lead to (illegal) female foeticide = ½ + ½

[1 mark]

SECTION B

Q. Nos. 9 - 18 are of two marks each

9. **A moss plant produces a large number of antherozoids but relatively only a few egg cells. Why ?**

Ans. Eggs are stationary / non-motile within the plant body / antherozoids carried by water, lost in transit = ½ × 4

[2 marks]

10. **Mention the reasons for difference in ploidy of zygote and primary endosperm nucleus in an angiosperm.**

Ans. Zygote formed by the fusion of male gamete (n) and egg cell (n) , hence diploid (2n) = ½ + ½

Primary endosperm nucleus formed by the fusion of two polar nuclei / secondary nucleus (n + n) and male gamete (n) , hence triploid (3n) = ½ + ½

[1 + 1 = 2 marks]

11. **How does an electrostatic precipitator work to remove particulate pollutants released from the thermal power plants ?**

Ans. Electrode wires at several thousand volts produce a corona that releases electrons , electrons attach to dust particles , (dust particles) become negatively charged , are attracted to collecting plates , low velocity of air help settling of dust = ½ × 4

[2 marks]

12. **Name the type of food chains responsible for the flow of larger fraction of energy in an aquatic and a terrestrial ecosystem respectively. Mention one difference between the two food chains.**

Ans. Aquatic ecosystem - Grazing Food Chain / GFC = ½

Terrestrial ecosystem - Detritus Food Chain / DFC = ½

Difference : GFC begins with phytoplanktons / producers whereas DFC begins with dead organisms / detritus = 1

[1 + 1 = 2 marks]

13. **How does a test-cross help in identifying the genotype of the organism ? Explain.**

Ans. Cross between an organism with unknown genotype (expressing dominant trait) , and an organism with recessive trait (homozygous) = ½ + ½

If all offsprings show dominant trait the organism is homozygous (dominant) , if half organisms show dominant and half recessive then the organism is heterozygous (dominant) = ½ + ½

[1 + 1 = 2 marks]

14. **Name the host and the site where the following occur in the life-cycle of a malarial parasite:**

    (a) **Formation of gametocytes**

    (b) **Fusion of gametocytes**

Ans. (a) Human , RBC = ½ + ½

(b) Female Anopheles (mosquito) , intestine = ½ + ½

[1 + 1 = 2 marks]

15. **Honey collection improves when beehives are kept in crop-fields during flowering season. Explain.**

Ans. Bees visit flowers for collecting nectar / pollen (for honey) , more the number of flowers (during flowering season) larger is the nectar / pollen collection (hence more honey production) = 1 + 1

[2 marks]

OR

How does addition of a small amount of curd to fresh milk help in formation of curd? Mention a nutritional quality that gets added to the curd.

Inoculum or starter contains (millions) of LAB which multiply at a suitable temperature, produce acids / lactic acid that coagulates, and partially digests the milk proteins thus converting milk to curd, it also improves its nutritional quality (of milk) by increasing vitamin $B_{12} = \frac{1}{2} \times 4$

[2 marks]

16. **Why is the introduction of genetically engineered lymphocytes into an ADA deficiency patient not a permanent cure ? Suggest a possible permanent cure.**

Ans. Lymphocytes not immortal / short lived, hence patient requires periodic infusion of such genetically engineered lymphocytes, however if a gene producing ADA is isolated from marrow cells, and introduced into the cells at early embryonic stages it could be a permanent cure $= \frac{1}{2} \times 4$

[2 marks]

17. **How does the floral pattern of Mediterranean orchid <u>Ophrys</u> guarantee cross pollination?**

Ans. One petal of <u>Ophrys</u> resembles the female of a bee, male bees are attracted to it / perceives it as female, pseudocopulates, same male bee pseudocopulates with another flower of <u>Ophrys</u> and pollination is completed $= \frac{1}{2} \times 4$

[2 marks]

18. **In the biosphere immense biological diversity exists at all levels of biological organisation. Explain any two levels of biodiversity.**

Ans. (i) *Genetic diversity:* A single species might show high diversity at the genetic level over its distributional range. The genetic variation shown by the medicinal plant *Rauwolfia vomitoria* growing in different Himalayan ranges might be in terms of the potency and concentration of the active chemical (reserpine) that the plant produces. India has more than 50000 genetically different strains of rice and 1000 varieties of mango / any other example explained

(ii) *Species diversity:* The diversity at the species level. For example, the Western Ghats have a greater amphibian species diversity than the Eastern Ghats.
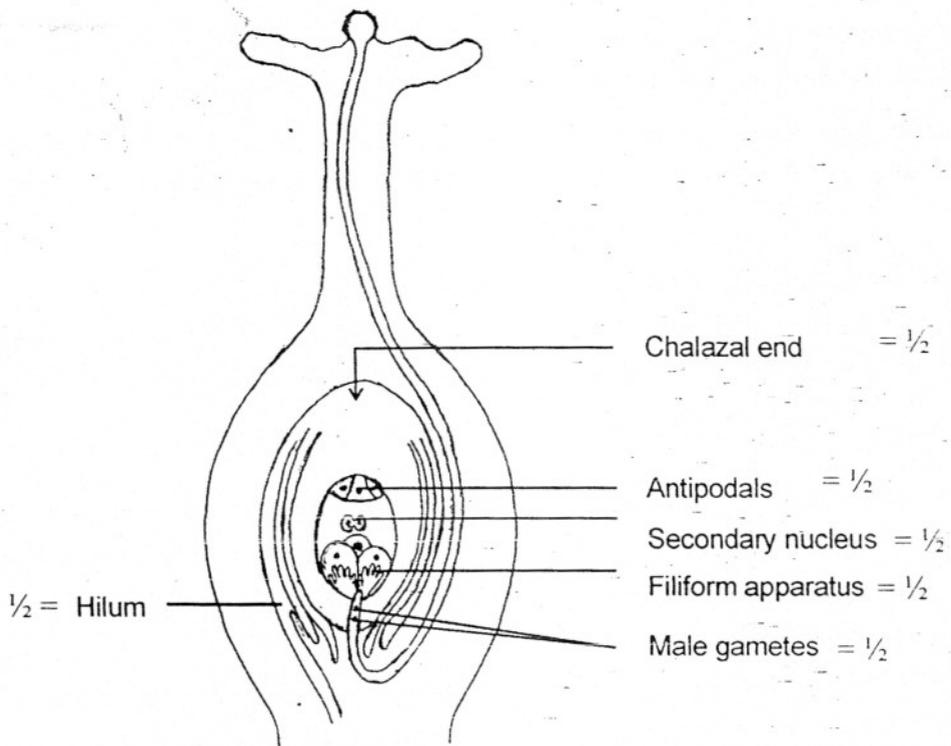
(iii) *Ecological diversity:* At the ecosystem level, India, for instance, with its deserts / rain forests / mangroves / coral reefs / wetlands / estuaries / and alpine meadows has a greater ecosystem diversity than a Scandinavian country like Norway *(Any two)* $= 1 + 1$
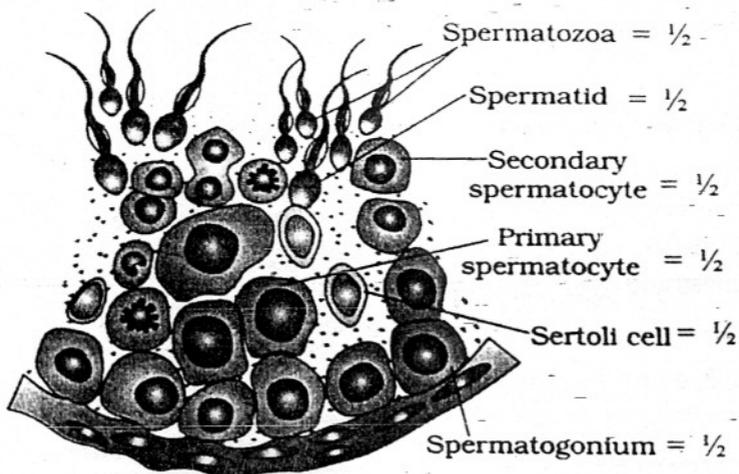
[2 marks]

SECTION C

Q. Nos. 19 - 27 are of three marks each

19. **Draw a longitudinal section of a post - pollinated pistil showing entry of pollen tube into a mature embryo-sac. Label filiform apparatus, chalazal end, hilum, antipodals, male gametes and secondary nucleus.**

Chalazal end $= \frac{1}{2}$

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

Secondary nucleus $= \frac{1}{2}$

Filiform apparatus $= \frac{1}{2}$

Male gametes $= \frac{1}{2}$

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

OR

Draw a labelled sectional view of seminiferous tubule of a human male.

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

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

Secondary spermatocyte $= \frac{1}{2}$

Primary spermatocyte $= \frac{1}{2}$

Sertoli cell $= \frac{1}{2}$

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

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

20. During his studies on genes in <u>Drosophila</u> that were sex-linked T.H. Morgan found F_2 - population phenotypic ratios deviated from expected 9:3:3: 1. Explain the conclusion he arrived at.

