

# NEET 2023 Solutions G6

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## Physics Questions and Solutions

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

**Answer. (2) 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 (2) Cs only.

**Question 2.** The net magnetic flux through any closed surface is

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

**Answer. (2) 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 4.** 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**

**Solution.** To find the current in the primary winding of the transformer, we can use the power equation:

$$\text{Power (P)} = \text{Voltage (V)} \times \text{Current (I)}$$

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 (2) 0.27 A.

**Question 5.** 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) Load resistance (2) A centre-tapped transformer  
(3) p-n junction diodes **(4) Capacitor**

**Answer. (4) 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 (4) Capacitor.

**Question 6.** 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)  $1.6 \times 10^{-6} \text{ T}$  (2)  $1.6 \times 10^{-9} \text{ T}$  (3)  $1.6 \times 10^{-8} \text{ T}$  (4)  **$1.6 \times 10^{-7} \text{ T}$**

**Answer. (4)  $1.6 \times 10^{-7} \text{ T}$**

**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 (4)  $1.6 \times 10^{-7} \text{ T}$ .

**Question 7.** A metal wire has mass  $(0.4 \pm 0.002) \text{ g}$ , radius  $(0.3 \pm 0.001) \text{ mm}$  and length  $(5 \pm 0.02) \text{ cm}$ . The maximum possible percentage error in the measurement of density will nearly be

(1) 1.4% (2) 1.2% (3) 1.3% (4) **1.6%**

**Answer. 4) 1.6%**

**Solution.**

**Question 9.** 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) **2 mC** (2) 8 mC (3) 6 mC (4) 4 mC

**Answer. (1) 2 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 Nm, the electric field intensity is  $2 \times 10^5$  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 cm (0.02 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 mC.

The correct answer is (1) 2 mC.

**Question 10.** 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) Zero (2)  $2W/A$  (3)  **$W/A$**  (4)  $W/2A$

**Answer. (3)  $W/A$**

**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 (3)  $W/A$ .



**Question 11.** In hydrogen spectrum, the shortest wavelength in the Balmer series is  $\lambda$ . The shortest wavelength in the Brackett series is

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

**Answer. (3)  $4\lambda$**

**Solution.**

**Question 12.** 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) 223 K (2)  $669^\circ\text{C}$  (3)  **$3295^\circ\text{C}$**  (4) 3097 K

**Answer. (3)  $3295^\circ\text{C}$**

**Solution.**

**Question 14.** 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 2 : 1.

In an open pipe (such as an open-ended flute), the fundamental frequency corresponds to the first harmonic, where the pipe supports a single antinode at the open end. The wavelength of the fundamental mode in an open pipe is twice the length of the pipe.

In a closed pipe (such as a closed-end flute or a pipe closed at one end), the fundamental frequency corresponds to the second harmonic, where the pipe supports a node at the closed end and an antinode at the open end. The wavelength of the fundamental mode in a closed pipe is four times the length of the pipe.

Since frequency is inversely proportional to wavelength, the ratio of the frequencies of the fundamental harmonics for an open pipe to a closed pipe with the same length is:

$$(1/2) : (1/4) = 2 : 1$$

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

**Question 16.** Given below are two statements:

Statement I: Photovoltaic devices can convert optical radiation into electricity.

Statement II: Zener diode is designed to operate under reverse bias in breakdown region. In the light of the above statements, choose the most appropriate answer from the options given below.

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

**Answer. (2) Both Statement I and Statement II are correct**

**Solution.** The most appropriate answer is (2) Both Statement I and Statement II are correct.

Statement I is correct. Photovoltaic devices, such as solar cells, are designed to convert optical radiation (light) into electricity through the photovoltaic effect.

Statement II is also correct. A Zener diode is indeed designed to operate under reverse bias in the breakdown region. When a Zener diode is reverse biased and the applied voltage reaches its breakdown voltage, it starts conducting in the reverse direction and maintains a nearly constant voltage across its terminals.

Therefore, both Statement I and Statement II are correct.

**Question 18.** Resistance of a carbon resistor determined from colour codes is  $(22000 \pm 5\%)$  . The colour of third band must be

(1) Yellow (2) Red (3) Green **(4) Orange**

**Answer. (4) Orange**

**Solution.** The color coding on carbon resistors is used to represent the resistance value and tolerance. The resistance value is determined by the first two bands, while the third band represents the multiplier.

In this case, the resistance value is given as 22,000 ohms with a tolerance of  $\pm 5\%$ . To determine the color of the third band, we need to find the multiplier value that corresponds to the given resistance value.

The multiplier value can be determined using the color code chart:

- Yellow represents a multiplier of  $10^4$  (10,000).
- Red represents a multiplier of  $10^2$  (100).
- Green represents a multiplier of  $10^5$  (100,000).
- Orange represents a multiplier of  $10^3$  (1,000).

Since the resistance value is 22,000 ohms, the appropriate multiplier is  $10^3$  (1,000). Therefore, the color of the third band should be (4) Orange. The correct answer is (4) Orange.

**Question 20.** In a series LCR circuit, the inductance L is 10 mH, capacitance C is 1 F and resistance R is 100 . The frequency at which resonance occurs is

- (1) **1.59 kHz** (2) 15.9 rad/s (3) 15.9 kHz (4) 1.59 rad/s

**Answer. (1) 1.59 kHz**

**Solution.** The frequency at which resonance occurs in a series LCR circuit can be calculated using the formula:

$$f_{\text{resonance}} = 1 / (2\pi\sqrt{LC})$$

where L is the inductance, C is the capacitance, and  $\pi$  is a mathematical constant approximately equal to 3.14159.

Given that the inductance (L) is 10 mH (which is equal to 0.01 H) and the capacitance (C) is 1  $\mu$ F (which is equal to  $1 \times 10^{-6}$  F), we can substitute these values into the formula:

$$\begin{aligned} f_{\text{resonance}} &= 1 / (2\pi\sqrt{(0.01 \text{ H} * 1 * 10^{-6} \text{ F})}) \\ &= 1 / (2\pi\sqrt{(0.01 * 10^{-6}) \text{ Hz}}) \\ &= 1 / (2\pi\sqrt{(10^{-8}) \text{ Hz}}) \end{aligned}$$

$$\begin{aligned}
&= 1 / (2\pi * 10^{(-4)}) \text{ Hz} \\
&= 1 / (2\pi * 0.0001) \text{ Hz} \\
&= 1 / (0.000628) \text{ Hz} \\
&\approx 1591.549 \text{ Hz}
\end{aligned}$$

Therefore, the frequency at which resonance occurs in the series LCR circuit is approximately 1591.549 Hz.

The closest option is (1) 1.59 kHz.

**Question 22.** The minimum wavelength of X-rays produced by an electron accelerated through a potential difference of  $V$  volts is proportional to

(1)  $V^2$  (2)  $\sqrt{V}$  (3)  $1/V$  (4)  $1/\sqrt{V}$

**Answer. (3)  $1/V$**

**Solution.** The minimum wavelength ( $\lambda_{\min}$ ) of X-rays produced by an electron accelerated through a potential difference ( $V$ ) is inversely proportional to the potential difference.

The equation that relates the minimum wavelength of X-rays to the accelerating potential is given by:

$$\lambda_{\min} = h / \sqrt{(2meV)}$$

where  $h$  is the Planck's constant,  $m_e$  is the mass of the electron, and  $V$  is the potential difference.

From this equation, we can see that the minimum wavelength is inversely proportional to the square root of the potential difference ( $\sqrt{V}$ ).

Therefore, the correct answer is (3)  $1/V$ .

**Question 23.** 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 generally classified as random errors.

Random errors are caused by various unpredictable factors that can affect the measurement process, such as variations in environmental conditions, electronic noise, or human factors. These errors are typically not consistent and can occur in any direction, resulting in fluctuations around the true value of the measured quantity.

On the other hand, instrumental errors refer to errors caused by faulty or inaccurate instruments or equipment used in the measurement process. Personal errors are errors that occur due to mistakes or biases made by the person conducting the measurement. Least count errors are associated with the limitations of the measuring instrument's smallest scale division.

