

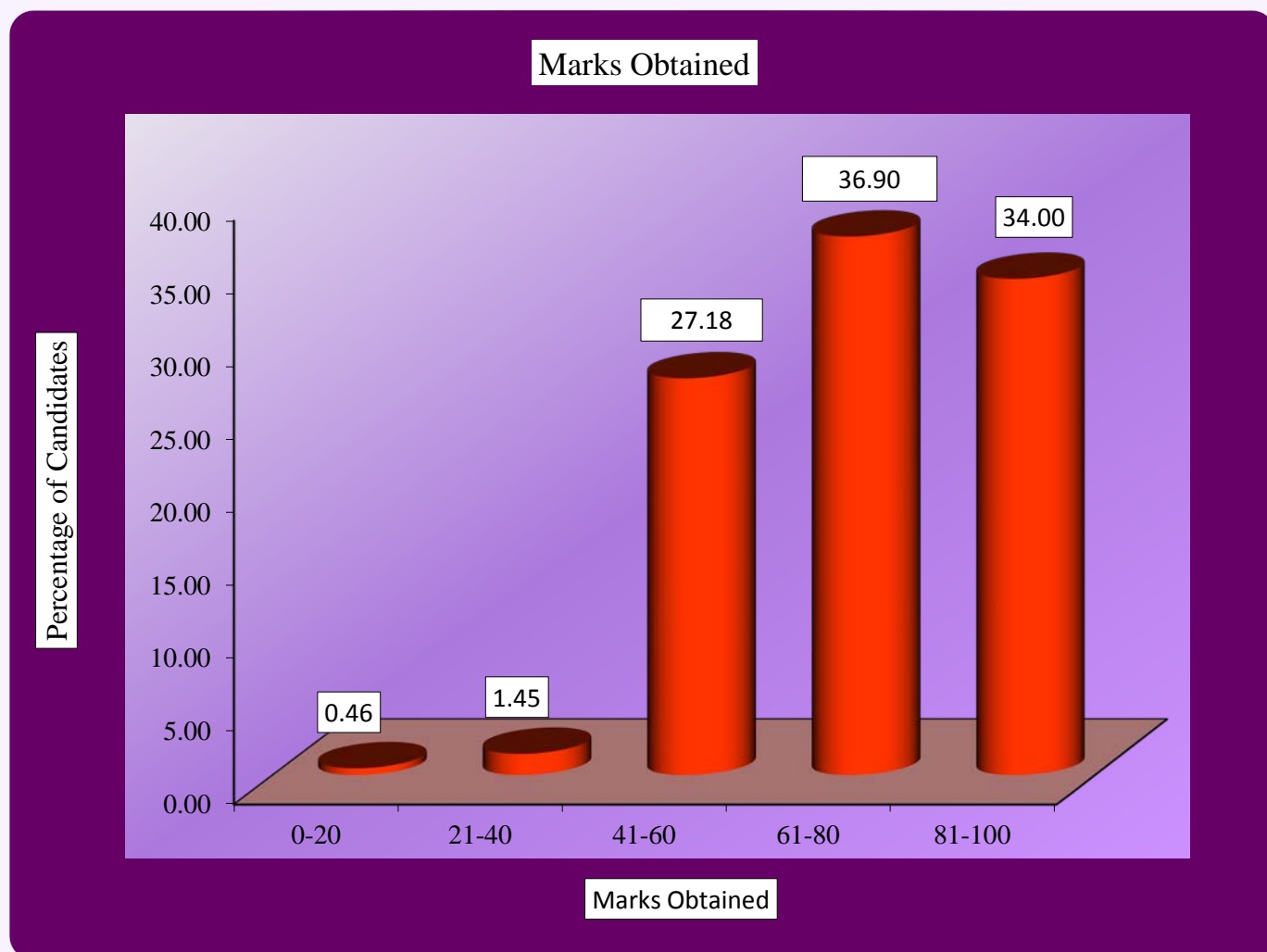
BIOLOGY

STATISTICS AT A GLANCE

Total Number of students who took the examination	14,443
Highest Marks Obtained	100
Lowest Marks Obtained	2
Mean Marks Obtained	71.64

Percentage of Candidates according to marks obtained

Details	Mark Range				
	0-20	21-40	41-60	61-80	81-100
Number of Candidates	67	210	3925	5330	4911
Percentage of Candidates	0.46	1.45	27.18	36.90	34.00
Cumulative Number	67	277	4202	9532	14443
Cumulative Percentage	0.46	1.92	29.09	66.00	100.00



BIOLOGY PAPER – 1 (THEORY)

(Botany and Zoology)

Question 1

(a)	Give a brief answer for each of the following:			[4]
	(i)	What is <i>central dogma</i> ?		
	(ii)	Define <i>cryopreservation</i> .		
	(iii)	What is <i>symbiosis</i> ?		
	(iv)	Explain the term <i>perianth</i> .		
(b)	Each of the following question(s)/statement(s) has four suggested answers. Choose the correct option in each case.			[4]
	1.	The curve showing the amount of light absorbed at each wavelength is:		
		(i)	Action spectrum	
		(ii)	Absorption spectrum	
		(iii)	Quantum yield	
		(iv)	Quantum requirement	
	2.	After fertilisation, the integument of an ovule develops into:		
		(i)	Seed	
		(ii)	Seed coat	
		(iii)	Fruit	
		(iv)	Fruit wall	
	3.	Meselson and Stahl's Experiment proved:		
		(i)	Transduction	
		(ii)	Transformation	
		(iii)	DNA is the genetic material	
		(iv)	Disruptive DNA replication	
	4.	The act of expelling the full term foetus from the uterus is termed as:		
		(i)	Gestation	
		(ii)	Implantation	
		(iii)	Parturition	

