1. The development of specialized cell type is called:

(A) Specification

(B) Determination

(C) Autonomous specification

(D) Differentiation

Answer: (D) Differentiation

The development of specialized cell types from undifferentiated cells is called differentiation. During differentiation, cells acquire specific structures and functions that allow them to perform particular roles within an organism. The other terms are related to aspects of cellular development:

Specification: The process by which cells are initially set aside for specific developmental fates.

Determination: The commitment of a cell to a particular developmental fate.

Autonomous specification: Specification that occurs autonomously within a cell, independent of signals from neighboring cells.

2. Stem cells in the early embryo, capable generating all the structures of the embryo, are called:

(A) Committed stem cells

(B) Progenitor cells

(C) Pluripotent stem fells

(D) Precursor cells

Answer: (C) Pluripotent stem cells.

The pluripotent stem cells have the unique ability to differentiate into all the different cell types found in the adult body, making them the best choice for cells capable of generating all the structures of the embryo. They play a crucial role in early development and hold great promise for regenerative medicine applications.

3. In mammals, the vitelline envelope is a separate and thick extracellular matrix called the

(A) Cumulus

(B) Corona radiata

(C) Egg jelly

(D) Zona pellucida

Answer: (D) zona pellucida

In mammals, the vitelline envelope is a separate and thick extracellular matrix called the zona pellucida. The mammalian egg is also surrounded by a layer of cells called the cumulus , which is made up of the ovarian follicular cells that were nurturing the egg at the time of its release from the ovary. Mammalian sperm have to get past these cells to fertilize the egg. The innermost layer of cumulus cells, immediately adjacent to the zona pellucida, is called the corona radiata. https://www.ncbi.nlm.nih.gov/books/NBK10005/

4. In plants, the second sperm cell fuses with a multinucleated somatic cell to produce the:

(A) Haploid endosperm

(B) Diploid endosperm

(C) Triploid endosperm

(D) Microspores

Answer: (C) triploid endosperm

In plants, the second sperm cell fuses with a multinucleated somatic cell called the central cell, resulting in a triploid structure called the triploid endosperm.

Haploid endosperm: This wouldn't be possible since the fusion of two gametes (sperm cell and central cell) would always result in a diploid structure.

Diploid endosperm: This could only occur if the second sperm cell fused with a haploid central cell, which is not the typical scenario in most plants.

Microspores: These are haploid pollen grains produced by the male gametophyte, not structures resulting from fertilization.

5. In Dictyostelium, a tip arises at the top of tight aggregate and bends over to produce the migrating

(A) Slug

(B) Spore

(C) Stalk

(D) Prespore cell

Answer: (A) Slug

In Dictyostelium, a cellular slime mold, the correct sequence of events is as follows:

- Dictyostelium cells aggregate to form a tight aggregate.
- A tip arises at the top of this tight aggregate.

- The tip bends over and produces a structure known as a slug.

The slug is a mobile, multicellular structure that moves toward conditions favorable for spore formation. It is a transitional stage in the life cycle of Dictyostelium before the formation of the fruiting body, which consists of a stalk and spores. The stalk cells differentiate from the slug to form the stalk, and the spores are produced at the top of the stalk.

6. What determines the specification of different types in Drosophila?

(A) Micropyle

(B) Energids

(C) Pole cells

(D) Morphogens

Answer: (D) Morphogens

In Drosophila (fruit fly) development, the specification of different cell types is determined by the distribution of morphogens.

Morphogens are signaling molecules that form concentration gradients within the developing embryo, providing positional information to cells and determining their fate.

7. When individual leaves arise from each node on stem of a plant, it is called:

(A) Opposite phyllotaxy

(B) Alternate phyllotaxy

(C) Whorled phyllotaxy

(D) Internode

Answer: (B) Alternate phyllotaxy.

When individual leaves arise from each node on the stem, one after the other in a spiral pattern, it signifies alternate phyllotaxy.

Opposite phyllotaxy: In this arrangement, two leaves arise at each node, opposite each other on the stem.

Whorled phyllotaxy: In this arrangement, three or more leaves arise at each node, forming a "whorl" around the stem.

Internode: This refers to the region of the stem between two nodes, not the arrangement of leaves themselves.

8. The tissue that produces a signal (or signals) change(s) the cellular behaviour of the other tissues is Wan:

(A) Responder

(B) Inducer

(C) Induction

(D) Producer

Answer: (B) Inducer.

Inducer precisely captures the concept of a tissue that actively initiates the signal transduction process by producing and sending a signal molecule that impacts the behavior of other tissues. It's the instigator, the source of the influence, making it the most appropriate answer in this context.

Responder: This term refers to the tissue that receives the signal and changes its behavior in response. It's the target of the signal, not the originator.

Induction: This describes the overall process of one tissue influencing the behavior of another through a signal. It's the outcome, not the Specific player involved.

Producer: While producer can be understood as someone who generates something, it's not specific enough to accurately represent the role of the tissue sending the signal in this context.

9. Which of the following is not the major factor contributing to water potential during plant growth under normal conditions?

(A) Temperature.

(B) Solute Potential

(C) Hydrostatic Pressure

(D) Gravity

Answer: (D) Gravity is the least significant factor contributing to water potential.

Gravity certainly exists, its effect on water potential in plants under normal conditions is minimal compared to the other factors. While tall trees might experience slightly different water potential gradients due to gravity, it's not a major driving force for water movement within the plant's internal system compared to the influence of temperature, solute potential, and hydrostatic pressure.

Temperature: Temperature influences water potential because it affects transpiration (water loss) and the physical properties of water. Higher temperatures generally lead to increased transpiration and decreased water potential.

Solute Potential: This is a crucial factor, reflecting the amount of dissolved solutes in the plant's cells and tissues. Higher solute

concentration results in lower water potential, drawing water into the plant to maintain balance.

Hydrostatic Pressure: This refers to the internal pressure within the plant's cells and tissues, pushing water outwards. It typically opposes solute potential and maintains a positive water potential for water uptake.

10. Chloroplast distribution in chlorenchymatous cell is governed by blue light sensing phototropin-2. When the cells are exposed to high intensity blue light, the chloroplasts:

(A) aggregate in the middle of the cell

(B) move to the side walls

(C) aggregate in small clusters

(D) are evenly distributed

Answer: (B) move to the side walls

Blue light sensing phototropin-2 plays a crucial role in chloroplast movement in response to light. In chlorenchymatous cells, phototropin-2 is distributed unevenly on the plasma membrane.

When exposed to high-intensity blue light, phototropin-2 on the side exposed to the light undergoes a conformational change, triggering a signaling cascade. This signaling cascade leads to the accumulation of actin filaments on the side opposite the light stimulus. Motor proteins attached to the chloroplasts and actin filaments then guide the chloroplasts towards the cell walls with actin accumulation, effectively moving them away from the light source.

Therefore, in response to high-intensity blue light, the uneven distribution of phototropin-2 and the light-induced signaling cascade drive the chloroplasts to move towards the side walls of the chlorenchymatous cell, maximizing their exposure to lower-intensity blue light and minimizing potential damage from photoinhibition.

11. Which one of the following photoreceptors plays a role in circadian rhythms and perception of day length?

(A) Cryptochromes

(B) Phototropins

(C) Zeitlupe family

(D) UV Resistance locus

Answer: (A) Cryptochromes

Phototropins: These primarily mediate blue light responses related to chloroplast movement and phototropism, not directly influencing circadian rhythms or day length perception.

Zeitlupe family: This family encompasses specific genes involved in the Drosophila circadian clock, not photosensitive receptors themselves.

UV Resistance locus: This refers to a genetic region associated with UV resistance in plants, not directly contributing to the perception of day length or circadian rhythms.

Cryptochromes, along with melanopsin, are crucial photoreceptors for both entrainment (setting) of the circadian clock and photoperiodic responses (day length perception). They respond to blue light and contribute to regulating various light-sensitive processes like sleep-wake cycles, hormone release, and plant flowering.

Therefore, based on their documented role in circadian rhythms and day length perception, cryptochromes stand out as the most relevant choice among the listed options.

12. Exposure of dark-grown seedlings to ethylene results in triple response. Which one of the following is *not* a part of triple response?

(A) Thickening of shoot

(B) Horizontal growth of the epicotyl

(C) Decrease in the elongation of epicotyl

(D) Rapid unfolding and expansion of leaves

Answer: (D) rapid unfolding and expansion of leaves is not a part of the response.

Thickening of shoot: This refers to the increased radial growth of the hypocotyl (lower stem) due to cell enlargement.

Horizontal growth of the epicotyl: This involves the bending of the epicotyl (upper stem) towards a horizontal orientation.

Decrease in the elongation of epicotyl: This is the most characteristic feature of the triple response, where ethylene inhibits the longitudinal growth of the epicotyl.

While leaves are present in dark-grown seedlings, they remain folded and unexpanded. Ethylene exposure actually delays the unfolding and expansion of leaves, further inhibiting shoot growth. Conversely, light exposure promotes leaf expansion in a process called skotomorphogenesis.

13. Nitrogen gas is reduced to ammonia during nitrogen fixation. Which of the following compound is necessary for this process?

(A) ADP

(B) UDP

(C) ATP

(D) GTP

Answer: (C) ATP

ADP: While ADP is a product of ATP hydrolysis, it doesn't directly participate in the nitrogen fixation reaction itself.

UDP: UDP has various roles in cellular metabolism but isn't directly required for nitrogen fixation.

GTP: Although GTP is used in some other biological processes, including protein synthesis, it doesn't play a specific role in nitrogen fixation in most organisms.