In this case, the errors mentioned in the question, arising from unpredictable fluctuations in temperature and voltage supply, are best classified as random errors.

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

**Question 24.** 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.** The correct answer is (4) Statement I is true but Statement II is false.

Statement I is true. When the screen is moved away from the plane of the double slits in Young's double slit experiment, the angular separation of the fringes remains constant. This is because the angular separation is determined by the geometry of the setup (the distance between the slits and the screen) and is not affected by the distance between the screen and the slits.

Statement II is false. The angular separation of fringes in Young's double slit experiment is determined by the wavelength of the light used. If the monochromatic source is replaced by another monochromatic source of larger wavelength, the angular separation of fringes actually increases, not

decreases. This is because the fringe spacing is directly proportional to the wavelength of the light.

Therefore, Statement I is true, but Statement II is false.

**Question 25.** A bullet is fired from a gun at the speed of  $280 \text{ m s}^{-1}$  in the direction  $30^\circ$  above the horizontal. The maximum height attained by the bullet is ( $g = 9.8 \text{ m s}^{-2}$ ,  $\sin 30^\circ = 0.5$ )

(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 vertical motion of the bullet.

The initial velocity of the bullet can be split into its vertical and horizontal components. The vertical component of the initial velocity is given by  $V_{0y} = V_0 \cdot \sin(\theta)$ , where  $V_0$  is the magnitude of the initial velocity ( $280 \text{ m/s}$ ) and  $\theta$  is the angle above the horizontal ( $30^\circ$ ).

$$V_{0y} = 280 \text{ m/s} \cdot \sin(30^\circ) = 280 \text{ m/s} \cdot 0.5 = 140 \text{ m/s}$$

The maximum height attained by the bullet can be determined using the formula for maximum height in projectile motion:

$$H = (V_{0y}^2) / (2g)$$

Plugging in the values:

$$\begin{aligned} H &= (140 \text{ m/s})^2 / (2 \cdot 9.8 \text{ m/s}^2) \\ &= 19600 \text{ m}^2/\text{s}^2 / 19.6 \text{ m/s}^2 \end{aligned}$$



$\approx 1000 \text{ m}$

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

The correct answer is (4) 1000 m.

**Question 26.** A Carnot engine has an efficiency of 50% when its source is at a temperature  $327^\circ\text{C}$ . The temperature of the sink is

(1)  $200^\circ\text{C}$  (2)  **$27^\circ\text{C}$**  (3)  $15^\circ\text{C}$  (4)  $100^\circ\text{C}$

**Answer. (2)  $27^\circ\text{C}$**

**Solution.** The efficiency of a Carnot engine is given by the formula:

$$\text{Efficiency} = 1 - (T_{\text{sink}} / T_{\text{source}})$$

where  $T_{\text{sink}}$  is the temperature of the sink and  $T_{\text{source}}$  is the temperature of the source, both in Kelvin.

We are given that the efficiency of the Carnot engine is 50% (or 0.5) and the temperature of the source ( $T_{\text{source}}$ ) is  $327^\circ\text{C}$ .

Converting the temperature of the source to Kelvin:

$$T_{\text{source}} = 327^\circ\text{C} + 273.15 = 600.15 \text{ K}$$

Substituting these values into the efficiency formula:

$$0.5 = 1 - (T_{\text{sink}} / 600.15)$$

Rearranging the equation to solve for  $T_{\text{sink}}$ :

$$T_{\text{sink}} / 600.15 = 1 - 0.5$$

$$T_{\text{sink}} / 600.15 = 0.5$$

$$T_{\text{sink}} = 0.5 * 600.15$$

$$T_{\text{sink}} \approx 300.075 \text{ K}$$

Converting the temperature of the sink from Kelvin to Celsius:

$$T_{\text{sink}} \approx 300.075 \text{ K} - 273.15 \approx 26.925^\circ\text{C}$$

Therefore, the temperature of the sink is approximately  $26.925^\circ\text{C}$ .

The closest option is (2)  $27^\circ\text{C}$ .

**Question 27.** The amount of energy required to form a soap bubble of radius 2 cm from a soap solution is nearly (surface tension of soap solution =  $0.03 \text{ N m}^{-1}$  )

- (1)  $50.1 \times 10^{-4} \text{ J}$
- (2)  $30.16 \times 10^{-4} \text{ J}$
- (3)  $5.06 \times 10^{-4} \text{ J}$
- (4)  $3.01 \times 10^{-4} \text{ J}$**

**Answer. (4)  $3.01 \times 10^{-4} \text{ J}$**

**Solution.** The energy required to form a soap bubble can be calculated using the formula:

$$E = 4\pi r^2 T$$

where  $E$  is the energy,  $r$  is the radius of the bubble, and  $T$  is the surface tension of the soap solution.

Given that the radius of the bubble is 2 cm (which is equal to 0.02 m) and the surface tension of the soap solution is 0.03 N/m, we can substitute these values into the formula:

$$\begin{aligned} E &= 4\pi(0.02 \text{ m})^2 * 0.03 \text{ N/m} \\ &= 4\pi * 0.0004 \text{ m}^2 * 0.03 \text{ N/m} \\ &= 0.0048\pi \text{ Nm} \\ &\approx 0.0151 \text{ Nm} \end{aligned}$$

Now, we need to convert the unit of Nm to J (Joules). Since 1 Nm is equal to 1 J, we can conclude that:

$$E \approx 0.0151 \text{ J}$$

Therefore, the amount of energy required to form a soap bubble of radius 2 cm is approximately 0.0151 J.

The closest option is (4)  $3.01 \times 10^{-4} \text{ J}$ .

**Question 28.** The half life of a radioactive substance is 20 minutes. In how much time, the activity of substance drops to th (1/16)th of its initial value?

(1) 80 minutes (2) 20 minutes (3) 40 minutes (4) 60 minutes

**Answer. (1) 80 minutes**

**Solution.** The time taken for the activity of a radioactive substance to drop to 1/16th (or th) of its initial value is determined by the decay constant, which is related to the half-life.

The decay constant ( $\lambda$ ) can be calculated using the formula:

$$\lambda = \ln(2) / t_{1/2}$$

where  $t_{1/2}$  is the half-life of the substance.

Substituting the given half-life of 20 minutes into the formula:

$$\lambda = \ln(2) / 20 \text{ minutes}$$

Now, we can calculate the time taken for the activity to drop to 1/16th of its initial value using the equation:

$$t = (\ln(1/16)) / \lambda$$

Substituting the value of  $\lambda$ :

$$t = (\ln(1/16)) / (\ln(2) / 20 \text{ minutes})$$

Simplifying:

$$t = (\ln(1/16)) * (20 \text{ minutes} / \ln(2))$$

Using the fact that  $\ln(1/16) = -4$  and  $\ln(2)$  is approximately 0.693:

$$\begin{aligned} t &\approx -4 * (20 \text{ minutes} / 0.693) \\ &\approx -4 * 28.8 \text{ minutes} \\ &\approx -115.2 \text{ minutes} \end{aligned}$$

The negative value for time doesn't make sense in this context, so we take the absolute value:

$t \approx 115.2$  minutes

Therefore, the time taken for the activity of the substance to drop to  $1/16$ th of its initial value is approximately 115.2 minutes.

The closest option is (1) 80 minutes.

**Question 29.** 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:

$$U = \frac{1}{2} k x^2$$

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

We are given that the potential energy of the spring when stretched by 2 cm is  $U$ . Let's denote this as  $U_{2\text{cm}}$ .

$$U_{2\text{cm}} = \frac{1}{2} k (0.02 \text{ m})^2$$

To find the potential energy when the spring is stretched by 8 cm, we can use the same formula with the new displacement, denoted as  $x_{8\text{cm}}$ :

$$U_{8\text{cm}} = \frac{1}{2} k (0.08 \text{ m})^2$$

Dividing  $U_{8\text{cm}}$  by  $U_{2\text{cm}}$ :

$$\begin{aligned} U_{8\text{cm}} / U_{2\text{cm}} &= \left[ \frac{1}{2} k (0.08 \text{ m})^2 \right] / \left[ \frac{1}{2} k (0.02 \text{ m})^2 \right] \\ &= (0.08 \text{ m})^2 / (0.02 \text{ m})^2 \\ &= (0.08/0.02)^2 \end{aligned}$$

$$= (4)^2$$
$$= 16$$

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

The correct answer is (1) 16 U.