	(iv)	Capacitation	
(c)	Give scientific terms for each of the following:		[4]
	(i)	The smallest unit of DNA which can mutate.	
	(ii)	Type of water absorption by roots where metabolic energy is required.	
	(iii)	Statistical study of human population.	
	(iv)	Multiple effects of a gene on the phenotype of an organism.	
(d)	Expand the following abbreviations:		[4]
	(i)	rDT	
	(ii)	BAC	
	(iii)	SSBP	
	(iv)	IUCD	
(e)	Name the scientists who have contributed to the following:		[4]
	(i)	Reverse transcription	
	(ii)	Photorespiration	
	(iii)	Principle of limiting factors	
	(iv)	Photolysis of water	

Comments of Examiners

- (a) (i) 'Central dogma' was not understood clearly by many candidates. Some candidates only wrote 'DNA to RNA' and made no mention of protein. Some correctly mentioned replication, transcription and translation.
- (ii) Most of the candidates attempted this part well. Some candidates failed to mention 'preservation of germplasm'. A few candidates wrote 'low temperature' but not mention 'subzero or -196°C'.
- (iii) Candidates gave incomplete definitions such as, 'association' between two organisms without mentioning 'of two different species'. Some wrote 'type of association' between organisms which harm each other. Some just gave examples of parasites. A few did not mention the names of partners and the benefit available to both.

Suggestions for teachers

- Replication, transcription and translation should be taught together. This will help students understand that these three processes are involved in transfer of information not only within the cell but also in transfer of information from generation to generation.
- Explain the meaning of the term 'cryopreservation'- cryo indicates cold or low temperature and preservation of germplasm should be highlighted.
- Explain terms such as 'perianth', 'gynoecium' and 'placenta' clearly.
- The fate of different floral parts after fertilization must be discussed. Many teachers conclude their explanation at 'double fertilization' or 'embryogenesis'.

- (iv) Most of the candidates wrote 'petals and sepals are fixed together'. Some only gave the example that 'perianth is found in onion'.
- (b) (1) Some candidates wrote 'Action spectrum' instead of 'Absorption spectrum'.
- (2) Most of the candidates attempted this part correctly. Some selected 'fruit wall' in place of 'seed coat'.
- (3) Candidates were able to score marks in this part.
- (4) Some candidates got confused between 'parturition' and 'gestation'.
- (c) (i) Some of the candidates wrote 'mutation' for 'muton'. Many wrote 'gene/ nucleotide/ nitrogenous base', etc.
- (ii) A number of candidates were confused between 'absorption and transport'.
- (iii) Most candidates attempted this part correctly. However, some wrote 'population density' instead of 'demography'.
- (iv) Candidates gave different answers such as, 'multiple allelism' or 'polygenic inheritance'.
- (d) (i) Some candidates left the question altogether and others coined their own terms for rDT. Instead of 'Recombinant DNA Technology' a few wrote, 'Respiratory Distress Treatment', etc.
- (ii) A number of candidates wrote 'bacteria' instead of 'bacterial'.
- (iii) Several candidates wrote 'simple' instead of 'single' and 'stranded' in place of 'strand'.
- (iv) Wrong words such as, 'inter' was used by in place of 'intra'.
- (e) While most of the candidates answered this part correctly, some made mistakes in writing the names of scientists. Some candidates did not write the full name of the scientist, e.g. only Robert written instead of Robert Hill.

- The difference between action and absorption spectrum must be discussed.
- Encourage students to learn the names of scientists prescribed in the syllabus and their major contributions.
- Define terms such as, 'fertilisation, capacitation, implantation, gestation, parturition', while teaching 'Human Embryonic Development'.
- The fact that 'Muton is the smallest unit of mutation which may involve just one nucleotide or a longer sequence of nucleotide' should be clearly highlighted. Terms such as 'cisteron, recon' should also be discussed together.
- Teach water absorption in plants by both active and passive methods. The importance of energy and direction of movement of molecules must be stressed upon while teaching the definitions.
- Make students familiar with words like 'demography', natality, etc.
- Discuss terms such as, 'pleiotropism', 'multiple allelism' and 'polygenic inheritance'.
- Stress upon learning the abbreviations listed in the syllabus along with correct spellings.
- Inform candidates that the list of scientists and their contributions are given in the syllabus itself. Special attention should be given to the correct spellings of the names of the scientists.
- Contributions of Scientists must be recapitulated in class while a topic is being discussed.

MARKING SCHEME

Question 1.

