CHAPTER 8

Evolution and Genetics

GENETICS

- **Genetics** is the branch of science that deals with study of heredity and variations.
- **Heredity** is the transmission of genetic characters from parents to offsprings or one generation to the next.
- **Variations** are differences present in morphological, physiological and other traits found among individuals belonging to the same species.
- The variations result due to mutations occurring during DNA replication.
- **Mutations** are **sudden inheritable variations**.
- **Gregor Johann Mendel** is considered as the **'Father of Genetics'** and he conducted his experiments on **garden pea**, *Pism sativum*.
- Mendel studied the inheritance of **7 pairs** of **contrasting characters** in **pea plants**.
- The colour of the flower (red, white), seed colour (yellow, green), shape of the seed (round, wrinkled) height of the stem (tall, dwarf) etc. were the contrasting characters selected for hybridization.
- From the experiments on pea plants, Mendel formulated certain laws. These are known as **Mendle's laws of inheritance**.
- The **rediscovery of Mendel's work** was done by three scientists. **Hugo de Vries, Carl Correns** and **Erich Von Tschermak**.
- Mendel conducted crosses involving traits of a **single character** as **monohybrid** cross and involving traits of **two characters** as **dihybrid cross**.
- The offsprings formed in a cross are called **hybrids**.
- Mendel arrived at certain interferences from his experiments.
- A **pair of factors** responsible for each character is present in all organisms.
- One factor in each pair is received from the mother and other from the father.
- Factors of both the contrasting characters will be present in F_1 generation, but only one character will be expressed.
- The term **factor** has been replaced by gene by **Johannsen** in 1909.
- **Gene** is a unit of inheritance which consists of a segment of DNA that takes part in expressing a particular character.
- **Alleles** are **alternate forms of a gene** which occur at same locus on the chromosome.
- The external observable characters of an individual is called **phenotype** and the gene complement of an individual is **genotype**.
- A **factor** or allele which **can express its effect** whether present in homozygous or heterozygous state is called as **dominant factor**.

- A **factor** or allele which is **unable to express** its effect in the presence of dominant factor is called **recessive factor**.
- Monohybrid **phenotypic ratio** is **3:1** and **genotypic ratio** is **1: 2: 1**
- Dihybrid **phenotypic ratio** is **9: 3: 3: 1** whereas **genotypic ratio** is **1: 2: 1: 2: 4: 2: 1: 2: 1.**

Mendelism

- **Law of Dominance** states that when a pair of contrasting characters combines, only one is **expressed** and other **remains hidden**. The expressed factor is **dominant** where as hidden one is **recessive**.
- **Law of segregation** states that during gametogenesis, the pair of hereditary factors that determine the characters segregate from each other and only one factors enter each gamete.
- **Law of Independent Assortment** states that when two or more pairs of characters combine, factors for each character pair segregate and assort independently transmit to next generation.

Sex Determination

- In human beings and other animals, there are **two types** of **chromosomes** as **autosomes** and **allosomes**.
- **Autosomes** are the chromosomes which control **normal characters of the body**.
- **Allosomes** determine the **sex** of the individual. Allosomes are also called **sex chromosomes**.
- Human beings have 23 pairs of chromosomes of which **22 pairs** are **autosomes** and the **remaining pair** as **sex chromosomes**.
- In female, the two sex chromosomes are similar and called **XX-chromosomes**.
- They are **homogametic** and produce one type of gamete only.
- In males, **two** types of **sex chromosomes** are present as **X and Y**.
- They are **heterogametic** producing two types of gametes.
- **Sex of a child is determined** by the **type of sperms** fusing with the egg (by the **father only**).
- If an X-containing sperm fuses with egg, the child becomes female whereas if Y-containing sperm fuses with egg, the child becomes male. There is 50:50 chance of a boy or girl being born to every couple.
- Changes can occur in the numbers of autosomes and sex chromosomes and result abnormalities.
- **Down's syndrome** is due to **an extra-chromosome** (three chromosome in 21st pair) resulting in **47 chromosomes**.
- Mental retardation, sterility, low immunity are the symptoms of Down's syndrome.
- **Turner's syndrome** results due to the **loss of one sex chromosome**.
- Only one X-chromosome is present in such a person.
- The individuals are females with mental retardation, under developed and sterile.
- Total number of **chromosomes** is **45** in **Turner's syndrome**.
- **Klinefelter's syndrome** results due to the presence of an **additional Y chromosome** making the total number of **chromosomes 47**.
- Such individuals are males with mental retardation and sterility.