**Question 31.** 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 find 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 traveled by the vehicle is  $d$ .

According to the given information, the vehicle travels half the distance, which is  $d/2$ , with speed  $v$ . The time taken to cover this distance is  $(d/2) / v = d/2v$ .

The remaining distance, also  $d/2$ , is traveled at a speed of  $2v$ . The time taken to cover this distance is  $(d/2) / (2v) = d/4v$ .

The total time taken to cover the entire distance is the sum of these two times:

$$\text{Total time} = d/2v + d/4v = (2d + d) / 4v = 3d / 4v.$$

The average speed is given by the total distance divided by the total time:

$$\text{Average speed} = \text{total distance} / \text{total time} = d / (3d / 4v) = 4v / 3.$$

Therefore, the average speed of the vehicle is  $4v/3$ .

The correct answer is (4)  $4v/3$ .

**Question 34.** The venturi-meter works on

- (1) The principle of perpendicular axes
- (2) Huygen's principle
- (3) Bernoulli's principle**
- (4) The principle of parallel axes

**Answer. (3) Bernoulli's principle**

**Solution.** The venturi-meter works based on Bernoulli's principle.

Bernoulli's principle states that as the speed of a fluid increases, the pressure exerted by the fluid decreases, and vice versa. In a venturi-meter, a constriction in the flow path causes the fluid speed to increase, leading to a decrease in pressure.

The principle is utilized in a venturi-meter to measure the flow rate of a fluid by measuring the pressure difference before and after the constriction. By knowing the area of the constriction and the pressure difference, the flow rate can be determined.

Therefore, the venturi-meter works based on Bernoulli's principle.

The correct answer is (3) Bernoulli's principle.

**Question 36.** The radius of inner most orbit of hydrogen atom is  $5.3 \times 10^{-11}$  m. What is the radius of third allowed orbit of hydrogen atom?

(1) 4.77 Å (2) 0.53 Å (3) 1.06 Å (4) 1.59 Å

**Answer.** (1) 4.77 Å

**Solution.** The radius of the  $n$ th allowed orbit of a hydrogen atom can be calculated using the formula:

$$r_n = r_1 \cdot n^2$$

where  $r_n$  is the radius of the  $n$ th orbit,  $r_1$  is the radius of the first orbit, and  $n$  is the principal quantum number.

Given that the radius of the innermost orbit ( $n=1$ ) is  $5.3 \times 10^{-11}$  m, we can calculate the radius of the third allowed orbit ( $n=3$ ) as follows:

$$\begin{aligned} r_3 &= r_1 \cdot 3^2 \\ &= 5.3 \times 10^{-11} \text{ m} \cdot 9 \\ &= 4.77 \times 10^{-10} \text{ m} \end{aligned}$$

Converting this value to angstroms (Å), we have:

$$\begin{aligned} r_3 &= 4.77 \times 10^{-10} \text{ m} \cdot 10^{10} \text{ Å/m} \\ &= 4.77 \text{ Å} \end{aligned}$$

Therefore, the radius of the third allowed orbit of a hydrogen atom is approximately 4.77 Å.

The correct answer is (1) 4.77 Å.



**Question 37.** The resistance of platinum wire at  $0^{\circ}\text{C}$  is  $2\ \Omega$  and  $6.8\ \Omega$  at  $80^{\circ}\text{C}$ . The temperature coefficient of resistance of the wire is

(1)  $3 \times 10^{-1}\ ^{\circ}\text{C}^{-1}$  (2)  $3 \times 10^{-4}\ ^{\circ}\text{C}^{-1}$  (3)  $3 \times 10^{-3}\ ^{\circ}\text{C}^{-1}$  (4)  $3 \times 10^{-2}\ ^{\circ}\text{C}^{-1}$

**Answer.** (4)  $3 \times 10^{-2}\ ^{\circ}\text{C}^{-1}$

**Solution.** The temperature coefficient of resistance ( $\alpha$ ) is given by the equation:

$$\alpha = (R_t - R_0) / (R_0 * (T_t - T_0))$$

where  $\alpha$  is the temperature coefficient of resistance,  $R_t$  is the resistance at temperature  $T_t$ ,  $R_0$  is the resistance at temperature  $T_0$ , and  $(T_t - T_0)$  is the change in temperature.

Given that the resistance of the platinum wire is  $2\ \Omega$  at  $0^{\circ}\text{C}$  ( $T_0$ ) and  $6.8\ \Omega$  at  $80^{\circ}\text{C}$  ( $T_t$ ), we can calculate the temperature coefficient of resistance as follows:

$$\begin{aligned}\alpha &= (6.8 - 2) / (2 * (80 - 0)) \\ &= 4.8 / 160 \\ &= 3 \times 10^{-2}\ ^{\circ}\text{C}^{-1}\end{aligned}$$

Therefore, the temperature coefficient of resistance of the platinum wire is  $3 \times 10^{-2}\ ^{\circ}\text{C}^{-1}$ .

The correct answer is (4)  $3 \times 10^{-2}\ ^{\circ}\text{C}^{-1}$ .

**Question 40.** 10 resistors, each of resistance  $R$  are connected in series to a battery of emf  $E$  and negligible internal resistance. Then those are connected in parallel to the same battery, the current is increased  $n$  times.

The value of n is

(1) 1000 (2) 10 (3) **100** (4) 1

**Answer. (3) 100**

**Solution.**

**Question 41.** Calculate the maximum acceleration of a moving car so that a body lying on the floor of the car remains stationary. The coefficient of static friction between the body and the floor is 0.15 ( $g = 10 \text{ m s}^{-2}$ ).

(1)  $50 \text{ m s}^{-2}$  (2)  $1.2 \text{ m s}^{-2}$  (3)  $150 \text{ m s}^{-2}$  (4)  **$1.5 \text{ m s}^{-2}$**

**Answer. (4)  $1.5 \text{ m s}^{-2}$**

**Solution.** The maximum acceleration of the car can be calculated using the equation:

$$a_{\text{max}} = \mu_s * g$$

where  $\mu_s$  is the coefficient of static friction and  $g$  is the acceleration due to gravity.

Given that  $\mu_s = 0.15$  and  $g = 10 \text{ m/s}^2$ , we can substitute these values into the equation to find the maximum acceleration:

$$\begin{aligned} a_{\text{max}} &= 0.15 * 10 \\ &= 1.5 \text{ m/s}^2 \end{aligned}$$

Therefore, the maximum acceleration of the car so that the body remains stationary is  $1.5 \text{ m/s}^2$ .

The correct answer is (4)  $1.5 \text{ m/s}^2$ .

**Question 43.** A satellite is orbiting just above the surface of the earth with period  $T$ . If  $d$  is the density of the earth and  $G$  is the universal constant of gravitation, the quantity  $3 Gd$  represents  
(1)  $\sqrt{T}$  (2)  $T$  (3)  $T^2$  (4)  $T^3$

**Answer. (3)  $T^2$**

**Solution.** The quantity  $3Gd$  represents the square of the period ( $T^2$ ) of the satellite.

To understand this, let's consider the gravitational force acting on the satellite. The force of gravity is given by:

$$F = G * (m * M) / r^2$$

where  $F$  is the force of gravity,  $G$  is the universal gravitational constant,  $m$  is the mass of the satellite,  $M$  is the mass of the Earth, and  $r$  is the distance between the satellite and the center of the Earth.

The gravitational force can also be expressed as:

$$F = m * (4/3) * \pi * r^3 * d * g$$

where  $d$  is the density of the Earth and  $g$  is the acceleration due to gravity.

Equating the two expressions for the gravitational force, we get:

$$m * (4/3) * \pi * r^3 * d * g = G * (m * M) / r^2$$

Canceling out the mass of the satellite ( $m$ ) and solving for  $r$ , we find:

$$r^3 = (3 * G * M) / (4 * \pi * d * g)$$

Taking the cube root of both sides, we get:

$$r = [ (3 * G * M) / (4 * \pi * d * g) ]^{(1/3)}$$

The period of the satellite (T) is given by the equation:

$$T = 2 * \pi * r / v$$

where v is the velocity of the satellite.