ATP: ATP serves as the energy currency for living cells, driving numerous cellular processes. In nitrogen fixation, ATP provides the energy necessary for the nitrogenase enzyme complex to break the triple bond in nitrogen gas (N_2), making it a crucial component of this energy-intensive process.

14. Following are some of the statements regarding phytohormones:

i. Ethylene regulates abscission.

ii. Gibberellins do not play any role in flowering.

iii. Auxins and Cytokinins promote cell division.

iv. Overexpression of cytokinin oxidase would promote root growth.

v. ABA inhibits root growth and promotes shoot growth at low water potential.

vi. ABA promotes leaf senescence independent of ethylene.

Which one of the following combinations of the above statements is correct?

(A) i, iii and vi

(B) ii, iii and iv

(C) iv, v and vi

(D) ii, iv and v

(Also in CSIR NET Dec 2011)

Answer: (A) i, iii and vi

Statement (ii) is incorrect because gibberellins induce femaleness. Statement (iv) is incorrect because overexpression of cytokinin oxidase will break down available cytokinin that will alternatively inhibit root growth. Statement (v) is incorrect because ABA promotes root growth and promotes shoot growth at low water potential.

15. Which one of the following compounds is normally translocated in the phloem?

(A) D-Fructose

(B) Sucrose

(C) D-Glucose.

(D) D-Mannose

Answer: (B) Sucrose

D-Fructose: While fructose is a component of sucrose and exists in some fruits, it isn't the main translocated sugar. Phloem transports mostly sucrose because it's less reactive, more stable, and easier to load and unload compared to fructose or glucose.

D-Glucose: Similar to fructose, glucose is only a minor component of phloem sap and plays a less significant role in long-distance sugar transport.

D-Mannose: This sugar is rarely found in significant amounts in plants and isn't typically involved in phloem transport.

Therefore, based on its abundance and suitability for long-distance sugar movement, sucrose stands out as the primary sugar translocated in the phloem in most plants.

16. The Krebs cycle in respiration yields:

(A) 4 GTP, 6 NADH, 4 $FADH_2$, $2CO_2$

(B) 32 GTP, 2 NADH, 4 $FADH_2$, $4CO_2$

(C) 2 GTP, 2 $FADH_2$, 6 NADH, $2CO_2$

(D) 1 GTP, 3 NADH, 1 $FADH_2$, CO_2

Answer: (C) 2 GTP, 2 FADH2, 6 NADH, $2CO_2$

The Krebs cycle typically yields:

2 GTP (or ATP), 6 NADH, 2 FADH2, and 4 CO_2 per turn of the cycle.

17. The changes in lung volume can be measured by

(A) Micrometer

(B) Sphygmomanometer

(C) Thermometer

(D) Spirometer

Answer: (D) Spirometer

Micrometer: This instrument is used for measuring minute distances, not suitable for measuring the volume of air inside the lungs.

Sphygmomanometer: This instrument is used for measuring blood pressure, not lung volume.

Thermometer: This instrument is used for measuring temperature, not lung volume.

Spirometer: A spirometer is specifically designed to measure lung function, including lung volumes. It works by recording the volume of air inhaled and exhaled by a person in a controlled setting.

18. Renin functions as an enzyme to convert:

(A) Angiotensin II to Angiotensin I

(B) Angiotensin I to Angiotensin II

(C) Angiotensinogen to Angiotensin I

(D) Angiotensinogen to Angiotensin II

Answer: (C) Angiotensinogen to Angiotensin I

Renin is an enzyme that converts angiotensinogen to angiotensin I. This is the first step in the renin–angiotensin–aldosterone system.

Renin is also a hormone produced by the kidneys. It is released in response to low blood pressure.

Angiotensin I is then converted to angiotensin II, which narrows blood vessels and stimulates the release of aldosterone.

> Renin, enzyme secreted by the kidney (and also, possibly, by the placenta) that is part of a physiological system that regulates blood pressure. In the blood, renin acts on a protein known as angiotensinogen, resulting in the release of angiotensin I. (https://www.britannica.com/science/renin)

19. The tissue capable of converting chemical energy into heat is

(A) White adipose tissue

(B) Brown adipose tissue

(C) Liver (Hepatic tissue)

(D) Connective tissue

Answer: (B) Brown adipose tissue

White adipose tissue: This tissue primarily functions as an energy storage depot, mainly storing excess calories as triglycerides. While it does contribute to basal metabolic rate and heat production, it's not as specialized for thermogenesis as brown adipose tissue.

Liver (Hepatic tissue): The liver plays various metabolic roles, including thermogenesis to some extent. However, its primary functions involve glucose metabolism, detoxification, and protein synthesis, rather than dedicated heat production.

Connective tissue: This diverse tissue type primarily provides structural support and doesn't have a significant role in thermogenesis.

Brown adipose tissue: This is specifically adapted for heat production. It contains abundant mitochondria with uncoupling protein-1 (UCP1), which decouple oxidative phosphorylation, enabling energy dissipation as heat instead of ATP production. This thermogenic capacity helps maintain body temperature in cold environments and can also contribute to burning calories.

20._____ gland secretes an alkaline fluid that neutralizes the acidic vaginal secretions:

(A) Vesicular

(B) Prostate

(C) Bulbourethral

(D) Preputial

Answer: (B) Prostate

Vesicular: These glands produce seminal fluid, which itself is slightly alkaline but not specifically meant to neutralize vaginal acidity.

Bulbourethral: While these glands (also known as Cowper's glands) contribute to lubrication and semen viscosity, their secretions are not primarily involved in neutralizing vaginal acidity.

Preputial: These glands are primarily found in some non-human mammals and are not relevant to human male reproductive anatomy.

B Prostate gland:

i) Semen is a fructose-rich, alkaline fluid containing sperm that is secreted by the prostate gland.

ii) The alkalinity of the prostatic fluid serves to neutralize the acidity of the female vaginal tract in order to prolong the survival of sperm in this harsh environment.

21. Reduced O_2 delivery to the kidneys stimulates secretion of the hormone:

(A) ADH

(B) Vasopressin

(C) Erythropoietin

(D) Oxytocin

Answer: (C) Erythropoietin is the hormone secreted in response to reduced oxygen delivery to the kidneys.

ADH (Antidiuretic Hormone) and Vasopressin are both involved in water reabsorption in the kidneys and are primarily stimulated by dehydration or low blood pressure, not decreased oxygen levels. Oxytocin is primarily associated with lactation and uterine contractions, and it's not involved in oxygen regulation.

Erythropoietin plays a crucial role in red blood cell production. When kidney cells sense decreased oxygen levels, they produce erythropoietin, which then stimulates the bone marrow to release more red blood cells. Increased red blood cells improve oxygen-carrying capacity, helping to compensate for the initial oxygen deficit.

22. In ECG, the QRS complex represents:

(A) Atrial depolarization

(B) Ventricular depolarization

(C) Ventricular repolarization

(D) Atrial repolarization

Answer: (B) Ventricular depolarization.

QRS complex: Represents the rapid depolarization (electrical activation) of the ventricles, the large, muscular chambers of the heart that pump blood out to the body. Appears as a large, spike-like complex on the ECG tracing.

P wave: Represents atrial depolarization (electrical activation of the atria, the smaller chambers that collect blood from the body and lungs).

T wave: Represents ventricular repolarization (recovery of the ventricles after contraction).

PR interval: Represents the time it takes for the electrical impulse to travel from the atria to the ventricles.

23. The point on the retina at which the optic nerve leaves and through which blood vessel pass in the optic disc, is called

(A) Rods

(B) Cones

(C) Blind spot

(D) Visual streak

Answer: (C) Blind spot.

Rods and Cones are the two types of photoreceptor cells in the retina, responsible for light perception. They are not specific locations on the retina. Visual streak is the area of the retina with the highest concentration of cones, responsible for sharp central vision. It's located around the fovea centralis, not the optic disc. The optic disc, also known as the **blind spot**, is the area on the retina where the optic nerve fibers exit the eye and blood vessels enter. It lacks photoreceptor cells, hence the name "blind spot" as we cannot see from this area.

24. Stress relaxation response is an inherent property of:

(A) Cardiac muscle

(B) Connective tissue

(C) Smooth muscle

(D) Cardiomyocytes

Answer: (A) Cardiac muscle.

While some types of connective tissue, like ligaments and tendons, exhibit some elastic properties, they don't show significant stress relaxation compared to cardiac muscle. Smooth muscle can exhibit stress relaxation, but it's not as pronounced or rapid as in cardiac muscle. Additionally, the question specifically mentions "inherent property," which suggests a characteristic feature of the tissue itself, and cardiac muscle is known for its strong stress relaxation response as a key functional property.

Cardiomyocytes are the individual cells that make up cardiac muscle. While they are responsible for the muscle's contractile function, the statement refers to a tissue-level property, and attributing it specifically to cardiomyocytes wouldn't accurately reflect the collective behaviour of the muscle as a whole. Therefore, based on its inherent property of pronounced stress relaxation and its role in the cardiac cycle, cardiac muscle is right answer.

25. Which of the following statement is correct?

(A) Both penetrance and expressivity are qualitative concepts.

(B) Both penetrance and expressivity are quantitative concepts.

(C) Penetrance is a qualitative concept and expressivity is a quantitative concept.

(D) Penetrance is a quantitative concept and expressivity is a qualitative concept.

Answer: Penetrance is a qualitative concept and expressivity is a quantitative concept.

Penetrance: This refers to the proportion of individuals with a specific genotype who express the associated phenotype. It's a qualitative

measure because it answers the question of "does the trait appear or not?" It's expressed as a percentage or fraction, like 80% penetrance meaning 80% of individuals with the genotype show the trait.