Nucleic Acids

- Nucleic acids are long polymers of nucleotides.
- **Friedrich Meischer** in **1869** discovered nucleic acid and termed it as **'nuclein'**.
- In **1902, Walter. S. Sutton** and **Theodore Boveri** discovered the hereditary factors are located on chromosomes.
- In **1905**, **William Bateson** named the branch of science. **Genetics**.
- In **1943**, **Oswald Avery**, **Mac Loed** and **Mc Carty** identified DNA as the genetic material.
- DNA and RNA are the two types of nucleic acids.
- In 1953, **James Watson** and **Francis Crick** elucidated the **double helical** model of DNA.
- In 1970's **Marshall Nirenberg** and **Har Gobrid Khorana** discovered the **genetic code**.
- DNA molecule is formed of two strands of nucleotides and is made up of **sugar** and **phosphate** as longitudinal strands and the steps made by **nitrogenous bases**.
- A nucleotide is made up of three components: **Ribose sugar**, a **phosphate group** and **nitrogen base**.
- Nitrogen bases may be **purines** or **pyrimidines**. Purines are **adenine** and **guanine** where as pyrimidines are **cytosine** and **thymine**.
- **Purines** always **pairs with pyrimidines**.
- **Adenine** always **pairs with thymine** whereas **guanine pairs with cytosine**.
- Specific parts of DNA are responsible for regulating metabolism and effecting specific characters. These parts are known as **genes**.

- Genes are said to be expressed when proteins are formed.
- **DNA makes RNA** by the process of **transcription** and **RNA reaches ribosomes** and **synthesizes proteins** by linking together with various aminoacids. This process is called **translation**.
- Information for the synthesis of specific proteins is encoded in each gene.
- **RNA** (Ribonucleic acid) also serves as genetic **material** especially **in certain viruses**.
- **RNA** differes from DNA in possessing only a **single strand**, thymine replaced by **uracil** and **ribose sugar** instead of 2–deoxyribose sugar.

Genetic Abnormalities

- Spontaneous changes in the structures and number of chromosomes are known as **mutations**.
- **Sickle cell anaemia** is a **gene mutation** or **point mutation** disorder seen in human beings.
- Sickle cell anaemic persons show **sickle-shaped RBCs** along with normal RBCs.
- **Sickle-shaped RBCs** decrease the **oxygen carrying capacity of blood** and causes **severe anaemia**. It is common in tribals.
- **Haemophilia** and **colour blindness** are the sex **chromosome** (**X–chromosome**) related **mutation disorders** seen in humans.
- **Haemophilia** and **colour blindness** are **more common** and **prone to males** than females in humans.
- Haemophilia shows **inability of blood clot** due to the **absence of clotting factor** production.
- **Colour blind** persons are **not able to distinguish** red-green colour.
- Majority of the **mutated genes** are **recessive** in nature.
- **Tuner's syndrome**, **Klinefelter's syndrome** and **Down's syndrome** are due to the chromosomal number variations.
- **Turner's syndrome** is common in female with only one X-chromosome, hence total number of chromosomes is 45 (**44 autosomes + 1 allosome**), i.e., **44 + X**.
- **Dwarfness** and **sterility** are the characters of Turner's syndrome.
- **Kline felter's syndrome** is common in males with an **extra X-chromosomes** (sex chromosome), hence show 44AA + XXY configuration with **47 chromosomes**.
- **Mental retardation**, **sterility**, **low immunity** etc., are the features of **Down's syndrome**.
- **45 + XX** or **45 + XY** is the genetic nature of **Down's syndrome** patient.

