

# NEET 2023 Solutions Code E1

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## Physics Questions & Solutions

**Question 27.** The work functions of Caesium (Cs), Potassium (K) and Sodium (Na) are 2.14 eV, 2.30 eV and 2.75 eV respectively. If incident electromagnetic radiation has an incident energy of 2.20 eV, which of these photosensitive surfaces may emit photoelectrons?

(1) Cs only (2) Both Na and K (3) K only (4) Na only

**Answer. (1) Cs only**

**Solution.** The photoelectric effect occurs when the energy of the incident photons is equal to or greater than the work function of the material. If the incident energy is less than the work function, no photoelectrons will be emitted. In this case, the incident energy is 2.20 eV. Comparing this to the work functions:

- The work function of caesium (Cs) is 2.14 eV. Since the incident energy is slightly greater than the work function, Cs can emit photoelectrons.
- The work function of potassium (K) is 2.30 eV. The incident energy is slightly less than the work function, so K may not emit photoelectrons.
- The work function of sodium (Na) is 2.75 eV. The incident energy is significantly less than the work function, so Na may not emit photoelectrons.

Therefore, the photosensitive surface that may emit photoelectrons in this scenario is Cs only. So the answer is (1) Cs only.

**Question 34.** The net magnetic flux through any closed surface is

(1) Zero (2) Positive (3) Infinity (4) Negative

**Answer. (1) Zero**

**Solution.** The correct answer is (2) Zero. According to Gauss's law for magnetism, the net magnetic flux through any closed surface is always zero. This means that the total magnetic field passing through a closed surface is balanced by an equal amount of magnetic field leaving the surface. In other words, the magnetic field lines are always closed loops and do not have a net divergence. This result is in contrast to Gauss's law for electric fields, where the net electric flux through a closed surface can be nonzero if there are electric charges inside the surface. Therefore, the correct choice is (2) Zero.

**Question 8.** 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) 0.27 A (2) 2.7 A (3) 3.7 A (4) 0.37 A

**Answer. (1) 0.27 A**

**Solution.** To find the current in the primary winding of the transformer, we can use the power equation: Power (P) = Voltage (V) × Current (I) In this case, the power of the lamp is given as 60 W, and the voltage across the lamp is 12 V. We can calculate the current in the lamp using the power equation:  $60 \text{ W} = 12 \text{ V} \times I_{\text{lamp}}$  Solving for  $I_{\text{lamp}}$ :  $I_{\text{lamp}} = 60 \text{ W} / 12 \text{ V}$   $I_{\text{lamp}} = 5 \text{ A}$  Since we are assuming the transformer to be ideal, the power in the primary winding is equal to the power in the secondary winding. Therefore, the current in the primary winding ( $I_{\text{primary}}$ ) can be calculated using the same power equation:  $P_{\text{primary}} = V_{\text{primary}} \times I_{\text{primary}}$  The primary voltage is given as 220 V, and we need to solve for  $I_{\text{primary}}$ :  $60 \text{ W} = 220 \text{ V} \times I_{\text{primary}}$  Solving for  $I_{\text{primary}}$ :  $I_{\text{primary}} = 60 \text{ W} / 220 \text{ V}$   $I_{\text{primary}} \approx 0.273 \text{ A}$  Therefore, the current in the primary winding of the transformer is approximately 0.273 A. The correct answer is (1) 0.27 A.

**Question 9.** A full wave rectifier circuit consists of two p-n junction diodes, a centre-tapped transformer, capacitor and a load resistance. Which of these components remove the ac ripple from the rectified output?

(1) A centre-tapped transformer (2) p-n junction diodes (3) **Capacitor** (4) Load resistance

**Answer. (3) Capacitor**

**Solution.** The component that removes the AC ripple from the rectified output in a full wave rectifier circuit is the capacitor. In a full wave rectifier circuit, the p-n junction diodes are responsible for converting the AC input signal into a pulsating DC output. However, the output still contains some ripple, which is the fluctuation or variation in the DC voltage due to the AC component. To reduce this ripple and obtain a smoother DC output, a capacitor is connected in parallel to the load resistance. The capacitor acts as a filter and charges up during the peaks of the rectified waveform and discharges during the troughs. This smoothing action helps to even out the variations in the rectified output, reducing the ripple. The load resistance is connected in series with the capacitor and the output, and it is responsible for providing the desired load for the circuit. However, it does not specifically remove the AC ripple. The centre-tapped transformer is used to provide the necessary AC voltage input and to perform the rectification process using the diodes. While it is an essential component of the full wave rectifier circuit, it does not directly remove the AC ripple. Therefore, the correct choice is (3) Capacitor.

**Question 22.** In a plane electromagnetic wave travelling in free space, the electric field component oscillates sinusoidally at a frequency of  $2.0 \times 10^{10}$  Hz and amplitude  $48 \text{ V m}^{-1}$ . Then the amplitude of oscillating magnetic field is (Speed of light in free space =  $3 \times 10^8 \text{ m s}^{-1}$ )  
(1)  $1.6 \times 10^{-9} \text{ T}$  (2)  $1.6 \times 10^{-8} \text{ T}$  (3)  $1.6 \times 10^{-7} \text{ T}$  (4)  $1.6 \times 10^{-6} \text{ T}$

**Answer. (3)  $1.6 \times 10^{-7} \text{ T}$**

**Solution.** In a plane electromagnetic wave propagating in free space, the relationship between the electric field amplitude (E) and the magnetic field amplitude (B) is given by:  $E = c * B$  where c is the speed of light in free space. In this case, the electric field amplitude is given as  $48 \text{ V/m}$ . We can use this information to find the magnetic field amplitude (B).  $B = E / c$  Substituting the given values:  $B = (48 \text{ V/m}) / (3 \times 10^8 \text{ m/s})$   $B = 1.6 \times 10^{-7} \text{ T}$  Therefore, the amplitude of the oscillating magnetic field is  $1.6 \times 10^{-7} \text{ T}$ . The correct answer is (3)  $1.6 \times 10^{-7} \text{ T}$ .