Ans. (i) Linkage , genes on the same chromosome were either closely associated or far apart

(ii) Higher percentage of parental combination and fewer percentage of recombinants are observed when two genes are located very close / tightly linked on the same chromosome

(iii) Higher percentage of recombinants and fewer percentage of parental combinations are observed when two genes are located far apart / loosely linked on the same chromosome = 1×3

[3 marks]

21. Describe the initiation process of transcription in bacteria.

Ans. (DNA dependent) RNA polymerase , binds to the promoter , at 5' end, associates transiently with initiation factor / sigma factor , using nucleoside triphosphates as substrate , and energy initiates transcription = $\frac{1}{2} \times 6$

[3 marks]

22. Explain convergent and divergent evolution with the help of one example of each.

Ans. *Convergent* - different structures evolving in the same direction in different organisms = 1

eg. wings of butterfly and of birds / eye of octopus and of mammals / the flippers of penguins and dolphins / sweet potato and potato. *Any one = ½*

Divergent - Same structure evolving in different directions in different organisms = 1

eg. forelimbs of whales , bats , cheetah and humans / vertebrate hearts or brains / thorns of Bougainvillea and tendrils of cucurbita. *Any one = ½*

[1½ + 1½ = 3 marks]

23. Name the type of human cell HIV attacks on its entry into the body. Explain the events that occur in the cell which further lead to cause immunodeficiency syndrome.

Ans. Macrophages = ½

Virus enters a macrophage where RNA genome of the virus with the help of reverse transcriptase , replicates to form a viral DNA , viral DNA incorporates into host cell's DNA , directs infected cells to produce virus particles , These virus particle enters the helper T-lymphocytes repeatedly to produce progeny viruses thus decreasing their number drastically = $\frac{1}{2} \times 5 = 2\frac{1}{2}$

[½ + 2½ = 3 marks]

24. Explain the efforts which must be put in to improve health, hygiene and milk yield of cattle in a dairy farm.

Ans. Should be taken to veterinary doctor , housed well , have adequate water , be maintained disease free , feeding should be carried out keeping quality , and quantity of fodder in mind , maintain stringent cleanliness and hygiene *Any six = ½ × 6*

[3 marks]

25. Identify a, b, c, d, e and f in the table given below :

	Organism	Bioactive molecule	Use
1.	Monascus purpureus (yeast)	a	b
2.	c	d	antibiotic
3.	e	Cyclosporin A	f

Ans. a - Statins = ½

b - Blood cholesterol lowering agent = ½

c - *Penicillium notatum* = ½

6

d - Penicillin = ½

e - *Trichoderma polysporum* = ½

f - Immuno-suppressive agent in organ transplant patients = ½
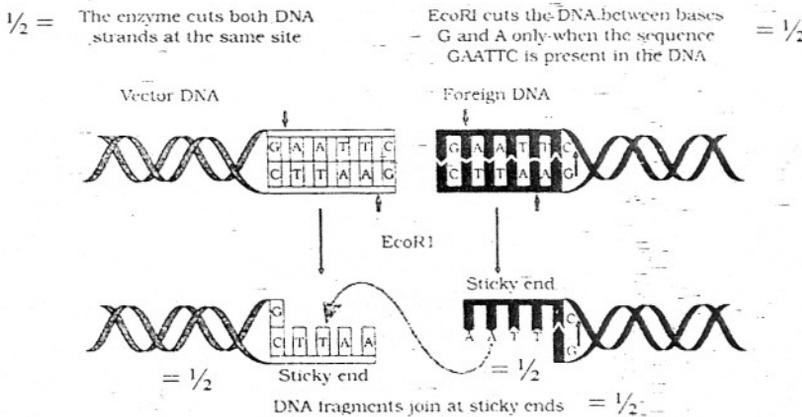
[½ ×6 = 3 Marks]

26. Eco RI is used to cut a segment of foreign DNA and that of a vector DNA to form a recombinant DNA. Show with the help of schematic diagrams.

(i) The set of palindromic nucleotide sequence of base pairs the Eco RI will recognise in both the DNA segments. Mark the site at which Eco RI will act and cut both the segments.

(ii) Sticky ends formed on both the segments where the two DNA segments will join later to form a recombinant DNA.

Ans. Palindromic sequence GAATTC = ½

Action of Restriction enzyme

½ = The enzyme cuts both DNA strands at the same site

EcoRI cuts the DNA between bases G and A only when the sequence GAATTC is present in the DNA = ½

Vector DNA   Foreign DNA

GAATTC / CTTAAG   GAATTC / CTTAAG

EcoRI

Sticky end

= ½   Sticky end   = ½

DNA fragments join at sticky ends = ½

[½ × 6 = 3 marks]

27. How does RNA interference help in developing resistance in tobacco plant against nematode infection ?

Ans With RNA interference (RNAi) technique transgenic tobacco plant is protected against nematode / *Meloidegyne incognitia* using *Agrobacterium* as the vectors, nematode-specific genes were introduced into the host plant, it produces both sense & anti sense RNA, these 2 RNAs form ds RNA, it silences specific mRNA of nematode (no protein synthesis / no translation), hence nematode cannot survive in tobacco plant = ½ × 6

[3 Marks]

SECTION-D

Q. Nos. 28 - 30 are of five marks each

28. (a) How does a chromosomal disorder differ from a Mendelian disorder ?

(b) Name any two chromosomal aberration associated disorders.

(c) List the characteristics of the disorders mentioned above that help in their diagnosis.

Ans. (a) Mendelian disorders are mainly determined by alteration or mutation in the single gene, chromosomal disorders are due to absence / excess / abnormal arrangement of one or more chromosomes $= \frac{1}{2} + \frac{1}{2}$

(b) Turner's syndrome, Klinefelter's syndrome, Down's syndrome *(Name Any two)* $= 1 + 1$

(c) *Turner's syndrome* : (XO) Such females are sterile as ovaries are rudimentary besides other features including lack of secondary sexual characters.

Klinefelter's syndrome : (XXY) Such an individual though has over all masculine development but feminine development (development of breast i.e Gynaecomastia) is also expressed. Such individual are sterile.

Down's syndrome : (Trisomy of 21) The affected individual is short statured with small round head, furrowed tongue and partially opened mouth. Palm is broad with characterisitic palm crease. Physical -psychomotor and mental development is retarded.

Characteristics of **Any two** disorders named and evaluated above $= 1 + 1$

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

OR

Fitness is the end result of the ability to adapt and get selected by Nature. Explain with suitable example.

Ans. *Industrial Melanism* : Before industrialisation set in in England it was observed, there were more white-winged peppered moth, on trees than dark winged moth, but after industrialisation, there were more dark-winged moths in the same area, predators spot a moth against a contrasting background, post industrialisation the tree trunks became dark due to industrial smoke and soot, Under this condition the white-winged moth did not survive, due to predators, but the dark-winged moth managed to survive.

// or any other example explained under the following heads in the text book - fitness, selection and adaptation.

$[5$ marks$]$

29. **When and where are primary oocytes formed in a human female ? Trace the development of these oocytes till ovulation (in menstrual cycle). How do gonadotropins influence this developmental process ?**

Ans. During embryonic development, in foetal ovary $= \frac{1}{2} + \frac{1}{2}$

Each primary oocyte gets surrounded by a layer of granulosa cells and is called a primary follicle, large number of these primary follicles degenerate from birth to puberty, primary follicles gets surrounded by more granulosa cells and a new theca and is now called secondary follicle which transform to tertiary follicle that has a fluid filled cavity called antrum, it completes its first meiotic division which results in the formation of a large haploid secondary oocyte and a tiny first polar body, tertiary follicle changes into mature Graafian follicle (secondary oocyte forms new membrane called zona pellucida), which ruptures to release ovum (this is called ovulation) $= \frac{1}{2} \times 6$

Gonadotropins (LH and FSH) help in follicular development, LH surge induces ovulation. $= \frac{1}{2} + \frac{1}{2}$

$[1 + 3 + 1 = 5$ marks$]$

<div align="center">OR</div>

(a) **Explain the events taking place at the time of fertilization of an ovum in a human female.**

(b) **Trace the development of the zygote upto its implantation in the uterus.**

(c) **Name and draw a labelled sectional view of the embryonic stage that gets implanted.**

Ans. (a) During fertilization a sperm comes in contact with the zona pellucida layer of the ovum and induces changes in the membrane , this blocks the entry of additional sperms and only one sperm can fertilise and ovum , the secretions of acrosome help the sperm enter into the cytoplasm of the ovum through zona pellucida and the plasma membrane , soon the haploid nucleus of the sperm and the ovum fuse together to form a diploid zygote $= \frac{1}{2} \times 4$

