

CUET PG 2024 Nano Science Nano Technology Question Paper with Solutions

Time Allowed :1 Hour 45 Mins	Maximum Marks :300	Total Questions :75
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General Instructions

Read the following instructions very carefully and strictly follow them:

1. The examination duration is 105 minutes. Manage your time effectively to attempt all questions within this period.
2. The total marks for this examination are 300. Aim to maximize your score by strategically answering each question.
3. There are 75 mandatory questions to be attempted in the Nano Science Nano Technology paper. Ensure that all questions are answered.
4. Questions may appear in a shuffled order. Do not assume a fixed sequence and focus on each question as you proceed.
5. The marking of answers will be displayed as you answer. Use this feature to monitor your performance and adjust your strategy as needed.
6. You may mark questions for review and edit your answers later. Make sure to allocate time for reviewing marked questions before final submission.
7. Be aware of the detailed section and sub-section guidelines provided in the exam. Understanding these will aid in effectively navigating the exam.

1: Bond angle in ammonia molecule is:

- (A) Higher than the methane molecule
- (B) Higher than the water molecule
- (C) Lower than the water molecule
- (D) Equal to the methane molecule

Correct Answer: (B) Higher than the water molecule

Solution: The bond angle in ammonia (NH_3) is approximately 107° , which is higher than that in water (H_2O), where the bond angle is 104.5° . This difference arises due to the stronger lone pair-bond pair repulsion in water, which compresses its bond angle more than in ammonia.

 Quick Tip

Remember: Bond angles decrease with increasing lone pair-bond pair repulsions.

2: Fullerene is the allotrope of:

- (A) Carbon
- (B) Sulphur
- (C) Phosphorus
- (D) Fluorine

Correct Answer: (A) Carbon

Solution: Fullerenes, also known as buckyballs, are allotropes of carbon. These molecules consist of carbon atoms arranged in a spherical, tubular, or ellipsoidal structure. The most common fullerene is C_{60} , which has a structure resembling a soccer ball.

 Quick Tip

Fullerenes belong to the carbon family, similar to graphite and diamond.

3: Which of the following oxidation states of lanthanides is preferably more stable?

- (A) +2 oxidation state
- (B) +3 oxidation state
- (C) +4 oxidation state
- (D) +1 oxidation state

Correct Answer: (B) +3 oxidation state

Solution: The +3 oxidation state is the most stable and common for lanthanides. This stability arises because the removal of three electrons results in a half-filled or empty $4f$ orbital configuration, which is energetically favorable.

 Quick Tip

Lanthanides prefer +3 oxidation due to their electron configuration stability.

4: Which pair of the following transition elements shows the highest number of oxidation states?

- (A) Chromium and Titanium
- (B) Nickel and Iron
- (C) Copper and Zinc
- (D) Chromium and Manganese

Correct Answer: (D) Chromium and Manganese

Solution: Chromium and Manganese exhibit the highest number of oxidation states due to their ability to lose multiple d -electrons during bonding. Chromium exhibits oxidation states

from +1 to +6, while Manganese shows oxidation states ranging from +2 to +7.

 Quick Tip

The number of oxidation states increases with the availability of unpaired d -electrons.

5.: Ziegler-Natta catalyst is used for the polymerization of ethylene to produce:

- (A) Stereoregular polyethylene
- (B) Branched polyethylene
- (C) Low-density polyethylene
- (D) Random polyethylene

Correct Answer: (C) Low-density polyethylene

Solution: The Ziegler-Natta catalyst is specifically used to produce low-density polyethylene, such as isotactic and syndiotactic polymers. These polymers have well-defined arrangements of their molecular chains, leading to higher strength and crystallinity.

 Quick Tip

Ziegler-Natta catalysts are designed for controlling the low-density of polymers.

6: PCl_5 is highly reactive; hence, in solid state, it is dissociated into:

- (A) $[\text{PCl}_4]^+$ tetrahedral and $[\text{PCl}_6]^-$ octahedral respectively
- (B) $[\text{PCl}_3]^+$ and $[\text{PCl}_3]^-$ respectively
- (C) $[\text{PCl}_2]^+$ tetrahedral and $[\text{PCl}_4]^-$ octahedral respectively
- (D) $[\text{PCl}_2]^+$ tetrahedral and $[\text{PCl}_3]^-$ octahedral respectively

Correct Answer: (A) $[\text{PCl}_4]^+$ tetrahedral and $[\text{PCl}_6]^-$ octahedral respectively

Solution: In the solid state, PCl_5 dissociates into $[\text{PCl}_4]^+$ and $[\text{PCl}_6]^-$. $[\text{PCl}_4]^+$ adopts a tetrahedral geometry due to sp^3 hybridization, while $[\text{PCl}_6]^-$ adopts an octahedral geometry due to sp^3d^2 hybridization.

 Quick Tip

Remember: PCl_5 in solid state dissociates due to ionic interactions stabilizing the ions.

7: For the change $\text{Fe}^{3+}/\text{Fe}^{2+}$, E° is +0.77 V, which indicates:

- (A) Fe^{3+} has the tendency to reduce to Fe.
- (B) Fe^{2+} has the tendency to reduce to Fe.
- (C) Fe^{2+} has the tendency to reduce to Fe but Fe^{3+} does not have the tendency to reduce to Fe.

(D) Neither Fe^{3+} nor Fe^{2+} have the tendency to reduce to Fe.

Correct Answer: (D) Neither Fe^{3+} nor Fe^{2+} have the tendency to reduce to Fe.

Solution: The positive standard electrode potential ($E^\circ = +0.77 \text{ V}$) indicates that Fe^{3+} has a strong tendency to gain electrons and reduce to Fe^{2+} . However, the reduction of Fe^{2+} to Fe is less favorable compared to Fe^{3+} to Fe^{2+} .

 Quick Tip

A positive E° value indicates a spontaneous reduction tendency.

8: Liquid drop model was proposed to explain:

- (A) The structure of an atom
- (B) The stability of the nucleus
- (C) Geometry of the molecules
- (D) Polarization in the molecule

Correct Answer: (B) The stability of the nucleus

Solution: The liquid drop model explains the stability of the nucleus by considering the nucleus as a drop of incompressible nuclear fluid. It accounts for nuclear binding energy and processes such as nuclear fission.

 Quick Tip

The liquid drop model helps in understanding nuclear forces and binding energy variations.

9: Gadolinium belongs to the:

- (A) s-block elements
- (B) p-block elements
- (C) d-block elements
- (D) f-block elements

Correct Answer: (D) f-block elements

Solution: Gadolinium is an f-block element, specifically a lanthanide, with its electrons filling the 4f orbital. It exhibits properties typical of rare-earth elements.

 Quick Tip

Remember: Lanthanides and actinides belong to the f-block of the periodic table.

10: Which of the following has the highest bond order?

- (A) O_2^-
- (B) O_2^{2-}
- (C) O_2^+
- (D) O_2^{++}

Correct Answer: (D) O_2^{++}

Solution: The bond order can be calculated using the formula:

$$\text{Bond Order} = \frac{\text{Number of bonding electrons} - \text{Number of antibonding electrons}}{2}$$

For O_2^{++} , the bond order is highest as there are fewer antibonding electrons compared to other species.

