Senior School Certificate Examination

April 2018

Marking Scheme - Biology (Theory)

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 (<u>in words only</u>).

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 "<u>extra</u>".

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 - 5 are of one mark each)

1. **Write the dual purpose served by Deoxyribonucleoside triphosphates in polymerisation.**

Ans. Acts as a substrate , provide energy (from the terminal two phosphates) $= \frac{1}{2} + \frac{1}{2}$

[1 mark]

2. **Name two diseases whose spread can be controlled by the eradication of *Aedes* mosquitoes.**

Ans. Dengue , Chikunguniya // Yellow Fever / Eastern Equine Encephalitis / West Nile Fever / Zika / Zika Virus Disease *(Any two)* $= \frac{1}{2} + \frac{1}{2}$

[1 mark]

3. **How do cytokine barriers provide innate immunity in humans ?**

Ans. Interferon (proteins) , secreted by virus infected cells (protect non - infected cells from further viral infection) $= \frac{1}{2} + \frac{1}{2}$

[1 mark]

4. **Write the names of the following :**

(a) **A 15 *mya* primate that was ape-like**

(b) **A 2 *mya* primate that lived in East African grasslands**

Ans. (a) *Dryopithecus = ½*

(b) *Australopithecines / Australopithecus / Homo habilis = ½*

[1 mark]

5. **Mention the chemical change that pro-insulin undergoes, to be able to act as mature insulin.**

Ans. Removal of C - peptide (from pro-insulin)

[1 mark]

6. **Your advice is sought to improve the nitrogen content of the soil to be used for cultivation of a non-leguminous terrestrial crop.**

   (a) **Recommend two microbes that can enrich the soil with nitrogen.**

   (b) **Why do leguminous crops not require such enrichment of the soil ?**

Ans. (a) *Azospirillum / Azotobacter / Anabaena / Nostoc / Oscillatoria / Frankia* (**Any two correct names of microbes**) = ½ + ½

   (If cyanobacteria mentioned = ½ , but if along with cyanobacteria *Anabaena / Nostoc / Oscillatoria mentioned then **No mark*** on cyanobacteria)

   (b) They can fix atmospheric nitrogen , due to presence of *Rhizobium* / N_2 fixing bacteria in their root nodules = ½ + ½

   [1 + 1 = 2 marks]

7. **With the help of an algebraic equation, how did Hardy-Weinberg explain that in a given population the frequency of occurrence of alleles of a gene is supposed to remain the same through generations ?**

Ans. In a population of diploid organisms

   If frequency of allele A = p   and frequency of allele   a = q   = ½

   Expected genotype frequency under random mating are

   AA =   p² (for the AA homozygotes)
   aa =   q² (for the aa homozygotes)
   Aa =   2pq (for the Aa heterozygotes) = ½

   (In absence of selection , mutation , genetic drift or other forces allelic frequency p and q are constant through generation)

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

   [2 marks]

OR

Although a prokaryotic cell has no defined nucleus , yet DNA is not scattered throughout the cell. Explain.

DNA is negatively charged , positively charged proteins , hold it in places , in large loops (in a region termed as nucleiod) = ½ × 4

[2 marks]

8. **How did a citizen group called Friends of Arcata Marsh, Arcata, California, USA, help to improve water quality of the marshland using Integrated Waste Water Treatment ? Explain in four steps.**

Ans. - Water is treated by conventional method // sedimentation / filtration / chlorination

- Water flows to six connected marshes

- The water in marshes is seeded with appropriate plants / algae / fungi / bacteria

- Which helps to neutralise the pollutants / assimilate the pollutants / absorb pollutants / Remove heavy metals = ½ × 4

[2 marks]

9. **You have obtained a high yielding variety of tomato. Name and explain the procedure that ensures retention of the desired characteristics repeatedly in large populations of future generations of the tomato crop.**

Ans. - Tissue culture / micropropagation / somaclonal propagation / apomixis = **½**

- Explant / any part of plant taken out and grown (in a test tube / vessel) ,

- under sterile condition ,

- in special nutrient medium (containing carbon source / sucrose , inorganic salt vitamins / amino acids and growth regulator) = ½ × 3

[½ + 1½ = 2 marks]

10. (a) **Name the source plant of heroin drug. How is it obtained from the plant ?**

    (b) **Write the effects of heroin on the human body.**

Ans. (a) - *Papaver somniferum* / Poppy plant = ½

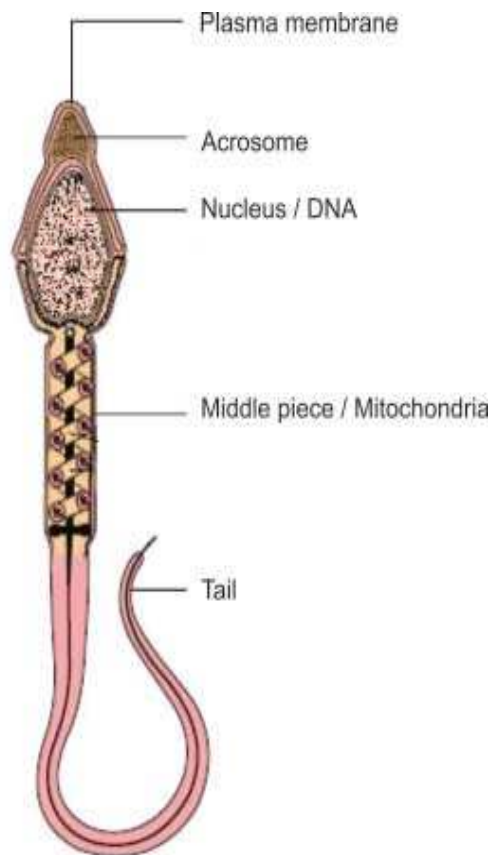   - Extracted from latex of the plant / acetylation of morphine (obtained from the latex of plant) = ½

(b)   Depressant , slows down body function = ½ + ½

[1 + 1 = 2 marks]

SECTION C

(Q. Nos. 11 - 22 are of three marks each)

11.   **Draw a diagram of a mature human sperm. Label any three parts and write their functions.**

(Any three labelling) **=** ½ × 3

Plasma membrane - Envelope of the sperm

Acrosome   - Filled with enzyme that help fertilization of ovum

Mitochondria   - Energy source for swimming

Middle Piece   - Possess mitochondria which is the energy source for swimming

Tail   - For movement of sperm

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Nucleus   -   Containing chromosomal material

(Functions of the parts labelled) = ½ × 3

$$[1½ + 1½ = 3 \text{ marks}]$$

12. **(a)** **Expand VNTR and describe its role in DNA fingerprinting.**

       (b) **List any two applications of DNA fingerprinting technique.**

Ans. (a)   VNTR   -   Variable Number of Tandem Repeat(s) = ½

                        -    used as a probe (because of its high degree of polymorphism) = ½

      (b)   Forensic science / criminal investigation (any point related to forensic science) / determine population and genetic diversities / paternity testing / maternity testing / study of evolutionary biology (*Any two*) = 1 + 1

$$[1 + 2 = 3 \text{ marks}]$$

13. **Differentiate between Parthenocarpy and Parthenogenesis. Give one example of each.**

Ans.

