

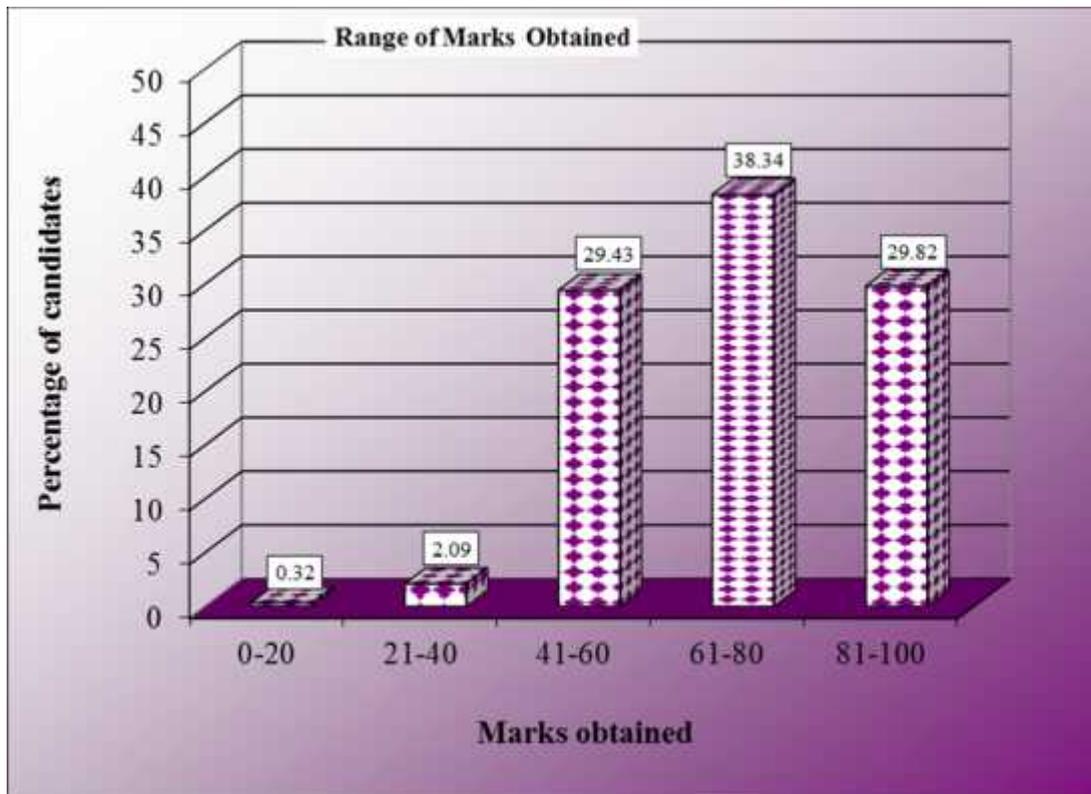
# BIOLOGY

## A. STATISTICS AT A GLANCE

Total number of students taking the examination	12,917
Highest marks obtained	100
Lowest marks obtained	13
Mean marks obtained	70.33

### Percentage of candidates according to marks obtained

	Mark Range				
	<i>0-20</i>	<i>21-40</i>	<i>41-60</i>	<i>61-80</i>	<i>81-100</i>
Number of candidates	41	270	3801	4953	3852
Percentage of candidates	0.32	2.09	29.43	38.34	29.82
Cumulative Number	41	311	4112	9065	12917
Cumulative Percentage	0.32	2.41	31.83	70.18	100



## B. ANALYSIS OF PERFORMANCE

### BIOLOGY PAPER 1 (THEORY)

#### PART I (20 Marks)

*Answer all questions.*

#### Question 1

- (a) Mention *one* significant difference between each of the following: [5]
- (i) *Parenchyma* and *Sclerenchyma*.
  - (ii) *Epistasis* and *dominance*.
  - (iii) *Hormones of ovulatory phase* and *hormones of luteal phase*.
  - (iv) *Symplastic movement* and *apoplastic movement*.
  - (v) *Phenotype* and *Genotype*.
- (b) Give reasons for the following: [5]
- (i) Testes descend into the scrotum before birth.
  - (ii) Secondary growth does not occur in monocot stems.
  - (iii) Nitrogenous fertilizers are not applied in fields where leguminous crops grow.
  - (iv) Genetic code is 'universal'.
  - (v) At higher temperatures, green plants start evolving CO<sub>2</sub> instead of O<sub>2</sub>.
- (c) Each of the following questions / statements has four suggested answers. Rewrite the correct answer in each case: [5]
- (i) Typhoid is classified as a:
    - (A) Viral disease
    - (B) Genetic disorder
    - (C) Bacterial disease
    - (D) Protozoan disease
  - (ii) Bt cotton is resistant to:
    - (A) Insects
    - (B) Herbicides
    - (C) Salt
    - (D) Drought
  - (iii) Roots and shoots lengthen through the activity of:
    - (A) Apical meristem
    - (B) Vascular Cambium
    - (C) Lateral meristem
    - (D) Cork Cambium

(iv) An antiviral protein released from infected and dying cells is:

- (A) Antigen
- (B) Antibody
- (C) Antiserum
- (D) Interferon

(v) Opening and closing of stomata is due to:

- (A)  $\text{Ca}^{2+}$
- (B)  $\text{Na}^+$
- (C)  $\text{K}^+$
- (D)  $\text{Cl}^-$

(d) State the best known contribution of:

[3]

- (i) Alec Jeffery
- (ii) P.K. Sethi
- (iii) Hugo de Vries

(e) Expand the following :

[2]

- (i) SCID
- (ii) ZIFT

### Comments of Examiners

- (a) (i) Most of the candidates attempted this part correctly. Some candidates did not give compatible differences - they gave the shape of *parenchyma* and the function of *sclerenchyma*. Some mistook *parenchyma* for dividing cells and *sclerenchyma* as non - dividing cells.
- (ii) Some candidates were confused regarding the term *epistasis*. The term 'non-allelic' was not mentioned by most of the candidates.
- (iii) This part was well attempted by most of the candidates. Some did not name the hormones, instead, they discussed the changes taking place during the phases.
- (iv) This part was well attempted by most of the candidates. Some wrote the opposite differences. Some wrote about *sympatric speciation* instead of *symplastic movement*.
- (v) Most candidates wrote 'morphological appearance' for *phenotype* without mentioning 'genetically controlled'. For *genotype* some wrote total number of genes which actually is the definition of genome.

### Suggestions for teachers

- Teachers must emphasize the importance of writing compatible points, while writing differences.
- Proper classification of plant tissues should be discussed.
- Difference between simple dominance of allelic pairs and epistasis between non-allelic pairs should be discussed. The concept should be taught with the help of diagrams.
- When Menstrual Cycle is taught, hormonal changes, organs involved, histological changes in the uterus, in the ovary must be taught, to give a clear concept of the topic.
- Apoplastic and symplastic pathways must be taught by means of diagrams.