Genetic Engineering and Related Products

- The **genetic manipulation** achieved by **introducing new genes into an organism's** DNA for useful products in known as **genetic engineering**.
- **Genetically modified organisms** (**GMOs**) are also known as **transgenics**.
- *Bt.cotton*, *Bt.brinjal*, *Bt.soyabean*, *Bt.tomato* etc., are **transgenic plants**.
- **Insulin producing** *E.coli* bacterium is another **transgenic microbe**.
- *Pseudomonas putida* is the genetically modified bacterium developed by **Ananda Mohan Chakrabarty.** Commonly known as Super bugs, capable **degradation of oil spils**.

Human Genome Project (HGP)

- **DNA sequencing** of **human chromosomes** is known as **Human Genome project** (**HGP**).
- HGP helps to **identify** the **total genes** (approximately 30,000 genes) and each **gene's** specific genetic role.
- The **largest human gene** being identified is **dystrophin** having **2.4 million bases**.

Evolution

- It is the development of new types of organisms from the pre-existing ones through modifications.
- Modifications occur due to accumulation of variations.
- **Variations** develop **due to mutations** during DNA replication, gametogenesis, crossing over in meiosis. These are **genetic variations**.
- Certain variations develop during life time of an organisms. These are called **acquired variations**.
- Acquired variations are **non-heritable**.

Origin of Life

- Life originated on earth through **chemical reactions** or formation and coming together of biochemicals. It is called the theory of **chemical evolution**.
- In 1924, the Russian scientist **Oparin** and British scientist **J.B.S. Haldane** formulated the theory of chemical evolution and concluded that **life originated** from **non-living components**.

- Earth's atmosphere was **highly reducing** and always **exposed to ultra violet radiations**, cosmic rays, lightening and volcanic eruptions in earlier.
- Gases like **hydrogen**, **ammonia**, **water vapour** and **methane** that were present in **the reduced atmosphere** of primitive earth **reacted together** to form **simple organic molecules** like sugars, aminoacids, alcohols, fatty acids, nucleic acids etc.
- The simple organic molecules undergo further interactions and polymerization to form **complex organic molecules**. This results **coacervatives** that developed to produce **protocells** or primitive cells.
- In 1953, **Stanley Miller** and **Harold Urey** recreated the conditions of primitive earth in the laboratory.
- They took a mixture of **ammonia**, **methane** and Evi**hydrogen** and **water** and exposed it to electric sparks.
- The experiment resulted in the formation of organic compounds like **sugars**, **aminoacids, organic acids**, **purines** and **pyrimidines**.

Theories on Evolution

- The **'Theory of Inheritance of Acquired Characters'** was proposed by French biologist **Jean Baptist Lamarck** and is known as **Lamarckism**.
- Lamarck's Theory relied on the **use or disuse** of **organs**, which changed the structure of organs. This was transmitted to the next generation which gave rise to new species of organism.
- The **long neck of giraffes** and **snakes without limbs** are cited as the examples of **Lamarck's use** and **disuse theory**.
- The **'Theory of inherited traits'** was put forth by the famous naturalist, **Charles Darwin**, who is considered to be the **'Father of Evolution'**.
- Charles Darwin began his voyage in his survey ship **H.M.S. Beagle** in 1831 to **Galapagos Islands** at South America.
- In Galapagos Islands, he found different species of **finches** (**sparrow** like **birds**) having **varied forms of beaks**, **size** and **food habits**. All of them were related to finches on the mainland.
- There are 13 types of finches in 15 Islands. **Finches** were **similar in sound** and **nesting habits** but showed differences in beaks and food habits.
- Darwin also studied on **Galapagos Tortoises** and on **Iguanas** belonging to the class Reptilia.
- Darwin formulated the theory of evolution in his book, **'The Origin of Species'**.
- The British naturalist **Alfred Russel Wallace** also arrived at Darwin's interferences on evolution. He conducted his studies in Indonesian islands.
- **'Theory of Natural selection'** also known as **Darwinism** states that organic evolution occurs through **natural selection** and accumulation of **inheritable variations** made them successful for their **survival** and **reproduction**.
- The important features of the theory are **overproduction**, **limited resources, struggle** for **existence**, **variations**, **natural selection**, **survival** of **fittest** and finally formation of a new species.
- **Hugo de Vries** postulated the **mutation theory** which states that **sudden and heritable changes lead to evolution**.
- Another reason for the origin of new species is **isolation**.
- **Continental drift** and **natural calamities** are the reasons for isolation.
- The process of **formation of new species** is called **speciation**.

