SCIENCE
WORKSHEET_180825
CHAPTER 08 HEREDITY (ANSWERS)

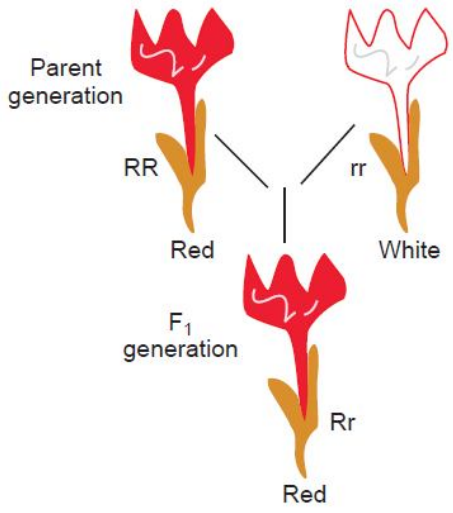
SUBJECT: SCIENCE **MAX. MARKS : 40**
CLASS : X **DURATION : 1½ hrs**

General Instructions:
(i). **All** questions are compulsory.
(ii). This question paper contains 2**0** questions divided into five Sections A, B, C, D and E.
(iii). **Section A** comprises of **10 MCQs** of **1 mark** each. **Section B** comprises of 4 questions of **2 marks** each. **Section C** comprises of 3 questions of **3 marks** each. **Section D** comprises of 1 question of **5 marks** each and **Section E** comprises of 2 Case Study Based Questions of **4 marks** each.
(iv). There is no overall choice.
(v). Use of Calculators is not permitted

SECTION – A
Questions 1 to 10 carry 1 mark each.

1. In peas, a pure tall plant (TT) is crossed with a pure short plant (tt). The ratio of pure tall plants to pure short plants in F_2 generation will be:
(a) 1 : 3 (b) 3 : 1 (c) 1 : 1 (d) 2 : 1
Ans. (c) 1 : 1
The genotypic ratio of F_2 generation is: TT : Tt : tt = 1 : 2 : 1. Therefore, the ratio of pure tall (TT) and pure short (tt) plants of F_2 generation will be the same.

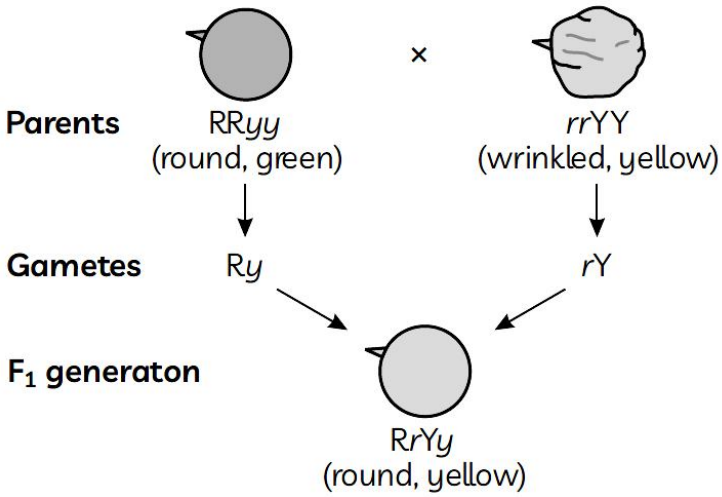
2. The inheritance of colour trait in flower is shown below:



R and r denote two different genes for colour.
Which law of Mendel can be explained using the image?
(a) Only law of segregation
(b) Only Law of independent assortment
(c) Law of segregation and Law of dominance
(d) Law of segregation and Law of independent assortment
Ans. (c) Law of segregation and Law of dominance
In F_1 generation, only red colour is expressed which is the dominant character and it follows the law of dominance. Red and white colour trait express themselves in definite proportion in F_2 generation and follows the law of segregation.

3. If a round, green-seeded pea plant (RRyy) is crossed with wrinkled, yellow–seeded pea plant (rrYY), the seeds produced in F_1 generation are:
(a) round and yellow (b) round and green

(c) wrinkled and green (d) wrinkled and yellow.
Ans. (a) round and yellow
The cross between RRyy and rrYY seeds will obtain RrYy offspring which will exhibit round and yellow phenotype, as these traits are the dominant ones.



