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Q.1 List three distinguishing features, in tabular form, between acquired traits and the inherited traits. [CBSE 2016]

Ans.

S. No.	Acquired traits	Inherited traits
1.	Do not bring changes in the DNA of germ cells.	Bring changes in the DNA of germ cells.
2.	Cannot direct evolution.	Can direct evolution.
3.	Cannot be passed on to the progeny.	Can be passed on to the progeny.

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Q.2. What is molecular phylogeny?

[CBSE 2013]

Ans. The approach of molecular phylogeny is based on the idea that organisms which are more distantly related will accumulate a greater number of differences in their DNA. Such studies trace the evolutionary relationships among different organisms and thus help in their classification.

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Q.3. The modern human beings have originated in Africa.

(a) What evidence suggests this fact?

(b) If an animal is similar to its ancestors, what does it imply?

[CBSE 2014]

Ans. (a) Discovery of a number of fossils in Africa.

(b) (i) Organism is recently evolved from ancestor.

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(ii) Animal has not accumulated variations.

Q.4. In a monohybrid cross between tall pea plants denoted by TT and short pea plants denoted by tt, Sehaj Anant obtained only tall plants denoted by Tt in the F₁ generation.

However, in F₂ generation she obtained both tall and short plants.

Using the above information explain the law of dominance.

[CBSE 2013,14]

Ans. According to the law of dominance, trait that is dominant gets expressed in the F₁ generation. Although both the dominant and the recessive traits get inherited in the F₁ generation, it is only the dominant trait which gets expressed i.e., a single copy of dominant trait is enough for the expression of the tall trait. Trait like 'T' is thus called dominant trait.

Q.5. What evidence do we have for the origin of life from inanimate matter? [CBSE 2012,14]

Ans. An experiment conducted by Stanley L. Miller and Harold C. Urey in 1953 proved that origin of life takes place from inanimate matter. They assembled the atmosphere containing NH₃, CH₄ and H₂S but no O₂ over water. This was maintained at a temperature just below 100°C and sparks were passed through the mixture of gases. At the end of a week, 15% carbon from methane had been converted to simple compounds of carbon like amino acids, which make up protein molecules. So, life arose afresh on earth.

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Q.6. Only variations that confer an advantage to an individual organism will survive in a population. Do you agree with this statement? Why or why not? [CBSE 2011,13,14]

Ans. No, many of the times the variations are not advantageous to an individual organism but they still survive in a population, e. g., take the case of free ear lobe and attached ear lobe. Most of the other variations not only give survival advantage to an individual but also contribute to genetic drift. Thus, we can say that most of the variations lead to better adaptation of an organism to the changing environment. In this way, it gives survival advantage to that organism and will also survive in the coming population.

Q.7. How does the creation of variations in a species promote survival? [CBSE 2014]

Ans. All the variations in the species do not have equal chances of surviving in the environment. The survival of the variations depend on the nature of variations. Different individuals have different chances. Selection of variants by the environmental factors forms the bases for evolutionary process.

Q.8. How do Mendel's experiments show that traits may be dominant or recessive? [CBSE 2014,16]

Ans. Mendel took pea plants having different characteristics, like a tall plant and a short plant. He produced progeny from them and calculated the percentages of tall or short progeny. There was no halfway characteristics in the first generation. All plants were tall. This meant that only one of the parental traits was seen, not the other. Here, the trait of tallness is dominant while shortness is the recessive characteristic.