 Quick Tip

Higher bond order indicates stronger and shorter bonds; fewer antibonding electrons increase bond order.

11: The correct energy order for molecular orbitals is:

- (A) Bonding MO ; Non-bonding MO ; Antibonding MO
- (B) Antibonding MO ; Non-bonding MO ; Bonding MO
- (C) Non-bonding MO ; Bonding MO ; Antibonding MO
- (D) Bonding MO ; Antibonding MO ; Non-bonding MO

Correct Answer: (A) Bonding MO ; Non-bonding MO ; Antibonding MO

Solution: The energy order of molecular orbitals is based on the principle that bonding molecular orbitals have the lowest energy, non-bonding orbitals have intermediate energy, and antibonding molecular orbitals have the highest energy. This arrangement arises from the stabilization of bonding orbitals and the destabilization of antibonding orbitals.

 Quick Tip

Bonding orbitals stabilize the molecule, antibonding orbitals destabilize it, and non-bonding orbitals neither stabilize nor destabilize.

12. $[Co(NH_3)_6][Cr(CN)_6]$ and $[Cr(NH_3)_6][Co(CN)_6]$ are the examples of:

- (A) Linkage isomerism
- (B) Coordination isomerism
- (C) Ionisation isomerism
- (D) Hydrate isomerism

Correct Answer: (B) Coordination isomerism

Solution: Coordination isomerism occurs when the ligands in the cation and anion exchange positions. Here, the ammonia ligand in $[\text{Co}(\text{NH}_3)_6]$ and the cyanide ligand in $[\text{Cr}(\text{CN})_6]$ are swapped, showing coordination isomerism.

 Quick Tip

Coordination isomerism involves exchange of ligands between the coordination entities of a salt.

13. A thermodynamic process which is carried out at constant temperature is called:

- (A) Isochoric process
- (B) Isothermal process
- (C) Isobaric process
- (D) Adiabatic process

Correct Answer: (B) Isothermal process

Solution: An isothermal process occurs at constant temperature, where the internal energy of the system remains unchanged. The heat added or removed from the system is fully utilized in doing work.

 Quick Tip

In an isothermal process, temperature is constant, and work done equals the heat exchanged.

14. Which of the following is correct for ionic product of water:

- (A) $K_w = [\text{H}^+][\text{OH}^-]$
- (B) $K_w = [\text{H}^+] + [\text{OH}^-]$
- (C) $K_w = [\text{H}^+] - [\text{OH}^-]$
- (D) $K_w = [\text{H}^+] = [\text{OH}^-]$

Correct Answer: (A) $K_w = [\text{H}^+][\text{OH}^-]$

Solution: The ionic product of water is defined as the product of the concentrations of hydrogen ions and hydroxide ions in water at a given temperature. It is mathematically expressed as:

$$K_w = [\text{H}^+][\text{OH}^-]$$

💡 Quick Tip

Always remember that the ionic product K_w is a constant at a given temperature and depends only on the temperature.

15. For the isolated system, if the entropy change is positive, then the process will be:

- (A) Spontaneous
- (B) Non-spontaneous
- (C) In equilibrium
- (D) Reversible

Correct Answer: (A) Spontaneous

Solution: In thermodynamics, if the entropy change (ΔS) of an isolated system is positive, it implies that the process is naturally occurring or spontaneous. A spontaneous process increases the overall disorder of the system.

💡 Quick Tip

Remember, for an isolated system, entropy (S) always increases for spontaneous processes, as per the second law of thermodynamics.

16. Lower value ($< 10^{-3}$) of equilibrium constant shows that the:

- (A) Forward reaction is favoured.
- (B) Backward reaction is favoured.
- (C) Equilibrium will never be established.
- (D) Concentration of products dominate over the concentration of reactants.

Correct Answer: (B) Backward reaction is favoured.

Solution: A lower value of the equilibrium constant ($K_c < 10^{-3}$) indicates that the reaction does not proceed significantly towards the products, meaning the concentration of reactants is much higher than that of the products. Therefore, the backward reaction is favoured.

💡 Quick Tip

The equilibrium constant provides insight into the extent of a reaction; small values favour reactants, while large values favour products.

17. Manufacturing of ammonia is favoured at:

- (A) Low temperature and high pressure.
- (B) High temperature and low pressure.
- (C) High temperature and high pressure.
- (D) Low temperature and low pressure.

Correct Answer: (A) Low temperature and high pressure.

Solution: The Haber process for manufacturing ammonia ($N_2 + 3H_2 \leftrightarrow 2NH_3 + \Delta H$) is exothermic. Lower temperatures shift the equilibrium towards ammonia production due to Le Chatelier's principle. High pressure favours the formation of ammonia since fewer moles of gas are produced on the product side.

 Quick Tip

The optimal conditions for the Haber process are low temperature (to favour exothermic reaction) and high pressure (to favour fewer moles of gas).

18. Which of the following statement is not correct for acids?

- (A) They turn blue litmus to red
- (B) They react with active metal to produce hydrogen
- (C) They turn red litmus to blue
- (D) They are sour in taste

Correct Answer: (C) They turn red litmus to blue

Solution: - Acids turn blue litmus to red, which is a correct property of acids. - Acids react with active metals to produce hydrogen gas. - Acids do not turn red litmus to blue; this is characteristic of bases. - Acids are sour in taste, which is also a correct property.

 Quick Tip

Always analyze chemical properties of acids and bases for identification.

19. The conjugate base of H_2SO_4 is

- (A) SO_4^{2-}
- (B) HSO_4^-
- (C) HSO_4^{2-}
- (D) SO_4^-

Correct Answer: (C) HSO_4^{2-}

Solution: - The conjugate base is formed when an acid donates a proton (H^+). - For H_2SO_4 , the conjugate base is HSO_4^{2-} after losing one proton.

 Quick Tip

Identify the conjugate base by removing one H^+ ion from the acid molecule.

20. Which of the following acidity order is correct?

- (A) $\text{HI} < \text{HBr} = \text{HCl} < \text{HF}$
- (B) $\text{HF} < \text{HCl} < \text{HI} < \text{HBr}$
- (C) $\text{HI} < \text{HBr} < \text{HCl} < \text{HF}$
- (D) $\text{HF} < \text{HCl} < \text{HBr} < \text{HI}$

Correct Answer: (D) $\text{HF} < \text{HCl} < \text{HBr} < \text{HI}$

Solution: - Acidity of hydrogen halides increases as the bond strength decreases down the group. - Therefore, HF has the strongest bond and lowest acidity, while HI has the weakest bond and highest acidity.

 Quick Tip

Remember: Acidity increases down the halogen group in the periodic table.

21: In methyl cation (CH_3^+), carbon is

- (A) sp^3 -hybridized
- (B) sp^2 -hybridized
- (C) sp -hybridized
- (D) sp^{d^2} -hybridized

Correct Answer: (B) sp^2 -hybridized

Solution: The methyl cation (CH_3^+) has three sigma bonds formed by carbon. The fourth orbital is empty, leaving the carbon atom with sp^2 -hybridization. The geometry of the methyl cation is planar trigonal due to the sp^2 -hybridization.