Parthenocarpy	Parthenogenesis
- Formation of fruit without fertilization = 1	- New organism develops without fertilization = 1
- e.g. banana / grapes / any other correct example = ½	- e.g. Drones /male honey bee / turkey / rotifers / some lizards / any other correct example = ½

$$[1½ + 1½ = 3 \text{ marks}]$$

14. **Medically it is advised to all young mothers that breastfeeding is the best for their newborn babies. Do you agree ? Give reasons in support of your answer.**
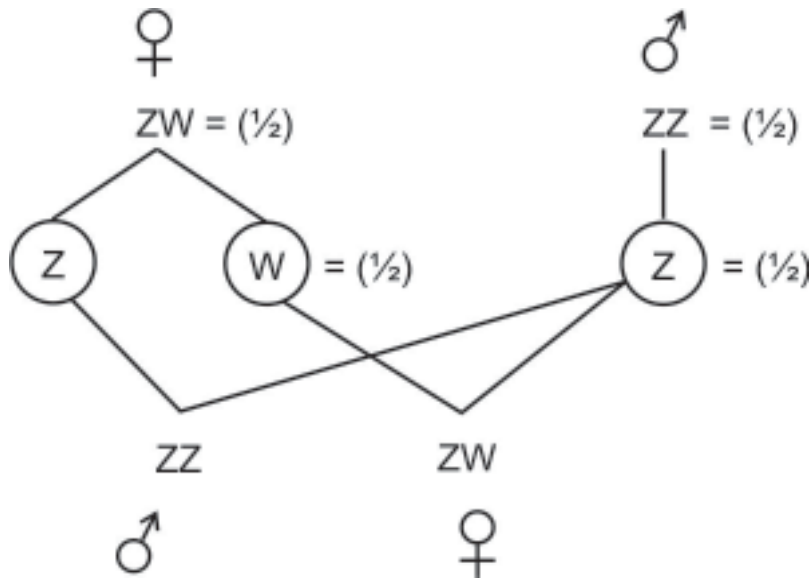
Ans. Yes = 1 ,

provides nutrition (calcium , fats , lactose) / provides (passive) immunity / provides antibodies / Ig A *(Any two)* = 1 + 1

$$[1 + 2 = 3 \text{ marks}]$$

15. **Explain the mechanism of 'sex determination' in birds. How does it differ from that of human beings ?**

Ans.   In birds ;

Birds : female heterogamety / female produces (Z) type and (W) type of gametes = ½

Humans : male heterogamety / male produces (X) type and (Y) type of gametes = ½

[2 + 1 = 3 marks]

16. **(a)** **How has the development of bioreactor helped in biotechnology ?**

(b) **Name the most commonly used bioreactor and describe its working.**

Ans. (a)   Larger biomass / large volume of culture can be processed leading to higher yields of desired specific products (protein / enzymes) , under controlled condition = ½ + ½

(b)   Stirring type = ½

-    Mixing of reactor contents evenly (with agitator system or a stirrer) = ½

-    Facilitates oxygen availability = ½

-    Temperature / pH / foam control // under optimum conditions = ½

[1 + 2 = 3 marks]

17. **Explain the roles of the following with the help of an example each in recombinant DNA technology:**

    (a) **Restriction Enzymes**

    (b) **Plasmids**

Ans. (a)   It recognises a specific sequence of base pairs / pallindromes, and cuts the DNA strand at a specific site = ½ + ½

     eg. EcoRI / Hind II or any other correct example = ½

     (b)   Act as vectors / cloning of desired alien gene / foreign gene = 1

     eg. pBR322 / plasmid of *Salmonella* / plasmid of *Agrobacterium* / Ti Plasmid / Tumour inducing Plasmid = ½

                                                              [1½ + 1½ = 3 marks]

18. **Explain out-breeding, out-crossing and cross-breeding practices in animal husbandry.**

    Out breeding   –   Breeding of unrelated animals (which may be between individual of same breed or between individuals of different species) = 1

    Out crossing   –   (a kind of out breeding) Mating of animals within the same breed but having no common ancestors on either side of their pedigree upto 4 – 6 generations = 1

    Cross breeding –   (another type of out breeding) Superior males of one breed are mated with superior females of another breed = 1

                                                              [1+1+1 = 3 marks]

19. (a) **Organic farmers prefer biological control of diseases and pests to the use of chemicals for the same purpose. Justify.**

    (b) **Give an example of a bacterium, a fungus and an insect that are used as biocontrol agents.**

Ans. (a)   -   Reduces dependence on toxic chemicals

           -    Protects our ecosystem or environment

           -    Protects and conserves non-target organisms / they are species - specific

           -    These chemicals being non-biodegradable may pollute the environment permanently

           -    These chemicals being non-biodegradable may cause biomagnification

                (Any three) = ½ × 3

(b) Bacteria – *Bacillus thuringiensis* = ½

Fungus – *Trichoderma* = ½

Insect – Ladybird / Dragonfly / Moth or any other correct example = ½

[1½ + 1½ = 3 marks]

20. (a) Differentiate between analogous and homologous structures.

(b) Select and write analogous structures from the list given below :

(i) Wings of butterfly and birds

(ii) Vertebrate hearts

(iii) Tendrils of bougainvillea and cucurbita

(iv) Tubers of sweet potato and potato

Ans. (a) Analogous - Anatomically not similar though perform similar functions / are a result of convergent evolution = 1

Homologus - Anatomically similar (but perform different functions) / are a result of divergent evolution = 1

(b) Option (i) Wings of butterfly and birds / (iv) Tubers of sweet potato and potato *(Any one)* = 1

[2 + 1 = 3 marks]

21. (a) "India has greater ecosystem diversity than Norway." Do you agree with the statement ? Give reasons in support of your answer.

(b) Write the difference between genetic biodiversity and species biodiversity that exists at all the levels of biological organisation.

Ans. (a) Yes = ½

India / tropical region	Norway / temperate region
- are less seasonal	- more seasonal /
/ more constant / more predictable	/ less constant / less predictable
- promote niche specialisation	- do not promote niche specialisation
leading to greater bio-diversity	leading to low bio-diversity

- Species diversity increases as we move towards equator	- Species diversity decreases as we move away from equator
- More number of species exist	- Less number of species exist

(Any one) = ½

(b) Genetic diversity - Diversity / variation within a species over its distributional range / same explained with the help of a correct example = 1

Species diversity - Diversity / variation at a species level / same explained with the help of a correct example = 1

$[1 + 2 = 3$ marks$]$

OR

Explain the effect on the characteristics of a river when urban sewage is discharged into it.

Ans. - Rise in organic matter , leads to increased microbial activity / growth of microbes = ½ + ½

- It results in decrease in dissolved oxygen / rise in BOD / rise in Biochemical Oxygen Demand = 1

- Leads to fish mortality / algal bloom / colour change / foul odour / increase in toxicity *(Any two)* = ½ + ½

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

22. **How has the use of *Agrobacterium* as vectors helped in controlling *Meloidegyne incognitia* infestation in tobacco plants ? Explain in correct sequence.**

Ans. - Using *Agrobacterium* vector nematode specific genes introduced into host plant

- Sense and antisense strands of mRNA are produced

- ds RNA is formed

- ds RNA initiates RNAi

- Prevents translation of mRNA / silencing of mRNA of parasite / nematode

- Parasite will not survive

$[½ \times 6 = 3$ marks$]$

SECTION D

(Q. Nos. 23 is of four marks)

23. **Looking at the deteriorating air quality because of air pollution in many cities of the country, the citizens are very much worried and concerned about their health. The doctors have declared health emergency in the cities where the air quality is very severely poor.**

    (a) **Mention any two major causes of air pollution.**

    (b) **Write any two harmful effects of air pollution to plants and humans.**

    (c) **As a captain of your school Eco-club, suggest any two programmes you would plan to organise in the school so as to bring awareness among the students on how to check air pollution in and around the school.**

Ans. (a)   Vehicular discharge / smoke from industries / burning of agricultural wastes / smoke from incinerator / dust / smoke from thermal plants or any other correct cause

        (Any two) = ½ + ½

    (b)   Reduces growth of plants / reduces yields of crops / premature death of plants / respiratory problems / acid rain / any other relevant point *(Any two - one from plant and one from human)* = 1 + 1

    (c)   Plantation drive / awareness programmes through posters / nukkad natak / film show / rallies / debates or any other *(Any two)* = 1 + 1

                                           [1 + 1 + 2 = 4 marks]

SECTION E

(Q. Nos. 24 - 26 are of five marks each)

24. **(a)** **Describe any two devices in a flowering plant which prevent both autogamy and geitonogamy.**

    (b) **Explain the events upto double fertilisation after the pollen tube enters one of the synergids in an ovule of an angiosperm.**

Ans. (a)   -   Dioecy / production of unisexual flowers (in different plants)

           -   Self incompatibility = 1 + 1

    (b)   -   Pollen tube releases 2 male gametes in the cytoplasm of synergid

           -   One male gamete fuses with egg cell / syngamy , resulting in diploid zygote

- Other male gamete fuses with polar nuclei / triple fusion , to form triploid PEN (Primary Endosperm Nucleus) / PEC (Primary Endosperm Cell) $= 1 \times 3$

$$[2 + 3 = 5 \text{ marks}]$$

OR

(a) **Explain menstrual cycle in human females.**

(b) **How can the scientific understanding of the menstrual cycle of human females help as a contraceptive measure ?**