Evidences of Evolution

- Evidences may be **palaeontological** (fossils), **physiological** and **biochemical** and **comparative anatomical** and **morphological**.
- **Fossils** are direct evidences of evolutions and are remnants of an organisms obtaining from rocks, soil, ice etc. They remain preserved in the earth's crust.
- The branch of science which deals with fossils is called **Palaeontology**.
- Fossils are called **written documents of evolution**.
- The best example is the fossil of *Archaeopteryx*, which is considered as a **connecting link** between **birds** and **reptiles**.
- *Archaeopteryx* shows **beaks**, **feathers** and **wings like birds** and **reptilian characters** like **clawed fingers**, **teeth** on **both jaws** and **solid bones**.
- **Homologous** and **Analogons organs** provide anatomical and morphological evidences of evolution.
- **Homologous** organs are organs with **similar embryonic origin** but perform **different functions**. E.g., Fore hind of bat, whale, cheetah and man.
- **Analogous** organs are organs which **differ** in their **embryonic origin** but appear **similar in their structure and function**. E.g., Wings of birds and butterflies.

- **Vestigial organs** are **reduced** and **non-functional organs** present in some organisms which were **fully developed** and **functional** in **ancestors only**.
- Examples are the **nyctitating membrane** in human eyes, **tail bones**, **vermiform appendix**, **body hairs**, **wisdom teeth** and **canines**.

Origin and Evolution of Man

- The branch of science which investigates human evolution is known as **Palaeoanthropology**.
- **Eugene Dubois** a Dutch evolutionist in 1891 discovered *Homo erectus*, the most important **link of human evolution**.
- *Homo erectus* fossil is known as **Java Man**.
- **Donald Johanson**, palaeoanthrpologist in 1971 discovered the **oldest fossil**, *Australopithecus* and the fossil become **popular as Lucy**.
- Humans belong to the **Order Primata** of class mammalia.
- **Prosomians**, **cercopithecoidea** and **Hominoidea** are the families of primates.
- **Family Hominoidea** comprises the man, chimpanzee, gorilla, gibbon, organgutans etc and is the **largest family**.
- The earliest of the primates which existed were *Dryopithecus* and *Ramapithecus*.
- *Dryopithecus* was more ape like and *Ramapithecus* was man like.
- These were supposed to have lived from 20 million, 40 million years ago.
- *Ardipithecus* is the **first ancestor of man** who is considered to have lived 4.4 mya. Their fossils were discovered from **Ethiopia**.
- *Australopithecus* fossils were discovered from south east Africa, Tanzania and Ethiopia.
- They were about 4 feet tall and **walked** nearly **upright**.
- They **ate fruits** and **hunted** with **stone weapons**.
- *Homo habilis*, is the **oldest fossil of genus Homo**, which expresses the biological and behavioural characteristics of **modern man**.
- These fossils were discovered from **Tanzania** and they had **practical knowledge** of **using weapons**.
- They were **vegetarians**.
- *Homo erectus* were considered to have lived 1.8 mya. Their fossils were found in **Java Islands,** Indonesia, so known as **Java man**. They were supposed to have **good intelligence** and **physical strength**. They used **advanced weapons** and **probably ate meat**.
- *Homo neandenthalensis* (**Neandenthal Man**) is **primitive man** whose fossils were formed in east and central Africa. They used **hides to protect their body** and lived about 50, 000 mya.
- *Homo sapiens* known as **modern man** arose 75,000–10,000 years ago. They spread all over the earth and knew the art of **agriculture** and **domestication of animals**.

PRACTICE EXERCISE 8 (A)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. Consider the following statements.