(a)	(i)	1. Unilateral flow of information from the DNA to the mRNA to the ribosomes. 2. The sequence of nucleotide on DNA determines the sequence of nucleotide on mRNA which determines the sequence of amino acids on the polypeptide chain. 3. DNA →(Replication) → DNA →(Transcription) → RNA → (Translation) → Protein 4. DNA transcribed into RNA which is translated into proteins. 5. Instructions in DNA are converted into a functional product/ protein. 6. Flow of genetic information in living organisms
	(ii)	Cryopreservation is a process where cells/tissues/germplasm are preserved by cooling to low/sub-zero temperatures (such as -196°C) /liquid nitrogen/biological/organic/living material
	(iii)	1. Symbiosis is an interaction between two species which is mutually beneficial to both species. (E.g.: <i>Rhizobium</i> in root nodules of legumes, lichens.) 2. Living together of two living organisms (of different species).
	(iv)	1. When petals and sepals cannot be distinguished from each other, they are collectively called perianth. 2. Petals and sepals are collective called perianth. 3. Collection of tepals 4. Collection of accessory/non-essential whorls
(b)	1.	(i) Absorption spectrum
	2.	(ii) Seed coat
	3.	(iv) Disruptive DNA replication
	4.	(iii) Parturition
(c)	(i)	Muton
	(ii)	Active (non-osmotic) (Absorption) (transport)
	(iii)	Demography
	(iv)	Pleiotropy/Pleiotropism/Pleiotropic (genes)
(d)	(i)	Recombinant DNA Technology
	(ii)	Bacterial Artificial Chromosome
	(iii)	Single Strand Binding Protein
	(iv)	Intra Uterine Contraceptive Device
(e)	(i)	Temin, Baltimore (and Dulbecco)/ Temin/ Baltimore/ Dulbecco (any one)
	(ii)	Decker
	(iii)	Blackman
	(iv)	Robert Hill (Scarisbrick)/ Hill

PART II (50 Marks)

SECTION A

Answer any **two** questions.

Question 2

- (a) Mention *three* features of the Neanderthal Man. [3]
- (b) Differentiate between *connecting link* and *missing link*. [1]
- (c) What is *adaptive radiation*? [1]

Comments of Examiners

- (a) This question was well attempted by most candidates. Some candidates however made mistakes – a few wrote ‘erect posture’ instead of ‘semi erect’; some wrote ‘short statured’ without mentioning the approximate height. Accurate dimension for cranial capacity was not mentioned in a few cases.
- (b) Many candidates wrote ‘dead’ for connecting links and some wrote ‘dead’ for missing link instead of ‘extinct’. The differences given by some were not compatible. Several candidates only wrote examples.
- (c) The term ‘common ancestor’ was not used in most scripts. The example of Darwin’s Finches was given by candidates but not explained in most cases. In place of ‘adaptive radiation’, some candidates defined ‘radiation’, while some candidates defined adaptations without mentioning speciation from a common ancestor.

Suggestions for teachers

- Precise and specific features of the fossils of human ancestors should be given to students. They should be able to differentiate between general and specific features.
- Stress upon connecting links being living organisms and missing links as extinct. Students should be taught to write compatible differences. They should also be told that only examples cannot be taken as differences.
- Importance of key words in the definitions should be stressed upon.

MARKING SCHEME

Question 2.

(a)	Important features of the Neanderthal man: 1. Heavily built/muscular body/ broad shoulder 2. Outwardly curved thigh bones/ legs bent. 3. Short limbs 4. Semi-erect/ stooping posture 5. Rounded cranium 6. Thick skull bones 7. Low and slanting (flat and receding) forehead 8. Thick / heavy brow ridges 9. Orthognathous/ Prognathous/ Deep jaws/ no chin 10. Large/ rounded orbits (eye sockets) 11. Large and broad nose 12. Cranial capacity around 1300 – 1600 CC. 13. Height 5 - 5½ feet / 1.5 to 1.6 meters 14. Used stone tools, weapons and fire. 15. Intelligent 16. Good hunters 17. Used animal skin for clothing 18. Buried the dead 19. Performed ceremonies/rituals 20. Constructed huts/ dwelling structures/ lived in caves 21. Communicated by mono-syllabic language 22. Developed primitive social life/lived in families. (Any three)	
(b)	Connecting links Living organisms that possess characters of two different groups.	Missing links The fossils (extinct organisms) that possess characters of two different groups.

(c)	It is the process of evolution of different species in a given geographical area from a common ancestor/ divergent evolution/ Darwin's finches explained/ Australian marsupials/ branching descent.
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Question 3

- (a) Give an account of Lederberg's replica plating experiment to show the genetic basis of evolution. [3]
- (b) Define *phylogeny*. [1]
- (c) What is *Founder's effect*? [1]

Comments of Examiners

- (a) Most candidates answered this part correctly. However, some did not mention 'supports natural selection' which was an important point. Some candidates tried to define 'cognogeny, biogeny and chemogeny'.
- (b) This part was generally attempted correctly. Some candidates got confused and wrote 'developmental history' instead of 'ancestral history'.
- (c) Several candidates did not seem to have clarity about this topic. Some only wrote 'move away' but no mention was made of 'genetic drift'. Candidates were confused between 'Founder's effect and 'Bottle neck effect'.

Suggestions for teachers

- While teaching Darwinism, Lederberg's experiment must be taught as an example of natural selection. The concept of survival of the fittest can be explained with the help of this experiment, mentioning the role of mutations and variations in natural selection and evaluation.
- Students must be taught to give accurate definitions with the required key words.
- Discuss examples of 'Founder's Effect and 'Bottleneck Effect' together. Teach these concepts with the examples of Dunkers in Germany and Cheetah's decline.

MARKING SCHEME

Question 3.