Q.9. How do Mendel's experiments show that traits are inherited independently? [CBSE 2014,16]

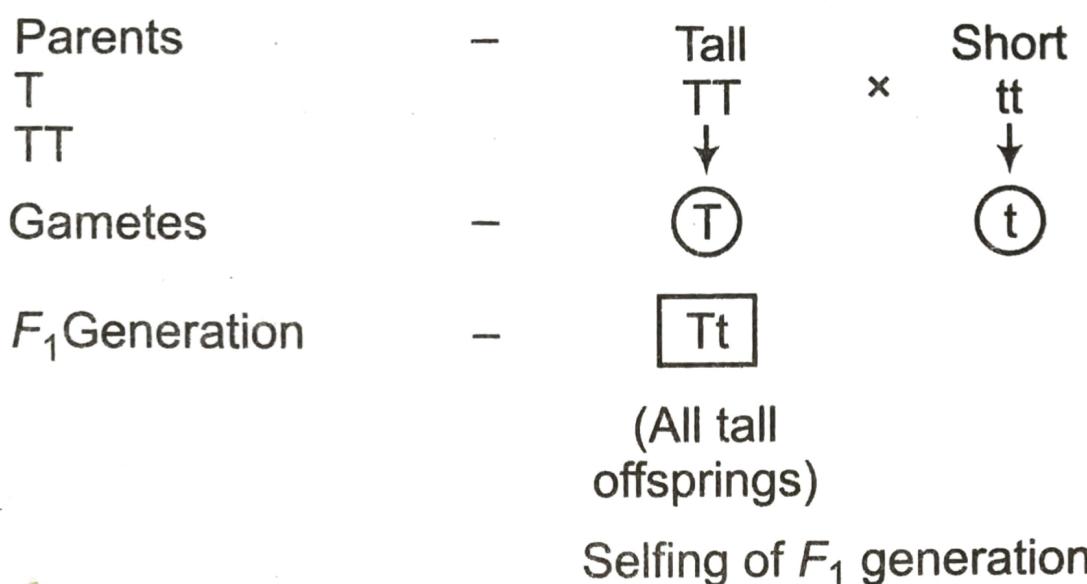
Ans. Mendel performed an experiment in which he took two different traits, like tall and short plant, and round and wrinkled seeds. In 2nd (F_2) generation, some plants, were tall with round seeds and some were short with wrinkled seeds. There would also be short plants having round seeds. Thus, the tall/short traits and round/wrinkled seed traits are independently inherited.

Q.10. Name the plant Mendel used for his experiment. What type of progeny was obtained by Mendel in F₁ and generations when he crossed the tall and short plants?

Write the ratio he obtained in F_2 generation plants.

[CBSE 2019]

Sol. The plant Mendel used for his experiment was *Pisum sativum* (garden pea).



Gametes	-	Tt	x	Tt	
		(T)	(t)	(T)	(t)
F_1 Generation	-				
		♂	(T)	(t)	
		♀	TT (Tall)	Tt (Tall)	
			TT (Tall)	tt (Short)	
F_2 Phenotypic ratio	-			Tall : Short 3 : 1	
F_2 Genotypic ratio	-			TT : Tt : tt 1 : 2 : 1	

Q.11. Explain how do organism create an exact copy of themselves.

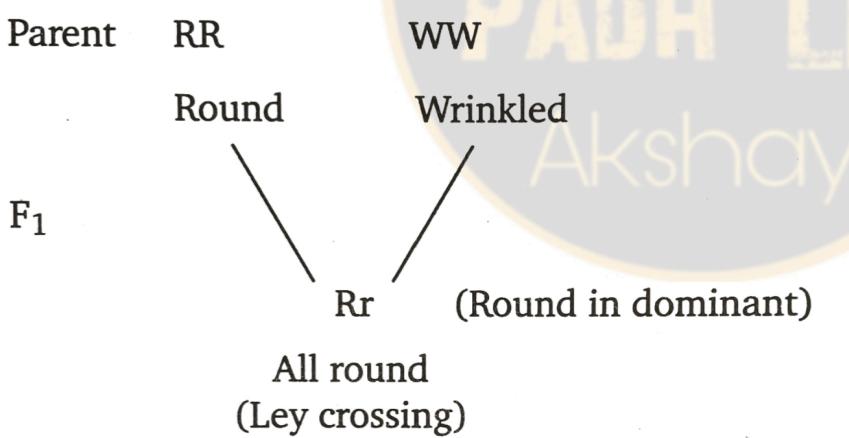
[CBSE 2016,19]

Ans. To build the copies of DNA or the genetic material, the cells use biochemical reactions. Additional cellular apparatus along with the DNA copies are separated and so a cell divides to give rise to two almost identical cells.