A. Law of dominance, law of segregation and law of independent assortment etc are the Mendelian principles.

B. Recombination in the progeny level result due to crossing over of chromosomes in meiosis.

C. Sex determining chromosomes are known as autosomes.

D. X–Y mechanism of sex determination is seen in human beings.

The correct ones are given in

(1) A, B and C (2) B, C and D
(3) A, B and D (4) A, C and D

2. A breeding experiment studying a single trait is

(1) Monozygous (2) Dizygous
(3) Dihybrid (4) Monohybrid

3. Which one of the following does not account for Mendelian conclusion?

(1) Dominance
(2) Purity of gametes
(3) Independant assortment
(4) Linkage

4. Identify and select the wrongly matched pair.

(1) Hybrid – Pure breeding progeny
(2) Incomplete dominance – An exception to Mendelism

(3) Heredity – Transmission of characters from one generation to the next.
(4) Allele – Alternate representation of a gene

5. The allele which does not express its effect in the hybrid is
(1) Dominant (2) Recessive
(3) Moderate (4) Passive

6. The monohybrid genotypic ratio is
(1) 1:1 (2) 3:1
(3) 1: 2: 1 (4) 9: 3: 3: 1

7. The recessive trait in pea plant is:
(1) Violet flower colour
(2) Tall stem
(3) Wrinkled seed
(4) Yellow coloured seed

8. The ABO blood grouping in man is an example
(1) Codominance
(2) Multple allelism
(3) Incomplete dominance
(4) Both 1 and 2

9. Select the incorrect statement(s).
A. Mendel's works were rediscovered by Hugo de Vries, Carl Correns and Erich Von Tschermak.
B. Sutton and Boveri put forward the chromosomal theory of Inheritance.
C. The term genetics was put forwarded by Bateson.
D. Alfred Russel Wallace is considered as Father of Evolution.
The incorrect ones are given in
(1) D only (2) A and B
(3) B and C (4) B and D

10. Which of the following is the principle of purity of gametes?
(1) Law of dominance
(2) Law of Independent Assortment
(3) Law of segregation
(4) Both (1) and (3)

11. Attached ear lobe in humans is
(1) Recessive trait
(2) Dominant trait
(3) Homozygous trait
(4) Heterozygous trait

12. The number of autosomes in humans is
(1) 46 (2) 23
(3) 22 (4) 44

13. The principle of independent assortment means:
(1) Separation of characters of one parent.
(2) Non-separation of characters of one parent.
(3) Separation of characters of both parents together.
(4) Combination of both parental characters.

14. A Mendelian experiment involved the hybridization between tall (T) pea plants with violet (W) flowers and dwarf (t) pea plant with white (w) flowers. The genetic makeup of the F_1 hybrid can be depicted as:
(1) TT ww (2) TT Ww
(3) Tt Ww (4) tt Ww

15. The fully dominant and recessive genotypes in the F_2 generation of monohybrid cross is:
(1) $\frac{2}{4}$ each (2) $\frac{1}{4}$ each
(3) $\frac{1}{16}$ each (4) $\frac{3}{4}$ each

16. The genes which show independent assortment are located on:
(1) Same locus of homologous chromosomes.
(2) Different chromosomes
(3) Same chromosome
(4) Different locus of homologous chromosomes

17. How many types of gametes are formed from an individual with genotype TtRr?
(1) 2 (2) 6
(3) 8 (4) 4

18. Nucleic acids are the polymers of
(1) Nucleosides (2) Nucleotides
(3) Nitrogenous bases (4) Sugars

19. Which of the following are the pyrimidine bases of DNA?
(1) Cytosine and Thymine
(2) Cytosine and Uracil
(3) Guanine and Adenine
(4) Adenine and Thymine

20. Choose the mismatched pair:
(1) Nuclein – Friedrich Meischer
(2) Double helix of DNA – Watson and Crick
(3) Genetic code – Anand Mohan Chakrabarty
(4) Gene – Johannsen