- (b) (i) Several candidates did not mention the role of temperature in the process of spermatogenesis.
- (ii) Many candidates wrote in general without mentioning the role of cambium
- (iii) Candidates gave vague answers like, 'leguminous plants do not need nitrogen because they already have nitrogen', without mentioning the role of nitrogen fixing bacteria
- (iv) This part was well attempted by most of the candidates. However, a few candidates wrote, 'it is uniform in all countries', instead of 'same amino acids in all organisms'.
- (v) This part was not attempted well by several candidates. Many wrote 'solarisation' instead of 'photorespiration'. Some wrote Blackman's Law of Limiting Factors
- (c) (i) This part was mostly well attempted. Some candidates selected the wrong option i.e 'Viral' instead of 'Bacterial'.
- (ii) Some candidates wrote 'Herbicides' instead of 'Insects'.
- (iii) Some candidates gave the answer as 'Lateral meristem' instead of 'Apical meristem'.
- (iv) A few candidates wrote antibodies or antigen instead of interferon.
- (v) Some candidates gave the answer as,  $\text{Ca}^{++}$  or  $\text{Na}^{+}$  instead of  $\text{K}^{+}$
- (d) (i) Most of the candidates attempted this part correctly. Some candidates gave the answer as, 'Human genome/ genetics', instead of 'DNA fingerprinting'. A few candidates wrote only 'Fingerprinting'.
- (ii) Most of the candidates were able to attempt this part well.
- (iii) Some candidates wrote only 'evolution' as answer to this part of the question.
- (e) (i) Instead of 'Severe' some candidates wrote 'Sexual'. Others wrote 'Chronic' instead of 'Combined'.
- (ii) In place of 'Intra' some candidates wrote 'Inter'. In place of 'Transfer', terms like 'tube' or 'technology' were used by a few candidates.

- Students should be taught to highlight key words in definitions.
- While explaining the term *spermatogenesis*, temperature of 2 to 3 degrees below body temperature must be emphasized.
- The examples of whales and elephants which have abdominal testes due to low BMR should be given for a proper understanding.
- Apical, Intercalary and Lateral meristem must be discussed. Practice must be given in reasoning type questions.
- Nitrogen cycle should be discussed in detail with specific examples of bacteria involved at each step.
- Each property of the *Genetic Code* must be defined clearly. Special attention should be given to terms such as, ambiguity, degeneracy, universality.
- The fact that RUBISCO acts as oxygenase as well as carboxylase in  $\text{C}_3$  cycle should be discussed for better understanding.
- Communicable diseases should be taught with respect to causative agent, symptoms prevention and cure.
- Apical, Intercalary and Lateral Meristems should be discussed with their functions.

- Definitions of *antigen, antibodies, antiserum* should be discussed in class. *Interferon* should be discussed in terms of their ability to interfere with viral replication.
- $K^+$  transport mechanism should be taught graphically and the exchange of  $K^+/H^+$  should be stressed upon for ionic balance and pH regulation.
- Important scientists and their main contribution should be discussed as per the list of scientists and their contributions given in the syllabus.
- Precision and accuracy must be stressed upon in elaboration of abbreviations.

## MARKING SCHEME

### Question 1.

(a)	(i)	<b><u>Parenchyma</u></b>	<b><u>Sclerenchyma</u></b>
		<ul style="list-style-type: none"> <li>• Location – Medullary ray, cortex, epidermis, pith</li> <li>• Living cells</li> <li>• Thin cell walls/ of cellulose</li>   <li>• Distinct nucleus</li> <li>• Store food / water / produce and store tannins / oils</li> <li>• Conduct water / food</li> <li>• Isodiametric/ Oval.</li> </ul>	<ul style="list-style-type: none"> <li>• Bundle sheath, pericycle, petiole, hypodermis, veins, xylem, phloem, bark</li> <li>• Dead cells</li> <li>• Thick cell walls due to lignin deposition</li> <li>• Do not have nucleus</li> <li>• Give rigidity and mechanical strength.</li>   <li>Elongated / tapering ends</li> </ul>
	(ii)	<b><u>Epistasis</u></b>	<b><u>Dominance</u></b>
		<ul style="list-style-type: none"> <li>• Interaction of two pairs of non-allelic genes.</li> <li>• Gene present on one locus suppresses expression of gene present on some other locus of the same chromosome/ different chromosome.</li> </ul>	<ul style="list-style-type: none"> <li>• Involves interaction of intra allelic genes</li> <li>• Intragenic suppression where dominant allele does not allow the recessive allele to express itself/ character expresses itself.</li> </ul>

(iii)	<b><u>Ovulatory phase hormones</u></b>	<b><u>Luteal phase hormones</u></b>
	<ul style="list-style-type: none"> <li>• Luteinising hormone/FSH/Estrogen</li> </ul>	<ul style="list-style-type: none"> <li>• Progesterone/ LH</li> </ul>
(iv)	<b><u>Symplastic movement</u></b>	<b><u>Apoplastic movement</u></b>
	<ul style="list-style-type: none"> <li>• Consists of cytoplasm and plasmodesmata</li> <li>• Water enters living cells either in the area of root hair cells or endodermis</li> <li>• There is some resistance to movement of water</li> <li>• Relatively slower process</li> <li>• Influenced by the metabolic status of cell.</li> <li>• Requires ATP/ energy</li> <li>• Along DPD gradient</li> </ul>	<ul style="list-style-type: none"> <li>• Consists of non-living parts, i.e. cell walls and intercellular spaces</li> <li>• Water does not enter the living cells.</li> <li>• There is little resistance to the movement of water</li> <li>• It is a faster process</li> <li>• Not affected by the metabolic activity of the root.</li> <li>• No ATP/ Solar energy</li> <li>• Along transpirational pull</li> </ul>
(v)	<b><u>Phenotype</u></b>	<b><u>Genotype</u></b>
	<ul style="list-style-type: none"> <li>• Morphological expression/External appearance of an organism that is genetically controlled/.</li> </ul>	<ul style="list-style-type: none"> <li>• Genetic constitution of an organism.</li> </ul>

- (b)
- (i) To avoid the high body temperature/low temperature (2 to 3 degree less than body temperature)/ for spermatogenesis/ to keep sperms alive
  - (ii) Secondary growth does not occur in monocot stems as they contain closed collateral vascular bundle, i.e. they do not have a cambium which allows for secondary growth/ vascular bundles are scattered.
  - (iii) Nitrogenous fertilizers are not applied in fields where leguminous crops grow as the roots of leguminous crops contain nitrogen fixing bacteria such as Rhizobium or Azotobacter, which fix the free nitrogen of the atmosphere into nitrates which make it available to the plant.
  - (iv) The same genetic code is present in all living organisms.
  - (v) At higher temperatures, green plants start evolving CO<sub>2</sub> instead of O<sub>2</sub> due to photorespiration, where RubisCO functions as RuBPoxygenase. More photosynthetically fixed carbon is lost by photorespiration.
- (c)
- (i) (C) Bacterial disease
  - (ii) (A) Insects
  - (iii) (A) Apical meristem
  - (iv) (D) Interferon
  - (v) (C) K<sup>+</sup>

- |     |       |  |
|-----|-------|--|
| (d) | (i)   | Alec Jeffery: DNA fingerprinting         |
|     | (ii)  | P.K. Sethi : Prosthesis/Jaipur Foot      |
|     | (iii) | Hugo de Vries: Mutation/Saltation        |
| (e) | (i)   | SCID : Severe Combined Immuno Deficiency |
|     | (ii)  | ZIFT : Zygote Intrafallopian Transfer    |

## PART II (50 Marks)

### SECTION A

*Answer any two questions.*

#### Question 2

- (a) Describe the Miller and Urey experiment on the origin of life. [3]
- (b) Define the following: [2]
- (i) Frame shift mutations.
- (ii) Genetic drift.

