CHAPTER

9 HEREDITY AND EVOLUTION

Syllabus

➢ *Heredity and Evolution : Heredity, Origin of Life, Mendel's contribution—Law for inheritance of traits, Sex determination, Brief introduction; Basic concepts of evolution.*

Quick Review

- Variations arise during the process of reproduction. They may be few in asexual reproduction, but many in case of sexual reproduction.
- The minor variations arising during Sexual reproduction are caused by slight inaccuracies in DNA copying. In sexual reproduction, variations are also caused by crossing over process of meiosis.
- Beneficial variations help the species to survive better in the environment.
- Nature selects the beneficial variations thereby leading to evolution.
- Reproduction produces offsprings with similar body design of the parents. However the offsprings are not identical, but show a great deal of variation from the parents.

Importance of Variation :

(i) Depending upon the nature of variations different individuals would have different kinds of advantages. Example, Bacteria that can withstand heat will survive better in a heat wave.

(ii) Main advantage of variation to species is that it increases the changes of its survival in a changing environment.

- Sexually reproducing organisms such as humans have two (or more) versions of genes for each trait, called alleles.
- **Gregor Johann Mendel** carried out several experiments on pea plants. He carried out large number of monohybrid and dihybrid crosses using many contrasting characteristics and put forward several important conclusions.

Mendel and His Work on Inheritance

- **Gregor Johann Mendel (1833 & 1884) :** Started his experiments on plant breeding and hybridisation. He proposed the laws of inheritance in living organisms.
  Mendel was known as **Father of Genetics.**
- **Plant selected by Mendel :** *Pisum sativum* (garden pea). Mendel used a number of contrasting characters for garden pea.
  Seven pairs of contrasting characters in Garden Pea.

Character	Dominant Trait	Recessive Trait
Flower colour	Violet	White
Flower position	Axial	Terminal
Seed colour	Yellow	Green
Seed shape	Round	Wrinkled
Pod shape	Inflated	Constricted
Pod colour	Green	Yellow
Height of plant	Tall	Dwarf/Short

- In case of monohybrid cross with pure variety of plants, the phenotypic ratio obtained in F_2 generation is 3 : 1.
- In case of dihybrid cross involving two pairs of contrasting characters, the phenotypic ratio obtained in F_2 generation is 9 : 3 : 3 : 1.

- Mendel concluded that out of any pair of contrasting characters, one is dominant and the other is recessive.
- The homozygous dominant trait is denoted by two capital letters whereas the homozygous recessive trait is denoted by two small letters.
- The factors or genes controlling a particular trait separate from each other during gamete formation. Hence gamete is always pure as far as contrasting characters are considered. Each gamete will possess only one gene set.
- In crossing if two or more traits are involved, their genes assort independently, irrespective of the combinations present in the parents.
- Genes carry information for producing proteins, which in turn control the various body characteristics.
- For a particular trait, the offspring receives one allele from the father and one allele from the mother.
- The combination of the male and female germ cells gives a diploid zygote. Thus the normal diploid number of chromosomes in the offspring is restored.
- Different mechanisms are used for sex determination in different species.

Determination of sex of an offspring.

FACTORS

Responsible for sex Determination

Environmental	Genetic
In some animals, the temperature at which the fertilized eggs are kept, decides the gender. E.g., in turtle	In some animals like humans gender or individual is determined by a pair of chromosomes called sex chromosomes. XY – Female XY – Male

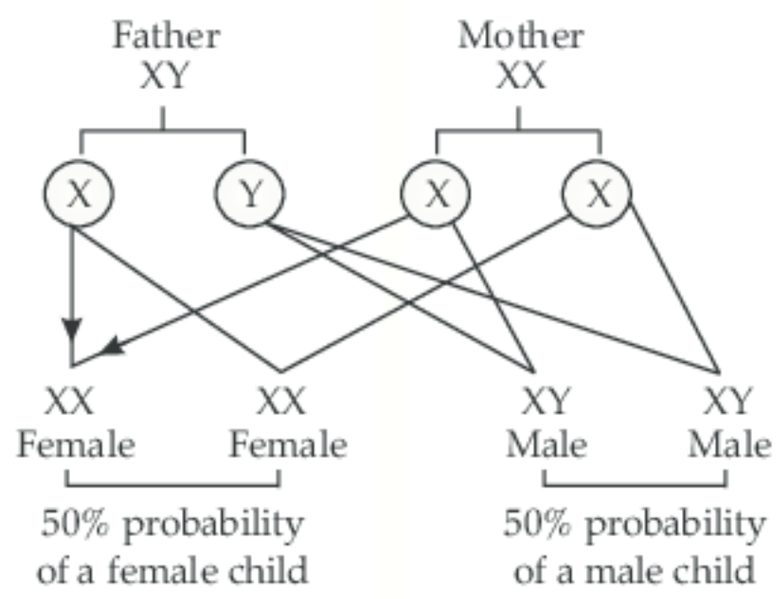
Sex Chromosomes : In human beings, there are 23 pairs of chromosome. Out of these 22 chromosomes pairs are called autosomes and the last pair of chromosome which helps in deciding gender of the individual is called sex chromosome.

XX – Female

XY – Male

SEX DETERMINATION IN HUMAN BEINGS

Sex determination in Human Beings



Evolution

- Evolution is the sequence of gradual changes which takes place in the primitive organisms, over millions of years, in which new species are produced.
- Genetic drift can alter gene frequencies in small population and provide diversity without any survival benefits.
- Several factors such as environment, mutations, reproduction, etc can cause alterations in gene frequencies in a population over generations, leading to evolution.
- Changes occurring in the DNA of germ cells are heritable whereas changes taking place in the non-reproductive tissues are not inherited.
- Charles Darwin proposed that evolution of species occurred by natural selection, but he did not know the underlying mechanism.
- Natural selection, genetic drift, variations and geographical isolation can lead to speciation in sexually reproducing organisms.
- Gene flow between the members of a population prevents speciation.
- **The fundamental characteristics used to classify organisms are :**
  - **(i)** presence of prokaryotic or eukaryotic cells.
  - **(ii)** whether the organism is unicellular or multicellular.

(iii) ability to perform photosynthesis.
(iv) presence of endoskeleton or exoskeleton in heterotrophic organisms.

➢ Classification of living organisms is closely related to their evolution.

Evolution and Classification

Both evolution and classification are interlinked.

1. Classification of species is reflection of their evolutionary relationship.
2. The more characteristics two species have in common the more closely they are related.
3. The more closely they are related, the more recently they have a common ancestor.
4. Similarities among organisms allow us to group them together and to study their characteristics.

I. Homologous Organs : (Morphological and anatomical evidences). These are the organs that have same structural plan and origin but different functions.

Homologous organs provides evidence for evolution by telling us that they are derived from the same ancestor.

Example :

Forelimb of horse	(Running)	Same basic structural plan, but perform different functions
wings of bat	(Flying)	
Paw of a cat	(Walk/scratch/attack)	

II. Analogous Organs : These are the organs that have different origin and structural plant but same function.

Example : Analogous organs provide mechanism for evolution.

Wings of bat →	Elongated fingers with skin folds	Different basic structure, but performs similar function *i.e.,* flight.
Wings of bird →	Feathery covering along the arm	

➢ Fossils help in tracing evolutionary pathways.
➢ The age of fossils can be determined by using the relative method or the isotope dating method.
➢ Evolution is not a one-step process, but a continuous process occurring in several stages.
➢ Complex organs are formed slowly over many generations, sometimes with intermediate forms playing an important role.
➢ Sometimes the use of certain features gets modified with time. For example : Feathers may have provided insulation initially, but later became associated with flight.
➢ Evolutionary studies have shown that birds are closely related to reptiles.
➢ Humans have carried out artificial selection for various features of cabbage and produced different vegetables.

Vegetable produced	Selected feature
Broccoli	Arrested flower development
Cauliflower	Sterile flowers
Kohlrabi	Swollen parts
Kale	Larger leaves

➢ Molecular phylogeny can also be used to trace evolutionary relationships. Here the DNA of different species is compared. Greater the differences in DNA, more distantly related are the species.
➢ Disappearance of the existing species is not a requirement for formation of new species.
➢ The new species formed are better adapted to the environment but they need not be superior to the existing species.
➢ The common ancestor of humans and chimpanzees evolved in different ways to produce the present forms.
➢ Evolution produces more diverse and complex body forms over a period of time, but the newly formed species are not more progressive than the already existing ones. So it is wrong to say that evolution produces progressive higher forms from lower ones.
➢ All human beings, whether fair skinned or dark skinned, belong to the same species *i.e., Homo sapiens* that originated in Africa.
➢ The human ancestors gradually migrated from Africa to various parts of the world such as Asia, Europe, Australia and America. Thus they spread to different parts of the earth and adapted as best as they could to their environmental conditions.

Know the Terms

➢ **F_1 generations :** The generations resulting immediately from a cross of the first set of parents (parental generation).
➢ **F_2 generations :** Offsprings resulting from a cross of the members of F_1 generation.
➢ **Dominant :** The gene which expresses itself if F_1 generation is known as dominant gene.

- **Recessive :** The gene which is unable to express itself in presence of the dominant gene.
- **Genotype :** It is the genetic constitution of an organism which determines the characters.
- **Phenotype :** It is the appearance of an individual.
- **Progeny :** The offspring produced as a result of reproduction of the parents.
- **Dominant trait :** A genetic trait is considered dominant if it is expressed in a person who has only one copy of that gene.
- **Recessive trait :** A genetic trait is considered recessive if it is expressed only when two copies of the gene are present.
- **Homozygous :** Having two identical alleles of the same gene.
- **Heterozygous :** Having dissimilar alleles at corresponding chromosomal loci.
- **Monohybrid cross :** A type of cross in which only one pair of contrasting characters are considered.
- **Dihybrid cross :** A type of cross that involves two sets of characteristics.
- **Allele :** Either of a pair (or series) of alternative forms of a gene that can occupy the same locus on a particular chromosome and that control the same character.
- **Somatic cells :** All cells forming the body of an organism, except the reproductive cells.
- **Sex chromosomes :** Either of a pair of chromosomes, usually designated X or Y, in the germ cells of most animals, that combine to determine the sex and sex-linked characteristics of an individual.
- **Gene :** A segment of DNA that is involved in producing a polypeptide chain and forms the basic unit of heredity.
- **Trait :** A trait is a distinct variant of a phenotypic character of an organism that may be inherited or environmentally determined.
- **Haploid cell :** Cell that has only one complete set of chromosomes.
- **Diploid cell :** Cell that has two sets of chromosomes, one of paternal origin, the other of maternal origin.
- **Micro-evolution :** Evolution resulting from small specific genetic changes that can lead to a new sub-species.
- **Genetic drift :** It refers to the random change in gene frequencies in a small population, presumably owing to change rather than natural selection, thereby providing diversity without any adaptations.
- **Speciation :** The process of formation of a new species.
- **Homologous organs :** Organs of different organisms which may be dissimilar externally and in function, but are similar in origin and in fundamental structural plan.
- **Analogous organs :** Organs of different organisms which are similar in function and external appearance, but dissimilar in origin and structural plan.
- **Fossils :** All preserved traces of living organisms.
- **Molecular phylogeny :** The use of a gene's molecular characteristics to trace the evolutionary history of organisms.

TOPIC-1
Heredity and Mendel's Contribution

Very Short Answer Type Questions (1 mark each)

R **Q. 1. What is DNA ?**
[Board Term II, Foreign Set II, 2016]

Ans. DNA is the carrier of hereditary information from parents to the next generation. 1
[CBSE Marking Scheme, 2016]

R **Q. 2. What is a gene ?**
[Board Term II, Outside Delhi Set I, 2014]

Ans. Gene is a part of DNA that encodes the instructions that allow a cell to produce a specific protein or enzyme. 1

R **Q. 3. Where is DNA found in a cell ? [O.D. Set II, 2015]**

Ans. DNA is found in the cell nucleus. 1

R **Q. 4. What is heredity ?**
[Board Term II, Outside Delhi Set II, 2014]

Ans. The transmission of characteristics from one generation to another is known as heredity. 1

R **Q. 5. Name the information source for making proteins in the cells. [Board Term II, Delhi Set-II, 2014]**

Ans. Cellular DNA is the information source for making proteins in cells. 1

R **Q. 6. Give the respective scientific terms used for studying :**
(i) the mechanism by which variations are created and inherited and
(ii) the development of new type of organisms from the existing ones. [Board Term II, Delhi Set I, 2014]

Ans. (i) Genetics is the study of mechanism by which variations are created and inherited.
(ii) Evolution is used for studying the development of new type of organisms from the existing ones. ½+½

U **Q. 7. No two individuals are absolutely alike in population. Why ?**
[Board Term II, Outside Delhi Set-III, 2014]

Ans. No two individuals are absolutely alike in a population because variation arises due to DNA copying. 1

A **Q. 8. How does comparing the DNA of different species helps in evolutionary studies ?**

Ans. Comparing the DNA of different species gives a direct estimate of how much the DNA has changed during the formation of these species. Thus, it helps us to a great extent in tracing the evolutionary pathways. 1

U **Q. 9. How do genes control traits ?**

Ans. Genes carry information for producing proteins, which in turn control the various body characteristics. 1

R **Q. 10. How many pairs of chromosomes are present in human beings ?**

[Board Term II, Set UV6TF2N, 2015]

Ans. 23 pairs. 1

U **Q. 11. In a cross between a tall pea plant (TT) and a short pea plant (tt), what will be the characteristics shown by the F1 generation ?**

Ans. All the plants would be tall plants (Tt). 1

A **Q. 12. If the weight of an elephant is reduced because of starvation, the progeny elephants will not have low weight. Give reason.**

Ans. This is because the decrease in weight will not cause a change in the DNA of germ cells, due to which this change cannot be inherited. 1

U **Q. 13. In a cross between round yellow seeds (RRYY) and wrinkled green seeds (rryy) of pea plant, what is the ratio of plants obtained in F_2 generation ?**

Ans. 9 round yellow : 3 round green : 3 wrinkled yellow : 1 wrinkled green. 1

A **Q. 14. In turtle, high incubation temperature leads to the development of female offspring. On the other hand in lizards, high incubation temperature leads to the development of male offspring. What determines the sex of the offspring in these examples ?**

Ans. In these examples, the temperature at which the fertilized eggs are incubated determines whether the offspring will be a male or a female. 1

U **Q. 15. When a black guinea pig is crossed with a white guinea pig, what coloured guinea pigs are obtained in F_1 if black colour is dominant over white ?**

Ans. Black. 1

Short Answer Type Questions-I

(2 marks each)

R **Q. 1. What are characteristics ? Give an example.**

Ans. Characteristics are details of appearance of behaviour, in other words, a particular form or a particular function. Presence of four limbs in humans is an example of characteristics. 2

R **Q. 2. Where are the genes located ? What is the chemical nature of gene ?** **[DDE 2017]**

Ans. Genes are located on chromosomes in linear sequence and at fixed positions. 1

Chemically genes are made up of nucleic acids which constitute DNA. 1

U **Q. 3. Why will each gamete contain only one gene set ?**

Ans. The genes controlling a particular trait separate from each other during gamete formation. Hence gamete is always pure as far as contrasting characters are considered and will possess only one gene set. 2

A **Q. 4. Organisms showing asexual reproduction show very little variation from each other. Why ?**

Ans. In asexually reproducing organisms, there is no mixing of genes of two different individuals since only one partner is involved. 1

There are very minor variations generated in such organisms due to small inaccuracies in DNA copying. 1

A **Q. 5. "The chromosome number of the sexually reproducing parents and their offspring is the same." Justify this statement.**

[Board Term II, Delhi Set-I, 2013]

Ans. Male individual have 46 chromosomes but because the gametes are always haploid *i.e.,* they have half the number of chromosomes; sperms will be haploid (23 chromosomes). Female individual also contains only 23 chromosomes in egg. It is the fusion of the sperm and egg which leads to an offsprings with 46 chromosomes. 2

U **Q. 6. What is the difference between F_1 generation and F_2 generation ?**

Ans.