Q.12. Mendel, in one of his experiments with pea plants, crossed a variety of pea plant having round seeds with one having wrinkled seeds. State Mendel's observations giving reasons of F₁ and F₂ progeny of this cross. Also, list any two contrasting characters, other than round seeds of pea plants that Mendel used in his experiments. [CBSE 2019]

[CBSE 2019]

Ans. Pure-Breeding



F_2	R	r
R	RR Round	Rr Round
r	Rr Round	rr Round

Phenotypic ratio
3 : 1
sound : Wrinkled

Other contracting characters :

Character	Dominant	Recessive
Height	Tall
Seed color	Yellow	Green

- Q.1. (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.** [CBSE (F)2016]

Ans.(a) Mendel choose garden pea for his experiment because

- (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)**

(b) Mendel used the following contrasting characters

Round/Wrinkled seeds, Tall/Short plants

White/purple flowers, Green/yellow seeds

(c) When Mendel crossed two pea plants with a pair of contrasting characters only one character appeared in all the members of F₁ progeny, the others remain hidden. On selfing F₁, the hidden characters reappeared in just 25% of the offsprings and the other 75% shared the characters expressed in F₁. Mendel concluded that the character which expresses itself in F₁ and in 75% of the individuals of F₂ is dominating while the other is recessive.

- Q.2. Name any five vegetables generated from a common ancestor through artificial selection rather than natural selection. Also mention the features for which each vegetable is selected.** [CBSE 2012,13]

Ans. Some of the vegetables generated from a common ancestor, wild cabbage, through artificial selection rather than natural selection are

- (i) Cabbage selected for short distance between leaves.**
- (ii) Broccoli selected for arrested flower development and thick stem.**
- (iii) Cauliflower selected for sterile flowers forming a large flower.**
- (iv) Kohlrabi selected for a swollen edible stem.**
- (v) Kale selected for large leaves.**

X

- Q.3. Explain Mendel's concept of heredity, by giving three points.**

[CBSE 2016]

Ans. (i) Mendel worked on pea plant (*Pisum sativum*) and discovered the fundamental laws of inheritance. He found that traits (characteristics) are controlled by factors (which are now called genes) and each factor (gene) come in pairs. These factors (genes) are inherited as distinct units, one from each parent.

(ii) Mendel studied that genes segregate during the formation of gametes (sperms in males and ova in females) and they again combine in the offspring (one from each parent) and appear as dominant or recessive trait. This can be worked out by making a test cross.

(iii) Mendel proposed three laws, namely

(a) Law of segregation Each inherited trait is defined by a pair of gene. Parental genes are randomly separated to the germ-cells so that germ contain only one pair of gene.

(b) Law of independent assortment Genes of different traits are sorted separately from one another so that the inheritance of one trait is not dependent on the inheritance of another.

(c) Law of dominance An organism with alternate forms of a gene will express the form that is dominant.

Q.4. (a) What are monohybrid and di-hybrid cross?

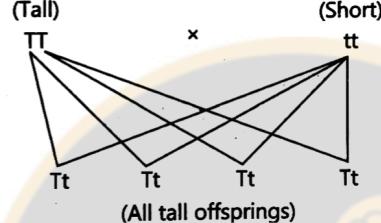
(b) How Mendel proved that tallness is the dominant trait and dwarfness is recessive in a pea plant? Explain with the help of a monohybrid cross.

[CBSE 2014,16]

Ans. (a) A monohybrid cross is the cross between two homozygous parents, which differ in only one contrasting trait in F_2 generation. This type of genetic cross yields a phenotypic ratio of 3:1.