#### Comments of Examiners

- (a) This question was well attempted by most of the candidates. Some candidates did not mention the composition of gaseous mixture in the flask. Some did not write the importance of the experiment in supporting Oparin's theory
- (b) (i) Definition of *Frame shift mutations* was confused with *Translocation* by several candidates. Some explained only Mutation.
- (ii) *Genetic Drift* was defined as, 'any change in gene or genotype'. The term 'frequency' was missing in many answers.

#### Suggestions for teachers

- Diagrams should be used for explanation. Oparin's Theory should be discussed along with the Miller Urey experiment. The explanation should include description of the experimental set up and its significance
- Key words should be highlighted in definitions and differences.

#### **MARKING SCHEME**

##### **Question 2.**

- (a) Miller and Urey experiment on the origin of life:

##### **Process:**

- Created probable conditions of primitive earth in the laboratory
- Spark discharge apparatus
- Two tungsten electrodes to provide electric discharge (simulating lightning of primitive atmosphere)
- An atmosphere of gases (CH<sub>4</sub>, NH<sub>3</sub>, H<sub>2</sub>O, H<sub>2</sub>) were created in a chamber and condensed liquid allowed to accumulate in another chamber.
- Energy supplied by heating water in another chamber.

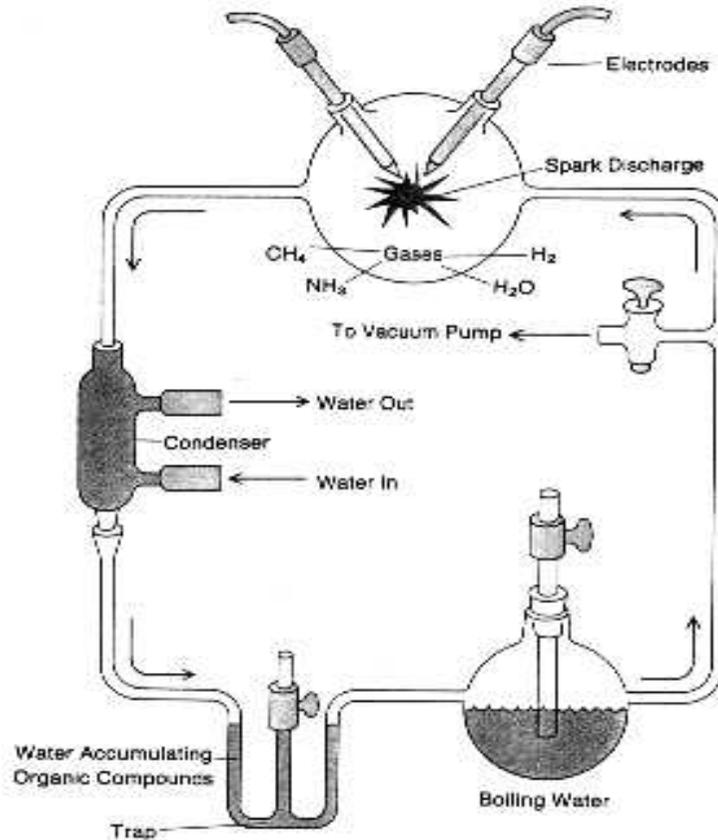
**Products:**

- Amino acids like glycine, alanine and some more complex organic compounds were collected in vitro after a few days/ purine/ pyrimidine/ sugar/ glycerol/ formic acid/ short chain fatty acids/ acetic acid

**Significance:**

- Confirming abiogenesis / chemical evolution / Oparin theory
- Reducing atmosphere essential

(self-explanatory diagram accepted)



- (b) (i) Frameshift mutations: Shifting of entire reading frame/caused either by addition or deletion of one or more nucleotide pairs in a molecule of DNA segment at one or more places OR diagrammatic representation
- (ii) *Genetic drift*: The sudden and random changes in the allele frequency/ gene frequency occurring in small population by chance alone.

### Question 3

- (a) Name and define the *three* types of natural selection. [3]
- (b) State the following: [2]
- Hardy Weinberg's principle
  - Theory of recapitulation

#### Comments of Examiners

- (a) Instead of *Types of Natural selection*, some candidates described industrial melanism and G-6-PD deficiency. In some cases, instead of using specific terms like 'Stabilising', candidates wrote *Standard* or *Normal*. In place of 'Disruptive' some candidates used the word 'disturbed'.
- (b) (i) Many candidates did not mention that allelic frequencies remain constant. Some wrote the equation as  $p^2 + 2pq + q^2$  instead of  $p^2 + 2pq + q^2 = 1$ .
- (ii) Some candidates wrote 'repeats' instead of 'recapitulates'.

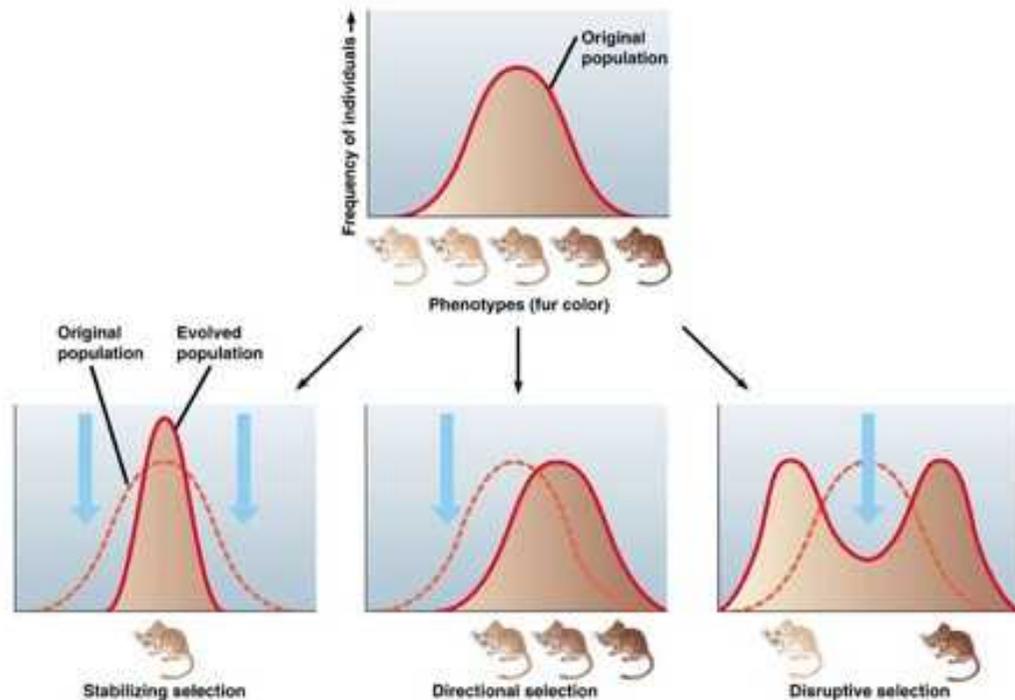
#### Suggestions for teachers

- Graphs should be used for better understanding.
- Important words and points should be stressed upon