Ans. (a) - Menstrual Phase - Menstrual flow occurs / due to breakdown of endometrial lining of uterus , when fertilization does not occur

- Follicular Phase - Primary follicles grow into mature graafian follicles and endometrium regenerates through proliferation , changes induced by pituitary and ovarian hormones

- Ovulatory Phase - LH surge , induces rupture of graafian follicle and release of secondary oocyte / ovum during middle of cycle (i.e. 14th day)

- Luteal phase - Ruptured graafian follicle transforms into corpus luteum which secrete large amount of progesteron , essential for maintaining endometrium $= 1 \times 4$

(b) Because ovulation occurs during mid cycle chances of fertilisation are very high so , couples should abstain from coitus between day 10 - 17 $= \frac{1}{2} + \frac{1}{2}$

25. (a) **Write the scientific name of the organism Thomas Hunt Morgan and his colleagues worked with for their experiments. Explain the correlation between linkage and recombination with respect to genes as studied by them.**

(b) **How did Sturtevant explain gene mapping while working with Morgan ?**

Ans. (a) *Drosophila melanogaster* = 1

They observed that two genes (located closely on a chromosome) did not segregate independently of each other (F_2 ratio deviated significantly from 9 : 3 : 3 : 1) $= \frac{1}{2}$

Tightly linked genes tend to show fewer (lesser) recombinant frequency of parental traits / show higher (more) frequency of parental type $= \frac{1}{2}$

Loosely linked genes show higher percentage (more) of recombinant frequency of

parental traits / lower frequency percentage of parental type = ½
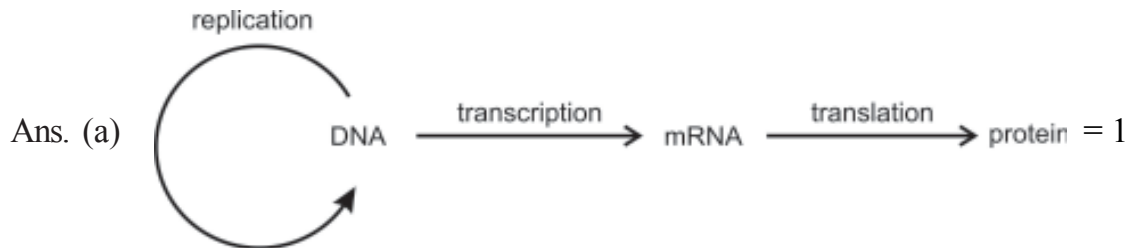
Genes present on same chromosome are said to be linked and the recombinant frequency depends on their relative distance on the chromosome = ½

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

[3 + 2 = 5 marks]

OR

(a)   State the 'Central dogma' as proposed by Francis Crick. Are there any exceptions to it ? Support your answer with a reason and an example.

(b)   Explain how the biochemical characterisation (nature) of 'Transforming Principle' was determined, which was not defined from Griffith's experiments.

Ans. (a)

Yes , in some viruses flow of information is in reverse direction / reverse transcription = ½ + ½

e.g. Any Retrovirus / HIV = ½

(b)   Protein and DNA and RNA were purified from heat killed S strain / smooth *Streptococcus / Diplococcus pneumoniae* = ½

Protein + Protease → transformation occured (R cell to S type) = ½

RNA + RNA ase → transformation occured (R cell to S type) = ½

DNA + DNA ase → transformation inhibited = ½

Hence DNA alone is the transforming material = ½

[2 + 3 = 5 marks]

26. (a) Following are the responses of different animals to various abiotic factors. Describe each one with the help of an example.

    (i) Regulate

    (ii) Conform

    (iii) Migrate

    (iv) Suspend

(b) If 8 individuals in a population of 80 butterflies die in a week, calculate the death rate of population of butterflies during that period.

Ans. (a) (i)   Regulate - Maintain constant internal temperature / osmotic concentration /homeostasis = ½

                             e.g. birds / mammals = ½

      (ii)   Conform - Do not maintain constant internal temperature / osmotic concentration / No homeostasis = ½

                             e.g. any one example of animal other than birds and mammals = ½

      (iii) Migrate - Temporary movement of organisms from the stressful of habitats to hospitable areas and return when stressful period is over = ½

                             e.g. birds from Siberia / or any other correct example = ½

      (iv) Suspend - Reducing / minimising the metabolic activities during unfavourable conditions = ½

                             e.g. Polar bear / amphibian / snails / fish / any other example of animals = ½

(b) Death rate $= \dfrac{8}{80} = 0.1$, individuals per butterfly per week   = ½ + ½

$$[4 + 1 = 5 \text{ marks}]$$

OR

(a) What is a trophic level in an ecosystem ? What is 'standing crop' with reference to it ?

(b) Explain the role of the 'first trophic level' in an ecosystem.

(c) How is the detritus food chain connected with the grazing food chain in a natural ecosystem ?

Ans. (a) Specific place of an organism in a food chain , mass of living material (biomass) at each trophic level at a particular time = 1 + 1

(b) First trophic level has producers / autotrophs , which trap solar energy / to produce food (photosynthesis) = 1 + 1

(c) Organisms of the Detritus food chain (DFC) are the prey to the Grazing food chain (GFC) organism , the dead remains of GFC are decomposed into simple inorganic materials which are absorbed by DFC organisms = ½ + ½

[2 + 2 + 1 = 5 marks]

SECTION – A

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

1. **Mention the chemical change that proinsulin undergoes, to be able to act as mature insulin.**

Ans. Removal of C - peptide (from pro-insulin)

[1 mark]

2. **Write the names of the following :**

   (a) A 15 *mya* primate that was ape-like

   (b) A 2 *mya* primate that lived in East African grasslands

Ans. (a) *Dryopithecus = ½*

   (b) *Australopithecines / Australopithecus / Homo habilis = ½*

[1 mark]

3. **Name two diseases whose spread can be controlled by the eradication of *Aedes* mosquitoes.**

Ans. Dengue , Chikunguniya // Yellow Fever / Eastern Equine Encephalitis / West Nile Fever / Zika / Zika Virus Disease *(Any two)* = ½ + ½

[1 mark]

4. **How do cytokine barriers provide innate immunity in humans ?**

Ans. Interferon (proteins) , secreted by virus infected cells (protect non - infected cells from further viral infection) =½ + ½

[1 mark]

5. **Write the dual purpose served by Deoxyribonucleoside triphosphates in polymerisation.**

Ans. Acts as a substrate , provide energy (from the terminal two phosphates) = ½ + ½

[1 mark]

(Q. Nos. 2 - 10 are of two marks each)

6. **(a)** **Name the source plant of heroin drug. How is it obtained from the plant ?**

   (b) **Write the effects of heroin on the human body.**

Ans. (a)   -   *Papaver somniferum* / Poppy plant = ½

   -   Extracted from latex of the plant / acetylation of morphine (obtained from the latex of plant) = ½

   (b)   Depressant , slows down body function = ½ + ½

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

7. **You have obtained a high yielding variety of tomato. Name and explain the procedure that ensures retention of the desired characteristics repeatedly in large populations of future generations of the tomato crop.**

Ans.   -   Tissue culture / micropropagation / somaclonal propagation / apomixis = **½**

   -   Explant / any part of plant taken out and grown (in a test tube / vessel) ,

   -   under sterile condition ,

   -   in special nutrient medium (containing carbon source / sucrose , inorganic salt vitamins / amino acids and growth regulator) = ½ × 3

$$[½ + 1½ = 2 \text{ marks}]$$

8. **With the help of an algebraic equation, how did Hardy-Weinberg explain that in a given population the frequency of occurrence of alleles of a gene is supposed to remain the same through generations ?**

Ans. In a population of diploid organisms

   If frequency of allele A = p   and frequency of allele a = q   = ½

   Expected genotype frequency under random mating are

   AA = p^2 (for the AA homozygotes)

   aa = q^2 (for the aa homozygotes)

Aa = 2pq (for the Aa heterozygotes) = ½

(In absence of selection , mutation , genetic drift or other forces allelic frequency p and q are constant through generation)

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

[2 marks]

OR

Although a prokaryotic cell has no defined nucleus , yet DNA is not scattered throughout the cell. Explain.

