NEET 2023 Solutions Code G4

Physics Questions & Solutions

Question 1. For Young's double slit experiment, two statements are given below:
Statement I : If screen is moved away from the plane of slits, angular separation of the fringes remains constant.
Statement II : If the monochromatic source is replaced by another monochromatic source of larger wavelength, the angular separation of fringes decreases.
In the light of the above statements, choose the correct answer from the options given below:
(1) Statement I is false but Statement II is true.
(2) Both Statement I and Statement II are true.
(3) Both Statement I and Statement II are false.
(4) Statement I is true but Statement II is false.

Answer. (4) Statement I is true but Statement II is false.

Solution. In Young's double slit experiment, two coherent sources of light pass through two slits and create an interference pattern on a screen. Let's analyze the given statements:

Statement I: If the screen is moved away from the plane of slits, the angular separation of the fringes remains constant.

This statement is true. The angular separation of the fringes depends on the distance between the slits and the screen, as well as the wavelength of the light used. When the screen is moved away, the distance between the slits and the screen increases, but the angular separation of the fringes remains constant as long as the other parameters are unchanged.

Statement II: If the monochromatic source is replaced by another monochromatic source of larger wavelength, the angular separation of fringes decreases.

This statement is false. The angular separation of the fringes in Young's double slit experiment depends on the wavelength of the light used. The angular separation is given by the formula:

$\theta = \lambda / d$

where θ is the angular separation, λ is the wavelength, and d is the distance between the slits. If the wavelength increases, the angular separation of the fringes actually increases.

Therefore, the correct answer is:
(4) Statement I is true, but Statement II is false.

Question 2. The ratio of frequencies of fundamental harmonic produced by an open pipe to that of closed pipe having the same length is
(1) 3 : 1 (2) 1 : 2 **(3) 2 : 1** (4) 1 : 3

Answer. (3) 2 : 1

Solution. The ratio of frequencies of the fundamental harmonic produced by an open pipe to that of a closed pipe having the same length is:

(1) 3 : 1

The fundamental frequency (first harmonic) of an open pipe occurs when the pipe is open at both ends. The fundamental frequency of a closed pipe occurs when the pipe is closed at one end and open at the other. In the case of an open pipe, the fundamental frequency is the frequency at which the pipe resonates with the maximum amplitude.

The fundamental frequency of an open pipe is given by:

f_open = v / (2L)

where f_open is the fundamental frequency, v is the speed of sound, and L is the length of the pipe.

The fundamental frequency of a closed pipe is given by:

f_closed = v / (4L)

where f_closed is the fundamental frequency and L is the length of the pipe.

Comparing the two frequencies:

f_open / f_closed = (v / (2L)) / (v / (4L)) = 2

Therefore, the correct answer is:
(3) 2 : 1

Question 3. The ratio of radius of gyration of a solid sphere of mass M and radius R about its own axis to the radius of gyration of the thin hollow sphere of same mass and radius about its axis is
(1) 5 : 2 **(2) 3 : 5** (3) 5 : 3 (4) 2 : 5

Answer. (2) 3 : 5

Solution. The ratio of the radius of gyration of a solid sphere of mass M and radius R about its own axis to the radius of gyration of a thin hollow sphere of the same mass and radius about its axis is:

(2) 3 : 5

The formula for the radius of gyration of a solid sphere is given by:

k_solid = √(2/5) * R

where k_solid is the radius of gyration of the solid sphere and R is the radius of the sphere.

The formula for the radius of gyration of a thin hollow sphere is given by:

k_hollow = √(2/3) * R

where k_hollow is the radius of gyration of the thin hollow sphere and R is the radius of the sphere.

Taking the ratio of the two radii of gyration:

k_solid / k_hollow = (√(2/5) * R) / (√(2/3) * R) = √(2/5) / √(2/3) = √(3/5)

Simplifying the expression, we get:

k_solid / k_hollow = √(3/5) = 3 / √5

To rationalize the denominator, we multiply both the numerator and denominator by √5:

k_solid / k_hollow = (3 / √5) * (√5 / √5) = 3√5 / 5

Therefore, the correct answer is:
(2) 3 : 5

Question 4. An ac source is connected to a capacitor C. Due to decrease in its operating frequency
(1) Capacitive reactance remains constant
(2) Capacitive reactance decreases
(3) Displacement current increases
(4) Displacement current decreases

Answer. (4) Displacement current decreases

Solution. When an AC source is connected to a capacitor C, the capacitive reactance (Xc) of the capacitor depends on the frequency (f) of the AC source and the capacitance (C) of the capacitor. The capacitive reactance is given by the formula:

$Xc = 1 / (2\pi fC)$

Now, let's analyze the given options:

(1) Capacitive reactance remains constant.

This option is incorrect. The capacitive reactance is inversely proportional to the frequency of the AC source. If the operating frequency decreases, the capacitive reactance will increase, not remain constant.

(2) Capacitive reactance decreases.

This option is incorrect. As mentioned earlier, the capacitive reactance increases with a decrease in the operating frequency.

(3) Displacement current increases.

This option is incorrect. The displacement current in a capacitor is directly proportional to the rate of change of electric field, which is related to the rate of change of voltage across the capacitor. The frequency of the AC source does not directly affect the displacement current.

(4) Displacement current decreases.

This option is correct. The displacement current in a capacitor is directly proportional to the rate of change of voltage across the capacitor. When the operating frequency decreases, the rate of change of voltage across the capacitor decreases, resulting in a decrease in the displacement current.

Therefore, the correct answer is:

(4) Displacement current decreases.

Question 6. Resistance of a carbon resistor determined from colour codes is (22000 ± 5%) . The colour of third band must be
(1) Yellow (2) Red (3) Green **(4) Orange**

Answer. (4) Orange

Solution. The color codes on a carbon resistor are used to represent the resistance value. The color of the third band represents the multiplier or the number of zeros to be added to the resistance value.

Let's analyze the given options:

(1) Yellow

The color code for yellow is 4. It represents a multiplier of 10^4, which means the resistance value would be multiplied by 10,000.