(a)	1. Obtained a master plate of several bacterial colonies without antibiotic 2. Created replica plates with antibiotic (streptomycin) of colonies/penicillin 3. Colonies which could grow were resistant to antibiotic. 4. Supports natural selection/ pre-adaptive mutations/ variations. (Any three)
(b)	Phylogeny: The evolutionary (ancestral) history of an organism/ group/ race/ species.
(c)	1. Founder effect: When a few individuals move away from the parent population to establish an isolated population, they will not have all the genes of the parent population and so can cause a change in the allelic frequency leading to genetic drift. 2. An example of genetic drift, when a new colony is started by a few members of the original population in a new area. 3. An example of genetic drift due to non-random sampling of genes of original population. 4. Genetic drift due to migration.

Question 4

- (a) With reference to the levels of organisation, differentiate between *living organisms* and *non-living objects*. [3]
- (b) Mention *one* cause for variation in nature. [1]
- (c) What is the difference between the teeth of apes and the teeth of man? [1]

Comments of Examiners

- (a) The question required candidates to differentiate with reference to the levels of organisation, where they had to mention about organic molecules, macro molecules, DNA, cells, tissues, organs, etc. However, many candidates wrote general differences between living and non-living. Some wrote differences between living and dead.
- (b) Most candidates wrote correct answers. However, a few candidates wrote 'Environment' without specifying the actual environmental factor, example radiation.
- (c) Some candidates wrote opposite characteristics for 'Apes' and 'Man'. Many candidates wrote 'teeth are large', for apes, without mentioning 'canines'.

Suggestions for teachers

- The features of living, non-living and dead are basic concepts in biology. Teachers should reinforce these concepts before starting the formal teaching of core concepts.
- Teach causes of variations with proper examples.
- Advise students to write precise and to the point answers.
- Teach differences between apes and humans in a tabular form, highlighting morphological, anatomical, chromosomal, etc.
- Teach importance of U shaped dental arch in Apes and parabolic in case of man.

MARKING SCHEME

Question 4.

(a)	Living Organisms	Non-living objects
	1. Organic molecules present	Absent
	2. Macromolecules present	Absent
	3. Genetic material in the form of DNA	Absent
	4. Sub-cellular components/ organelles	Crystals, colloids and mixtures
	5. Cells, tissues, organs and organ systems	Absent
	6. Requires energy	Not required
	7. Regular intake of minerals and excretion	Neither take nor produce waste
	8. Open System	Closed System
	9. Repair and replacement	
	10. Metabolism	
		(Any three)
(b)	1. Genetic recombinations (i) Random fusion of gametes during sexual reproduction/ Independent assortment (ii) Crossing over	

	2. Mutation/types/chromosomal aberrations 3. Migration 4. Genetic drift/ gene flow 5. Selection 6. Hybridisation/Polyploidy/Ploidy 7. Any environmental factor <div style="text-align: right;">(Any one)</div>		
(c)		Apes	Man
	Teeth	1. Large canines 2. Diastema (simian gap) present 3. Thin enamel 4. Projecting 5. U shaped dental arch	1. Small canines 2. Diastema absent 3. Thick enamel 4. Do not project 5. Parabolic <div style="text-align: right;">(Any one)</div>

SECTION B

Answer any *two* questions.

Question 5

- (a) Give a graphic representation of the C₃ cycle. [4]
- (b) Discuss the role of cambium in secondary growth of dicot stems. [4]
- (c) State *two* advantages of vegetative propagation. [2]

Comments of Examiners

- (a) Key steps like carboxylation (role of Rubisco/involvement of CO₂), glycolytic reversal (role of NADPH₂) and regeneration of RuBP (mention of intermediates-like erythrulose-4P, Xylulose-5P, ribose-5P, etc.) were missing. Instead of glucose, some candidates straightaway mentioned starch as the end product. A few candidates wrote about C₄ cycle instead of C₃ cycle.
- (b) A number of candidates got confused between intra-fascicular and inter-fascicular cambium. Points were not written in the proper sequence. A few candidates got confused between 'Phellem, Phelloderm, etc.

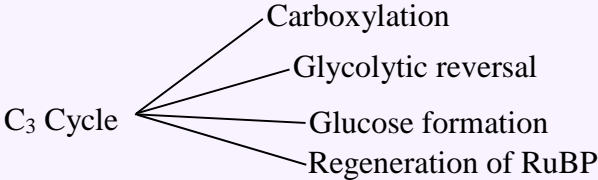
Suggestions for teachers

- Stress upon the importance of correct sequence of reactants and products (along with enzymes and co-factors) in questions like C₃ and C₄ cycles.
- Ask students to read the question carefully.
- The importance and function of cambium tissue should be stressed upon. Formation and gradual development should be explained with diagram. Proper position of primary and secondary xylem and phloem along with formation of cork/bar, etc. should be shown.
- Differences between sexual reproduction and vegetative propagation should be taught clearly with examples.

- (c) Most of the candidates performed well. Some explained advantages of sexual reproduction instead of vegetative reproduction.

MARKING SCHEME

Question 5.

