

# 29 AIIMS BIOLOGY

CHAPTER-WISE SOLVED PAPERS

(1997-2019) *with* REVISION TIPS  
& 3 ONLINE MOCK TESTS

disha  
Publishing Private Limited

## Includes

- All 8 Papers of AIIMS 2018 & 2019 (4 Shifts)
- 1160 Multiple Choice Questions
- 580 Assertion-Reason Questions
- Divided into 38 Chapters
- Critical Points to Remember
- Problem Solving Tips

Fully Solved

2nd  
Edition

4 Shifts  
2018 &  
2019  
Solved  
Papers





29

# AIIMS BIOLOGY

**CHAPTER-WISE SOLVED PAPERS**  
(1997-2019) *with* REVISION TIPS  
& 3 ONLINE MOCK TESTS

Corporate Office : 45, 2nd Floor, Maharshi Dayanand Marg, Corner Market,  
Maitra Nagar, New Delhi - 110017  
Tel. : 011-4942349 / 4942130

By  
Sanju Priyadarshi

Typeset by Disha DTP Team.

## How to access the Online Test(s)?

### INSTRUCTIONS

1. Visit the link given below.  
<http://bit.ly/AHMS2020>
2. You can also scan the QR code provided here.



**Note:** No login required.

**DISHA PUBLICATION**  
ALL RIGHTS RESERVED

© Publisher

*No part of this publication may be reproduced in any form without prior permission of the publisher. The author and the publisher do not take any legal responsibility for any errors or misrepresentations that might have crept in. We have tried and made our best efforts to provide accurate up-to-date information in this book.*

---

For further information about the books from DISHA,  
Log on to [www.dishapublication.com](http://www.dishapublication.com) or email to [info@dishapublication.com](mailto:info@dishapublication.com)

# CONTENTS

•	AIIMS Solved Paper 25 May 2019 (Morning)	1-8
•	AIIMS Solved Paper 25 May 2019 (Evening)	10-17
•	AIIMS Solved Paper 26 May 2019 (Morning)	18-25
•	AIIMS Solved Paper 26 May 2019 (Evening)	26-32

Sl. No.	Chapter Name	Page No.
1.	The Living World	1-4
2.	Biological Classification	5-10
3.	Plant Kingdom	11-18
4.	Animal Kingdom	19-27
5.	Morphology of Flowering Plants	28-34
6.	Anatomy of Flowering Plants	35-40
7.	Structural Organisation in Animals	41-46
8.	Cell: The Unit of Life	47-51
9.	Biomolecules	52-57
10.	Cell Cycle and Cell Division	58-61
11.	Transport in Plants	62-65
12.	Mineral Nutrition	66-69
13.	Photosynthesis in Higher Plants	70-74
14.	Respiration in Plants	75-79
15.	Plant Growth and Development	80-83
16.	Digestion and Absorption	84-90
17.	Breathing and Exchange of Gases	91-94
18.	Body Fluids and Circulation	95-99
19.	Excretory Products and their Elimination	100-103

20. Locomotion and Movement	104-106
21. Neural Control and Coordination	109-114
22. Chemical Coordination and Integration	115-120
23. Reproduction in Organisms	121-124
24. Sexual Reproduction in Flowering Plants	125-130
25. Human Reproduction	131-137
26. Reproductive Health	138-140
27. Principles of Inheritance & Variation	141-148
28. Molecular Basis of Inheritance	149-155
29. Evolution	156-161
30. Human Health and Disease	162-170
31. Strategies for Enhancement in Food Production	171-176
32. Microbes in Human Welfare	177-180
33. Biotechnology: Principles and Processes	181-185
34. Biotechnology and its Applications	186-188
35. Organisms and Population	189-195
36. Ecosystem	196-200
37. Biodiversity and Conservation	201-205
38. Environmental Issues	206-212

### 3 Online Mock Tests

Mock Test-1

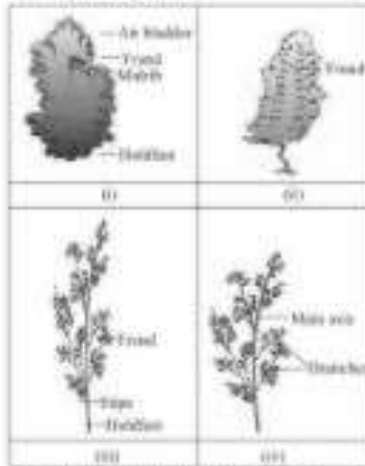
Mock Test-2

Mock Test-3

# AIIMS Solved Paper

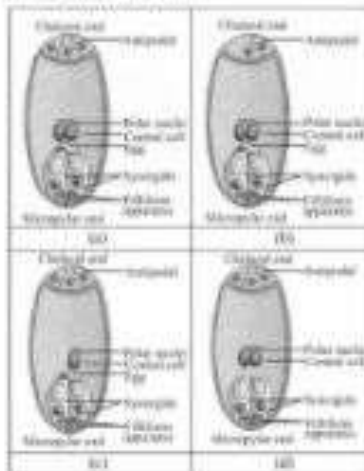
25 May 2019 (Morning)