Expressivity: This describes the degree or severity of the phenotype in individuals who possess the genotype. It's a quantitative measure because it focuses on the variation in how the trait manifests. It can be described using various scales or indices, like mild, moderate, or severe for a particular characteristic.

Therefore, while both concepts are related to genetics and trait expression, they differ in their nature:

- Penetrance is qualitative, concerned with the presence or absence of the trait.
- Expressivity is quantitative, focusing on the degree or intensity of the trait.

26. Angelman Syndrome is caused by:

(A) Terminal deletions

(B) Ring chromosomes

(C) Interstitial deletions

(D) Microdeletions

Answer: (D) Microdeletions

Terminal deletions involve the loss of genetic material at the end of a chromosome. While they can be a cause of Angelman Syndrome, they are not the most common. Ring chromosomes occur when the ends of a chromosome fuse together, forming a ring-shaped structure. They can also be a cause of Angelman Syndrome, but again, less common than microdeletions. Interstitial deletions involve the loss of genetic material from within a chromosome. While they can be a cause of Angelman Syndrome, they are even less common than terminal deletions or ring chromosomes. **Microdeletions are the most common cause of Angelman Syndrome.** They involve the loss of a very small amount of genetic material, often just a few genes. In the case of Angelman Syndrome, the microdeletion usually involves the UBE3A gene on chromosome 15.

27. Choose the incorrect statement about Robertsonian translocations:

(A) It is the centric fusion of the long arm of two acrocentric chromosomes with lose short arms.

(B) The carrier will not show any abnormality until reproduction.

(C) Reproduction may result in trisomics or monosomics.

(D) Robertsonian translocation involves only chromosomes 17, 18 and 20.

Answer: (D) Robertsonian translocation involves only chromosomes 17, 18 and 20.

Robertsonian translocations can involve any acrocentric chromosome, not just 17, 18, and 20. Acrocentric chromosomes are those with short arms and satellite stalks. The most common chromosomes involved in Robertsonian translocations are 13, 14, 15, 21, and 22.

Other are all correct:

(A) Robertsonian translocations indeed involve the centric fusion of the long arms of two acrocentric chromosomes, with the short arms being lost.

(B) Carriers of Robertsonian translocations typically don't exhibit any physical or developmental abnormalities themselves.

(C) During reproduction, carriers of Robertsonian translocations have an increased risk of producing gametes with an unbalanced number of chromosomes, which can lead to trisomic or monosomic offspring with various genetic conditions.

28. Match the following:

a. Epistasis	One gene affects multiple. apparently unrelated phenotypes.
b. Pleiotropy	One of the dominant inhibit or suppress the expression of the other dominant gene.
c. Inhibitory factor	Masking of effect of one dominant gene by the other gene.
d. Duplicate factor	Dominant forms of both genes either alone, or in combination,

Codes:

	a	b	c	d
(A)	iv	iii	i	ii
(B)	iii	i	ii	iv
(C)	i	iii	ii	iv
(D)	i	iii	iv	Ii

Answer: (B) iii, I, ii, iv

29. Who coined the term "QTL (Quantitative Trait Loci)"?

(A) Richard

(B) Botstein

(C) Geldermann

(D) Wagner

Answer: (C) Geldermann

G.H. Geldermann first used the term "QTL" in his 1975 paper "Genetic variance in populations of self-fertilizing plants under selection: Part 3. Environmental heterogeneity and its effects on selection in relation to QTL mapping." (https://link.springer.com/book/10.1007/978-1-61779-785-9)

30. Which of the following is not an example for sex-limited inheritance?

(A) Premature baldness

(B) Genes for milk production in humans

(C) Some type of white forelock

(D) Absence of upper lateral incisor teeth

Answer:(B) Genes for milk production in humans

While both men and women can experience some hair loss, androgenetic alopecia (the most common type of baldness) is primarily influenced by testosterone and primarily affects men. Certain genes for specific hair patterns, like a white forelock, can be expressed exclusively in men. Absence of upper lateral incisor teeth is rare genetic trait called hypodontia affects both sexes, but it's significantly more common in males.

Genes for milk production in humans fall outside the definition of sex-limited inheritance because both men and women possess these genes. While milk production itself is restricted to females with functional mammary glands, the underlying genetic machinery is present in both sexes.

31. Which of the following is an example for incomplete dominance?

(A) Flower colour in garden pea

(B) Flower colour in snapdragon

(C) Eye colour in Drosophila

(D) Coat colour in mice

Answer: (B) Flower colour in snapdragon.

(A) Flower colour in garden pea exhibits simple dominance, where one allele completely masks the expression of the other. Red is dominant over white in pea flowers.

(C) Eye colour in Drosophila also shows simple dominance, with red eye colour fully dominating white in fruit flies.

(D) Coat colour in mice can involve multiple forms of dominance, including incomplete dominance and co-dominance, depending on the specific genes involved. However, a more classic example of incomplete dominance would be snapdragon flower colour.

In snapdragon, red and white flower colour alleles are incompletely dominant to each other. When crossed, they produce heterozygous offspring with pink flowers, representing a blend of the parental phenotypes. This perfectly showcases the principle of incomplete dominance.

32. Codominance is the condition in which there is:

(A) Joint expression of both alleles in a homozygote

(B) Joint expression of both alleles in a heterozygote,

(C) Domination of one allele due to the presence of another allele.

(D) Alteration of one allele due to the influence of another allele.

Answer: (B) Joint expression of both alleles in a heterozygote

Codominance is a genetic condition in which both alleles of a gene are expressed simultaneously in the heterozygote. Unlike incomplete dominance, where the heterozygote exhibits an intermediate phenotype, in codominance, both alleles are fully expressed, and their effects are visible in the phenotype.

33. Which of the following structures are formed due to adaptive radiation?

(A) Analogous structures

(B) Vestigial structures

(C) Homologous structures

(D) Rudimentary structures

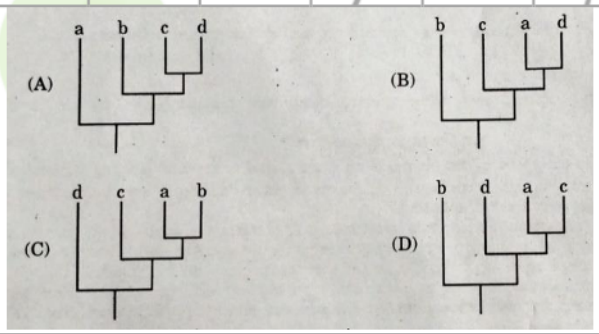
Answer: (A) Analogous structures

Adaptive radiation is a process in which a single ancestral species rapidly diversifies into a wide variety of forms to adapt to different environments or ecological niches. During adaptive radiation, analogous structures may arise. Analogous structures are similar in function but have different evolutionary origins. They evolve

independently in different lineages as a result of adapting to similar environmental challenges.

34. Identify the most appropriate cladogram that can be considered using the data matrix for four hypothetical species (a— d) given below, assuming 'O' are plesiomorphic and '1' are apomorphic characters.

	1	2	3	4	5
a	0	1	1	0	0
b	0	0	0	0	0
c	0	1	0	0	0
d	0	1	1	0	1



Answer: Option B

- Species 'b' is the outgroup or the most ancestral.
- Species 'a', 'c', and 'd' share a common ancestor after diverging from 'b'.
- Species 'a' and 'd' share a more recent common ancestor.
- Species 'd' has an additional unique character.

35. Plants forms symbioses with different groups of soil fungi called Mycorrhiza. Which one of the following statement is not correct ?

(A) Vesicles are produced by arbuscular mycorrhizal fungi.

(B) Hartig net is an intraradical structure.

(C) Hyphal coils in orchid mycorrhiza are called pelotons.

(D) Ectendomycorrhiza forms arbuscules.

Answer: D) Ectendomycorrhiza forms arbuscules.

Vesicles are indeed produced by arbuscular mycorrhizal fungi.

Hartig net is an intraradical structure formed by the hyphae of ectomycorrhizal fungi.

Hyphal coils in orchid mycorrhiza are called pelotons.

Arbuscules are characteristic structures formed by arbuscular mycorrhizal fungi, not ectendomycorrhiza.

36. In which Indian State are mangroves mostly found?

(A) Gujarat

(B) Andaman and Nicobar Islands

(C) Tamil Nadu

(D) West Bengal

Answer: (D) West Bengal

Mangroves are predominantly found in the state of West Bengal in India. The Sundarbans, the largest mangrove forest in the world, is located in the delta region of the Padma, Meghna, and Brahmaputra River basins between India and Bangladesh, with a significant portion falling within the state of West Bengal.

37. Which Of the following criteria are essential to designate a region as a hot spot?

i. It should contain at least Or 1500 speci es of vascular plants as endemics.

ii. It should con tain more than 500 animal species.

iii. It must have lost 70% of its original natural vegetation.

iv. Its vegetation area should be more than 1000 sq. km.

(A) i and iv

(B) i and iii

(C) ii and iv

(D) iii and iv

Answer: (B) i and iii.

To designate a region as a biodiversity hot spot, it typically needs to meet the following criteria:

- It should contain at least 1500 species of vascular plants as endemics.
- It must have lost 70% of its original natural vegetation.

38. The principle 'One fungus, one name' came into existence from which of the following dates?

(A) 1st July,2011

(B) 14th September, 2013

(C) 1st January, 2013

(D) 1st January, 2015

Answer: (C) 1st January 2013

The principle of "One Fungus, One Name" officially came into effect on 1st January 2013, following the decisions made at the 18th International Botanical Congress held in Melbourne, Australia.