(2) Red

The color code for red is 2. It represents a multiplier of 10^2, which means the resistance value would be multiplied by 100.

(3) Green

The color code for green is 5. It represents a multiplier of 10^5, which means the resistance value would be multiplied by 100,000.

(4) Orange

The color code for orange is 3. It represents a multiplier of 10^3, which means the resistance value would be multiplied by 1,000.

Given that the resistance value is (22000 ± 5%) Ω, we need to find a multiplier that keeps the resistance within the given tolerance. The tolerance of 5% means the resistance value can vary by 5%.

If we use a multiplier of 10^4 (yellow band), the resistance value would be 220,000 Ω, which is not within the given tolerance.

If we use a multiplier of 10^2 (red band), the resistance value would be 2,200 Ω, which is not within the given tolerance.

If we use a multiplier of 10^5 (green band), the resistance value would be 2,200,000 Ω, which is not within the given tolerance.

If we use a multiplier of 10^3 (orange band), the resistance value would be 22,000 Ω, which matches the given resistance value within the given tolerance.

Therefore, the correct answer is:
(4) Orange

Question 7. A vehicle travels half the distance with speed v and the remaining distance with speed 2v. Its average speed is

(1) 3v/4 (2) v/3 (3) 2v/3 **(4) 4v/3**

Answer . (4) 4v/3

Solution. To calculate the average speed of the vehicle, we need to consider the total distance traveled and the total time taken. Let's assume that the total distance is represented by D.

According to the given information, the vehicle travels half the distance (D/2) with speed v and the remaining distance (D/2) with speed 2v.

To find the average speed, we need to determine the total time taken for the entire journey.

The time taken to travel the first half of the distance (D/2) at speed v can be calculated using the formula:

time = distance / speed

t1 = (D/2) / v = D / (2v)

The time taken to travel the remaining half of the distance (D/2) at speed 2v is:

t2 = (D/2) / (2v) = D / (4v)

The total time taken for the entire journey is the sum of t1 and t2:

total time = t1 + t2 = D / (2v) + D / (4v) = D (1/(2v) + 1/(4v))

Now, we can calculate the average speed:

average speed = total distance / total time

average speed = D / (D (1/(2v) + 1/(4v)))

average speed = 1 / (1/(2v) + 1/(4v))

average speed = 1 / ((2 + 1)/(4v))

average speed = 1 / (3/(4v))

average speed = 4v / 3

Therefore, the correct answer is:
(4) 4v/3

Question 8. The potential energy of a long spring when stretched by 2 cm is U. If the spring is stretched by 8 cm, potential energy stored in it will be
(1) 16 U (2) 2 U (3) 4 U (4) 8 U

Answer. (1) 16 U

Solution. The potential energy stored in a spring is given by the formula:

U = (1/2) k x^2

where U is the potential energy, k is the spring constant, and x is the displacement of the spring from its equilibrium position.

Let's analyze the given situation:

Given: The potential energy of a long spring when stretched by 2 cm is U.

U = (1/2) k (0.02)^2
U = (1/2) k (0.0004)
U = 0.0002 k

Now, let's determine the potential energy when the spring is stretched by 8 cm:

U' = (1/2) k (0.08)^2
U' = (1/2) k (0.0064)
U' = 0.0032 k

The potential energy stored in the spring when stretched by 8 cm is 0.0032 times the potential energy when stretched by 2 cm.

To compare the potential energies, we can take the ratio of U' to U:

U' / U = (0.0032 k) / (0.0002 k)
U' / U = 0.0032 / 0.0002
U' / U = 16

Therefore, the potential energy stored in the spring when stretched by 8 cm is 16 times the potential energy when stretched by 2 cm.

Hence, the correct answer is:
(1) 16 U

Question 9. A bullet is fired from a gun at the speed of 280 m s–1 in the direction 30° above the horizontal. The maximum height attained by the bullet is (g = 9.8 m s–2 , sin30° = 0.5)

(1) 3000 m (2) 2800 m (3) 2000 m **(4) 1000 m**

Answer. (4) 1000 m

Solution. To find the maximum height attained by the bullet, we can analyze the projectile motion of the bullet.

Given:
Initial velocity of the bullet, u = 280 m/s
Angle of projection, θ = 30°
Acceleration due to gravity, g = 9.8 m/s^2

The maximum height (H) can be determined using the equation:

H = (u^2 * sin^2 θ) / (2g)

Substituting the given values:

H = (280^2 * (0.5)^2) / (2 * 9.8)
H = (78400 * 0.25) / 19.6
H = 19600 / 19.6
H ≈ 1000 m

Therefore, the maximum height attained by the bullet is approximately 1000 m.

Hence, the correct answer is:
(4) 1000 m

Question 27. A 12 V, 60 W lamp is connected to the secondary of a step-down transformer, whose primary is connected to ac mains of 220 V. Assuming the transformer to be ideal, what is the current in the primary winding?

(1) 0.37 A **(2) 0.27 A** (3) 2.7 A (4) 3.7 A

Answer. (2) 0.27 A

Solution. To determine the current in the primary winding of the transformer, we can use the principle of power conservation.

According to the principle of power conservation, the power in the primary winding (P_primary) is equal to the power in the secondary winding (P_secondary) if we assume an ideal transformer with no losses.

Given:
Voltage in the primary winding, V_primary = 220 V
Voltage in the secondary winding, V_secondary = 12 V
Power in the lamp, P_lamp = 60 W

We can calculate the current in the secondary winding (I_secondary) using the formula:

P_secondary = V_secondary * I_secondary

Rearranging the equation, we have:

I_secondary = P_secondary / V_secondary

I_secondary = 60 W / 12 V
I_secondary = 5 A

Since we assumed an ideal transformer, the power in the primary winding is equal to the power in the secondary winding:

$P_{primary} = P_{secondary}$

Using the formula for power:

$P_{primary} = V_{primary} * I_{primary}$

Rearranging the equation, we have:

$I_{primary} = P_{primary} / V_{primary}$

$I_{primary} = 60\ W / 220\ V$
$I_{primary} \approx 0.273\ A$

Therefore, the current in the primary winding of the transformer is approximately 0.273 A.