1. Identify the diagrams.



- (a) (i) - *Lammaria*, (ii) - *Porphyra*, (iii) - *Fucus*  
(iv) - *Polysiphonia*  
(b) (i) - *Polysiphonia*, (ii) - *Lammaria*, (iii) - *Porphyra*,  
(iv) - *Fucus*  
(c) (i) - *Fucus*, (ii) - *Porphyra*, (iii) - *Lammaria*  
(iv) - *Polysiphonia*  
(d) (i) - *Fucus*, (ii) - *Lammaria*, (iii) - *Porphyra*  
(iv) - *Polysiphonia*

2. Select the correct diagram.



Identify (i), (ii) and (iii).

- (a) (i) Elongation, (ii) Termination, (iii) Initiation  
(b) (i) Initiation, (ii) Termination, (iii) Elongation  
(c) (i) Initiation, (ii) Elongation, (iii) Termination  
(d) (i) Termination, (ii) Elongation, (iii) Initiation

4. Match the column I and II.

Column-I	Column-II
(A) Pseudism	(i) ++
(B) Commensalism	(ii) +-
(C) Amensalism	(iii) 0+
(D) Mutualism	(iv) 0-

(a) (A)-(ii), (B)-(i), (C)-(iv), (D)-(i)  
(b) (A)-(i), (B)-(ii), (C)-(iii), (D)-(iv)  
(c) (A)-(ii), (B)-(iii), (C)-(i), (D)-(iv)  
(d) (A)-(iv), (B)-(iii), (C)-(ii), (D)-(i)

5. Genes on same chromosome can be:

- (a) Linked (b) Homologous  
(c) Autosomes (d) Identical alleles

6. Match the column I and II.

Column-I	Column-II
(A) Pusa shubhra	(i) Leaf and stripe rust
(B) Pusa swarnim	(ii) Causal agent black rot
(C) Pusa sadashar	(iii) Chilly mosaic virus
(D) Jhagdi	(iv) White rust

(a) (A)-(i), (B)-(ii), (C)-(iv), (D)-(ii)  
(b) (A)-(ii), (B)-(iv), (C)-(iii), (D)-(i)  
(c) (A)-(iv), (B)-(iii), (C)-(ii), (D)-(i)  
(d) (A)-(i), (B)-(ii), (C)-(iii), (D)-(iii)

7. Which of the following is correct about cytoplasm?

- (a) Living continuum  
(b) Cell wall and intercellular space  
(c) Non-Living continuum  
(d) None of the above

8. Match the column I and II:

Column-I	Column-II
(A) Elongoplast	(i) Storage of Starch
(B) Aleuroplast	(ii) Storage of fat
(C) Amyloplast	(iii) Storage of protein
(D) Chromoplast	(iv) Coloured pigments

- (a) (A)-(i), (B)-(ii), (C)-(iii), (D)-(iv)  
 (b) (A)-(iv), (B)-(iii), (C)-(ii), (D)-(i)  
 (c) (A)-(iv), (B)-(ii), (C)-(iii), (D)-(i)  
 (d) (A)-(ii), (B)-(iii), (C)-(iv), (D)-(i)

9. Virus free plants can be formed by:

- (a) Meristem culture (b) Callus culture  
 (c) Somatic cell culture (d) Protoplast fusion

10. Which of the following is correct set of macromolecules?

- (a) K, B, C, H (b) K, H, Mn, N  
 (c) C, Zn, H, N (d) C, H, Mg, N

11. Percentage of (G + C) is

- (a)  $\frac{G+C}{A+G+T+C} \times 100$  (b)  $\frac{100}{A+T} \times G+C$   
 (c)  $\frac{G+C}{A+T+G+C}$  (d)  $\frac{[G+C] \times [A+T]}{100}$