(Reference: Hawksworth, D. L. (2011). "A new dawn for the naming of fungi: impacts of decisions made in Melbourne in July 2011 on the future publication and regulation of fungal names." MycoKeys, 1, 7–20. doi:10.3897/mycokeys.1.2062)

39. Buffer Zone is a part of which Of the following in-situ conservation method?

(A) Biosphere Reserve

(B) Sacred Groves

(C) National Parks

(D) Wildlife Sanctuaries

Answer: (A) Biosphere Reserve

A buffer zone is a part of a Biosphere Reserve. A Biosphere Reserve is a conservation unit that aims to reconcile the conservation of biodiversity with its sustainable use. It typically consists of three interrelated zones: the core zone (strictly protected for conservation), the buffer zone (for cooperation between conservation and sustainable development), and the transition zone (where human settlements and economic activities are allowed).

40. Imperfect fungi is a group represented by fungal species which have

(A) Simple mycelia

(B) Unknown phylogenetic relationship

(C) Unknown mechanism of sexual reproduction

(D) Inst its survival mechanism against harsh environment

Answer: (C) Unknown mechanism of sexual reproduction

The term "imperfect fungi" refers to a group of fungi in which the sexual reproductive phase is not known or has not been observed. These fungi were traditionally classified under the form classification Deuteromycota. In recent taxonomic revisions, efforts are made to identify their sexual reproductive stages and place them in appropriate taxonomic groups.

41. Arrange the following ecosystems in descending order of Net Primary Productivity (NPP) :

i. Alpine and Tundra

ii. Desert

iii. Tropical rainforest

iv. Temperate forest

(A) iii, iv, ii, i (B) ii, iii, iv, i

(C) iii, i, iv, ii (D) iii, iv, i, ii

Answer: (D) iii, iv, i, i

Tropical rainforest: These ecosystems have the highest NPP globally, reaching up to 2000g Cm^{-2} yr^{-1} due to abundant sunlight, moisture, and warm temperatures, favoring rapid plant growth and photosynthesis.

Temperate forest: With moderate temperatures and rainfall, temperate forests have lower NPP than tropical rainforests but still achieve good productivity, ranging from 1000 to 1500g Cm^{-2} yr^{-1}.

Alpine and Tundra: Cold temperatures, strong winds, and limited soil nutrients restrict plant growth in these high-altitude ecosystems, leading to a lower NPP ranging from 200 to 500g Cm^{-2} yr^{-1}.

Desert : Arid conditions with scarce water and extreme temperatures significantly limit plant productivity in deserts, resulting in the lowest NPP among these ecosystems, often below 100g $Cm^{-2}yr^{-1}$.

42. Which of the following is not a qualitative character of a community? *

(A) Physiognomy

(B) Phenology

(C) Abundance

(D) Dominance

Answer: (C) Abundance

The answer is actually (C) Abundance. While the other options represent qualitative characteristics of a community, abundance falls under quantitative characteristics.

Physiognomy: This refers to the overall appearance of a community based on dominant species and growth forms (e.g., dense forest, grassy savanna). It describes a qualitative aspect of the community's structure.

Phenology: This focuses on the seasonal timing of biological events in a community (e.g., flowering, fruiting, migration). It also represents a qualitative characteristic related to community dynamics.

Dominance: This describes the relative influence of certain species on the community's structure and function. It's another qualitative aspect indicating the competitive relationships within the community.

Abundance: This refers to the number of individuals of a particular species within a community, usually expressed as density or cover. Unlike the other options, abundance is quantifiable. We can measure and compare the number of individuals of different species, making it a quantitative characteristic rather than a qualitative one.

Therefore, while physiognomy, phenology, and dominance all describe qualitative aspects of a community, abundance deviates by being a measurable and quantifiable feature.

43. What is the criteria to select Biodiversity hotspots in the world?

(A) Maximum number of threatened plants

(B) Maximum number of threatened plants and loss of original habitat

(C) Maximum number of endemic flowering plants

(D) Maximum number of endemic flowering plants and loss of original habitat

Answer: (D) Maximum number of endemic flowering plants and loss of original habitat

As defined by Conservation International, a region qualifies as a biodiversity hotspot if it meets the following criteria:

- Contains at least 1,500 species of vascular plants as endemics: This high level of plant endemism signifies unique biodiversity.
- Has lost at least 70% of its primary native vegetation: Significant habitat loss highlights the urgency for conservation efforts.

Therefore, both a high number of endemic flowering plants and substantial habitat loss are crucial criteria for identifying biodiversity hotspots, making option (D) the most accurate answer.

44. Nudation, invasion, competition, reaction and stabilization are the various steps involved during the development of:

(A) A plant community

(B) An ecosystem

(C) Plant succession

(D) A food chain

Answer: (C) Plant succession

Nudation, invasion, competition, reaction, and stabilization are stages involved in plant succession. Plant succession refers to the process of vegetation development over time in a given area. These stages represent the sequence of changes in plant and animal communities as an ecosystem develops. So, the correct answer is (C) Plant succession.

45. Which of the following is not a popular theory of climax concept? *

(A) Monoclimax Theory

(B) Heteroclimax Theory

(C) Climax Pattern Hypothesis

(D) Polyclimax Theory

Answer: (A) Monoclimax Theory. Or (C) Climax Pattern Hypothesis.

Monoclimax Theory: This proposes a single, stable climax community for each site under specific environmental conditions. It was the dominant view for a long time but has faced criticisms for its rigidity and inability to explain variations in climax communities.

Heteroclimax Theory: This acknowledges the possibility of multiple climax communities existing within a region, influenced by factors like soil type and topography. It offers more flexibility than the monoclimax theory but can be complex to apply in practice.

Climax Pattern Hypothesis: This focuses on the dynamic nature of climax communities, suggesting they don't exist as fixed endpoints but as patterns of fluctuating populations influenced by environmental disturbances. It's a relatively recent theory gaining traction due to its emphasis on ecological resilience and adaptation.

Polyclimax Theory: This posits that different kinds of climax communities can develop even within the same region, depending on the initial conditions and ecological history of the site. It's considered a broader framework encompassing both monoclimax and heteroclimax concepts.

46. Which of the following is not a factor which affects the density of a population in a given habitat during a given period?

(A) Natality

(B) Immigration

(C) Mortality

(D) Age of population

Answer: (D) Age of population

The age of a population is not a direct factor that affects the density of a population in a given habitat during a given period. Density is typically influenced by factors such as natality (birth rate), mortality (death rate), immigration (movement into the population), and emigration (movement out of the population). The age structure of a population can influence factors like natality and mortality, but it is not considered a direct factor affecting population density.

47. Which of the following is not a feature of energy flow in an ecosystem?

(A) The energy captured by autotrophs does not revert back to solar input.

(B) At each trophic level there is a progressive increase in energy.

(C) Due to one-way flow of energy, the system will collapse if the primary source of energy is cut off.

(D) A lot of energy is lost during metabolic reactions coupled with unutilized energy.

Answer: (B) At each trophic level, there is a progressive increase in energy.

The correct statement is that at each trophic level, there is a progressive decrease in energy, not an increase. This is because energy is lost as heat during metabolic processes, and only a fraction of the energy is transferred to the next trophic level. The correct understanding is that energy decreases as we move up the trophic levels in an ecosystem.

48. Which of the statements is wrong about ecological pyramids?

(A) Pyramid of numbers may be upright or inverted.

(B) Pyramid of energy may be upright or inverted.

(C) Pyramid of biomass may be upright or inverted.

(D) They are the graphical representation of different trophic levels.

Answer: (B) Pyramid of energy may be upright or inverted.

According to the second law of thermodynamics, there is a progressive loss of energy at each trophic level in an ecosystem. Due to this energy loss, it's impossible for the pyramid of energy to be inverted.

The pyramid of energy will always be upright, with the base representing the total energy captured by producers and the subsequent levels showing decreasing amounts of energy available at each trophic level.

49. Theory of inheritance of acquired characters is stated in:

(A) Darwinism

(B) Lamarckism

(C) Species concept

(D) Neo-Lamarckism

Answer: (B) Lamarckism

The theory of the inheritance of acquired characters is associated with Lamarckism. Jean-Baptiste Lamarck proposed this theory, suggesting that characteristics acquired or developed by an organism during its lifetime could be passed on to its offspring. This concept is now largely discredited, and the modern understanding of inheritance is based on the principles of genetics proposed by Mendel.

50. The term Evolution was first used by:

(A) Lamarck

(B) Herbert Spencer

(C) Darwin

(D) Hugo de Vries

Answer: (B) Herbert Spencer

Herbert Spencer, an English philosopher, sociologist, and biologist, is credited with introducing the term "evolution" in a biological context before Darwin's use of the term in a more specific sense related to natural selection.

Spencer used the term in the 19th century to describe a broader concept of developmental change and progress in the natural world.

51. The change in allele frequency over a period of time within a population is known as:

(A) Mega evolution

(B) Microevolution

(C) Macroevolution

(D) Coevolution

Answer: (B) Microevolution

The change in allele frequency over a relatively short period of time within a population is known as microevolution.

It involves small-scale genetic changes such as those occurring within a single population or species.

52. The raw material of Evolution is:

(A) Mutation

(B) Acquired characters

(C) Sexual reproduction

(D) Natural Selection

Answer: (A) Mutation

The raw material of evolution is genetic variation, and mutations provide the primary source of new genetic variation.

Mutations are changes in the DNA sequence of an organism, and they can lead to the introduction of new alleles or variations in existing

alleles. Natural selection acts on this variation, shaping the evolution of populations over time.