(b) Zygote moves through the isthmus of the oviduct and undergoes cleavage and it moves towards the uterus to form blastomeres , the embryo with 8 - 16 blastomeres is called morula which continues to divide and transforms into a blastocyst as it moves further into the uterus . It is arranged into an outer layer called trophoblast and an inner cell mass , the trophoblast get attached to the endometrium and inner cell mass gets differentiated into the embryo the uterine cell divides rapidly and covers the blastocysts which get embedded into the uterus. (This is called implantation) $= \frac{1}{2} \times 4$
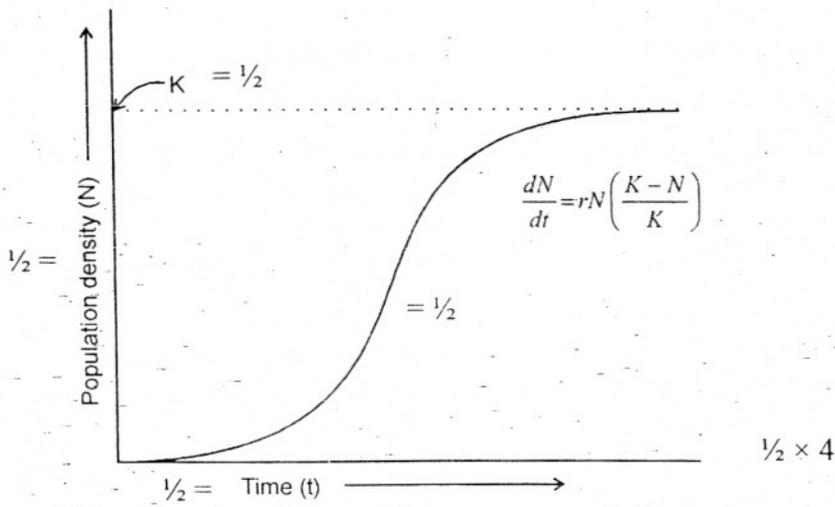
(c)

$= \frac{1}{2}$

Inner cell mass

$= \frac{1}{2}$

Trophoblast
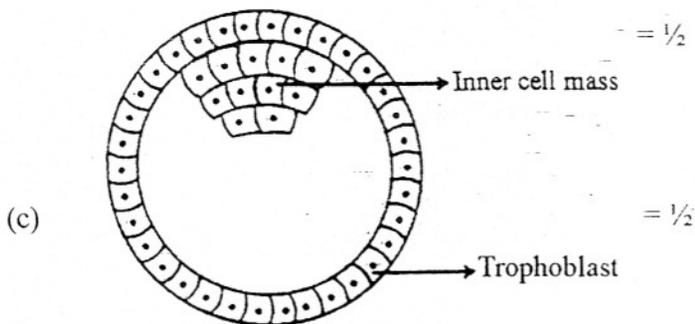
<div align="right">[2 + 2 + 1 = 5 marks]</div>

30. **Draw and explain a logistic curve for a population of density (N) at time (t) whose intrinsic rate of natural increase is (r) and carrying capacity is (k).**

Ans. A population growing in a habitat with limited resources show initially a lag phase , this is followed by phases of acceleration and deceleration , and finally an asymptote when the population density reaches carrying capacity (K) , A plot of N in relation to time (t) result in a sigmoid curve (Verhulst - Pearl Logistic Growth) $= \frac{1}{2} \times 4$

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right) = 1$$

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

K = ½

½ =

= ½

½ × 4

½ = Time (t)

Population density (N)

[2 + 1 + 2 = 5 marks]

OR

Describe the process of decomposition of detritus under the following heads : Fragmentation; leaching; catabolism; humification and mineralization.

Ans. *Fragmentation* : Breakdown of detritus into smaller particles

Leaching : Water soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts

Catabolism : Bacterial and fungal enzymes degrade detritus into simpler inorganic substances

Humification : It leads to the accumulation of a dark coloured amorphous substance called humus that is highly resistant to microbial action and undergoes decomposition at an extremely slow rate

Mineralization : The humus is further degraded by some microbes and release inorganic substances by this process

[1 × 5 = 5 marks]

SECTION - A
Q. Nos. 1 - 8 are of one marks each

1. **Name the scientist who disproved spontaneous generation theory.**

Ans. Louis Pasteur (If only Pasteur = ½)

[1 mark]

2. **Name a molecular diagnostic technique to detect the presence of a pathogen in its early stage of infection.**

Ans. Recombinant DNA technology / Polymerase Chain Reaction (PCR) / ELISA *Any one* = 1

[1 mark]

3. **Why is the enzyme cellulase used for isolating genetic material from plant cells but not for animal cells ?**

Ans. Animal cells do not have cellulose cell walls; (hence do not need the enzyme) , plant cell have cellulose in their cell wall; (hence need enzyme to break it down) = ½ + ½

[1 mark]

4. **Mention one positive and one negative application of amniocentesis.**

Ans. To detect genetic disorder, may lead to (illegal) female foeticide = ½ + ½

[1 mark]

5. **What is it that prevents a child to suffer from a disease he/she is vaccinated against ? Give one reason.**

Ans. Antibodies produced , kills pathogen / destroys antigen

// provides immunity against pathogen = ½ + ½

[1 mark]

6. **An anther with malfunctioning tapetum often fails to produce viable male gametophytes. Give one reason.**

Ans. Tapetum nourishes the developing male gametophytes.

[1 mark]

7. **Mention two functions of the codon AUG.**

Ans. Initiator Codon, codes for Methionine = ½ + ½

[1 mark]

8. **In a pond there were 20 Hydrilla plants. Through reproduction 10 new Hydrilla plants were added in a year. Calculate the birth rate of the population.**

Ans. 10 / 20 = 0.5 , offspring per hydrilla per year = ½ + ½

[1 mark]

SECTION-B
Q. Nos. 9 - 18 are of two marks each

9. **Biodiversity must be conserved as it plays an important role in many ecosystem services that nature provides. Explain any two services of the ecosystem.**

Ans. The products of ecosystem processes are known as ecosystem services eg. A healthy forest ecosystem purifies air and water / mitigates droughts and floods / cycles nutrients / generate fertile soils /

provides wildlife habitat / maintains biodiversity / pollinates crops / provides storage sides for carbon / provides aesthetic cultural and spiritual values. *Any two = 2*

[2 marks]

10. **Honey collection improves when beehives are kept in crop-fields during flowering season. Explain.**

Ans. Bees visit flowers for collecting nectar / pollen (for honey) , more the number of flowers (during flowering season) larger is the nectar / pollen collection (hence more honey production) = 1 + 1

[2 marks]

OR

How does addition of a small amount of curd to fresh milk help formation of curd ? Mention a nutritional quality that gets added to the curd.

Inoculum or starter contains (millions) of LAB which multiply at a suitable temperature , produce acids / lactic acid that coagulates , and partially digests the milk proteins thus converting milk to curd, it also improves its nutritional quality (of milk) by increasing vitamin B_{12} = ½ × 4

[2 marks]

11. **How does the floral pattern of Mediterranean orchid <u>Ophrys</u> guarantee cross pollination ?**

Ans. One petal of <u>Ophrys</u> resembles the female of a bee, male bees are attracted to it / perceives it as female , pseudocopulates , same male bee pseudocopulates with another flower of <u>Ophrys</u> and pollination is completed = ½ × 4

[2 marks]

12. **A moss plant produces a large number of antherozoids but relatively only a few egg cells. Why?**

Ans. Eggs are stationary / non-motile within the plant body / antherozoids carried by water , lost in transit = ½ × 4

[2 marks]

13. **Name the host and the site where the following occur in the life-cycle of a malarial parasite :**

   (a)   Formation of gametocytes

   (b)   Fusion of gametocytes

Ans. (a)   Human , RBC = ½ + ½

   (b)   Female Anopheles (mosquito) , intestine = ½ + ½

[1 + 1 = 2 marks]

14. **How many haploid cells are present in a mature female gametophyte of a flowering plant ? Name them.**

Ans. At maturity (in a female gametophyte) there are two options :

   (i)   If the two polar nuclei do not fuse (in the central cell) then there are seven haploid cells in the embryo sac = ½

   Names : Three antipodals , two synergids , one egg cell , one central cell = ½ × 3

   / OR

   (ii)   If the two polar nuclei fuse to form a diploid secondary nucleus then there are six haploid cells in the embryo sac , = ½

Names . Three antipodals , two synergids , one egg cell = ½ × 3

<div align="right">[½ + 1½ = 2 marks]</div>

15. **When a tall pea plant was selfed, it produced one-fourth of its progeny as dwarf. Explain with the help of a cross.**

Ans.