12. Arrange them on the basis of increasing size:

- (a) Nucleotide, chromosome, gene, genome  
 (b) Genome, chromosome, nucleotide, gene  
 (c) Nucleotide, genome, gene, chromosome  
 (d) Nucleotide, gene, chromosome, genome

13. Which of the following is microelement?

- (a) Ca (b) Mg  
 (c) Mn (d) S

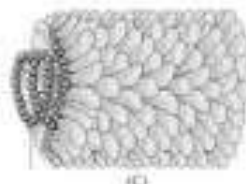
14. The genetic code of proline are:

- (a) CCC, CCG, CCU (b) CUU, UCA, CUG  
 (c) GUU, GUC, GUG (d) GGU, GUC, GGA

15. The coding strand of DNA is:

- 5' AATCAAATTAGG 3'  
 What is the sequence of mRNA?  
 (a) 3' TTAAGTTTAATCC 5'  
 (b) 5' AAUUCAAAUUAGG 3'  
 (c) 3' AAUUCAAAUUAGG 5'  
 (d) 5' TTAAGTTTAATCC 3'

16. Match the following:



(C)

- (a) (A)-Tobacco mosaic virus, (B)-Coccus, (C)-Bacillus  
 (b) (A)-Coccus, (B)-Bacillus, (C)-Tobacco mosaic virus  
 (c) (A)-Bacillus, (B)-Coccus, (C)-Tobacco mosaic virus  
 (d) (A)-Coccus, (B)-Tobacco mosaic virus, (C)-Bacillus

17. Synthesis of lipid is function of:

- (a) SER (b) RER  
 (c) Golgi body (d) Mitochondria

18. DNA polymerase links nucleotide by forming which type of bond?

- (a) Phosphodiester bond  
 (b) Hydrogen bond  
 (c) Glycosidic bond  
 (d) Ester bond

19. Match the following:

Column-I	Column-II
(A) Silique	(i) <i>Leucoperdium</i> <i>circulatum</i>
(B) Caryopsis	(ii) <i>Triticum aestivum</i>
(C) Berry	(iii) <i>Helianthus annuus</i>
(D) Capsule	(iv) <i>Brassica campestris</i>

- (a) (A)-(ii), (B)-(i), (C)-(iii), (D)-(iv)  
 (b) (A)-(i), (B)-(ii), (C)-(iii), (D)-(iv)  
 (c) (A)-(iv), (B)-(iii), (C)-(i), (D)-(ii)  
 (d) (A)-(iii), (B)-(ii), (C)-(i), (D)-(iv)

20. Select the wrong statement:

- (a) The human genome contains 3164.7 million nucleotide bases.  
 (b) Less than 10% of the genome codes for protein.  
 (c) Repeated sequences make up very large portion of the human genome.  
 (d) Chromosome 1 has most genes (2968) and Y has the fewest (231).

21. Match the column I and II:

Column-I	Column-II
(A) Pleiotropic gene	(i) Both allele express equally
(B) Co-dominance	(ii) Change in nucleotide
(C) Epistasis	(iii) One gene shows multiple phenotypic expressions
(D) Mutation	(iv) Non-allelic gene interaction

- (a) (A)-(i), (B)-(ii), (C)-(iii), (D)-(iv)  
 (b) (A)-(ii), (B)-(iii), (C)-(iv), (D)-(i)  
 (c) (A)-(iii), (B)-(i), (C)-(iv), (D)-(ii)  
 (d) (A)-(i), (B)-(iii), (C)-(iv), (D)-(ii)

22. Match the column I and II:

Column-I	Column-II
(A) K.C. Mehra	(i) Fluid mosaic model
(B) P. Maheshwari	(ii) First recombinant plasmid
(C) Cohen and Boyer	(iii) Haploid culture
(D) Singer and Nicolson	(iv) Root disease

(a) (A)-(i), (B)-(ii), (C)-(iii), (D)-(iv)  
 (b) (A)-(iv), (B)-(iii), (C)-(ii), (D)-(i)  
 (c) (A)-(i), (B)-(ii), (C)-(iii), (D)-(iv)  
 (d) (A)-(ii), (B)-(iii), (C)-(iv), (D)-(i)

23. Choose the correct statement.

- (a) Transcription and translation occur in same compartment for prokaryotes.  
 (b) Monocistronic RNA-carry more than one structural genes under single promoter.  
 (c) Introns and exons both code for protein synthesis.  
 (d) In prokaryotes, splicing and capping occurs before translation.