53. Muller was the first to produce induced mutation in:

(A) Drosophila

(B) Xenopus

(C) Paramecium

(D) Arabidopsis

Answr: (A) Drosophila

Hermann Joseph Muller was the first to produce induced mutations in the fruit fly Drosophila melanogaster. His pioneering work in the 1920s involved exposing fruit flies to X-rays, which increased the mutation rate and allowed the study of the effects of mutations on inheritance and evolution.

54. Origin of Species was written by:

(A) Oparin

(B) Weismann

(C) Lamarck

(D) Darwin

Answer: (D) Darwin

Oparin - 'Origin of Life'.

Weismann - various books on evolutionary theories.

Lamarck - 'Philosophie zoologique'.

Charles Darwin - 'On the Origin of Species by Means of Natural Selection'.

55. Species inhabiting different geographical areas is known as:

(A) Sympatric

(B) Allopatric

(C) Siblings

(D) Biospecies

Answer: (B) Allopatric

Species inhabiting different geographical areas are termed "allopatric" species. In allopatric speciation, populations of a species become geographically isolated from each other, leading to the divergence of characteristics and eventually the formation of distinct species.

56. Which geological epoch period is marked by dinosaur dominance?

(A) Paleozoic Era

(B) Mesozoic Era

(C) Cenozoic Era

(D) Proterozoic Era

Answer: (B) Mesozoic Era

The Mesozoic Era, specifically the Jurassic and Cretaceous periods within it, is marked by the dominance of dinosaurs. This era, often referred to as the "Age of Dinosaurs," spanned from approximately 252 to 66 million years ago. The Mesozoic Era ended with the mass extinction event that also led to the extinction of dinosaurs, except for the avian dinosaurs (birds).

57. Which of the following is essential for fermentation process to occur?

(A) Inorganic Substrate

(B) Organic Substrate

(C) Sodium Salts

(D) Ethanol

Answer: (B) Organic Substrate

Fermentation is a metabolic process that occurs in the absence of oxygen, and it involves the breakdown of organic substrates (such as sugars or carbohydrates) by microorganisms to produce energy. The presence of an organic substrate, typically a sugar or carbohydrate, is essential for the fermentation process to occur.

58. Which of the following vaccines do not have age restriction for administration?

(A) MMR Vaccines

(B) Polio Vaccines

(C) HPV Vaccines

(D) Rabies Vaccines

Answer:(D) Rabies Vaccines

MMR Vaccines: Typically recommended for children between 12 and 18 months and again between 4 and 6 years old. Some settings might recommend boosters for adults.

Polio Vaccines: Generally administered in multiple doses during childhood, starting at 6 weeks old. Some boosters might be recommended for adults depending on risk factors and travel history.

HPV Vaccines: Recommended for both boys and girls, typically between 9 and 14 years old. In some cases, catch-up vaccination might be recommended for adults up to 26 years old.

Rabies Vaccines: Primarily focused on post-exposure prophylaxis after animal bites. Rabies vaccines generally do not have age restrictions for administration. Rabies vaccinations are often recommended for individuals of all ages, especially those at risk of exposure to the rabies virus, such as individuals working with animals or living in regions where rabies is prevalent.

59. Biofortification using transgenic animals by gene manipulation can be achieved by carrying out which one of the following?

(A) Improving Disease Resistance

(B) Improving Reproductive Performance

(C) Improving Carcass Composition

(D) Improving Growth Rate

Answer: (C) Improving Carcass Composition

Biofortification typically refers to the process of enhancing the nutritional content of crops. However, in the context of transgenic animals and gene manipulation, improving carcass composition might involve enhancing the nutritional quality of animal products such as meat, milk, or eggs. This could include increasing the levels of specific nutrients beneficial for human health.# Carcass (body of a dead animal, especially one that has been slaughtered for food.)

60. The use of genomics in diagnostics has significant benefits in terms of quickly identifying disease etiology for:

(A) Monogenic Diseases

(B) Polygenic Diseases

(C) X-linked Disorders

(D) Trisomies

Answer: (A) Monogenic Diseases

The use of genomics in diagnostics has significant benefits in quickly identifying the disease etiology for monogenic diseases, which are caused by mutations in a single gene. Genomic techniques, such as next-generation sequencing, can help identify specific genetic variations responsible for monogenic diseases, allowing for accurate diagnosis and potential targeted treatments.

Polygenic Diseases involve complex interactions of multiple genes and environmental factors. While genomics can reveal genetic susceptibility factors, pinpointing the exact causative genetic combination can be challenging and often doesn't offer a definitive or rapid diagnosis.

X-linked Disorders are caused by mutations on the X chromosome and predominantly affect males. While genetic testing plays a role in diagnosis, some clinical features and specific gene tests might offer comparable or even faster confirmation in some cases.

Trisomies is a category that includes chromosomal abnormalities like Trisomy 21 (Down syndrome). Karyotyping, a conventional cytogenetic technique, can already provide a rapid and definitive diagnosis for these conditions.

61. Resins of medicinal value are an example of:

(A) Primary Bioresource

(B) Secondary Bioresource

(C) Value-added plant product

(D) Biofortified entity

Answer: (B) Secondary Bioresource

Resins of medicinal value are an example of secondary bioresources. Secondary bioresources are derived from primary bioresources (such as plants) but undergo additional processing to extract or enhance specific properties or compounds for specific uses, such as medicinal applications.

Primary bioresources are directly obtained from organisms, such as wood, food crops, and fibers. The term "value-added" typically refers to processing or modification of a primary product to enhance its value. Biofortified entity involves breeding or engineering crops to increase their nutritional content.

62. Thriving of diverse living species on the Earth is solely due to:

(A) Inbreeding

(B) Outbreeding

(C) Selective breeding

(D) Pure breeding

Answer: (B) Outbreeding

Outbreeding is the practice of crossing different breeds or species of animals. It can increase genetic diversity and introduce new alleles into the breeding population. The thriving of diverse living species on Earth is primarily due to outbreeding.

Outbreeding contributes to genetic diversity within populations, enhancing the adaptability and evolutionary potential of species to different environmental conditions.

63. At which stage of waste treatment do methanogenic microbes play a role in detoxification?

(A) Primary treatment

(B) Secondary treatment

(C) Sludge digestion

(D) Biological oxidation

Answer: (C) Sludge digestion

Primary treatment is the stage that physically removes large solids and grease from wastewater through processes like screening and sedimentation. Methanogenic microbes are not involved here. Secondary treatment uses biological processes to break down dissolved organic matter remaining after primary treatment. **Sludge digestion** is the stage that focuses on stabilizing the residual organic matter, primarily in the form of sludge, left over from primary and secondary treatment. Methanogenic microbes thrive in the anaerobic environment of sludge digesters, breaking down organic matter and generating methane as a byproduct. This process reduces sludge volume, minimizes odors, and recovers potential bioenergy from the waste. Biological oxidation is a general term for aerobic processes where bacteria use oxygen to break down organic matter.

Therefore, due to their ability to degrade organic matter and stabilize sludge in an anaerobic environment, methanogenic microbes play a vital role in sludge digestion, contributing to efficient wastewater treatment and resource recovery.

64. What are the elements of biosensors?

(A) Substrate, Receptor, Signal amplifier, Signal receiver

(B) Analyte, Receptor, Transducer, Signal output

(C) Analyte, Signal amplifier, Transducer, Signal receiver

(D) Substrate, Signal amplifier, Transducer, Signal output

Answer: (B) Analyte, Receptor, Transducer, Signal output.

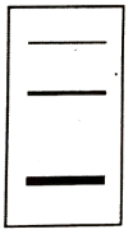
Analyte: The substance that the biosensor is designed to detect. It can be a chemical, biological molecule, or other substance of interest.

Receptor: A biological molecule or component that specifically recognizes and binds to the analyte. It acts as the sensing element, initiating the detection process.

Transducer: A device that converts the biological interaction between the analyte and receptor into a measurable signal, often electrical, optical, or mechanical. It acts as the bridge between the biological and electronic components of the biosensor.

Signal output: The final result of the biosensor's measurement, displayed in a readable format, such as a numerical value, light intensity, or sound. This output allows for interpretation and analysis of the analyte concentration or presence.

65. In the image given below, different conformations of plasmid were resolved in a 1% agarose gel. Identify which conformation migrates Slower ⟶ Faster?*



(A) Linear, Nicked, Supercoiled

(B) Linear, Supercoiled, Nicked

(C) Supercoiled, Linear, Nicked

(D) Nicked, Linear, Supercoiled

Answer: (C) Supercoiled, Linear, Nicked

Supercoiled plasmids are the most compact due to the presence of supercoils, twisted strands of DNA within the molecule. This compact structure makes them move through the agarose gel pores more slowly. Linear plasmids have both ends free and are less compact than supercoiled plasmids. They can move through the gel pores slightly faster than supercoiled forms. Nicked plasmids have a single break in one of the DNA strands, disrupting the supercoiled structure and slightly loosening the molecule. They are the least compact form and migrate through the gel pores the fastest.

Therefore, the order based on migration speed is: **supercoiled (slowest) > linear > nicked (fastest).**

66. What is the main limitation for using Edman degradation method for protein sequencing?*

(A) It cannot determine the N-terminal sequence.

(B) It requires a large amount of protein.

(C) It cannot sequence proteins with modified amino acids.

(D) It cannot be automated.

Answer: C) It cannot sequence proteins with modified amino acids.

(A) is not true as Edman degradation specifically focuses on determining the amino acid sequence starting from the N-terminus of

the protein. (B) Edman degradation requires more protein compared to some modern mass spectrometry methods, it can still be performed with picomole quantities, making it suitable for many applications. While the original Edman method was manual, automated Edman sequencers have been available since the 1960s, significantly improving efficiency and throughput.