F_1 generation	F_2 generation
F_1 generation refers to the offspring resulting immediately from a cross among the first set of parents.	F_2 generation on the other hand, refers to the offspring resulting from a cross among the members of F_1 generation.

2

U **Q. 7. During crossing, why do new features which are not present in the parents appear in the offsprings ?**

Ans. In crossing, if two or more traits are involved, their genes assort independently, irrespective of the combinations present in the parents. 1

So, new combinations of genes appear in the offsprings leading to new traits. 1

A **Q. 8. Why cannot the experiences of an individual during its lifetime be passed on to its progeny ?**

Ans. The experiences of an individual may only affect the somatic cells, but will not change the DNA of the germ cells. 1

Change in non-reproductive tissues cannot be passed on to the DNA of the germ cells. Therefore, the experiences of an individual during its lifetime cannot be passed on to its progeny. 1

A Q. 9. **Why are traits acquired during lifetime of an individual not inherited ?**

Ans. Traits acquired by an organism during its lifetime are known as acquired traits. 1

These traits are not inherited because they do not cause any change in the DNA of the organism. 1

U Q. 10. **How is the equal genetic contribution of male and female parents ensured in the progeny ?**

Ans. During sexual reproduction, a female gamete (egg) fuses with a male gamete (sperm) which are haploid to form zygote. Zygote is diploid and contains 23 chromosomes from mother and 23 from father. 1

In this way, an equal genetic contribution of male and female parents is ensured in the progeny. 1

A Q. 11. **If a trait A exists in 10% of a population of an asexually reproducing species and a trait B exists in 60% of the same population, which trait is likely to have arisen earlier ?**

Ans. As the population of the given species reproduce asexually there would be only very minor differences generated due to small inaccuracies in DNA copying, so trait B is likely to be arisen earlier as it is present in 60% of the population. 1

Trait A which exists in 10% of the population may have originated due to variations. 1

A Q. 12. **A man with blood group A marries with a woman with blood group O and their daughter has blood group O. Is this information enough to tell you which of the traits—blood group A or O is dominant ? Why or why not ?**

Ans. No, the information provided is not enough to tell whether blood group A or O is dominant. 1

Every character is controlled by a pair of alleles. And here it is not mentioned whether the man and woman were homozygous or heterozygous for their traits. 1

Short Answer Type Questions-II

(3 marks each)

U Q. 1. **Explain Mendel's experiment with peas on inheritance of characters considering only one visible contrasting character.**

[Board Term II, Foreign II 2016]

Ans. Mendel conducted breeding experiments with garden peas :

(i) He studied (pure) plants of a tall/short varieties.

(ii) He crossed them and obtained F_1 progeny.

(iii) He found that F_1 progeny was all tall plants.

(iv) He selfed the (hybrid) plants of F_1 progeny.

(v) He found that in F_2 progeny there were tall as well as short plants.

(vi) The three quarter plants were tall and one quarter was short .

(Or any other contrasting character may be taken.) [CBSE Marking Scheme, 2016] 6 × ½ = 3

R Q. 2. **How do Mendel's experiment show that traits are inherited independently ?**

[Board Term II, O.D. Set I, 2016]

Ans. (i) When a cross was made between a tall pea plant with round seeds and a short pea plant with wrinkled seeds, the F_1 progeny plants are all tall with round seeds. This indicates that tallness and round seeds are the dominant traits. 1

(ii) When the F_1 plants are self pollinated the F_2 progeny consisted of some tall plants with round seeds and some short plants with wrinkled seeds which are the parental traits. 1

(iii) There were also some new combinations like tall plants with wrinkled seeds and short plants with round seeds. ½

(iv) Thus it may be concluded that tall and short traits and round and wrinkled seed traits have been inherited independently. ½

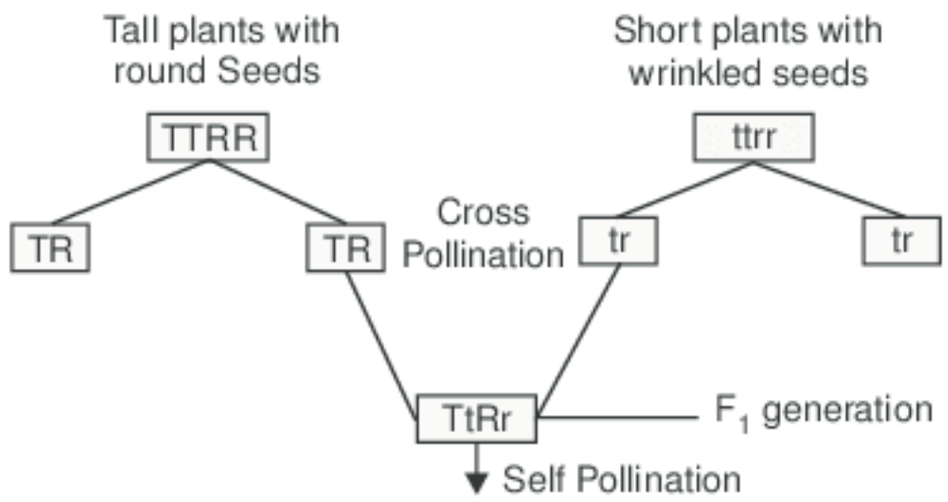
OR

A flow chart depicting the same.

Note : Any other contrasting characters can also be taken **[CBSE Marking Scheme, 2016]**

[Topper Answer, 2016]

Detailed Answer :



2

♂ \ ♀	TR	Tr	tr	tr
	TTRR Tall Round	TTRr Tall Round	TTRR Tall Round	TTRr Tall Round
Tr	TTRr Tall Round	TTrr Tall wrinkled	TtRr Tall Round	Ttrr Tall wrinkled
tR	TtRR Tall Round	TtRr Tall Round	ttRR Short Round	ttRr Short Round
tr	TtRr Tall Round	Ttrr Tall wrinkled	ttRr Short Round	ttrr Short wrinkled

Genotype = 9 : 3 : 3 : 1
9 = Tall Round
3 = Tall Wrinkled
3 = Short Round
1 = Short Wrinkled 3

A Q. 3. **If we cross-bred tall (dominant) pea plant with pure-bred dwarf (recessive) pea plant, we will get plants of F_1 generation. If we now self-cross the pea plant of F_1 generation, we obtain pea plants of F_2 generation.**

(i) What do the plants of F_1 generation look like ?

(ii) State the ratio of tall plant to dwarf plants in F_2 generation.

(iii) State the type of plants not found in F_1 generation but appeared in F_2 generation. Write the reason for the same.

[OD Comptt. 31/1 2017]

Ans. (i) Tall 1

(ii) 3 : 1 ½

(iii) Dwarf ½

Reason : Being a recessive trait, dwarfness can only be expressed in the absence of dominant trait/ in its pure form. **1**

U **Q. 4. List two differences in tabular form between dominant trait and recessive traits. What percentage / proportion of the plants in the F_2 generation/progeny were round, in Mendel's cross between round and wrinkled pea plants ?**
[Board Term II, Foreign I, 2016]

Ans.

S. No.	Dominant trait	Recessive trait
(i)	The trait which appears in the F_1 progeny, is dominant.	The trait which remains hidden or which does not appear in the F_1 progeny is the recessive trait.
(ii)	It appears in more numbers.	It appears in less number.

75% of the plants were with round seeds. **2 + 1**
[CBSE Marking Scheme, 2016]

U **Q. 5. List in tabular form, two distinguishing features between the acquired traits and the inherited traits with one example of each.**
[NCERT Exemplar]
[Board Term II 2015 (Delhi), 2014 (Foreign), 2013]

Ans.

S. No.	Acquired Traits	Inherited Traits
(i)	These traits are the characteristics which are developed during the lifetime of an individual.	These are the characteristics transmitted from parents to the offspring.
(ii)	Acquired traits are not passed on to the next generation. *e.g.,* Less body weight due to starvation.	Inherited traits is genetically determined characteristic that distinguishes a person. *e.g.,* colour of hair and eye **1½ + 1½**

R **Q. 6. What is DNA copying ? State its importance.**
[Board Term II, Delhi Set II, 2015]

Ans. DNA replication or DNA copying is the process of producing two identical replicas from one original DNA molecule during cell division.

Importance of DNA Copying :

(i) DNA replication needs to occur so that during cell division, new cells will also have a copy of organism's DNA.

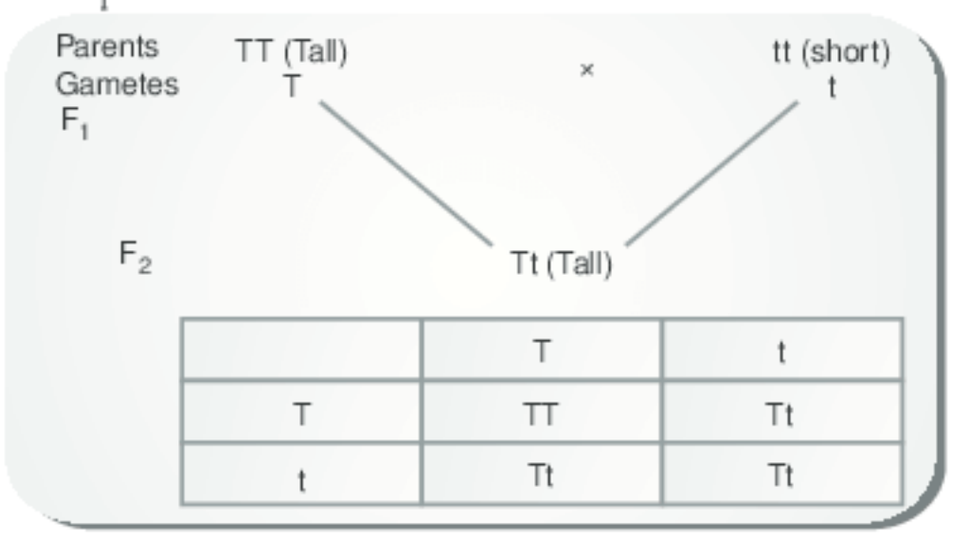
(ii) DNA is necessary to make all the RNA and proteins needed for cells to carry out necessary reactions and cellular processes in order for them to survive.

1+ 1 + 1

A **Q. 7. "A trait may be inherited, but may not be expressed." Justify this statement with the help of a suitable example.**
[Board Term II, Outside Delhi Set I, II, III, 2014]

Ans. Let us take the following example to justify the above statement.

Mendel crossed tall pea plants with dwarf pea plants.



	T	t
T	TT	Tt
t	Tt	Tt

Mendel's Observation

F_1 generation contained all tall plants. When F_1 generation underwent selfing, the trait that was unexpressed in F_1 (dwarf) was observed in some F_2 progeny. Thus, both traits, tall and dwarf, were expressed in F_2 generation in the ratio 3 : 1.

The above experiment indicates that although both the traits of tallness and shortness were inherited in F_1 plants, only the tallness trait was expressed. This shows that traits may not show up in an individual but are passed on to the next generation. **3**

A **Q. 8. "It is possible that a trait is inherited but may not be expressed." Give a suitable example to justify this statement.**
[Board Term II, Foreign I 2015]

Ans. Yes, it is possible. **1**

Example—When pure tall pea plants are crossed with pure dwarf pea plants, only tall pea plants are obtained in F_1 generation. ½

On selfing tall plants of F_1, both tall and dwarf plants are obtained in F_2 generation in the ratio 3 : 1. ½

Reappearance of the dwarf character, a recessive trait in F_2 generation shows that the dwarf trait/ character was present in individuals of F_1 but it did not expressed (due to the presence of tallness, a dominant trait/character). **1**
[CBSE Marking Scheme, 2015]

R **Q. 9. How do Mendel's experiments show that traits may be dominant or recessive ?**
[Board Term II, Set (2023), 2012]

Ans. When Mendel cross-pollinated a pure male tall pea plant with a pure female dwarf pea plant, he got only tall plants in the F_1 generation.

When F_1 tall plants were self-pollinated, Mendel got both tall and dwarf plants in the F_2 generation in the ratio 3 : 1.

The trait of dwarfness was present in F_1 generation but was not expressed and only trait of tallness was expressed. The character which gets expressed in the presence of its contrasting form is termed dominant trait. The trait which remains unexpressed in the presence of its contrasting form is termed recessive trait. **3**
[CBSE Marking Scheme, 2012]

U **Q. 10. (i) Name the unit of inheritance. What is its functions ?**

(ii) How are inherited traits different from acquired traits ? Give example.