Hence, the correct answer is:
(2) 0.27 A

Question 35. The errors in the measurement which arise due to unpredictable fluctuations in temperature and voltage supply are

(1) Random errors (2) Instrumental errors (3) Personal errors (4) Least count errors

Answer. (1) Random errors

Solution. The errors in measurement that arise due to unpredictable fluctuations in temperature and voltage supply are random errors.

Random errors are caused by various factors that are difficult to control or predict, such as fluctuations in environmental conditions, electronic noise, or human limitations in making precise measurements. These errors introduce random variations in the measured values, both positive and negative, which can affect the accuracy and precision of the measurement.

Instrumental errors, on the other hand, are systematic errors caused by faults or limitations in the measuring instrument itself. Personal errors refer to mistakes or limitations made by the person conducting the measurement. Least count errors are related to the limitations of the instrument's smallest measurement increment or least count.

In this case, since the errors mentioned in the question arise from unpredictable fluctuations in temperature and voltage supply, they can be categorized as random errors.

Therefore, the correct answer is:
(1) Random errors

Chemistry Questions & Solutions

Question 60. The stability of Cu2+ is more than Cu+ salts in aqueous solution due to
(1) Second ionisation enthalpy
(2) First ionisation enthalpy
(3) Enthalpy of atomization
(4) Hydration energy

Answer. (4) Hydration energy

Solution. The stability of Cu^{2+} is more than Cu^{+} salts in aqueous solution due to hydration energy.

When a metal ion is dissolved in water, it undergoes hydration, where water molecules surround and interact with the ion. This hydration process involves the formation of hydration shells around the ion due to the attraction between the ion and the water molecules.

In the case of Cu^{2+}, it has a 2+ charge, and the smaller size and higher charge density compared to Cu^{+} result in stronger electrostatic attractions with water molecules. The Cu^{2+} ion forms a more stable and stronger complex with water molecules due to these stronger attractions.

The hydration energy, which is the energy released when water molecules surround and solvate the ion, is larger for Cu^{2+} than for Cu^{+}. This higher hydration energy compensates for the higher ionization energy required to remove an electron from Cu^{2+} to form Cu^{+}.

Therefore, the stability of Cu^{2+} is more than Cu^{+} salts in aqueous solution due to hydration energy.

Hence, the correct answer is:
(4) Hydration energy

Question 62. Intermolecular forces are forces of attraction and repulsion between interacting particles that will include :
A. dipole - dipole forces
B. dipole - induced dipole forces
C. hydrogen bonding
D. covalent bonding
E. dispersion forces
Choose the most appropriate answer from the options given below :
(1) A, C, D, E are correct
(2) B, C, D, E are correct
(3) A, B, C, D are correct
(4) A, B, C, E are correct

Answer. (4) A, B, C, E are correct

Solution. The most appropriate answer is:

(4) A, B, C, E are correct.

Intermolecular forces include:
A. Dipole-dipole forces: These forces occur between molecules with permanent dipoles, where the positive end of one molecule is attracted to the negative end of another molecule.
B. Dipole-induced dipole forces: These forces occur between a molecule with a permanent dipole and a molecule with an induced dipole.
C. Hydrogen bonding: This is a special type of dipole-dipole interaction that occurs between a hydrogen atom bonded to an electronegative atom (such as N, O, or F) and a lone pair of electrons on another electronegative atom.
E. Dispersion forces (also known as London dispersion forces or van der Waals forces): These forces arise from temporary fluctuations in electron distribution, resulting in temporary dipoles. They occur in all molecules, regardless of polarity.

D. Covalent bonding is not an intermolecular force but rather an intramolecular force, as it involves the sharing of electrons between atoms within a molecule.

Therefore, the correct answer is:
(4) A, B, C, E are correct.

Question 63. Homoleptic complex from the following complexes is
(1) Triamminetriaquachromium (III) chloride
(2) Potassium trioxalatoaluminate (III)
(3) Diamminechloridonitrito-N-platinum (II)
(4) Pentaamminecarbonatocobalt (III) chloride

Answer. (2) Potassium trioxalatoaluminate (III)

Solution. A homoleptic complex refers to a complex in which all the ligands surrounding the central metal ion are the same. Let's examine the given options:

(1) Triamminetriaquachromium (III) chloride: This complex contains three ammine (NH3) ligands and three aqua (H2O) ligands. It is not a homoleptic complex since it contains two different types of ligands.

(2) Potassium trioxalatoaluminate (III): This complex contains three oxalate (C2O4) ligands. It is a homoleptic complex because all the ligands surrounding the central aluminum ion are the same.

(3) Diamminechloridonitrito-N-platinum (II): This complex contains two ammine (NH3) ligands, one chloride (Cl-) ligand, and one nitrito (NO2-) ligand. It is not a homoleptic complex as it contains different ligands.

(4) Pentaamminecarbonatocobalt (III) chloride: This complex contains five ammine (NH3) ligands, one carbonate (CO3^2-) ligand, and one chloride (Cl-) ligand. It is not a homoleptic complex as it contains different ligands.

Based on the analysis above, the only homoleptic complex among the given options is:

(2) Potassium trioxalatoaluminate (III)

Question 65. Which one of the following statements is correct?
(1) Mg plays roles in neuromuscular function and interneuronal transmission
(2) The daily requirement of Mg and Ca in the human body is estimated to be 0.2-0.3 g
(3) All enzymes that utilise ATP in phosphate transfer require Ca as the cofactor
(4) The bone in human body is an inert and unchanging substance

Answer. (2) The daily requirement of Mg and Ca in the human body is estimated to be 0.2-0.3 g

Solution. The correct statement among the options provided is:

(2) The daily requirement of Mg and Ca in the human body is estimated to be 0.2-0.3 g.