However, the presence of modified amino acids in a protein can significantly disrupt the Edman degradation process. Modifications like phosphorylation, glycosylation, or acetylation can block the reaction between the phenylisothiocyanate reagent and the N-terminal amino acid, hindering the chain of reactions and preventing complete sequencing.

Therefore, the inability to sequence proteins with modified amino acids remains a significant limitation of the Edman degradation method, despite its advantages for determining N-terminal sequences and its historical significance in protein sequencing.

67. What does the total sum of squares in ANOVA represent?

(A) The sum of squares between groups

(B) The sum of squares within groups

(C) The total variation in data

(D) The mean of the data

Answer: (C) The total variation in data

In Analysis of Variance (ANOVA), the total sum of squares (SST) represents the total variation in the data.

It is calculated as the sum of the squared differences between each individual data point and the overall mean of the data.

The total sum of squares is then partitioned into the sum of squares between groups (explained variation) and the sum of squares within groups (unexplained or residual variation).

68. If the values of the two variables move in opposite directions, the correlation is said to be:

(A) Positive

(B) Negative

(C) Linear

(D) Non-linear

Answer: (B) Negative

If the values of two variables move in opposite directions, the correlation between them is said to be negative.

In a negative correlation, as one variable increases, the other variable tends to decrease, and vice versa. So, the correct answer is (B) Negative.

69. Radioactive isotopes used in Hershey-Chase experiment were:

(A) 3H and 14C

(B) 14C and 35S

(C) 32P and 35S

(D) 14C and 32P

Answer: (C) 32P and 35S

3H and 14C: While these isotopes are used in other biological experiments, they were not used by Hershey and Chase.

14C and 35S: Although carbon-14 was used in other experiments by Hershey and Chase, in the specific experiment testing DNA transmission it was phosphorus-32 (32P) that was attached to the DNA to trace its movement.

14C and 32P: Carbon-14 was not used in the specific experiment analyzing DNA transmission, only phosphorus-32.

Therefore, the combination of 32P (for DNA) and 35S (for protein) was crucial for the Hershey-Chase experiment's success in demonstrating that DNA, not protein, carries the genetic material in bacteriophages.

70. Freeze-fracture method for microscopic examination does not involve : *

(A) Rapid freezing

(B) Fracturing

(C) Cytoprotection

(D) Sublimation

Answer: (C) Cytoprotection.

Rapid freezing: This is a crucial step in the freeze-fracture method. It helps to preserve the cell structure by quickly immobilizing molecules and preventing ice crystal formation, which can distort the sample.

Fracturing: Following freezing, the sample is fractured to expose internal surfaces for visualization. This fracturing plane typically passes through the lipid bilayer of cell membranes.

Cytoprotection: This term does not apply directly to the freeze-fracture method. It refers to measures taken to protect cells from damage during other microscopic techniques, such as chemical fixation.

Sublimation: This refers to the transition of a solid directly to a gas phase without going through a liquid state. Freeze-fracture methods

often utilize sublimation under vacuum to remove ice from the fractured surface, revealing the underlying structures for detailed examination.

Therefore, **cytoprotection is not involved in the freeze-fracture method**, as it focuses on preserving and revealing the native state of biological structures rather than protecting them from external influences. It refers to methods or techniques used to protect cells from damage during freezing or other procedures.

71. PET scan techniques are used to study:

(A) Abnormal activity in our body

(B) The cause of pathogenesis in our body

(C) The progress of pregnancy

(D) The activity of babies

Answer: (A) Abnormal activity in our body

Positron Emission Tomography (PET) scans are imaging techniques used to study abnormal activity in the body. PET scans involve the use of a small amount of radioactive material (tracer) that is injected into the body. The emitted positrons from the radioactive material are detected, and the data is used to create detailed images of the metabolic and biochemical processes in the body.

PET scans are commonly used in the diagnosis and monitoring of various medical conditions, including cancer, neurological disorders, and cardiovascular diseases.

72. In a field study, to estimate the number of mongoose in a locality, 60 mongoose were initially captured, marked and released. 80 mongoose were captured after one month from the same field of which 10 were previously marked. From these findings, estimate the population size of mongoose in that field.

(A) 320

(B) 480

(C) 420

(D) 380

Answer: (B) 480

We can estimate the population size of mongoose in the field using the Lincoln-Peterson index, which is a capture-mark-recapture (CMR) technique. Here's how to calculate it:

N = (M1 * M2) / R

Where N: Estimated population size

M1: Number of individuals initially captured and marked (60)

M2: Number of individuals captured in the second sample (80)

R: Number of marked individuals recaptured in the second sample (10). Plugging in the values, we get:

N = (60 * 80) / 10

N = 480

Therefore, the estimated population size of mongoose in the field is 480 (Option B).

73. Which of the following amino acid is a precursor of niacin?

(A) Leucine

(B) Isoleucine

(C) Tryptophan

(D) Tyrosine

Answer: (C) Tryptophan

While all the listed amino acids are essential for human health, only tryptophan can be converted into niacin (vitamin B3) in the human body. This conversion pathway takes place primarily in the liver and involves several enzymatic steps.

Leucine is involved in muscle protein synthesis and energy production, but it cannot be converted into niacin. Similar to leucine, isoleucine plays roles in protein synthesis and energy metabolism, but it lacks the specific molecular structure needed for niacin biosynthesis. Tyrosine is used for building proteins and producing other important molecules like neurotransmitters, but it also isn't a direct precursor of niacin. Therefore, tryptophan stands out as the only amino acid capable of generating niacin within the human body, highlighting its dual role as an essential building block for proteins and a vital precursor for this vital vitamin.

74. The isotopes of a neutral atom of an element show variation in which of the following properties?

(A) Atomic number

(B) Chemical properties

(C) Physical properties

(D) Mass number

Answer: (D) Mass number

Isotopes of a neutral atom of an element have the same atomic number (which defines the element) but different mass numbers. The mass number is the sum of protons and neutrons in the

nucleus of an atom. Since isotopes of an element have the same number of protons (and, therefore, the same atomic number), they exhibit similar chemical properties. However, their physical properties, such as density and nuclear stability, can vary due to differences in mass numbers.

75. One of the following thermodynamic law gives the concept of enthalpy:

(A) First law of thermodynamics

(B) Second law of thermodynamics

(C) Third law of thermodynamics

(D) Fourth law of thermodynamics

Answer: (A) First law of thermodynamics

The concept of enthalpy is derived from the First Law of Thermodynamics, which is also known as the Law of Energy Conservation. The First Law states that energy cannot be created or destroyed in an isolated system; it can only change forms. Enthalpy (H) is a thermodynamic quantity defined as the sum of the internal energy (U) and the product of pressure (P) and volume (V):

$$[H = U + PV]$$

The change in enthalpy (ΔH) is often used to quantify heat transfer during chemical reactions at constant pressure.

76. Ramachandran plot predicts which one of the following parameters of a protein?

(A) Total number of hydrogen atoms

(B) Possible number of interactions of side chains of the amino acid

(C) Number of reactive groups in a protein

(D) Dihedral angle

Answer: (D) Dihedral angle

The Ramachandran plot is a tool used in structural biology to predict the allowed regions for the backbone dihedral angles (phi and psi) in a protein. These dihedral angles describe the rotations about the bonds connecting the successive alpha carbons in the protein backbone. The plot helps in identifying sterically allowed or disallowed regions for these angles, providing insights into the protein's structure and stability.

77. In a nucleotide, sugar and base are linked to each other by

(A) Hydrogen bond

(B) Glycoside bond

(C) Phosphodiester bond

(D) Ionic bond

Answer: (B) Glycoside bond

In a nucleotide, the sugar and base are linked to each other by a glycosidic bond. This bond forms between the anomeric carbon of the sugar molecule and the nitrogenous base. The specific type of glycosidic bond can vary depending on the nucleotide. For example, in DNA, the bond between the deoxyribose sugar and the nitrogenous base is a beta-glycosidic bond.

78. Which of the following enzyme is not involved in galactose metabolism?

(A) Galactose-1-Phosphate Uridyltransferase

(B) UDP-Galactose-4-epimerase

(C) Glucokinase

(D) Galactokinase

Answer: (C) Glucokinase

Glucokinase is not directly involved in galactose metabolism. It primarily phosphorylates glucose to glucose-6-phosphate in glycolysis and plays a role in glucose homeostasis.

Galactokinase is involved in the initial phosphorylation of galactose to galactose-1-phosphate. Galactose-1-Phosphate Uridyltransferase converts galactose-1-phosphate to glucose-1-phosphate. UDP-Galactose-4-epimerase is involved in the interconversion of UDP-galactose and UDP-glucose during the synthesis of glycoproteins and glycolipids.

79. Which of the following forces is most favourable for protein folding?

(A) Hydrophobic interactions

(B) Conformational entropy

(C) Van der Waals interactions

(D) Hydrogen bonds

Answer: (A) Hydrophobic interactions

Hydrophobic interactions are often considered the most favorable for protein folding. The hydrophobic effect is driven by the tendency of water molecules to exclude nonpolar substances, such as hydrophobic amino acid side chains, from their surroundings. In the process of protein folding, hydrophobic residues tend to cluster

together in the interior of the protein, away from the surrounding water, leading to increased stability.

While other forces like hydrogen bonds, van der Waals interactions, and conformational entropy also contribute to protein stability, hydrophobic interactions are particularly significant in the folding process.

80. Which of the following is not true about Lipid rafts?

(A) Lipid rafts are mainly constituted of cholesterol.