21. The process of formation of RNA from DNA is

(1) Transduction (2) Transcription
(3) Transversion (4) Transition

22. An egg involved in male child formation has the genetic constitution of

(1) 22 + X (2) 22 + Y
(3) 44 + XY (4) 44 + XX

23. The syndrome exhibiting trisomy in 21st chromosome is

(1) Cri du chat syndrome
(2) Turner's syndrome
(3) Klinefelter's syndrome
(4) Down's syndrome

24. The elongation of neck in giraffe is considered as an example of

(1) Lamarckism
(2) Mendelism
(3) Darwinism
(4) Neo-Darwinism

25. Homologous structures are

(1) Dissimilar in origin, similar in function.
(2) Dissimilar in origin and function.
(3) Similar in origin, dissimilar in function.
(4) Similar in origin and function.

26. Which one is not a vestigial organ in man?

(1) Vermiform appendix
(2) Epiglottis
(3) Nictitating members
(4) Wisdom teeth

27. Which of the following is a correct statement?

(1) Wings of bats and butterflies are analogous.
(2) Wings of bats and flippers of whales are analogous.
(3) Vestigial organs are the functional organs seen in adult humans.
(4) Mutations are sudden, non-heritable changes leading to evolution.

28. If the fossil of an organism is found in deep layers of earth, then we can predict that.

(1) The organism became extinct recently.
(2) The extinction of organism occurred years back.
(3) The time of extinction is not related to layers of earth.
(4) Cannot be determined

29. The author of the book 'Origin of Species' is

(1) Darwin (2) Wallace
(3) Oparin (4) Lamarck

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

(1) Two species of a genus
(2) Two genera of a family
(3) Two individuals of same species
(4) Two genera of two families.

31. Palaeontology is the study of

(1) Bones (2) Embryo
(3) Birds (4) Fossils

32. The direct evidence of evolutions are

(1) Homologous organs
(2) Analogous organs
(3) Vestigial organs
(4) Fossils

33. The primitive ancestor of elephant is

(1) *Pheomea* (2) *Stegodon*
(3) *Moretherium* (4) African elephant

34. The reptilian character observed in *Archaeopteryx*.

(1) Vertebral column extends up to the tail.
(2) Presence of feathered wings.
(3) Presence of beak
(4) Streamlined body.

35. The main features of Darwin's theory of evolution are

(1) Struggle for existence
(2) Natural selection
(3) Survival of the fittest
(4) All (1), (2) and (3)

36. Select the incorrect statement regarding human evolution.

(1) *Dryopithecus* are ape-like
(2) *Ramapithecus* are man-like
(3) The *Australopithecus* fossils were discovered from Australia.
(4) The oldest fossil of the genus, Homo is *Homo habilis*.

37. The fossil of human evolution known as Jawa man is

(1) Homo habilis
(2) Homo erectus
(3) Australopithecus
(4) Homo sapiens

38. Which is the common group that includes man and monkeys?

(1) Hominidae (2) Prosimians
(3) Cercopithecoidea (4) Primates

39. Reasons for origin of new species include

(1) Mutations
(2) Continental drift
(3) Natural calamities
(4) All (1), (2) and (3)

40. Theory of Acquired Characters was put forward by

(1) Lamarck
(2) Hugo de Vries
(3) Darwin
(4) Wallace

PRACTICE EXERCISE 8 (B)

Directions for questions 1 to 40: Select the correct alternative from the given choices.

1. The number of pairs of contrasting pairs studied by Mendel in pea plants.

(1) 2 (2) 5
(3) 7 (4) 9

2. On which plant did Gregor Johan Mendel conducted his experiments?

(1) *Antirrhinum* (2) *Pisum sativum*
(3) *Lathyrus* (4) *Mirabilis*

3. Select the incorrect statement.

(1) Each character of an individual is controlled by a unit factor.
(2) During gamete formation, the alleles do not segregate, so that each gamete receives both the pair of alleles.
(3) The various forms of genes occupying a bones on homologous chromosomes are called as alleles or allelomorphs.
(4) Locus is the position on chromosomes were genes are located.