4. In human beings, the sex of the offspring in the zygote after fertilisation of the male and female gametes is determined by the sex chromosomes. A zygote which has an X chromosome inherited from the father will develop into a:
(a) boy (b) girl
(c) X chromosome does not determine the sex of a child (d) either boy or girl.
Ans. (b) girl
Humans use the XX-XY system for sex determination, where women have XX sex chromosomes and men have XY sex chromosomes. All children inherit an X chromosome from their mother, regardless of their sex.
Therefore, the child's sex is determined by the chromosome inherited from the father. A child who receives an X chromosome from the father will be a girl, while a child who receives a Y chromosome will be a boy.

5. The statement that correctly describes the characteristic(s) of a gene is:
(a) In individuals of a given species, a specific gene is located on a particular chromosome.
(b) A gene is not the information source for making proteins in the cell.
(c) Each chromosome has only one gene located all along its length.
(d) All the inherited traits in human beings are not controlled by genes.
Ans. (a) In individuals of a given species, a specific gene is located on a particular chromosome.
The position of a gene on a specific chromosome is fixed in an individual of a given species. The term “allele” refers to a gene’s alternative form.

6. Consider the following statements:
(i) The sex of a child is determined by what it inherits from the mother.
(ii) The sex of a child is determined by what it inherits from the father.
(iii) The probability of having a male child is more than that of a female child.
(iv) The sex of a child is determined at the time of fertilisation when male and female gametes fuse to form a zygote.
The correct statements are:
(a) (i) and (iii) (b) (ii) and (iv) (c) (iii) and (iv) (d) (i), (iii) and (iv)
Ans. (b) (ii) and (iv).
There is 50% probability of a male child and 50% of a female child.

7. Which of the following cannot be an outcome of Mendel’s experiment on crossing a tall pea plant with a short pea plant?
(a) 3 tall and 1 short plant (b) 4 tall plants and 1 medium height plant.

(c) 24 tall and 8 short plants (d) 9 tall and 3 short plants
Ans. (b) 4 tall plants and 1 medium height plant.
Medium height plants are not obtained when a cross of a tall pea plant with a short pea plant is performed. There will be either tall (TT or Tt) or short (tt) plants only.

8. A homozygous dominant guinea pig with black fur is crossed with a homozygous guinea pig with white fur. The F_1 generation is crossed with itself.
What percentage of F_2 generation is expected to show white fur coat?
(a) 25% (b) 50% (c) 75% (d) 100%
Ans. (a) 25%
Let the phenotype of homozygous dominant black pig be BB and the phenotype of homozygous recessive white pig be bb.
The genotype of F_1 generation by crossing these alleles will be Bb. The offspring from F1 generation will have black fur.
If F_1 generation is crossed with itself, then F_2 generation will be produced.
In F_2 generation, there will be 75% dominant black fur guinea pig and 25% white fur guinea pig i.e., 3:1.

In the following questions 9 and 10, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
(c) Assertion (A) is true but reason (R) is false.
(d) Assertion (A) is false but reason (R) is true.

9. **Assertion (A):** The sex of a child in human beings will be determined by the type of chromosome he/she inherits from the father.
Reason (R): A child who inherits the 'X' chromosome from his father would be a girl (XX), while a child who inherits a 'Y' chromosome from the father would be a boy (XY).
Ans. (a) Both (A) and (R) are true and (R) is the correct explanation of the assertion (A).
Assertion statement: The chromosome that the male provides determines the biological sex (male or female) of the child.
The X or Y chromosome can be contributed by the male, who has XY sex chromosomes, whereas the X chromosome must be contributed by the female, who has XX sex chromosomes.
Depending on whether a man's sperm carries an X or Y chromosome, a baby's sex is determined.
A newborn girl (XX) is created when an X chromosome joins with the mother's X chromosome, while a boy is created; when a Y chromosome combines with the mother's (XY).
Reason statement: A chromosome known as a sex chromosome is distinct from a typical autosome in terms of shape, size, and function.
When, two chromosomes—the X and the Y chromosome—determine whether you are a boy or a girl.
Sex chromosomes are referred to as: there are two X chromosomes in females.
Each male has one X and one Y chromosome.
As opposed to the sex chromosomes, an autosome is one of the numbered chromosomes.
Humans contain one pair of sex chromosomes and 22 pairs of autosomes (XX or XY).
In general, autosome numbers correspond to autosome sizes.
Since both pass through here and the sea is also present, we can save both are true.