(B) Lipid rafts are assembled in Golgi complex and directly sent to plasma membrane.

(C) One Lipid raft is large enough to be seen under microscope.

(D) Lipid rafts when activated, form clusters.

Answer: (A) Lipid rafts are mainly constituted of cholesterol.

Lipid rafts are enriched in cholesterol and sphingolipids. They can be assembled in the Golgi complex and are involved in membrane trafficking to the plasma membrane. Lipid rafts are small and dynamic, typically below the resolution limit of a standard light microscope (C). Lipid rafts can undergo clustering when activated, especially during signaling events. Hence, the statement (C) is not true about lipid rafts. Lipid rafts are not individually visible under a microscope due to their small size

81. Fluidity of the plasma membrane is mostly decided by the following constituent:

(A) Phospholipid

(B) Sphingolipid

(C) Cholesterol

(D) Protein

Answer: (C) Cholesterol

Phospholipids are the main building blocks of the plasma membrane, phospholipids possess both a hydrophilic headgroup and a hydrophobic tail. The ratio of head to tail groups and the fatty acid composition influence fluidity, but alone, they don't have the dramatic effect of cholesterol. Sphingolipids are Similar to phospholipids, sphingolipids have a head and tail structure, but their longer saturated hydrocarbon tails contribute to some rigidity. While they can impact fluidity to some extent, their effect is less pronounced than cholesterol. Proteins include Integral membrane proteins can restrict the movement of phospholipids and influence local fluidity, but they don't directly determine the overall membrane fluidity like cholesterol.

Cholesterol, with its rigid ring structure and hydroxyl group, packs tightly between phospholipid molecules, hindering their free movement and reducing membrane fluidity. This property makes cholesterol crucial in regulating membrane permeability and maintaining proper structure and function.

Therefore, due to its unique ability to stiffen the phospholipid bilayer and control fluidity, cholesterol stands out as the most influential factor in determining the overall fluidity of the plasma membrane.

82. The only electron carrier in Electron Transport Chain which is not a protein bound prosthetic group is

(A) Cytochrome C

(B) Coenzyme Q

(C) Iron-Sulphur Cluster

(D) NADH reductase

Answer: B) Coenzyme Q

Cytochrome C: This is a protein containing a heme prosthetic group, acting as a mobile electron carrier within the electron transport chain.

Iron-Sulphur Cluster: Similar to Cytochrome C, this is a protein-bound prosthetic group with iron and sulfur atoms facilitating electron transfer.

NADH reductase: This is a large protein complex containing various protein subunits and prosthetic groups including flavin mononucleotide (FMN) and iron-sulfur clusters, making it firmly tethered to the mitochondrial membrane.

Coenzyme Q (ubiquinone): This small, lipid-soluble molecule is the only molecule in the electron transport chain that freely diffuses within the inner mitochondrial membrane, transporting both electrons and protons between complex I and complex III. It exists outside of any protein structures, making it the only non-protein bound mobile electron carrier.

83. Match the following:

a. Microtubules	i. Muscle contraction
b. Actin	ii. Cell adhesion
C. Lamin	iii. Spindle formation

	a	b	c	d
(A)	iii	i	ii	iv
(B)	iii	i	iv	ii
(C)	iii	ii	iv	i
(D)	ii	i	iv	iii

d. Keratin	iv. Desmosomes

Codes:

Answer: (C) iii, ii, iv, i

Microtubules: This is the most crucial component for spindle formation (iii) during cell division, as they form the microtubule fibers that pull and separate chromosomes.

Actin: Actin plays a major role in muscle contraction (i), as it forms the contractile fibers within muscle cells.

Lamin: This type of intermediate filament provides structural support and helps maintain cell adhesion (ii) through connections with the nuclear envelope and cytoskeleton.

Keratin: Keratin is the primary protein component of intermediate filaments in epithelial cells, contributing to desmosomes (iv), specialized cell junctions that provide strong adhesion between cells.

Therefore, by matching the functions with their corresponding cellular components based on their specific roles and properties, option (C) emerges as the correct answer.

84. Chromatin condensation in a cell to form fibres requires

(A) Acetylation of histone tails

(B) Deacetylation of histone tails

(C) Methylation of serine and threonine

(D) Phosphorylation of arginine

Answer: (B) Deacetylation of histone tails

Chromatin condensation involves various modifications to histones, and one of the key processes is the deacetylation of histone tails. Acetylation of histone tails generally leads to a more relaxed and open chromatin structure, allowing for gene expression. On the other hand, deacetylation results in a more condensed chromatin structure, inhibiting gene expression.

85. The following cell cycle transition is not an irreversible process:

(A) $G_1 \longrightarrow$ S phase

(B) $G_1 \longrightarrow$ Go phase

(C) Metaphase $\longrightarrow$ Anaphase

(D) Anaphase $\longrightarrow$ Telophase

Answer: (B) $G_1 \rightarrow G_o$ phase

G_1 phase: This phase represents cell growth and preparation for DNA replication.

G_o phase: This is a resting phase where cells can remain for extended periods and are not actively dividing.

Transition: Cells in G_1 can enter the Go phase if they receive specific signals indicating unfavorable conditions for division. These signals can be internal, like reaching a certain cell density, or external, like nutrient deprivation or stress.

The key point is that cells in Go phase haven't committed to the cell cycle and retain the potential to re-enter G_1 and resume proliferation when conditions become favorable. This characteristic distinguishes it from transitions like Metaphase $\longrightarrow$ Anaphase or Anaphase $\longrightarrow$ Telophase, which involve significant chromosomal rearrangements and are essentially irreversible once initiated.

Therefore, even though entering G_o phase signifies a temporary halt in cell division, its inherent reversibility sets it apart from the other listed cell cycle transitions that represent more committed stages in the cell cycle progression.

86. The following statement is not correct about auxotrophs:

(A) They are unable to synthesize all of the vital nutrients.

(B) TRP1 is a auxotrophic marker gene.

(C) They grow in minimal media, not in supplemented media.

(D) Auxotrophic mutants can be isolated by filtration enrichment technique.

Answer: (C) They grow in minimal media, not in supplemented media.

(A) is generally true for auxotrophs. They lack the ability to make one or more essential nutrients (amino acids, vitamins, nucleotides, etc.) required for their growth and survival. (B) is also correct. TRP1 encodes tryptophan synthase, an enzyme necessary for tryptophan synthesis. Mutants lacking a functional TRP1 gene become auxotrophic for tryptophan and can only grow if tryptophan is added

to the media (supplemented media). (D is also true. This technique takes advantage of the selective pressure imposed by minimal media (lacking the required nutrient). Only auxotrophic mutants requiring the filtered-in nutrient will survive and form colonies, allowing their identification and isolation.

Therefore, auxotrophs can actually grow in both minimal and supplemented media. In minimal media, they only grow if their specific required nutrient is provided (filtration enrichment) or if they possess a suppressor mutation that compensates for the auxotrophic defect. However, in supplemented media containing all the essential nutrients, they can grow normally like prototrophs (wild-type strains).

87. The amino acid that is encoded by only a single triplet code is:

(A) Phenylalanine
(B) Alanine
(C) Leucine
(D) Methionine

Answer: (D) Methionine

Phenylalanine, Alanine, and Leucine each have more than one codon that can encode them. For example:

- Phenylalanine is coded by UUU and UUC.
- Alanine is coded by GCU, GCC, GCA, and GCG.
- Leucine is coded by UUA, UUG, CUU, CUC, CUA, and CUG.

Methionine stands out as the only amino acid with a singular codon, AUG. This codon is also unique as it serves as the universal start codon for protein synthesis, signaling the beginning of a protein-coding sequence in mRNA.

88. Which of the following double-strand repair mechanism occurs throughout the cell cycle?

(A) Post replication repair
(B) Nucleotide excision repair
(C) Homologous recombination
(D) Non-homologous DNA end joining

Answer: D) Non-homologous DNA end joining (NHEJ)

NHEJ works efficiently throughout all cell cycle phases, regardless of the availability of sister chromatids or homologous sequences. This makes it a versatile repair mechanism capable of addressing double-strand breaks whenever they occur.

Unlike post-replication repair, which specifically targets breaks during DNA replication, NHEJ can handle breaks induced by different sources, including radiation, chemical damage, and replication errors.

Therefore, considering its broad activity, versatility in handling diverse break types, and independence from specific conditions, NHEJ emerges as the clear winner for a repair mechanism operating throughout the cell cycle.

89. Histone acetylation increases transcription of gene because:

(A) It enhances the DNA-Histone interaction
(B) It induces DNA bending which is recognised by RNA polymerase
(C) The acetyl groups on histones are recognized by the RNA polymerase
(D) It loosens the DNA histone complex to make it accessible to RNA polymerase

Answer: (D) It loosens the DNA-histone complex to make it accessible to RNA polymerase

Histone acetylation involves the addition of acetyl groups to histone proteins, leading to a less compact and more open chromatin structure. This modification weakens the electrostatic interactions between histones and DNA, making the DNA more accessible to transcriptional machinery, including RNA polymerase. As a result, transcription factors and RNA polymerase can bind more easily to the DNA, facilitating gene transcription.

90. The eukaryotic RNA polymerase that transcribes Pre-mRNAs is:

(A) RNA Polymerase I
(B) RNA Polymerase II
(C) RNA Polymerase III
(D) RNA Polymerase IV

Answer: (B) RNA Polymerase II

RNA Polymerase I: This enzyme transcribes ribosomal RNA (rRNA) genes, not pre-mRNAs.

RNA Polymerase III: This enzyme transcribes transfer RNA (tRNA) and other small non-coding RNAs, not pre-mRNAs.