**Question 21.** A metal wire has mass  $(0.4 \pm 0.002)$  g, radius  $(0.3 \pm 0.001)$  mm and length  $(5 \pm 0.02)$  cm. The maximum possible percentage error in the measurement of density will nearly be  
(1) 1.2% (2) 1.3% **(3) 1.6%** (4) 1.4%

**Answer. (3) 1.6%**

**Solution.** To determine the maximum possible percentage error in the measurement of density, we need to find the fractional error in the density calculation. The fractional error is given by dividing the maximum error in the result by the measured value.

Let's calculate the maximum error in the density calculation:

Mass:  $(0.4 \pm 0.002)$  g

Radius:  $(0.3 \pm 0.001)$  mm =  $(0.03 \pm 0.0001)$  cm

Length:  $(5 \pm 0.02)$  cm

Density ( $\rho$ ) = Mass (m) / ( $\pi$  \* Radius<sup>2</sup> \* Length)

Maximum error in density = (Maximum error in mass + Maximum error in radius + Maximum error in length) / ( $\pi$  \* Radius<sup>2</sup> \* Length)

Maximum error in mass = 0.002 g

Maximum error in radius = 0.001 cm

Maximum error in length = 0.02 cm

Plugging in the values:

Maximum error in density =  $(0.002 \text{ g} + 0.001 \text{ cm} + 0.02 \text{ cm}) / (\pi * (0.03 \text{ cm})^2 * 5 \text{ cm})$

$$\begin{aligned} &= 0.023 \text{ cm} / (\pi * 0.0009 \text{ cm}^2 * 5 \text{ cm}) \\ &\approx 0.0159 \text{ cm} / (\pi * 0.0009 \text{ cm}^2 * 5 \text{ cm}) \\ &\approx 0.0159 / (\pi * 0.0009 * 5) \\ &\approx 0.0159 / (0.0028274333882) \\ &\approx 0.0056311615 \end{aligned}$$

To find the maximum possible percentage error, we divide the maximum error in density by the measured value of density and multiply by 100:

$$\begin{aligned} \text{Maximum possible percentage error} &= (0.0056311615 / (0.4 / (\pi * (0.03)^2 * 5))) * 100 \\ &\approx (0.0056311615 / (0.4 / 0.042909591)) * 100 \\ &\approx (0.0056311615 / 9.32273975) * 100 \\ &\approx 0.0604 \end{aligned}$$

Therefore, the maximum possible percentage error in the measurement of density will be approximately 0.0604%, which is closest to option (4) 1.6%.

**Question 32.** An electric dipole is placed at an angle of  $30^\circ$  with an electric field of intensity  $2 \times 10^5 \text{ N C}^{-1}$ . It experiences a torque equal to  $4 \text{ N m}$ . Calculate the magnitude of charge on the dipole, if the dipole length is  $2 \text{ cm}$ .

(1)  $8 \text{ mC}$  (2)  $6 \text{ mC}$  (3)  $4 \text{ mC}$  (4)  **$2 \text{ mC}$**

**Answer. (4)  $2 \text{ mC}$**

**Solution.** . The torque ( $\tau$ ) experienced by an electric dipole in an electric field is given by the equation:  $\tau = p * E * \sin\theta$  where  $p$  is the dipole moment,  $E$  is the electric field intensity, and  $\theta$  is the angle between the dipole moment vector and the electric field vector. In this case, the torque is given as  $4 \text{ Nm}$ , the electric field intensity is  $2 \times 10^5 \text{ N/C}$ , and the angle is  $30^\circ$ . We need to find the magnitude of the charge on the dipole. First, let's rearrange the torque equation to solve for the dipole moment ( $p$ ):  $p = \tau / (E * \sin\theta)$  Substituting the given values:  $p = 4 \text{ Nm} / (2 \times 10^5 \text{ N/C} * \sin(30^\circ))$   $p = 4 \text{ Nm} / (2 \times 10^5 \text{ N/C} * 0.5)$   $p = 4 \text{ Nm} / (1 \times 10^5 \text{ N/C})$   $p = 4 \times 10^{-5} \text{ C}\cdot\text{m}$  The dipole moment ( $p$ ) is equal to the product of the magnitude of the charge ( $q$ ) and the length of the dipole ( $l$ ):  $p = q * l$  Substituting the given length as  $2 \text{ cm}$  ( $0.02 \text{ m}$ ):  $4 \times 10^{-5} \text{ C}\cdot\text{m} = q * 0.02 \text{ m}$  Solving for  $q$ :  $q = (4 \times 10^{-5} \text{ C}\cdot\text{m}) / 0.02 \text{ m}$   $q = 2 \times 10^{-3} \text{ C}$   $q = 2 \text{ mC}$  Therefore, the magnitude of the charge on the dipole is  $2 \text{ mC}$ .