Parent =   Tt   x   Tt

= ½

Gametes   (T) (t)   (T) (t)

= ½

♀ \ ♂	T	t
T	TT	Tt
t	Tt	tt

= ½

Genotype	TT	Tt	tt
Phenotype	Pure tall	Hybrid Tall	dwarf

one fourth of the progeny is dwarf = ½

<div align="right">[½ × 4 = 2 marks]</div>

16. **Chlorofluorocarbons (CFCs) are widely used as refrigerants. Then why it is suggested to reduce its emission as far as possible ? Explain.**

Ans. CFCs reach stratosphere / upper layer of atmosphere where UV layer acts on them , releasing Cl atoms , Cl degrades ozone releasing molecular oxygen , thus CFC causes depletion of ozone which protects us from UV radiation which damages (DNA / causes mutation) = ½ ×4

<div align="right">[2 marks]</div>

17. **Why is the introduction of genetically engineered lymphocytes into a ADA deficiency patient not a permanent cure ? Suggest a possible permanent cure.**

Ans. Lymphocytes not immortal / short lived , hence patient requires periodic infusion of such genetically engineered lymphocytes , however if a gene producing ADA is isolated from marrow cells , and introduced into the cells at early embryonic stages it could be a permanent cure = ½ × 4

<div align="right">[2 marks]</div>

18. **Name the type of food chains responsible for the flow of larger fraction of energy in an aquatic and a terrestrial ecosystem respectively. Mention one difference between the two food chains.**

Ans. Aquatic ecosystem - Grazing Food Chain / GFC = ½

Terrestrial ecosystem - Detritus Food Chain / DFC = ½

Difference : GFC begins with phytoplanktons / producers whereas DFC begins with dead organisms / detritus = 1

<div align="right">[1 + 1 = 2 marks]</div>

Q. Nos. 19 - 27 are of three marks each

19. Explain convergent and divergent evolution with the help of one example of each.

Ans. *Convergent* - different structures evolving in the same direction in different organisms = 1

eg. wings of butterfly and of birds / eye of octopus and of mammals / the flippers of penguins and dolphins / sweet potato and potato. *Any one* = ½

Divergent - Same structure evolving in different directions in different organisms = 1

eg. forelimbs of whales, bats, cheetah and humans / vertebrate hearts or brains / thorns of Bougainvillea and tendrils of cucurbita. *Any one* = ½
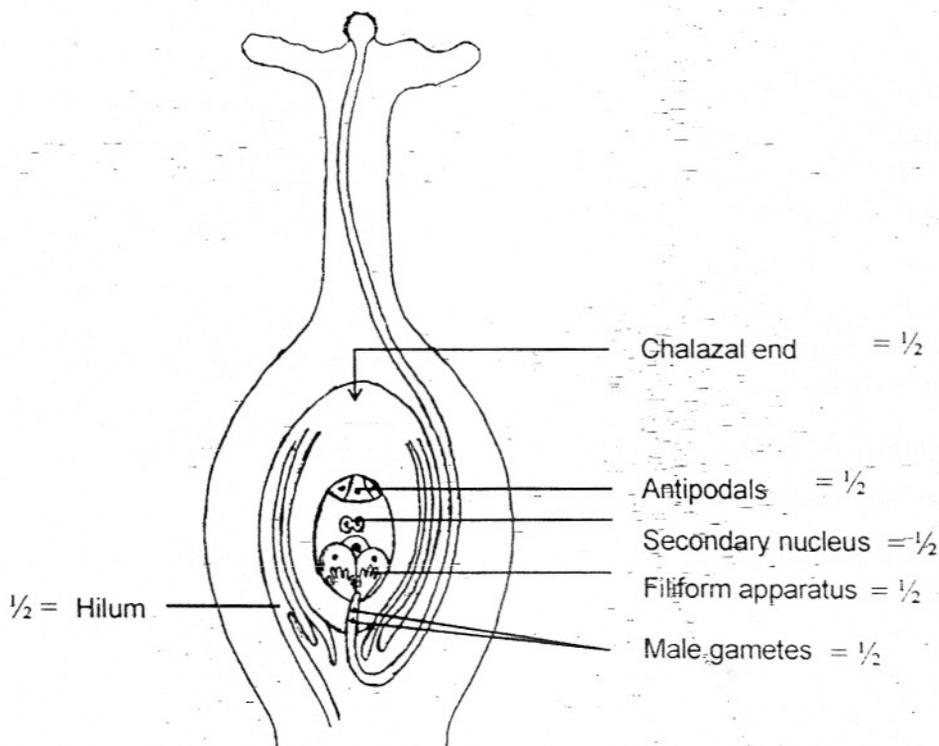
[1½ + 1½ = 3 marks]

20. How does RNA interference help in developing resistance in tobacco plant against nematode infection?

Ans With RNA interference (RNAi) technique transgenic tobacco plant is protected against nematode / *Meloidegyne incognitia* using *Agrobacterium* as the vectors, nematode-specific genes were introduced into the host plant, it produces both sense & anti sense RNA, these 2 RNAs form ds RNA, it silences specific mRNA of nematode (no protein synthesis / no translation). hence nematode cannot survive in tobacco plant = ½ × 6
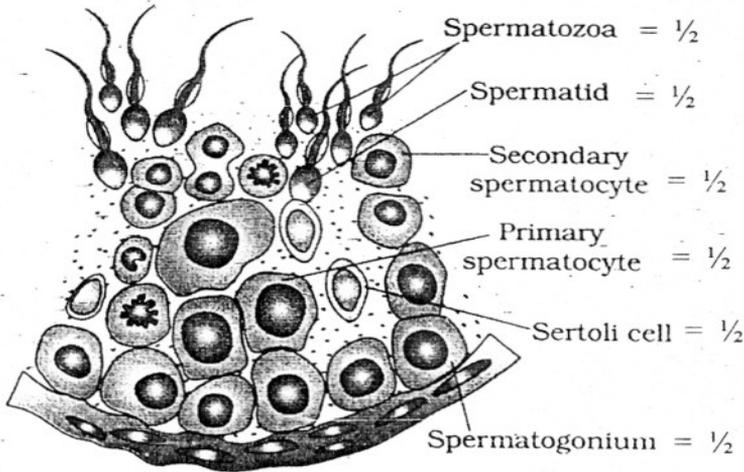
[3 Marks]

21. Draw a longitudinal section of a post - pollinated Pistil showing entry of pollen tube into a mature embryo-sac. Label filiform apparatus, chalazal end, Hilum, antipodals, male gametes and secondary nucleus.
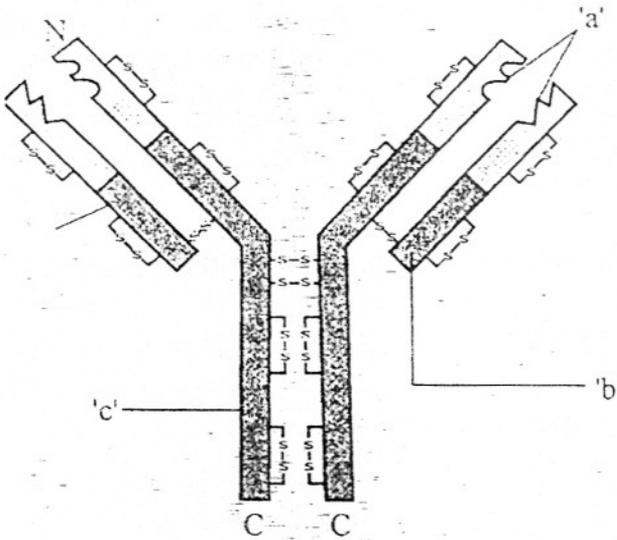

Chalazal end = ½

Antipodals = ½

Secondary nucleus = ½

Filiform apparatus = ½

Male gametes = ½

½ = Hilum

OR

Draw a labelled sectional view of seminiferous tubule of a human male.

Spermatozoa = ½
Spermatid = ½
Secondary spermatocyte = ½
Primary spermatocyte = ½
Sertoli cell = ½
Spermatogonium = ½

[½ × 6 = 3 marks]

22.

'a'
'b'
'c'
C   C

Identify a, b and c in the schematic diagram of an antibody given above and answer the questions.

(i) Write the chemical nature of an antibody.

(ii) Name the cells that produce antibodies in humans.

(iii) Mention the type of immune response provided by an antibody.

Ans. a = antigen binding site , b = light chain , c = heavy chain ,

(i) Proteins / Ig / Immunoglobulins ,

(ii) B-cells ,

(iii) Humoral immune system / antibody mediated response

[½ × 6 = 3 marks]

23. Identify a, b, c, d, e and f in the table given below :

	Organism	Bioactive molecule	Use
1.	Monascus purpureus (yeast)	a	b
2.	c	d	antibiotic
3.	e	Cyclosporin A	f

Ans. a - Statins = ½

b - Blood cholesterol lowering agent = ½

c - *Penicillium notatum* = ½

d - Penicillin = ½

e - *Trichoderma polysporum* = ½

f - Immuno-suppressive agent in organ transplant patients = ½

[½ ×6 = 3 marks]

24. During his studies on genes in <u>Drosophila</u> that were sex-linked T.H. Morgan found F_2 - population phenotypic ratios deviated from expected 9:3:3:1. Explain the conclusion he arrived at.