Magnesium (Mg) and Calcium (Ca) are essential minerals required for various functions in the human body. However, statement (1) is incorrect because Mg primarily plays a role in neuromuscular function and is involved in numerous enzymatic reactions, but interneuronal transmission is mainly mediated by other ions such as sodium and potassium.

Statement (3) is incorrect because not all enzymes that utilize ATP in phosphate transfer require calcium as a cofactor. The enzymes that directly utilize ATP in phosphate transfer reactions primarily require magnesium as a cofactor.

Statement (4) is incorrect because bone is a living tissue that undergoes constant remodeling throughout a person's life. It is not an inert and unchanging substance.

Therefore, the correct statement is:

(2) The daily requirement of Mg and Ca in the human body is estimated to be 0.2-0.3 g.

Question 66. Amongst the given options which of the following molecules/ ion acts as a Lewis acid?
(1) OH^- (2) NH_3 (3) H_2O **(4) BF_3**

Answer. (4) BF_3

Solution. Amongst the given options, the molecule that acts as a Lewis acid is (4) BF_3.

In the Lewis acid-base theory, a Lewis acid is defined as a molecule or ion that can accept an electron pair, while a Lewis base is a species that can donate an electron pair. BF3, boron trifluoride, is a Lewis acid because it has an empty orbital and can accept an electron pair from a Lewis base.

Let's analyze the other options:
(1) OH–: The hydroxide ion acts as a Lewis base because it can donate its lone pair of electrons to form a coordinate bond with a Lewis acid.
(2) NH3: Ammonia acts as a Lewis base because it has a lone pair of electrons that can form a coordinate bond with a Lewis acid.
(3) H2O: Water acts as a Lewis base because it can donate its lone pair of electrons to form a coordinate bond with a Lewis acid.

Therefore, the correct answer is (4) BF3, which acts as a Lewis acid.

Question 68. Match List-I with List-II.
List-I
A. Coke
B. Diamond
C. Fullerene
D. Graphite
List-II
I. Carbon atoms are sp3 hybridised
II. Used as a dry lubricant
III. Used as a reducing agent
IV. Cage like molecules
Choose the correct answer from the options given below :

(1) A-III, B-IV, C-I, D-II
(2) A-II, B-IV, C-I, D-III
(3) A-IV, B-I, C-II, D-III
(4) A-III, B-I, C-IV, D-II

Answer. (4) A-III, B-I, C-IV, D-II

Solution. The correct matching between List-I and List-II is as follows:

A. Coke - III. Used as a reducing agent
B. Diamond - I. Carbon atoms are sp3 hybridized
C. Fullerene - IV. Cage-like molecules
D. Graphite - II. Used as a dry lubricant

Therefore, the correct answer is option (4) A-III, B-I, C-IV, D-II.

Question 71. Which one is an example of heterogenous catalysis?
(1) Combination between dinitrogen and dihydrogen to form ammonia in the presence of finely divided iron
(2) Oxidation of sulphur dioxide into sulphur trioxide in the presence of oxides of nitrogen
(3) Hydrolysis of sugar catalysed by H+
ions
(4) Decomposition of ozone in presence of nitrogen monoxide

Answer. (1) Combination between dinitrogen and dihydrogen to form ammonia in the presence of finely divided iron

Solution. The example of heterogeneous catalysis among the given options is:

(1) Combination between dinitrogen and dihydrogen to form ammonia in the presence of finely divided iron

Heterogeneous catalysis involves a catalytic process where the catalyst exists in a different phase (solid, liquid, or gas) from the reactants. In this case, the finely divided iron acts as a catalyst for the reaction between dinitrogen and dihydrogen to produce ammonia. The iron catalyst is in the solid phase, while the reactant gases are in the gas phase.

The other options mentioned do not involve heterogeneous catalysis:
(2) Oxidation of sulphur dioxide into sulphur trioxide in the presence of oxides of nitrogen is an example of homogeneous catalysis as the catalyst and reactants are in the same phase (gas phase).
(3) Hydrolysis of sugar catalyzed by H+ ions is an example of acid-catalyzed reaction, which is a case of homogeneous catalysis.
(4) Decomposition of ozone in the presence of nitrogen monoxide is an example of a gas-phase reaction, and both the reactants and catalyst are in the same phase, so it is not an example of heterogeneous catalysis.

Therefore, the correct answer is (1) Combination between dinitrogen and dihydrogen to form ammonia in the presence of finely divided iron.

Question 73. In Lassaigne's extract of an organic compound, both nitrogen and sulphur are present, which gives blood red colour with Fe^{3+} due to the formation of
(1) $[Fe(SCN)]^{2+}$
(2) $Fe_4[Fe(CN)_6]_3xH_2O$
(3) NaSCN
(4) $[Fe(CN)_5NOS]^{4-}$

Answer. (1) $[Fe(SCN)]^{2+}$

Solution. In Lassaigne's extract, both nitrogen and sulfur are present in the organic compound. When Fe3+ is added to the extract, it forms a blood-red color due to the formation of a complex compound. Among the options provided, the complex compound that is responsible for the blood-red color with Fe3+ is:

(1) [Fe(SCN)]2+

The formation of the blood-red color is attributed to the reaction between Fe3+ and thiocyanate ions (SCN-). The thiocyanate ions combine with Fe3+ to form the complex ion [Fe(SCN)]2+, which exhibits a deep red color.

The other options provided are not relevant to the blood-red color formation with Fe3+ in Lassaigne's extract:
(2) Fe4[Fe(CN)6]3·xH2O: This compound is Prussian blue, which is a blue pigment, not a blood-red color.
(3) NaSCN: Sodium thiocyanate is not responsible for the blood-red color.
(4) [Fe(CN)5NOS]4–: This compound does not match the description of the blood-red color formation.

Therefore, the correct answer is (1) [Fe(SCN)]2+.