[Board Term II, Set (2024) 2012]

Ans. (i) Gene. ½

It is the carrier of genetic information from one generation to another. ½

(ii) The traits that are obtained from parents are inherited traits. ½

e.g., Fused and free ear lobes. ½

The traits that develop during lifetime of an individual are acquired traits. ½

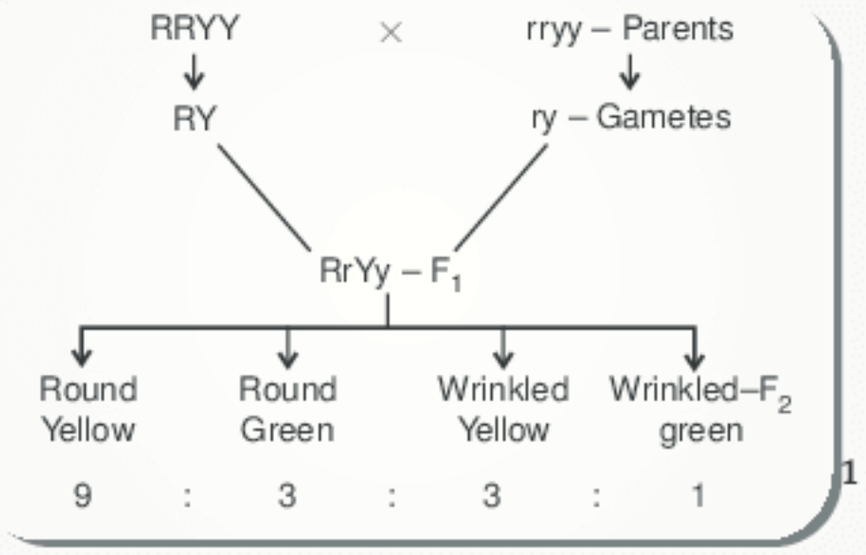
Example : Muscular body of a wrestler. ½

[CBSE Marking Scheme, 2012]

U **Q. 11. Show inheritance of two characters over two generations by making a cross between round and yellow seeded plant (RRYY) with wrinkled green seeded plant. (rryy).**

[Board Term II, Set (2036), 2012]

Ans.



1

[CBSE Marking Scheme, 2012] ½ × 4 = 2

R **Q. 12. (i) Define Genetics.**

(ii) Who is regarded as the 'Father of Genetics' ? Name the plant on which he performed his experiment.

(iii) Why did he selected that specific plant for his experiments ? **[Board Term II, Set (2024), 2012]**

Ans. (i) Genetics is the branch of biology that deals with the study of heredity and variations. **1**

(ii) Gregor Johann Mendel, garden pea. ½ + ½

(iii) Garden pea plants were easily available / they grow in one season / fertilization was easy.

(Any two) ½ + ½

[CBSE Marking Scheme, 2012]

A **Q. 13. Give the basic features of the mechanism of inheritance.** **[NCERT Exempler 2017]**

Sol. The Basic features of the mechanism of inheritance are :

(i) The traits could be hidden in many generations but can reappear in any generation unchanged.

(ii) Traits which remain together may get separated in the next generation.

(iii) One form of a particular character is exhibited frequently than the other form of the same character. **1+1+1**

U **Q. 14. Give reasons for the appearance of new combination of characters in the F_2 progeny.**

[NCERT Exemplar 2017]

Sol. If pea plants with two different pairs of characteristics are bred with each other, the F_1 progeny would have all tall plants with round seeds. This implies that round seed in dominant character over wrinkled seed. In F_2 progeny there would be some tall plants with round seeds wrinkled seed. However, there would be some plants with mixed characters - tall plants with wrinkled seeds and short plants with wrinkled seeds. However, there would be some plants with mixed characters - tall plants with wrinkled seeds and short plants with rough seeds. This depicts that tall/dwarf trait and round/wrinkled trait are inherited independent of each other. **3**

R **Q. 15. In a cross between plants with purple flowers and plants with white flowers the offsprings of F_1 generation all had white flowers. When the F_1 generation was self-crossed, it was observed in the F_2 generation that out of 100, 75 flowers were white. Make a cross and answer the following :**

(i) What are the genotypes of the F_2 progeny ?

(ii) What is the ratio of 'White : Purple' flowers in the F_2 generation ? **[Board Term II, Set (2044) 2012]**

Ans. Monohybrid Cross.

White Flowers × Purple Flowers

WW × ww

Ww

White Flowers **1**

(i) Genotypes of F_2 progeny are

WW, Ww, ww **1**

(ii) Ratio between White : Purple flowers are :

3 : 1 **1**

[CBSE Marking Scheme, 2012]

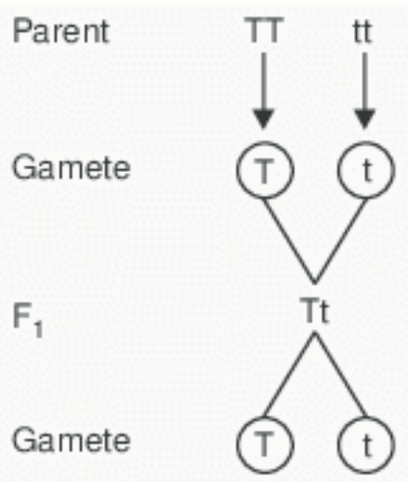
A **Q. 16. In one of his experiments with pea plants Mendel observed that when a pure tall pea plant is crossed with a pure dwarf pea plants, in the first generation, F_1 only tall plants appear.**

(i) What happens to the traits of the dwarf plants in this case ?

(ii) When the F_1 generation plants were self-fertilised, he observed that in the plants of second generation, F_2 both tall plants and dwarf plants were present. Why it happened ? Explain briefly.

[Board Term II, Delhi Set I 2016]

Ans. (i)



1

The dwarf traits of the plants is not expressed in the presence of the dominant tall trait.

F_2	TT	Tt	tt
	Tall	Tall	Dwarf

Tall : Dwarf = 3 : 1 ratio **1**

(ii) In the F_2 generation, both the tall and dwarf traits are present in the ratio of 3 : 1. This showed that the traits for tallness and dwarfness are present in the F_1 generation, but the dwarfness, being the recessive trait does not express itself in the presence of tallness, the dominant trait. **1**

[CBSE Marking Scheme, 2016]

U **Q. 17. How did Mendel interpret his result to show that traits may be dominant or recessive ? Describe briefly.**

[Board Term II, Delhi Set II 2016]

Ans. Mendel conducted breeding experiments on Pea plants.

(i) He selected pure bred tall and dwarf plants. ½

(ii) He cross-pollinated these plants. ½

(iii) In the F_1 generation, he obtained only tall plants. Tallness is the dominant trait. ½

(iv) Then, he produced F_2 generation by selfing of hybrids / F_1. ½

(v) He found that $3/4^{th}$ of the plants were tall and $1/4^{th}$ were dwarf. ½

(vi) The trait which remains hidden in F_1 generation plants is the recessive traits. ½

[CBSE Marking Scheme, 2016]

U **Q. 18. In a monohybrid cross between tall pea plants (TT) and short pea plants (tt) a scientist obtained only tall pea plants (Tt) in the F_1 generation. However, on selfing the F_1 generation pea plants, he obtained both tall and short plants in F_2 generation. On the basis of above observations with other angiosperms also, can the scientist arrive at a law ? If yes, explain the law. If not give justification for your answer.**

[Board Term II, Delhi Set III, 2016]

Ans. Yes, the scientist may arrive at the law of dominance according to which the trait that is expressed in the F_1 generation is the dominant trait, although both the dominant and recessive traits are present in the F_1 generation. In the F_2 generation the recessive traits is also expressed along with the dominant traits. **[CBSE Marking Scheme, 2016]** **1 + 1 + 1**

A **Q. 19. 'Different species use different strategies to determine sex of a newborn individual. It can be environmental cues or genetically determined.' Explain the statement by giving example for each strategy.** **[Board Term II, SQP, 2016]**

Ans. Environmental Cue : (i) In some animals, the temperature at which fertilized eggs are kept determines whether the developing animal in egg is male or female.

(ii) In some animals like snail, individual can change sex.

Genetical Cue : A child who inherits an X-chromosome from her father will be a girl and one who inherits a Y- chromosome from the father will be boy. **1 + 1 + 1**

[CBSE Marking Scheme, 2016]

U **Q. 20. What will happen if both the characters present in F_1 generation pass together in F_2 generation ?**

Ans. If both the characters present in F_1 generation pass together in F_2 generation, then gametes and offsprings would receive double dose of information, that will be abnormal. **3**

U **Q. 21. A pea plant with blue colour flower denoted by BB is cross-bred with a pea plant with white flower denoted by WW.**

(i) What is the expected colour of the flowers in their F_1 progeny ?

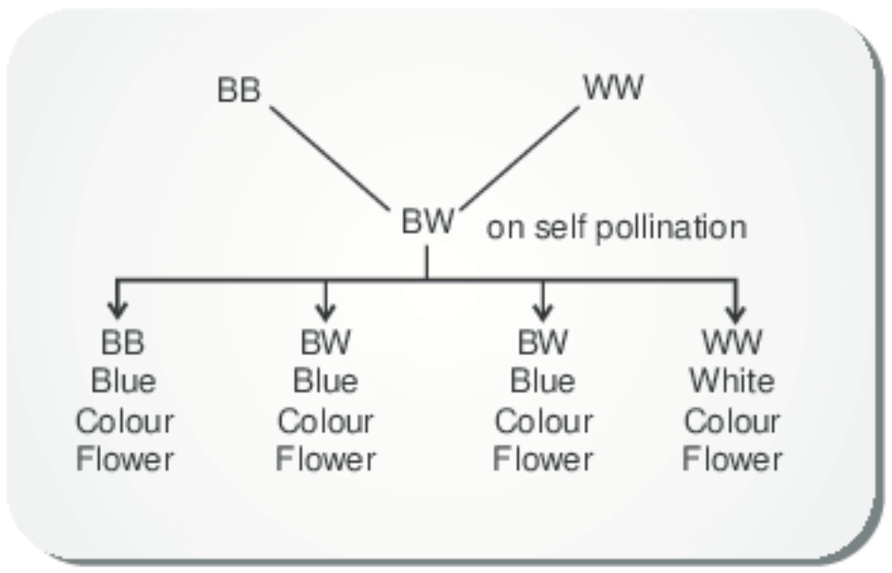
(ii) What will be the percentage of plants bearing white flower in F_2 generation, when the flowers of F_1 plants were selfed ?

(iii) State the expected ratio of the genotype BB and BW in the F_2 progeny. **[O.D. Set II, 2015]**

Ans. (i) All the flowers in F_1 generation will have dominant blue colour.

(ii) When F_1 plants were selfed, the percentage of white flower in F_2 generation will be 25%.

(iii) Genotype of BB and BW in the F_2 progeny are 1 : 2.



1 + 1 + 1

U **Q. 22. A cross was made between pure breeding pea plants one with round and green seeds and the other with wrinkled and yellow seeds.**

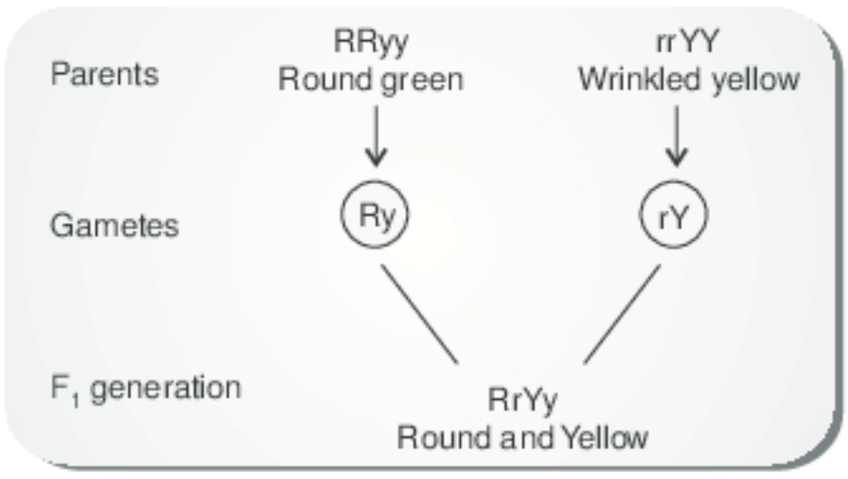
(i) Write the phenotype of F_1 progeny. Give reason for your answer.

(ii) Write the different types of F_2 progeny obtained along with their ratio when F_1 progeny was selfed. **[Board Term II, Delhi Set I 2014]**

Ans. (i) The cross was made between round, green seeds and wrinkled, yellow seeds

In the given cross, two traits were taken into account, which is a dihybrid cross.

Yellow colour and round shape is dominant over green colour and wrinkled shape.



The above cross shows round and yellow seeds in the F_1 generation. It occurs because dominant traits (round and yellow) express itself, whereas recessive traits (wrinkled and green) get suppressed.

(ii) On selfing of F_1 generation :

F_1 generation on selfing: RrYy Round yellow × RrYy Round yellow

	RY	Ry	rY	ry
RY	RRYY Round yellow	RRYy Round yellow	RrYY Round yellow	RrYy Round yellow
Ry	RRYy Round yellow	RRyy Round green	RrYy Round yellow	Rryy Round green
rY	RrYY Round yellow	RrYy Round yellow	rrYY Wrinkled yellow	rrYy Wrinkled yellow
ry	RrYy Round yellow	Rryy Round green	rrYy Wrinkled yellow	rryy Wrinkled green

Round yellow : Wrinkled yellow : Round green : Wrinkled green

9 : 3 : 3 : 1

Phenotypic ratio – 9 : 3 : 3 : 1

Round yellow – 9 Round green – 3

Wrinkled yellow – 3 Wrinkled green – 1

1½ + 1½

R **Q. 23. (a) Mendel crossed tall pea plants with dwarf pea plants in his experiment. Write his observations giving reason on the F_1 and F_2 generations.**

(b) List any two contrasting characters other than height that Mendel used in his experiments in pea plants. [Board Term II, Delhi Set II, III, 2014]

Ans. (a) Mendel crossed tall pea plants with dwarf pea plants.

Parents

Pure tall plant (TT) × Pure short plant (tt)

↓

F_1 generation

(Tt) (Tt) (Tt) (Tt)

Selfing of F_1

Tall plant (Tt) × Tall plant (Tt)

↓

F_2 generation

(Tt) (Tt) (Tt) (tt)

Mendel's Observation

The F_1 generation contained all tall plants. When F_1 generation underwent selfing, the trait that was unexpressed in F_1 (dwarf) was observed in some F_2 progeny. Thus, both traits, tall and dwarf, were expressed in F_2 generation in the ratio 3 : 1.

Mendel proposed that something was being passed unchanged from generation to generation. He called these things factors (presently called genes). Factors contain and carry hereditary information.

He also observed that traits might not show up in an individual but were passed to the next generation.