4. The character which is expressed in both homozygous and heterozygous conditions is

(1) Dominant (2) Recessive
(3) Phenotype (4) Genotype

5. The genetic nature of a true breeding plant is

(1) Hemizygous (2) Heterozygous
(3) Homozygous (4) Both 1 and 3

6. Find out the incorrect match:

(1) Natural selection – Charles Darwin
(2) Mutation Theory – Carl Correns
(3) Use and Disuse theory – Lamarck
(4) Chemical Evolution – Oparin and Haldane

7. The phenotypic ratio in a dihybrid cross is

(1) 1: 1 (2) 1: 2: 1
(3) 3: 1 (4) 9: 3: 3: 1

8. Results of two or three factors crosses can be easily analysed by

(1) Principle of segregation
(2) Principle of dominance
(3) Principle of independent assortment
(4) Both 1 and 2

9. The number of recombinant phenotypes formed during F_2 generation of dihybrid cross.

(1) 6 (2) 10
(3) 4 (4) 2

10. A nucleotide comprises of

(1) Nitrogen base
(2) Pentose sugar
(3) Phosphate
(4) All 1, 2 and 3

11. The number of gametes formed from a homozygotic individual in a dihybrid cross.

(1) Four (2) Two
(3) One (4) Six

12. A cross between a tall pea plant and dwarf pea plant resulted tall progenies in F_1 generation because

(1) Tallness is a recessive trait
(2) Dwarfness is a dominant trait
(3) Tallness is a dominant trait
(4) Neither 'T' or 't' governs stem height.

13. A zygote which has an X-chromosome inherited from the father will become

(1) Boy (2) Girl
(3) Either girl or boy (4) Cannot be predicted

14. A trait in an organism is influenced by

(1) Paternal DNA
(2) Maternal DNA
(3) Both paternal and maternal
(4) Neither Paternal nor Maternal

15. Two pea plants, one with yellow round seeds (YYRR) and another with green wrinkled seeds (yyrr) produce F_1 progeny that have yellow round seeds (Yy Rr). The possible new combinations in F_2 generation is.

A. Yellow Round B. Yellow wrinkled
C. Green Round D. Green wrinkled

Correct ones are given in

(1) A and B (2) B and C
(3) C and D (4) A and D

16. Which of the following statements is incorrect?

(1) For every hormone there is a gene.
(2) For every protein there is a gene
(3) For production of every enzyme, there is a gene.
(4) For every molecule of sugar, there is a gene.

17. According to the theory of Darwinism, the survival of fittest individuals means

(1) Organisms capable of indefinite growth.
(2) Vigorous feeders.
(3) Organisms resistant to natural calamities.
(4) Maximum reproduction capacity.

18. Consider the following pairs.

A. Haemophilia – X-linked genetic disorder
B. Trisomy – An extra one chromosome seen along with diploid number of chromosomes.
C. Holandric genes – Y-linked gene characters seen only in males
D. Sickle cell anaemia – Heterozygous and autosomal related

The correctly paired matchings are

(1) A, B, C and D (2) A, C and D
(3) B, C and D (4) A, B and D

19. The condition where the total number of chromosomes is 47.

(1) Down's syndrome
(2) Turner's syndrome
(3) Klinefelter's syndrome
(4) Both 1 and 3

20. The karyotype of an individual with Turner's syndrome is

(1) 44 A + XX (2) 45 A + XY
(3) 44 A + XO (4) 44 A + XXY

21. The technology that is used to make desired changes in gene structure is

(1) Genetic engineering
(2) Recombinant DNA technology
(3) Gene cloning
(4) All 1, 2 and 3

22. Males are heterogametic because

(1) They can produce two types of gametes.
(2) They produce two similar gametes
(3) They are able to produce both egg and sperms.
(4) Both 1 and 2

23. The karyotype of a normal male is

(1) 22 AA + XY (2) 44 AA + XY
(3) 22 A + XX (4) Both 1 and 2

24. In the experiment, Urey and Miller provided an electric discharge in a mixture of:

(1) Ammonia, oxygen, steam, hydrogen.
(2) Methane, hydrogen, nitrogen, steam.
(3) Steam, methane, hydrogen, ammonia.
(4) Carbon dioxide, oxygen, ammonia

25. Theory of panspermia accounts on the origin of life in earth.

(1) Came as spores from outer space.
(2) Came out of dead and decaying matter.
(3) Comes only from pre-existing life.
(4) From inorganic molecules.