Question 75. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R Assertion A : In equation rG = –nFEcell' value of rG depends on n. Reasons R : Ecell is an intensive property and rG is an extensive property. In the light of the above statements, choose the correct answer from the options given below
(1) A is false but R is true
(2) Both A and R are true and R is the correct explanation of A
(3) Both A and R are true and R is NOT the correct explanation of A
(4) A is true but R is false

Answer. (3) Both A and R are true and R is NOT the correct explanation of A

Solution. The correct answer is:

(3) Both A and R are true and R is NOT the correct explanation of A.

Explanation:
Both Assertion A and Reason R are true statements, but Reason R does not provide the correct explanation for Assertion A.

Assertion A states that in the equation ΔrG = -nFEcell', the value of ΔrG depends on n. This is true because the value of ΔrG (change in Gibbs free energy) is directly proportional to the stoichiometric coefficients (n) of the balanced chemical

equation. The value of n represents the number of moles of electrons transferred in the redox reaction, and it influences the magnitude of ΔrG.

Reason R states that Ecell is an intensive property and ΔrG is an extensive property. This is also true. Ecell, the cell potential or electromotive force, is an intensive property because it does not depend on the amount of substance present but only on the nature and concentrations of the species involved in the redox reaction. On the other hand, ΔrG is an extensive property as it depends on the amount of substance involved in the reaction.

However, Reason R does not provide the correct explanation for Assertion A. The dependence of ΔrG on n is related to the stoichiometry of the reaction, whereas the intensive/extensive property difference between Ecell and ΔrG does not directly explain why the value of ΔrG depends on n. Hence, Reason R does not explain Assertion A correctly.

Therefore, the correct answer is option (3) Both A and R are true, but R is NOT the correct explanation of A.

Question 76. A compound is formed by two elements A and B. The element B forms cubic close packed structure and atoms of A occupy 1/3 of tetrahedral voids. If the formula of the compound is AxBy, then the value of x + y is in option (1) 2 **(2) 5** (3) 4 (4) 3

Answer. (2) 5

Solution . In a cubic close-packed (CCP) structure, there are 4 tetrahedral voids per unit cell. Given that atoms of element A occupy 1/3 of the tetrahedral voids, it means that for every 3 tetrahedral voids, there is one atom of element A.

Since element B forms the cubic close-packed structure, it occupies the face-centered positions in the unit cell. In a CCP structure, each unit cell contains 4 atoms at face-centered positions, which can be considered as the B atoms.

Therefore, the ratio of A to B atoms in the compound is 1:4.

The formula of the compound AxBy indicates that there is one atom of element A for every x formula units and one atom of element B for every y formula units.

From the given information, we know that the ratio of A to B atoms is 1:4. Therefore, the value of x is 1 and the value of y is 4.

So, x + y = 1 + 4 = 5.

Hence, the value of x + y is option (2) 5.

Question 77. Amongst the following the total number of species NOT having eight electrons around central atom in its outermost shell, is NH_3, $AlCl_3$, $BeCl_2$, CCl_4, PCl_5 :
(1) 1 **(2) 3** (3) 2 (4) 4

Answer. (2) 3

Solution. To determine the total number of species that do not have eight electrons around the central atom in their outermost shell, we need to examine the electron configurations and octet rule compliance for each molecule.

Let's analyze each species:

1. NH_3 (Ammonia): Nitrogen (N) has 5 valence electrons, and each hydrogen (H) atom contributes 1 valence electron. In NH_3, nitrogen shares three electrons with three hydrogen atoms, resulting in a total of 8 electrons around the central nitrogen atom. It satisfies the octet rule.

2. $AlCl_3$ (Aluminum chloride): Aluminum (Al) has 3 valence electrons, while each chlorine (Cl) atom contributes 7 valence electrons. In $AlCl_3$, aluminum shares three electrons with three chlorine atoms, but it only has 6 electrons around the central aluminum atom, which does not satisfy the octet rule.

3. $BeCl_2$ (Beryllium chloride): Beryllium (Be) has 2 valence electrons, and each chlorine (Cl) atom contributes 7 valence electrons. In $BeCl_2$, beryllium shares two electrons with two chlorine atoms, resulting in a total of 4 electrons around the central beryllium atom. It does not satisfy the octet rule.

4. CCl_4 (Carbon tetrachloride): Carbon (C) has 4 valence electrons, and each chlorine (Cl) atom contributes 7 valence electrons. In CCl_4, carbon shares four electrons with four chlorine atoms, resulting in a total of 8 electrons around the central carbon atom. It satisfies the octet rule.

5. PCl_5 (Phosphorus pentachloride): Phosphorus (P) has 5 valence electrons, and each chlorine (Cl) atom contributes 7 valence electrons. In PCl_5, phosphorus shares five electrons with five chlorine atoms, but it has 10 electrons around the central phosphorus atom, which does not satisfy the octet rule.

Therefore, out of the given species, there are 3 species that do not have eight electrons around the central atom in their outermost shell: $AlCl_3$, $BeCl_2$, and PCl_5.

The correct answer is option (2) 3.

Botany Questions & Solutions

Question 101. Which micronutrient is required for splitting of water molecule during photosynthesis?
(1) Copper **(2) Manganese** (3) Molybdenum (4) Magnesium

Answer. (2) Manganese

Solution. The micronutrient required for splitting water molecules during photosynthesis is (2) Manganese.

In the process of photosynthesis, plants use light energy to convert carbon dioxide and water into glucose and oxygen. This process takes place in the chloroplasts, specifically in the thylakoid membranes where the light-dependent reactions occur.

During the light-dependent reactions, water molecules are split, releasing electrons, protons (H+ ions), and oxygen. This splitting of water molecules is known as photolysis, and it is facilitated by a complex called the oxygen-evolving complex (OEC) within Photosystem II (PSII) of the thylakoid membrane.

The oxygen-evolving complex (OEC) contains manganese ions (Mn2+) that play a crucial role in the photolysis of water. Manganese is responsible for the binding and activation of water molecules, facilitating the extraction of electrons and protons from water, and releasing oxygen as a byproduct.

Therefore, the correct answer is (2) Manganese.