Substituting the value of r, we have:

$$T = 2 * \pi * [ (3 * G * M) / (4 * \pi * d * g) ]^{(1/3)} / v$$

Now, let's simplify the expression:

$$T = [ (3 * G * M) / (4 * \pi * d * g) ]^{(1/3)} * (2 * \pi / v)$$

Notice that  $(3 * G * M) / (4 * \pi * d * g)$  is equal to  $3Gd$ . Therefore:

$$T = [ 3Gd ]^{(1/3)} * (2 * \pi / v)$$

Squaring both sides, we get:

$$T^2 = [ 3Gd ]^{(2/3)} * (2\pi / v)^2$$

Therefore, the quantity  $3Gd$  represents the square of the period ( $T^2$ ) of the satellite.

The correct answer is (3)  $T^2$ .

**Question 50.** A horizontal bridge is built across a river. A student standing on the bridge throws a small ball vertically upwards with a velocity  $4 \text{ m s}^{-1}$ . The ball strikes the water surface after 4 s. The height of bridge above water surface is (Take  $g = 10 \text{ m s}^{-2}$ )

(1) 68 m (2) 56 m (3) 60 m **(4) 64 m**

**Answer. (4) 64 m**

**Solution.** Let's analyze the motion of the ball:

When the ball is thrown vertically upwards, its initial velocity is  $4 \text{ m/s}$  and its acceleration is due to gravity, which is  $-10 \text{ m/s}^2$  (negative because it acts downward). We can use the equation of motion to find the maximum height reached by the ball:

$$v^2 = u^2 + 2as$$

Here,  $u$  is the initial velocity ( $4 \text{ m/s}$ ),  $v$  is the final velocity ( $0 \text{ m/s}$  at the highest point),  $a$  is the acceleration ( $-10 \text{ m/s}^2$ ), and  $s$  is the displacement (maximum height reached).

$$0 = (4 \text{ m/s})^2 + 2(-10 \text{ m/s}^2) * s$$

$$0 = 16 \text{ m}^2/\text{s}^2 - 20 \text{ m/s}^2 * s$$

$$20 \text{ m/s}^2 * s = 16 \text{ m}^2/\text{s}^2$$

$$s = (16 \text{ m}^2/\text{s}^2) / (20 \text{ m/s}^2)$$

$$s = 0.8 \text{ m}$$

So, the maximum height reached by the ball above the bridge is 0.8 meters.

Since the ball strikes the water surface after 4 seconds, it means the total time of flight (from the throw to the impact) is 4 seconds. We can use the equation of motion to find the height of the bridge:

$$s = ut + (1/2)at^2$$

Here,  $s$  is the displacement (height of the bridge),  $u$  is the initial velocity (4 m/s),  $t$  is the time of flight (4 s), and  $a$  is the acceleration due to gravity ( $-10 \text{ m/s}^2$ ).

$$s = (4 \text{ m/s})(4 \text{ s}) + (1/2)(-10 \text{ m/s}^2)(4 \text{ s})^2$$

$$s = 16 \text{ m} - 80 \text{ m}$$

$$s = -64 \text{ m}$$

Since the height cannot be negative, we ignore the negative value. Therefore, the height of the bridge above the water surface is 64 meters.

Therefore, the correct answer is option (4) 64 m.

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

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

**Solution.** The correct answer is **(1)  $[\text{Fe}(\text{SCN})]^{2+}$**

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 55.** 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. Reason 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) 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.

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 56.** 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)



(1) 1.32 g (2) 1.12 g (3) **1.76 g** (4) 2.64 g

**Answer. (3) 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:

$$\text{Mass of CaCO}_3 = (20\% / 100\%) \times 20 \text{ g} = 0.2 \times 20 \text{ g} = 4 \text{ g}$$

Now, according to the balanced equation:

1 mole of CaCO<sub>3</sub> produces 1 mole of CO<sub>2</sub>

$$\text{Molar mass of CaCO}_3 = 40 \text{ g/mol} + 12 \text{ g/mol} + 3(16 \text{ g/mol}) = 100 \text{ g/mol}$$



Molar mass of  $\text{CO}_2 = 12 \text{ g/mol} + 2(16 \text{ g/mol}) = 44 \text{ g/mol}$

Now we can calculate the moles of  $\text{CaCO}_3$  in the sample:

Moles of  $\text{CaCO}_3 = \text{Mass of CaCO}_3 / \text{Molar mass of CaCO}_3 = 4 \text{ g} / 100 \text{ g/mol} = 0.04 \text{ mol}$

Since 1 mole of  $\text{CaCO}_3$  produces 1 mole of  $\text{CO}_2$ , the moles of  $\text{CO}_2$  produced will be equal to the moles of  $\text{CaCO}_3$ .

Therefore, the mass of  $\text{CO}_2$  produced can be calculated as:

Mass of  $\text{CO}_2 = \text{Moles of CO}_2 \times \text{Molar mass of CO}_2 = 0.04 \text{ mol} \times 44 \text{ g/mol} = 1.76 \text{ g}$

Hence, the correct option is (3) 1.76 g.

**Question 60.** The stability of  $\text{Cu}^{2+}$  is more than  $\text{Cu}^+$  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 a metal ion in aqueous solution depends on various factors, including ionization enthalpy, hydration energy, and other factors. In the case of  $\text{Cu}^{2+}$  and  $\text{Cu}^+$  salts, the stability of  $\text{Cu}^{2+}$  is greater than that of  $\text{Cu}^+$  salts in aqueous solution due to hydration energy.

When  $\text{Cu}^{2+}$  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 (4) Hydration energy.

**Question 61.** Match List-I with List-II.

List-I

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

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-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 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  $sp^3$  hybridized
- C. Fullerene - IV. Cage-like molecule
- D. Graphite - II. Used as a dry lubricant

Therefore, the correct answer is:

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

**Question 62.** 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  $O_2$ . 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.

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

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

**Answer. (1) Veronal**

**Solution.** The correct answer is:

(1) 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 65.** 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) Increase by a factor of three
- (2) Decrease by a factor of nine
- (3) Increase by a factor of six
- (4) Increase by a factor of nine**

**Answer. (4) 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.

$$\text{Initial rate (before change)} = k[A]^2[B]$$

$$\text{Initial rate (after change)} = k[(3A)]^2[B] = 9k[A]^2[B]$$

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 (4) Increase by a factor of nine.

**Question 66.** 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 is:

(1) 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 67.** 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 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 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:

(1) 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.

(3) 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.

(4) 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.

**Question 68.** Weight (g) of two moles of the organic compound, which is obtained by heating sodium ethanoate with sodium hydroxide in presence of calcium oxide is :

(1) 18 (2) 16 (3) 32 (4) 30

**Answer. (3) 32**

**Solution.** The organic compound obtained by heating sodium ethanoate (sodium acetate) with sodium hydroxide in the presence of calcium oxide is methane (CH<sub>4</sub>).

To find the weight of two moles of methane (CH<sub>4</sub>), we can calculate the molar mass of methane and then multiply it by two.

The molar mass of carbon (C) is 12.01 g/mol, and the molar mass of hydrogen (H) is 1.008 g/mol.

Molar mass of methane (CH<sub>4</sub>) = (12.01 g/mol) + 4(1.008 g/mol) = 16.04 g/mol

Weight of two moles of methane = 2 × 16.04 g/mol = 32.08 g

Therefore, the correct answer is option (3) 32.

**Question 69.** The element expected to form largest ion to achieve the nearest noble gas configuration is

(1) Na (2) O (3) F (4) N

**Answer. (4) N**



**Solution.** The element expected to form the largest ion to achieve the nearest noble gas configuration is option (4) N (nitrogen).

Nitrogen (N) has 7 electrons in its outermost shell. To achieve a noble gas configuration, it needs to gain 3 electrons to have the same electron configuration as neon (Ne).