#### **MARKING SCHEME**

##### **Question 3.**

- (a) *Three* types of natural selection:
- Directional Selection: Any one phenotype produces a regular change in a gene pool of a population in one direction with respect to one or some specific characteristics- Progressive.
  - Disruptive or diversifying selection: It acts to break up a previously homogenous population into several different adaptive norms. It simultaneously favours individuals at both extremes of the distribution curve/eliminates intermediate types/ population represented by both extreme phenotypes.
  - Stabilizing Selection: favours average or normal phenotypes and eliminates variants/New mutation. It favours homozygosity/Mostly intermediate (Unspecialised)/ Balancing selection/ phenotypic features of organism coincide with optimal environmental conditions/ best adapted.



- (b) (i) Hardy Weinberg's Principle: States that the allele and genotype frequencies in a population will remain constant from generation to generation in the absence of other evolutionary factors or sources/Mathematical Expression ( $p^2 + 2pq + q^2 = 1$ ).
- (ii) Theory of Recapitulation: Ontogeny (embryonic development of an organism) recapitulates phylogeny of their ancestors in an abbreviated form. / Embryos in their development repeat the evolutionary history of their ancestors.

#### Question 4

- (a) Mention the important features of the Neanderthal man. [3]
- (b) What are homologous organs? How do they help in providing evidence for organic evolution? [2]

#### Comments of Examiners

- (a) Specific points were not written by a number of candidates. However, most candidates scored well. Some did not mention the actual cranial capacity but just wrote 'large cranial capacity'.
- (b) Several candidates wrote about Organic Evolution instead of Common Ancestor. Many did not attempt the second part of the question.

#### *Suggestions for teachers*

- Distinguishing features of fossils of human ancestors should be clarified.
- Convergent and divergent evolution or adaptive radiation should be properly correlated.

## MARKING SCHEME

### Question 4.

- (a) Important features of the Neanderthal man:
- Heavily built, outward curved thigh bones.
  - The skull bones were thick,
  - Forehead low and slanting,
  - Eyebrow ridges were heavy/prominent/ protruded
  - Strong lower jaw (mandible)/ The jaw was deep with no chin/ orthognathus/ flat face
  - Cranial capacity was 1300 – 1600 CC,
  - Short limbs, broad shoulder, legs bent / semi erect/stooping posture,
  - Height 5 - 5½ feet / 1.5 to 1.6 meters, 150 to 160 cms
  - Used stone tools, weapons and fire/ cooking
  - Intelligent, good hunters, used animal skin for clothing,
  - Buried the dead, performed ceremonies/ religious belief
  - Constructed hut dwelling structures / lived in caves,
  - Communicated by some syllabic language/speech,
  - Developed primitive social life/social organisation. *(Any three)*
- (b) Homologous organs: Organs though different in functions, but similar embryonic origin and development, internal structure and basic plan.
- Arms of man (grasping), legs of horse (running), wings of a bird (flying) and flippers of a seal are different from one another in functions, yet all are built on the same pentadactyl plan and have same mode of development.
  - Legs of all insects
  - Seven cervical vertebrae in all mammals.
- Evidence: *(any one example with explanation).*
- Evidences indicate that the organisms having homologous structures must have arisen from common ancestors through successive generations.
  - Support divergent evolution/adaptive divergence/monophyletic origin / common origin/ same origin

## SECTION B

Answer any *two* questions.

### Question 5

- (a) Describe the different types of vascular bundles. [4]
- (b) Give *three* anatomical differences between a *monocot root* and a *dicot root*. [3]
- (c) Explain the effect of light and temperature on photosynthesis. [3]

#### Comments of Examiners

- (a) Most of the candidates scored well in this part. In some cases, for radial vascular bundles, 'alternate arrangement of xylem and phloem' was found to be missing in the answers. Some candidates wrote about open and closed vascular bundles.
- (b) Some candidates described monocot and dicot leaf instead of root. Some wrote the points vice-versa. Several candidates did not seem to understand the meaning of 'anatomical differences' in the question. They wrote morphological differences and also mentioned about secondary growth taking place.
- (c) Valid points were not given by candidates in some cases. Candidates gave a general answer, just mentioning that light and temperature affect photosynthesis. There was no mention of intensity, wavelength and duration of light. Similarly, effects of optimum, low and high temperature were not discussed separately in many cases.

#### Suggestions for teachers

- Teaching of this topic should be supported by diagrams.
- Morphological and anatomical differences should be explained separately so that students get a clear concept.
- Factors and their effects should be discussed separately

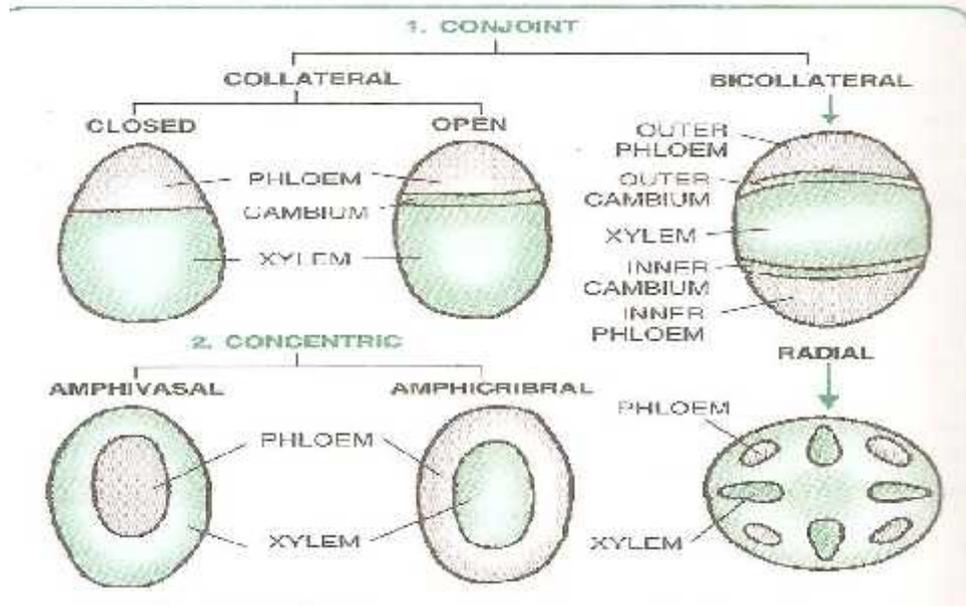
#### **MARKING SCHEME**

##### **Question 5.**

- (a) 1) Radial Vascular Bundle: In these, the xylem and phloem are arranged in different radii / alternative with each other.
- 2) Conjoint Collateral: Xylem and phloem are present on the same radius. Phloem located on the outer side of the xylem. (Open and closed types).
- 3) Conjoint Bicollateral: Phloem and cambium on the outer and inner side of the central xylem / central xylem with outer phloem outer cambium and inner phloem inner cambium.
- 4) Concentric: One type of vascular bundle surrounded by the other. (Amphicribal (Hadrocentric) – Phloem surrounds xylem and Amphivasal (leptocentric) – xylem surrounds phloem).