Question 103. Given below are two statements :
Statement I : Endarch and exarch are the terms often used for describing the position of secondary xylem in the plant body.
Statement II : Exarch condition is the most common feature of the root system. In the light of the above statements, choose the correct answer from the options given below:

(1) Statement I is incorrect but Statement II is true
(2) Both Statement I and Statement II are true
(3) Both Statement I and Statement II are false
(4) Statement I is correct but Statement II is false

Answer. (1) Statement I is incorrect but Statement II is true

Solution. The correct answer is:

(1) Statement I is incorrect, but Statement II is true.

Explanation:

Statement I states that endarch and exarch are terms often used for describing the position of secondary xylem in the plant body. This statement is incorrect. Endarch and exarch actually describe the arrangement of primary xylem in a plant stem or root, not secondary xylem. Endarch refers to the condition where the xylem elements in a vascular bundle are arranged with the protoxylem (first-formed xylem) towards the center and metaxylem (later-formed xylem) towards the periphery. Exarch, on the other hand, describes the condition where the protoxylem is located towards the periphery of the vascular bundle and the metaxylem towards the center. Therefore, Statement I is incorrect.

Statement II states that the exarch condition is the most common feature of the root system. This statement is true. In the majority of plants, the root system exhibits an exarch arrangement of xylem, where the protoxylem is found towards the periphery of the root and the metaxylem towards the center. This allows for efficient water and nutrient uptake from the soil.

Therefore, the correct answer is (1) Statement I is incorrect, but Statement II is true.

Question 104. Cellulose does not form blue colour with Iodine because

(1) It breaks down when iodine reacts with it
(2) It is a disaccharide
(3) It is a helical molecule
(4) It does not contain complex helices and hence cannot hold iodine molecules

Answer. (4) It does not contain complex helices and hence cannot hold iodine molecules

Solution. The correct answer is:

(4) It does not contain complex helices and hence cannot hold iodine molecules.

The reason cellulose does not form a blue color with iodine is that cellulose does not contain complex helices. The blue color formation with iodine is due to the formation of a starch-iodine complex. Starch, which is a polysaccharide, has a helical structure that allows it to form a complex with iodine, resulting in the blue color.

Cellulose, on the other hand, is also a polysaccharide but has a different structure than starch. Cellulose molecules are arranged in long, straight chains that are held together by hydrogen bonding. The absence of the complex helices found in starch prevents cellulose from forming a complex with iodine and, therefore, it does not exhibit the blue color reaction with iodine.

Therefore, the correct answer is (4) It does not contain complex helices and hence cannot hold iodine molecules.

Question 105. Family Fabaceae differs from Solanaceae and Liliaceae. With respect to the stamens, pick out the characteristics specific to family Fabaceae but not found in Solanaceae or Liliaceae.
(1) Epiphyllous and Dithecous anthers
(2) Diadelphous and Dithecous anthers
(3) Polyadelphous and epipetalous stamens
(4) Monoadelphous and Monothecous anthers

Answer. (2) Diadelphous and Dithecous anthers

Solution. The characteristics specific to the family Fabaceae but not found in Solanaceae or Liliaceae with respect to stamens are:

(2) Diadelphous and Dithecous anthers.

In the family Fabaceae (Leguminosae), the stamens are often diadelphous, which means they are fused into two groups. Typically, there are nine stamens,

with one separate from the other eight. This arrangement is characteristic of the family Fabaceae and is not found in Solanaceae or Liliaceae.

Additionally, the anthers in Fabaceae are dithecous, meaning they consist of two distinct lobes or thecae. Each anther lobe contains pollen sacs where pollen grains are produced. This characteristic is also specific to the family Fabaceae and differs from Solanaceae and Liliaceae.

Therefore, the correct answer is (2) Diadelphous and Dithecous anthers.

Question 107. Upon exposure to UV radiation, DNA stained with ethidium bromide will show

(1) Bright orange colour
(2) Bright red colour
(3) Bright blue colour
(4) Bright yellow colour

Answer. (1) Bright orange colour

Solution. Upon exposure to UV radiation, DNA stained with ethidium bromide will show a bright orange color.

Ethidium bromide is a fluorescent dye commonly used to visualize DNA in gel electrophoresis and other molecular biology techniques. It intercalates between the base pairs of DNA and becomes fluorescent when exposed to UV light. Under UV radiation, the ethidium bromide-DNA complex emits orange fluorescence, allowing for the visualization and analysis of DNA fragments.

Therefore, the correct answer is (1) Bright orange color.

Question 108. The phenomenon of pleiotropism refers to
(1) More than two genes affecting a single character
(2) Presence of several alleles of a single gene controlling a single crossover
(3) Presence of two alleles, each of the two genes controlling a single trait
(4) A single gene affecting multiple phenotypic expression
Answer. (4) A single gene affecting multiple phenotypic expression

Solution. The phenomenon of pleiotropism refers to:

(4) A single gene affecting multiple phenotypic expressions.

Pleiotropism occurs when a single gene has multiple effects on different traits or phenotypic characteristics. In other words, a single gene influences multiple seemingly unrelated traits. These effects can be observed at different stages of development or in different parts of the organism.

Pleiotropy is a common phenomenon in genetics, and it can have significant implications for the overall phenotype of an organism. It occurs when a gene product or protein affects multiple cellular processes or developmental pathways, leading to a wide range of phenotypic effects.

Therefore, the correct answer is (4) A single gene affecting multiple phenotypic expressions.

Question 109. The historic Convention on Biological Diversity, 'The Earth Summit' was held in Rio de Janeiro in the year
(1) 2002
(2) 1985
(3) 1992
(4) 1986

Answer. (3) 1992

Solution. The historic Convention on Biological Diversity, also known as 'The Earth Summit,' was held in Rio de Janeiro in the year:

(3) 1992.