Ans. (i) Linkage , genes on the same chromosome were either closely associated or far apart

(ii) Higher percentage of parental combination and fewer percentage of recombinants are observed when two genes are located very close / tightly linked on the same chromosome

(iii) Higher percentage of recombinants and fewer percentage of parental combinations are observed when two genes are located far apart / loosely linked on the same chromosome = 1×3

[3 marks]

25. Explain the efforts which must be put in to improve health, hygiene and milk yield of cattle in a dairy farm.

Ans. Should be taken to veterinary doctor , housed well , have adequate water , be maintained disease free , feeding should be carried out keeping quality , and quantity of fodder in mind , maintain stringent cleanliness and hygiene *Any six* = ½ × 6

[3 marks]

26. Describe the elongation process of transcription in bacteria.

Ans. (DNA dependent) RNA polymerase , uses nucleoside triphosphates as substrate , template dependent polymerisation from 5' → 3' direction , following the rule of complementarity alongwith opening the helix , and using energy it continues elongation = ½ × 6
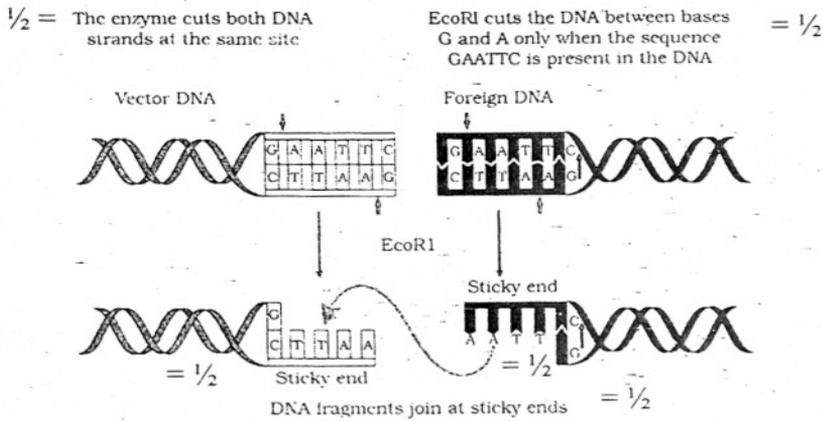
27. Eco RI is used to cut a segment of foreign DNA and that of a vector DNA to form a recombinant DNA. Show with the help of schematic diagrams.

(i) The set of palindromic nucleotide sequence of base pairs the Eco RI will recognise in both the DNA segments. Mark the site at which Eco RI will act and cut both the segments.

(ii) Sticky ends formed on both the segments where the two DNA segments will join later to form a recombinant DNA.

Ans. Palindromic sequence GAATTC = ½

Action of Restriction enzyme

½ = The enzyme cuts both DNA strands at the same site

EcoRI cuts the DNA between bases G and A only when the sequence GAATTC is present in the DNA = ½

Vector DNA

Foreign DNA

EcoR1

Sticky end

= ½   Sticky end

= ½

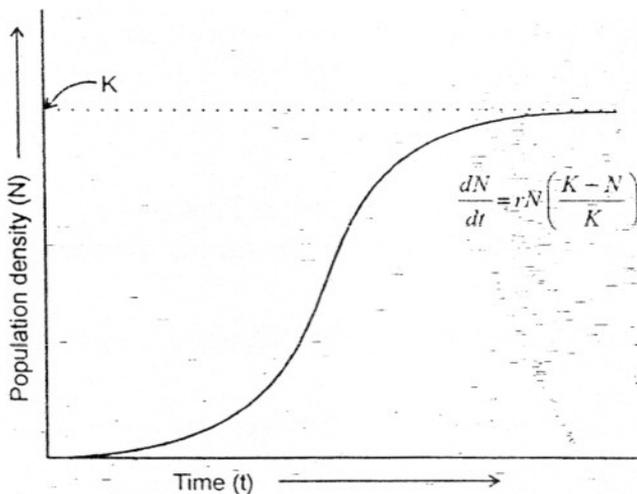DNA fragments join at sticky ends = ½

[½ × 6 = 3 marks]

SECTION - D

Q. Nos. 28 - 30 are of five marks each

28. Draw and explain a logistic curve for a population of density (N) at time (t) whose intrinsic rate of natural increase is (r) and carrying capacity is (k).

Ans. A population growing in a habitat with limited resources show initially a lag phase, this is followed by phases of acceleration and deceleration, and finally an asymptote when the population density reaches carrying capacity (K), A plot of N in relation to time (t) result in a sigmoid curve (Verhulst - Pearl Logistic Growth) = ½ ×4

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right) = 1$$

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

½ × 4

[2 + 1 + 2 = 5 marks]

OR

17

Describe the process of decomposition of detritus under the following heads : Fragmentation; leaching; catabolism; humification and mineralization.

Ans. *Fragmentation* : Breakdown of detritus into smaller particles

Leaching : Water soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts

Catabolism : Bacterial and fungal enzymes degrade detritus into simpler inorganic substances

Humification : It leads to the accumulation of a dark coloured amorphous substance called humus that is highly resistant to microbial action and undergoes decomposition at an extremely slow rate

Mineralization : The humus is further degraded by some microbes and release inorganic substances by this process

$[1 \times 5 = 5 \text{ marks}]$

29. **Explain the causes, inheritance pattern and symptoms of any two Mendelian genetic disorders.**

Ans. **I   Haemophilia**

    (a)   Causes - Alteration or mutation of a single gene , protein involved in clotting of blood is affected / defective = ½ + ½

    (b)   Inheritance pattern - sex linked / criss cross pattern of inheritance / heterozygous female may pass on the trait to her son / a carrier mother and haemophilic father may pass on the trait to their daughter = ½

    (c)   Symptoms - no clotting of blood leading to uncontrolled bleeding = 1

II   Sickle Cell Anaemia

    (a)   Cause - Substitution of Glutamic Acid (Glu) by Valine (Val) at the sixth position of the beta globin chain of the haemoglobin molecule = 1

    (b)   Inheritance pattern - Autosome linked recessive trait that can be transmitted from parents to the offspring when both the partners are carriers for the gene (heterozygous) = ½

    (c)   Symptoms - Mutant haemoglobin molecule undergoes polymerisation under low oxygen tension causing the change in the shape of the RBC from biconcave disc to elongated sickle like structure = 1

III   Phenylketonuria

    (a)   Causes - Affected individual lacks an enzyme that converts the amino acids phenylalanine into tyrosine which results in the accumulation of phenyl pyruvic acid and other derivatives = 1

    (b)   Inheritance pattern - Inborn error of metabolism is inherited through an autosomal recessive trait = ½

    (c)   Symptoms - Mental retardation , excretion of phenyl pyruvic acid through urine = 1

    Any two correct disorders = 2½ + 2½

$[2 \frac{1}{2} + 2\frac{1}{2} = 5 \text{ marks}]$

OR

(a)   Natural selection operates when nature selects for fitness. Explain.

(b)   The rate of appearance of new forms is linked to the life span of an organism. Explain with the help of a suitable example.

Ans. Ans. *Industrial Melanism* : Before industrialisation set in it was observed that there were more white-winged moth on trees than dark winged moth , but after industrialisation there were more dark-winged moths in the same area , Predators spot a moth against a contrasting background , Post industrialisation the tree trunks became dark due to industrial smoke and soot , Under this condition the white-winged moth did not survive due to predators but the dark-winged moth managed to survive $= \frac{1}{2} \times 5$

// or any other example explained under the following heads in the text book - fitness , selection and adaptation.

(b) Microbes / bacteria have the ability to multiply in minutes and become millions , a colony of bacteria (A) growing on a given medium has built in variation , in terms of its ability to utilize a certain component in the nutrient medium , change in the medium composition , could bring about only that part of the population (B) that can survive under new condition , and evolve into a new species in a very short time hence the rate of appearance of new forms / species is linked to the life span / life cycle $= \frac{1}{2} \times 5$

$$[2\frac{1}{2} + 2\frac{1}{2} = 5 \text{ marks}]$$

30. **When and where are primary oocytes formed in a human female ? Trace the development of these oocytes till ovulation (in menstrual cycle). How do gonadotropins influence this developmental process ?**

Ans. During embryonic development , in foetal ovary $= \frac{1}{2} + \frac{1}{2}$

Each primary oocyte gets surrounded by a layer of granulosa cells and is called a primary follicle , large number of these primary follicles degenerate from birth to puberty , primary follicles gets surrounded by more granulosa cells and a new theca and is now called secondary follicle which transform to tertiary follicle that has a fluid filled cavity called antrum , it completes its first meiotic division which results in the formation of a large haploid secondary oocyte and a tiny first polar body , tertiary follicle changes into mature Graafian follicle (secondary oocyte forms new membrane called zona pellucida) , which ruptures to release ovum (this is called ovulation) $= \frac{1}{2} \times 6$

Gonadotropins (LH and FSH) help in follicular development , LH surge induces ovulation. $= \frac{1}{2} + \frac{1}{2}$