A di-hybrid cross is a cross between two heterozygous parents which differ in two contrasting traits. This type of cross yields a phenotypic ratio of 9:3:3:1 in F₂ generation.

(b) Mendel took pea plants with different characteristics-a tall plant and a short plant, produced progeny from them and calculated the percentage of tall or short progeny.



It was found that all plants were tall. This proves that tallness is the dominant trait while dwarfness is the recessive trait.

Q.5. How is the equal genetic contribution of male and female parents ensured in the progeny? [CBSE 20

[CBSE 2012,13]

Ans. Genetically organisms are of two types

(i) **Haploid** They have single set of chromosomes, where each chromosome is represented singly. As the chromosomes are the bearer of genes so haploids have single set of genes. A single gene determines the expression of character.

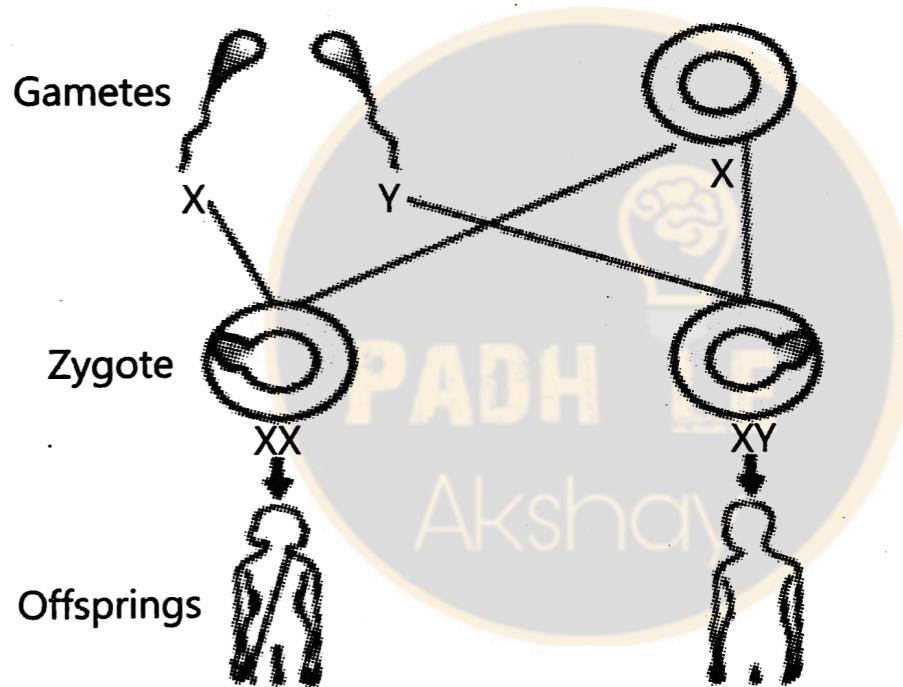
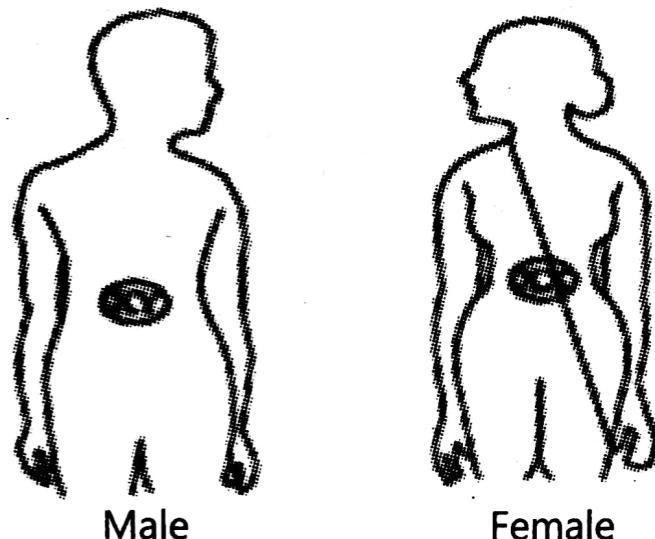
(ii) **Diploid** They have two sets of homologous chromosomes, where the chromosome occur in pair, one maternal contributed by the mother through her ovum and the second chromosome of the pair is contributed by the male parent through his sperm. The resultant cell zygote produces by the fusion of male and female gametes have two sets of chromosomes, each set contributed by each parent. In diploids, a character is controlled by two genes/ factors. Both the father and mother contribute practically equal amount of genetic material to the child. It means that each trait can be influenced by both paternal and maternal DNA.