 Quick Tip

Always analyze the hybridization by counting sigma bonds and lone pairs.

22: In naphthalene, total number of delocalized π -electrons are

- (A) 4
- (B) 10
- (C) 8

(D) 12

Correct Answer: (B) 10

Solution: Naphthalene is an aromatic compound with two fused benzene rings. Each ring contributes 6 π -electrons, but 2 electrons are shared between the two rings, giving a total of 10 delocalized π -electrons. This satisfies Huckel's rule ($4n + 2$) for aromaticity.

 Quick Tip

For aromatic compounds, use Huckel's rule ($4n + 2$) to calculate delocalized π -electrons.

23: Friedel-Craft acylation is an example of

- (A) Electrophilic substitution reaction
- (B) Nucleophilic substitution reaction
- (C) Electrophilic addition reaction
- (D) Nucleophilic addition reaction

Correct Answer: (A) Electrophilic substitution reaction

Solution: Friedel-Craft acylation involves the substitution of a hydrogen atom in an aromatic ring with an acyl group ($-CO-$). This reaction proceeds via an electrophilic substitution mechanism, where the acylium ion acts as the electrophile.

 Quick Tip

Understand the reaction mechanism to classify it correctly as electrophilic or nucleophilic.

24. Which of the following order of carbocation stability is correct?

- (A) $CH_3^+ < CH_3CH_2^+ < (CH_3)_2CH^+ < (CH_3)_3C^+$
- (B) $CH_3^+ > CH_3CH_2^+ > (CH_3)_2CH^+ > (CH_3)_3C^+$
- (C) $CH_3CH_2^+ < CH_3^+ < (CH_3)_2CH^+ < (CH_3)_3C^+$
- (D) $(CH_3)_2CH^+ < CH_3^+ < CH_3CH_2^+ < (CH_3)_3C^+$

Correct Answer:(A) $CH_3^+ < CH_3CH_2^+ < (CH_3)_2CH^+ < (CH_3)_3C^+$

Solution: The stability of carbocations increases with the number of alkyl groups attached to the positively charged carbon. This is due to the inductive and hyperconjugation effects provided by alkyl groups, which help stabilize the positive charge. Thus, tertiary carbocations $(CH_3)_3C^+$ are more stable than secondary carbocations $(CH_3)_2CH^+$, which are more stable than primary carbocations $CH_3CH_2^+$, with methyl carbocations CH_3^+ being the least stable.

💡 Quick Tip

Carbocation stability increases with the substitution on the positively charged carbon due to hyperconjugation and inductive effects.

25. The monomer unit of natural rubber is

- (A) Isoprene
- (B) Ethylene
- (C) Isobutylene
- (D) Propene

Correct Answer: (A) Isoprene

Solution: Natural rubber is a polymer made up of repeating units of isoprene (C_5H_8). Isoprene undergoes polymerization to form polyisoprene, which constitutes natural rubber.

💡 Quick Tip

Natural rubber is formed through polymerization of isoprene, a hydrocarbon monomer.

26. Which of the following are coherent sources?

- (A) A 60 W and a 100 W bulbs
- (B) Two bulbs each of 60 W
- (C) Two halves of a 60 W bulb
- (D) Two virtual sources obtained by a biprism

Correct Answer: (D) Two virtual sources obtained by a biprism

Solution: Coherent sources are those that maintain a constant phase difference and have the same frequency. Two virtual sources obtained by a biprism satisfy these conditions, as they originate from a single coherent source.

💡 Quick Tip

Coherence by considering sources with consistent phase relationships and identical frequencies.

27. In Newton's rings arrangement with air film in reflected light, the diameter of n^{th} bright ring is D_n . If the air is replaced by liquid film of refractive index μ , the diameter of n^{th} ring will become:

- (A) $\sqrt{\mu}D_n$

- (B) $\frac{1}{\sqrt{\mu}}D_n$
 (C) $\frac{1}{\mu}D_n$
 (D) μD_n

Correct Answer: (B) $\frac{1}{\sqrt{\mu}}D_n$

Solution: When the air film is replaced with a liquid film of refractive index μ , the effective optical path length changes. The diameter of the n^{th} ring is inversely proportional to the square root of the refractive index. Hence, D_n becomes $\frac{1}{\sqrt{\mu}}D_n$.

💡 Quick Tip

Refractive index inversely affects the diameter of Newton's rings in optical interference setups.

28. The intensity ratio of the two interfering beams of light is β . What is the value of $\frac{(I_{\max} - I_{\min})}{(I_{\max} + I_{\min})}$?

- (A) $2\sqrt{\beta}$
 (B) $\frac{2\sqrt{\beta}}{(1+\beta)}$
 (C) $\frac{2}{(1+\beta)}$
 (D) $\frac{(1+\beta)}{2\sqrt{\beta}}$

Correct Answer: (B) $\frac{2\sqrt{\beta}}{(1+\beta)}$

Solution: The contrast in the interference pattern is determined by the intensity ratio of the beams. The fringe visibility is given by:

$$V = \frac{I_{\max} - I_{\min}}{I_{\max} + I_{\min}}$$

where the intensity ratio β relates to $I_{\max}$ and $I_{\min}$. Simplifying the expression, we find that:

$$\frac{(I_{\max} - I_{\min})}{(I_{\max} + I_{\min})} = \frac{2\sqrt{\beta}}{(1 + \beta)}$$

💡 Quick Tip

The fringe visibility measures the sharpness of the interference pattern and depends on the intensity ratio β .

29. In an experiment similar to Young's experiment, interference is observed using waves associated with electrons. The electron being produced in an electron gun. In order to increase the fringe width:

- (A) Electron gun voltage be increased
 (B) Electron gun voltage be decreased
 (C) The slits be moved away from each other
 (D) The screen be moved closer to interfering slits

Correct Answer: (B) Electron gun voltage be decreased

Solution: Decreasing the voltage of the electron gun reduces the energy of the electrons, which increases their wavelength. According to the fringe width equation for interference,

$$w = \frac{\lambda D}{d}$$

where λ is the wavelength, D is the distance between the slits and the screen, and d is the slit separation. A larger λ results in a larger fringe width w .

💡 Quick Tip

The fringe width increases with the wavelength of the electron waves, which can be adjusted by varying the voltage.

30. Using light of $\lambda = 5.9 \times 10^{-7}$ m, it is found that in a thin film of air, 7.4 fringes occur between two points. Deduce the difference of film thickness between these points.

- (A) 0.22×10^{-5} m
- (B) 0.32×10^{-5} m
- (C) 0.44×10^{-5} m
- (D) 2.21×10^{-5} m

Correct Answer: (A) 0.22×10^{-5} m

Solution:

The difference in film thickness Δt can be calculated using the formula:

$$\Delta t = \frac{m\lambda}{2}$$

where m is the number of fringes, and λ is the wavelength of light.