24. Identify the given diagram of tissue performing secretion and absorption.



Cuboidal cell

- (a) Simple cuboidal epithelium  
 (b) Simple columnar epithelium  
 (c) Stratified cuboidal epithelium  
 (d) Stratified columnar epithelium
25. Cervical vertebrae differ from other vertebra in having:  
 (a) Spinous process (b) Centrum  
 (c) Transverse process (d) Transverse foramen
26. Protein or reaction with which yields Ruhemann's purple?  
 (a) Ninhydrin (b)  $\text{Cu}^{2+}$   
 (c)  $\text{H}_2\text{O}_2$  (d) Benedict's solution
27. Which maintains static equilibrium?  
 (a) Cerebrum (b) Diencephalon  
 (c) Cerebellum (d) Semicircular canal
28. Which of the following is correct about biogas?  
 (a) Methane gas is produced along with ethyl alcohol by methanogen.  
 (b) Methanogens acts on cellulose and release biogas.  
 (c) Biogas is produced by thunder and lightning.  
 (d) Maximum gas found in biogas is  $\text{CO}_2$ .
29. Blood group of the father is A and blood group of mother is B. Then predict the blood group of the progeny:  
 (a) A, AB (b) A, B, AB, O  
 (c) B, AB (d) O, A, B
30. Skeletal muscles are controlled by:  
 (a) Sympathetic nervous system  
 (b) Parasympathetic nervous system  
 (c) Somatic nervous system  
 (d) Sympathetic and parasympathetic both

31. Hardy-Weinberg equilibrium is affected by:

- (a) Natural selection (b) Mutation  
 (c) Genetic drift (d) All of these

32. Mark the incorrect statement for inbreeding.

- (a) Inbreeding depression increases productivity.  
 (b) Inbreeding depression can be overcome by outcrossing.  
 (c) Produces pure lines.  
 (d) Increases homozygosity.

33. Mark the correct one.

- (a) Labeo - Internal fertilisation  
 (b) Frog - Internal fertilisation  
 (c) Birds - External fertilisation  
 (d) *Balaoscyra* - Internal fertilisation

34. Mark the correct statement.

- (a) Sahali is once a week oral contraceptive.  
 (b) Progesterone releases oestrogen.  
 (c) Cu-T is a barrier method.  
 (d) Vasectomy and tubectomy are temporary methods of contraception.

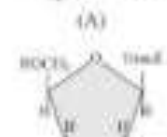
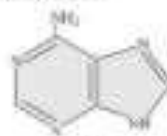
35. Choose the correct statement for
- Peripartus americana*
- .

- (a) It has 6 muscular hearts.  
 (b) It has 10 thoracic segments.  
 (c) Anal style is present in both male and female.  
 (d) It is nocturnal and present in damp places.

36. Animal of which phylum have hooks and suckers and are endoparasite on other animals?

- (a) Platyhelminthes (b) Annelida  
 (c) Aschelminthes (d) Arthropoda

37. Nucleoside is:



- (a) (A) and (B) (b) (B) and (C)  
 (c) (C) and (D) (d) (D) and (A)

38. Accelerate animals with flame cells are:

- (a) platyhelminthes (b) annelida  
 (c) aschelminthes (d) arthropoda

39. In gene cloning:

- (a) Gene is isolated and inserted in same organism.  
 (b) Gene is isolated and inserted in different organism.  
 (c) Gene is isolated and inserted in plasmid of other organism.  
 (d) Gene is isolated and inserted in chromosomal DNA.