RNA Polymerase IV: This enzyme is specific to plants and transcribes small interfering RNAs (siRNAs) involved in gene silencing, not pre-mRNAs.

RNA Polymerase II: This enzyme is the key player in transcribing pre-mRNAs for protein-coding genes in eukaryotes. It recognizes specific

promoter sequences and initiates transcription, leading to the synthesis of RNA precursors that undergo further processing to become mature mRNAs.

91. Which organelle is responsible for the modification, sorting and packaging of proteins for secretion or intracellular use?

(A) Nucleus

(B) Endoplasmic reticulum

(C) Golgi apparatus

(D) Mitochondria

Answer: (C) Golgi apparatus

The Golgi apparatus is responsible for the modification, sorting, and packaging of proteins for secretion or for use within the cell. After proteins are synthesized in the endoplasmic reticulum (ER), they are transported to the Golgi apparatus, where they undergo post-translational modifications, sorting, and are packaged into vesicles for transportation to their final destination.

92. Which kind of the following post-translational modification increases the stability of the proteins?

(A) O-linked glycosylation

(B) N-linked glycosylation

(C) C-linked glycosylation

(D) Glypiation

Answer: (B) N-linked glycosylation

O-linked glycosylation modification involves attaching sugar chains to the side chains of serine or threonine residues on proteins. While it can affect protein folding, solubility, and interactions, its impact on stability is context-dependent and not always positive.

C-linked glycosylation is type of glycosylation is rare and typically involves attaching sugars to the C-terminus of proteins. Its effects on stability are also context-dependent and not generally associated with increased stability.

Glypiation is modification involves attaching a glycosylphosphatidylinositol (GPI) anchor to proteins, anchoring them in the cell membrane. This can increase the stability of membrane proteins by protecting them from degradation. However, it doesn't necessarily translate to increased stability for non-membrane proteins.

N-linked glycosylation is modification involves attaching sugar chains to the nitrogen atom of asparagine residues within specific amino acid sequences. N-linked glycosylation can significantly increase protein stability in several ways: Folding and conformation, Protection from proteases and Solubility and interaction

Therefore, considering the potential for stabilizing protein folding, conformation, and protection from proteases, N-linked glycosylation emerges as the most likely candidate for increasing protein stability among the listed options.

93. In the RNAi regulatory pathway, the dicer enzyme cleaves

(A) RNA polymerase into non-functional pieces

(B) Single stranded DNA into repetitive sequences

(C) Double stranded RNA into short strands

(D) mRNA of genes to be repressed

Answer: (C) Double stranded RNA into short strands.

This can occur from various sources, including viral infections, cellular defense mechanisms, or experimental introduction of dsRNA.

Dicer cleaves dsRNA into short fragments: Dicer, an RNase III enzyme, recognizes and binds to dsRNA, then cleaves it into short double-stranded fragments, typically around 20-25 nucleotides long, called small interfering RNAs (siRNAs).

siRNAs are loaded into the RNA-induced silencing complex (RISC): siRNAs associate with a protein complex called RISC, which helps unwind the siRNA duplex and retain one strand as a guide strand.

Guide strand directs target mRNA degradation: The guide strand of the siRNA guides RISC to complementary mRNA sequences, leading to their cleavage and degradation, effectively silencing gene expression.

94. Bacterial pathogen enter the host through their appendages which are

(A) Fimbria produced by P cluster of genes

(B) FimH gene product that binds with trimannose residues

(C) Prepilin like proteins

(D) Fibrinogen and fibronectin

Answer: (A) Fimbria produced by P cluster of genes

Fimbria, which are hair-like appendages produced by various genes, including the P cluster in some bacteria, makes them the most fitting answer for structures directly involved in bacterial pathogen entry into the host through physical attachment to host cells.

It's important to note that bacterial entry into the host can involve diverse mechanisms, and not all pathogens rely solely on

fimbriae. Some might utilize flagella for motility, toxins for tissue disruption, or specialized virulence factors for specific host interactions. However, in the context of appendages specifically facilitating entry, fimbriae stand out as a prominent mechanism for many bacterial pathogens.

95. The following GPCR signalling does not lead to opening of Ion channel:

(A) Muscarinic acetylcholine receptor

(B) Rhodopsin

(C) Epinephrine receptor

(D) Nicotinic acetylcholine receptor

Answer: (A) Muscarinic acetylcholine receptor

Muscarinic acetylcholine receptor typically acts through second messenger systems and does not directly open ion channels.

Rhodopsin is involved in vision and activates a G protein, leading to changes in ion channel conductance in photoreceptor cells. Epinephrine receptor (beta-adrenergic receptor) can activate adenylyl cyclase and regulate ion channel activity indirectly through cAMP. Nicotinic acetylcholine receptor is an ionotropic receptor that directly opens ion channels upon acetylcholine binding.

96. Match the following:

a. TFG-B	i. Ser/thr kinase
b. Cytokine receptor	ii. SMAD
C. RAF	iii. Tyrosine kinase
d. RAS	iv. JAK

Codes:

	a	b	c	d
(A)	iv	iii	ii	i
(B)	ii	iv	i	iii
(C)	iii	i	iv	ii
(D)	iv	iii	i	ii

Answer: (A) iv iii ii i

TGF-B (Transforming Growth Factor-B) is associated with Ser/Thr kinase activity.

Cytokine receptor is often associated with JAK (Janus kinase), which is a Tyrosine kinase.

RAF is a protein kinase involved in the MAP kinase/ERK signaling pathway, which is a Ser/Thr kinase.

RAS is associated with Tyrosine kinase activity.

97. Match the following:

a. Adherens junction	i. Plakoglobin
b. Desmosomes	ii. CAM
c. Tight junctions	iii. Integrins
d. Hemidesmosomes	iv. Claudin-1

Codes:

	a	b	c	d
(A)	ii	iii	iv	i
(B)	iv	iii	i	ii
(C)	iii	iv	i	ii
(D)	ii	i	iv	iii

Answer: (D) ii, i, iv, iii.

a. Adherens junction - ii. CAM (Cell Adhesion Molecule)

Adherens junctions primarily rely on cadherins, a type of CAM, to mediate cell-cell adhesion.

b. Desmosomes - i. Plakoglobin

Desmosomes are characterized by the presence of plakoglobin, a protein that links cadherins to intermediate filaments, providing strong mechanical strength to the junction.

c. Tight junctions - iv. Claudin-1

Tight junctions regulate paracellular transport between cells and are composed of transmembrane proteins like claudins, with claudin-1 being a prominent example.

d. Hemidesmosomes - iii. Integrins

Hemidesmosomes anchor cells to the extracellular matrix, and integrins are key proteins in this process, bridging the junction to extracellular components like laminin.

Therefore, the correct match aligns the junctions with their respective characteristic proteins, reflecting their distinct roles in cell-cell adhesion, cell-matrix adhesion, and barrier formation.

98. Match the following:

a. RB gene	i. Cell cycle checkpoint
b. C-jun	ii. Signal transducers
c. p53	iii. Transcription factors
d. TFG-B	iv. Progress through cell cycle

Codes:

	a	b	c	d
(A)	iv	iii	i	ii
(B)	iii	i	iv	ii
(C)	ii	i	iv	iii
(D)	iii	iv	ii	i

Answer: (B) iii, i, iv, ii.

a. RB gene - iii. Transcription factors:

The RB gene encodes the retinoblastoma protein (RB), which acts as a tumor suppressor by regulating the transcription of genes involved in cell cycle progression. It functions as a transcription factor, binding to specific DNA sequences and controlling gene expression.

b. C-jun - i. Cell cycle checkpoint:

C-jun is a component of the AP-1 transcription factor complex, which is involved in regulating cell growth and differentiation. It can also play a role in cell cycle checkpoints, ensuring proper cell cycle progression.

c. p53 - iv. Progress through cell cycle:

The p53 protein is another crucial tumor suppressor that acts as a "guardian of the genome." It responds to DNA damage and other stress signals by arresting the cell cycle at checkpoints, allowing for DNA repair or triggering apoptosis if damage is irreparable. It can also inhibit the progress of cells through the cell cycle under certain conditions.

d. TGF-B - ii. Signal transducers:

Transforming growth factor-beta (TGF-B) is a signaling molecule that plays diverse roles in cell growth, differentiation, and apoptosis. It signals through a pathway involving SMAD proteins, which act as signal transducers, relaying the TGF-B signal into the nucleus to regulate gene expression.

99. The following statement about Antibody Engineering is not correct :

(A) This involves polyclonal antibodies only.

(B) This involves monoclonal antibodies.

(C) This involves modification of the structure of antibody.

(D) This involves modification of sequence of antibody.

Answer: (A) This involves polyclonal antibodies only.

While antibody engineering methods can be used to improve polyclonal antibody properties to a certain extent, this isn't the main focus or the most common application. Modifying individual B cell clones for monoclonal antibody production generally offers greater control and specificity.

Therefore, while antibody engineering may occasionally involve optimizing polyclonal antibodies, its core technology and applications revolve around monoclonal antibodies.

100. Covaxin is a vaccine which is :

(A) developed by India

(B) administered against SARS virus

(C) a naive and mRNA vaccine

(D) advised for persons with anaphylaxis history

Answer: (A) developed by India

Covaxin is a COVID-19 vaccine developed by Bharat Biotech, an Indian biotechnology company. It was developed to provide protection against the SARS-CoV-2 virus, which causes COVID-19. Covaxin is an inactivated virus vaccine, not an mRNA vaccine, and it is recommended for individuals without a known history of anaphylaxis to any component of the vaccine.