Q.6. How is the sex of a child determined in human beings?

[CBSE 2012,13,14]

Ans. There are 23 pairs of chromosomes in the cell of human body. Out of these, 22 pairs do not take part in sex-determination in human beings. The 23rd pair in gonadal cell called sex chromosome which is not always a perfect pair. Women have perfect pair having XX a chromosomes. But men have a pair having XY chromosomes. This cell is divided meiotically in both men and women to form gametes. All children will inherit an X-chromosome from mother and an X- or Y-chromosomes from their father. Thus, the sex of children is determined by the chromosomes they inheriting from their father.

A child inheriting X-chromosome from father will be a girl and one inheriting Y-chromosome from him will be a boy.



Sex-determination in human beings

Sahil performed an experiment to study the inheritance pattern of genes. He crossed tall pea plants (TT) with short pea plants (tt) and obtained all tall plants in F1 generation.

a). What will be set of genes present in the F1 generation?

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

c). When F1 plants were self - pollinated, a total of 800 plants were produced.

How many of these would be tall, medium height or short plants? Give the genotype of F2 generation.

OR

When F1 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 F2 generation.

Ans.

a. Tt

b. Traits like 'T' are called dominant traits, while those that behave like 't' are called recessive traits./Alternatively accept the definition of dominant and recessive traits with examples of T and t respectively /Alternatively accept the law of Dominance with examples of T and t.

**c. Out of 800 plants 600 plants will be tall and 200 plants will be small,
1TT: 2Tt: 1tt**

OR

In the cross between Tt X tt, 400 Tall (Tt) and 400 short (tt) plants will be produced.

1Tt:1tt

1. Human teeth and elephant's tusk are

- (a) Analogous organs
- (b) Vestigeal organs
- (c) Homologous organs
- (d) Rudimentary organs

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2. Independent inheritance of two separate traits, shape and colour of seeds in Mendel's cross on pea plants resulted in a observable ratio of:

- (a) 3 : 1
- (b) 9 : 3 : 3 : 1
- (c) 1 : 1
- (d) 9 : 4 : 2 : 1

3. Which of these is not a vestigial organ in human beings?

- (a) Appendix
- (b) Wisdom tooth
- (c) Nictitating membrane
- (d) Gall bladder

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4. Evolution of wild cabbage is an example of:

- (a) Artificial selection
- (b) Natural selection
- (c) Mutation
- (d) Genetic drift

×

5. The modern day Human species has evolved from its earliest ancestors who lived in:

- (a) Asia
- (b) Australia
- (c) Africa
- (d) China

×

6. Two pink coloured flowers on crossing resulted in 1 red, 2 pink and 1 white flower progeny. The nature of the cross will be

- (a) double fertilisation
- (b) self pollination
- (c) cross fertilisation
- (d) no fertilisation

7. Which of the following statement is incorrect?

- (a) For every hormone there is a gene.
- (b) For every protein there is a gene.
- (c) For production of every enzyme there is a gene.
- (d) For every molecule of fat there is a gene

8. If a round, green seeded pea plant ($RR\ yy$) is crossed with wrinkled, yellow seeded pea plant ($rr\ YY$), the seeds produced in F1 generation are

- (a) round and yellow
- (b) round and green
- (c) wrinkled and green
- (d) wrinkled and yellow