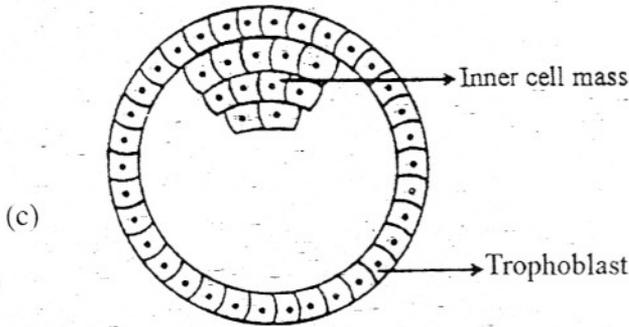$$[1 + 3 + 1 = 5 \text{ marks}]$$

OR

(a) **Explain the events taking place at the time of fertilization of an ovum in a human female.**

(b) **Trace the development of the zygote upto its implantation in the uterus.**

(c) **Name and draw a labelled sectional view of the embryonic stage that gets implanted.**

Ans. (a) During fertilization a sperm comes in contact with the zona pellucida layer of the ovum and induces changes in the membrane , this blocks the entry of additional sperms and only one sperm can fertilise and ovum , the secretions of acrosome help the sperm enter into the cytoplasm

of the ovum through zona pellucida and the plasma membrane , soon the haploid nucleus of the sperm and the ovum fuse together to form a diploid zygote = ½ × 4

(b)   Zygote moves through the isthmus of the oviduct and undergoes cleavage and it moves towards the uterus to form blastomeres , the embryo with 8 - 16 blastomeres is called morula which continues to divide and transforms into a blastocyst as it moves further into the uterus , It is arranged into an outer layer called trophoblast and an inner cell mass , the trophoblast get attached to the endometrium and inner cell mass gets differentiated into the embryo the uterine cell divides rapidly and covers the blastocysts which get embedded into the uterus. (This is called implantation) = ½ × 4

(c)

Inner cell mass

Trophoblast

[2 + 2 + 1 = 5 marks]

SECTION - A

Q. Nos. 1 - 8 are of one marks each

1. **Mention one positive and one negative application of amniocentesis.**

Ans. To detect genetic disorder, may lead to (illegal) female foeticide $= \frac{1}{2} + \frac{1}{2}$

[1 mark]

2. **How do animals like fish and snails avoid summer related unfavourable conditions ?**

Ans. Fish migrates , snails undergo aestivation $= \frac{1}{2} + \frac{1}{2}$

[1 mark]

3. **In a pond there were 200 frogs. 40 more were born in a year. Calculate the birth rate of the population.**

Ans. $40/200 = 0.2$ individuals / offsprings per frog per year $= \frac{1}{2} + \frac{1}{2}$

[1 mark]

4. **Mention two functions of the codon AUG.**

Ans. Initiator Codon, codes for Methionine $= \frac{1}{2} + \frac{1}{2}$

[1 mark]

5. **Name a molecular diagnostic technique to detect the presence of a pathogen in its early stage of infection.**

Ans. Recombinant DNA technology / Polymerase Chain Reaction (PCR) / ELISA *Any one* $= 1$

[1 mark]

6. **Name the scientist who disproved spontaneous generation theory.**

Ans. Louis Pasteur (If only Pasteur $= \frac{1}{2}$)

[1 mark]

7. **What is it that prevents a child to suffer from a disease he/she is vaccinated against ? Give one reason.**

Ans. Antibodies produced , kills pathogen / destroys antigen

// provides immunity against pathogen $= \frac{1}{2} + \frac{1}{2}$

[1 mark]

8. **Why is the enzyme cellulase used for isolating genetic material from plant cells but not for animal cells ?**

Ans. Animal cells do not have cellulose cell walls; (hence do not need the enzyme) , plant cell have cellulose in their cell wall; (hence need enzyme to break it down) $= \frac{1}{2} + \frac{1}{2}$

[1 mark]

SECTION B

Q. Nos. 9 - 18 are of two marks each

9. **Where does triple fusion take place in a flowering plant ? Why is it so called ? Mention its significance.**

Ans. The central cell of embryo sac, involves fusion of three haploid nuclei / 2 polar nuclei and one male gamete , forms the primary endosperm cell (3n) , which develops into the endosperm / nutritional source

for the developing embryo $= \frac{1}{2} \times 4$

<div align="right">[2 marks]</div>

10. **Why certain regions have been declared as biodiversity "hot spots" by environmentalists of the world ? Name any two "hot spot" regions of India.**

Ans. Region of very high level of species richness, and high degree of endemism $= \frac{1}{2} + \frac{1}{2}$

Western Ghats, Himalayas $= \frac{1}{2} + \frac{1}{2}$

<div align="right">[2 marks]</div>

11. **A moss plant produces a large number of antherozoids but relatively only a few egg cells. Why ?**

Ans. Eggs are stationary / non-motile within the plant body / antherozoids carried by water, lost in transit $= \frac{1}{2} \times 4$
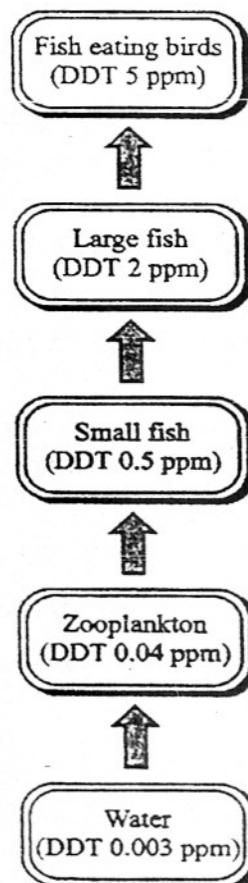
<div align="right">[2 marks]</div>

12. **Why is the introduction of genetically engineered lymphocytes into a ADA deficiency patient not a permanent cure ? Suggest a possible permanent cure.**

Ans. Lymphocytes not immortal / short lived, hence patient requires periodic infusion of such genetically engineered lymphocytes, however if a gene producing ADA is isolated from marrow cells, and introduced into the cells at early embryonic stages it could be a permanent cure $= \frac{1}{2} \times 4$

<div align="right">[2 marks]</div>

13. **Study the given aquatic food chain and answer the questions that follow :**

Fish eating birds
(DDT 5 ppm)

↑

Large fish
(DDT 2 ppm)

↑

Small fish
(DDT 0.5 ppm)

↑

Zooplankton
(DDT 0.04 ppm)

↑

Water
(DDT 0.003 ppm)

(i) **Give reasons why there is a continuous increase in the DDT content in different trophic levels of the chain.**

(ii) **Name the phenomenon responsible for the increase in DDT content.**

Ans. (i) DDT is a toxic substance which cannot be metabolised / excreted / is fat soluble and gets accumulated by an organism, it is passed on to the subsequent trophic levels = ½ + ½

(ii) Biomagnification = 1

[1 + 1 = 2 marks]

14. **Honey collection improves when beehives are kept in crop-fields during flowering season. Explain.**

Ans. Bees visit flowers for collecting nectar / pollen (for honey), more the number of flowers (during flowering season) larger is the nectar / pollen collection (hence more honey production) = 1 + 1

[2 marks]

OR

How does addition of a small amount of curd to fresh milk help in formation of curd? Mention a nutritional quality that gets added to the curd.

Inoculum or starter contains (millions) of LAB which multiply at a suitable temperature, produce acids / lactic acid that coagulates, and partially digests the milk proteins thus converting milk to curd, it also improves its nutritional quality (of milk) by increasing vitamin B_{12} = ½ × 4

[2 marks]

15. **Name the type of food chains responsible for the flow of larger fraction of energy in an aquatic and a terrestrial ecosystem respectively. Mention one difference between the two food chains.**

Ans. Aquatic ecosystem - Grazing Food Chain / GFC = ½

Terrestrial ecosystem - Detritus Food Chain / DFC = ½

Difference : GFC begins with phytoplanktons / producers whereas DFC begins with dead organisms / detritus = 1

[1 + 1 = 2 marks]

16. **Name the host and the site where the following occur in the life-cycle of a malarial parasite:**

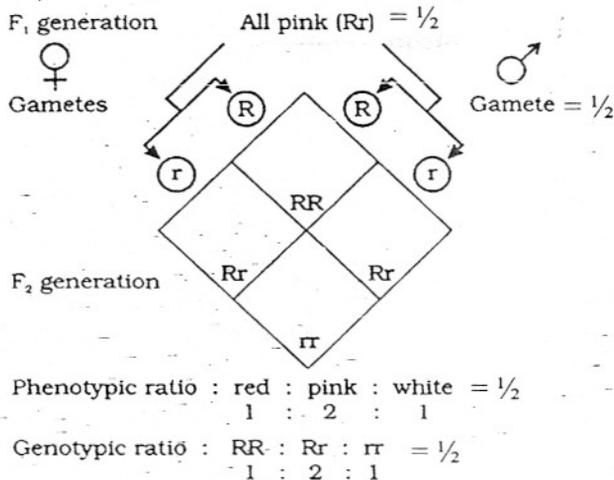(a) **Formation of gametocytes**

(b) **Fusion of gametocytes**

Ans. (a) Human, RBC = ½ + ½

(b) Female Anopheles (mosquito), intestine = ½ + ½

[1 + 1 = 2 marks]

17. **Why are F_2 phenotypic and genotypic ratios same in a cross between red-flowered snapdragon and white-flowered snapdragon plants. Explain with the help of a cross.**

Ans.