DNA is negatively charged , positively charged proteins , hold it in places , in large loops (in a region termed as nucleiod) = ½ × 4

[2 marks]

9. **How did a citizen group called Friends of Arcata Marsh, Arcata, California, USA, help to improve water quality of the marshland using Integrated Waste Water Treatment ? Explain in four steps.**

Ans.- Water is treated by conventional method // sedimentation / filtration / chlorination

- Water flows to six connected marshes

- The water in marshes is seeded with appropriate plants / algae / fungi / bacteria

- Which helps to neutralise the pollutants / assimilate the pollutants / absorb pollutants / Remove heavy metals = ½ × 4

[2 marks]

10. **Your advice is sought to improve the nitrogen content of the soil to be used for cultivation of a non-leguminous terrestrial crop.**

   (a) **Recommend two microbes that can enrich the soil with nitrogen.**

   (b) **Why do leguminous crops not require such enrichment of the soil ?**

Ans. (a) *Azospirillum / Azotobacter / Anabaena / Nostoc / Oscillatoria / Frankia* (**Any two correct names of microbes**) = ½ + ½

(If cyanobacteria mentioned = ½ , but if along with cyanobacteria *Anabaena* / *Nostoc / Oscillatoria mentioned then **No mark** on cyanobacteria*)

(b) They can fix atmospheric nitrogen , due to presence of *Rhizobium* / N_2 fixing bacteria in their root nodules = ½ + ½

[1 + 1 = 2 marks]

SECTION C

(Q. Nos. 11 - 22 are of three marks each)

11. Differentiate between Parthenocarpy and Parthenogenesis. Give one example of each.

Ans.

| <u>Parthenocarpy</u>	<u>Parthenogenesis</u>
- Formation of fruit without fertilization = 1	- New organism develops without fertilization = 1
- e.g. banana / grapes / any other correct example = ½	- e.g. Drones /male honey bee / turkey / rotifers / some lizards / any other correct example = ½

[1½ + 1½ = 3 marks]

12. Medically it is advised to all young mothers that breastfeeding is the best for their newborn babies. Do you agree ? Give reasons in support of your answer.

Ans. Yes = 1 ,

provides nutrition (calcium , fats , lactose) / provides (passive) immunity / provides antibodies / Ig A *(Any two)* = 1 + 1

[1 + 2 = 3 marks]

13. Draw a diagram of a mature human sperm. Label any three parts and write their functions.
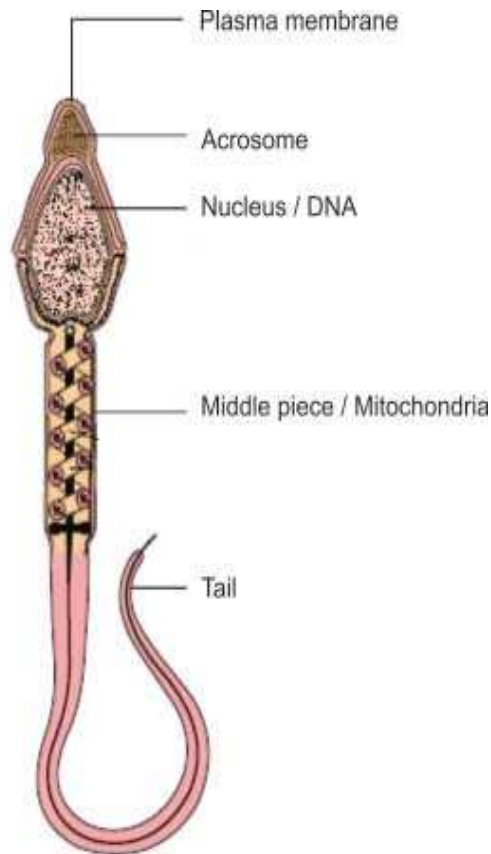
(Any three labelling) = ½ × 3

Plasma membrane - Envelope of the sperm

Acrosome   - Filled with enzyme that help fertilization of ovum

Mitochondria   - Energy source for swimming

Middle Piece   - Possess mitochondria which is the energy source for swimming

Tail   - For movement of sperm

Nucleus   - Containing chromosomal material

(Functions of the parts labelled) = ½ × 3

[1½ + 1½ = 3 marks]

14. (a) Expand VNTR and describe its role in DNA fingerprinting.

(b) List any two applications of DNA fingerprinting technique.

Ans. (a) VNTR - Variable Number of Tandem Repeat(s) = ½

- used as a probe (because of its high degree of polymorphism) = ½

(b) Forensic science / criminal investigation (any point related to forensic science) / determine population and genetic diversities / paternity testing / maternity testing / study of evolutionary biology (*Any two*) = 1 + 1

[1 + 2 = 3 marks]

15. (a) Organic farmers prefer biological control of diseases and pests to the use of chemicals for the same purpose. Justify.

(b) Give an example of a bacterium, a fungus and an insect that are used as biocontrol agents.

Ans. (a) - Reduces dependence on toxic chemicals

- Protects our ecosystem or environment

- Protects and conserves non-target organisms / they are species - specific

- These chemicals being non-biodegradable may pollute the environment permanently

- These chemicals being non-biodegradable may cause biomagnification

(*Any three*) = ½ × 3

(b) Bacteria – *Bacillus thuringiensis* = ½

Fungus – *Trichoderma* = ½

Insect – Ladybird / Dragonfly / Moth or any other correct example = ½

[1½+ 1½ = 3 marks]

16. Explain the roles of the following with the help of an example each in recombinant DNA technology:

(a) Restriction Enzymes

(b) Plasmids

Ans. (a)   It recognises a specific sequence of base pairs / pallindromes, and cuts the DNA strand at a specific site = ½ + ½

eg. EcoRI / Hind II or any other correct example = ½

(b)   Act as vectors / cloning of desired alien gene / foreign gene = 1

eg. pBR322 / plasmid of *Salmonella* / plasmid of *Agrobacterium* / Ti Plasmid / Tumour inducing Plasmid = ½

[1½ + 1½ = 3 marks]

17. Explain out-breeding, out-crossing and cross-breeding practices in animal husbandry.

Out breeding   –   Breeding of unrelated animals (which may be between individual of same breed or between individuals of different species) = 1

Out crossing   –   (a kind of out breeding) Mating of animals within the same breed but having no common ancestors on either side of their pedigree upto 4 – 6 generations = 1

Cross breeding –   (another type of out breeding) Superior males of one breed are mated with superior females of another breed = 1

[1+1+1 = 3 marks]

18. Explain the mechanism of 'sex determination' in birds. How does it differ from that of human beings ?

Ans.   In birds ;
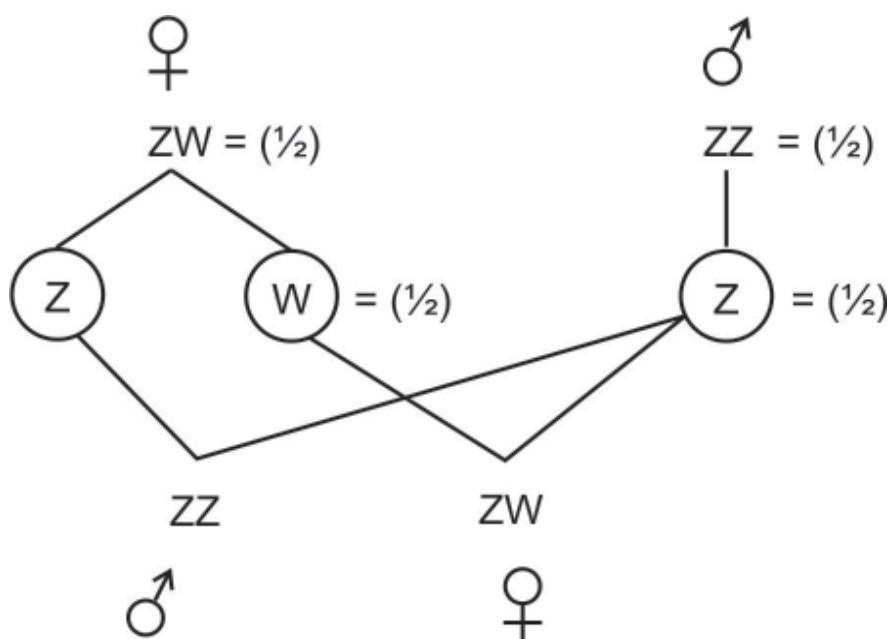
Birds : female heterogamety / female produces (Z) type and (W) type of gametes = ½

Humans : male heterogamety / male produces (X) type and (Y) type of gametes = ½

[2 + 1 = 3 marks]

19. (a) How has the development of bioreactor helped in biotechnology ?