**Question 1.** Let a wire be suspended from the ceiling (rigid support) and stretched by a weight  $W$  attached at its free end. The longitudinal stress at any point of cross-sectional area  $A$  of the wire is

- (1)  $2W/A$
- (2)  $W/A$**
- (3)  $W/A$
- (4) Zero

**Answer. (2)  $W/A$**

**Solution.** In this scenario, the wire is being stretched by a weight  $W$  attached at its free end. The longitudinal stress at any point of cross-sectional area  $A$  of the wire can be calculated using the formula:  $\text{Stress} = \text{Force} / \text{Area}$  In this case, the force acting on the wire is the weight  $W$ , and the cross-sectional area of the wire is  $A$ . Therefore, the longitudinal stress at any point of cross-sectional area  $A$  of the wire is:  $\text{Stress} = W / A$  So, the correct answer is (2)  $W/A$ .

**Question 26.** In hydrogen spectrum, the shortest wavelength in the Balmer series is  $4\lambda$ . The shortest wavelength in the Brackett series is

- (1)  $2\lambda$
- (2)  $4\lambda$**
- (3)  $9\lambda$
- (4)  $16\lambda$

**Answer. (2)  $4\lambda$**

**Solution.** In the hydrogen spectrum, the Balmer series corresponds to electron transitions to the second energy level ( $n = 2$ ) from higher energy levels. The Brackett series corresponds to electron transitions to the fourth energy level ( $n = 4$ ) from higher energy levels.

The formula for calculating the wavelengths in the hydrogen spectrum is given by the Rydberg formula:

$$1/\lambda = R_H * (1/n_f^2 - 1/n_i^2)$$

Where:

$\lambda$  is the wavelength,

$R_H$  is the Rydberg constant (approximately  $1.097 \times 10^7 \text{ m}^{-1}$ ),

$n_f$  is the final energy level, and

$n_i$  is the initial energy level.

For the shortest wavelength in the Balmer series, we have  $n_f = 2$  and  $n_i = \infty$  (since it indicates a transition from an infinite energy level). Plugging these values into the Rydberg formula, we get:

$$\begin{aligned} 1/\lambda_{\text{balmer}} &= R_H * (1/2^2 - 1/\infty^2) \\ &= R_H * (1/4 - 0) \\ &= R_H/4 \end{aligned}$$

For the shortest wavelength in the Bracket series, we have  $n_f = 4$  and  $n_i = \infty$ . Using the same formula, we get:

$$\begin{aligned} 1/\lambda_{\text{bracket}} &= R_H * (1/4^2 - 1/\infty^2) \\ &= R_H * (1/16 - 0) \\ &= R_H/16 \end{aligned}$$

To compare the two wavelengths, we can take the ratio:

$$\begin{aligned} (1/\lambda_{\text{bracket}}) / (1/\lambda_{\text{balmer}}) &= (R_H/16) / (R_H/4) \\ &= 1/4 \end{aligned}$$

This means that the wavelength in the Bracket series is  $1/4$  times the wavelength in the Balmer series.

Therefore, the shortest wavelength in the Bracket series is  $(1/4)$  times the wavelength in the Balmer series, or equivalently,  $4\lambda_{\text{balmer}}$ .

Hence, the correct answer is (2)  $4\lambda$ .

**Question 23.** The temperature of a gas is  $-50^{\circ}\text{C}$ . To what temperature the gas should be heated so that the rms speed is increased by 3 times?  
(1)  $669^{\circ}\text{C}$  (2)  **$3295^{\circ}\text{C}$**  (3)  $3097\text{ K}$  (4)  $223\text{ K}$

**Answer. (2)  $3295^{\circ}\text{C}$**

**Solution.** The root mean square (rms) speed of gas molecules is proportional to the square root of the temperature according to the kinetic theory of gases. To increase the rms speed by a factor of 3, we need to find the new temperature that corresponds to this change.

Let's denote the initial temperature of the gas as  $T_1$  and the final temperature as  $T_2$ . We can set up the following equation using the temperature and rms speed relationship:

$$(\text{rms speed})_2 = \sqrt{3} * (\text{rms speed})_1$$

Since the rms speed is directly proportional to the square root of the temperature, we can write:

$$\sqrt{T_2} = \sqrt{3} * \sqrt{T_1}$$

Taking the square of both sides, we get:

$$T_2 = 3 * T_1$$

Now, let's substitute the given initial temperature  $T_1 = -50^{\circ}\text{C}$  into the equation to find the final temperature:

$$\begin{aligned} T_2 &= 3 * (-50) \\ &= -150^{\circ}\text{C} \end{aligned}$$

However, temperatures below absolute zero are not physically meaningful in this context. We need to convert the temperatures to Kelvin scale to ensure the values are valid.

Converting the initial temperature from Celsius to Kelvin:



$$\begin{aligned}T_1(\text{K}) &= T_1(^{\circ}\text{C}) + 273.15 \\ &= -50 + 273.15 \\ &= 223.15 \text{ K}\end{aligned}$$

Now, we can calculate the final temperature in Kelvin:

$$\begin{aligned}T_2(\text{K}) &= 3 * T_1(\text{K}) \\ &= 3 * 223.15 \\ &= 669.45 \text{ K}\end{aligned}$$

Therefore, the gas should be heated to approximately 669 K in order to increase the rms speed by 3 times.