*(Conjoint or Collateral and Bicollateral accepted; self-explanatory diagrams accepted)*

*Any four correctly named and explained.*



(b)	Monocot Root	Dicot Root
	<ul style="list-style-type: none"> <li>• Vascular bundles are numerous, i.e. or more/ polyarch</li> <li>• Cambium is absent</li> <li>• Xylem vessels are large</li> <li>• More or less circular in outline / polyarch/oval or rounded</li> <li>• Pith is well developed</li> <li>• The inner walls of the endodermis are considerably thickened and give a U shaped appearance.</li> <li>• Epidermis is retained throughout the life.</li> <li>• Cortex is wide</li> <li>• Pericycle is multi-layered</li> <li>• Phloem parenchyma is absent</li> </ul>	<ul style="list-style-type: none"> <li>• Vascular bundles vary from 2 to 4 and rarely 6/ few/ not numerous – diarch to hexarch</li> <li>• Cambium appears at the time of secondary growth.</li> <li>• Xylem vessels are smaller in size</li> <li>• Polygonal outline, angular</li> <li>• Pith is small or absent</li> <li>• Thickenings are not so prominent due to presence of casparian strips.</li> <li>• Epidermis is destroyed during secondary growth and is replaced by periderm.</li> <li>• Cortex is narrow</li> <li>• Pericycle is single layered</li> <li>• Phloem parenchyma is present</li> </ul>

- (c) Light:
- Increase in light and intensity up to a certain limit increases the rate of photosynthesis.
  - Intensity of light affects the rate of photolytic reaction and controls the rate of ATP and NADP production.

- Plants getting an average of 10 – 12 hours of light per day show higher rate of photosynthesis than those who receive light continuously.
- High light intensity may become inhibitory as they bring about photo-oxidation/solarisation of chlorophyll. Reduce turgidity and close stomata.
- Photosynthesis takes place only in the visible part of electromagnetic radiation.
- Different wavelengths influence photosynthesis differently. Green is least effective, blue and red regions are most effective.
- Excess light increases transpiration / stomatal closure affects photosynthesis.

*(Any three)*

Temperature:

- Increase in temperature up to a certain optimum, increases the rate of photosynthesis.
- Low temperatures inhibit the rate of photosynthesis by declining CO<sub>2</sub> diffusion rates or directly affecting enzymatic action / photosynthesis stops at 40°C.
- Optimum temperature for photosynthesis ranges between 30°C and 35°C.
- Beyond this activity of photosynthetic enzymes declines.
- For every 10°C rise in temperature, the rate of photosynthesis doubles.
- High temperature increases transpiration, wilting of leaves / stomatal closure – affects photosynthesis.

*(Any three)*

### Question 6

- (a) Explain the transpiration pull theory for ascent of sap. **[4]**
- (b) Explain the process of spermatogenesis in humans. **[3]**
- (c) Define the following: **[3]**
- (i) Placentation
  - (ii) Parthenocarpy
  - (iii) Diffusion

## Comments of Examiners

- (a) Several candidates did not mention 'Dixon and Jolly'. Some discussed the process of absorption of water but made no mention about ascent of sap and transpirational pull. Many did not follow the sequence and wrote randomly.
- (b) The phases were not written in chronological order by a number of candidates. Many related growth with cell division and spermatogenesis was not discussed.
- (c) (i) In several cases, 'placentation' was confused with 'implantation' in animals.  
(ii) 'Parthenocarpy' was confused with 'parthenogenesis' by some candidates.  
(iii) 'Diffusion' was confused with 'osmosis' in some cases.

### Suggestions for teachers

- Stress upon writing in the correct sequence. Explanation with the help of diagrams will give a clear concept of the processes.
- All the phases of spermatogenesis must be discussed with proper explanation. The changes during spermatogenesis should be discussed separately.
- Instruct students to give accurate and precise definitions. Key words should be given
- Confusing terms and definitions should be discussed together so that students have a clear understanding.

## **MARKING SCHEME**

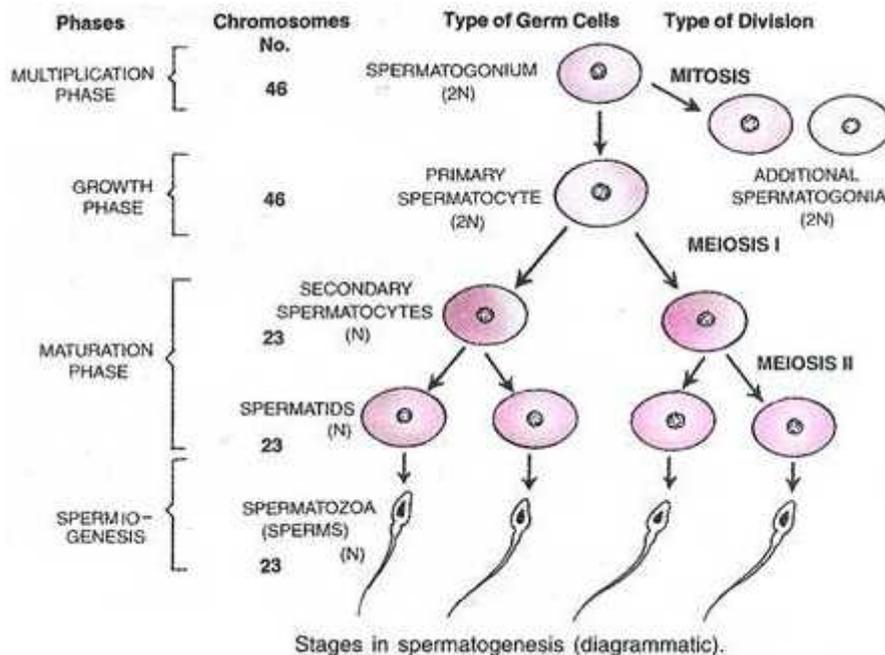
### **Question 6.**

- (a)
- Proposed by Dixon and Jolly
  - Water lost from mesophyll cells by transpiration
  - DPD increases in mesophyll cells due to loss of water causing cells to absorb water from neighbouring cells. / Endosmosis./ OP increase, water potential decreases.
  - In turn, water absorbed from leaf xylem.
  - Continuous water column set up due to cohesion and adhesion / suction pressure developed / transpirational pull.
  - Pull transmitted to stem and finally roots.
  - Roots absorb more water.
- (b) Spermatogenesis in humans:
- Formation of Spermatid:**
- Multiplication phase/division: undifferentiated germ cells arise by mitotic division of primordial germ cells to form spermatogonia or sperm mother cells. These undergo mitosis to form supermatogonia which move towards the lumen of seminiferous tubules and enter growth phase. These cells are called spermatocytes.
  - Growth phase: Spermatocytes grow in size, accumulate nutrients and replicate DNA. They are now called primary spermatocytes.