(a)	<p>Graphic representation of the C_3 cycle:</p> 
(b)	<p>Secondary growth in a dicot stem:</p> <p>I. Role of vascular cambium/ intrastellar/ stellar</p> <ul style="list-style-type: none"> (i) Intra-fascicular cambium (ii) Fascicular cambium (iii) Cambium ring (iv) Fusiform initials (v) Secondary xylem on outer side (vi) Secondary phloem on the inner side (vii) Ray initials form medullary/ pith rays (viii) Secondary growth takes place due to activity of cambium <p>II. Role of cork cambium /Exrastellar</p> <ul style="list-style-type: none"> (i) Ruptured epidermis (ii) Outer layer of cortex or epidermal cells form cork cambium/ phellogen (iii) Outer cork/ phellem/ dead cells (iv) Inner side secondary cortex/ phelloderm (v) Annual rings/ Autumn & Spring wood (vi) Heart wood/ sap wood (vii) Bark/ periderm
(c)	<p>Advantages of vegetative propagation</p> <ol style="list-style-type: none"> 1. Rapid method 2. Sure 3. Easy/simple 4. Less expensive 5. Useful in plants that cannot produce viable seeds/ seedless/grow only vegetatively 6. Clones with superior traits of the parent/ Maintains purity of race 7. Suitable for plants which produce less seeds. 8. Useful for plants with long seed dormancy 9. Breed improvement 10. Pest free <p style="text-align: right;"><i>(Any two)</i></p>

Question 6

- (a) Explain the role of hormones during the menstrual cycle. [4]
- (b) Give *four* adaptations shown by flowers pollinated by wind. [4]
- (c) Give *two* differences between *heart wood* and *sap wood*. [2]

Comments of Examiners

- (a) A number of candidates wrote in general about the phases of the menstrual cycle whereas the role of hormones was asked. Some only mentioned the names of hormones without their specific functions. Very few candidates mentioned the role of GnRH.
- (b) Some candidates discussed dispersal of seeds, instead of pollen grains. Several candidates got confused between insect and wind pollination. A few candidates wrote that the stamen should be light and winged (instead of pollen grain).
- (c) Some candidates wrote the alternative names duramen and alburnum as a point of difference. Instead of 'centrally' and 'peripherally located', a few candidates wrote 'inside' and 'outside'. Some candidates interchanged the differences.

Suggestions for teachers

- Menstrual cycle should be taught with respect to: changes in the uterus and ovary, hormonal involvement
- The teacher must stress upon the various hormones along with their functions in the cycle during different phases.
- Differences must be discussed when teaching secondary growth. They should be precise and compatible.

MARKING SCHEME

Question 6.

(a)	Hormone	Function
	GnRH released by hypothalamus	<ul style="list-style-type: none"> Regulates the release of FSH and LH (gonadotropins) from anterior pituitary
	FSH from anterior pituitary	<ul style="list-style-type: none"> Stimulates the formation of Graafian follicle from primordial follicle It also stimulates GF to secrete oestrogen
	Oestrogen from ovary	<ul style="list-style-type: none"> Oestrogen repairs the endometrial lining High oestrogen stimulates LH and cuts off FSH
	LH from anterior pituitary	<ul style="list-style-type: none"> LH surge causes ovulation and LH favours conversion of GF to corpus luteum LH causes secretion of progesterone from CL
	Progesterone from ovary/ CL	<ul style="list-style-type: none"> Progesterone makes endometrial lining soft/spongy/thick and vascular Progesterone inhibits LH and hence inhibits its production;
	<ul style="list-style-type: none"> Whole cycle starts again as without progesterone lining peels off <p>(Any 4 hormones and one function of the corresponding hormone.)</p>	
(b)	1. Large number of pollen grains	

	2. Light, dry or non-sticky/ winged pollen grains 3. Long and feathery stigma that hangs out of the flower. 4. Versatile anther 5. Inconspicuous flowers 6. Dull/ colourless flowers. 7. No fragrance 8. No nectar 9. If flower is unisexual more number of staminate flowers 10. Male flowers are placed at higher level. (Any four)																
(c)	Differences between heart wood and sap wood. <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Heart wood</th><th style="text-align: center;">Sap wood</th></tr> </thead> <tbody> <tr> <td>1. Centrally situated</td><td>1. Peripherally situated</td></tr> <tr> <td>2. Hard, durable and resistant to microorganism</td><td>2. Soft and susceptible to damage by microbes</td></tr> <tr> <td>3. Blocked with tannins, oils, gums and resins called extractives</td><td>3. No extractives present.</td></tr> <tr> <td>4. Dark in colour</td><td>4. Light in colour</td></tr> <tr> <td>5. It does not conduct water but gives mechanical support/ Xylem non-functional</td><td>5. Conducts water and minerals in plants/Xylem functional</td></tr> <tr> <td>6. Tyloses present</td><td>6. Tyloses absent</td></tr> <tr> <td>7. Mostly dead cells</td><td>7. Mostly living cells (Any two)</td></tr> </tbody> </table>	Heart wood	Sap wood	1. Centrally situated	1. Peripherally situated	2. Hard, durable and resistant to microorganism	2. Soft and susceptible to damage by microbes	3. Blocked with tannins, oils, gums and resins called extractives	3. No extractives present.	4. Dark in colour	4. Light in colour	5. It does not conduct water but gives mechanical support/ Xylem non-functional	5. Conducts water and minerals in plants/Xylem functional	6. Tyloses present	6. Tyloses absent	7. Mostly dead cells	7. Mostly living cells (Any two)
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Question 7

- (a) Explain *chemiosmotic hypothesis* for ATP synthesis. [4]
- (b) Draw a neat labelled diagram of the vertical section of a monocot leaf. [4]
- (c) Mention *any two* functions of the human placenta. [2]

Comments of Examiners

- (a) A number of candidates wrote the Z-scheme instead of the Chemiosmotic hypothesis. Vital terms like creation of H^+ gradient and the role of ATPase were missing in many answers.
- (b) Some candidates drew a dicot leaf instead of a monocot leaf. Many did not draw the correct location of xylem and phloem. The number of stomata was not uniform on both surfaces.
- (c) This part was attempted correctly by most candidates. Many wrote 'shock absorber' or protection but very few wrote about diffusion of substances from mother to foetus and vice versa.