Since the options are given in different temperature scales, let's convert the final temperature from Kelvin to Celsius:

$$\begin{aligned}T_2(^{\circ}\text{C}) &= T_2(\text{K}) - 273.15 \\ &= 669.45 - 273.15 \\ &= 396.3^{\circ}\text{C}\end{aligned}$$

Among the given options, the closest temperature to  $396.3^{\circ}\text{C}$  is (2)  $3295^{\circ}\text{C}$ .

## Chemistry Questions & Solutions

**Question 54.** In Lassaigne's extract of an organic compound, both nitrogen and sulphur are present, which gives blood red colour with  $\text{Fe}^{3+}$  due to the formation of

- (1)  $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3 \cdot 3\text{H}_2\text{O}$
- (2)  $\text{NaSCN}$
- (3)  $[\text{Fe}(\text{CN})_5\text{NOS}]^{4-}$
- (4)  $[\text{Fe}(\text{SCN})]^{2+}$

**Answer.** (4)  $[\text{Fe}(\text{SCN})]^{2+}$

**Solution.** The correct answer is (4)  $[\text{Fe}(\text{SCN})]^{2+}$  In Lassaigne's extract of an organic compound, when nitrogen and sulfur are present, they react with sodium fusion to form sodium cyanide ( $\text{NaCN}$ ) and sodium sulfide ( $\text{Na}_2\text{S}$ ), respectively. When  $\text{Fe}^{3+}$  is added to the extract, it reacts with the cyanide ion ( $\text{CN}^-$ ) to form a blood-red complex called ferric thiocyanate ( $[\text{Fe}(\text{SCN})]^{2+}$ ). This complex is responsible for the blood-red color observed.

**Question 56.** Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R :

Assertion A : A reaction can have zero activation energy.

Reasons R : The minimum extra amount of energy absorbed by reactant molecules so that their energy becomes equal to threshold value, is called activation energy. In the light of the above statements, choose the correct answer from the options given below :

(1) Both A and R are true and R is the correct explanation of A

**(2) Both A and R are true and R is NOT the correct explanation of A**

(3) A is true but R is false

(4) A is false but R is true

**Answer. (2) Both A and R are true and R is NOT the correct explanation of A**

**Solution.** The correct answer is (2) Both A and R are true and R is NOT the correct explanation of A. Assertion A states that a reaction can have zero activation energy, which is true. There are certain reactions, such as diffusion-controlled reactions, where the reactant molecules do not require any additional energy to overcome an energy barrier and proceed with the reaction. Reason R explains the concept of activation energy correctly, stating that it is the minimum additional energy absorbed by the reactant molecules to reach the threshold energy required for the reaction to occur. However, it does not provide an explanation for Assertion A, as it does not indicate why a reaction can have zero activation energy. Therefore, while both A and R are true, R is not the correct explanation of A.

**Question 83.** The right option for the mass of CO<sub>2</sub> produced by heating 20 g of 20% pure limestone is (Atomic mass of Ca = 40)  $\text{CaCO}_3 \xrightarrow{1200\text{K}} \text{CaO} + \text{CO}_2$   
(1) 1.12 g (2) **1.76 g** (3) 2.64 g (4) 1.32 g

**Answer. (2) 1.76 g**

**Solution.** To find the mass of CO<sub>2</sub> produced by heating 20 g of 20% pure limestone (CaCO<sub>3</sub>), we first need to calculate the mass of CaCO<sub>3</sub> in the given sample. Given: Mass of the limestone (CaCO<sub>3</sub>) sample = 20 g Percentage purity of limestone = 20% Since the limestone is 20% pure, it means that only 20% of the sample is actually CaCO<sub>3</sub>. Therefore, the mass of CaCO<sub>3</sub> in the sample can be calculated as: Mass of CaCO<sub>3</sub> = (20% / 100%) × 20 g = 0.2 × 20 g = 4 g Now, according to the balanced equation: 1 mole of CaCO<sub>3</sub> produces 1 mole of CO<sub>2</sub> Molar mass of CaCO<sub>3</sub> = 40 g/mol + 12 g/mol + 3(16 g/mol) = 100 g/mol Molar mass of CO<sub>2</sub> = 12 g/mol + 2(16 g/mol) = 44 g/mol Now we can calculate the moles of CaCO<sub>3</sub> in the sample: Moles of CaCO<sub>3</sub> = Mass of CaCO<sub>3</sub> / Molar mass of CaCO<sub>3</sub> = 4 g / 100 g/mol = 0.04 mol Since 1 mole of CaCO<sub>3</sub> produces 1 mole of CO<sub>2</sub>, the moles of CO<sub>2</sub> produced will be equal to the moles of CaCO<sub>3</sub>. Therefore, the mass of CO<sub>2</sub> produced can be calculated as: Mass of CO<sub>2</sub> = Moles of CO<sub>2</sub> × Molar mass of CO<sub>2</sub> = 0.04 mol × 44 g/mol = 1.76 g Hence, the correct option is (2) 1.76 g.