(b) The two contrasting traits other than height used by Mendel are :

(i) Pod colour - Green pod colour dominant over yellow colour

(ii) Seed shape - Round seed shape dominant over wrinkled seed shape. **2 + ½ + ½**

U **Q. 24. A cross was carried out between a pure bred tall pea plant and a pure bred dwarf pea plant and F_1 progeny was obtained. Later, the F_1 progeny was selfed to obtain F_2 progeny. Answer the following questions :**

(i) What is the phenotype of the F_1 progeny and why ?

(ii) Give the phenotypic ratio of the F_2 progeny.

(iii) Why is the F_2 progeny different from the F_1 progeny ?

[Board Term II, O.D. Set I, 2013]

Ans. (i) The phenotype of F_1 progeny is Tt because F_1 or hybrid plants were not intermediate between the two alternate forms of a character. They resembled only one parent. In a cross between tall and dwarf of pea plants, the F_1 plants were all tall.

(ii) The phenotypic ratio of F_2 progeny is 3 : 1.

(iii) F_1 progeny resembled only one parent which is dominant in nature but in F_2 progeny phenotypically three plants are tall and one plant is dwarf. But according to genotype ratio one plant is pure tall, two are hybrid tall and one plant is pure dwarf. **1 + 1 + 1**

A **Q. 25. A blue colour flower plant denoted by BB is crossbred with a white colour flower plant denoted by ww.**

(i) State the colour of flower we would expect in their F_1 progeny.

(ii) Write the percentage of plants bearing white flower in F_2 generation when the flowers of F_1 plants were selfed.

(iii) State the expected ratio of the genotype BB : Ba : ww in the F_2 progeny.

[Board Term II, O.D. Set II, 2013]

Ans. (i) F_1 generation yields only blue flowering plants. (Bw).

(ii) On self-breeding the F_1 generation plants, both blue flowered and white flowered plants appeared in the ratio of 3 : 1. It shows that the factors or traits for blue flower are dominant over the traits for white flower.

(iii) Genotypes in F_2 progeny is 1 : 2 : 1

1 (BB)	:	2 (Bw)	:	1 (ww)
Pure blue		Violet		White

1 + 1 + 1

U **Q. 26. (i) Differentiate between dominant and recessive traits.**

(ii) 'Gene control traits' ? Explain this statement with an example. [Board Term II, Set (2015) 2012]

Ans. (i) (a) The character which gets expressed in the presence of its contrasting form is termed as dominant trait. **1**

(b) The trait which remains unexpressed in the presence of its contrasting form is called recessive trait. **1**

(ii) Consider tallness as a characteristic. Plant height depends upon particular plant hormone which in turn will depend on the efficiency of the process for making it. If the enzyme responsible for the production of this hormone is efficient, plant will be tall. If the gene for that enzyme has an alteration that makes enzyme less efficient, the amount of hormone will be less and plant will be short. **1**

U **Q. 27. The genotype of green-stemmed tomato plants is denoted by GG and that of purple-stemmed tomato plants as gg. When these two plants are crossed :**

(i) What colour of stem would you expect in their F_1 progeny ?

(ii) Give the percentage of purple-stemmed plant if F_1 plants are self pollinated.

(iii) In what ratio would you find the green and purple colour in the F_1 progeny ?

[Board Term II, Set (2022), 2012]

Ans. (i) Green colour. **1**

(ii) 25%. **1**

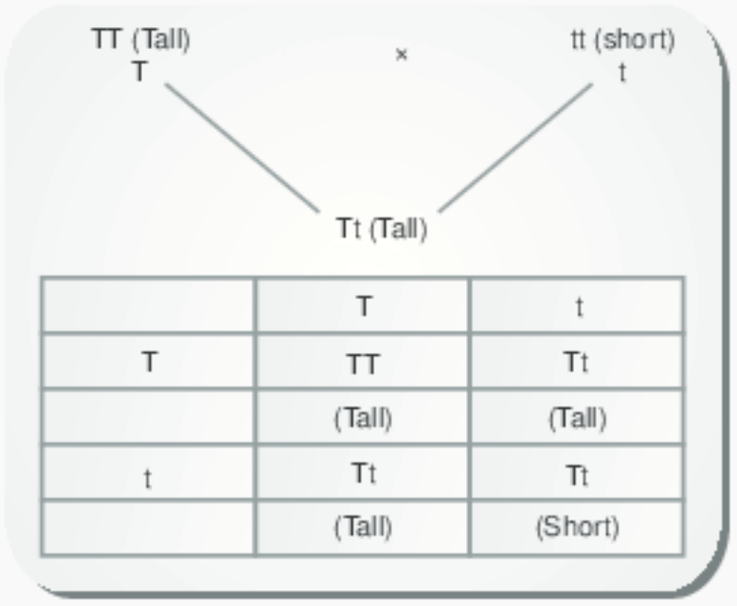
(iii) 3 : 1. **[CBSE Marking Scheme, 2012]** **1**

U **Q. 28. In Mendel's monohybrid cross between tall and short pea plants, all offsprings were tall. What does this tell us about the trait ? What is the ratio of tall and short plants in the F_2 generation ?**

[Board Term II, Foreign Set-I, II, III, 2014]

[Board Term II, Set (2017), 2012]

Ans. The appearance of all Tall plants in the F_1 generation shows that tall is the dominant character while short is the recessive character. **1**



	T	t
T	TT (Tall)	Tt (Tall)
t	Tt (Tall)	Tt (Short)

1

The ratio of Tall to Short in F_2 generation is 3 : 1. **1**

[CBSE Marking Scheme, 2012]

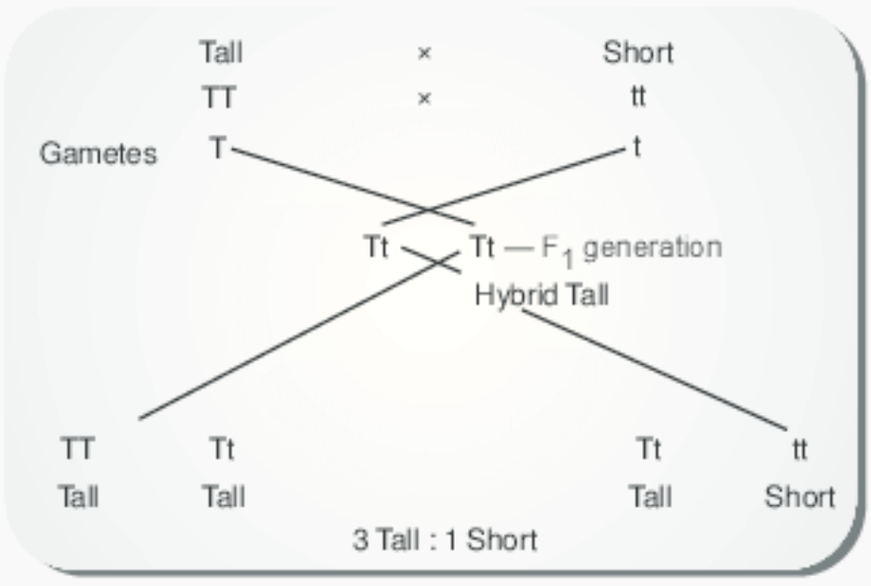
A **Q. 29. With the help of suitable examples, explain why certain traits cannot be passed on to the next generation. What are such traits called ?**

[Board Term II 2014; Outside Delhi Set I, 2015]

Ans. Such traits are called acquired traits. Acquired traits are experienced by an individual during his lifetime. These traits involve changes in non- reproductive cells (somatic cells) which are not transferred to germ cells. So, these traits cannot be passed on to the next generation. For example: Learning skills like swimming, dancing, cooking, body building, etc are acquired traits and cannot be passed on to the next generation. **2 + 1**

R **Q. 30. With the help of a cross done with garden pea plants, trace the work done by Mendel with a tall and a short plant to arrive at a 3 : 1 ratio in the F_2 generation. [Board Term II, Set (2021), 2012]**

Ans.



[CBSE Marking Scheme, 2012] **3**

U **Q. 31. What are chromosomes ? Explain how in sexually reproducing organisms the number of chromosomes in the progeny is maintained.**

[Board Term II, O.D. Set I, 2015]

Ans. Chromosomes are long thread-like structures which contain hereditary information of the individual and are thereby the carriers of genes.

Male individual have 46 chromosomes but because the gametes are always haploid., *i.e.*, they have half the number of chromosomes; sperms will be haploid (23 chromosomes). Female individual also contains 23 chromosomes in egg. It is the fusion of the sperm and egg which leads to an offspring's with 46 chromosomes. **1 + 2**

U **Q. 32. 'It is a matter of chance whether a couple will give birth to a male child or a female child." Justify this statement with the help of a flow chart showing the fusion of sex chromosomes.**

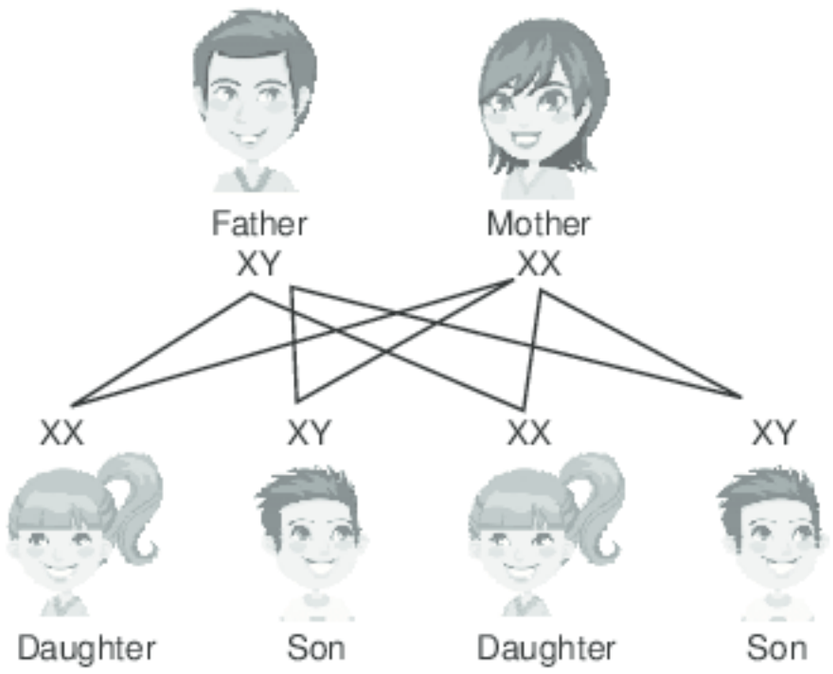
[Board Term II, Outside Delhi Set II, 2014]

OR

How sex is determined in human beings ?

[KVS-2014]

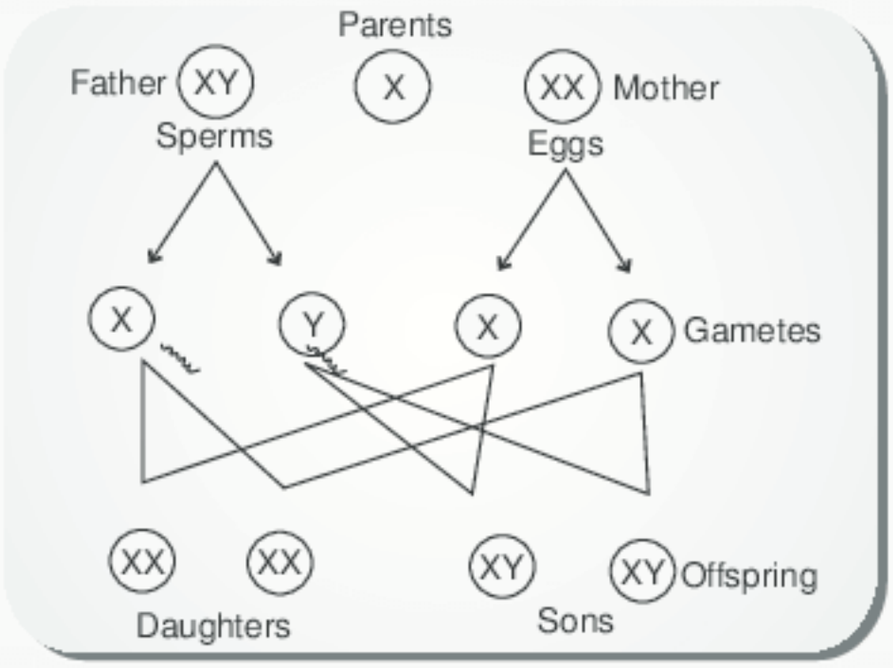
Ans. Sex of a child is dependent on the type of the male gamete fusing with the female gamete. Human beings possess 23 pairs of chromosomes. Out of these, 22 pairs are known as autosomes, while the remaining one pair comprises sex chromosomes (XX in females and XY in males). At the time of fertilisation, the egg cell fuses with the sperm cell, resulting in the formation of the zygote. If the egg cell carrying an X chromosome fuses with the sperm carrying an X chromosome, the resulting child would be a girl. If the egg cell carrying an X chromosome fuses with the sperm carrying a Y chromosome, the resulting child would be a boy.



Q. 33. In human beings, the statistical probability of getting either a male or a female child is 50%. Give reasons and explain with the help of a diagram.

[Board Term II, Set 8XSVHLC, QNA4XWT 2014]

Ans. A child who inherits a 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). Since, the sex of the child in determined by what he/she inherit from father, therefore the probability of getting either male or female child is 50%.



[CBSE Marking Scheme, 2014] 3

U **Q. 34. Explain with the help of a figure that father is responsible for the sex of a child.**

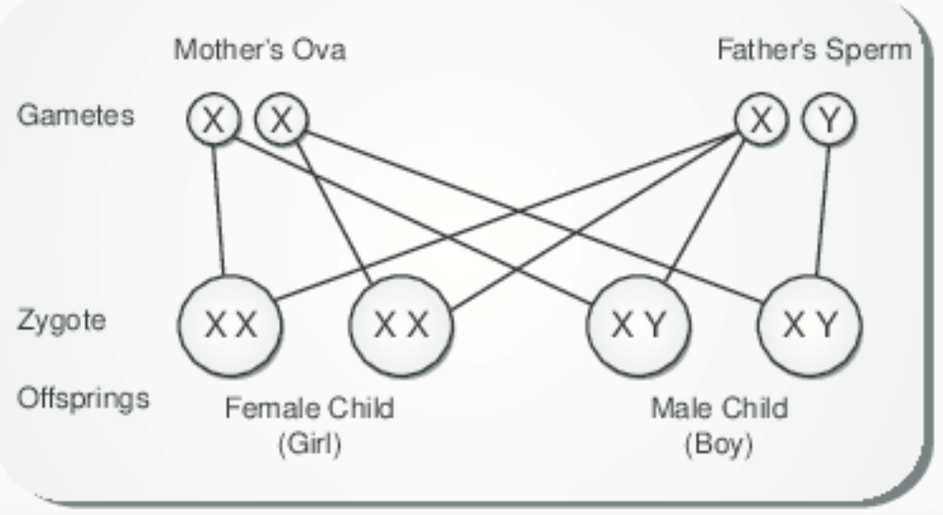
[Board Term II, Set GFUTB86, 2015]

Ans. Sex of a child depends on what happens during fertilisation.