Given:

$$m = 7.4, \lambda = 5.9 \times 10^{-7} \text{ m}$$

Substitute the values:

$$\Delta t = \frac{7.4 \times 5.9 \times 10^{-7}}{2}$$

$$\Delta t = \frac{43.66 \times 10^{-7}}{2}$$

$$\Delta t = 21.83 \times 10^{-7} \text{ m} = 0.22 \times 10^{-5} \text{ m}$$

Hence, the difference in film thickness is 0.22×10^{-5} m.

Quick Tip

For thin films, the fringe count and wavelength are directly proportional to the thickness difference. Always use $\Delta t = \frac{m\lambda}{2}$ for such problems.

31. The main difference in the phenomenon of interference and diffraction is that:

- (A) Diffraction is due to superposition of light waves from the same wave front whereas interference is the superposition of waves from two isolated sources.
- (B) Diffraction is due to superposition of light waves from different wave fronts, whereas the interference is the superposition of two waves derived from the same source.
- (C) Diffraction is due to superposition of waves derived from the same source, whereas the interference is the bending of light from the same wavefront.
- (D) Diffraction is caused by reflected waves from a source whereas interference caused is due to refraction of waves from a surface.

Correct Answer: (B) Diffraction is due to superposition of light waves from different wave fronts, whereas the interference is the superposition of two waves derived from the same source.

Solution: Diffraction occurs when light waves from a single wavefront interact due to obstacles, creating characteristic patterns. In contrast, interference results from the interaction of waves from two coherent sources. The key difference lies in the origin of the wavefronts involved.

 Quick Tip

Differentiate between wavefront interactions: diffraction involves single wavefront bending; interference requires two coherent sources.

32. If N is the total number of lines on the grating, n is the order of spectrum and λ is the wavelength of light used, then resolving power of grating is given by:

- (A) $Nn\lambda$
- (B) Nn
- (C) $\frac{N\lambda}{n}$
- (D) $\frac{N}{n}$

Correct Answer: (B)

Solution: The resolving power of a grating is directly proportional to the number of lines (N) and the order of the spectrum (n). Thus, it is given by Nn .

 Quick Tip

Resolving power increases with the number of lines and the order of the spectrum.

33. The condition for obtaining Fraunhofer diffraction from a single slit is that the light wavefront incident on the slit should be:

- (A) Spherical
- (B) Cylindrical

- (C) Elliptical
- (D) Plane

Correct Answer: (D) Plane

Solution: Fraunhofer diffraction occurs when the incident wavefront is plane, implying that the source and the screen are at infinity, or collimating lenses are used to produce and receive parallel light beams.

 Quick Tip

Plane wavefront ensures uniform and coherent light for Fraunhofer diffraction.

34. In a diffraction experiment, the size of obstacle in the path of light should be of the order of:

- (A) 1 mm
- (B) 0.1 mm
- (C) 10^{-4} mm
- (D) 1 cm

Correct Answer: (C) 10^{-4} mm

Solution: The size of the obstacle in a diffraction experiment is comparable to the wavelength of light. For visible light, this corresponds to approximately 10 mm. Larger or smaller obstacles would not produce observable diffraction patterns.

 Quick Tip

Diffraction occurs when the obstacle's size is similar to the wavelength of the light used.

35. Yellow light is used in a single slit diffraction experiment with slit width of 0.6 mm. If yellow light is replaced by X-rays, then the observed pattern will reveal:

- (A) That the central maximum has become narrower
- (B) More number of fringes
- (C) Less number of fringes
- (D) No diffraction pattern

Correct Answer: (D) No diffraction pattern

Solution: The wavelength of X-rays is much smaller than the slit width of 0.6 mm. As a result, the condition for diffraction (slit width comparable to wavelength) is not met, and no

diffraction pattern is observed.

💡 Quick Tip

Diffraction requires the slit width to be comparable to the wavelength of light.

36. If a wave can be polarized, it must be:

- (A) A transverse wave
- (B) A stationary wave
- (C) A longitudinal wave
- (D) An electromagnetic wave

Correct Answer: (A) A transverse wave

Solution: Polarization is a property of transverse waves, where the oscillations occur in directions perpendicular to the direction of wave propagation. Longitudinal waves, like sound, cannot be polarized as their oscillations are along the direction of propagation.

💡 Quick Tip

Only transverse waves exhibit polarization due to their perpendicular oscillation nature.

37. When a circularly polarized light, after passing through a quarter-wave plate is examined through a rotating Nicol prism, the emergent light would show that:

- (A) the intensity of emergent light is $(1/4)^{th}$ to the intensity of incident light
- (B) there is no variation of intensity
- (C) there is variation of intensity with minimum zero
- (D) that the intensity of emergent and that of incident light is same

Correct Answer: (C) there is variation of intensity with minimum zero

Solution: Circularly polarized light passing through a Nicol prism exhibits intensity variations due to interference. The minimum intensity observed corresponds to destructive interference.

💡 Quick Tip

The Nicol prism allows the analysis of polarization states, revealing intensity variations with circularly polarized light.

38. When unpolarized light falls on two Nicol prisms so oriented that no light is transmitted. If a third Nicol prism is placed between them, not parallel to either

of the two above Nicol prisms, then:

- (A) no light is transmitted
- (B) some light is transmitted
- (C) light may or may not be transmitted
- (D) exactly 50% light is transmitted

Correct Answer: (B) some light is transmitted

Solution: The addition of a third Nicol prism between two crossed Nicol prisms introduces a plane of polarization, allowing some light to pass through.

 Quick Tip

A third Nicol prism alters the orientation of light's polarization, enabling partial transmission in otherwise blocked configurations.

39. Unpolarized light can be converted into a partially polarized or plane polarized light by several processes. Which of the following can do this?

- (A) Reflection
- (B) Refraction
- (C) Double refraction
- (D) Diffraction

Choose the correct answer from the options given below:

- (A) (A), (B) and (D) only.
- (B) (A), (B) and (C) only.
- (C) (A), (B), (C) and (D).
- (D) (B), (C) and (D) only.

Correct Answer: (B) (A), (B) and (C) only.

Solution: - Reflection: Polarization occurs as light reflects off a non-metallic surface at specific angles, leading to partially polarized light.

- Refraction: At the boundary between two media, refracted light can become partially polarized.

- Double refraction: Certain anisotropic materials split unpolarized light into two polarized rays.

- Diffraction: Does not cause polarization. It involves the bending of light around obstacles but does not alter the polarization state.

 Quick Tip

Reflection, refraction, and double refraction are key phenomena used to polarize light, while diffraction does not contribute to polarization.

40. If 8 cm length of 5% solution causes the optical rotation of 20° , how much

length of 10% solution of the same substance will cause 35° rotation?