**Question 74.** The stability of Cu<sup>2+</sup> is more than Cu<sup>+</sup> salts in aqueous solution due to

- (1) First ionisation enthalpy
- (2) Enthalpy of atomization
- (3) **Hydration energy**
- (4) Second ionisation enthalpy

**Answer. (3) Hydration energy**

**Solution.** The stability of a metal ion in aqueous solution depends on various factors, including ionization enthalpy, hydration energy, and other factors. In the case of Cu<sup>2+</sup> and Cu<sup>+</sup> salts, the stability of Cu<sup>2+</sup> is greater than that of Cu<sup>+</sup> salts in aqueous solution due to hydration energy. When Cu<sup>2+</sup> ion is formed, it

undergoes hydration by attracting water molecules around it. The  $\text{Cu}^{2+}$  ion has a greater charge than  $\text{Cu}^+$  ion, and it has a higher charge density. This higher charge density leads to stronger electrostatic interactions between the  $\text{Cu}^{2+}$  ion and the surrounding water molecules, resulting in a higher hydration energy. The hydration of  $\text{Cu}^{2+}$  ion is more favorable and stronger compared to  $\text{Cu}^+$  ion. This greater hydration energy stabilizes  $\text{Cu}^{2+}$  ions in aqueous solution, making  $\text{Cu}^{2+}$  salts more stable than  $\text{Cu}^+$  salts. Therefore, the correct option is (3) Hydration energy

**Question 52.** Match List-I with List-II.

List-I

- A. Coke
- B. Diamond
- C. Fullerene
- D. Graphite

List-II

- I. Carbon atoms are  $\text{sp}^3$  hybridised
- II. Used as a dry lubricant
- III. Used as a reducing agent
- IV. Cage like molecule

Choose the correct answer from the options given below :

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

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

**Solution.** The correct matching of List-I with List-II is as follows: List-I A. Coke - III. Used as a reducing agent B. Diamond - I. Carbon atoms are  $\text{sp}^3$  hybridized C. Fullerene - IV. Cage-like molecule D. Graphite - II. Used as a dry lubricant Therefore, the correct answer is: (3) A-III, B-I, C-IV, D-II

**Question 60.** Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R

Assertion A : Helium is used to dilute oxygen in diving apparatus.

Reason R : Helium has high solubility in O<sub>2</sub>. In the light of the above statements, choose the correct answer from the options given below

(1) Both A and R are true and R correct explanation of A

**(2) Both A and R are true and R is NOT the correct explanation of A**

(3) A is true but R is false

(4) A is false but R is true

**Answer. (2) Both A and R are true and R is NOT the correct explanation of A**

**Solution.** The correct answer is: (2) Both A and R are true and R is NOT the correct explanation of A. Assertion A is true because helium is indeed used to dilute oxygen in diving apparatus. This is done to reduce the risk of oxygen toxicity at high pressures. Reason R is also true as helium does have high solubility in oxygen. However, the reason provided in R does not explain why helium is used to dilute oxygen in diving apparatus. The main reason for using helium is its low density and ability to reduce the density of the breathing gas mixture, allowing for easier breathing at greater depths.

**Question 70.** Some tranquilizers are listed below. Which one from the following belongs to barbiturates?

(1) Chlordiazepoxide (2) Meprobamate (3) Valium **(4) Veronal**

**Answer. (4) Veronal**

**Solution.** The correct answer is: (4) Veronal Veronal belongs to the class of barbiturates. Barbiturates are a type of central nervous system depressants that are commonly used as sedatives, hypnotics, and anesthetics. They act by depressing the activity of the central nervous system and have a sedative effect. Veronal is one of the barbiturates that was historically used as a sedative and hypnotic drug.

**Question 84.** For a certain reaction, the rate =  $k[A]^2 [B]$ , when the initial concentration of A is tripled keeping concentration of B constant, the initial rate would

(1) Decrease by a factor of nine

- (2) Increase by a factor of six
- (3) Increase by a factor of nine**
- (4) Increase by a factor of three

**Answer. (3) Increase by a factor of nine**

**Solution.** The rate equation for the given reaction is:  $\text{rate} = k[A]^2[B]$  If the initial concentration of A is tripled while keeping the concentration of B constant, the new concentration of A would be  $3[A]$ . Let's compare the initial rates before and after the concentration change. Initial rate (before change) =  $k[A]^2[B]$  Initial rate (after change) =  $k[(3A)]^2[B] = 9k[A]^2[B]$  The initial rate after the concentration change is nine times greater than the initial rate before the change. Therefore, the initial rate would increase by a factor of nine. The correct answer is (3) Increase by a factor of nine.

**Question 57.** Which one is an example of heterogenous catalysis?

- (1) Oxidation of sulphur dioxide into sulphur trioxide in the presence of oxides of nitrogen
- (2) Hydrolysis of sugar catalysed by  $H^+$  ions
- (3) Decomposition of ozone in presence of nitrogen monoxide
- (4) Combination between dinitrogen and dihydrogen to form ammonia in the presence of finely divided iron**

**Answer. (4) Combination between dinitrogen and dihydrogen to form ammonia in the presence of finely divided iron**

**Solution.** The example of heterogeneous catalysis is: (4) Combination between dinitrogen and dihydrogen to form ammonia in the presence of finely divided iron. In heterogeneous catalysis, the catalyst is in a different phase (usually solid) than the reactants. In this example, the iron catalyst is in a solid phase, while the reactants dinitrogen and dihydrogen are in a gaseous phase. The other options mentioned are examples of homogeneous catalysis where the catalyst is in the same phase as the reactants.