40. Mark the correct statement regarding earthworm.
- One pair of female genital pores are present in 14<sup>th</sup> segment.
  - Four pairs of spermathecae are situated on ventro lateral sides of the intersegmental grooves i.e. 3<sup>rd</sup> segments.
  - Cloacum is present in 13-15 segments.
  - Four pairs of spermathecae are located in 6<sup>th</sup>-9<sup>th</sup> segments.
- Directions for Qs. 41 to 60:** In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as:
- If both assertion and reason are true and reason is the correct explanation of assertion.
  - If both assertion and reason are true but reason is not the correct explanation of assertion.
  - If assertion is true but reason is false.
  - If both assertion and reason are false.
- 
41. **Assertion:** Cockroach shows sexual dimorphism.  
**Reason:** The female cockroach bears a pair of short thread like anal styles.
42. **Assertion:** Parthenocarpy involves formation of seedless fruit.  
**Reason:** Apomixis occurs without fertilisation.
43. **Assertion:** Somaclonal variations produce slight differences in plants.  
**Reason:** They are produced while performing tissue culture.
44. **Assertion:** In eukaryotes, transcription occurs in nucleus.  
**Reason:** In bacteria, transcription and translation occurs in cytoplasm.
45. **Assertion:** Fig and wasp cannot complete their life cycle without each other.  
**Reason:** It is mutualistic relationship.
46. **Assertion:** Biofertilisation is used to increase nutrient value of crops.  
**Reason:** Meristem culture is used to obtain virus resistant plants.
47. **Assertion:** Isolated protoplasts are used for somatic hybridisation.  
**Reason:** Callus culture does not allow variation.
48. **Assertion:** In  $C_3$  cycle, the first stable compound is 3C compound.  
**Reason:** In  $C_4$  plants, Calvin cycle is absent.
49. **Assertion:** In vernalization, flowering is induced by low temperature.  
**Reason:** ABA is growth inhibiting hormone.
50. **Assertion:** In commensalism, one organism is benefited and other is unaffected.  
**Reason:** Cattle egret bird and cattle is an example of commensalism.
51. **Assertion:** Amoxicillin is a broad spectrum antibiotic.  
**Reason:** It is derived from penicillin G.
52. **Assertion:** 100 ml of blood delivers 5 ml  $O_2$  to tissues in normal conditions.  
**Reason:** One molecule of Hb can bind with 4 molecules of  $O_2$ .
53. **Assertion:** Proto-oncogenes are present in normal cells.  
**Reason:** Proto-oncogenes may causes malignant tumour in animals, if activated.
54. **Assertion:** Insertion of recombinant DNA within the coding sequence of  $\beta$ -galactosidase results in colourless colonies.  
**Reason:** Presence of insert results in inactivation of enzyme  $\beta$ -galactosidase known as insertional inactivation.
55. **Assertion:** *Agrobacterium tumefaciens* is popular in genetic engineering because this bacterium is associated with roots of all cereals and pulse crops.  
**Reason:** A gene incorporated in the bacterial chromosomal genome gets automatically transferred to the crop with which the bacterium is associated.
56. **Assertion:** Na and K ions are necessary for muscle contraction.  
**Reason:** Na and K concentration changes across the muscle cell membrane resulting in development of potential difference.
57. **Assertion:** Malpighian tubules are excretory organs in most of the insects.  
**Reason:** These help in excretion of urea and creatinine.
58. **Assertion:** Opioids are used as drugs of abuse.  
**Reason:** These slow down metabolism and produce hallucinations.
59. **Assertion:** Amount of cyanocobalamin required daily is 3 mcg.  
**Reason:** Its deficiency causes pernicious anaemia.
60. **Assertion:** In eukaryotes, both intron and exon are transcribed to form hnRNA.  
**Reason:** Splicing is required in prokaryotes.

