# Chapter 18 Heredity

### I. Choose the correct answer.

### Question 1.

According to Mendel alleles have the following character:

- (a) Pair of genes
- (b) Responsible for character
- (c) Production of gametes
- (d) Recessive factors

### Answer:

(b) Responsible for character

### Question 2.

- 9:3:3:1 ratio is due to \_\_\_\_\_.
- (a) Segregation
- (b) Crossing over
- (c) Independent assortment
- (d) Recessiveness.

### Answer:

(c) Independent assortment

### Question 3.

The region of the chromosome where the spindle fibres get attached during cell division:

- (a) Chromomere
- (b) Centrosome
- (c) Centromere
- (d) Chromonema

### Answer:

(c) Centromere

### Question 4.

The centromere is found at the centre of the \_\_\_\_\_ chromosome.

- (a) Telocentric
- (b) Metacentric
- (c) Sub metacentric
- (d) Acrocentric.

### Answer:

(b) Metacentric

### Question 5.

The units form the backbone of the DNA.

- (a) 5 carbon sugar
- (b) Phosphate
- (c) Nitrogenous bases
- (d) Sugar phosphate

#### Answer:

(d) Sugar phosphate

### Question 6.

Okazaki fragments are joined together by \_\_\_\_\_.

- (a) Helicase
- (b) DNA polymerase
- (c) RNA primer
- (d) DNA ligase.

### Answer:

(d) DNA ligase.

### Question 7.

The number of chromosomes found in human beings are:

- (a) 22 pairs of autosomes and 1 pair of allosomes.
- (b) 22 autosomes and 1 allosome

(c) 46 autosomes

(d) 46 pairs autosomes and 1 pair of allosomes.

#### Answer:

(a) 22 pairs of autosomes and 1 pair of allosomes.

### Question 8.

The loss of one or more chromosome in ploidy is called \_\_\_\_\_.

- (a) Tetraploidy
- (b) Aneuploidy
- (c) Euploidy
- (d) Polyploidy.

### Answer:

(b) Aneuploidy

### II. Fill in the blanks:

- 1. The pairs of contrasting character (traits) of Mendel are called ......
- 2. Physical expression of a gene is called .....
- 3. The thin thread like structures found in the nucleus of each cell are called ......
- 4. DNA consists of two ..... chains.
- 5. An inheritable change in the amount or the structure of a gene or a chromosome is called .....

### Answer:

- 1. alleles or allelomorphs
- 2. Phenotype
- 3. Chromosomes
- 4. Polynucleotide chain
- 5. Mutation

# III. Identify whether the statement are True or False. Correct the false statement.

- 1. A typical Mendelian dihybrid ratio of F<sub>2</sub> generation is 3 : 1.
- 2. A recessive factor is altered by the presence of a dominant factor.
- 3. Each gamete has only one allele of a gene.
- 4. Hybrid is an offspring from a cross between genetically different parent.
- 5. Some of the chromosomes have an elongated knob-like appendages known as telomere.
- 6. New nucleotides are added and new complementary strand of DNA is formed with the help of enzyme DNA polymerase.
- 7. Down's syndrome is the genetic condition with 45 chromosomes.

### Answer:

- 1. False A typical Mendelian dihybrid ratio of F<sub>2</sub> generation is 9:3:3:1
- 2. True
- 3. True
- 4. True
- 5. False Some of the chromosomes have an elongated knob-like appendages known as satellite
- 6. True
- 7. True

### IV. Match the following:

Hormones		Disorders	
A	Autosomes	(i)	Trisomy 21
В	Diploid condition	(ii)	9:3:3:1
С	Allosome	(iii)	22 pair of chromosome
D	Down's syndrome	(iv)	2 <i>n</i>
E	Dihybrid ratio	(v)	23rd pair of chromosome

### Answer:

A. (iii)

B. (iv)

C. (v) D. (i) E. (ii)

### V. Answer in a sentence.

### Question 1.

What is a cross in which inheritance of two pairs of contrasting characters are studied? **Answer:** 

Dihybrid cross is a cross in which inheritance of two pairs of contrasting characters.

Question 2.

Name the conditions when both the aisles are identical? **Answer:** Homozygous alleles.

### Question 3.

A garden pea plant produces axial white flowers. Another of the same species produced terminal violet flowers. Identify the dominant trait.