- (A) 7 cm
- (B) 8 cm
- (C) 12 cm
- (D) 15 cm

Correct Answer: (A) 7 cm

Solution: The optical rotation (α) is directly proportional to the concentration (C) of the solution and the path length (l):

$$\alpha \propto C \cdot l$$

Given:

$$\alpha_1 = 20^\circ, C_1 = 5\%, l_1 = 8 \text{ cm}, \alpha_2 = 35^\circ, C_2 = 10\%$$

Using proportionality:

$$\frac{\alpha_1}{\alpha_2} = \frac{C_2 \cdot l_2}{C_1 \cdot l_1}$$

Substitute the values:

$$\begin{aligned}\frac{20}{35} &= \frac{10 \cdot l_2}{5 \cdot 8} \\ \frac{4}{7} &= \frac{2 \cdot l_2}{8} \\ l_2 &= \frac{4 \cdot 8}{7 \cdot 2} = 7 \text{ cm}\end{aligned}$$

 Quick Tip

Use the direct proportionality between optical rotation, concentration, and path length to solve such problems.

41. Choose the correct statements for the photoelectric effect:

- (A) The number of photoelectrons emitted is proportional to light intensity.
- (B) The velocity of photoelectrons is proportional to the frequency of light.
- (C) The photoelectric effect is an instantaneous process.
- (D) The stopping potential is independent of the incident frequency.

Choose the **correct** answer from the options given below:

- (A) (A), (B), and (D) only.
- (B) (A), (B), and (C) only.
- (C) (A), (B), (C), and (D).
- (D) (B), (C), and (D) only.

Correct Answer: (B) (A), (B), and (C) only.

- Solution:** 1. The number of photoelectrons emitted is proportional to the light intensity because higher intensity provides more photons to release electrons.
2. The velocity of photoelectrons depends on the frequency of light, as the energy of photoelectrons is given by $E = hf - \phi$.
3. The photoelectric effect is an instantaneous process as the emission of photoelectrons occurs without any delay when sufficient energy is provided.
4. The stopping potential depends on the frequency of the incident light, so statement (D) is incorrect.

 Quick Tip

For the photoelectric effect, remember: intensity influences the number of photoelectrons, while frequency impacts their velocity.

42. According to the uncertainty relation, the minimum uncertainty in the velocity of an electron orbiting around the nucleus in an orbit of radius r is:

- (A) $\frac{h}{2\pi mr}$
- (B) $\frac{h}{2mr}$
- (C) $2mr$
- (D) 0

Correct Answer: (A)

Solution:

Using the Heisenberg uncertainty principle, $\Delta p \cdot \Delta x \geq \frac{\hbar}{2}$, we calculate the uncertainty in velocity for an electron in orbit, leading to the given answer.

 Quick Tip

The relationship $\hbar = \frac{h}{2\pi}$ for conversions.

43. In a reversible process, the entropy of the system:

- (A) increases
- (B) decreases
- (C) remains constant
- (D) remains zero

Correct Answer: (C) remains constant

Solution:

For a reversible process, entropy changes are zero as there is no net entropy production in the

system. The entropy remains constant.

💡 Quick Tip

Reversible processes are idealized and involve no dissipation.

44. The relative permittivity of distilled water is 81. Calculate the velocity of light in it.

- (A) 2.0×10^7 m/s
- (B) 2.8×10^7 m/s
- (C) 3.3×10^7 m/s
- (D) 3.0×10^8 m/s

Correct Answer: (C)

Solution:

Using the formula $v = \frac{c}{\sqrt{\epsilon_r}}$, where c is the speed of light in a vacuum and ϵ_r is the relative permittivity:

$$v = \frac{3.0 \times 10^8}{\sqrt{81}} = 3.3 \times 10^7 \text{ m/s.}$$

💡 Quick Tip

$v = \frac{c}{\sqrt{\epsilon_r}}$ for speed in dielectric media.

45. Copper crystal belongs to:

- (A) bcc structure
- (B) close packed fcc structure
- (C) close packed hexagonal structure
- (D) face centred tetragonal structure

Correct Answer: (B) close packed fcc structure

Solution:

Copper crystallizes in a face-centered cubic (fcc) structure due to its high atomic packing factor, making it stable and dense. This type of structure ensures efficient atomic arrangement and provides optimal mechanical and thermal properties.

 Quick Tip

Metals with high ductility and thermal conductivity often exhibit an fcc structure.

46. Dielectric materials are mainly:

- (A) insulating
- (B) conducting
- (C) semiconducting
- (D) ferroelectric

Correct Answer: (A) insulating

Solution:

Dielectric materials are poor conductors of electricity but can store electrical energy when placed in an electric field. They are primarily used as insulators in capacitors, transformers, and other electronic devices.

 Quick Tip

Dielectric materials have high resistivity and a large breakdown voltage, making them ideal for insulation.

47. The resistivity of a metal

- (A) increases linearly with T at high temperatures
- (B) decreases linearly with T at high temperatures
- (C) is proportional to T^3 at high temperatures
- (D) is proportional to $T^{1/3}$ at high temperatures

Correct Answer: (A) increases linearly with T at high temperatures

Solution:

As temperature increases, the lattice vibrations in metals intensify, causing more frequent collisions of conduction electrons with lattice ions. This results in a linear increase in resistivity with temperature at high ranges.

 Quick Tip

Resistivity of metals is dominated by temperature-dependent lattice vibrations.

48. The resistivity of a sample semiconductor is 9 milli-ohm-metre. Its holes have mobility of $0.03 \text{ m}^2/\text{V} \cdot \text{s}$. The Hall coefficient is:

- (A) $1.7 \times 10^{-4} m^3/C$
- (B) $2.7 \times 10^{-4} m^3/C$
- (C) $3.4 \times 10^{-4} m^3/C$
- (D) $4.9 \times 10^{-4} m^3/C$

Correct Answer: (B)

Solution:

The Hall coefficient (R_H) is calculated using the formula:

$$R_H = \frac{\mu \cdot \rho}{1}$$

where $\mu = 0.03 m^2/V \cdot s$ and $\rho = 9 \times 10^{-3} \Omega \cdot m$.

Substituting:

$$R_H = 0.03 \cdot 9 \times 10^{-3} = 2.7 \times 10^{-4} m^3/C$$

💡 Quick Tip

The Hall coefficient is directly proportional to the mobility and resistivity of the material.

49.. Cooper pair is a system of two electrons bound by exchange of:

- (A) phonon between them
- (B) photon between them
- (C) proton between them
- (D) neutron between them

Correct Answer: (A) phonon between them

Solution:

In the BCS theory of superconductivity, Cooper pairs are formed when electrons interact with the crystal lattice through the exchange of phonons (quantized lattice vibrations). This interaction causes an attractive force that overcomes the natural repulsion between electrons.

💡 Quick Tip

Phonons play a key role in binding electrons into Cooper pairs, crucial for understanding superconductivity.

50. The diamagnetic susceptibility of a diamagnetic material is:

- (A) small and negative
- (B) small and positive
- (C) large and negative
- (D) large and positive

Correct Answer: (A)small and negative

Solution:

Diamagnetic materials have no unpaired electrons, and their magnetic susceptibility (χ) is always negative and small. This is because they slightly oppose the applied magnetic field due to the induced current loops within the material.

💡 Quick Tip

Diamagnetic materials always exhibit a small negative susceptibility regardless of the temperature.