10. **Assertion (A):** Variations always provide a survival advantage to an organism.
Reason (R): Variations can be caused due to incorrect DNA copying.
Ans. (d) A is false but R is true.
Not all variations in organisms provide a survival advantage. While some variations may offer benefits in specific environments, others can be neutral or even harmful. An example of genetic variation is mutation, which can happen due to errors in DNA copying during processes like

replication. Mutations are a natural aspect of genetic processes and contribute to differences in traits.

SECTION – B

Questions 11 to 14 carry 2 marks each.

11. If a pure tall pea plant is crossed with a pure dwarf pea plant, then in F1 generation only tall plants appear. What happens to the traits of the dwarf plant?
Ans. Although in F1 generation only the tall plants appear, both the tallness and dwarfness traits are inherited in the F1 plants but as the tallness trait is dominant, it is expressed, whereas, dwarfness trait being recessive is not expressed. It is expressed in F2 generation.

12. In a pea plant, the trait of flowers bearing violet colour (PP) is dominant over white colour (pp). Explain the inheritance pattern of F_1 and F_2 generations with the help of a cross following the rules of inheritance of traits. State the visible characters of F_1 and F_2 progenies.
Ans. Trait of flowers bearing violet colour = PP
Trait of flowers bearing white colour = pp

Parents PP × pp

↓

F_1 generation Pp

↓ (On selfing)

F_2 generation

Gametes	P	p
P	PP	Pp
p	Pp	pp

All flowers are violet coloured in F_1 generation and in F_2 generation, 3 flowers are violet coloured and 1 flower is white coloured.

13. What is DNA? Where is DNA found in a cell?
Ans. Deoxyribonucleic Acid (DNA) is a molecule which carries the hereditary information in a coded form from one generation to the other in all the organisms. DNA is found in the nucleus of a cell.

14. In an asexually reproducing species, if a trait X exists in 5% of a population and trait Y exists in 70% of the same population, which of the two trait is likely to have arisen earlier? Give reason.
Ans. Trait Y which exists in 70% (larger fraction) of the population is likely to have arisen earlier because in asexual reproduction, identical copies of DNA are produced and variations do not occur. New traits come in the population due to sudden mutation and then are inherited. 70% of the population with trait Y is likely to have been replicating that trait for a longer period than 5% of population with trait X.

OR

Mustard was growing in two fields- A and B. While Field A produced brown coloured seeds, field B produced yellow coloured seeds.
It was observed that in field A, the offsprings showed only the parental trait for consecutive generations, whereas in field B, majority of the offsprings showed a variation in the progeny. What are the probable reasons for these ?
Ans. In field A, the reason for parental trait in consecutive generations of the offsprings is self-pollination. In field B, variation is seen to occur because of recombination of genes as cross-pollination is taking place.

SECTION – C

Questions 15 to 17 carry 3 marks each.

15. In humans, there is a 50% probability of the birth of a boy and 50 % probability that a girl will be born. Justify the statement on the basis of the mechanism of sex-determination in human beings.

Ans. In human beings, the genes inherited from our parents decide whether we will be boys or girls. Women have a perfect pair of sex chromosomes (XX). But, men have a mismatched pair (XY). All children will inherit an X chromosome from their mother regardless of whether they are boys or girls. Thus, the sex of the children will be determined by what they inherit from their father. A child who inherits an X chromosome from her father will be a girl, and one who inherits a Y chromosome from him will be a boy.

16. What are chromosomes? Explain how in sexually reproducing organisms the number of chromosomes in the progeny is maintained.

Ans. Chromosomes are thread-like structures, made of proteins and DNA, found in the nucleus at the time of cell division.

In sexually reproducing organisms, the gametes undergo meiosis, and hence, each gamete contains only half a set of chromosomes. When two gametes fuse, the zygote formed contains the full set of chromosomes. Hence, the formation of gametes by meiosis helps to maintain the number of chromosomes in the progeny.

17. What is the probability of a girl or a boy being born in a family? Justify your answer.

Ans. There are 50% chances that a girl may be born and 50% chances that a boy may be born.