(i) If a sperm carrying X chromosomes fertilises an ovum which carries X chromosome, then the child born will be a girl.

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

Thus, sperm (from father) determines the sex of the child.



[CBSE Marking Scheme, 2015] 2 + 1

R **Q. 35. (i) Do genetic combination of mothers play a significant role in determining the sex of a new born ?**

(ii) Why do all the gametes formed in human females have an X chromosomes ?

[NCERT Exemplar 2017]

Ans. (i) No, because mothers have a pair of X-chromosomes. All children will inherit an X chromosome from their mother regardless of whether they are boys or girls.

(ii) The 23rd pair in a somatic cell of human females contains XX chromosomes. During gametogenesis, each gamete gets one X-chromosome as the 23rd chromosome. A girl child is born by the fusion of two X-chromosomes. One X chromosome from father and one X chromosome from mother. This means a female has two X-chromosomes. **1½ + 1½**

Long Answer Type Questions

(5 marks each)

R **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. **[Board Term II, Foreign I, 2016]**

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)** $2 \times ½ = 1$

(b) Contrasting characters :

Round / Wrinkled seeds

Tall / Short plants

White / purple flowers

Green / yellow seeds **(Or any other)** **(Any two)** $2 \times ½$

(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, the others remain hidden.

On selfing F_1, 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 same thing can be explained by using an example)**

1 + 1 + 1

[CBSE Marking Scheme, 2016]

U **Q. 2. How do Mendel's experiments show that**

(a) traits may be dominant or recessive ?

(b) inheritance of two traits is independent of each other ? **[Delhi 31/1/1 2017]**

Ans. (a) Mendel conducted a Monohybrid cross/(crossed pure tall pea plants with pure dwarf pea plants), observed only tall pea plants in the F_1 generation, but on selfing the F_1 progeny both tall and dwarf pea plants were observed in F_2 generation in the ratio 3 : 1. Appearance of tall character in F_1 and F2 generations shows tallness to be a dominant character. But absence of dwarf character in F1 and its reappearance in F2 confirms that dwarfness is recessive character. 2½

(b) Mendel conducted a dihybrid cross and observed that though he started with two types of parents, he obtained four types of individuals in F_2. The appearance of new recombination in F2 generations along with parental type characters show that traits are inherited independently of each other. 2½

[CBSE Marking Scheme, 2017]

Detailed Answer :

(i) Mendel conducted experiment on garden pea plant selecting seven visible contrasting characters. He selected and crossed homozygous tall pea plant having the genotype TT with a homozygous dwarf pea plant having the genotype tt. F1 generation consists only of tall plants having genotype Tt.

The expressed allele T for tallness is dominant over the unexpressed allele t for dwarfness. Hence the trait of tallness is dominant while dwarfness of shortness is the recessive characteristics. Thus, Mendel's experiment showed that traits may be dominant or recessive.

(ii) Mendel performed an experiment in which he took two different traits like tall and dwarf plant and round and wrinkled seeds. In F2 (second) generation, some plants were tall with round seeds and some were dwarf with wrinkled seeds. There would also be dwarf plants having round seeds. Thus, the tall/short traits and round/wrinkled seed traits are independently inherited. 5

U **Q. 3. How did Mendel's experiments show that different traits are inherited independently ? Explain.** **[Delhi 31/1/3 2017]**

Ans. Mendel conducted a dihybrid cross; and observed that though he started with two types of parents, he obtained four types of individuals in F_2; The appearance of new recombination in F_2 generations along with parental type characters show that traits are inherited independently of each other. **1+1+1**

[CBSE Marking Scheme, 2017]

Detailed Answer :

When a cross was made between a tall pea plant with round seeds and a short pea plant with wrinkled seeds, the F_1 progeny plants are all tall with round seed. This indicates that tallness and round seeds are the dominant traits. **1**

When the F1 plants are self pollinated the F2 progeny consisted of some tall plants with round seeds and some short plants with wrinkled seeds which are the parental traits. **1**

There were also some new combinations like tall plants with wrinkled seeds and short plants with round seeds. ½

Thus it may be concluded that tall and short traits and round and wrinkled seed traits have been inherited independently. ½

U **Q. 4. How did Mendel explain that it is possible that a trait is inherited but not expressed in an organism ?**

[OD 31/1 2017]

Ans. (a)

[Topper Answer, 2016]

A Q. 5. **With the help of one example for each, distinguish between the acquired traits and the inherited traits., Why are the traits/experiences acquired during the entire lifetime of an individual not inherited in the next generation ? Explain the reason of this fact with an example.** [OD 31/1 2017]

Ans. ● **Acquired traits :** Traits which develop in the life time of an individual and do not pass to the progeny. 1½
Example : Learning a skill such as dance/music/loss of body parts/weight/any other example. 1
● **Inherited traits :** Traits present in the gamete/germ cells which can be seen in the progeny. ½
Example : Skin colour/eyebrows/any other example.
½
● **Reason :** Traits/characteristics acquired during one's life time do not bring any change in the DNA of the reproducing cells/germ cells.
Example : Decrease in body weight of beetles due to starvation do not pass on to the next generation because there is no change in the germ, cells of beetles. **[CBSE Marking Scheme, 2017]**

[Topper Answer, 2017]

Detailed Answer :

Acquired traits are the characters that are acquired by the individual during its lifetime. These traits cannot be inherited. For example, if a wrestler develops large muscles due to his training program that does not mean it will be passed on to his offspring.

Inherited traits are the characters which are inherited by the offspring from the parents. These traits are expressed in the offspring and later carried on to the next generation. For example skin colour, eye colour and shape.

Acquired traits occur due to changes in the lifestyles, injury, loss of body parts, disuse of some body parts. These traits/experiences occur in the somatic cells which do not evolve germ cells and genetic materials. Therefore, these traits are not transferred or inherited in the next generation. Example, low weight of a starving beetle. 5

R **Q. 6. (i) What is meant by traits of an individual ?**
(ii) Explain inherited trait and acquired trait.
(iii) Define speciation. List the factors which could lead to rise of a new species.
[Board Term II, SQP, 2013]

Ans. (i) Traits : A characteristic feature is called trait. 1
(ii) Inherited Traits are the traits which are transferred from parents to young ones.
Acquired Traits are the traits which an organism acquires in life time. 2
(iii) Formation of new species from the existing ones is called speciation.
Factors which could lead to the rise of new species are : geographical isolation, genetic drift, natural selection. 2

U Q. 7. **(i) Why are two letters (such as TT, Tt, Tt) used to denote the character of height ?**

(ii) If a purple pea plant (PP) is crossed with a white coloured pea plant (pp), will we have white flowered pea plant in the F_1 generation ? Why ?

(iii) Define dominant and recessive traits.

Ans. (i) This is to show that each trait is influenced by both paternal and maternal DNA. **1**

(ii) No. **1**

This is because all the F_1 progeny plants show the genetic makeup Pp, which results in purple flowers. **1**

(iii) Dominant trait is a genetic trait that is expressed in a person who has only one copy of that gene. **1**

Recessive trait is a genetic trait that is expressed only when two copies of the gene are present. **1**

A Q. 8. **(i) Explain whether traits like eye colour or height is genetically inherited. Do power to lift weights and reading french also belong to the same category ?**

(ii) How do variations affect the evolution of those organisms that reproduce sexually ?

[Board Term II, Set GFUTB86 2012]

Ans. (i) Yes, eye colour and height are genetically inherited traits, as these are expressed by genes. No, weight lifting and reading French are acquired traits. **3**

(ii) Variations in individuals during sexual reproduction gives survival advantages to them, and help them to adapt even in extreme environments. **[CBSE Marking Scheme, 2012]** 2

A Q. 9. **(i) Some dinosaurs had feathers but could not fly using these feathers. Why ?**

(ii) What are inherited and acquired traits ?

(iii) What is a sex chromosome ?

Ans. (i) The evolution of feathers in certain dinosaurs had nothing to do with flight. **1**

In them, the feathers carried out the function of providing insulation in cold weather. **1**

(ii) Inherited traits are characters that are transferred from one generation to another. **1**

Acquired traits on the other hand are developed during the life time of an individual and cannot usually be transferred to future generations. **1**

(iii) Sex chromosome is either a pair of chromosomes, usually designated X or Y, in the germ cells of most animals, that combine to determine the sex and sex-linked characteristics of an individual. **1**

TOPIC-2
Origin of Life and Evolution

Very Short Answer Type Questions (1 mark each)

R Q. 1. **What is speciation ?**

[Board Term II, Delhi Set II, 2015] [KVS-2014]

Ans. Speciation is the evolution of reproductive isolation among once interbreeding populations *i.e.*, the development of one or more species from an existing species. **1**

[CBSE Marking Scheme, 2015]

U Q. 2. **List any two factors that could lead to speciation ?**

[Board Term II, Delhi Set II, 2013]

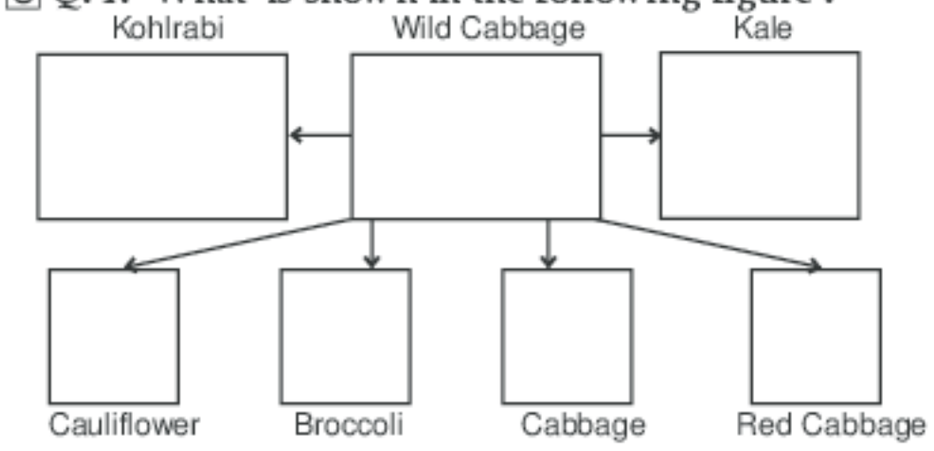
Ans. Two factors that could lead to speciation are—

(i) Genetic drift, **(ii)** Reproductive isolation. ½ + ½

A Q. 3. **What is the only progressive trend seen in evolution ?**

Ans. The only progressive trend in evolution seems to be that more and more complex body designs have emerged over a period of time. **1**

U Q. 4. **What is shown in the following figure ?**



Ans. The figure shows the evolution of wild cabbage. **1**

A Q. 5. **How does creation of variations in a species promote survival ?**

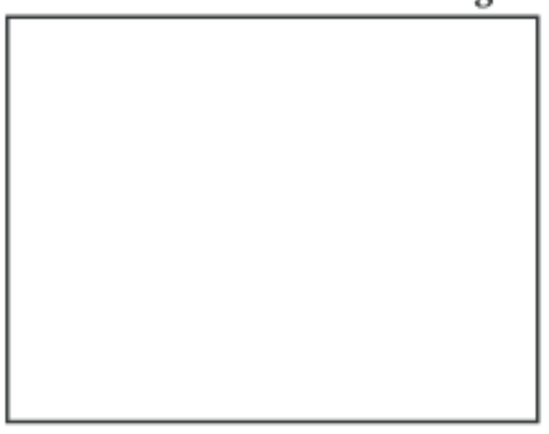
Ans. Favourable variation helps a species to adapt to change in their environment and they promote survival of the species. **1**

R Q. 6. **Write the contribution of Charles Darwin in the field of evolution.**

[Board Term II, Delhi, Set III 2014]

Ans. Charles Darwin proposed that evolution of species occurred by natural selection. **1**

R Q. 7. **Name the fossil shown is the figure below—**



Ans. The figure shows the fossil of an invertebrate animal—Ammonite. **1**

U Q. 8. **How was the vegetable kale obtained from cabbage ?**

Ans. Farmers carried out artificial selection of plants with slightly larger leaves in the wild cabbage and came up with a leafy vegetable called kale. **1**

U **Q. 9. What is the main reason for evolution according to Darwin ?**

Ans. According to Darwin, evolution took place due to natural selection. **1**

A **Q. 10. One of the examples of two analogous organs can be the wing of parrot and**

(i) flipper of whale (ii) foreleg of horse

(iii) front leg of frog (iv) wings of housefly.

Ans. (iv) Wings of parrot and wings of housefly have similar appearance and perform similar functions. **1**

A **Q. 11. In evolutionary terms, can we say which among bacteria, spiders, fish and chimpanzee have a 'better' body design ? Why or why not ?**

Ans. In evolutionary terms, chimpanzee has the most complex body design but it will be wrong to say that they have a better body design as all the organisms are very well adapted to their environment and have their body designs evolved according to their body adaptation. **1**

U **Q. 12. 70% of individuals in a population of hydra show long tentacles whereas 10% of individuals in the same population show short tentacles. Which trait is likely to have arisen earlier ?**

Ans. Long tentacles. **1**

Short Answer Type Questions-I

(2 marks each)

R **Q. 1. What are analogous organs ? Why cannot the wing of a butterfly and the wing of a bat be considered homologous organs ? State one reason. [OD Comptt. 2017]**

Sol. Analogous organs : Organs with dissimilar basic structure or origin, but performing same function. **1**

Because though they perform similar function, they have different origin/basic structure. **1**

R **Q. 2. What is speciation ? State any two factors which could lead to speciation.**

Sol. Speciation : Origin of a new species from pre-existing one. **1**

Factors : Mutation, Genetic drift, Geographical isolation, Reproduction isolation. **(Any two)** ½×2

R **Q. 3. Write full forms of DNA. Where is it located ? [Board Term II, Set QNA4XWT, 2014]**

Ans. Deoxyribonucleic Acid. It is located in the cell nucleus. **[CBSE Marking Scheme, 2014]** 1+1

R **Q. 4. What do the following terms mean ?**
(i) Micro-evolution, (ii) Fossils.