51. Out of all the 20 standard amino acids, which one of the following amino acids does not have any asymmetric carbon atom?

- (A) Lysine
- (B) Glycine
- (C) Alanine
- (D) Tyrosine

Correct Answer: (B) Glycine

Solution:

Glycine is the simplest amino acid with the formula $\text{NH}_2\text{-CH}_2\text{-COOH}$. Its alpha carbon is bonded to two hydrogen atoms, making it symmetric and thus not chiral. In contrast, all other amino acids except glycine have at least one asymmetric (chiral) carbon atom.

💡 Quick Tip

Glycine's lack of a chiral center makes it the only achiral standard amino acid.

52: A sample of purified DNA contains 20 mole percentage of Cytosine (C). If only the four major bases are present i.e., A, T, G, and C, then the mole percentage of Purine residues in the DNA sample is:

- (A) 40%
- (B) 60%
- (C) 30%
- (D) 20%

Correct Answer: (C) 30%

Solution:

DNA bases include two purines (Adenine, A and Guanine, G) and two pyrimidines (Cytosine, C and Thymine, T). Given Cytosine is 20%, Thymine must also be 20% to maintain base pairing. Thus, purines (A and G) together make up the remaining 60% (equally divided). Therefore, the total mole percentage of purine residues (A + G) is 30%.

 Quick Tip

DNA base pairing ensures $\%A + \%G = \%T + \%C$ in a sample.

53: Match List-I with List-II:

List I (Enzymes)	List II (Function/Role)
A. Hydrolases	IV. Cleavage of bonds by adding water
B. Isomerases	III. Catalyze intramolecular arrangements and produces isomeric forms
C. Oxidoreductases	II. Catalyze oxidation-reduction reactions
D. Transferases	I. Transfer of groups from one molecule to another

Choose the **correct** answer from the options given below:

- (A) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)
(B) (A) - (IV), (B) - (III), (C) - (II), (D) - (I)
(C) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)
(D) (A) - (IV), (B) - (II), (C) - (I), (D) - (III)

Correct Answer: (B) (A) - (IV), (B) - (III), (C) - (II), (D) - (I)

Solution:

- Hydrolases (A) catalyze the cleavage of bonds by adding water (IV).
- Isomerases (B) catalyze intramolecular arrangements to produce isomers (III).
- Oxidoreductases (C) catalyze oxidation-reduction reactions (II).
- Transferases (D) transfer functional groups between molecules (I).

 Quick Tip

Enzyme classification is based on the type of reaction they catalyze. Memorize key examples for better recall.

54: In Citric acid cycle, how many steps are involved in Oxidation-Reduction?

- (A) Two
(B) One
(C) Five
(D) Four

Correct Answer: (D) Four

Solution:

The Citric acid cycle, also known as the Krebs cycle, involves four oxidation-reduction steps:

1. Isocitrate is oxidized to alpha-ketoglutarate.
2. Alpha-ketoglutarate is oxidized to succinyl-CoA.
3. Succinate is oxidized to fumarate.
4. Malate is oxidized to oxaloacetate.

Each of these steps produces reduced cofactors such as NADH or FADH₂, which are critical for ATP production during oxidative phosphorylation.

 Quick Tip

The intermediates of the Krebs cycle and their associated enzymes for quick recall in exams.

55: Blood performs which of the following functions?

- (A) Transportation of gases, nutrients, hormones, and wastes.
- (B) Protection against blood loss by clotting.
- (C) Regulation of pH, body temperature, and water content of cells.
- (D) Protection against diseases through phagocytic activity with cells and antibodies.

Choose the **correct answer** from the options given below:

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

Correct Answer: (3) (A), (B), (C) only

Solution:

Blood performs multiple essential functions in the body:

1. **Transportation:** It carries oxygen, nutrients, hormones, and metabolic waste products.
2. **Protection:** Blood clots to prevent excessive blood loss and fights infections through immune responses.
3. **Regulation:** It helps in maintaining pH balance, body temperature, and water content of cells.

Thus, all options (A), (B), (C) only are correct.

 Quick Tip

The acronym **TPR** (Transportation, Protection, Regulation) to recall the major functions of blood.

56: Phospholipids derived from sphingosine are known as:

- (A) Glycolipids
- (B) Sphingophospholipids
- (C) Lipoproteins
- (D) Glycerophospholipids

Correct Answer: (B) Sphingophospholipids

Solution:

Sphingophospholipids are a class of phospholipids that incorporate sphingosine as a backbone. These lipids play an essential role in cell membrane structure and signaling pathways.

 Quick Tip

Sphingosine-based lipids primarily form the backbone of sphingophospholipids, crucial for nerve cell membranes.

57: The plasma membrane of human RBC has:

- (A) 45% Lipid and 47% Protein
- (B) 43% Lipid and 49% Protein
- (C) 40% Lipid and 52% Protein
- (D) 35% Lipid and 57% Protein

Correct Answer: (B) 43% Lipid and 49% Protein

Solution:

The plasma membrane of human red blood cells contains a composition of approximately 43% lipids and 49% proteins. This composition allows the membrane to maintain flexibility and stability while facilitating transport functions.

 Quick Tip

Red blood cell membranes have more protein than lipids to support oxygen exchange and structural integrity.

58: Given below are two statements, one is labelled as Assertion (A) and the other as Reason (R).

Assertion (A): The overall size of prokaryotic and eukaryotic ribosomes are 70 S and 80 S, respectively.

Reason (R): The small subunit of prokaryotic and eukaryotic ribosomes are 30 S and 40 S, respectively. The large subunit of prokaryotic and eukaryotic ribosomes are 50 S and 60 S, respectively.

In light of the above statements, choose the **correct** answer from the options given below:

- (A) Both (A) and (R) are true, and (R) is the correct explanation of (A).
- (B) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
- (C) (A) is true, but (R) is false.
- (D) (A) is false, but (R) is true.

Correct Answer: (A) Both (A) and (R) are true, and (R) is the correct explanation of (A).

Solution:

Ribosomes in prokaryotes and eukaryotes differ in their sedimentation coefficients. Prokaryotic ribosomes are 70 S (with 50 S large and 30 S small subunits), and eukaryotic ribosomes are 80

S (with 60 S large and 40 S small subunits). The reason correctly explains the assertion.

💡 Quick Tip

The sedimentation coefficient (S) is not additive due to the shape and density of ribosomal subunits.

59: Match List-I with List-II

List-I (Phases)	List-II (Features)
A. Metaphase	III. Chromosomes get aligned along metaphase plate through spindle fibres
B. Anaphase	I. Splitting of centromeres, separation of chromatids, they move opposite poles
C. Telophase	IV. Nuclear envelope assembles around the chromosomes
D. Cytokinesis	II. Formation of furrow/cell plate and division of cytoplasm into two

Choose the **correct** answer from the options given below:

(A) (A) - (I), (B) - (III), (C) - (II), (D) - (IV)

(B) (A) - (III), (B) - (I), (C) - (IV), (D) - (II)

(C) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

(D) (A) - (IV), (B) - (I), (C) - (III), (D) - (II)

Correct Answer: (C) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Solution:

The phases of cell division are characterized by specific events: - **Metaphase:** Chromosomes align along the metaphase plate through spindle fibres. - **Anaphase:** Centromeres split, and chromatids move toward opposite poles. - **Telophase:** Nuclear envelope reassembles around chromosomes. - **Cytokinesis:** The cytoplasm divides into two cells via a furrow or cell plate.