## Hints and Solutions

1. (b) The given diagrams represents algae which are chlorophyll-bearing, simple, thick-walled, autotrophic and largely aquatic (both fresh water and marine) organisms. Out of the given diagrams (i) and (iii) are *Fucus* and *Laminaria*, respectively and both of them belongs to brown algae. Whereas diagram (ii) and (iv) are *Porphyra* and *Polysiphonia* respectively and both are red algae.
  2. (a) The correct diagram among the given options is (a), which represents a mature embryo sac. Embryo sac is a female gametophyte (an oval structure in the nucellus of the ovule) of flowering plants. Three cells are grouped together at the micropylar end and constitute the egg apparatus which consists of two synergids and one egg cell. The synergids have special cellular thickenings at the micropylar tip called filiform apparatus. Three cells are at the chalazal end known as antipodals. Six of the eight nuclei are surrounded by cell walls and organised into cells; the remaining two nuclei, called polar nuclei are situated below the egg apparatus in the large central cell.
  3. (b) The given diagrams represent the process of transcription in bacteria. In diagram (i), RNA polymerase binds to the DNA of the gene at a region called promoter and initiates the transcription, hence this process is termed as initiation. In diagram (ii), the polymerase reaches the terminator region, the nascent RNA and RNA polymerase falls off. This results in termination of transcription. Diagram (iii) represents the process of elongation which begins with the release of the  $n$  subunit from the polymerase. The dissociation of  $\sigma$  allows the core RNA polymerase-enzyme to proceed along the DNA template, synthesising mRNA in the 5' to 3' direction.
  4. (b) Parasitism is a type of symbiotic relationship between two species, where one member, the parasite, gains benefits (+) that come at the expense of the host member (-), e.g., fleas or ticks that live on dogs and cats are parasites. Commensalism is a type of relationship between two living organisms in which one organism benefits (+) from the other and the other derives neither benefit nor harm (0), e.g., barnacles that grow on whales are commensal. Amensalism is the association between organisms of two different species in which one is destroyed (-) and the other is unaffected (0), e.g., *Penicillium* and bacteria in which the secretion of penicillin (*penicillium*) kills the bacteria but it remains unaffected i.e., not harmed nor benefited.
- Mutualism is symbiotic relationship that is beneficial for both (+, +) of the different species involved in the association, e.g., the mycorrhizae are associations between fungi and the roots of higher plants in which the fungi help the plant in the absorption of essential nutrients from the soil while the plant in turn provides the fungi with energy-yielding carbohydrates.
5. (a) When two genes are on the same chromosome, they do not assort independently and are said to be linked genes. A homologous gene is a gene inherited in two species by a common ancestor. Autosome is a chromosome which is not considered as a sex chromosome, or is not involved in sex determination. It controls the inheritance of an organism's characteristics. Identical alleles are those in which the DNA sequences of the alleles of a gene are identical.
  6. (b) *Pusa shubhra*, a variety of cauliflower, is resistant to a disease called black rot. *Pusa swarnim* (Karni rat), a variety of *Brassica*, is resistant to disease called white rust. *Pusa sadabahar*, a variety of chili, is resistant to disease called mosaic virus. *Himgiri*, a variety of wheat is resistant to a disease named leaf and stripe rust.
  7. (a) Symplast consists of cytoplasm network of every plant cell interconnected by plasmodesmata. It does not include intercellular spaces and cell wall and therefore considered as the complete living component of the plant tissue.
  8. (b) Chloroplast, leucoplast, amyloplast are types of leucoplast. Leucoplast are colourless plastids found in the endosperm, tubers, roots and other non-photosynthetic tissues of plants. An elaioplast is primarily involved in storing fats or lipids inside fat droplets (plastoglobuli) in plants (particularly in nuts and liverworts). An aleuroplast is involved in the storage of proteins. An amyloplast is involved in the storage of carbohydrates (starch). Chromoplasts are carotenoid-accumulating plastids conferring colour to many flowers and fruits as well as to some tubers and roots.
  9. (a) Virus free plants can be formed by meristem culture in which one can collect the apical meristem from the infested plant and cultivate it in appropriate media (*in vitro*) to obtain virus-free plants. Callus culture is defined as an unorganised tissue mass growing on solid substrata with both auxin and cytokinin in an optimum conditions. Protoplast fusion, also called somatic fusion, is a type of genetic modification in plants by which two distinct species of plants are fused together to form a new hybrid plant with the characteristics of both, a somatic hybrid.