Ans. (i) Micro-evolution : Evolution resulting from small specific genetic changes that can lead to a new sub-species. **1**

(ii) Fossils : Fossils are preserved traces of living organisms, that got buried deep inside the earth million of years ago. **1**

U **Q. 5. Name any four mechanisms which can lead to speciation in sexually reproducing organisms.**

Ans. Natural selection, genetic drift, variations and geographical isolation can lead to speciation in sexually reproducing organisms. ½ × 4 = 2

U **Q. 6. How does natural selection differ from genetic drift ?**

Ans. Natural selection selects those variations in a population which give a survival advantage and helps the better population to fit their environment better. **1**

On the other hand, genetic drift can alter gene frequencies in small populations and provide diversity without any survival benefits. **1**

U **Q. 7. How are areas of study-evolution and classification interlinked ? [NCERT]**

Ans. The field of evolution and classification are interlinked in the following manner :

(i) The more characteristics two species have in common, the more closely they are related. Classification of species is a reflection of their evolutionary relationship. **1**

(ii) The more number of characteristics shared by two organisms, more is the probability of their having common ancestors. **1**

Thus, classification of an organism is the reflection of its evolutionary path.

R **Q. 8. State two methods of determining the age of fossils. [Board Term II, O.D. III 2014]**

Ans. (i) If we dig into the earth and start finding fossils, it can be assumed that the fossils closer to the surface are more recent to those found in the deeper layers.

(ii) By detecting the ratios of different isotopes of the same element in the fossil material. **1 + 1**

A **Q. 9. Can a wing of a butterfly and the wing of a bat be considered homologous organs ? Why or why not ?**

Ans. No. **1**

A wing of a butterfly and wing of a bat can't be considered homologous organs because wings of a bat are skin folds in between the fingers and wings of a butterfly are membrane supported by muscles. They are analogous organs. **1**

A **Q. 10. In an area A, the leaf material available to beetles was very less. What are the two consequences seen in the beetles ? [Board Term II, Set-8XSVHLC, 2014]**

Ans. The consequences are as follows :

(i) They switched to new type of food and entered new niches.

(ii) This lead to arise of diverse variety of beetles as some changes in beetles will take place to make them adaptable to new niches. **1+1**

A **Q. 11. Will geographical isolation be a major factor in the speciation of an organism that reproduces asexually ? Why or why not ?**

Ans. No. **1**

Geographical isolation prevents gene flow between populations of a species whereas asexual reproduction generally involves only one individual. In an asexually reproducing organism, variations can occur only when the copying of DNA is not accurate. Therefore, geographical isolation cannot prevent the formation of new species in an asexually reproducing organism. 1

A **Q. 12. Give an example of characteristics being used to determine how close two species are in evolutionary terms.**

Ans. Analogous organs are one such evidence that is used to determine how close two species are related.

The presence of feathers in dinosaurs and birds indicates that they are evolutionarily related.

Dinosaurs had feathers not for flying but instead these feathers provided insulation to these warm-blooded animals. However, the feathers in birds are used for flight.

This proves that reptiles and birds are closely related and that the evolution of wings started in reptiles. 2

U **Q. 13. Explain the importance of fossils in deciding evolutionary relationships. [NCERT]**

Ans. Fossils are very important in tracing the path of evolution as by studying characters of fossils we are able to find their descendants and thus we can know what new variations have come. They provide evidence and missing links between the two classes. They are helpful in forming a sequence of organisms in the pathway of evolution.

Thus, fossils have an importance in deciding evolutionary relationship. 2

Short Answer Type Questions-II

(3 marks each)

R **Q. 1. What is speciation ? Explain in brief the role of natural selection and genetic drift in this process. [Board Term II, Foreign Set II 2016]**

Ans. (i) Speciation : Origin of new species from pre–existing ones. 1

Role of Genetic drift and natural selection : Genetic drift is flow of genes from one population to another by chance factor or randomly. Over generation it will accumulate different changes in different population. 1

In addition, natural selection operates differently in different population selecting the fittest/favourable feature in both the population. Over a long period of time the differences in the two population may become so drastic that they no longer reproduce with each other and thus give rise to new species. 1

[CBSE Marking Scheme 2016]

R **Q. 2. What is speciation ? List four factors responsible for speciation. [Board Term II, Delhi Set I, 2015]**

Ans. Speciation is the evolution of reproductive isolation among once interbreeding population.

Factors which can lead to speciation are—

(i) Genetic drift–Over generation, genetic drift may accumulate which lead to speciation.

(ii) Natural selection may work differently in different location which may give rise to speciation.

(iii) Severe **DNA change.**

(iv) A **variation may** occur which does not allow sexual act between two groups. 1 + 2

[CBSE Marking Scheme 2015]

R **Q. 3. Explain the following :**

(a) Speciation

(b) Natural Selection

[Board Term II, Delhi Set II, 2015]

Ans. (a) Speciation : It is the evolution of reproductive isolation among once–interbreeding populations *i.e.,* the development of one or more species from an existing species.

Factors which can lead to speciation are :

(i) Genetic drift may accumulate which lead to speciation.

(ii) Natural selection may work differently in different location which may give rise to speciation.

(iii) Severe DNA change.

(iv) A variation may occur which does not allow sexual act between two group.

(b) Natural Selection : (i) There is natural variation within any population and same individuals have more favourable variations than others.

(ii) Population remains fairly constant even though all species produce a large number of offsprings.

(iii) This is due to 'competition' or struggle for existence between same and different species.

(iv) The struggle for survival within population eliminates the unfit individuals and those with 'favourable variations' survive and pass on these variations to their progeny to continue. This is called natural selection. The favourable variations are accumulated over a long time period leading to the origin of a new species. 1½ + 1½

[CBSE Marking Scheme 2015]

R **Q. 4. "Natural Selection and Speciation leads to evolution." Justify this statement.**

[Delhi 31/1/2 2017]

Ans.
- Natural selection is defined as the change in frequency of some genes in a population, which gives survival advantage to a species. 1
- Whereas speciation is the development of a new species from pre-existing ones.
- This leads to a sequence of gradual change in the primitive organisms over millions of years, to form newer species which are very different from older ones. This is called evolution.

[CBSE Marking Scheme 2017]

Detailed Answer :

Natural selection is the phenomenon by which the nature selects those species which possess survival advantage over the other species. According to theory of natural selection, there is struggle of existence within the species of a population for the environmental resources and their struggle leads to survival of certain organisms and elimination of the less competent species. The better adapted organisms would, thus, survive and pass on their traits to next generation, gradually leading to evolution.

Speciation is a process of formation of new species from the existing one due to reproductive isolation of a part of its population. This reproductive isolation can occur due to geographical isolation of a part of population. With time, the genetic drift will accumulate different variations in each of the geographically separated sub-population. Ultimately all the individuals of these two groups will isolate reproductively, thus, leading to formation and evolution of new species. Thus we can say that both natural selection and speciation lead to the evolution of species on earth. 3

U **Q. 5. Explain with an example for each, how the following provides evidences in favour of evolution in organisms :**

(i) Homologous organs

(ii) Analogous organs **[Delhi 31/1/1 2017]**

(iii) Fossils. **[Board Term II, Delhi Set II, 2015]**

Ans. (i) Homologous organs : Forelimb of human and bird are homologous organs. They have same structural design and developmental origin but they have different functions and appearance. Homologous organs help us to understand that the organism have evolved from a common ancestor. The more common characteristics the two species have the more closely they are related.

(ii) Analogous organs : Analogous organs are those organs which have different basic structural design and development origin but have similar appearance and perform similar functions.

Example : The wings of birds and bats look similar but have different design in their structure. They have a common function of flying but their origins are not common. So, birds and bats are not closely related.

(iii) Fossils and their study is useful in knowing about the species which are no longer alive. They provide evidence and missing links between two classes. They are helpful in forming a sequence of organisms in the pathway of evolution.

Thus, fossils have an importance in deciding evolutionary relationship. Archaeopteryx is a fossil bird. It had feathers, fused bones and beak which are exclusively bird structures. It also had some features which are found in reptiles *e.g.,* teeth in jaw, claws on free fingers and a long tail. This fossil provides a clue that birds have evolved from reptiles. **[CBSE Marking Scheme 2015]** 1+1+1

U **Q. 6. List three main factors responsible for the speciation and briefly describe each of them.**

[Board Term II, Outside Delhi Set II, 2014]

Ans. Factors responsible for speciation :

(i) Gene flow must be stopped so that sub-populations become genetically isolated.

(ii) Mutation plays a role in speciation. Changes in allele and genotype frequencies within the populations, by natural selection.

(iii) Genetic isolation leads to the formation of new species.

(iv) Geographical barriers such as mountain ranges, seas or rivers may produce a barrier to gene flow and the inability of organisms or their gametes to meet, leads to reproductive isolation and hence speciation. Sometimes crossing of two unrelated species (Genetic Engineering) can also lead to speciation. **(Any three)** 1+1+1

R **Q. 7. Define the following with one example for each :**

(i) Genetic Drift.

(ii) Natural selection.

(iii) Reproductive isolation. **[KVS-2014]**

Ans. (i) Genetic drift : It refers to the random change in gene frequencies in a small population, presumably owing to change rather than natural selection, thereby providing diversity without any adaptations. 1

(ii) Natural selection : In this new suitable traits are selected to live in the prevailing environment. 1

(iii) Reproductive isolation : When same members of a particular species are not able to mate with other members of the same species due to environmental barriers or due to other geographical barriers , it is known as reproductive isolation. 1

U **Q. 8. Differentiate between homologous and analogous organs. Give one example of each.**

[NCERT]

[KVS-2014] [Board Term II, Set (2007), 2012]

Ans. Organs which have similar structure but different functions are known as homologous organs. *e.g.* forelimbs of a lizard and forelimb of a man. 1½

Organs which have similar functions but different structures are known as analogous organs. *e.g.* wing of a bat and wing of a bird. 1½

U **Q. 9. Define evolution. Why are traits acquired during life time of an individual not inherited ?**

[NCERT]

[Board Term II, Foreign Set-III 2014]

[Board Term II, Set (2008) 2012]

Ans. Formation of new species because of barriers, genetic drift and natural selection takes place which leads to complex structures with better survival advantage. This is known as evolution.

The traits, which are acquired during the life time of an organism affect the structure and functioning of cells, tissues and organs without affecting the genetic material and thus are not inherited.

[CBSE Marking Scheme, 2012] 1½+1½

U **Q. 10. "Evolution and Classification of organisms are interlinked." Give reasons to justify this statement.**
[OD 31/1 2017]

Ans.

[Topper Answer 2017]

Detailed Answer :

Every organism has an in built tendency for genetic variation which plays an important role in the origin of new species and forms the basis for evolution. The more characteristics two species have in common, the more closely they are related. Classification of organisms involves organising them in different groups, based on the similarities and dissimilarities of characteristics. Therefore, classification of species is a reflection on their evolutionary relationship. Thus, we can say that evolution and classification of organisms are interlinked. **3**

U **Q. 11. Define evolution. How does it occur ? Explain how fossils provide evidences in support of evolution ? (OD Comptt. 2017)**

Ans. ● **Evolution :** Gradual accumulation of variations and its selection by nature leading to formation of new species. **1**

● Variations may arise in a population due to mutations or sexual reproduction. Sub-populations are formed due to genetic drift and geographical isolation. When natural selection acts on them, most suitable variation survives leading to evolution of a new species. **2**

● Fossils provide missing link between the species/ who has evolved from whom. They provide information about prehistoric organisms. **1, 1**

[CBSE Marking Scheme, 2017]

U **Q. 12. What is organic evolution ? It cannot be equated with progress. Explain with the help of a suitable example. [OD 31/3 2017]**

Ans. Organic evolution is the process or event of change in an organism by which descendants differ from their ancestors. **1**

Evolution cannot be equated to progress. From lower forms to higher forms it gives rise to more complex body designs even while the simpler body designs continue to flourish. For example, human beings have not evolved from chimpanzees but both have common ancestor. **2**

A **Q. 13. With the help of two suitable examples, explain why certain experiences and traits earned by people during their lifetime are not passed on to their next generations. When can such traits be passed on ?**

Ans. Learning skills like swimming, dancing and low weight of beetle due to starvation earned by people during their lifetime are not passed on to their next generation. If a person knows swimming or dancing, it is not necessary that this trait it seen in the progeny because learning a new skill does not change the genes of the germ cells of humans. Also, low weight in beetle is not a trait that can be inherited by the progeny of a starving beetle.

These traits/experiences occur in the somatic cells which do not involve germ cells and genetic materials. Therefore, these traits are not passed on to their next generation. **2**

A **Q. 14. What is DNA Copying ? State its importance ?**
[OD Comptt. 31/3 2017]

Ans. Creating a new copy of DNA in a reproducing cell is known as DNA copying. **1**

Importance : Since DNA is the carrier of the blue print of the genetic characters, its copying is essential to pass on this blue print to the offsprings. **[CBSE Marking Scheme] 2**

U **Q. 15. What are homologous organs ? Give one example. Can the wings of a butterfly and the wings of bat be regarded as homologous ? Give reason in support of your answers.**
[OD Comptt. 31/1 2017]

Ans. Homologous Organs : Organs with similar basic structure/origin but modified to perform different functions. **(or any other) 1**

Example : Forelimbs of various vertebrates. ½

Wings of butterfly and the wings of a bat cannot be regarded as homologous organs. ½

Reasons : Though they perform the similar function, they have different origin/basic structure. **[CBSE Marking Scheme] 1**

U **Q. 16. What are fossils ? State their importance in the study of evolution with the help of a suitable example. [Board Term II, Delhi Set III, 2013]**

OR

What are fossils ? What do they tell us about the process of evolution ? [NCERT]

Ans. Fossils are remains or impressions of past organisms that are found in the rocks. Fossils of lower strata belong to early periods while those of upper strata are of later periods. Arranging the fossils stratum wise will indicate the occurrence of different forms of life at different times. It is found that the early fossils generally belong to simple organisms. Complexity and elaboration increased gradually with evolution.

(i) Fossils indicate the path of evolution of different groups.

(ii) They can indicate the phylogeny of some organisms. *e.g.* horse, elephants.

(iii) Some fossils have characteristics intermediate between two groups *e.g.* Toothed bird Archaeopteryx.