💡 Quick Tip

Memorize the sequence and key events of mitotic phases for quick identification.

60: Formation of Chiasmata occurs at which stage of Prophase I in Meiosis I?

(A) Leptotene

(B) Pachytene

(C) Zygotene

(D) Diplotene

Correct Answer: (D) Diplotene

Solution:

Chiasmata formation, which represents the physical manifestation of crossing over between homologous chromosomes, occurs during the Diplotene stage of Prophase I in Meiosis I. During this stage, the homologous chromosomes begin to separate, but remain connected at the points of crossing over, termed chiasmata.

💡 Quick Tip

The sequence of Prophase I stages as Leptotene, Zygotene, Pachytene, Diplotene, and Diakinesis, and associate key events with each.

61. From the following, identify the statements which are true for a tumor suppressor gene, p53:

- (A) It encodes 53 kDa protein.
- (B) It is located on chromosome no. 17.
- (C) It is known as guardian of genome.
- (D) It checks progression of cell cycle in G_1 phase.

Choose the correct answer from the options given below:

- (A) (A), (B), and (D) only.
- (B) (A), (B), and (C) only.
- (C) (A), (B), (C), and (D).
- (D) (B), (C), and (D) only.

Correct Answer: (C) (A), (B), (C), and (D)

Solution:

The p53 gene encodes a 53 kDa protein that functions as a tumor suppressor. It is located on chromosome 17 and plays a critical role in regulating cell cycle progression at the G_1 phase. It is often referred to as the "guardian of the genome" for its role in preventing genomic instability and maintaining the integrity of DNA.

💡 Quick Tip

The mnemonic "p53 = Protector of 53 kDa genome," highlighting its role in regulating the cell cycle and genomic stability.

62. If pH of a solution HA, which dissociates into $H^+ + A^-$, equals the pK_a , then

- (A) The concentration of the acid form of compound $[HA]$ equals the concentration of dissociated form of the compound $[A^-]$.
- (B) The solution has higher capacity for buffering than at any other pH.
- (C) The pH of a solution is 7.
- (D) The hydrogen ion concentration is equal to dissociated of the acid HA into $H^+ + A^-$.

Which of the above statements are correct?

- (A) (A), (B), and (D) only.
- (B) (A), (B), and (C) only.

(C) (A), (B), (C), and (D).

(D) (B), (C), and (D) only.

Correct Answer: (A) (A), (B), and (D) only

Solution:

When the pH of a solution equals the pK_a , the concentrations of $[HA]$ and $[A^-]$ are equal, indicating the solution is at its maximum buffering capacity. The pH may not necessarily be 7 as it depends on the acid dissociation constant K_a . Statement (D) is true since $[H^+]$ equals the dissociated form of HA .

 Quick Tip

The rule of thumb for buffers is: $pH = pK_a$ means equal concentrations of weak acid and its conjugate base.

63. Match List-I with List-II:

List-I	Endocrine Glands	List-II Hormones
A	Adrenal Cortex	I. T_3 and T_4
B	Ovaries	II. Testosterone
C	Thyroid Gland	III. Aldosterone
D	Testes	IV. Progesterone

Choose the correct answer from the options given below:

(A) (A) - (I), (B) - (II), (C) - (III), (D) - (IV).

(B) (A) - (III), (B) - (IV), (C) - (I), (D) - (II).

(C) (A) - (I), (B) - (III), (C) - (IV), (D) - (II).

(D) (A) - (III), (B) - (I), (C) - (IV), (D) - (II).

Correct Answer: (B) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Solution:

- The adrenal cortex primarily secretes aldosterone (III), which regulates sodium and potassium levels.
- The ovaries produce progesterone (IV), a hormone critical for maintaining pregnancy.
- The thyroid gland secretes T_3 and T_4 (I), which regulate metabolic processes.
- The testes produce testosterone (II), responsible for male secondary sexual characteristics.

 Quick Tip

The glands and their associated hormones using mnemonics like "ATP" for Adrenal-Aldosterone, Thyroid- T_3/T_4 , and Progesterone-Ovaries.

64.

Statement (I): DNA Polymerase activity is involved in the proofreading activity during DNA replication.

Statement (II): 5' to 3' exonuclease activity is involved in the proofreading activity during DNA replication.

- (A) Both Statement (I) and Statement (II) are true.
- (B) Both Statement (I) and Statement (II) are false.
- (C) Statement (I) is true but Statement (II) is false.
- (D) Statement (I) is false but Statement (II) is true.

Correct Answer: (C) Statement (I) is true but Statement (II) is false.

Solution:

DNA Polymerase activity is responsible for proofreading during DNA replication, specifically correcting mismatches via 3' to 5' exonuclease activity. The mentioned 5' to 3' exonuclease activity is not involved in proofreading; instead, it is used for primer removal and strand replacement in certain polymerases.

 Quick Tip

Proofreading occurs via 3' to 5' exonuclease activity, ensuring high fidelity in DNA replication.

65. Telomerase is:

- (A) Involved in replication of linear double-stranded DNA.
- (B) Species-specific.
- (C) A ribonucleoprotein.
- (D) Present in somatic cells.

Choose the correct answer from the options given below:

- (A) (A), (B), and (D) only.
- (B) (A), (B), and (C) only.
- (C) (A), (B), (C), and (D).
- (D) (B), (C), and (D) only.

Correct Answer: (B) (A), (B), and (C) only.

Solution:

Telomerase is essential for the replication of linear chromosomes, preventing the shortening of telomeres during cell division. It is species-specific, and as a ribonucleoprotein enzyme, it uses

its RNA component as a template for adding telomeric sequences. However, telomerase is not commonly present in somatic cells, except in cases like cancer cells or stem cells.

💡 Quick Tip

Link telomerase function with telomere length maintenance and its role in aging and cancer biology.

66. In *E. coli*, during mismatch repair, the parental strand is identified by:

- (A) Glycosylated adenines.
- (B) Methylated adenines.
- (C) Single-stranded breaks.
- (D) Methylation of guanine at the 6th position.

Correct Answer: (B) Methylated adenines.

Solution:

During mismatch repair in *E. coli*, the parental DNA strand is identified by the presence of methylated adenines. The Dam methylase enzyme methylates the adenine residues in the sequence GATC on the parental strand. The newly synthesized strand remains temporarily unmethylated, allowing the mismatch repair machinery to distinguish between the parental and the daughter strands.

💡 Quick Tip

E. coli, GATC methylation is the key to distinguishing the strands during mismatch repair.

67. Assertion-Reason on tRNA Processing

Assertion (A): During pre-tRNA processing, addition of a poly-A tail takes place.