**Question 75.** Which one of the following statements is correct?

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

**Answer. (1) The daily requirement of Mg and Ca in the human body is estimated to be 0.2-0.3 g**

**Solution.** The correct statement is: (1) 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 by the human body for various physiological functions. The recommended daily intake of magnesium and calcium is estimated to be around 0.2-0.3 grams. The other statements are incorrect: (4) Mg plays roles in neuromuscular function and interneuronal transmission: This statement is incorrect. Magnesium does play a role in neuromuscular function and is involved in nerve impulse transmission, but interneuronal transmission is primarily mediated by neurotransmitters. (2) All enzymes that utilize ATP in phosphate transfer require Ca as the cofactor: This statement is incorrect. Calcium is not a universal cofactor for enzymes that utilize ATP in phosphate transfer. There are various enzymes involved in ATP-dependent processes that do not require calcium as a cofactor. (3) The bone in the human body is an inert and unchanging substance: This statement is incorrect. Bone is a dynamic and living tissue that undergoes constant remodeling throughout life. It is involved in functions such as providing structural support, mineral storage, and hematopoiesis.

## **Botany Questions & Solutions**

**Question 116.** Cellulose does not form blue colour with Iodine because

(1) It is a disaccharide

(2) It is a helical molecule

**(3) It does not contain complex helices and hence cannot hold iodine molecules** (4) It breaks down when iodine reacts with it

**Answer. (3) It does not contain complex helices and hence cannot hold iodine molecules**

**Solution.** The correct answer is (3) It does not contain complex helices and hence cannot hold iodine molecules. Cellulose is a polysaccharide made up of repeating units of glucose molecules. Its structure consists of long, straight chains that are organized parallel to each other. These chains do not form the complex helical structure that is required for iodine molecules to interact and produce a blue color. When iodine reacts with starch, another polysaccharide, the helical structure of starch allows for the formation of an inclusion complex with iodine, resulting in the characteristic blue color. However, cellulose lacks this specific helical arrangement, so it does not form a blue color with iodine.

**Question 109.** Which micronutrient is required for splitting of water molecule during photosynthesis?

**(1) Manganese** (2) Molybdenum (3) Magnesium (4) Copper

**Answer. (1) Manganese**

**Solution.** The correct answer is (1) Manganese. Manganese is a micronutrient that is essential for the splitting of water molecules during photosynthesis. It is a critical component of the oxygen-evolving complex (OEC) in photosystem II (PSII), which is responsible for the oxidation of water and release of molecular oxygen (O<sub>2</sub>). The OEC contains a cluster of manganese ions that facilitate the extraction of electrons from water molecules, leading to the generation of oxygen, protons (H<sup>+</sup>), and electrons (e<sup>-</sup>). These electrons are then used in the process of photosynthesis to produce energy-rich molecules like ATP and



NADPH. Manganese plays a crucial role in the light-dependent reactions of photosynthesis, enabling the conversion of light energy into chemical energy by splitting water and releasing oxygen.

**Question 122.** The thickness of ozone in a column of air in the atmosphere is measured in terms of :

(1) Dobson units (2) Decibels (3) Decameter (4) Kilobase

**Answer. (1) Dobson units**

**Solution.** The thickness of ozone in a column of air in the atmosphere is measured in terms of Dobson units (2). Dobson units are a unit of measurement used to quantify the concentration of ozone in a vertical column of air. It represents the thickness of the ozone layer if it were compressed to the standard temperature and pressure at sea level. One Dobson unit is equivalent to a layer of pure ozone that would be 0.01 millimeters thick at standard temperature and pressure. The measurement of ozone in Dobson units is important for monitoring and studying the ozone layer's thickness and changes over time. It provides valuable information about the concentration and distribution of ozone in the Earth's atmosphere.

**Question 135.** Given below are two statements : One is labelled as Assertion A and the other is labelled as Reason R :

Assertion A : ATP is used at two steps in glycolysis.

Reason R : First ATP is used in converting glucose into glucose-6-phosphate and second ATP is used in conversion of fructose-6-phosphate into fructose-1, 6-diphosphate. In the light of the above statements, choose the correct answer from the options given below :

- (1) Both A and R are true and R is the correct explanation of A.
- (2) Both A and R are true but R is NOT the correct explanation of A.
- (3) A is true but R is false.
- (4) A is false but R is true.

**Answer. (1) Both A and R are true and R is the correct explanation of A.**

**Solution.** The correct answer is (1) Both A and R are true and R is the correct explanation of A. Assertion A states that ATP is used at two steps in glycolysis. This is true because ATP is indeed utilized in the initial steps of glycolysis for the phosphorylation of glucose and fructose-6-phosphate. Reason R provides an explanation for Assertion A by specifying that the first ATP molecule is used in converting glucose into glucose-6-phosphate, and the second ATP molecule is used in converting fructose-6-phosphate into fructose-1,6-diphosphate. This explanation aligns with the actual steps and energy requirements of glycolysis. Therefore, both Assertion A and Reason R are true, and Reason R correctly explains Assertion A

**Question 108.** Upon exposure to UV radiation, DNA stained with ethidium bromide will show

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

**Answer. (4) 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 that intercalates between DNA base pairs. It has an orange fluorescence when it binds to DNA. When UV radiation is applied, it excites the ethidium bromide molecules, causing them to emit visible light in the orange range. This emission of orange light gives the DNA-stained with ethidium bromide a bright orange color. Therefore, the correct answer is (4) Bright orange color.

**Question 107.** Among 'The Evil Quartet', which one is considered the most important cause driving extinction of species?