The United Nations Conference on Environment and Development (UNCED), popularly known as the Earth Summit, took place in Rio de Janeiro, Brazil, from June 3 to June 14, 1992. It was a significant international event that brought together world leaders, policymakers, scientists, and activists to address environmental and sustainable development issues. One of the major outcomes of the Earth Summit was the adoption of the Convention on Biological Diversity (CBD), which aimed to promote the conservation and sustainable use of biodiversity.

Therefore, the correct answer is (3) 1992.

Question 110. During the purification process for recombinant DNA technology, addition of chilled ethanol precipitates out
(1) Polysaccharides (2) RNA **(3) DNA** (4) Histones

Answer. (3) DNA

Solution. During the purification process for recombinant DNA technology, the addition of chilled ethanol precipitates out:

(3) DNA.

The addition of chilled ethanol is a common technique used to isolate and purify DNA in recombinant DNA technology. When ethanol is added to a DNA solution, it causes the DNA molecules to become insoluble and precipitate out of the solution. This precipitation step helps in separating the DNA from other cellular components.

By adding chilled ethanol, the DNA molecules lose their solubility and form a visible white or stringy precipitate. This precipitate can then be collected by centrifugation, washed, and further processed to obtain purified DNA.

Therefore, the correct answer is (3) DNA.

Question 111. Frequency of recombination between gene pairs on same chromosome as a measure of the distance between genes to map their position on chromosome, was used for the first time by
(1) Henking
(2) Thomas Hunt Morgan
(3) Sutton and Boveri
(4) Alfred Sturtevant

Answer. (4) Alfred Sturtevant

Solution. The frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes to map their position on the chromosome was first used by:

(4) Alfred Sturtevant.

Alfred Sturtevant, an American geneticist, is credited with developing the concept of genetic mapping using recombination frequencies. He worked in Thomas Hunt Morgan's laboratory at Columbia University and conducted extensive experiments with fruit flies (Drosophila melanogaster) in the early 20th century.

Sturtevant observed that the frequency of recombination between two genes on the same chromosome was proportional to the physical distance between them. He proposed that this recombination frequency could be used as a measure of gene linkage and distance along the chromosome. This concept formed the basis for constructing genetic maps, also known as linkage maps, which show the relative positions of genes on a chromosome.

Therefore, the correct answer is (4) Alfred Sturtevant.

Question 112. Given below are two statements : One labelled as Assertion A and the other labelled as Reason R:
Assertion A : The first stage of gametophyte in the life cycle of moss is protonema stage.
Reason R : Protonema develops directly from spores produced in capsule.
In the light of the above statements, choose the most appropriate answer from options given below:

(1) A is not correct but R is correct
(2) Both A and R are correct and R is the correct explanation of A
(3) Both A and R are correct but R is NOT the correct explanation of A
(4) A is correct but R is not correct

Answer. (2) Both A and R are correct and R is the correct explanation of A

Solution. The correct answer is:

(2) Both A and R are correct, and R is the correct explanation of A.

Explanation:

Assertion A states that the first stage of the gametophyte in the life cycle of moss is the protonema stage. This statement is correct. Protonema is the initial stage in the development of the gametophyte in mosses. It consists of a mass of green, branched, and filamentous cells that develop directly from the spores.

Reason R states that the protonema develops directly from spores produced in the capsule. This statement is also correct and provides the correct explanation for Assertion A. The spores of mosses are produced within the capsule, which is a part of the sporophyte generation. These spores are released from the capsule

and germinate to give rise to the protonema stage of the gametophyte generation.

Therefore, both Assertion A and Reason R are correct, and Reason R is the correct explanation of Assertion A.

Zoology Questions & Solutions

Question 153. Which one of the following common sexually transmitted diseases is completely curable when detected early and treated properly?
(1) HIV Infection (2) Genital herpes
(3) Gonorrhoea (4) Hepatitis-B

Answer. (3) Gonorrhoea

Solution. Among the options provided, the common sexually transmitted disease that is completely curable when detected early and treated properly is:

(3) Gonorrhea.

Gonorrhea is caused by the bacterium Neisseria gonorrhoeae and can be transmitted through sexual contact. When detected early, gonorrhea can be effectively treated with antibiotics, which can cure the infection and prevent complications. It is important to seek medical attention and complete the prescribed treatment to ensure the complete eradication of the infection.

It is worth noting that the other options listed:
(1) HIV infection is not curable, although treatment options exist to manage the virus and improve the quality of life of affected individuals.
(2) Genital herpes is a viral infection caused by the herpes simplex virus (HSV). While antiviral medications can help manage outbreaks and reduce transmission, there is currently no cure for genital herpes.
(4) Hepatitis-B is a viral infection that can be sexually transmitted. Although there is no cure for hepatitis B, vaccination is available to prevent infection, and

antiviral medications can help manage the virus and reduce the risk of complications.

Therefore, among the options provided, gonorrhea (option 3) is the sexually transmitted disease that is completely curable when detected early and treated properly.

Question 155. Given below are two statements:
Statement I: Vas deferens receives a duct from seminal vesicle and opens into urethra as the ejaculatory duct.
Statement II: The cavity of the cervix is called cervical canal which along with vagina forms birth canal.In the light of the above statements, choose the correct answer from the options given below:

(1) Statement I is incorrect but Statement II is true.
(2) Both Statement I and Statement II are true.
(3) Both Statement I and Statement II are false.
(4) Statement I is correct but Statement II is false.

Answer. (2) Both Statement I and Statement II are true.

Solution. The correct answer based on the given statements is:

(2) Both Statement I and Statement II are true.

Explanation:

Statement I states that the vas deferens receives a duct from the seminal vesicle and opens into the urethra as the ejaculatory duct. This statement is true. The vas deferens is a duct that transports sperm from the testes. It receives a duct from the seminal vesicle, forming the ejaculatory duct, which then opens into the urethra. This arrangement allows for the passage of sperm and seminal fluid during ejaculation.

Statement II states that the cavity of the cervix is called the cervical canal, which, along with the vagina, forms the birth canal. This statement is also true. The cervical canal is the passage within the cervix that connects the uterus to the vagina. During childbirth, the cervix dilates and the cervical canal, along with the vagina, provides the pathway for the baby to pass through, forming the birth canal.