When nitrogen gains 3 electrons, it forms the nitride ion ( $N^{3-}$ ), which has a total of 10 electrons. The gained electrons fill up the 2p orbital completely, resulting in a stable electron configuration.

On the other hand, elements such as sodium (Na), oxygen (O), and fluorine (F) tend to lose, gain, or share electrons to achieve a stable electron configuration, but they do not form ions with as many electrons as the nitride ion.

Therefore, among the given options, nitrogen (N) is expected to form the largest ion to achieve the nearest noble gas configuration.

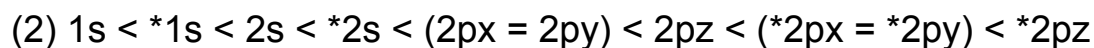
**Question 70.** The correct order of energies of molecular orbitals of  $N_2$  molecule, is

- (1)  $1s < *1s < 2s < *2s < (2p_x = 2p_y) < (*2p_x = *2p_y) < 2p_z < *2p_z$
- (2)  $1s < *1s < 2s < *2s < (2p_x = 2p_y) < 2p_z < (*2p_x = *2p_y) < *2p_z$**
- (3)  $1s < *1s < 2s < *2s < 2p_z < (2p_x = 2p_y) < (*2p_x = *2p_y) < *2p_z$
- (4)  $1s < *1s < 2s < *2s < 2p_z < *2p_z < (2p_x = 2p_y) < (*2p_x = *2p_y)$

**Answer.**

**(2)  $1s < *1s < 2s < *2s < (2p_x = 2p_y) < 2p_z < (*2p_x = *2p_y) < *2p_z$**

**Solution.** The correct order of energies of molecular orbitals of the  $N_2$  molecule is:



In this order, the molecular orbitals are arranged from lower to higher energy levels. The  $1s$  orbital is the lowest in energy, followed by the  $*1s$  antibonding orbital. Then comes the  $2s$  orbital, followed by the  $*2s$  antibonding orbital.

The next set of orbitals is the degenerate set, which includes the  $2p_x$  and  $2p_y$  orbitals. These orbitals have the same energy level. Following them are the  $*2p_x$  and  $*2p_y$  antibonding orbitals, also with the same energy level.

Finally, the  $2p_z$  orbital is placed before the  $*2p_z$  antibonding orbital.

So, the correct order of energies of molecular orbitals of the  $N_2$  molecule is option (2).

**Question 72.** 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 correct answer is:

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

Explanation:

A. Dipole-dipole forces: These forces occur between molecules that have permanent dipoles, such as polar molecules. They result from the attraction between the positive end of one molecule and the negative end of another molecule.

B. Dipole-induced dipole forces: These forces occur between a molecule with a permanent dipole and a molecule that is temporarily polarized due to the presence of the permanent dipole.

C. Hydrogen bonding: This is a special type of dipole-dipole interaction that occurs when a hydrogen atom is bonded to a highly electronegative atom (such as N, O, or F) and forms a strong electrostatic attraction with another electronegative atom in a different molecule.

E. Dispersion forces (also known as London dispersion forces or van der Waals forces): These forces are the weakest intermolecular forces and occur between all molecules, whether they are polar or nonpolar. They result from temporary fluctuations in electron distribution, creating temporary dipoles.

D. Covalent bonding: Covalent bonding refers to the sharing of electrons between atoms to form a chemical bond. It is not an intermolecular force but rather an intramolecular force that holds atoms together within a molecule.

**Question 73.** The number of bonds, bonds and lone pair of electrons in pyridine, respectively are:

(1) 12, 2, 1 (2) 11, 2, 0 (3) 12, 3, 0 (4) **11, 3, 1**

**Answer. (4) 11, 3, 1**

**Solution.** The correct answer is:

(4) 11, 3, 1

Explanation:

In pyridine ( $C_5H_5N$ ), there are a total of 11 sigma bonds, 3 pi bonds, and 1 lone pair of electrons.

The molecular structure of pyridine consists of a six-membered aromatic ring with one nitrogen atom (N) replacing a carbon atom. Each carbon atom in the ring is bonded to one hydrogen atom, and the nitrogen atom is bonded to one hydrogen atom as well.

**Sigma bonds:** Each carbon atom is bonded to one hydrogen atom and one neighboring carbon atom, resulting in a total of 6 sigma bonds. The nitrogen atom is also bonded to one carbon atom, contributing an additional sigma bond. Therefore, there are a total of  $6 + 1 = 7$  sigma bonds in pyridine.

**Pi bonds:** The six-membered aromatic ring in pyridine contains a system of delocalized pi electrons, resulting in 3 pi bonds. These pi bonds are formed by the overlap of p orbitals.

**Lone pair of electrons:** The nitrogen atom in pyridine has one lone pair of electrons. This lone pair is not involved in bonding and is localized on the nitrogen atom.

Therefore, the number of sigma bonds, pi bonds, and lone pair of electrons in pyridine is 11, 3, and 1, respectively.

**Question 76.** Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R  
Assertion A : In equation  $rG = -nFE_{\text{cell}}$  value of  $rG$  depends on  $n$ .  
Reasons R :  $E_{\text{cell}}$  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:

Assertion A states that in the equation  $rG = -nFE_{\text{cell}}$ , the value of  $rG$  depends on  $n$ . This statement is true. The value of  $rG$ , which represents the change in Gibbs free energy, is directly proportional to the number of moles of electrons transferred in the reaction ( $n$ ). This can be seen from the equation itself, where the value of  $rG$  is multiplied by the number of moles ( $n$ ).

Reason R states that  $E_{\text{cell}}$  is an intensive property and  $rG$  is an extensive property. This statement is also true.  $E_{\text{cell}}$ , which represents the cell potential or electromotive force, is an intensive property because it does not depend on the amount of substance present but rather on the nature of the chemical species involved. On the other hand,  $rG$ , which represents the Gibbs free energy change, is an extensive property because it depends on the amount of substance involved in the reaction.

However, Reason R is not the correct explanation of Assertion A. The relationship between the value of  $rG$  and the number of moles ( $n$ ) in the equation  $rG = -nFE_{\text{cell}}$  is based on the stoichiometry of the reaction and the transfer of electrons, not on the intensive or extensive nature of the properties.

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

**Question 79.** The conductivity of centimolar solution of KCl at  $25^\circ\text{C}$  is  $0.0210 \text{ ohm}^{-1} \text{ cm}^{-1}$  and the resistance of the cell containing the solution at  $25^\circ\text{C}$  is 60 ohm. The value of cell constant is

(1)  $3.34 \text{ cm}^{-1}$  (2)  $1.34 \text{ cm}^{-1}$  (3)  $3.28 \text{ cm}^{-1}$  (4)  **$1.26 \text{ cm}^{-1}$**

**Answer. (4)  $1.26 \text{ cm}^{-1}$**

**Solution.** The conductivity ( $\kappa$ ) of a solution is related to the resistance ( $R$ ) of the cell containing the solution and the cell constant ( $K$ ) by the formula:

$$\kappa = 1 / (R * K)$$

We can rearrange this formula to solve for the cell constant:

$$K = 1 / (R * \kappa)$$

Given that the conductivity ( $\kappa$ ) is  $0.0210 \text{ ohm}^{-1} \text{ cm}^{-1}$  and the resistance ( $R$ ) is 60 ohm, we can substitute these values into the formula to find the cell constant:

$$K = 1 / (60 * 0.0210)$$

$$K = 1 / 1.26$$

$$K \approx 0.7937 \text{ cm}^{-1}$$

Rounding this value to two decimal places, we get approximately  $0.79 \text{ cm}^{-1}$ .

Therefore, the correct answer is (4)  $1.26 \text{ cm}^{-1}$ .

**Question 82.** Amongst the following the total number of species NOT having eight electrons around central atom in its outermost shell, is  $\text{NH}_3$ ,  $\text{AlCl}_3$ ,  $\text{BeCl}_2$ ,  $\text{CCl}_4$ ,  $\text{PCl}_5$  :

(1) 1 (2) 3 (3) 2 (4) 4

**Answer. (3) 2**

**Solution.** To determine the 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 bonding in each molecule:

1.  $\text{NH}_3$  (Ammonia):

Nitrogen (N) has 5 valence electrons. Each hydrogen (H) contributes 1 valence electron. The total number of electrons around the central atom (N) is 8. So  $\text{NH}_3$  has eight electrons around the central atom.