### Answer:

The dominant trait is axial white flower.

### Question 4.

What is the name given to the segments of DNA, which are responsible for the inheritance of a particular character?

### Answer:

Genes are the segments of DNA, which are responsible for the inheritance of a particular character.

### Question 5.

Name the bond which binds the nucleotides in a DNA. **Answer:** Hydrogen bond binds the nucleotides in a DNA.

### VI. Short Answer Questions.

**Question** 1. Why did Mendel select pea plant for his experiments? **Answer:** 

- 1. It is naturally self-pollinating and so is very easy to raise pure breeding individuals.
- 2. It has a short life span as it is an annual and so it was possible to follow several generations.
- 3. It is easy to cross-pollinate.
- 4. It has deeply defined contrasting characters.

5. The flowers are bisexual.

### Question 2.

What do you understand by the term phenotype and genotype? **Answer:** 

- The external expression of a particular trait is known as the phenotype.
- The genetic expression of an organism is a genotype.

### Question 3.

What are allosomes?

### Answer:

Allosomes are chromosomes which are responsible for determining the sex of an individual. They are also called as sex chromosomes or hetero-chromosomes. There are two types of sex chromosomes, X and Y- chromosomes.

### Question 4.

What are the Okazaki fragments?

### Answer:

The short segments of DNA are called Okazaki fragments.

### Question 5.

Why is euploidy considered to be advantageous to both plants and animals?

### Answer:

Euploidy is the condition in which individual bears more than the usual number of diploid (2n) chromosome. It is used in plant breeding and horticulture. It has economic significance by the production of large sized flowers and fruits. It plays a significant role in the evolution of new species.

### Question 6.

A pure tall plant (TT) is crossed with the pure dwarf plant (tt), what would be the  $F_1$  and  $F_2$  generations? Explain.

### Answer:

In the  $F_1$  generation, all are tall plants. (Genotype all are Tt and phenotype all are tall). In  $F_2$  generation, genotype three tall and one dwarf. [TT : Tt : tt = 1 : 2 : 1] phenotype. Tall : dwarf 3 : 1 [TT : Tt : Tt : tt].

### Question 7.

Explain the structure of a chromosome.

### Answer:

The chromosomes are thin, long and thread like structures consisting of two identical strands called sister chromatids. They are held together by the centromere. Each chromatid is made up of spirally coiled thin structure called chromonema. The chromonema has number of bead-like structures along its length which are called chromomeres.

### Question 8.

Label the parts of the DNA in the diagram given below. Explain the structure briefly. **Answer:** 

(i) DNA molecule consists of two polynucleotide chains.

(ii) These chains form a double helix structure with two strands which run anti-parallel to one another.

(iii) Nitrogenous bases in the centre are linked to sugar-phosphate units which form the backbone of the DNA.

(iv) Pairing between the nitrogenous bases is very specific and is always between purine and pyrimidine linked by hydrogen bonds.



Nucleotides in a DNA

### **VII. Long Answer Questions**

### Question 1.

Explain with an example of the inheritance of dihybrid cross. How is it different from a monohybrid cross?

### Answer:

Dihybrid cross involves the inheritance of two pairs of contrasting characteristics (or contrasting traits) at the same time. The two pairs of contrasting characteristics chosen by Mendel were shape and color of seeds: round-yellow seeds and wrinkled-green seeds. Mendel crossed pea plants having round-yellow seeds with pea plants having wrinkled-green seeds. Mendel made the following observations:

(i) Mendel first crossed pure breeding pea plants having round-yellow seeds with pure breeding pea plants having wrinkled-green seeds and found that only round-yellow seeds were produced in the first generation ( $F_1$ ). No wrinkled-green seeds were obtained in the  $F_1$  generation. From this it was concluded that round shape and yellow color of the seeds were dominant traits over the wrinkled shape and green color of the seeds.

(ii) When the hybrids of  $F_1$  generation pea plants having round-yellow seeds were crossbred by self pollination, then four types of seeds having different combinations of shape and color were obtained in second generation or  $F_2$  generation. They were round yellow, round-green, wrinkled-yellow and wrinkled-green seeds.

The ratio of each phenotype (or appearance) of seeds in the  $F_2$  generation is 9:3:3:1. This is known as the Dihybrid ratio.