- Maturation phase: Each primary spermatocyte undergoes first maturation division/meiosis and two haploid cells are formed. These are called secondary spermatocytes.
- They undergo a further second mitotic division to form 4 spermatids.

Spermiogenesis:

- Nucleus shrinks with closely packed DNA.
- Formation of acrosome.
- Axial filament formed from distal centriole.
- Mitochondrial spiral formed from mitochondria.
- Loss of cytoplasm, just a sheath remains around mitochondria.



- (c)
- (i) Placentation: arrangement of ovules within the ovary/formation of placenta in animals/ arrangement of placenta along ovarian wall.
  - (ii) Parthenocarpy: Phenomenon of development of fruits without fertilization/ seedless fruits
  - (iii) Diffusion: Movement of molecules of a substance from its higher concentration to its lower concentration/Intermixing of substances when in direct contact.

### Question 7

- (a) Why are xylem and phloem classified as complex tissues? Describe the structure of phloem. [4]
- (b) Describe the ultra-structure of chloroplast. [3]
- (c) State *three* functions of the placenta. [3]

## Comments of Examiners

- (a) This question was not attempted correctly by many candidates. They simply wrote that complex tissue is a tissue which is very complex.  
In phloem structure, several candidates mentioned the functions instead of discussing the structure of the individual components.
- (b) Most of the candidates drew the correct diagram but labelling was incomplete. The description given was also very superficial in several cases.
- (c) A number of candidates only mentioned the role of 'exchange of substances'. The endocrine and protective functions were not mentioned by most candidates.

### Suggestions for teachers

- Tissue classification should be taught in detail. Structure and function of individual components of xylem and phloem should be discussed.
- Ultra-structure of chloroplast must be taught with the help of a diagram and all labelling should be taught. Functions of every part should be discussed.
- Functions of placenta should be discussed clearly.

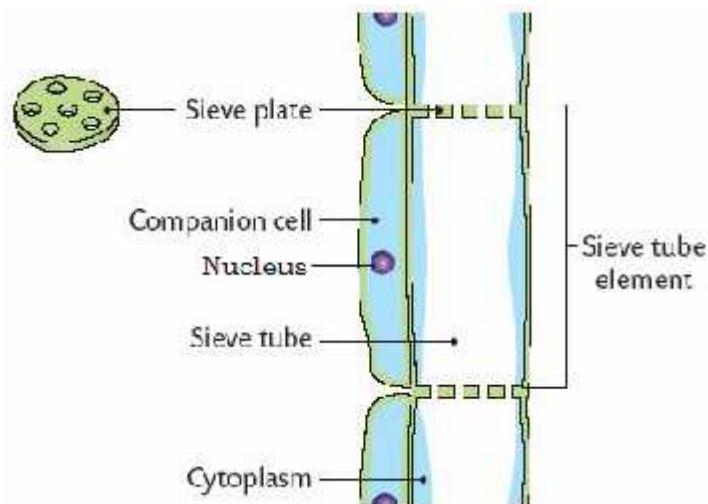
## **MARKING SCHEME**

### **Question 7.**

- (a) Xylem and phloem classified as complex tissues because they are made up of more than one type of cell which have a common origin and work together to perform a special function.

#### **Structure of Phloem:**

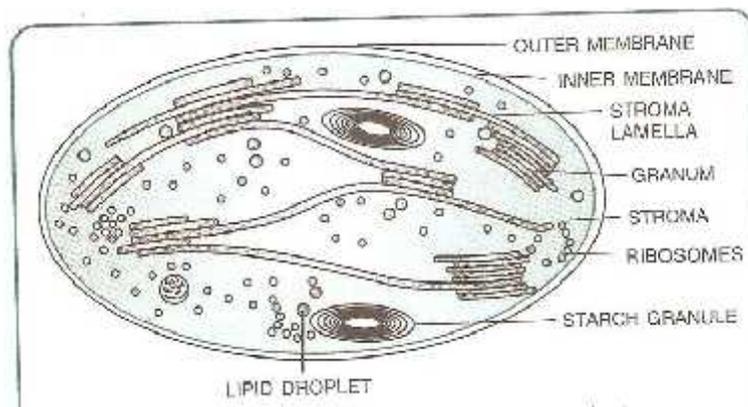
- Sieve tubes: living cells which are slender and elongated tubular cells. Transverse walls are obliquely placed and are perforated by a number of pores to form a sieve plate/ enucleated/ nucleus absent
- Companion cells: lie in association with sieve tube elements and assist in food translocation.
- Phloem parenchyma: living cylindrical parenchymatous cells with thin walls and dense cytoplasm.
- Phloem fibres: sclerenchymatous cells or bastfibres



(b) Ultra-structure of a Chloroplast:

Labels:

- Outer membrane
- Inner membrane
- Periplastideal space
- Stroma
- Grana
- Thylakoids
- Stroma lamellae / frets
- Ribosome
- Osmiophilic granules



(Any six)

(c) Functions of the Placenta:

- Transportation of nutrients from maternal blood to foetus.
- Helps in the exchange of oxygen and carbon dioxide between foetus and mother.
- Removes nitrogenous wastes from foetus by diffusion
- Antibodies from maternal blood passed on to foetus
- Transport of pathogens like viruses for syphilis, chicken pox, etc.
- Transport of drugs
- Storage of fat, glycogen and iron.
- Secretion of hormones – HCG, progesterone, estrogen, etc.
- Acts as a barrier

## SECTION C

Answer any *two* questions.

### Question 8

- (a) Describe the experiment performed by Griffith. What conclusions did he infer from his observations? [4]
- (b) What is artificial insemination? Mention *two* ways in which it is useful in breeding of dairy animals. [3]
- (c) What is *single cell protein*? Give its source and significance. [3]

### Comments of Examiners

- (a) Candidates were confused between 'R strain' and 'S strain'. 'Avirulent' and 'virulent' was also not correctly mentioned in several cases. Most of the candidates did not write the conclusion of the experiment.
- (b) In this part, most of the candidates wrote 'transfer of semen in female body' but did not mention the part of the female body where semen is transferred.
- (c) The question had three parts – definition, source and use. Many candidates only wrote the definition - 'protein from a single cell', without mentioning microbes.

### Suggestions for teachers

- Experiments to prove that DNA is the genetic material should be discussed with their actual principle.
- Key words should be stressed upon.
- Candidates should be instructed to read the questions properly and answer all parts and sub parts in a systematic manner.