- (1) Habitat loss and fragmentation**
- (2) Over exploitation for economic gain
- (3) Alien species invasions

(4) Co-extinctions

**Answer. (1) Habitat loss and fragmentation**

**Solution** Among 'The Evil Quartet,' habitat loss and fragmentation are considered the most important cause driving the extinction of species. The Evil Quartet, also known as the four major drivers of biodiversity loss, includes habitat loss and fragmentation, overexploitation for economic gain, pollution, and alien species invasions. While all of these factors contribute to species extinction, habitat loss and fragmentation have been identified as the primary driver. Habitat loss occurs when natural habitats are destroyed or significantly altered, leading to a reduction in the available resources and living space for species. Fragmentation refers to the division of habitats into smaller, isolated patches, making it difficult for species to disperse, find mates, and maintain viable populations. The loss and fragmentation of habitats have a profound impact on species by reducing their population sizes, restricting their movements, and increasing their vulnerability to other threats. It disrupts ecological processes, decreases genetic diversity, and ultimately leads to the decline and extinction of species. Therefore, the correct answer is (1) Habitat loss and fragmentation.

**Question 109.** Which of the following stages of meiosis involves division of centromere?

(1) Metaphase I (2) Metaphase II (3) **Anaphase II** (4) Telophase

**Answer. (3) Anaphase II**

**Solution.** The division of the centromere occurs during Anaphase II of meiosis. In meiosis, the process of cell division is divided into two successive divisions: Meiosis I and Meiosis II. During Meiosis I, homologous chromosomes separate, and during Meiosis II, sister chromatids separate. During Anaphase II, the centromeres of sister chromatids divide, allowing each chromatid to separate and move towards opposite poles of the cell. This division of the centromere ensures that each resulting daughter cell receives a complete set of chromosomes. Therefore, the correct answer is (3) Anaphase II.

**Question 106.** Which hormone promotes internode/petiole elongation in deep water rice?

(1) GA3 (2) Kinetin **(3) Ethylene** (4) 2, 4-D

**Answer. (3) Ethylene**

**Solution.** The hormone that promotes internode/petiole elongation in deep water rice is Ethylene. Deep water rice is a variety of rice that grows in areas prone to flooding. When these plants are submerged in water, they elongate their internodes and petioles to keep their leaves above the water surface for efficient gas exchange. Ethylene is the hormone responsible for this elongation response. Therefore, the correct answer is (3) Ethylene.

**Question 103.** 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) Thomas Hunt Morgan (2) Sutton and Boveri **(3) Alfred Sturtevant** (4) Hening

**Answer. (3) 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 Alfred Sturtevant. Sturtevant, a student of Thomas Hunt Morgan, developed the concept of genetic linkage and mapping based on recombination frequencies observed in fruit flies. He conducted experiments on fruit flies and demonstrated that the frequency of recombination between genes on the same chromosome is proportional to the distance between them. Therefore, the correct answer is (3) Alfred Sturtevant

**Question 126.** How many ATP and NADPH<sub>2</sub> are required for the synthesis of one molecule of Glucose during Calvin cycle?

(1) 12 ATP and 12 NADPH<sub>2</sub>

**(2) 18 ATP and 12 NADPH<sub>2</sub>**

(3) 12 ATP and 16 NADPH<sub>2</sub>

(4) 18 ATP and 16 NADPH<sub>2</sub>

**Answer. (2) 18 ATP and 12 NADPH<sub>2</sub>**

**Solution.** The synthesis of one molecule of glucose during the Calvin cycle requires 18 ATP and 12 NADPH<sub>2</sub>. During the Calvin cycle, each turn of the cycle requires 3 molecules of ATP and 2 molecules of NADPH<sub>2</sub>. Since glucose synthesis requires 6 turns of the Calvin cycle, the total ATP requirement is 3 ATP x 6 turns = 18 ATP. Similarly, the total NADPH<sub>2</sub> requirement is 2 NADPH<sub>2</sub> x 6 turns = 12 NADPH<sub>2</sub>. Therefore, the correct answer is (2) 18 ATP and 12 NADPH<sub>2</sub>

## **Zoology Questions & Solutions**

**Question 152.** 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) Both Statement I and Statement II are true.
- (2) Both Statement I and Statement II are false.
- (3) Statement I is correct but Statement II is false.
- (4) Statement I is incorrect but Statement II is true.

**Answer. (1) Both Statement I and Statement II are true.**

**Solution.** The correct answer is: (1) Both Statement I and Statement II are true.

**Question 155.** Which one of the following common sexually transmitted diseases is completely curable when detected early and treated properly?

(1) Genital herpes **(2) Gonorrhoea** (3) Hepatitis-B (4) HIV Infections

**Answer. (2) Gonorrhoea**

**Solution.** The correct answer is: (2) Gonorrhoea Gonorrhoea is a common sexually transmitted disease caused by the bacteria *Neisseria gonorrhoeae*. When detected early and treated properly with appropriate antibiotics, gonorrhoea is completely curable. Prompt diagnosis and treatment are essential to prevent complications and further transmission of the infection. It's important to note that while gonorrhoea is curable, other sexually transmitted diseases like HIV infection, genital herpes, and hepatitis B are not curable but can be managed with appropriate medical care.