Therefore, both Statement I and Statement II are true, making option (2) the correct answer.

Question 159. Which of the following functions is carried out by cytoskeleton in a cell?
(1) Transportation (2) Nuclear division (3) Protein synthesis **(4) Motility**

Answer. (4) Motility

Solution. The correct answer is:

(4) Motility.

Explanation:

The cytoskeleton is a network of protein filaments and tubules that provide structural support and contribute to various cellular functions. One of the important functions of the cytoskeleton is cell motility. The cytoskeleton is involved in cell movement, both at the cellular level (e.g., cell migration) and at the organismal level (e.g., muscle contraction). It provides the framework and structure necessary for cell movement and enables cells to change shape, crawl, and move in response to external stimuli.

While the cytoskeleton is involved in other cellular processes such as transportation (option 1), it primarily contributes to the movement of the cell and its components. Nuclear division (option 2) is primarily regulated by the mitotic apparatus, which includes microtubules and other components but is not solely

carried out by the cytoskeleton. Protein synthesis (option 3) occurs in the ribosomes and is not directly related to the cytoskeleton.

Therefore, the correct answer is (4) Motility.

Question 162. Given below are two statements: one is labelled as Assertion A and other is labelled as Reason R. Assertion A : Amniocentesis for sex determination is one of the strategies of Reproductive and Child Health Care Programme.
Reason R : Ban on amniocentesis checks increasing menace of female foeticide.
In the light of the above statements, choose the correct answer from the options given below.
(1) A is false but R is true.
(2) Both A and R are true and R is the correct explanation of A. (3) Both A and R are true and R is NOT the correct explanation of A. (4) A is true but R is false

Answer. (1) A is false but R is true.

Solution. The correct answer based on the given statements is:

(1) A is false but R is true.

Explanation:

Assertion A states that amniocentesis for sex determination is one of the strategies of the Reproductive and Child Health Care Programme. This statement is false. Amniocentesis is a medical procedure that involves the sampling of amniotic fluid during pregnancy for various diagnostic purposes, such as detecting genetic disorders. However, sex determination through amniocentesis is generally not a part of the Reproductive and Child Health Care Programme, as it has been banned in many countries due to concerns about the misuse of this procedure for sex-selective abortions.

Reason R states that the ban on amniocentesis checks the increasing menace of female foeticide. This statement is true. In many parts of the world, including India, the ban on sex determination through techniques like amniocentesis is aimed at addressing the issue of female foeticide. Sex-selective abortions based on the preference for male children have led to a significant gender imbalance in some regions. The ban on amniocentesis and other similar techniques is intended to prevent the misuse of these procedures for selective abortion based on the gender of the foetus.

Therefore, based on the given statements, the correct answer is (1) A is false but R is true.

Question 164. Match List I with List II.
List I (Type of Joint)
A. Cartilaginous Joint
B. Ball and Socket Joint
C. Fibrous Joint
D. Saddle Joint

List II (Found between)
I. Between flat skull bones
II. Between adjacent vertebrae in vertebral column
III. Between carpal and metacarpal of thumb
IV. Between Humerus and Pectoral girdle

Choose the correct answer from the options given below:
(1) A-II, B-IV, C-III, D-I
(2) A-III, B-I, C-II, D-IV
(3) A-II, B-IV, C-I, D-III
(4) A-I, B-IV, C-III, D-II

Answer. (3) A-II, B-IV, C-I, D-III

Solution. The correct matching of List I with List II is:

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

Explanation:

A. Cartilaginous Joint is found between flat skull bones (I).
B. Ball and Socket Joint is found between Humerus and Pectoral girdle (IV).
C. Fibrous Joint is found between carpal and metacarpal of thumb (III).
D. Saddle Joint is found between adjacent vertebrae in the vertebral column (II).

Therefore, the correct answer is (3) A-II, B-IV, C-I, D-III.

Question 165. Vital capacity of lung is _____.
(1) IRV + ERV + TV
(2) IRV + ERV
(3) IRV + ERV + TV + RV
(4) IRV + ERV + TV RV

Answer. (1) IRV + ERV + TV

Solution. Vital capacity of the lung is the maximum amount of air a person can exhale forcefully after taking a deep breath. It is calculated by summing up the inspiratory reserve volume (IRV), expiratory reserve volume (ERV), and tidal volume (TV). Therefore, the correct answer is:

(1) IRV + ERV + TV

Question 167. In which blood corpuscles, the HIV undergoes replication and produces progeny viruses?

(1) Eosinophils
(2) TH cells

(3) B-lymphocytes
(4) Basophiles

Answer. (2) TH cells

Solution. The HIV (Human Immunodeficiency Virus) primarily replicates and produces progeny viruses within the TH cells (T-helper cells). TH cells are a type of white blood cells that play a crucial role in the immune response. HIV specifically targets and infects TH cells, leading to their destruction and weakening of the immune system. This is one of the main reasons why HIV infection can lead to acquired immunodeficiency syndrome (AIDS), as the loss of TH cells impairs the body's ability to fight off infections. Therefore, the correct answer is:

(2) TH cells

Question 170. Select the correct group/set of Australian Marsupials exhibiting adaptive radiation.
(1) Lemur, Anteater, Wolf
(2) Tasmanian wolf, Bobcat, Marsupial mole
(3) Numbat, Spotted cuscus, Flying phalanger
(4) Mole, Flying squirrel, Tasmanian tiger cat

Answer. (3) Numbat, Spotted cuscus, Flying phalanger

Solution. The correct group/set of Australian marsupials exhibiting adaptive radiation is:

(3) Numbat, Spotted cuscus, Flying phalanger

Adaptive radiation refers to the diversification of a common ancestor into various species that occupy different ecological niches. In this case, the numbat, spotted cuscus, and flying phalanger are examples of Australian marsupials that have

undergone adaptive radiation, leading to the development of distinct species adapted to different habitats and lifestyles.