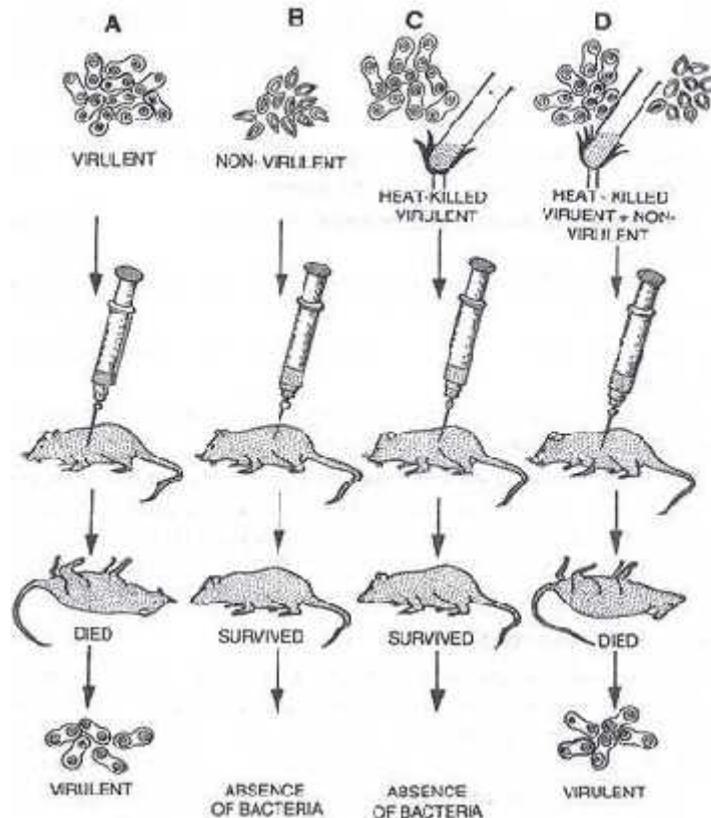
### MARKING SCHEME

#### Question 8.

- (a) Griffith's Experiment:
- Streptococcus pneumonia occurs in two forms: smooth virulent strains and rough non-virulent forms.
  - Live R Strain Injected non virulent bacteria in mice-mice remained healthy.
  - Live S Strain Injected virulent variety of Streptococcus pneumonia into mice- the mice developed pneumonia and died.
  - Killed S Strain Virulent bacteria were heated to 60°C and killed. When these were injected into mice, they did not develop pneumonia symptoms.
  - Both Live R Strain & Killed S Strain A mixture of non-virulent and heat killed bacteria were injected into mice; the mice developed pneumonia and died.
  - Bacteria isolated from these dead mice were found to contain a mixture of live virulent and non-virulent forms. Live S strain recovered

### Conclusion:

- Heat killed virulent bacteria have introduced some transforming principle/factor that has caused some non-virulent bacteria into virulent, capsulated form.
- This was described as Griffith effect or bacterial transformation.
- DNA is transforming (genetic) principle/ some factor transforming principle in heat killed S cells was transferred. It transformed R cells into live S cells



- (b) **Artificial insemination:** The semen of the chosen male is collected and injected into the reproductive tract of the selected female by the breeder.

### Importance in breeding of dairy animals:

- Semen of healthy males can be used to inseminate a number of females.
- Semen can be collected from the bull and used at distant places where transportation of bull is not possible / economical.
- Spread of diseases can be controlled.
- Helps to improve a particular breed.
- Easy to store
- Can be used at convenient place/time
- Reduces cost of transportation

- (c) SCP – single cell protein: Any microbial biomass/multicellular bacteria, yeast, fungi, algae which can be used as food
- Source:**
- Cyanobacteria such as spirulina / bacteria-Methylphilus methylotrophus / yeast – candida utilis / filamentous fungi – Fusarium graminearum, Trichosporon cutaneum (fungus)/ bacteria
- Significance:**
- Can be used as a protein rich supplement in the human diet.
  - Helps to bridge the gap between demand and supply of protein for human diet and reduces the pressure on agriculture.
  - Use of organic wastes and industrial effluents in raising SCP will reduce environmental pollution.
  - Absence of pathogenicity & toxicity
  - High protein quality & content
  - Easy to digest
  - Cost effective

### Question 9

- (a) How did Hershey and Chase prove that DNA is the genetic material? [4]
- (b) Give one main application of each of the following: [3]
- (i) MRI
  - (ii) Ultrasound
  - (iii) ECG
- (c) Explain the role of stem cells in medical treatment. [3]

### Comments of Examiners

- (a) Some candidates got confused about sulphur being in DNA and phosphorus in protein. Role of bacteriophage was not mentioned in many cases.
- (b) MRI and Ultrasound – Most of the candidates wrote vaguely that they are used for diagnosis of internal diseases, without mentioning specific organs. Some were confused between ECG and EEG.
- (c) Instead of the role of stem cells, many candidates discussed the types of stem cells i.e pluripotent, totipotent, etc.

### Suggestions for teachers

- Use of S<sup>35</sup> and P<sup>32</sup> should be explained with their proper use in labelling capsid or nucleic acid. The conclusion should be based on trace of radioactivity in specific parts.
- Application of medical tools should be discussed in detail.
- Transplantation and gene therapy should be explained for role of stem cells in medical field.

## MARKING SCHEME

### Question 9.

- (a) Hershey and Chase conducted experiment on T<sub>2</sub> phage, a parasite on common bacterium *Escherichia coli*.

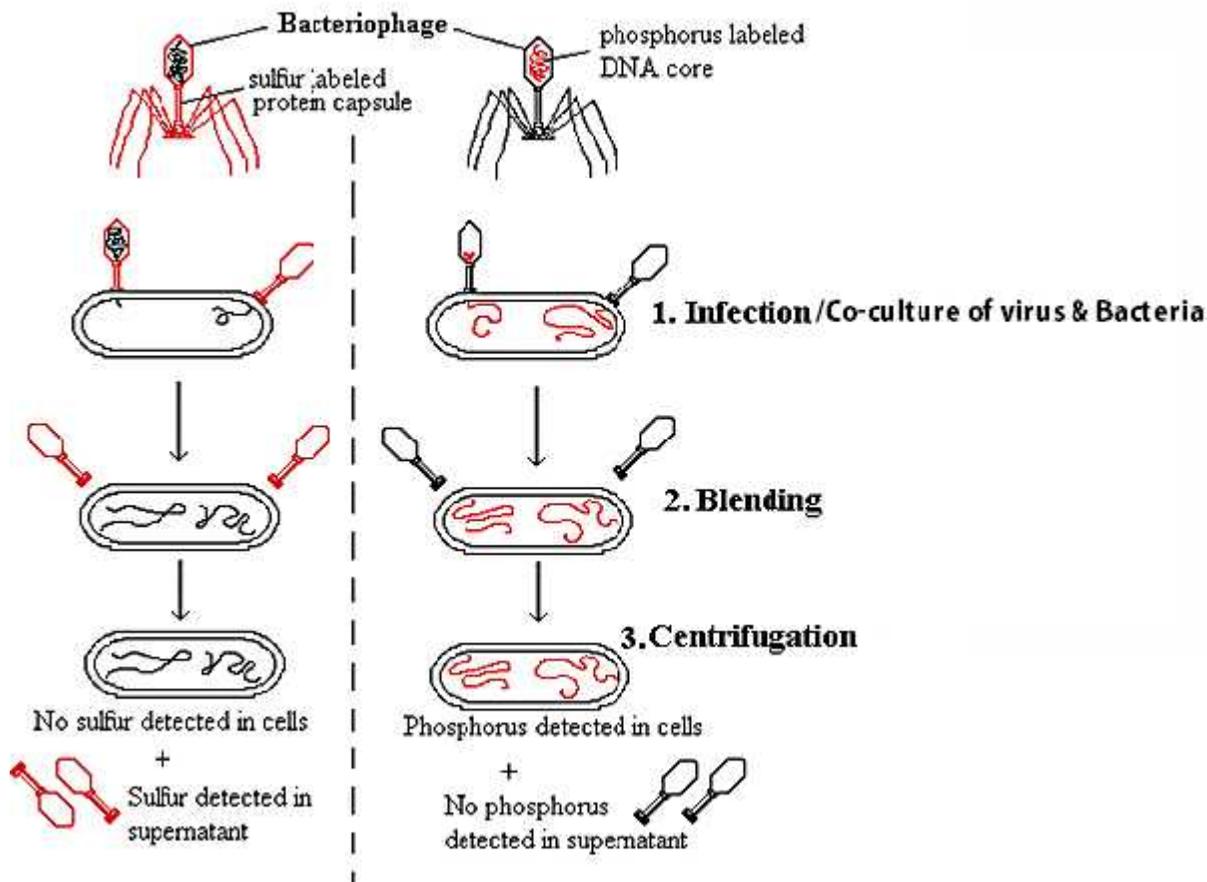
Some T<sub>2</sub> phages are grown in cultures of bacteria containing radioactive S<sup>(35)</sup>, whereas remaining T<sub>2</sub> phages are grown in cultures of bacteria containing radioactive P<sup>(32)</sup>.