It can be explained as follows: Most human chromosomes have a maternal copy and a paternal copy. We have 22 such chromosomes. One pair of chromosomes called sex chromosomes is odd in not always being a perfect pair. Women have a perfect pair of sex chromosomes, both called X. (XX)

But men have a mismatched pair of sex chromosomes in which one is normal sized – X chromosome while the other is a short one called Y chromosome. (XY)

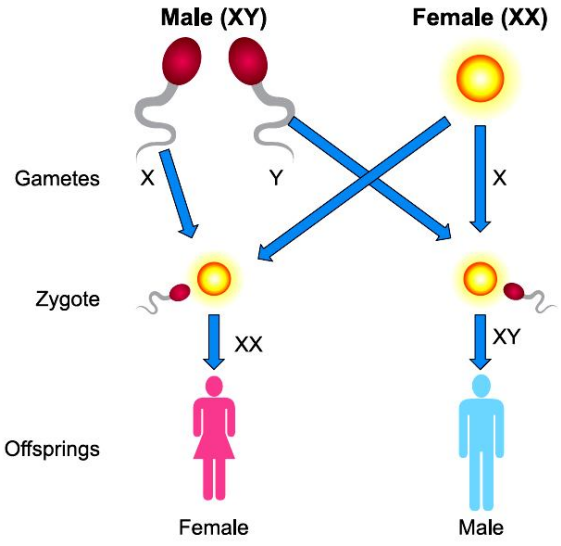
A child receives one chromosome from mother which is essentially X chromosome.

A child who inherits an X chromosome from her father will be a girl, and one who inherits a Y chromosome from him will be a boy.

OR

How is the sex of the child determined in human beings?

Ans. In human beings, sex of the child depends upon which kind of male gamete fertilises the female gamete. If sperm carrying X chromosome fertilises the ovum carrying X chromosome, then the child born will be a girl.



If a sperm carrying Y chromosome fertilises the ovum which carries X chromosome, then the child born will be a boy.

SECTION – D

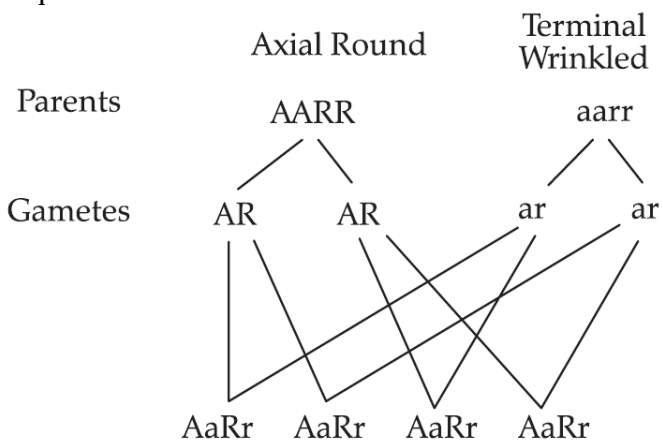
Questions 18 carry 5 marks.

18. (a) Why did Mendel choose garden pea for his experiments? Write two reasons.
(b) List two contrasting visible characters of garden pea, Mendel used for his experiment.
(c) Explain in brief how Mendel interpreted his results to show that the traits may be dominant or recessive.

Ans. (a) Reasons: (i) Pea plant is small and easy to grow.
(ii) A large number of true breeding varieties of pea plant are available.
(iii) Short life cycle.
(iv) Both self and cross-pollination can be made possible. (Any two reasons)
(b) Contrasting characters: Round / Wrinkled seeds, Tall / Short plants, White / Purple flowers, Green / Yellow seeds (Or any other) (Any two)
(c) When Mendel crossed two pea plants with a pair of contrasting characters, only one character appeared in all the members of F_1 progeny and the others remain hidden. On selfing F_1, the hidden characters reappeared in selfing F_2, the hidden characters reappeared in just 25% of the offsprings and the other 75% shared the characters expressed in F_1. Mendel concluded that the character which expresses itself in F_1 and in 75% of the individuals of F_2 is dominating while the other is recessive.

OR

Given below is a schematic diagram showing Mendel's experiment on sweet pea plants having axial flowers with round seeds (AARR) and terminal flowers with wrinkled seeds (aarr). Study the same and answer the questions that follows:



(i) Give the phenotype of F_1 progeny.
(ii) Give the phenotype of F_2 progeny produced upon by the self-pollination of F_1 progeny.
(iii) Give the phenotypic ratio of F_2 progeny.
(iv) Name and explain the law introduced by Mendel on the basis of the above observation.