Suggestions for teachers

- Pollination by air, water and insects should be taught separately.
- Students should be given sufficient practice of drawing diagrams. Importance of neat and well labelled diagrams showing cellular details wherever required should be emphasized.
- Functions of placenta should be categorized into: (i) endocrine functions (ii) Nutritive (iii) Placenta as a barrier.

MARKING SCHEME

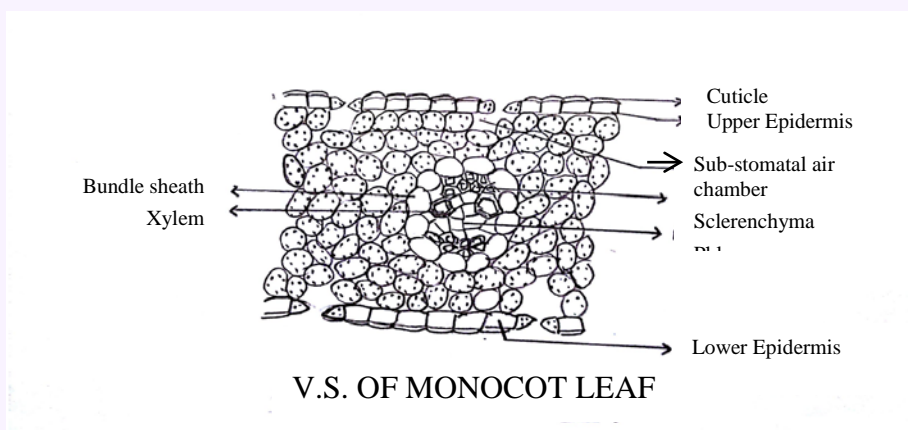
Question 7.

- (a)
1. **Photolysis** at PSII releases **protons** (H^+) inside the lumen of thylakoids
 2. Protons accumulate inside the thylakoids
 3. **Reduction** of NADP removes protons from the stroma.
 4. This creates a high concentration of protons inside the lumen creating a gradient.
 5. Protons flow through the channel of F_0 component of the ATPase located in the thylakoid membrane.
 6. This provides enough energy to cause a conformational change in the F_1 component of the ATPase that protrudes into stroma.
 7. Formation of ATP by $ADP + P_i$
 - Peter Mitchell

(Any four)

Graphical representation also accepted.

- (b) Labelled diagram of the vertical section of a monocot leaf:



1. Stoma
2. Spongy mesophyll
3. Sub stomatal air cavity
4. Border parenchyma/ bundle sheath
5. Sclerenchyma
6. Xylem
7. Phloem
8. Lower epidermis
9. Upper epidermis
10. Guard cells
11. Cuticle

	12. Bulliform cells/ Motor cells	(Any eight labels)
(c)	<p>Functions of the human placenta:</p> <ol style="list-style-type: none"> 1. Elimination of nitrogenous waste from foetus 2. Exchange of respiratory gases 3. Diffusion of digested material from maternal blood to foetal blood 4. Endocrine function 5. Placental barrier 6. Immunity 7. Placenta stores fat/glycogen/iron 	(Any two)

SECTION C

Answer any **two** questions.

Question 8

- (a) Explain the process of sex determination in honey bees. [4]
- (b) Define *complete linkage*. Give an example of a cross, showing complete linkage. [4]
- (c) Write a short note on Multiple Ovulation Embryo Transfer Technology. [2]

Comments of Examiners

- (a) Some candidates described sex determination in *Drosophila*. A few described the division of labour in honeybees but did not mention the mechanism of sex determination. Many missed the point that 'unfertilized eggs develop into males by parthenogenesis'.
- (b) Most of the candidates defined complete linkage but failed to explain the example of a cross showing complete linkage. Some explained incomplete linkage taking examples of *Lathyrus*.
- (c) Instead of MOET, which is used in cattle, many candidates described GIFT and ZIFT in humans. Many confused MOET with Artificial Insemination. Some candidates failed to explain the formation of many embryos.

Suggestions for teachers

- Sex determination according to type of chromosomes (XX/XY) and according to haplo-diploidy should be discussed taking suitable examples.
- As per the scope of the syllabus the complete working of the cross should be shown by Punnett Square. Appropriate examples should be taken to explain basic concepts of genetics, e.g., Mendelism, incomplete linkage, co-dominance, multiple allelism, etc.
- Important points like, superovulation by FSH injection, embryo transplantation into a surrogate mother, super milch cows/high quality meat producing bulls etc. should be stressed upon.