S<sup>35</sup> is incorporated in the protein coat whereas P<sup>32</sup> is incorporated in the DNA of T<sub>2</sub> phage.

These two types of radioactive phages were made to infect *Escherichia coli* in two separate samples.

The phages grown in S<sup>35</sup> did not transmit their radioactivity to their daughter phages. Whereas the phages P<sup>32</sup> pass their radioactivity to the daughter phage particle.

This proves that only DNA was passed on from one generation of T<sub>2</sub> to the next.



**THE HERSHEY-CHASE EXPERIMENT**

- (b) (i) MRI :
- In the examination of brain and spinal cord musculo skeletal disorders, blood flow.
  - In the examination of cancerous bone, pelvic, urinary bladder, joints, vertebral column and cancerous growth in liver and kidney, heart and brain strokes.
  - Identification of Parkinson's disease and changes in the brain during this disease internal haemorrhage.
  - Study of joints and musculo-skeletal disorders, joint injuries and slipped disc.
- (Any one)
- (ii) Ultrasound:
- Diagnosis of kidney and gall bladder stones, liver diseases, diseases of ovaries, uterus, etc.
  - To identify pregnancy, foetal abnormalities like encephaly, spina bifida
  - Echocardiography – for ultrasound imaging of heart
  - Blood flow through arteries and veins by Doppler ultrasound.
- (Any one)
- (iii) ECG:
- Rate and rhythm of atria and ventricles
  - Condition of cardiac muscles of different chambers of heart
  - Indicate irregularities of heart beat / coronary thrombosis / myocardial infarction/arrhythmia/angina pectoris/tachycardia
- (Any one)
- (c) Role of stem cells in medical treatment:  
Two types of stem cells are:  
Stem cell treatments are a type of intervention strategy that introduces new cells into damage tissue in order to treat disease or injury.
- Medical researchers believe that stem cell therapy has the potential to dramatically change the treatment of human diseases.
  - Treatment of genetic disorders/blood cancers/degenerative diseases/replacement of organs/gene therapy/ spinal injuries/ autoimmune diseases

### Question 10

- (a) Write short notes on: [4]
- (i) Multiple Alleles
- (ii) Artificial measures to control population
- (b) What complications will arise if the blood of an Rh positive person is transfused to an Rh negative person and vice versa? [3]
- (c) State *any three* goals of the human genome project. [3]

### Comments of Examiners

- (a) (i) Candidates were confused between ‘multiple alleles’ and ‘polygenic inheritance’.
- (ii) Most of the candidates attempted this part well. Some discussed natural methods instead of artificial methods of population control.
- (b) Instead of transfusion, several candidates wrote about incompatibility during pregnancy. Many used the term ‘clotting’ instead of ‘agglutination’.
- (c) This part was not attempted properly. There was confusion between ‘goals’ and ‘achievements’ of the human genome project.

### Suggestions for teachers

- Definition should be taught with special attention to key words.
- Terms like agglutination and clumping should be clearly differentiated while teaching blood groups. Similarly, consequences of Rh incompatibility should be discussed separately for transfusion and for pregnancy.
- Methodologies, goals, achievements ethical issues should be discussed separately.

### **MARKING SCHEME**

#### **Question 10.**

- (a) (i) Multiple Alleles:

Multiple alternatives of the same gene which influence the same character and produce different expressions in different individuals of a species or population/some genes have more than 2 allelic forms. These different forms of a single gene are referred to as multiple alleles., e.g. human blood groups

- (ii) Artificial measures to control population:

- Mechanical methods like use of condoms, diaphragms
- Chemical – Spermicidal creams, jellies, foams
- Oral contraceptive pills
- IUCD like copper T, Lippes loop
- Surgical Methods – Tubectomy/ Vasectomy
- MTPs / Induced Abortion

- (b) When Rh positive blood is given to Rh negative:

- Rh antigens induce formation of Rh antibodies in recipient’s blood.
- Anti Rh antibodies react with donors Rh antigens and agglutinate the blood/ clumping
- Transfusion of Rh negative blood to Rh positive produces no complication as no antibodies are found in Rh positive persons/ No agglutination.

(c) **Human genome project:**

- A research effort to map the entire genome by determining the sequence of nucleotides in the DNA of each of the 22+X and Y chromosome and to study the function of human genes.

**Goals:**

- To sequence the entire genome that includes above 3 billion base pairs
- To identify 20,000 to 25,000 genes in human DNA
- Store this information in database
- To obtain a physical map of human genome by cloning DNA into YACs and BACs and cosmids
- To identify thousands of genetic markers and map them in the genome.
- To develop technological advances in genetic methodologies such as gene cloning sequence/improve tools for data analysis.
- To transfer related technologies to other sectors such as industry.
- To address the ethical, legal and social implications of the results obtained from the project.

**GENERAL COMMENTS:**

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

- Frameshift Mutation
- Genetic drift
- Epistasis
- Types of Natural selection
- Factors influencing photosynthesis
- Complex tissues/components of phloem
- Griffiths experiment, Hershey & Chase experiment
- Single cell protein

**(b) Concepts in which candidates got confused:**

- Symplast/Apoplast
- Multiple alleles/Polygenic inheritance
- Types of natural selection/examples of natural selection
- Oparin Theory/Miller Urey experiment
- Human Genome Project
- Convergent and divergent evolution
- Rh+ve and Rh-ve in transfusion and pregnancy

**(c) Suggestions for candidates:**

- Practice diagrams with related topics
- Study from different reference books
- Solve previous years question papers
- Correlate structure and function relationships
- Write compatible differences
- Draw neat well labeled diagrams