They indicate how one group has evolved from another. 1½+1½

R **Q. 17. (i) What are fossils ? How do we know how old the fossils are ?**

(ii) State two differences between homologous and analogous organs. [Board Term II, Set (2024), 2012]

Ans. (i) Fossils : The remains and / or impressions of organisms that lived in the past. ½

(a) The fossils that we find close to the surface are more recent than the one we find in deeper layers. ½

(b) Dating fossils by detecting the ratio of different isotopes of the same element. ½

(ii) (a) Homologous organs have same basic structural design. ½

(b) Analogous organs have different basic structural design. ½

(c) Homologous organs perform different functions.

(d) Analogous organs perform similar functions.

[CBSE Marking Scheme, 2012] ½

R **Q. 18. (i) Which of the following fossils is invertebrate and which one is vertebrate ?**

(a) Dinosaur, (b) Ammonite.

(ii) How can the age of fossil be ascertained ? State in brief any two methods.

[Board Term II, Set (2036), 2012]

Ans. (i) (a) vertebrate, **(b)** invertebrate. ½+½

(ii) If we dig into a rock/earth then it is reasonable to suppose that the fossil found in the upper layers must be of more recent origin than the fossil found in the deeper layers. 1

The second way is by detecting the ratios of different isotopes of the same element in the fossil material. 1

[CBSE Marking Scheme, 2012]

R **Q. 19. Name three organisms which are fossilized.**

[Board Term II, Set-8XSVHLC, 2014]

Ans. (i) Dinosaur, **(ii)** Ammonite, **(iii)** Trilobite. 1 × 3 = 3

[CBSE Marking Scheme, 2014]

A **Q. 20. Give two uses of fossils. How does the study of fossils provide evidence in favour of organic evolution ?**

Ans. The two uses of fossils are :

(i) Racial history of plants. ½

(ii) Past climatic conditions of earth. ½

Study of fossils provide evidence in favour of organic evolution because :

(i) Fossils helps to identify an evolutionary relationship between apparently different species. 1

(ii) The fossils present in the bottom rocks are simple while the most recent fossil found in the upper strata are highly complex. This geographical succession completely agrees with the concept of evolution. 1

A **Q. 21. When organisms die, their bodies will decompose and be lost. Then how do we get fossils ? Give an example.**

Ans. In most cases when organisms die, their bodies decompose and become lost. 1

But every once in a while, the body or at least some parts of the body may be in an environment that does not decompose completely. 1

It is through such preserved traces of living organisms that we get fossils.

For example : If a dead insect gets caught in hot mud, it will not decompose quickly, the mud will eventually harden and retain the impression of the body parts of the insect. 1

A **Q. 22. How are fossil formed ? State any one role of fossils in the study of organic evolution ?**

[OD Comptt. 31/2 2017]

Ans. Formation : On certain occassions, a dead body or at least some parts may be in an environment that does not let it decompose completely and gets preserved, subsequently either the part or its impression becomes a fossil.

Role of Fossil : Provides missing link between the species/who has evolved from whom.

They tell us about prehistoric organisms.

[CBSE Marking Scheme]

R **Q. 23. Mention three important features of fossils which help in the study of evolution.**

[NCERT Exemplar 2017]

Ans. Three important features of fossils which help in the study of evolution are :

(i) Fossils represent modes of preservation of ancient species.

(ii) Fossils help in establishing evolutionary traits among organisms and their ancestors.

(iii) Their physical structure helps us provide a link between two different species of Organisms.

1+1+1

U **Q. 24. "Two areas of study namely 'evolution' and 'classification' are interlinked". Justify this statement.**

[NCERT] [Board Term II, O.D. Set I, 2016]

[Board Term II, Set 6TM6KWC, 2015]

Ans. (i) Different forms of organisms/ life have evolved during the course of evolution, and classification deals with grouping of these organisms into groups and subgroups based on their similarities and differences. ½ + ½

(ii) The more characteristics any two species have in common more closely they are related/ will have a more recent ancestor (and vice versa). **1**

(iii) Thus classification helps tracing the evolutionary relationships between the two organisms. Hence classification and evolution are interlinked. **[CBSE Marking Scheme 2015] 1**

OR

[Topper Answer, 2016]

R **Q. 25. Give an example of the characteristics being used to determine how close two species are in evolutionary terms. [Foreign 31/2/1 2017]**

Ans. Study of homologous organs as forelimbs of mammals, birds, reptiles and amphibian; show that though they perform different functions have similar basic / internal structure; this is because they have evolved from common ancestor and help us in determining the closeness between two species in evolutionary terms

[CBSE Marking Scheme 2015] 1 + 1 + 1

A **Q. 26. "Evolution should not be equated with progress". Why ?**

[Board Term II, Foreign Set III, 2014]

Ans. Evolution is simply the generation of diversity and the shaping of the diversity by environmental selection. Species adapt to the conditions available in their environment. Some older and simple species live on quite effectively. The only progressive trend in evolution seems to be that more and more complex body designs have emerged over time.

In fact, one of the simplest life forms like bacteria – inhabit the most inhospitable habitats like hot springs, deep-sea thermal vents and the ice in Antarctica. **3**

U **Q. 27. Homologous organs are different from analogous organs.**

(i) Mention the two basic characteristics that decide about analogy and homology between the two organs.

(ii) On what basis is the classification of organisms into prokaryotic and eukaryotic done ?

[Board Term II, Set FF7NBE6, 2015]

Ans. (i) The two basic characteristics that decide about analogy and homology are origin, structures and function.

(ii) In prokaryotic organism no true nucleus is found. Therefore, nucleus is absent.

In eukaryotic organisms true nucleus is found.

[CBSE Marking Scheme 2015] 1 + 1 + 1

U **Q. 28. There are two different types of organs, homologous and analogous. Differentiate between them by giving three points.**

[Board Term II, Set GFUTB86, 2015]

Ans.

S. No.	Homologous Organs	Analogous Organs
(i)	They have same basic structural design.	They have different basic structural design.
(ii)	They perform different functions.	They perform similar functions.
(iii)	Their appearances are different.	They have similar appearances.

[CBSE Marking Scheme 2015] 3

A **Q. 29. All human races like Africans, Asians, Europeans, Americans and others look so different from each other still they belong to the same species. Give three points to justify the statement.**

[Board Term II, Set UV6TE2N, 2015]

Ans. (i) Freely interbreeding, producing fertile offspring.

(ii) Same number of chromosomes–23 pairs.

(iii) Common body design, anatomy and physiology.

1 + 1 + 1

R **Q. 30. List three factors that provide evidences in favour of evolution in organisms and state the role of each in brief. [Foreign Set II, 2017]**

[Board Term II, Foreign Set I, 2016]

Ans. Three factors / evidences and their roles.

(i) Analogous organs : Organisms with similar looking organs may have different origin.

(ii) Homologous organs : Organisms with apparently different looking organs may have similar origin.

(iii) Fossils : Allow us to make estimates of how far back evolutionary relationships go. Fossils when chronologically arranged help in tracing the evolutionary history of an organism. **3 × 1 = 3**

[CBSE Marking Scheme 2016]

A **Q. 31.**

(A) (B)

(a) Identify the fossils A and B ?

(b) What type of fossils are these ?

[Board Term II, Set UV6TF2N, 2015]

Ans. (i) Ammonite, Trilobite

(ii) Invertebrate. **1½+1½**

A **Q. 32. (a)** Cite the evidence on the basis of which it is concluded that birds have evolved from reptiles.

(b) Insects, Octopus, *Planaria* and Vertebrates also possess eyes. Can these animals be grouped together on the basis of the eyes they possess. **Why or why not ? Give reason to justify your answer. [Board Term II, Delhi Set I, II, III, 2014]**

[Board Term II, Foreign Set I, 2015]

Ans. (a) (i) Fossils showing imprints of feathers along with the bones in dinosaurs/reptiles found.

(ii) They could not fly and presumably use the feathers for insulation.

(iii) Later they developed/evolved and adapted feathers for flight.

(iv) Thus, they give evidence that birds have evolved from reptiles. **½×4 = 2**

(b) No, the structure of the eye in each of these organisms is different/they have separate evolutionary origins. **½+½**

[CBSE Marking Scheme, 2015]

A **Q. 33. 'Variations that confer an advantage to an individual organism only will survive in a population.' Justify.**

[Board Term II, Set 8XSVHLC 2014]

OR

Only variation that confer an advantage to an individual organism will survive in a population. Do you agree with this statement ? Why or why not ? [NCERT]

Ans. Useful variations give advantage to individuals in obtaining more food, reproduction, adaptation to environmental changes and higher success in the struggle for existence. They give benefit in survival and increasing the population. Differential reproduction increases the useful variations in the populations. Other individuals with harmful variations will be destroyed. For example, some bacteria have ability to tolerate high temperature. But other non-resistant bacteria will be killed. **3**

[CBSE Marking Scheme, 2014]

A **Q. 34. (i)** ***Planaria*****, insects, octopus and vertebrates all have eyes. Can we group eyes of these animals together to establish a common evolutionary origin ? Justify your answer.**

(ii) "Birds have evolved from reptiles". State evidence to prove the statement.

[Board Term II, O.D. Set I 2015]

Ans. (i) Yes, eyes can be grouped together, which have evolved over generation from imperfect eyes in *Planaria* to perfect eyes in vertebrates.

(ii) Dinosaur is a type of reptile which has wings. Birds also have wings, so it can be proved that birds have evolved from reptiles. **1½ + 1½**

[CBSE Marking Scheme 2015]

A **Q. 35. The modern human beings have originated in Africa.**

(i) Which evidence suggests this fact ?

(ii) If an animal is similar to its ancestors, what does this imply ? [Board Term II, Set 8XSVHLC, 2014]

Ans. (i) This was shown by the help of fossil records of *Homo erectus*, according to which their cranial capacity had doubled. *Homo erectus* were the first to leave Africa and spread through Africa, Asia, and Europe. One population of *H. erectus*, stayed in Africa and evolved into *Homo sapiens*.

(ii) This implies that from the beginning of life on earth the inheritance of trait is going on, that result in the production of existing animals that look similar to their ancestors because they have inherited traits from them and these trait that make them similar to their ancestors have not gone under evolutionary change. **1½+1½**

[CBSE Marking Scheme, 2014]

A **Q. 36. Why are small number of surviving tigers a cause of worry from the point of view of genetics ? Explain. [Board Term II, SQP 2013]**

Ans. (i) If any natural calamity occurs and kills these small number of surviving tigers, they can become extinct resulting in the loss of genes forever.

(ii) Small number will lead to little recombination and lesser variations that are very important for giving better survival chances to the species.

(iii) Less number of species means lesser extent of diversity and lesser number of traits which reduce the chances of adaptability with respect to the change in the environment. **1+1+1**

A **Q. 37. (i) A husband has 46 chromosomes, his wife has 46 chromosomes. Then why don't their offsprings have 46 pairs of chromosomes, which is obtained by the fusion of male and female gametes?**

(ii) "Geographical isolation is not a major factor in the speciation of a self pollinating plant species." Justify this statement with the help of an example.

[Board Term II, Set (67003) 2012]

Ans. (i) Male individual has 46 chromosomes but because the gametes are always haploid *i.e.,* they have half the no. of chromosomes; sperms will be haploid (23 chromosomes). Female individual also contains only 23 chromosomes in egg. It is the fusion of this sperm and egg which leads to an offspring with 46 chromosomes. **1½**

(ii) Geographical isolation will not be a major factor in the speciation of a self-pollinating plant species. It involves the same flower / plant from where male and female gametes are formed. **1½**

A **Q. 38. Does the occurrence of diversity of animals on earth suggest their diverse ancestry also ? Discuss this point in the light of evolution.**

[NCERT Exemplar 2017]

Sol. Though animals have a vast diversity in structures they probably do not have a common ancestry because common ancestry may greatly limit the extent of diversity. As many of these diverse animals are inhabiting the same habitat, their evolution by geographical isolation and speciation is also not likely. **3**

A **Q. 39. How were farmers able to obtain present day cabbage, cauliflower and broccoli from wild cabbage?**

Ans. Farmers were able to grow present day cabbage, cauliflower and broccoli from wild cabbage by selective breeding. Broccoli was selected by breeding larger flower stalks and cabbage was bred by selecting shorter petioles. Cauliflower is also a descendent of wild cabbage. It was bred by selecting sterile flowers. **3**

Long Answer Type Questions

(5 marks each)

Q. 1. Define evolution. How does it occur ? Describe how fossils provide us evidences in support of evolution.

[Board term II, O.D. Set III 2016]

Ans.

[Topper Answer, 2016] 5

R **Q. 2. What is multiple fission ? How does it occur in an organism ? Explain briefly. Name one organism which exhibits this type of reproduction.**

[Board Term II, O.D. Set I, 2016]

Ans. In multiple fission, the nucleus divides several times simultaneously or successively into a number of daughter nuclei and then the cytoplasm divides into as many cells as there are nuclei. It is the common form of asexual reproduction in certain acellular organisms. **4 + 1**

Plasmodium, Chlamydomonas, Algae **(Any one)**

U **Q. 3. What is meant by speciation ? List four factors that could lead to speciation. Which of these cannot be a major factor in the speciation of a self-pollinating plant species. Give reason to justify your answer.**

[Board Term II, Delhi Set I 2016]

OR

What is speciation ? List four factors that could lead to speciation. Which of these cannot be a major factor in the speciation of a self-pollinating plant species ? Explain.

[Foreign II 2015]

Ans. (i) Speciation : The process of formation of a new species from a pre-existing one. **1**

(ii) Four factors :

Genetic drift

Mutation / Drastic change in the genes or DNA

Natural selection

Geographical isolation **4×½ = 2**

(iii) Geographical isolation cannot be a major factor in the speciation of a self-pollinating plant species. **1**

(iv) Reason : Physical barrier cannot be created in self-pollinating plants. **1**

R **Q. 4. What is speciation ? What are the factors that lead to speciation ? Explain any two factors.**

[Foreign 31/2/1, 2017][Board Term II, 2015]

Ans. (a) It is an evolutionary process by which new species arise.

Factors :

(i) Geographical isolation

(ii) Genetic drift

(iii) Natural selection **2**

(b) (Any two with explanation)

(i) Genetic Drift : It is the random change in the frequency of alleles in a population over successive generations due to sampling error in the gametes. Each new generation differs from its parental generation with regard to the allele frequencies simply because of random variation in the distribution of gametes.

This process is more rapid in smaller population, hence genetic drift can cause less of genetic diversity if there are no counteracting factors. **1½**

(ii) Natural Selection : It is the process, according to Darwin, which brings about the evolution of new species of animals and plants. Darwin found that variations existed between individuals of the population and concluded that disease, competition and other forces acting on the population eliminated those individuals which are less well adapted to their environment. The surviving population would pass the hereditary advantageous characteristic to their offsprings.