F$_1$ generation ♀

Gametes

All pink (Rr) = ½

♂ Gamete = ½

R   R

r   r

RR

F$_2$ generation   Rr   Rr

rr

Phenotypic ratio : red : pink : white = ½
                    1 : 2 : 1
Genotypic ratio : RR : Rr : rr = ½
                    1 : 2 : 1

[½ × 4 = 2 marks]

18. How does the floral pattern of Mediterranean orchid <u>Ophrys</u> guarantee cross pollination?

Ans. One petal of <u>Ophrys</u> resembles the female of a bee, male bees are attracted to it / perceives it as female, pseudocopulates, same male bee pseudocopulates with another flower of <u>Ophrys</u> and pollination is completed = ½ × 4

[2 marks]

SECTION-C

Q. Nos. 19 - 27 are of three marks each

19. During his studies on genes in <u>Drosophila</u> that were sex-linked T.H. Morgan found F$_2$-population phenotypic ratios deviated from expected 9:3:3:1. Explain the conclusion he arrived at.

Ans. (i)   Linkage : genes on the same chromosome were either closely associated or far apart

(ii) Higher percentage of parental combination and fewer percentage of recombinants are observed when two genes are located very close / tightly linked on the same chromosome

(iii) Higher percentage of recombinants and fewer percentage of parental combinations are observed when two genes are located far apart / loosely linked on the same chromosome = 1 × 3

[3 marks]

20. Describe the termination process of transcription in bacteria.

Ans. (DNA dependent) RNA polymerase reaches the terminator region, and attaches transiently with rho factor / termination factor, nascent RNA and RNA polymerase falls off and transcription terminates = 1 × 3
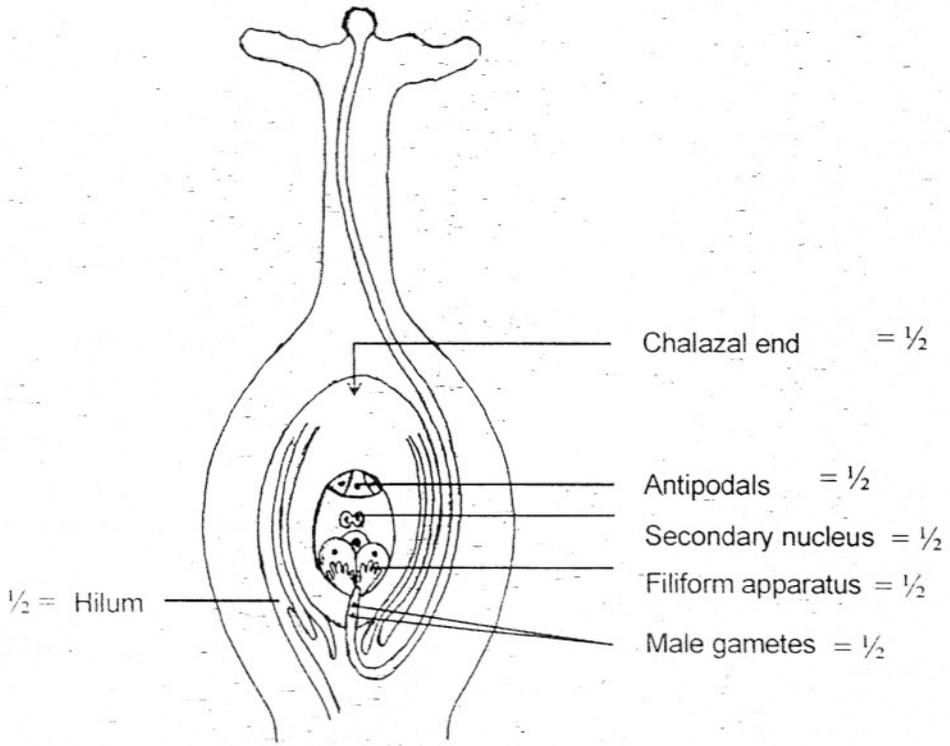
[3 marks]

21. How does RNA interference help in developing resistance in tobacco plant against nematode infection ?

Ans With RNA interference (RNAi) technique transgenic tobacco plant is protected against nematode / *Meloidegyne incognitia* using *Agrobacterium* as the vectors, nematode-specific genes were introduced into the host plant, it produces both sense & anti sense RNA, these 2 RNAs form ds RNA, it silences specific mRNA of nematode (no protein synthesis / no translation), hence nematode cannot survive in tobacco plant = ½ × 6
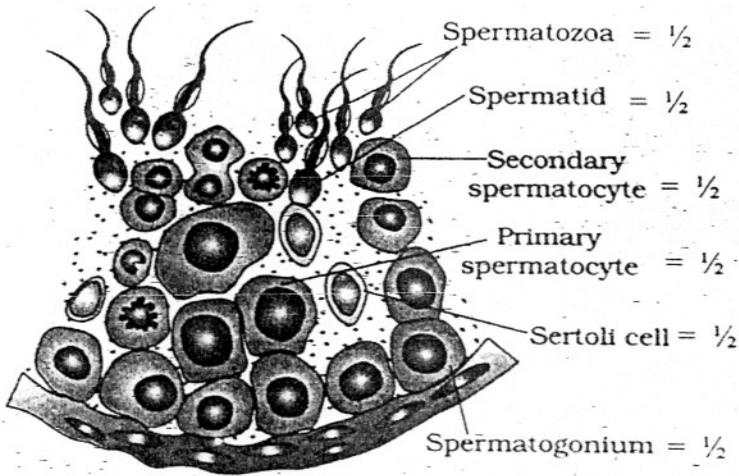
[3 marks]

22. Draw a longitudinal section of a post - pollinated Pistil showing entry of pollen tube into a mature embryo-sac. Label filiform apparatus, chalazal end, Hilum, antipodals, male gametes and secondary nucleus.

Chalazal end $= \frac{1}{2}$

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

Secondary nucleus $= \frac{1}{2}$

Filiform apparatus $= \frac{1}{2}$

Male gametes $= \frac{1}{2}$

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

OR

Draw a labelled sectional view of seminiferous tubule of a human male.

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

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

Secondary spermatocyte $= \frac{1}{2}$

Primary spermatocyte $= \frac{1}{2}$

Sertoli cell $= \frac{1}{2}$

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

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

23. **Explain the efforts which must be put in to improve health, nygiene and milk yield of cattle in a dairy farm.**

Ans. Should be taken to veterinary doctor , housed well , have adequate water , be maintained disease free , feeding should be carried out keeping quality , and quantity of fodder in mind , maintain stringent cleanliness and hygiene *Any six = ½ × 6*

[3 marks]

24. **Explain convergent and divergent evolution with the help of one example of each.**

Ans. *Convergent* - different structures evolving in the same direction in different organisms = 1

eg. wings of butterfly and of birds / eye of octopus and of mammals / the flippers of penguins and dolphins / sweet potato and potato. *Any one = ½*

Divergent - Same structure evolving in different directions in different organisms = 1

eg. forelimbs of whales , bats , cheetah and humans / vertebrate hearts or brains / thorns of Bougainvillea and tendrils of cucurbita. *Any one = ½*
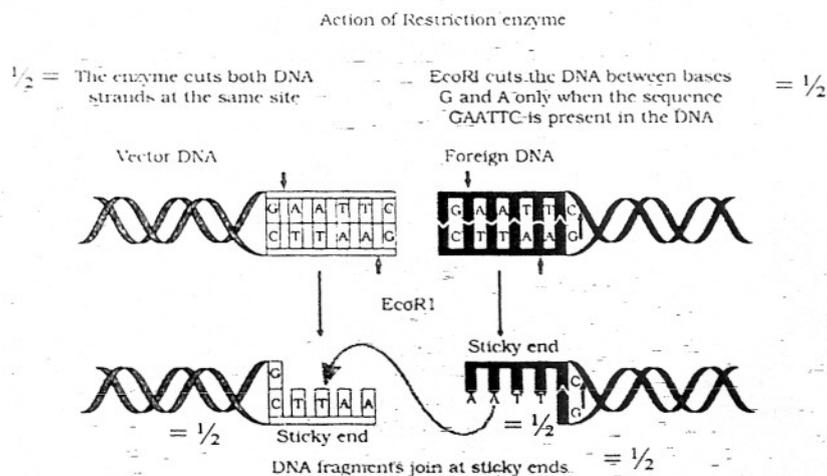
[1½ + 1½ = 3 marks]

25. **Eco RI is used to cut a segment of foreign DNA and that of a vector DNA to form a recombinant DNA. Show with the help of schematic diagrams.**

    (i) **The set of palindromic nucleotide sequence of base pairs the Eco RI will recognise in both the DNA segments. Mark the site at which Eco RI will act and cut both the segments.**

    (ii) **Sticky ends formed on both the segments where the two DNA segments will join later to form a recombinant DNA.**

Ans.   Palindromic sequence GAATTC = ½

Action of Restriction enzyme

½ = The enzyme cuts both DNA strands at the same site

EcoRI cuts the DNA between bases G and A only when the sequence GAATTC is present in the DNA = ½