MARKING SCHEME																											
Question 8.																											
(a)	The process of sex determination in honey bees: <ul style="list-style-type: none">- Haploid-diploid method of sex determination/chromosomal method- Fertilised eggs produce females ($2n = 32$)- Females (workers and queen) are diploid- Unfertilized eggs develop into males (drones) by parthenogenesis- Males are haploid ($n = 16$)																										
(b)	<p>Complete linkage without breakage of chromosome:</p> <p>Genes are closely located in the chromosome. They are transmitted together in their parental combination to the same gamete.</p> <p>e.g. 1. Genes for grey body and vestigial wings in male <i>Drosophila</i></p> <p>2. Cross between red-eyed and normal winged female <i>Drosophila</i>.</p> <p>grey body and long wings X black body and vestigial wings</p> <p>(BB VV) (bbvv)</p> <p>F₁ generation grey bodies and long wings</p> <p>(BbVv)</p> <p>Test Cross</p> <table><thead><tr><th colspan="2">Male</th><th colspan="2">Female</th></tr></thead><tbody><tr><td colspan="2">Grey body and long wings</td><td colspan="2">black body and vestigial wings</td></tr><tr><td colspan="2">(Bb Vv)</td><td colspan="2">(bbvv)</td></tr><tr><td>Grey body</td><td>Grey body</td><td>Black body</td><td>Black body</td></tr><tr><td>long wings</td><td>vestigial wings</td><td>long wings</td><td>vestigial wings</td></tr><tr><td>50%</td><td>0 %</td><td>0 %</td><td>50%</td></tr></tbody></table> <ul style="list-style-type: none">• Only parental combinations are formed in F₂ generation• No appearance of any new combinations.• The results indicate that genes of grey body character and long wings are completely linked.			Male		Female		Grey body and long wings		black body and vestigial wings		(Bb Vv)		(bbvv)		Grey body	Grey body	Black body	Black body	long wings	vestigial wings	long wings	vestigial wings	50%	0 %	0 %	50%
Male		Female																									
Grey body and long wings		black body and vestigial wings																									
(Bb Vv)		(bbvv)																									
Grey body	Grey body	Black body	Black body																								
long wings	vestigial wings	long wings	vestigial wings																								
50%	0 %	0 %	50%																								

Test cross

F-1 ♂ $\frac{b^+}{b} \frac{vg^+}{vg}$ black, vestigial ♀ $\frac{b}{b} \frac{vg}{vg}$

x

↓

numbers	phenotypes test cross prog.	Sperm	Eggs
200	wild	$b^+ \quad vg^+$	$b \quad vg$
200	black vestigial	$b \quad vg$	$b \quad vg$
0	vestigial	$b^+ \quad vg$	$b \quad vg$
0	black	$b \quad vg^+$	$b \quad vg$

(c)

Give a brief account of Multiple Ovulation Embryo Transfer technology.

- Used to improving the breed of cattle/increase herd size in the short time
- FSH like hormones injected to cause superovulation
- Ova fertilized by artificial insemination
- 4- 10 embryos are produced at a time.
- 8- 32 cell stage embryo is transplanted into a surrogate mother
- who may not have superior quality who carries it to full term.
- So a number of super milch cows or high quality meat producing bulls can be produced.
- By deep freezing it is possible to preserve 7 day old foetus for years.

Question 9

- (a) Give an account of artificial chromosomes in transfer of genetic material. [4]
- (b) Mention *any four* methods involved in the treatment of cancer. [4]
- (c) What is *RNA interference*? Give *any one* application of RNA interference. [2]

Comments of Examiners

- (a) This part was attempted by very few candidates. Among those who attempted, some described the formation of a chromosome by artificial means, e.g. by taking nucleotides, histones, etc. instead of mentioning BAC and YAC. Very few wrote about their role in transferring the genetic material.
- (b) Most candidates wrote chemotherapy and anti-cancer drugs as separate methods. Similarly, surgery and removal of tumour by operation were discussed as separate points.
- (c) Vague answers were written by candidates. Most of the candidates were clueless about RNAi. They explained 'RNA interference' as, interfering with RNA or interference of RNA with DNA.

Suggestions for teachers

- Each step of rDT should be explained with relevant details.
- While teaching diseases, all the possible methods of diagnosis and treatment and the characteristic symptoms should be discussed.
- The principles of RNAi and its application should be discussed properly with reference to the scope of the syllabus.
- RNAi should be taught in terms of inhibiting gene expression.

MARKING SCHEME

Question 9.

(a)	<p>Artificial chromosomes in transfer of genetic material:</p> <p>Bacterial Artificial Chromosome (BAC)</p> <ul style="list-style-type: none">- Those which are constructed from bacterial genomes are called BAC/Prokaryotes.- The construction of BAC is based on F-plasmid.- BAC can accept DNA inserts of the range of 300-350 kb.- It is more stable than Yeast Artificial Chromosome (YAC).- BAC has many restriction sites and therefore is also used in genome projects. <p>Yeast Artificial Chromosomes (YAC)</p> <ul style="list-style-type: none">- Constructed from yeast genome/eukaryotes.- It can accept large fragments of foreign DNA (upto 1 million bases).- It has centromeric and telomeric regions, ori site, and selectable markers along with autonomously replication sequences.- Both BAC and YAC are used as vectors for HGP. (Any four)
(b)	<p>Methods involved in the treatment of cancer:</p> <ul style="list-style-type: none">• Surgery• Radiation• Chemotherapy• Immunotherapy• Alternative medicine (Naturopathy, Acupuncture, Ayurveda <i>etc.</i>)/homeopathy• Stem cell therapy• Bone marrow transplantation• Hormonal treatment (Any four)
(c)	<p>RNA interference is silencing a specific mRNA by introducing a gene that produces the sense and antisense strand of mRNA so that a double stranded mRNA is produced which cannot be translated into the specific protein. Inhibiting gene expression</p> <p>This technique is used to create nematode resistant plants, delaying ripening of fruits, to know gene functions, production of vaccines/treatment of papilloma virus/ Hepatitis B/ genetic defects etc.</p>