(b) Name the most commonly used bioreactor and describe its working.

Ans. (a) Larger biomass / large volume of culture can be processed leading to higher yields of desired specific products (protein / enzymes) , under controlled condition = ½ + ½

(b) Stirring type = ½

- Mixing of reactor contents evenly (with agitator system or a stirrer) = ½

- Facilitates oxygen availability = ½

- Temperature / pH / foam control // under optimum conditions = ½

[1 + 2 = 3 marks]

20. How has the use of *Agrobacterium* as vectors helped in controlling *Meloidegyne incognitia* infestation in tobacco plants ? Explain in correct sequence.

Ans. - Using *Agrobacterium* vector nematode specific genes introduced into host plant

- Sense and antisense strands of mRNA are produced

- ds RNA is formed

- ds RNA initiates RNAi

- Prevents translation of mRNA / silencing of mRNA of parasite / nematode

- Parasite will not survive

[½ × 6 = 3 marks]

21. (a) Differentiate between analogous and homologous structures.

(b) Select and write analogous structures from the list given below :

(i) Wings of butterfly and birds

(ii) Vertebrate hearts

(iii) Tendrils of bougainvillea and cucurbita

(iv) Tubers of sweet potato and potato

Ans. (a) Analogous - Anatomically not similar though perform similar functions / are a result of convergent evolution = 1

   Homologus - Anatomically similar (but perform different functions) / are a result of divergent evolution = 1

   (b) Option (i) Wings of butterfly and birds / (iv) Tubers of sweet potato and potato *(Any one)* = 1

$$[2 + 1 = 3 \text{ marks}]$$

22. (a) "India has greater ecosystem diversity than Norway." Do you agree with the statement ? Give reasons in support of your answer.

   (b) Write the difference between genetic biodiversity and species biodiversity that exists at all the levels of biological organisation.

Ans. (a) Yes = ½

India / tropical region	Norway / temperate region
- are less seasonal / more constant / more predictable	- more seasonal / less constant / less predictable
- promote niche specialisation leading to greater bio-diversity	- do not promote niche specialisation leading to low bio-diversity
- Species diversity increases as we move towards equator	- Species diversity decreases as we move away from equator
- More number of species exist	- Less number of species exist

(Any one) = ½

   (b) Genetic diversity - Diversity / variation within a species over its distributional range / same explained with the help of a correct example = 1

Species diversity - Diversity / variation at a species level / same explained with
the help of a correct example = 1

[1 + 2 = 3 marks]

OR

Explain the effect on the characteristics of a river when urban sewage is discharged into it.

Ans. - Rise in organic matter , leads to increased microbial activity / growth of microbes
= ½ + ½

- It results in decrease in dissolved oxygen / rise in BOD / rise in Biochemical Oxygen
Demand = 1

- Leads to fish mortality / algal bloom / colour change / foul odour / increase in
toxicity *(Any two)* = ½ + ½

[1 + 1 + 1 = 3 marks]

SECTION D

(Q. Nos. 23 is of four marks)

23. **Looking at the deteriorating air quality because of air pollution in many cities of the country, the citizens are very much worried and concerned about their health. The doctors have declared health emergency in the cities where the air quality is very severely poor .**

   (a) Mention any two major causes of air pollution.

   (b) Write any two harmful effects of air pollution to plants and humans.

   (c) As a captain of your school Eco-club, suggest any two programmes you would plan to organise in the school so as to bring awareness among the students on how to check air pollution in and around the school.

Ans. (a) Vehicular discharge / smoke from industries / burning of agricultural wastes / smoke
from incinerator / dust / smoke from thermal plants or any other correct cause

   (Any two) = ½ + ½

   (b) Reduces growth of plants / reduces yields of crops / premature death of plants /
respiratory problems / acid rain / any other relevant point *(Any two - one from
plant and one from human)* = 1 + 1

(c) Plantation drive / awareness programmes through posters / nukkad natak / film show / rallies / debates or any other *(Any two)* = 1 + 1

[1 + 1 + 2 = 4 marks]

SECTION E

(Q. Nos. 24 - 26 are of five marks each)

24. **(a)** **Following are the responses of different animals to various abiotic factors. Describe each one with the help of an example.**

    (i) **Regulate**

    (ii) **Conform**

    (iii) Migrate

    (iv) Suspend

  (b) **If 8 individuals in a population of 80 butterflies die in a week, calculate the death rate of population of butterflies during that period.**

Ans. (a) (i) Regulate - Maintain constant internal temperature / osmotic concentration /homeostasis = ½

    e.g. birds / mammals = ½

    (ii) Conform - Do not maintain constant internal temperature / osmotic concentration / No homeostasis = ½

    e.g. any one example of animal other than birds and mammals = ½

    (iii) Migrate - Temporary movement of organisms from the stressful of habitats to hospitable areas and return when stressful period is over = ½

    e.g. birds from Siberia / or any other correct example = ½

    (iv) Suspend - Reducing / minimising the metabolic activities during unfavourable conditions = ½

    e.g. Polar bear / amphibian / snails / fish / any other example of animals = ½

(b) Death rate = $\dfrac{8}{80} = 0.1$, individuals per butterfly per week = ½ + ½

[4 + 1 = 5 marks]

(a) **What is a trophic level in an ecosystem ? What is 'standing crop' with reference to it ?**

(b) **Explain the role of the 'first trophic level' in an ecosystem.**

(c) **How is the detritus food chain connected with the grazing food chain in a natural ecosystem ?**

Ans. (a) Specific place of an organism in a food chain , mass of living material (biomass) at each trophic level at a particular time = 1 + 1

(b) First trophic level has producers / autotrophs , which trap solar energy / to produce food (photosynthesis) = 1 + 1

(c) Organisms of the Detritus food chain (DFC) are the prey to the Grazing food chain (GFC) organism , the dead remains of GFC are decomposed into simple inorganic materials which are absorbed by DFC organisms = ½ + ½

[2 + 2 + 1 = 5 marks]

25. **(a)** **Describe any two devices in a flowering plant which prevent both autogamy and geitonogamy.**

(b) **Explain the events upto double fertilisation after the pollen tube enters one of the synergids in an ovule of an angiosperm.**

Ans. (a) - Dioecy / production of unisexual flowers (in different plants)

- Self incompatibility = 1 + 1

(b) - Pollen tube releases 2 male gametes in the cytoplasm of synergid

- One male gamete fuses with egg cell / syngamy , resulting in diploid zygote

- Other male gamete fuses with polar nuclei / triple fusion , to form triploid PEN (Primary Endosperm Nucleus) / PEC (Primary Endosperm Cell) = 1 × 3

[2 + 3 = 5 marks]

OR

(a) **Explain menstrual cycle in human females.**

(b) **How can the scientific understanding of the menstrual cycle of human females help as a contraceptive measure ?**

Ans. (a) - Menstrual Phase - Menstrual flow occurs / due to breakdown of endometrial lining of uterus , when fertilization does not occur

- Follicular Phase - Primary follicles grow into mature graafian follicles and endometrium regenerates through proliferation , changes induced by pituitary and ovarian hormones

- Ovulatory Phase - LH surge , induces rupture of graafian follicle and release of secondary oocyte / ovum during middle of cycle (i.e. 14th day)

- Luteal phase - Ruptured graafian follicle transforms into corpus luteum which secrete large amount of progesteron , essential for maintaining endometrium $= 1 \times 4$

(b) Because ovulation occurs during mid cycle chances of fertilisation are very high so , couples should abstain from coitus between day 10 - 17 $= \frac{1}{2} + \frac{1}{2}$

26. (a) Write the scientific name of the organism Thomas Hunt Morgan and his colleagues worked with for their experiments. Explain the correlation between linkage and recombination with respect to genes as studied by them.