Vector DNA   Foreign DNA

EcoRI

Sticky end

= ½   Sticky end   = ½   = ½

DNA fragments join at sticky ends. = ½

[½ × 6 = 3 marks]

26. **An antibody molecule is represented as H_2L_2. Explain.**

Ans. Each antibody has four polypeptide chains two are smaller light chains two long heavy chains , long chains are Y shaped and held together by di-sulphide bonds , light chain binds with the arms of the long chain to form antigen binding site (hence called H_2L_2) = 1 ×3

[3 marks]

27. **Identify a, b, c, d, e and f in the table given below :**

	Organism	Bioactive molecule	Use
1.	Monascus purpureus (yeast)	a	b
2.	c	d	antibiotic
3.	e	Cyclosporin A	f

Ans. a - Statins = ½

b - Blood cholesterol lowering agent = ½

c - *Penicillium notatum* = ½

d - Penicillin = ½

e - *Trichoderma polysporum* = ½

f - Immuno-suppressive agent in organ transplant patients = ½

[½ ×6 = 3 marks]

SECTION-D

Q. Nos. 28 - 30 are of five marks each

28. **When and where are primary oocytes formed in a human female ? Trace the development of these oocytes till ovulation (in menstrual cycle). How do gonadotropins influence this developmental process ?**

Ans. During embryonic development, in foetal ovary = ½ + ½

Each primary oocyte gets surrounded by a layer of granulosa cells and is called a primary follicle , large number of these primary follicles degenerate from birth to puberty , primary follicles gets surrounded by more granulosa cells and a new theca and is now called secondary follicle which transform to tertiary follicle that has a fluid filled cavity called antrum , it completes its first meiotic division which results in the formation of a large haploid secondary oocyte and a tiny first polar body , tertiary follicle changes into mature Graafian follicle (secondary oocyte forms new membrane called zona pellucida) , which ruptures to release ovum (this is called ovulation) = ½ × 6

Gonadotropins (LH and FSH) help in follicular development , LH surge induces ovulation. = ½ + ½

[1 + 3 +1 = 5 marks]

OR

(a) **Explain the events taking place at the time of fertilization of an ovum in a human female.**
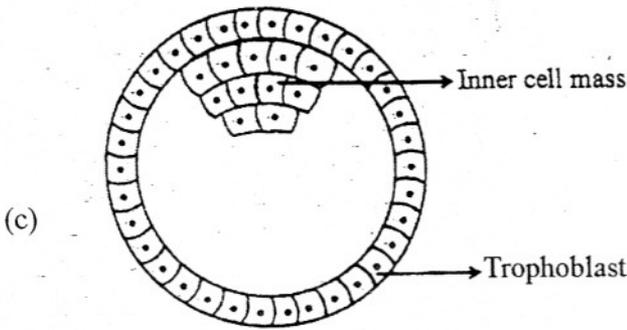
(b) **Trace the development of the zygote upto its implantation in the uterus.**

(c) **Name and draw a labelled sectional view of the embryonic stage that gets implanted.**

Ans. (a) During fertilization a sperm comes in contact with the zona pellucida layer of the ovum and induces changes in the membrane , this blocks the entry of additional sperms and only one sperm can fertilise and ovum , the secretions of acrosome help the sperm enter into the cytoplasm of the ovum through zona pellucida and the plasma membrane , soon the haploid nucleus of the sperm and the ovum fuse together to form a diploid zygote = ½ × 4

(b) Zygote moves through the isthmus of the oviduct and undergoes cleavage and it moves towards the uterus to form blastomeres , the embryo with 8 - 16 blastomeres is called morula which continues to divide and transforms into a blastocyst as it moves further into the uterus . It is

27

arranged into an outer layer called trophoblast and an inner cell mass , the trophoblast get attached to the endometrium and inner cell mass gets differentiated into the embryo the uterine cell divides rapidly and covers the blastocysts which get embedded into the uterus. (This is called implantation) = ½ × 4
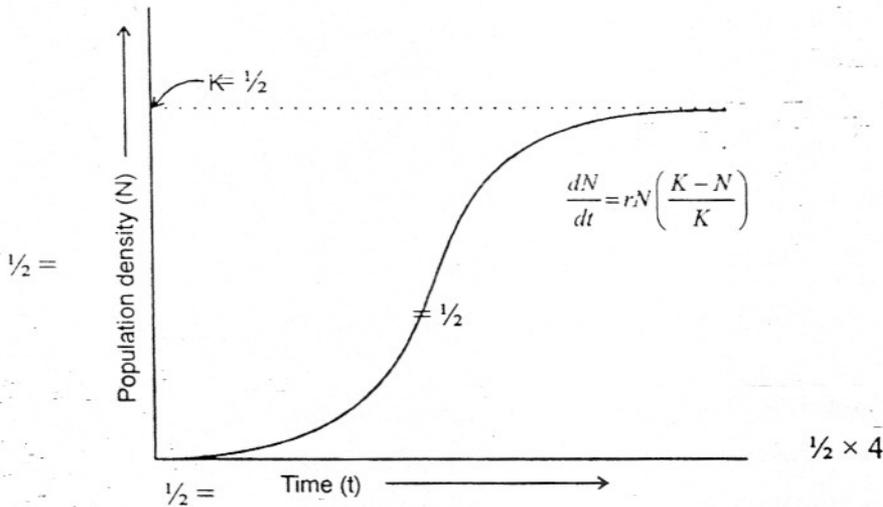
(c)

Inner cell mass

Trophoblast

[2 + 2 + 1 = 5 marks]

29. **Draw and explain a logistic curve for a population of density (N) at time (t) whose intrinsic rate of natural increase is (r) and carrying capacity is (k).**

Ans. A population growing in a habitat with limited resources show initially a lag phase , this is followed by phases of acceleration and deceleration , and finally an asymptote when the population density reaches carrying capacity (K) , A plot of N in relation to time (t) result in a sigmoid curve (Verhulst - Pearl Logistic Growth) = ½ × 4

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right) = 1$$

K= ½

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

≠ ½

½ =

Population density (N)

½ =   Time (t)

½ × 4

[2 + 1 + 2 = 5 marks]

OR

Describe the process of decomposition of detritus under the following heads : **Fragmentation; leaching; catabolism; humification and mineralization.**

Ans. *Fragmentation* : Breakdown of detritus into smaller particles

Leaching : Water soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts

Catabolism : Bacterial and fungal enzymes degrade detritus into simpler inorganic substances

Humification : It leads to the accumulation of a dark coloured amorphous substance called humus that is highly resistant to microbial action and undergoes decomposition at an extremely slow rate

Mineralization : The humus is further degraded by some microbes and release inorganic substances by this process

$[1 \times 5 = 5 \text{ marks}]$

30. **Write the symptoms of haemophilia and sickle-cell anaemia in humans. Explain how the inheritance pattern of the two diseases differ from each other.**

Ans. **Sickle Cell Anaemia**

   (i)   Presence of sickle cell RBC = 1

   (ii)   individual is anaemic = 1

   Pattern of Inheritance is Autosomal = 1

   Haemophilia

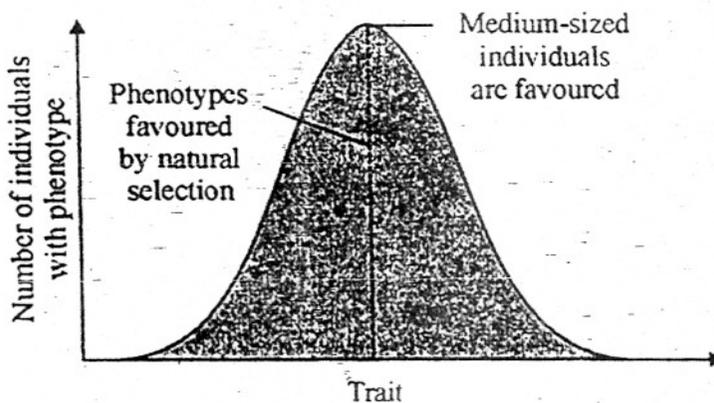   (i)   Blood does not clot (continuous bleeding) = 1

   Pattern of Inheritance = Sex linked / criss-cross = 1

$[1 \times 5 = 5 \text{ marks}]$

OR

(a) Write Hardy-Weinberg principle.

(b) Explain the three different ways the natural selection can affect the frequency of a heritable trait in a population shown in the graph given below.

Ans. (a) Allele frequencies in a population are stable and is constant, from generation to generation = 1 + 1

(b) The 3 different ways the natural selection can affect the frequency of a heritable trait in a

population shown in the graph below.-

(i) Stabilizing - Favours average sized individuals , maintains mean value from generation to generation = ½ + ½

(ii) Directional - Favours small or large sized individuals , mean size of the population changes in one particular direction = ½ + ½

(iii) Disruptive - Both small & large sized individuals favoured , mean sized population decreases leading to two different populations = ½ + ½

[2 + 3 = 5 marks]