Reason (R): Addition of a CCA sequence at the 3' end takes place during pre-tRNA processing.

In light of the above statements, choose the **correct answer** from the options given below:

- (A) Both (A) and (R) are true and (R) is the correct explanation of (A).
- (B) Both (A) and (R) are true but (R) is NOT the correct explanation of (A).
- (C) (A) is true but (R) is false.
- (D) (A) is false but (R) is true.

Correct Answer: (D) (A) is false but (R) is true.

Solution:

During pre-tRNA processing, a poly-A tail is **not** added. The poly-A tail addition is specific to mRNA. However, the CCA sequence is indeed added at the 3' end during tRNA maturation, as this sequence is necessary for amino acid attachment.

💡 Quick Tip

CCA addition is unique to tRNA, while the poly-A tail is specific to mRNA.

68. Shine Dalgarno sequence is involved in

- (A) Binding of DNA polymerase to ori during DNA replication.
- (B) Binding of RNA polymerase during transcription.
- (C) Binding of Snurps during splicing.
- (D) Binding of ribosomes to mRNA during translation initiation.

Correct Answer: (D) Binding of ribosomes to mRNA during translation initiation.

Solution: The Shine Dalgarno sequence is a ribosomal binding site in bacterial mRNA. It helps the ribosome align the mRNA properly for translation initiation. It is typically located upstream of the start codon.

Quick Tip

The Shine Dalgarno sequence is specific to prokaryotic mRNA and is absent in eukaryotes.

69. The clot consists of

- (A) Blood.
- (B) Network of insoluble protein fibers.
- (C) Serum.
- (D) Platelets.

Correct Answer: (B) Network of insoluble protein fibers.

Solution: Clots are formed during the coagulation process and are primarily made up of fibrin, an insoluble protein fiber network. This structure traps blood cells, effectively sealing wounds.

Quick Tip

Think of fibrin as the "glue" holding the clot structure together.

70. Given below are two statements, one is labelled as Assertion (A) and other one labelled as Reason (R).

Assertion (A): The first heart sound 'lub' is heard when ventricles contract at systole, and the second heart sound 'dup' is heard when ventricles relax at the beginning of diastole.

Reason (R): The 'lub' sound is associated with closure of AV valves, and the 'dup' sound is associated with closure of semilunar valves.

In light of the above statements, choose the *most appropriate answer* from the options given below.

- (A) Both (A) and (R) are correct and (R) is the correct explanation of (A).
- (B) Both (A) and (R) are correct but (R) is NOT the correct explanation of (A).
- (C) (A) is correct but (R) is not correct.
- (D) (A) is not correct but (R) is correct.

Correct Answer: (A) Both (A) and (R) are correct and (R) is the correct explanation of (A).

Solution: The first heart sound 'lub' is caused by the closure of atrioventricular (AV) valves during ventricular contraction (systole). The second heart sound 'dup' is caused by the closure of semilunar valves during ventricular relaxation (diastole). Thus, both the assertion and the reason are correct, and the reason explains the assertion.

Quick Tip

'Lub' = AV valve closure during systole. 'Dup' = Semilunar valve closure during diastole.

71. Match List-I with List-II

List-I (Disease)	List-II (Causative Agents)
A. Syphilis	I. Mycobacterium tuberculosis
B. Tuberculosis	II. Treponema pallidum
C. AIDS	III. Bordetella pertussis
D. Whooping Cough	IV. Human Immunodeficiency Virus

Choose the correct answer from the options given below:

- (A) (A) (I), (B) - (II), (C) - (III), (D) - (IV)
- (B) (A) (III), (B) - (I), (C) - (IV), (D) - (II)
- (C) (A) (I), (B) - (III), (C) - (IV), (D) - (II)
- (D) (A) (III), (B) - (IV), (C) - (I), (D) - (II)

Correct Answer: (D)(A) (III), (B) - (IV), (C) - (I), (D) - (II)

Solution: Syphilis is caused by *Bordetella pertussis* ,
Tuberculosis by Human Immunodeficiency Virus,
AIDS by Mycobacterium tuberculosis,
and Whooping Cough by Treponema pallidum.

Quick Tip

Causative agents by associating the disease with its unique symptoms or key features for easy memorization.

72. Methylcytosines are common sites for the mutations as

- (A) They can mispair with Adenine.
- (B) They can deaminate to Uracil.
- (C) They can pair with Uracil.
- (D) They can deaminate to Thymidine.

Correct Answer: (D) They can deaminate to Thymidine.

Solution:

Methylcytosines often undergo deamination, converting into thymine rather than uracil. This type of mutation can lead to point mutations, significantly impacting genetic sequences.

Quick Tip

Methylcytosines deaminate to thymidine, leading to common point mutations. Memorize this for understanding DNA mutation patterns.

73: Match List-I with List-II

List-I (Concept)	List-II (Example)
A. Incomplete Dominance	I. Skin colour in Human beings
B. Complementary Genes	II. AB blood group in Human beings
C. Polygenes	III. Pink Flower in 4 o'clock plant
D. Co dominance	IV. Purple color in maize

Choose the correct answer from the options given below:

- (A) (A)- (I), (B) - (II), (C) - (III), (D) - (IV)
- (B) (A)- (IV), (B) - (III), (C) - (II), (D) - (I)
- (C) (A)- (III), (B) - (IV), (C) - (I), (D) - (II)
- (D) (A)- (III), (B) - (IV), (C) - (II), (D) - (I)

Correct Answer: (D) (A) - (III), (B) - (IV), (C) - (II), (D) - (I)

Solution: Incomplete dominance is exemplified by Pink flowers in 4 o'clock plants,
Complementary genes by Purple color in maize,
Polygenes by AB blood group ,
and Co-dominance by Skin color in humans.

Quick Tip

Matching List questions can be answered easily by connecting the scientific concept to real-life examples.

74. Given below are two statements:

Statement (I): Innate immune response is antigen non-specific, and rapid.

Statement (II): Adaptive immune response is antigen specific, and rapid.

In light of the above statements, choose the **most appropriate** answer from the options given below.

- (A) Both Statement (I) and Statement (II) are true.
- (B) Both Statement (I) and Statement (II) are false.
- (C) Statement (I) is true but Statement (II) is false.
- (D) Statement (I) is false but Statement (II) is true.

Correct Answer: (C)

Explanation: The innate immune response is non-specific and rapid, whereas the adaptive immune response is specific but slower, requiring time to develop against a particular antigen. Hence, Statement (I) is true, but Statement (II) is false.

Quick Tip

Innate immunity acts as the body's first line of defense and is non-specific. Adaptive immunity takes longer to respond but is highly specific to the antigen.

75. The smallest unit of antigen that has capacity to bind with antibodies is known as

- (A) Paratope.
- (B) Epitope.
- (C) Monotope.
- (D) Hapten.

Correct Answer: (B) Epitope.

Solution:

The epitope is the specific part of an antigen recognized and bound by antibodies. It is the

smallest functional unit in antigen-antibody interactions.

Quick Tip
Epitope = Antigen's binding site; Paratope = Antibody's binding site.