10. (a) Macronutrients are energy-providing chemical substances consumed by plant tissues in large quantities (in excess of  $10 \text{ mmole Kg}^{-1}$  of dry matter). The macronutrients include carbon, hydrogen, oxygen, nitrogen, phosphorus, sulphur, potassium, calcium and magnesium.
11. (a) GC content is usually calculated as a percentage value and sometimes called G + C ratio or GC ratio. It is calculated as  $G + C / \text{total} (A + T + G + C) \times 100\%$ . The GC content of a strand of nucleic acid is the percentage of nucleotides in the strand that possess either cytosine or guanine bases.
12. (a) A combination of DNA segments together constitute a unit capable of expressing one or more functional gene products. The segments of a gene can include exons, introns, regulatory regions, and nucleotide sequences that indicate where transcription should begin and end. Genes are contained in chromosomes, which are mainly in the cell nucleus and a genome is simply the sum total of an organism's DNA.
13. (a) Microelement are needed in very small amounts (less than  $10 \text{ mmole Kg}^{-1}$  of dry matter). These include iron, manganese, copper, molybdenum, zinc, boron, chlorine and nickel.
14. (a) The genetic code is the sequence of nucleotides in deoxyribonucleic acid (DNA) and ribonucleic acid (RNA) that determines the amino acid sequence of proteins. For protein, the genetic code is CCC, CCG and CCU.
15. (a) The coding strand (DNA transcription) is the DNA strand whose base sequence corresponds to the base sequence of the RNA transcript produced (thymine replaced by uracil). So, the correct sequence of mRNA will be  $5' \text{ AAUUC AAAUU AAGG} 3'$ .
16. (a) Diagram (A), (B) and (C) represents coccus, bacillus, and tobacco mosaic virus respectively. Coccus is any bacterium or archaean that has a spherical, ovoid, or generally round shape. Bacillus is a rod-shaped or cylindrical bacterium of the genus *Bacillus*, comprising spore-producing bacteria. Tobacco mosaic virus (TMV) is the most serious pathogen causing mosaic on tobacco leaves and is transmitted by artificial inoculation.
17. (a) The smooth endoplasmic reticulum (SER) is a part of the endomembranous system of the cell and a subset of the endoplasmic reticulum. The main function of the smooth ER is to make cellular products like hormones and lipids.
18. (a) DNA polymerases are the enzymes that replicate DNA by adding individual nucleotides to the 3-prime hydroxyl group of a strand of DNA. DNA polymerase uses the bases of the larger strand as a template. During strand elongation, two phosphates are cleaved from the incoming nucleotide triphosphates and the resulting nucleotide monophosphate is added to the DNA strand. This results in the:
  - Formation of a phosphodiester bond between the phosphates attached to the 5' carbon of the incoming nucleotide and the hydroxyl group on the trailing 3' carbon. This forms a covalent bond between the oxygen sticking off the 3' carbon of the first nucleotide, and the phosphorous atom in the phosphate group that sticks off the 5' carbon of the second nucleotide. These bonds are called 3'-5' phosphodiester bonds.
  - Release of a pyrophosphate molecule.
  - Extension of the DNA polymer by one nucleotide.
19. (a) The typical fruit of the mustard family (Brassicaceae) is called a silique, which is formed from a bicarpellary ovary which belongs to *Brassica campestris*. The caryopsis is popularly called a grain and is the fruit of the family Poaceae (or Gramineae), which includes wheat, rice, and corn. The fruit of *Triticum aestivum* is caryopsis. The tomato is the edible fruit of *Solanum lycopersicum*, commonly known as a tomato-plant family, Solanaceae. Tomato fruit is classified as a berry. In members of the Asteraceae the fruit is achene-like called a cypsela. It is a single-seeded dry indehiscent fruit that is found in *Helianthus annuus*.
20. (a) The human genome is the genome of *Homo sapiens*. It is made up of 23 chromosome pairs with a total of about 3 billion DNA base pairs. There are 24 distinct human chromosomes: 22 autosomal chromosomes, plus the sex-determining X and Y chromosomes. In human genome, less than 2% of the genome, codes for proteins. Pleiotropic gene influences multiple, unrelated phenotypic traits. Co-dominance is when both alleles contribute to the phenotype of the organism and express them equally. Epistasis is the non-reciprocal interaction between of non-allelic genes so that one gene masks the phenotypic expression of another non-allelic gene. Mutation is a change in nucleotide sequence due to errors of DNA replication, recombination, chemical mutagen, viruses or transposons.
21. (a) Dr. K.C. Mehta made a unique contribution in the field of plant pathology, who made a research in cereals, especially in wheat on the disease cycle of rust. P. Maheshwari was known for his invention of the technique of test-tube fertilisation of angiosperms. He found that haploid plants could be obtained on a regular basis and in relatively large numbers by placing immature anthers of *Datura innoxia* into culture. Herbert Bower and Stanley Cohen combined their efforts in biotechnology to invent a method of cloning genetically engineered molecules in foreign cells. In 1972, they isolate resistance gene by cutting out a piece of DNA from a plasmid which was responsible for conferring antibiotic resistance. S. J. Singer and G. L. Nicolson describe the structure of cell membranes as the fluid mosaic model which explains that there is a lipid bilayer in which the protein molecules are embedded.
22. (a) Dr. K.C. Mehta made a unique contribution in the field of plant pathology, who made a research in cereals, especially in wheat on the disease cycle of rust. P. Maheshwari was known for his invention of the technique of test-tube fertilisation of angiosperms. He found that haploid plants could be obtained on a regular basis and in relatively large numbers by placing immature anthers of *Datura innoxia* into culture. Herbert Bower and Stanley Cohen combined their efforts in biotechnology to invent a method of cloning genetically engineered molecules in foreign cells. In 1972, they isolate resistance gene by cutting out a piece of DNA from a plasmid which was responsible for conferring antibiotic resistance. S. J. Singer and G. L. Nicolson describe the structure of cell membranes as the fluid mosaic model which explains that there is a lipid bilayer in which the protein molecules are embedded.