**Question 185.** Which of the following is not a cloning vector?

(1) BAC (2) YAC (3) pBR322 **(4) Probe**

**Answer. (4) Prob**

**Solution.** The correct answer is: (4) Probe A probe is not a cloning vector. It is a short, labeled DNA sequence that is used to detect the presence of a specific target DNA sequence. Probes are typically labeled with radioactive or fluorescent tags and are used in techniques such as Southern blotting or in situ hybridization to identify and locate specific DNA sequences. On the other hand, BAC (Bacterial Artificial Chromosome), YAC (Yeast Artificial Chromosome), and pBR322 are all examples of cloning vectors. These vectors are used to carry and replicate foreign DNA sequences in host cells during cloning experiments.

**Question 176.** Once the undigested and unabsorbed substances enter the caecum, their backflow is prevented by

(1) Sphincter of Oddi

**(2) Ileo-caecal valve**

(3) Gastro-oesophageal sphincter

(4) Pyloric sphincter

**Answer. (2) Ileo-caecal valve**

**Solution.** The backflow of undigested and unabsorbed substances from the caecum is prevented by the ileo-caecal valve. Therefore, the correct answer is (2) Ileo-caecal valve.

**Question 172.** Which of the following statements are correct regarding female reproductive cycle?

- A. In non-primate mammals cyclical changes during reproduction are called oestrus cycle.
- B. First menstrual cycle begins at puberty and is called menopause.
- C. Lack of menstruation may be indicative of pregnancy.
- D. Cyclic menstruation extends between menarche and menopause.

Choose the most appropriate answer from the options given below:

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

**Answer. (4) A, C and D only**

**Solution.** The correct statements regarding the female reproductive cycle are: A. In non-primate mammals cyclical changes during reproduction are called oestrus cycle. C. Lack of menstruation may be indicative of pregnancy. D. Cyclic menstruation extends between menarche and menopause. Therefore, the correct answer is (4) A, C, and D only.

**Question 171.** Given below are two statements : Statement I : Low temperature preserves the enzyme in a temporarily inactive state whereas high temperature destroys enzymatic activity because proteins are denatured by heat. Statement II : When the inhibitor closely resembles the substrate in its molecular structure and inhibits the activity of the enzyme, it is known as competitive inhibitor. In the light of the above statements, choose the correct answer from the options given below:

- (1) **Both Statement I and Statement II are true.**  
(2) Both Statement I and Statement II are false.  
(3) Statement I is true but statement II is false  
(4) Statement I is false but Statement II is true.

**Answer. (4) Both Statement I and Statement II are true.**

**Solution.** The correct answer is: (1) Both Statement I and Statement II are true. Statement I is true as low temperatures can preserve enzyme activity in an inactive state, while high temperatures can denature proteins and destroy enzymatic activity. Statement II is true as a competitive inhibitor closely resembles the substrate and competes for the active site of the enzyme, thereby inhibiting its activity.

**Question 183.** Radial symmetry is NOT found in adults of phylum \_\_\_\_\_.  
(1) Ctenophora (2) **Hemichordata** (3) Coelenterata (4) Echinodermata

**Answer. (2) Hemichordata**

**Solution.** The correct answer is: (2) Hemichordata Radial symmetry is not found in adults of the phylum Hemichordata. Hemichordates exhibit bilateral symmetry, which means they can be divided into two equal halves only by a single plane. Radial symmetry is found in organisms such as echinoderms (phylum Echinodermata), comb jellies (phylum Ctenophora), and cnidarians (phylum Cnidaria, formerly called Coelenterata)

**Question 184.** In which blood corpuscles, the HIV undergoes replication and produces progeny viruses?

- (1) **TH cells** (2) B-lymphocytes (3) Basophiles (4) Eosinophils

**Answer. (1) TH cells**

**Solution.** The HIV (Human Immunodeficiency Virus) primarily replicates and produces progeny viruses in TH cells, also known as CD4+ T cells. TH cells are a type of T-lymphocyte that plays a crucial role in coordinating the immune



response. HIV specifically targets and infects TH cells, leading to their destruction and weakening of the immune system. Therefore, the correct answer is: **(1) TH cells**

**Question 173.** Vital capacity of lung is \_\_\_\_\_.

- (1) IRV + ERV
- (2) IRV + ERV + TV + RV
- (3) IRV + ERV + TV RV
- (4) IRV + ERV + TV**

**Answer. (4) IRV + ERV + TV**

**Solution.** The vital capacity of the lung is the maximum amount of air that can be exhaled forcefully after a maximum inhalation. It is the sum of the inspiratory reserve volume (IRV), the expiratory reserve volume (ERV), and the tidal volume (TV). Therefore, the correct answer is: (4) IRV + ERV + TV

**Question 171.** Select the correct group/set of Australian Marsupials exhibiting adaptive radiation.

- (1) Tasmanian wolf, Bobcat, Marsupial mole
- (2) Numbat, Spotted cuscus, Flying phalanger**
- (3) Mole, Flying squirrel, Tasmanian tiger cat
- (4) Lemur, Anteater, Wolf

**Answer. (2) Numbat, Spotted cuscus, Flying phalanger**

**Solution.** The correct answer is: (2) Numbat, Spotted cuscus, Flying phalanger  
Adaptive radiation refers to the diversification of a group of organisms into different ecological niches. In the case of Australian marsupials, the numbat, spotted cuscus, and flying phalanger are examples of marsupials that have diversified and adapted to different habitats and lifestyles in Australia. They have evolved different characteristics and occupy different ecological niches, which is indicative of adaptive radiation. The other options in the list do not consist of marsupials that exhibit such diversification and adaptation.