(b) How did Sturtevant explain gene mapping while working with Morgan ?

Ans. (a) *Drosophila melanogaster* $= 1$

They observed that two genes (located closely on a chromosome) did not segregate independently of each other (F_2 ratio deviated significantly from 9 : 3 : 3 : 1) $= \frac{1}{2}$

Tightly linked genes tend to show fewer (lesser) recombinant frequency of parental traits / show higher (more) frequency of parental type $= \frac{1}{2}$

Loosely linked genes show higher percentage (more) of recombinant frequency of parental traits / lower frequency percentage of parental type $= \frac{1}{2}$

Genes present on same chromosome are said to be linked and the recombinant frequency depends on their relative distance on the chromosome $= \frac{1}{2}$
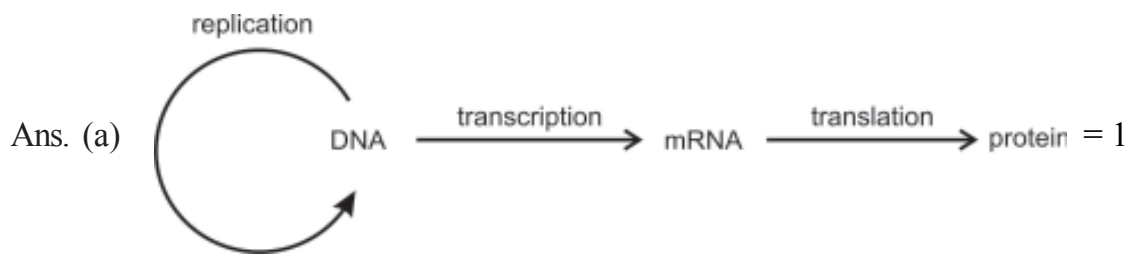
(b) He used the frequency of recombination between gene pairs on the same chromosome , as a measure of the distance between genes and mapped their position on the chromosome $= 1 + 1$

[3 + 2 = 5 marks]

OR

(a) State the 'Central dogma' as proposed by Francis Crick. Are there any exceptions to it ? Support your answer with a reason and an example.

(b) Explain how the biochemical characterisation (nature) of 'Transforming Principle' was determined, which was not defined from Griffith's experiments.

Ans. (a)

Yes , in some viruses flow of information is in reverse direction / reverse transcription = ½ + ½

e.g. Any Retrovirus / HIV = ½

(b) Protein and DNA and RNA were purified from heat killed S strain / smooth *Streptococcus / Diplococcus pneumoniae* = **½**

Protein + Protease → transformation occured (R cell to S type) = ½

RNA + RNA ase → transformation occured (R cell to S type) = ½

DNA + DNA ase → transformation inhibited = ½

Hence DNA alone is the transforming material = ½

[2 + 3 = 5 marks]

SECTION – A

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

1. How do cytokine barriers provide innate immunity in humans ?

Ans. Interferon (proteins) , secreted by virus infected cells (protect non - infected cells from further viral infection) =½ + ½

[1 mark]

2. Write the dual purpose served by Deoxyribonucleoside triphosphates in polymerisation.

Ans. Acts as a substrate , provide energy (from the terminal two phosphates) = ½ + ½

[1 mark]

3. Write the names of the following :

    (a) A 15 *mya* primate that was ape-like

    (b) A 2 *mya* primate that lived in East African grasslands

Ans. (a) *Dryopithecus = ½*

    (b) *Australopithecines / Australopithecus / Homo habilis = ½*

[1 mark]

4. Mention the chemical change that pro-insulin undergoes, to be able to act as mature insulin.

Ans. Removal of C - peptide (from pro-insulin)

[1 mark]

5. Name two diseases whose spread can be controlled by the eradication of *Aedes* mosquitoes.

Ans. Dengue , Chikunguniya // Yellow Fever / Eastern Equine Encephalitis / West Nile Fever / Zika / Zika Virus Disease *(Any two)* = ½ + ½

[1 mark]

6. **How did a citizen group called Friends of Arcata Marsh, Arcata, California, USA, help to improve water quality of the marshland using Integrated Waste Water Treatment ? Explain in four steps.**

Ans.- Water is treated by conventional method // sedimentation / filtration / chlorination

- Water flows to six connected marshes

- The water in marshes is seeded with appropriate plants / algae / fungi / bacteria

- Which helps to neutralise the pollutants / assimilate the pollutants / absorb pollutants / Remove heavy metals = ½ × 4

[2 marks]

7. **Your advice is sought to improve the nitrogen content of the soil to be used for cultivation of a non-leguminous terrestrial crop.**

    (a) Recommend two microbes that can enrich the soil with nitrogen.

    (b) Why do leguminous crops not require such enrichment of the soil ?

Ans. (a) *Azospirillum / Azotobacter / Anabaena / Nostoc / Oscillatoria / Frankia* (**Any two correct names of microbes**) = ½ + ½

    (If cyanobacteria mentioned = ½ , but if along with cyanobacteria *Anabaena* / *Nostoc / Oscillatoria mentioned then **No mark** on cyanobacteria*)

    (b) They can fix atmospheric nitrogen , due to presence of *Rhizobium* / N$_2$ fixing bacteria in their root nodules = ½ + ½

[1 + 1 = 2 marks]

8. **You have obtained a high yielding variety of tomato. Name and explain the procedure that ensures retention of the desired characteristics repeatedly in large populations of future generations of the tomato crop.**

Ans. - Tissue culture / micropropagation / somaclonal propagation / apomixis = **½**

- Explant / any part of plant taken out and grown (in a test tube / vessel) ,

- under sterile condition ,

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- in special nutrient medium (containing carbon source / sucrose , inorganic salt vitamins / amino acids and growth regulator) = ½ × 3

$$[½ + 1½ = 2 \text{ marks}]$$

9. (a) Name the source plant of heroin drug. How is it obtained from the plant ?

(b) Write the effects of heroin on the human body.

Ans. (a) - *Papaver somniferum* / Poppy plant = ½

- Extracted from latex of the plant / acetylation of morphine (obtained from the latex of plant) = ½

(b) Depressant , slows down body function = ½ + ½

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

10. With the help of an algebraic equation, how did Hardy-Weinberg explain that in a given population the frequency of occurrence of alleles of a gene is supposed to remain the same through generations ?

Ans. In a population of diploid organisms

If frequency of allele A = p and frequency of allele a = q = ½

Expected genotype frequency under random mating are

AA = p² (for the AA homozygotes)
aa = q² (for the aa homozygotes)
Aa = 2pq (for the Aa heterozygotes) = ½

(In absence of selection , mutation , genetic drift or other forces allelic frequency p and q are constant through generation)

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

$$[2 \text{ marks}]$$

OR

Although a prokaryotic cell has no defined nucleus , yet DNA is not scattered throughout the cell. Explain.

DNA is negatively charged , positively charged proteins , hold it in places , in large loops (in a region termed as nucleiod) = ½ × 4

$$[2 \text{ marks}]$$

11. **(a)** **Differentiate between analogous and homologous structures.**

(b) **Select and write analogous structures from the list given below :**

(i) **Wings of butterfly and birds**

(ii) **Vertebrate hearts**

(iii) **Tendrils of bougainvillea and cucurbita**

(iv) **Tubers of sweet potato and potato**

Ans. (a)   Analogous   -   Anatomically not similar though perform similar functions / are a result of convergent evolution = 1

Homologus   -   Anatomically similar (but perform different functions) / are a result of divergent evolution = 1

(b)   Option (i) Wings of butterfly and birds   /   (iv) Tubers of sweet potato and potato *(Any one)* = 1

[2 + 1 = 3 marks]

12. **How has the use of *Agrobacterium* as vectors helped in controlling *Meloidegyne incognitia* infestation in tobacco plants ? Explain in correct sequence.**

Ans.   -   Using *Agrobacterium* vector nematode specific genes introduced into host plant

-   Sense and antisense strands of mRNA are produced

-   ds RNA is formed

-   ds RNA initiates RNAi

-   Prevents translation of mRNA / silencing of mRNA of parasite / nematode

-   Parasite will not survive

[½ × 6 = 3 marks]