23. (a) Monocistronic RNA is a mRNA that encodes only one protein. All eukaryotic mRNAs are monocistronic. An intron is any nucleotide sequence within a gene that does not code for proteins and interrupts the sequence of genes while an exon is a coding region of a gene that contains the information required to encode a protein. In prokaryotes, splicing and tailing do not occur because these processes requires exons and introns. Introns are found only in eukaryotes while exons are found in both prokaryotes and in eukaryotes.
24. (a) The given diagram represent simple cuboidal epithelium. It is composed of a single layer of cube-like cells, commonly found in ducts of glands and tubular parts of nephrons in kidneys. It assist in performing secretion and absorption.
25. (a) Cervical vertebra has transverse foramen (also known as foramen transversarium). This is an opening on each of the transverse processes which gives passage to the vertebral artery and vein and a sympathetic nerve plexus.
26. (a) Ninhydrin is most commonly used to detect fingerprints. In fingerprint the terminal amines of lysine residues in peptides and proteins sloughed off and react with ninhydrin. When reacting with these free amines, a deep blue or purple colour (known as Ruhemann's purple) is produced.
27. (a) The horizontally positioned utricle and the vertically positioned saccule are the two sensory chambers present in the vestibule of the inner ear. The utricle and saccule are responsible to maintain the static equilibrium of the body. The brain coordinates all three signals from the inner ear, visual system and skeletal system to maintain balance and equilibrium of the body.
28. (a) Methanogens are microorganisms that produce methane as a metabolic byproduct in hypoxic conditions. They are prokaryotic and belong to the domain of archaea. The chemical composition of biogas is 50-85%  $\text{CH}_4$  (methane), 20-35%  $\text{CO}_2$ ,  $\text{H}_2$ ,  $\text{N}_2$  and  $\text{H}_2\text{S}$  form the rest. Biogas is produced by anaerobic digestion with methanogen or anaerobic organisms, which digest material inside a closed system, or fermentation of biodegradable materials. Maximum percentage of gas found in biogas is methane (50-85%).
29. (a) If blood group of father is A and mother is B, then there would be four possibilities of genotype of offspring, i.e.,  $I^A I^A$ ,  $I^B I^B$ ,  $I^A I^B$  and  $I^O I^O$  as it can be predicted that the blood group can be A, B, AB or O.
30. (a) The somatic nervous system is part of the peripheral nervous system whose major functions include voluntary movement of the muscles, organs and reflex movements. In the process of voluntary movement, sensory neurons carry impulses to the brain and the spinal cord.
31. (a) The Hardy-Weinberg equilibrium is a principle stating that the genetic variation in a population will remain constant from one generation to the next in the absence of disturbing factors. There are five factors that can lead to evolution which are genetic drift, gene flow, mutation, sexual selection and natural selection.
32. (a) Inbreeding depression is the reduction in the biological fitness in a given population as a result of inbreeding, or breeding of related individuals. Continued inbreeding, especially close inbreeding, usually reduces fertility and even productivity.
33. (a)
34. (a) Saheli is world's first and only oral non-steroidal contraceptive pill. It is taken once in a week with a very few side effects and high contraceptive value. Progestasert is a 'T'-shaped IUD that releases progesterone. This IUD had a short, 1-year lifespan due to which it never achieved widespread popularity. Barrier methods of contraception, work by creating a physical barrier between sperm and egg cells so that fertilisation cannot occur. The most common forms of barrier contraception are condoms, diaphragm, cervical caps and vaults. Cu-T is a small 'T' shape IUD. This device is inserted by doctors or expert nurses in the uterus through vagina and make vagina unsuitable for fertilisation. Vasectomy and tubectomy are the permanent surgical methods for males and females respectively. It blocks the gamete transport and thereby prevent conception.
35. (a) A cockroach has one heart with many chambers. The heart of cockroach is an elongated tube with a muscular wall which regulates the blood in the haemocoel. This elongated tube lies mid-dorsally in the abdomen and thorax. The thorax of *Periplaneta americana* consists of three parts- prothorax, mesothorax, and metathorax. The abdomen is made up of 10 segments. In males, the genital pouch is present at the hind end of the abdomen. The male cockroach has thread-like anal styles, which are absent in the female cockroach. The 10<sup>th</sup> segment has a filamentous structure called the anal cerci, in both male and female cockroach.
36. (a) Platyhelminthes are free-living flatworms. These animals are mostly endoparasites including humans. They absorb nutrients directly from the body surface of the host with the help of hooks and suckers. For example, *Leishia Fasciola* etc.
37. (a) A nucleoside (such as guanosine or adenosine) that consists of a purine or pyrimidine base combined with deoxyribose or ribose sugar. Out of the given structures, (A) is a nitrogenous base i.e. adenine, while (B) is adenosine and (C) is uridine, both are nucleoside and (D) is adenylic acid which is a nucleotide.