[CBSE Marking Scheme, 2015] 1½+1½

U **Q. 5. (a) How does speciation take place ?**

(b) Define the term gene.

(c) The gene for red hair is recessive to the gene for black hair. What will be the hair colour of a child if he inherits a gene for red colour from his mother and a gene for black hair from his father ? Express with the help of flow chart.

Ans. (a) Speciation may take place by :

(i) Migration

(ii) Natural selection

(iii) Mutation

(iv) Genetic Drift **2**

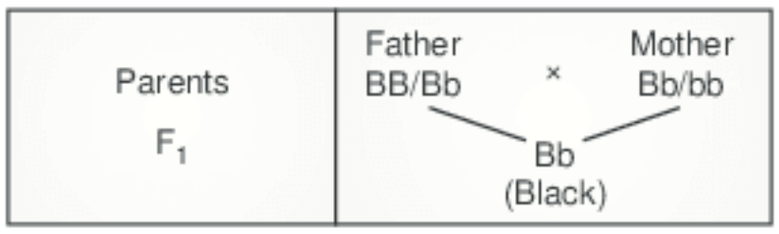
(b) Segment of DNA which is functional and are made of nucleic acids and protein. **1**

(Any other definition)

(c) Given,

Red hair-Mother-Recessive ∴ bb ½

Black hair-Father-Dominant ∴ BB ½



1

Thus, the child will have black hair.

R **Q. 6. What are fossils ? How are they formed ? List two methods of determining the age of fossils. Explain in brief the importance of fossils in deciding the evolutionary relationships.**

[Foreign 31/2/1, 2017]

OR

Explain the importance of fossils in deciding evolutionary relationships. [NCERT]

Ans. (i) Fossils : The remains/impression of dead / decayed plants / animals. ½

(ii) Formation of fossils : Formed when dead organisms are compressed under high pressure deep under the soil. **1**

(iii) Determination of age of fossil—Two methods :

(i) Relative method, ½

(ii) Carbon dating method. ½

(iv) The presence of fossilized remains of the organisms is the evidence of existence of the organisms millions of years ago, out of which some have become extinct. ½

(v) Fossil also helps in the determination of the connecting links between various groups and their origin from the primitive ones. **1 + 1**

U **Q. 7. What evidence do we have for the origin of life from inanimate matter ? [NCERT]**

Ans. J.B.S. Haldane suggested that life must have developed from the simple inorganic molecules which were present on earth soon after it was formed. He speculated that the conditions on earth at that time could have given rise to more complex organic molecules that were necessary for life. The first primitive organisms would arise from further chemical synthesis. 2

Later, Stanley L. Miller and Harold C. Urey conducted experiment to find out about the origin of organic molecules. They assembled an atmosphere similar to that thought to exist on early earth (molecules like ammonia, methane and hydrogen sulphide, but no oxygen over water). This was maintained at a temperature just below 100ºC and sparks were passed through the mixture of gases to stimulate lightning. 2

At the end of a week, 15% of the carbon had been converted to simple compounds of carbon including amino acids which make up protein molecules. 1

This is how life originated from inanimate matter.

A **Q. 8. A particular species 'X' has more common characteristics with species 'Y', whereas another species 'Z' has less common characteristics with species 'Y'. Which two species are more closely related ? Why ? On what basis are the eukaryotic organisms further classified ? Why is this basis important? What is the importance of homologous organs ?**

Ans. Species 'X' is more closely related with species 'Y'. **1**

The more closely related species will have more characteristics in common. Hence species X and Y are closely related. **1**

Eukaryotic organisms are further classified on the basis of whether they are unicellular or multicellular. **1**

This basis marks a very fundamental difference in body design, because of specialisation of cell types and tissues. **1**

Homologous organs help to identify an evolutionary relationship between apparently different species. **1**

High Order Thinking Skills (HOTS) Questions

Q. 1. Why did Mendel choose pea plant for his experiments. [NCERT Exemplar] 3

Ans. Mendel selected peas for his experiments because :

(i) Many varieties are available with observable contrasting characteristic or trait.

(ii) Peas are normally self pollinated and the flower structure is suitable for cross-pollination. **1½ + 1½**

Q. 2. Why is variation beneficial for the species, but not necessarily for the individual ? 3

Ans. Accumulation of variation in a species enables them to adapt according to the changes and the new needs. This provide survival advantage to the species. But an individual does not get any advantage due to variation that takes place on him

Thus, variation is beneficial for a species, but not necessary for the individual. **3**

Q. 3. Describe briefly four ways in which individuals with a particular trait may increase in a population. 3

Ans. The four ways in which individuals with a particular trait may increase in a population are as follows :

(i) Sexual reproduction results into variations.

(ii) The individuals with special traits survive the attack of their predators and multiply while the other will perish.

(iii) Genetic drift provides diversity without any adaptations.

(iv) Variations in the species may lead to increased survival of the individuals. 3

Q. 4. A study found that children with light - coloured eyes are likely to have parents with light - coloured eyes. On this basis, can we say anything about whether the light eye colour trait is dominant or recessive ? Why or why not ? 3

Ans. We can say that light eyes colour trait is dominant because only dominant traits are transferred from the parents to the children in the first generation. 3

Q. 5. Explain with an example how traits get expressed ? 5

Ans. DNA is the source of information for making proteins in the cell. The section of DNA is called gene. For example, the height of a plant depends on the hormone. The amount of hormone depends on the process of its formation. A protein is important for this process. If this protein works efficiently a lot of hormone will be made. If the gene responsible for that protein has an alteration, this will make the protein less efficient. The amount of hormone will be less and the plant will be short. Thus, traits get expressed. 5

Q. 6. Define genetics. What is the contribution of Mendel in this branch of biology ? 5

Ans. The science of heredity and variation is called genetics. Mendel conducted breeding experiments in a garden pea plant (*Pisum sativum*) with two different contrasting characters. He found that only one character appeared in first generation but both the characters reappeared in the subsequent generation. On the basis of results of his experiments,

he put forward the various principles of inheritance. He also suggested that each character of pea plant is controlled by 'factor'. 5

Q. 7. (a) Write the similarities between mode of transmission of 'factor' from parents to offspring as conceived by Mendel and chromosomes through gametes.

(b) What were the three main steps adopted by Mendel for his breeding experiments ? 5

Ans. (a) (i) Both Mendelian factors, which are now known as genes and chromosomes are found in pairs. **1**

(ii) Both segregate at the time of gamete formation, during meiotic cell division. **1**

(iii) The paired condition is again restored after fertilization. ½

(b) (i) Selection of a pure plant. ½

(ii) Production of first generation plants (hybrids) by cross-pollination between the two varieties. **1**

(iii) Raising of second and subsequent generation by self-fertilization of hybrids. **1**

Q. 8. State and describe in brief any three main factors responsible for the rise of a new species. 3

Ans. Factors responsible for rise of a new species are :

(i) Genetic drift : Over generation, genetic drift may accumulate which lead to the formation of a new species.

(ii) Natural selection : Due to natural selection, variation may occur which lead to the formation of a new species.

(iii) DNA change : Variation during DNA copying often lead to the formation of a new species. **(Any two)** 3

Q. 9. List three roles of fossils in tracing evolutionary relationships. 3

Ans. (i) Fossils and their study is useful in knowing about the species which are no longer alive.

(ii) They provide evidence and missing links between two classes.

(iii) They are helpful in forming a sequence of organisms in the pathway of evolution. Thus, fossils have an importance in deciding evolutionary relationship. 3

Q. 10. What is the significance of homologous and analogous organs in the process of evolution ? 5

Ans. The significance of homologous and analogous organs in the process of evolution are as follows :

(i) The existence of homologous anatomical structures implies a common evolutionary origin of amphibians, reptiles, birds and mammals from same ancient fish ancestor. 2

(ii) The homologous structures seen in successive generations indicate relationship and their possessors are the diverse descendants of common ancestry. They point to evolution and divergence from the ancestral type. 2

(iii) Analogous organs have arisen in the evolutionary process through adaptation of different organisms to a similar mode of life. **1**

Q. 11. How do you call in short the Lamarck's theory of evolution ? Who disapproved it initially and how ? 3

Ans. Lamarck theory is called theory of inheritance of acquired characters. It says that the organisms are exposed to new needs due to a change in the environment. They acquire same characters during their lifetime to adapt themselves to the new needs. These characters are passed on to the next generation. For example, the long neck of giraffe is due to need to catch the leaves of long tress.

A. Weismann rejected the theory of Lamarck, stating that adaptations based in the somatic cells cannot be inherited. 3

Q. 12. All the human races like Africans, Asians, Europeans, Americans and other might have evolved from a common ancestor. Provide a few evidences in support of this view. [NCERT] 5

Ans. All the human races have evolved from a common ancestor because they possess :

(i) Common body plan

(ii) Common structure

(iii) Common physiology

(iv) Common metabolism

(v) Constant chromosome number

(vi) Common genetic blue–print

(vii) Free inter–breeding **(Any five)** 1×5=5

Value Based Questions

Q. 1. Mrs. Sharma is pregnant for last three months and she goes for regular check-up to her doctor. During her last visit, the doctor asked Mrs. Sharma to get an ultrasound done. Both Mr. and Mrs. Sharma went to a radiologist and got the ultrasound done. Once the ultrasound is over. Mr. Sharma asked the doctor whether the baby in the womb is a boy or a girl.

(i) What should the doctor reply to the couple ? 1

(ii) Is ethical to determine the sex of a child ? 1

(iii) What should government do to discourage sex determination ? 1

Ans. (i) The doctor should tell the couple that prenatal sex determination is an offence. One should never go for prenatal sex determination. **1**

(ii) Both boys and girls have equal role and importance in our society. Whether a baby is a boy or a girl, they are all equal. It is unethical to determine the prenatal sex of a child. **1**

(iii) Law has already banned sex determination. Anybody involved in sex determination act should be punished. People should be made aware about the ill effects of sex determination which lead to female foeticide and consequently imbalanced ratio of boys and girls. 1

Q. 2. Reproductive process gives rise to new individuals that are similar but with some variations. Thus, the similarities between parents and their offsprings are due to heredity and the dissimilarities are due to 'variation'. Continuity of life is maintained through heredity and evolution.

(i) What do you mean by variation ? 1

(ii) Why is variation beneficial for the species, but not necessary for the individual ? 2

Ans. (i) Variation refers to the difference in the characters or traits among the individuals of a species. 1

(ii) Variation enables the organisms to adapt themselves in changing environment. It form the basis of heredity. They form raw materials for evolution and development of new species. 2

Q. 3. It is a disgrace for the Indian society which consider birth of a girl child as burden. This narrow view point of the Indian patriarchal society has lead to the horrified practice of female foeticide. Escalating demands for dowry is considered as the main reason behind it. Daughters are unable to provide social security to parents and are treated as unwanted commodities. Strict implementation of laws to stop female foeticide and dowry free and compulsory education for girls may help in eradicating this evil from the Indian society. Sex of a child depends on father but often mother is cursed in many societies for giving birth to a girl child.

(i) Do you think laws prohibiting pre-natal sex determination should be strictly enforced. Comment on the statement. 1

(ii) As a student, what initiative would you take in the common concern of 'Sex of a child depends on the chromosome it inherits from father.' Give any three suggestions. 2

Ans. (i) Yes, pre-natal sex-determination should be banned.

The female-male sex ratio should be maintained for the benefit of society. 1

(ii) Suggestions :

(a) Dramas or plays to make awareness in the public.

(b) Doctor's camp to satisfy the confusions of the people.

(c) Group discussion with people, about sex determination. 2

Q. 4. While playing near a sugarcane field, Mohan noticed that the plants are almost similar to one another. At the same time, he noticed the mango trees in the next plot of land are not similar to one another. Mohan concluded there is little variation. Mango reproduces sexually, hence there is larger variation.

(i) Why sugarcane cannot reproduce sexually ? 1

(ii) Can mango reproduce asexually ? 1

(iii) If a person wants to have a flower garden, what type of plants should he grow ? 1

Ans. (i) Because they do not bear flowers. 1

(ii) Yes, by grafting and layering. 1

(iii) Since, the flower garden will be ornamental in natural, the person should plant saplings which are obtained from the same parent asexually. This will give a uniform look to his garden. 1

Q. 5. Fossils are the remains, traces or impression of the dead animals and plants of geological past. Fossils are formed layer by layer in the earth's crust. Fossils of prokaryotes were found in older rocks than those of eukaryotes. Invertebrates were formed before vertebrates. Among vertebrates, fishes appeared earlier than amphibians and amphibians appeared earlier than reptiles, which are earlier than birds and mammals. Thus, fossils provide evidence for evolution.

(i) What is the main factor on which formation of fossil depends ? 1

(ii) What is fossil dating ? Why the study of fossils important ? 2

Ans. (i) Decomposition of organisms. 1

(ii) The age of fossils can be estimated by fossil dating. 1

The study of fossils is important because :

(i) It helps to analyse racial history of plants and animals. ½

(ii) It helps to measure the geological time. ½

Q. 6. Evolution is the change in the inherited traits of a population of organisms through successive generations. After a population splits into smaller groups, these groups evolve independently and diversity into new species. A hierarchy of anatomical and genetic similarities, geographical distribution of similar species and the fossil record indicate that all organisms are descended from a common ancestor. Laetoli is a site of Tanzania famous for its hominid (human and its fossil ancestors) footprints, preserved in volcanic ash.

(i) What is the main reason for evolution according to Darwin ? 1

(ii) 'Both Human beings and chimpanzee have a common ancestor'. Justify the statement by giving reason behind the conclusion. 2

Ans. (i) Natural selection and generation of new species. 1+1

(ii) (a) Changes due to genetic drift and natural selection will result in isolation of two sub-population which become more and more different from each other.

(b) Characters of the fossils also stated the characteristics of ancestors. **1½+1½**

Q. 7. Darwin's theory of 'Survival of the fittest' states that only the fittest will survive.

(i) How will you relate the Darwin's theory to your day–to–day life ? 2

(ii) How will you make yourself fit for a particular work? 1

Ans. (i) 'The Survival of the fittest' theory teaches us that whatever work one does, he or she should do it in the best way. For example, one who play very well will only survive for long time in sports. One who sings consistently well can only survive in the singing field. 2

(ii) To be fit for a work, we must practice it again and again. Practice will bring perfection in work. **1**

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