Ans. (i) Phenotype of F_1 progeny is axial flowers with round seeds.
(ii) Phenotype of F_2 progeny are axial round (9), axial wrinkled (3), terminal round (3) and terminal wrinkled (1).
(iii) Phenotypic ratio of F_2 progeny is 9 : 3 : 3 : 1
(iv) Mendel gave the law of independent assortment on the basis of above observation. It states that the factors of different pairs of contrasting characters behave independent to each other at the time of gamete formation, and at the time of fertilisation they bring about all the possible combinations of characters.

SECTION – E (Case Study Based Questions)

Questions 19 to 20 carry 4 marks each.

19. Mendel worked out the rules of heredity by working on garden pea using a number of visible contrasting characters. He conducted several experiments by making a cross with one or two pairs of contrasting characters of pea plant. On the basis of his observations, he gave some interpretations which helped to study the mechanism of inheritance.

Read the above passage carefully and give the answer of the following questions:

(a) When Mendel crossed pea plants with pure tall and pure short characteristics to produce F_1 progeny, which two observations were made by him in F1 plants?

(b) Write one difference between dominant and recessive trait.

(c) (i) In a cross with two pairs of contrasting characters.

RRYY × rryy

(Round Yellow) (Wrinkled Green)

Mendel observed 4 types of combinations in F2 generation. By which method did he obtain F_2 generation? Write the ratio of the parental combinations obtained and what conclusions were drawn from this experiment.

OR

(ii) Justify the statement: ''It is possible that a trait is inherited but may not be expressed.''

Ans. (a) Following two observations were made by Mendel:

(i) All the F1 progeny plants were tall.

(ii) Tall trait was dominant over the short trait in the F1 progeny.

(b) Dominant trait is able to express itself over another contrasting trait whereas recessive trait is unable to express its effect in the presence of dominant trait.

(c) (i) In a dihybrid cross, Mendel used the method of self pollination to obtain F2 generation.

Round yellow (9) and wrinkled green (1) are parental combinations.

So, required ratio = 9 : 1

Mendel concluded that traits assort independently, leading to the formation of offspring with various combinations of traits.

OR

(ii) Yes, it is possible that a trait is inherited but may not be expressed. Let us take the following example to explain the given statement. Mendel crossed tall pea plants with dwarf pea plants.

Parents	:	(TT) Pure tall plant	×	(tt) Pure dwarf plant
F_1 generation	:	(Tt) (Tt)	×	(Tt) (Tt)
Selfing of F_1	:	(Tt) Tall	×	(Tt) Tall
F_2 generation	:	(TT) (Tt) Tall Tall	×	(Tt) (tt) Tall Dwarf

The reappearance of the dwarf pea plants in the F_2 generation proves that the dwarf trait was inherited by the organism but not expressed in the F_1 generation.

20. Sahil performed an experiment to study the inheritance pattern of genes. He crossed tall pea plants (T T) with short pea plants (tt) and obtained all tall plants in F_1 generation.

Read the above passage carefully and give the answer of the following questions:

(a) What will be set of genes present in the F_1 generation?

(b) Give reason why only tall plants are observed in F1 progeny.

(c) When F_1 plants were self-pollinated, a total of 800 plants were produced. How many of these would be tall, medium height or short plant? Give the genotype of F_2 generation.

OR

When F_1 plants were cross-pollinated with plants having tt genes, a total of 800 plants were produced. How many of these would be tall, medium height or short plants? Give the genotype of F_2 generation.

Ans. (a) Genes present in F_1 generation is Tt.

(b) It is so because tallness (T) is a dominant trait and short (t) is a recessive trait in pea plants.

(c) When F1 plants were self-pollinated, both tall and short traits are expressed in F_2 generation in the ratio 3 : 1. Thus, 600 plants will be tall and 200 plants will be short.

The genotype of F_2 generation is

TT	:	Tt	:	tt
1	:	2	:	1

OR

	t	t
T	Tt	Tt
t	tt	tt

In this cross, 400 tall (Tt) and 400 short (tt) will be produced.

The genotype of F_2 generation is

Tt	:	tt
1	:	1