Question 10

- | | | |
|-----|--|-----|
| (a) | What is <i>Integrated Pest Management</i> ? | [4] |
| (b) | Explain the structure of a typical antibody molecule. | [4] |
| (c) | Why are bio-fertilizers preferred over chemical fertilizers? | [2] |

Comments of Examiners

- (a) Many candidates did not mention the points regarding biological control and mechanical control. The answer should have been divided into (a) Definition (b) Techniques and (c) Advantages. Most of the candidates explained either the techniques or the advantages.
- (b) Instead of heavy and light 'chains', some candidates wrote heavy and light 'bands'. Some discussed type of antibodies e.g. IgA, IgG, etc. and their function. Instead of disulphite bonds, many wrote sulphate and sulphite bonds.
- (c) Several candidates were confused between bio fertilizers and bio pesticides. They wrote more about chemical fertilizers instead of advantages of bio fertilizers.

Suggestions for teachers

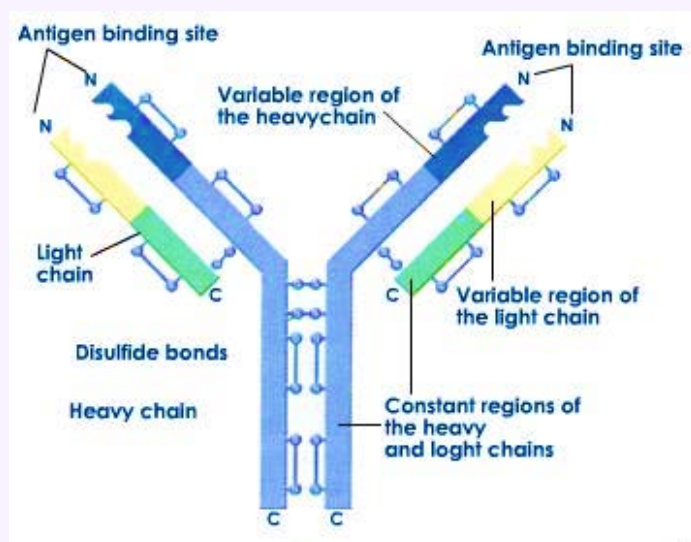
- Ask students to learn definitions with key words.
- Explain the term 'integrated'
- Bio fertilizers and bio pesticides should be compared and contrasted in a tabular form.
- Benefits should be explained in terms of economy, environmental richness, pollution decrease and utilization of energy.

MARKING SCHEME

Question 10.

(a)	<p>Integrated pest management is an ecosystem-based strategy that focuses on control of pests through a combination of techniques (such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties)/selective breeding. Use of bio pesticides. Selects and integrates different methods of pest control without excessive use of pesticides</p> <p>IPM is based on integration of the following methods:</p> <ul style="list-style-type: none"> • Cultural method – crop rotation, mulching, pheromones etc. • Mechanical and physical control- catch and kill, burning, confusion technique, sterilization of males etc. • Use of resistant varieties • Biological control – use of parasites and predators of pests to control them <p>Advantages/benefits</p> <ul style="list-style-type: none"> • Economic • Sociological • Ecological • Environmental
(b)	<p>The structure of a typical antibody molecule:</p> <ul style="list-style-type: none"> • Each antibody molecule is Y-shaped. • Formed of four peptide chains – 2 heavy (longer), 2. light (small)/ (H₂L₂) • Inter- and intra-chain disulphide bonds (– S – S –)

- Stem of 'Y' is formed by heavy chains
- The arm (fork) is formed by both light and heavy chains.
- Variable region (V-region) or antigen binding fragment / Fab.
- Constant region or crystalline fragment / FC.
- Glycoprotein
- Immunoglobulin



(Four points/labels)

- (c) Bio-fertilizers are preferred over chemical fertilizers because:
1. They do not pollute environment/eco-friendly/do not change the natural quality of soil
 2. They are cheap
 3. They are easy to produce
 4. No energy is utilised in their production
 5. Enrich the soil with nitrogenous nutrients/organic nutrients/humus/water holding capacity/increases aeration
- (Any two)*

GENERAL COMMENTS:

(a) Topics found difficult by candidates in the Question paper:

- Chemiosmotic hypothesis
- Example of cross showing complete linkage
- Artificial chromosomes
- RNA interference
- Integrated Pest Management

(b) Concepts between which candidates got confused:

- Action and absorption spectrum
- Living and non-living with reference to the levels of organization
- Role of hormones and their function during the menstrual cycle
- Multiple Ovulation Embryo transfer technology and artificial insemination

(c) Suggestions for candidates:

- Key words should be learnt in the definitions
- The process or phenomena should be learn in the correct sequence
- Differences should always be compatible. Avoid writing examples as differences
- Practice cross with the help of different characteristic features in three stages:
 - a) Parents
 - b) F₁ generation
 - c) F₂ generation
- Read the question paper carefully
- Practice self-explanatory diagrams with proper labelling, arrows and headings
- Pay attention to the correct structure and shape of different parts
- Highlight the key words
- Give answers point wise
- Give flow charts and graphic representations
- Understand the concept instead of rote learning