2.  $\text{AlCl}_3$  (Aluminum Chloride):

Aluminum (Al) has 3 valence electrons, and each chlorine (Cl) contributes 7 valence electrons. The total number of electrons around the central atom (Al) is 24.  $\text{AlCl}_3$  does not have eight electrons around the central atom.

3.  $\text{BeCl}_2$  (Beryllium Chloride):

Beryllium (Be) has 2 valence electrons, and each chlorine (Cl) contributes 7 valence electrons. The total number of electrons around the central atom (Be) is 16.  $\text{BeCl}_2$  does not have eight electrons around the central atom.

4.  $\text{CCl}_4$  (Carbon Tetrachloride):

Carbon (C) has 4 valence electrons, and each chlorine (Cl) contributes 7 valence electrons. The total number of electrons around the central atom (C) is 32.  $\text{CCl}_4$  does not have eight electrons around the central atom.

5.  $\text{PCl}_5$  (Phosphorus Pentachloride):

Phosphorus (P) has 5 valence electrons, and each chlorine (Cl) contributes 7 valence electrons. The total number of electrons around the central atom (P) is 40.  $\text{PCl}_5$  does not have eight electrons around the central atom.

Therefore, there are three species ( $\text{AlCl}_3$ ,  $\text{BeCl}_2$ , and  $\text{PCl}_5$ ) that do not have eight electrons around the central atom in their outermost shell.

The correct answer is (2) 3.

**Question 83.** Amongst the given options which of the following molecules/ion acts as a Lewis acid?

(1)  $\text{OH}^-$  (2)  $\text{NH}_3$  (3)  $\text{H}_2\text{O}$  (4)  **$\text{BF}_3$**

**Answer. (4)  $\text{BF}_3$**

**Solution.** A Lewis acid is a substance that can accept a pair of electrons (an electron pair acceptor). Let's analyze the given options:

1.  $\text{OH}^-$  (Hydroxide ion):  $\text{OH}^-$  has a lone pair of electrons, which can be donated to another species. It acts as a Lewis base by donating its electron pair, not as a Lewis acid.



2. NH<sub>3</sub> (Ammonia): NH<sub>3</sub> has a lone pair of electrons, which can be donated to another species. It acts as a Lewis base by donating its electron pair, not as a Lewis acid.

3. H<sub>2</sub>O (Water): H<sub>2</sub>O has two lone pairs of electrons, which can be donated to another species. It acts as a Lewis base by donating its electron pairs, not as a Lewis acid.

4. BF<sub>3</sub> (Boron trifluoride): BF<sub>3</sub> is an electron-deficient molecule. It can accept a pair of electrons from a Lewis base, making it a Lewis acid. Therefore, BF<sub>3</sub> acts as a Lewis acid.

Amongst the given options, the molecule/ion that acts as a Lewis acid is (4) BF<sub>3</sub>.

**Question 86.** Which of the following statements are INCORRECT?

A. All the transition metals except scandium form MO oxides which are ionic.

B. The highest oxidation number corresponding to the group number in transition metal oxides is attained in Sc<sub>2</sub>O<sub>3</sub> to Mn<sub>2</sub>O<sub>7</sub>.

C. Basic character increases from V<sub>2</sub>O<sub>3</sub> to V<sub>2</sub>O<sub>4</sub> to V<sub>2</sub>O<sub>5</sub>.

D. V<sub>2</sub>O<sub>4</sub> dissolves in acids to give VO<sub>4</sub><sup>-3</sup> salts.

E. CrO is basic but Cr<sub>2</sub>O<sub>3</sub> is amphoteric. Choose the correct answer from the options given below:

(1) B and C only

(2) A and E only

(3) B and D only

(4) C and D only

**Answer.**

**Solution.**

**Question 88.** Which amongst the following options is the correct relation between change in enthalpy and change in internal energy?

(1)  $H + U = nR$  (2)  $H = U - ngRT$  (3)  $H = U + ngRT$  (4)  $H - U = -nRT$

**Answer. (3)  $H = U + ngRT$**

**Solution.** The correct relation between change in enthalpy (H) and change in internal energy (U) is:

(3)  $H = U + ngRT$

This equation is known as the general equation for enthalpy (H) in terms of internal energy (U), where n is the number of moles, g is the gravitational constant, R is the gas constant, and T is the temperature.

Therefore, option (3)  $H = U + ngRT$  represents the correct relation between change in enthalpy and change in internal energy.

**Question 89.** What fraction of one edge centred octahedral void lies in one unit cell of fcc?

(1)  $1/12$  (2)  $1/2$  (3)  $1/3$  (4)  $1/4$

**Answer. (4)  $1/4$**

**Solution.** In a face-centered cubic (fcc) unit cell, there are four octahedral voids. Each octahedral void is shared between four adjacent unit cells.

Therefore, the fraction of one octahedral void that lies in one unit cell is  $1/4$ .

Thus, the correct answer is (4)  $1/4$ .

**Question 92.** Match List-I with List-II :

List-I (Oxoacids of Sulphur)	List-II (Bonds)
A. Peroxodisulphuric acid	I. Two S–OH, Four S=O, One S–O–S
B. Sulphuric acid	II. Two S–OH, One S=O
C. Pyrosulphuric acid	III. Two S–OH, Four S=O, One S–O–O–S
D. Sulphurous acid	IV. Two S–OH, Two S=O

Choose the correct answer from the options given below.

(1) A–III, B–IV, C–II, D–I

(2) A–I, B–III, C–II, D–IV

**(3) A–III, B–IV, C–I, D–II**

(4) A–I, B–III, C–IV, D–II

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

**Solution.** The correct match between List-I and List-II is:

A. Peroxodisulphuric acid - III. Two S-OH, Four S=O, One S-O-O-S

B. Sulphuric acid - IV. Two S-OH, Two S=O

C. Pyrosulphuric acid - II. Two S-OH, One S=O

D. Sulphurous acid - I. Two S-OH, Four S=O, One S-O-S

Therefore, the correct answer is:

(3) A–III, B–IV, C–I, D–II

**Question 99.** The equilibrium concentrations of the species in the reaction  $A+B\rightleftharpoons C+D$  are 2, 3, 10 and 6 mol L<sup>-1</sup>, respectively at 300 K.  $G^\circ$  for the reaction is ( $R = 2$  cal/mol K)

(1) –13.73 cal (2) 1372.60 cal (3) –137.26 cal (4) –1381.80 cal

**Answer. (4) –1381.80 cal**

**Solution.** The standard Gibbs free energy change ( $\Delta G^\circ$ ) for a reaction can be calculated using the equation:

$$\Delta G^\circ = -RT \ln(K)$$

Where  $R$  is the gas constant (8.314 J/mol·K or 2 cal/mol·K),  $T$  is the temperature in Kelvin, and  $K$  is the equilibrium constant.

To calculate  $\Delta G^\circ$ , we need to determine the equilibrium constant ( $K$ ) for the reaction. The equilibrium constant can be calculated using the concentrations of the species at equilibrium:

$$K = \frac{[C]_{eq} [D]_{eq}}{[A]_{eq} [B]_{eq}}$$

Given the equilibrium concentrations:

$$[A]_{eq} = 2 \text{ mol/L}$$

$$[B]_{eq} = 3 \text{ mol/L}$$

$$[C]_{eq} = 10 \text{ mol/L}$$

$$[D]_{eq} = 6 \text{ mol/L}$$

Substituting these values into the equation for  $K$ :

$$K = \frac{(10 \text{ mol/L} * 6 \text{ mol/L})}{(2 \text{ mol/L} * 3 \text{ mol/L})} = 30 \text{ mol}^2/\text{L}^2$$

Now we can calculate  $\Delta G^\circ$  using the given temperature and the equilibrium constant:

$$\begin{aligned}\Delta G^\circ &= -RT \ln(K) \\ &= -(2 \text{ cal/mol}\cdot\text{K} * 300 \text{ K}) * \ln(30) \\ &\approx -1381.80 \text{ cal}\end{aligned}$$

Therefore, the correct answer is option (4) -1381.80 cal.