13. (a) **"India has greater ecosystem diversity than Norway." Do you agree with the statement ? Give reasons in support of your answer.**

(b) **Write the difference between genetic biodiversity and species biodiversity that exists at all the levels of biological organisation.**

Ans. (a) Yes = ½

India / tropical region	Norway / temperate region
- are less seasonal / more constant / more predictable	- more seasonal / / less constant / less predictable
- promote niche specialisation leading to greater bio-diversity	- do not promote niche specialisation leading to low bio-diversity
- Species diversity increases as we move towards equator	- Species diversity decreases as we move away from equator
- More number of species exist	- Less number of species exist

(Any one) = ½

(b) Genetic diversity - Diversity / variation within a species over its distributional range / same explained with the help of a correct example = 1

Species diversity - Diversity / variation at a species level / same explained with the help of a correct example = 1
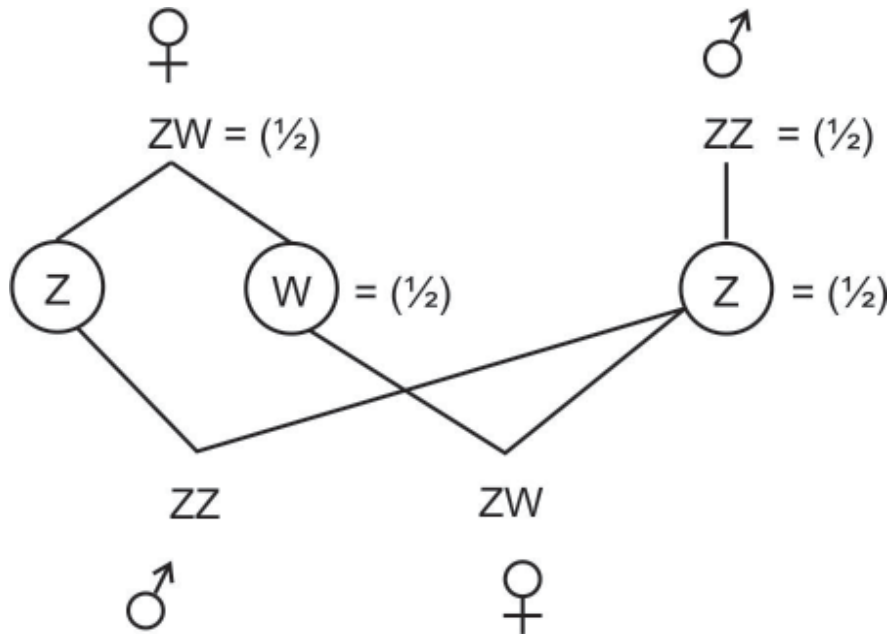
[1 + 2 = 3 marks]

OR

Explain the effect on the characteristics of a river when urban sewage is discharged into it.

Ans. - Rise in organic matter , leads to increased microbial activity / growth of microbes = ½ + ½

- It results in decrease in dissolved oxygen / rise in BOD / rise in Biochemical Oxygen Demand = 1

- Leads to fish mortality / algal bloom / colour change / foul odour / increase in toxicity *(Any two)* = ½ + ½

[1 + 1 + 1 = 3 marks]

14. Explain the mechanism of 'sex determination' in birds. How does it differ from that of human beings ?

Ans.   In birds ;

Birds : female heterogamety / female produces (Z) type and (W) type of gametes = ½

Humans : male heterogamety / male produces (X) type and (Y) type of gametes = ½

[2 + 1 = 3 marks]

15. Explain out-breeding, out-crossing and cross-breeding practices in animal husbandry.

Out breeding   –   Breeding of unrelated animals (which may be between individual of same breed or between individuals of different species) = 1

Out crossing   –   (a kind of out breeding) Mating of animals within the same breed but having no common ancestors on either side of their pedigree upto 4 – 6 generations = 1

Cross breeding –   (another type of out breeding) Superior males of one breed are mated with superior females of another breed = 1

[1+1+1 = 3 marks]

16. (a)   Organic farmers prefer biological control of diseases and pests to the use of chemicals for the same purpose. Justify.

(b) Give an example of a bacterium, a fungus and an insect that are used as biocontrol agents.

Ans. (a) - Reduces dependence on toxic chemicals

- Protects our ecosystem or environment

- Protects and conserves non-target organisms / they are species - specific

- These chemicals being non-biodegradable may pollute the environment permanently

- These chemicals being non-biodegradable may cause biomagnification

(Any three) = ½ × 3

(b) Bacteria – *Bacillus thuringiensis* = ½

Fungus – *Trichoderma* = ½

Insect – Ladybird / Dragonfly / Moth or any other correct example = ½

[1½ + 1½ = 3 marks]

17. (a) How has the development of bioreactor helped in biotechnology ?

(b) Name the most commonly used bioreactor and describe its working.

Ans. (a) Larger biomass / large volume of culture can be processed leading to higher yields of desired specific products (protein / enzymes) , under controlled condition = ½ + ½

(b) Stirring type = ½

- Mixing of reactor contents evenly (with agitator system or a stirrer) = ½

- Facilitates oxygen availability = ½

- Temperature / pH / foam control // under optimum conditions = ½

[1 + 2 = 3 marks]

18. Explain the roles of the following with the help of an example each in recombinant DNA technology:

(a) Restriction Enzymes

(b) Plasmids

Ans. (a) It recognises a specific sequence of base pairs / pallindromes, and cuts the DNA strand at a specific site = ½ + ½

eg. EcoRI / Hind II or any other correct example = ½

(b) Act as vectors / cloning of desired alien gene / foreign gene = 1

eg. pBR322 / plasmid of *Salmonella* / plasmid of *Agrobacterium* / Ti Plasmid / Tumour inducing Plasmid = ½

[1½ + 1½ = 3 marks]

19. Differentiate between Parthenocarpy and Parthenogenesis. Give one example of each.

Ans.

| Parthenocarpy	Parthenogenesis
- Formation of fruit without fertilization = 1	- New organism develops without fertilization = 1
- e.g. banana / grapes / any other correct example = ½	- e.g. Drones /male honey bee / turkey / rotifers / some lizards / any other correct example = ½

[1½ + 1½ = 3 marks]

20. Medically it is advised to all young mothers that breastfeeding is the best for their newborn babies. Do you agree ? Give reasons in support of your answer.

Ans. Yes = 1 ,

provides nutrition (calcium , fats , lactose) / provides (passive) immunity / provides antibodies / Ig A *(Any two)* = 1 + 1

[1 + 2 = 3 marks]

21. **Draw a diagram of a mature human sperm. Label any three parts and write their functions.**
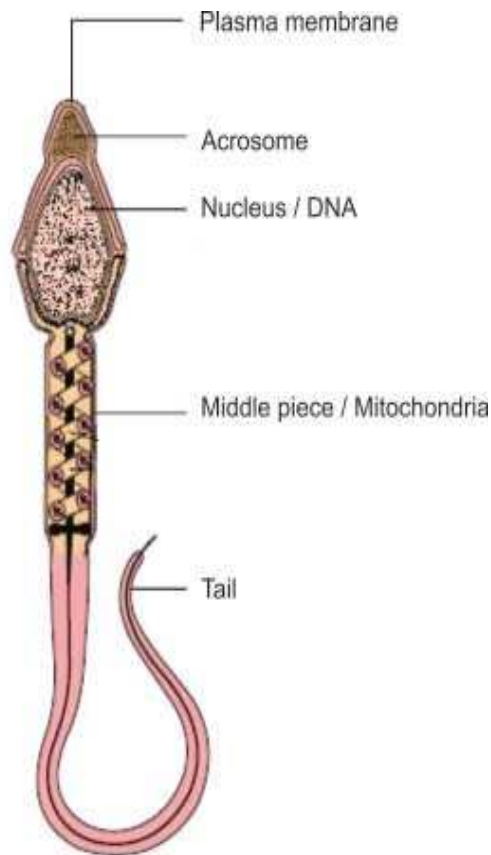
(Any three labelling) = ½ × 3

Plasma membrane - Envelope of the sperm

Acrosome - Filled with enzyme that help fertilization of ovum

Mitochondria - Energy source for swimming

Middle Piece - Possess mitochondria which is the energy source for swimming

Tail - For movement of sperm

Nucleus - Containing chromosomal material

(Functions of the parts labelled) = ½ × 3

[1½ + 1½ = 3 marks]

22. **(a)** **Expand VNTR and describe its role in DNA fingerprinting.**

(b) List any two applications of DNA fingerprinting technique.