26. Dinosaurs were abundant during

(1) Devonian (2) Jurassic
(3) Silurian (4) Carboniferous

27. The ultimate source of variation is

(1) Adaptability (2) Sexual variation
(3) Natural selection (4) Mutation

28. Life comes from pre-existing life was stated by

(1) Louis Pasteur (2) Oparin
(3) Darwin (4) Miller

29. Mutation as a reason for variation was proposed by

(1) Charles Darwin (2) Lamarck
(3) Hugo de Vries (4) Thomas Malthus

30. The first living cell is/are known as
(1) Coacervates
(2) Proto cell
(3) Protobiont
(4) Both 2 and 3

31. Consider the following human evolution:
(i) *Dryopithecus*
(ii) *Homo erectus*
(iii) *Neanderthal man*
(iv) *Australopithecines*
The correct sequence of human evolution is
(1) (i), (ii), (iii) and (iv)
(2) (i), (iv), (ii) and (iii)
(3) (iv), (iii), (ii) and (i)
(4) (i), (iv), (iii) and (ii)

32. In evolutionary terms, we are more related to
(1) Skull of baby chimpanzee
(2) Adult chimpanzee
(3) Gorilla
(4) Ape

33. Darwin's finches show
(1) Adaptive Radiation
(2) Parallel evolution
(3) Homology
(4) Natural selection

34. Most of the fossils occur in rocks as
(1) Metamorphic (2) Igneous
(3) Sedimentary (4) All 1, 2 and 3

35. Sum total of genes in a population is
(1) Genotype (2) Karyotype
(3) Genetic constitution (4) Gene pool

36. Formation of new species from pre-existing species is
(1) Mutation (2) Speciation
(3) Isolation (4) Polyploidy

37. Galapagos islands were visited by
(1) Wallace (2) Lamarck
(3) Darwin (4) Malthus

38. Cranial capacity of modern man is
(1) 450–650 cc (2) 600–1000 cc
(3) 900–1100 cc (4) 1200–1600 cc

39. In *Homo habilis*, the term habilis refers to
(1) Wandering Man (2) Tool maker
(3) Ancient man (4) Modern man

40. Which of the following is more ape-like?
(1) *Dryopithecus*
(2) *Ramapithecus*
(3) *Homo* erectus
(4) *Homo neanderthalensis*

ANSWER KEYS

PRACTICE EXERCISE 8 (A)

1. 3	**2.** 4	**3.** 4	**4.** 1	**5.** 2	**6.** 3	**7.** 3	**8.** 4	**9.** 1	**10.** 3
11. 1	**12.** 4	**13.** 3	**14.** 3	**15.** 2	**16.** 1	**17.** 4	**18.** 2	**19.** 1	**20.** 3
21. 2	**22.** 1	**23.** 4	**24.** 1	**25.** 3	**26.** 2	**27.** 1	**28.** 2	**29.** 1	**30.** 3
31. 4	**32.** 4	**33.** 3	**34.** 1	**35.** 4	**36.** 3	**37.** 2	**38.** 4	**39.** 4	**40.** 1

PRACTICE EXERCISE 8 (B)

1. 3	**2.** 2	**3.** 2	**4.** 1	**5.** 3	**6.** 2	**7.** 4	**8.** 3	**9.** 1	**10.** 4
11. 3	**12.** 3	**13.** 2	**14.** 3	**15.** 2	**16.** 3	**17.** 4	**18.** 1	**19.** 4	**20.** 3
21. 4	**22.** 1	**23.** 2	**24.** 3	**25.** 1	**26.** 2	**27.** 4	**28.** 1	**29.** 3	**30.** 4
31. 2	**32.** 1	**33.** 1	**34.** 3	**35.** 4	**36.** 2	**37.** 3	**38.** 4	**39.** 2	**40.** 1