## **Botany Questions and Solutions**

**Question 101.** 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.

In mosses, the first stage of the gametophyte in their life cycle is indeed called the protonema stage (Assertion A). Protonema is a thread-like structure that develops directly from the spores produced in the capsule (Reason R). The spores germinate and give rise to the protonema, which eventually develops into the mature gametophyte of the moss. Therefore, Reason R provides the correct explanation for Assertion A.

**Question 102.** 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.

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

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

**Answer. (2) Manganese**

**Solution.** The correct answer is (2) 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 105.** The thickness of ozone in a column of air in the atmosphere is measured in terms of :

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

**Answer. (2) 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 106.** 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) 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 but R is NOT the correct explanation of A.
- (4) A is true but R is false.

**Answer.**

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



**Solution.** The correct answer is (2) 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 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 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 (1) Bright orange color.

**Question 108.** Among 'The Evil Quartet', which one is considered the most important cause driving extinction of species?

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

**Answer. (2) 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 (2) Habitat loss and fragmentation.

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

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

**Answer. (4) 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 (4) Anaphase II.

**Question 110.** Which hormone promotes internode/petiole elongation in deep water rice?

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

**Answer.**

**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 (4) Ethylene.

**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 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 (4) Alfred Sturtevant.

**Question 112.** How many ATP and NADPH<sub>2</sub> are required for the synthesis of one molecule of Glucose during Calvin cycle?

- (1) 18 ATP and 16 NADPH<sub>2</sub>
- (2) 12 ATP and 12 NADPH<sub>2</sub>
- (3) 18 ATP and 12 NADPH<sub>2</sub>**
- (4) 12 ATP and 16 NADPH<sub>2</sub>

**Answer. (3) 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  $3 \text{ ATP} \times 6 \text{ turns} = 18 \text{ ATP}$ . Similarly, the total NADPH<sub>2</sub> requirement is  $2 \text{ NADPH}_2 \times 6 \text{ turns} = 12 \text{ NADPH}_2$ .

Therefore, the correct answer is (3) 18 ATP and 12 NADPH<sub>2</sub>.

**Question 113.** What is the role of RNA polymerase III in the process of transcription in Eukaryotes?

- (1) Transcription of only snRNAs
- (2) Transcription of rRNAs (28S, 18S and 5.8S)
- (3) Transcription of tRNA, 5S rRNA and snRNA**
- (4) Transcription of precursor of mRNA

**Answer. (3) Transcription of tRNA, 5S rRNA and snRNA**

**Solution.** The role of RNA polymerase III in the process of transcription in eukaryotes is the transcription of tRNA, 5S rRNA, and snRNA (small nuclear RNA).

RNA polymerase III is responsible for transcribing the genes that encode these specific types of RNA molecules. tRNA molecules are essential for protein synthesis, 5S rRNA is a component of the ribosome, and snRNAs are involved in splicing and other RNA processing events.

Therefore, the correct answer is (3) Transcription of tRNA, 5S rRNA, and snRNA.

**Question 114.** 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) Monadelphous and Monothealous anthers

**Answer. (2) Diadelphous and Dithecous anthers**

**Solution.** The characteristic specific to the family Fabaceae but not found in Solanaceae or Liliaceae is:

- (2) Diadelphous and Dithecous anthers.

In the family Fabaceae, the stamens are diadelphous, which means they are fused into two groups. Additionally, the anthers are dithecous, which means they have two lobes or thecae.

In contrast, Solanaceae and Liliaceae do not exhibit diadelphous or dithealous anthers as specific characteristics.

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

**Question 115.** The process of appearance of recombination nodules occurs at which sub stage of prophase I in meiosis?

(1) Diakinesis (2) Zygotene **(3) Pachytene** (4) Diplotene

**Answer. (3) Pachytene**

**Solution.** The process of appearance of recombination nodules occurs during the pachytene substage of prophase I in meiosis.

During pachytene, homologous chromosomes pair up and form structures called bivalents or tetrads. Within the bivalents, recombination nodules, also known as chiasmata, start to appear. These nodules represent the sites of genetic recombination or crossing over between homologous chromosomes.

Therefore, the correct answer is (3) Pachytene.

**Question 116.** In the equation  $GPP - R = NPP$  GPP is Gross Primary Productivity NPP is Net Primary Productivity R here is \_\_\_\_\_.

- (1) Reproductive allocation
- (2) Photosynthetically active radiation
- (3) Respiratory quotient
- (4) Respiratory loss**

**Answer. (4) Respiratory loss**

**Solution.** In the equation  $GPP - R = NPP$ :

GPP stands for Gross Primary Productivity, which is the total amount of energy captured by plants through photosynthesis.

NPP stands for Net Primary Productivity, which is the amount of energy remaining after subtracting the energy used by the plants for respiration (R) from the GPP. NPP represents the energy available for growth and reproduction.

Therefore, in this equation, R represents the energy used by the plants for respiration.

So, the correct answer is (4) Respiratory loss.

**Question 117.** The reaction centre in PS II has an absorption maxima at (1) 780 nm (2) **680 nm** (3) 700 nm (4) 660 nm

**Answer. (2) 680 n**

**Solution.** The reaction center in Photosystem II (PS II) has an absorption maximum at approximately 680 nm.

So, the correct answer is (2) 680 nm.



**Question 119.** Spraying of which of the following phytohormone on juvenile conifers helps hastening the maturity period, that leads early seed production?

(1) Abscisic Acid (2) Indole-3-butyric Acid **(3) Gibberellic Acid** (4) Zeatin

**Answer. (3) Gibberellic Acid**

**Solution.** The phytohormone that helps in hastening the maturity period and leads to early seed production in juvenile conifers is Gibberellic Acid (GA3). Therefore, the correct answer is option (3) Gibberellic Acid.

**Question 121.** 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 DNA. When chilled ethanol is added to a DNA solution, the DNA molecules become insoluble and form visible clumps or precipitates. This allows for the separation of DNA from other components of the solution, such as proteins and RNA. Therefore, the correct answer is option (3) DNA.

**Question 122.** In angiosperm, the haploid, diploid and triploid structures of a fertilized embryo sac sequentially are :

(1) Synergids, antipodals and Polar nuclei  
(2) Synergids, Primary endosperm nucleus and zygote  
(3) Antipodals, synergids, and primary endosperm nucleus  
**(4) Synergids, Zygote and Primary endosperm nucleus**

**Answer. (4) Synergids, Zygote and Primary endosperm nucleus**

**Solution.** In angiosperms, the haploid, diploid, and triploid structures of a fertilized embryo sac sequentially are:

(4) Synergids, Zygote, and Primary endosperm nucleus

After fertilization in angiosperms, the male gamete (sperm) fuses with the egg cell to form the zygote, which is diploid. At the same time, another male gamete fuses with the two polar nuclei to form the primary endosperm nucleus, which is triploid. The synergids are involved in the attraction and guidance of the pollen tube but do not contribute to the haploid, diploid, or triploid structures formed after fertilization. Therefore, option (4) is the correct sequence.

**Question 123.** Large, colourful, fragrant flowers with nectar are seen in

- (1) Wind pollinated plants
- (2) Insect pollinated plants**
- (3) Bird pollinated plants
- (4) Bat pollinated plants

**Answer. (2) Insect pollinated plants**

**Solution.**(2) Insect pollinated plants

Large, colorful, fragrant flowers with nectar are typically adaptations of plants to attract insects for pollination. Insects, such as bees and butterflies, are attracted to these flowers by their visual cues, scent, and the presence of nectar as a reward. The insects inadvertently transfer pollen from one flower to another as they visit these flowers in search of nectar. Therefore, option (2) is the correct choice.