Ans. (a) VNTR - Variable Number of Tandem Repeat(s) = ½

            - used as a probe (because of its high degree of polymorphism) = ½

(b) Forensic science / criminal investigation (any point related to forensic science) / determine population and genetic diversities / paternity testing / maternity testing / study of evolutionary biology (*Any two*) = 1 + 1

$$[1 + 2 = 3 \text{ marks}]$$

SECTION D

(Q. Nos. 23 is of four marks)

23. Looking at the deteriorating air quality because of air pollution in many cities of the country, the citizens are very much worried and concerned about their health. The doctors have declared health emergency in the cities where the air quality is very severely poor.

(a) Mention any two major causes of air pollution.

(b) Write any two harmful effects of air pollution to plants and humans.

(c) As a captain of your school Eco-club, suggest any two programmes you would plan to organise in the school so as to bring awareness among the students on how to check air pollution in and around the school.

Ans. (a) Vehicular discharge / smoke from industries / burning of agricultural wastes / smoke from incinerator / dust / smoke from thermal plants or any other correct cause

(Any two) = ½ + ½

(b) Reduces growth of plants / reduces yields of crops / premature death of plants / respiratory problems / acid rain / any other relevant point *(Any two - one from plant and one from human)* = 1 + 1

(c) Plantation drive / awareness programmes through posters / nukkad natak / film show / rallies / debates or any other *(Any two)* = 1 + 1

$$[1 + 1 + 2 = 4 \text{ marks}]$$

SECTION E

(Q. Nos. 24 - 26 are of five marks each)

24. (a) Write the scientific name of the organism Thomas Hunt Morgan and his

colleagues worked with for their experiments. Explain the correlation between linkage and recombination with respect to genes as studied by them.

(b) **How did Sturtevant explain gene mapping while working with Morgan ?**

Ans. (a) *Drosophila melanogaster* = 1

They observed that two genes (located closely on a chromosome) did not segregate independently of each other (F_2 ratio deviated significantly from 9 : 3 : 3 : 1) = ½

Tightly linked genes tend to show fewer (lesser) recombinant frequency of parental traits / show higher (more) frequency of parental type = ½

Loosely linked genes show higher percentage (more) of recombinant frequency of parental traits / lower frequency percentage of parental type = ½

Genes present on same chromosome are said to be linked and the recombinant frequency depends on their relative distance on the chromosome = ½
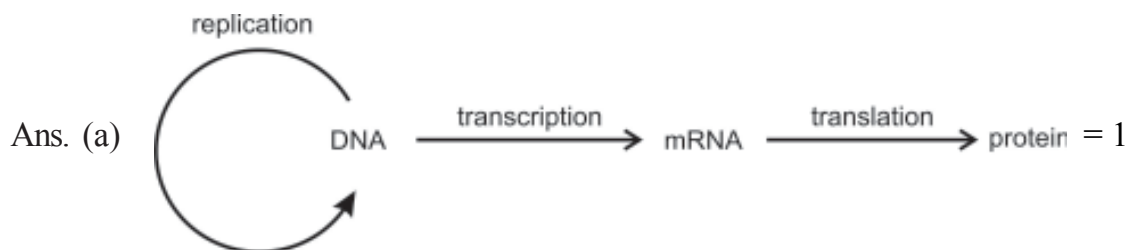
(b) He used the frequency of recombination between gene pairs on the same chromosome , as a measure of the distance between genes and mapped their position on the chromosome = 1 + 1

[3 + 2 = 5 marks]

OR

(a) **State the 'Central dogma' as proposed by Francis Crick. Are there any exceptions to it ? Support your answer with a reason and an example.**

(b) **Explain how the biochemical characterisation (nature) of 'Transforming Principle' was determined, which was not defined from Griffith's experiments.**

Ans. (a)

Yes , in some viruses flow of information is in reverse direction / reverse transcription = ½ + ½

e.g. Any Retrovirus / HIV = ½

(b) Protein and DNA and RNA were purified from heat killed S strain / smooth *Streptococcus / Diplococcus pneumoniae* = **½**

Protein + Protease → transformation occured (R cell to S type) = ½

RNA + RNA ase → transformation occured (R cell to S type) = ½

DNA + DNA ase → transformation inhibited = ½

Hence DNA alone is the transforming material = ½

[2 + 3 = 5 marks]

25. (a) Following are the responses of different animals to various abiotic factors. Describe each one with the help of an example.

(i) Regulate

(ii) Conform

(iii) Migrate

(iv) Suspend

(b) If 8 individuals in a population of 80 butterflies die in a week, calculate the death rate of population of butterflies during that period.

Ans. (a) (i)   Regulate - Maintain constant internal temperature / osmotic concentration /homeostasis = ½

e.g. birds / mammals = ½

(ii)   Conform - Do not maintain constant internal temperature / osmotic concentration / No homeostasis = ½

e.g. any one example of animal other than birds and mammals = ½

(iii)   Migrate - Temporary movement of organisms from the stressful of habitats to hospitable areas and return when stressful period is over = ½

e.g. birds from Siberia / or any other correct example = ½

(iv) Suspend - Reducing / minimising the metabolic activities during unfavourable conditions $= \frac{1}{2}$

e.g. Polar bear / amphibian / snails / fish / any other example of animals $= \frac{1}{2}$

(b) Death rate $= \frac{8}{80} = 0.1$, individuals per butterfly per week $= \frac{1}{2} + \frac{1}{2}$

$$[4 + 1 = 5 \text{ marks}]$$

OR

(a) What is a trophic level in an ecosystem ? What is 'standing crop' with reference to it ?

(b) Explain the role of the 'first trophic level' in an ecosystem.

(c) How is the detritus food chain connected with the grazing food chain in a natural ecosystem ?

Ans. (a) Specific place of an organism in a food chain , mass of living material (biomass) at each trophic level at a particular time $= 1 + 1$

(b) First trophic level has producers / autotrophs , which trap solar energy / to produce food (photosynthesis) $= 1 + 1$

(c) Organisms of the Detritus food chain (DFC) are the prey to the Grazing food chain (GFC) organism , the dead remains of GFC are decomposed into simple inorganic materials which are absorbed by DFC organisms $= \frac{1}{2} + \frac{1}{2}$

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

26. (a) Describe any two devices in a flowering plant which prevent both autogamy and geitonogamy.

(b) Explain the events upto double fertilisation after the pollen tube enters one of the synergids in an ovule of an angiosperm.

Ans. (a) - Dioecy / production of unisexual flowers (in different plants)

- Self incompatibility $= 1 + 1$

(b) - Pollen tube releases 2 male gametes in the cytoplasm of synergid

- One male gamete fuses with egg cell / syngamy , resulting in diploid zygote

- Other male gamete fuses with polar nuclei / triple fusion , to form triploid PEN (Primary Endosperm Nucleus) / PEC (Primary Endosperm Cell) $= 1 \times 3$

$$[2 + 3 = 5 \text{ marks}]$$

OR

(a) Explain menstrual cycle in human females.

(b) How can the scientific understanding of the menstrual cycle of human females help as a contraceptive measure ?

Ans. (a) - Menstrual Phase - Menstrual flow occurs / due to breakdown of endometrial lining of uterus , when fertilization does not occur

   - Follicular Phase - Primary follicles grow into mature graafian follicles and endometrium regenerates through proliferation , changes induced by pituitary and ovarian hormones

   - Ovulatory Phase - LH surge , induces rupture of graafian follicle and release of secondary oocyte / ovum during middle of cycle (i.e. 14th day)

   - Luteal phase - Ruptured graafian follicle transforms into corpus luteum which secrete large amount of progesteron , essential for maintaining endometrium $= 1 \times 4$

(b) Because ovulation occurs during mid cycle chances of fertilisation are very high so , couples should abstain from coitus between day 10 - 17 $= ½ + ½$