9. In human males all the chromosomes are paired perfectly except one. This/these unpaired chromosome is/are

- (i) large chromosome**
 - (ii) small chromosome**
 - (iii) Y-chromosome**
 - (iv) X-chromosome**
- (a) (i) and (ii)**
 - (b) (iii) only**
 - (c) (iii) and (iv)**
 - (d) (ii) and (iv)**

10. 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**

11. New species may be formed if

- (i) DNA undergoes significant changes in germ cells**
 - (ii) chromosome number changes in the gamete**
 - (iii) there is no change in the genetic material**
 - (iv) mating does not take place**
- (a) (i) and (ii)**
 - (b) (i) and (iii)**
 - (c) (ii), (iii) and (iv)**
 - (d) (i), (ii) and (iii)**

12. Two pea plants one with round green seeds (RRyy) and another with wrinkled yellow (rrYY) seeds produce F1 progeny

that have round, yellow (RrYy) seeds. When F1 plants are selfed, the F2 progeny will have new combination of characters. Choose the new combination from the following:

- (i) Round, yellow
 - (ii) Round, green
 - (iii) Wrinkled, yellow
 - (iv) Wrinkled, green
- (a) (i) and (ii)
 - (b) (i) and (iv)
 - (c) (ii) and (iii)
 - (d) (i) and (iii)

13. A basket of vegetables contains carrot, potato, radish and tomato. Which of them represent the correct homologous structures?

- (a) Carrot and potato
- (b) Carrot and tomato
- (c) Radish and carrot
- (d) Radish and potato

14. If the fossil of an organism is found in the deeper layers of Earth, then we can predict that

- (a) the extinction of organism has occurred recently
- (b) the extinction of organism has occurred thousands of years ago
- (c) the fossil position in the layers of Earth is not related to its time of extinction
- (d) time of extinction cannot be determined

15. A trait in an organism is influenced by

- (a) paternal DNA only
- (b) maternal DNA only
- (c) both maternal and paternal DNA
- (d) neither by paternal nor by maternal DNA

16. Select the group which shares maximum number of common characters.

- (a) two individuals of a species
- (b) two species of a genus
- (c) two genera of a family
- (d) two genera of two families

17. According to the evolutionary theory, formation of a new species is generally due to

- (a) sudden creation by nature ×
- (b) accumulation of variations over several generations
- (c) clones formed during asexual reproduction
- (d) movement of individuals from one habitat to another

18. Select the statements that describe characteristics of genes

- (i) genes are specific sequence of bases in a DNA molecule
 - (ii) a gene does not code for proteins
 - (iii) in individuals of a given species, a specific gene is located on a particular chromosome
 - (iv) each chromosome has only one gene
- (a) (i) and (ii)
 - (b) (i) and (iii)

(c) (i) and (iv)

(d) (ii) and (iv)

19. In peas, a pure tall plant (TT) is crossed with a short plant (tt). The ratio of pure tall plants to short plants in F₂ is

(a) 1 : 3

(b) 3 : 1

(c) 1 : 1

(d) 2 : 1

20. Some dinosaurs had feathers although they could not fly but birds have feathers that help them to fly. In the context of evolution this means that

(a) reptiles have evolved from birds

(b) there is no evolutionary connection between reptiles and birds X

(c) feathers are homologous structures in both the organisms

(d) birds have evolved from reptiles

ANSWERS

1. C

2. b

3. d

4. a

5. c

6. b

7. d

8. a

9. c

10. b

11. a

12. b

13. c

14. b

15. c

16. a

17. b

18. b

19. c

20. d

Case Study Questions

QUESTION 1

A scientist cross pure-bred tall (dominant) pea plant with pure-bred dwarf (recessive) pea plant he will get pea plants of F1 generation. If now self-cross the pea plant of F2 generation is done, then we obtain pea plants of F2 generation.