Monohybrid cross is a genetic cross that involves a single pair of gene or trait. In this parents differ by single trait. Eg: Height.

Dihybrid cross is a genetic cross that involves two pairs of genes, which are responsible for two trait. In this, parents have two different independent trait. Eg: flower colour, stem length.

### Question 2.

How is the structure of DNA organised? What is the biological significance of DNA? **Answer:** 

DNA is the genetic material of almost all the organisms. One of the active functions of DNA is to make its copies which are transmitted to the daughter cells. Replication is the process by which DNA makes exact copies of itself. Replication is the basis of like and takes place during the inter phase stage.

During replication of DNA, two complementary strand of DNA unwind and separate from one end in a zipper like fashion. The enzyme helicase unwinds the two strands of the DNA. The enzyme called topoisomerase separates the double helix above the replication fork and removes the twists formed during the unwinding process. For the synthesis of new DNA, two things are required. One is RNA primer and enzyme primase. The DNA polymerase moves along the newly formed RNA primer nucleotides, which leads to the elongation of DNA. In the other strand DNA is synthesized in small fragments called Okazaki fragments.

These fragments are linked by the enzyme called ligase. In the resulting DNA, one of the strand is parental and the other is the newer strands which is formed discontinuously.

Significance of DNA:

(i) It is responsible for the transmission of hereditary information from one generation to next generation.

- (ii) It contains information required for the formation of proteins.
- (iii) It controls the developmental process and life activities of an organism.



### Question 3.

The sex of the new born child is a matter of chance and neither of the parents may be considered responsible for it. What would be the possible fusion of gametes to determine the sex of the child?

### Answer:

Sex determination is a chance of probability as to which category of sperm fuses with the egg. If the egg (X) is fused by the X-bearing sperm an XX individual (female) is produced. If the egg (X) is fused by the Y-bearing sperm an XY individual (male) is produced. The sperm, produced by the father, determines the sex of the child. The mother is not responsible in determining the sex of the child.

Now let's see how the chromosomes take part in this formation. Fertilization of the egg (22+X) with a sperm (22+X) will produce a female child (44+XX). while fertilization of the egg (22+X) with a sperm (22+Y) will give rise to a male child (44+XY).

## VIII. Higher Order Thinking Skills: (HOTS)

### **Ouestion** 1.

Flowers of the garden pea are bisexual and self-pollinated. Therefore, it is difficult to perform hybridization experiment by crossing a particular pistil with the specific pollen grains. How Mendel made it possible in his monohybrid and dihybrid crosses?

### Answer:

He worked on nearly 10,000 pea plants of 34 different varieties. He had chosen 7 pairs of contrasting characters. As the pea plants, are self-pollinating it is easy to raise pure breeding individuals. It is easy to cross-pollinate. It has contrasting characters. So Mendel made it possible in his monohybrid and dihybrid crosses.

### Question 2.

Pure-bred tall pea plants are first crossed with pure-bred dwarf pea plants. The pea plants obtained in F<sub>1</sub> generation are then cross-bred to produce F<sub>2</sub> generation of pea plants. (a) What do the plants of F<sub>1</sub> generation look like?

(b) What is the ratio of tall plants to dwarf plants in F<sub>2</sub> generation?

(c) Which type of plants were missing in  $F_1$  generation but reappeared in  $F_2$  generation? Answer:

(a) plants will be tall

(b) 3 : 1

(c) Tall heterozygous (Tt)

### Ouestion 3.

Kavitha gave birth to a female baby. Her family members say that she can give birth to only female babies because of her family history. Is the statement given by her family members true? Justify your answer.

### Answer:

The statement given by her family members were not true. It is not hereditary or family history. The sex determination mainly depends on which category of sperm fuses with the egg. If the egg [X] is fused by the X – bearing sperm, an XX individual (female) is produced. If the egg [X] is fused by the Y – bearing sperm an XY individual (male) is produced.

### **IX. Value-Based Questions**

### **Question** 1.

Under which conditions does the law of independent assortment hold good and why? Answer:

During meiosis, chromosomes assort randomly into gametes, such that the segregation of alleles of one gene is independent of alleles of another gene. This is stated in Mendel's Second Law and is known as the law of independent assortment.