(a) State the type of plants not found in F2 generation but appeared in F2 generation, mentioning the reason for the same

Answer – In the F1 generation, Dwarf trait is recessive trait which was not expressed. After self pollination, the recessive trait gets expressed in F2 generation

(b) State the ratio of tall plants to dwarf plants in F2 generation.. Write the full form of DNA.

Answer- Ratio – 3:1

Full form of DNA – Deoxyribonucleic acid

(c) What do the plants of F2 generation look like ?

Answer – All plants of F1 generation will be tall plants.

(d) How does the creation of variations in a species promote survival ?

Answer – Variations promote the survival only when the species wants to allow by itself for survive to the continuous changing environment and conditions. During variations, different species get different kinds of advantages depending on the nature.

QUESTION 2

Mendel was educated in a monastery and went on to study science and mathematics at the University of Vienna. Failure in the examinations for a teaching certificate did not suppress his zeal for scientific quest. He went back to his monastery and started growing peas. Many others had studied the inheritance of traits in peas and other organisms earlier, but Mendel blended his knowledge of science and mathematics and was the first one to keep count of individuals exhibiting a particular trait in each generation. This helped him to arrive at the laws of inheritance.

Based on the above information, answer the following questions.

(a) Why did Mendel select a pea plant for his experiments?

Answer- Mandel Selects pea plant for his experiment, because pea plant grown easily in few days and also has some interesting characters. And also, many generations can examined by Mendel in few days or months

(b) Study the picture below that represents traits studied by Mendel in garden pea.

Seed		Flower	Pod		Stem	
Form	Cotyledon	Color	Form	Color	Place	Size
Round	2	Yellow	Full	Green	Axial pods	Tall
Wrinkled	1	Green	Constricted	Yellow	Terminal pods	Short

Answer- Yellow pod colour and axial position are dominant traits.

QUESTION 3

Pure bred pea plant with smooth seeds (dominant characteristic) were crossed with pure bred pea plant with wrinkled seeds (recessive characteristic) . The F1 generation was self pollinated to give rise to the F2 generation.

(a) What is the expected observation of the F1 generation of plants ?

Answer – All of them have smooth seeds.

(b) What is the expected observation of the F2 generation of plants ?

Answer- $\frac{1}{4}$ of them have wrinkled seeds and $\frac{3}{4}$ of them have smooth seeds

(c) What will be the genotypic ration of F2 offspring , also mention whether it will be homozygous or heterozygous ?

Answer- Genotypic ratio = 1: 2: 1

- Homozygous dominant
- Heterozygous dominant
- Homozygous recessive

QUESTION 4

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It is all very well to say that very dissimilar looking structures evolve from a common ancestral design. It is true that analysis of the organ structure in fossils allows us to make estimates of how far back evolutionary relationships go. Are there any current examples of such a process? The wild cabbage plant is a good example. Humans have, over more than two thousand years, cultivated wild cabbage as a food plant, and generated different vegetables from it by selection. This is, of course, artificial selection rather than natural selection.

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(a) What was the evolution history of cabbage?

Answer -Earlier, the human beings cultivates the wild cabbage for food and had produced different varieties of cabbage by doing artificial selection. The different varieties were kohlrabi, cauliflower, broccoli, cabbage, red cabbage and kale.

(b) What is molecular phylogeny?

Answer -It is a method to gather information of an organism regarding their evolutionary relationship.

(c) What are the different methods for tracing the evolutionary relationship?

Answer - Looking into the data of homologous organ and analogous organ, fossil and embryo development.

(d) Do you agree with the term that " evolution should not be equated with progress"?

Answer - Yes, evolution leads to more and more complex body design over time. It doesnt mean that older design are inefficient. For example, the bacteria the most primitive and simplest type of organism live in any harsh habitat and still they are surviving.

(e) Give one examples of evolution by stages?

Answer -Earlier, birds have feather only for heating purpose but as time passes, they evolve and now the feathers are used for flight also.