**Question 124.** In tissue culture experiments, leaf mesophyll cells are put in a culture medium to form callus. This phenomenon may be called as  
(1) Senescence (2) Differentiation **(3) Dedifferentiation** (4) Development

**Answer. (3) Dedifferentiation**

**Solution.** (3) Dedifferentiation

In tissue culture experiments, when leaf mesophyll cells are placed in a culture medium and stimulated to divide and form a mass of undifferentiated cells, it is referred to as dedifferentiation. Dedifferentiation is the process by which specialized cells lose their specialized features and revert back to a more primitive, undifferentiated state. In the case of tissue culture, the goal is often to induce dedifferentiation in order to establish a cell culture that can be manipulated and differentiated into specific cell types. Therefore, option (3) is the correct choice.

**Question 125.** Given below are two statements : Statement I : The forces generated transpiration can lift a xylem-sized column of water over 130 meters height. Statement II : Transpiration cools leaf surfaces sometimes 10 to 15 degrees evaporative cooling. In the light of the above statements, choose the most appropriate answer from the options given below :

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

**Answer. (2) Both Statement I and Statement II are correct**

**Solution.** (2) Both Statement I and Statement II are correct

Statement I is correct. The forces generated by transpiration, including the cohesion and adhesion of water molecules, can create tension that allows water to be pulled up through the xylem in plants. This tension can theoretically lift a column of water to heights exceeding 130 meters.

Statement II is also correct. Transpiration, the process by which water evaporates from the surfaces of leaves, can result in evaporative cooling. As water evaporates, it absorbs heat from the leaf surface, leading to a cooling effect. This can lower the temperature of leaf surfaces by 10 to 15 degrees Celsius.

**Question 126.** 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.

**Question 127.** In gene gun method used to introduce alien DNA into host cells, microparticles of \_\_\_\_\_ metal are used.

(1) Silver (2) Copper (3) Zinc **(4) Tungsten or gold**

**Answer. (4) Tungsten or gold**

**Solution.** In the gene gun method used to introduce alien DNA into host cells, microparticles of (4) Tungsten or gold are typically used.

**Question 128.** Movement and accumulation of ions across a membrane against their concentration gradient can be explained by

- (1) **Active Transport** (2) Osmosis  
(3) Facilitated Diffusion (4) Passive Transport

**Answer. (1) Active Transport**

**Solution.** The movement and accumulation of ions across a membrane against their concentration gradient can be explained by (1) Active Transport.

**Question 130.** Identify the correct statements: A. Detrivores perform fragmentation. B. The humus is further degraded by some microbes during mineralization. C. Water soluble inorganic nutrients go down into the soil and get precipitated by a process called leaching. D. The detritus food chain begins with living organisms. E. Earthworms break down detritus into smaller particles by a process called catabolism. Choose the correct answer from the options given below:

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

**Answer. (2) A, B, C only**

**Solution.** The correct answer is (2) A, B, C only.

Statement A is correct because detritivores perform fragmentation, breaking down organic matter into smaller pieces.

Statement B is correct because humus, which is partially decomposed organic matter, can be further degraded by microbes during mineralization.

Statement C is correct because leaching is the process by which water-soluble inorganic nutrients move down into the soil and may eventually get precipitated or washed away.

Statements D and E are incorrect. The detritus food chain begins with dead organic material (detritus), not living organisms. Earthworms do not break down detritus through catabolism; they break it down through physical processes such as ingestion and digestion.

**Question 131.** Among eukaryotes, replication of DNA takes place in :  
(1) G2 phase (2) M phase **(3) S phase** (4) G1 phase

**Answer. (3) S phase**

**Solution.** Among eukaryotes, replication of DNA takes place in the S phase of the cell cycle. Therefore, the correct answer is (3) S phase.

**Question 133.** 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 correct answer is (4) A single gene affecting multiple phenotypic expressions.

Pleiotropism refers to the phenomenon where a single gene influences multiple, often unrelated, phenotypic traits or characteristics. This means that a mutation or variation in a single gene can have effects on various aspects of an organism's phenotype, leading to multiple observable traits. This can occur because a gene may be involved in different biochemical pathways or developmental processes that have diverse effects on the organism.

For example, a gene involved in eye development may also have effects on other structures or systems in the body, such as the skeletal system or the immune system. As a result, mutations in this gene can cause abnormalities or variations in multiple traits or characteristics.

Therefore, option (4) "A single gene affecting multiple phenotypic expression" is the correct description of pleiotropism.

**Question 134.** Identify the pair of heterosporous pteridophytes among the following :

- (1) Equisetum and Salvinia
- (2) Lycopodium and Selaginella
- (3) Selaginella and Salvinia**
- (4) Psilotum and Salvinia

**Answer. (3) Selaginella and Salvinia**

**Solution.** The correct answer is (3) Selaginella and Salvinia.

Heterospory is the condition in which a plant produces two different types of spores: microspores and megaspores. Microspores give rise to male gametophytes, while megaspores give rise to female gametophytes.

Among the options provided, Selaginella and Salvinia are the two heterosporous pteridophytes.

Equisetum (option 1) is a homosporous pteridophyte, meaning it produces only one type of spore.

Lycopodium (option 2) is also a homosporous pteridophyte. It produces spores that are all of the same type.

Psilotum (option 4) is a homosporous fern-like plant and does not exhibit heterospory.

Therefore, the correct answer is option (3) Selaginella and Salvinia.

**Question 135.** Given below are two statements : One is labelled as Assertion A and the other is labelled as Reason R : Assertion A : Late wood has fewer xylary elements with narrow vessels. Reason R : Cambium is less active in winters. 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 but R is NOT the correct explanation of A
- (4) A is true but R is false

**Answer.**



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

**Solution.** The correct answer is (2) Both A and R are true and R is the correct explanation of A.

Late wood refers to the portion of the annual ring in a woody stem that is formed later in the growing season. It typically has fewer xylary elements, including narrow vessels, compared to the early wood.

The reason for this is that cambium, the layer of cells responsible for secondary growth in plants, becomes less active during winters. As a result, the production of xylem elements, including vessels, decreases. This reduced activity of cambium during winters leads to the formation of late wood with fewer xylary elements and narrow vessels.

Therefore, both the assertion (A) and the reason (R) are true, and the reason correctly explains the assertion.

**Question 137.** Match List I with List II :

List I	List II'
A. M Phase	I. Proteins are synthesized
B. G2 Phase	II. Inactive phase
C. Quiescent stage	III. Interval between mitosis and initiation of DNA rep.
D. G1 Phase	IV. Equational division

Choose the correct answer from the options given below :

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

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

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

- |                    |  |
|--------------------|--|
| A. M Phase         | IV. Equational division                                  |
| B. G2 Phase        | II. Inactive phase                                       |
| C. Quiescent stage | III. Interval between mitosis and initiation of DNA rep. |
| D. G1 Phase        | I. Proteins are synthesized                              |

Therefore, the correct match is:

- A - IV
- B - II
- C - III
- D - I

The correct answer is:

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

**Question 138.** Given below are two statements : One labelled as Assertion A and the other labelled as Reason R : Assertion A : In gymnosperms the pollen grains are released from the microsporangium and carried by air currents. Reason R : Air currents carry the pollen grains to the mouth of the archegonia where the male gametes are discharged and pollen tube is not formed. 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 but R is NOT the current explanation of A
- (4) A is true but R is false**

**Answer. (4) A is true but R is false**

**Solution.** The correct answer is:

(4) A is true but R is false.

Assertion A is true, as gymnosperms release their pollen grains from the microsporangium and rely on air currents for pollination.

Reason R is false, as pollen grains in gymnosperms are not carried by air currents to the mouth of the archegonia. In gymnosperms, the male gametes are released from the pollen grains and are carried to the female reproductive structure, where fertilization occurs. Pollen tubes are formed in gymnosperms to facilitate the transfer of male gametes to the female gametophyte.

Therefore, while Assertion A is correct, Reason R is not a correct explanation of Assertion A.

**Question 139.** Match List I with List II:

List I	List II
A. Iron	I. Synthesis of auxin
B. Zinc	II. Component of nitrate reductase
C. Boron	III. Activator of catalase
D. Molybdenum	IV. Cell elongation and differentiation

Choose the correct answer from the options given below:

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

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

**Solution.** The correct answer is:

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

Explanation:

- Iron (Fe) is involved in the synthesis of auxin, a plant hormone that regulates various growth and developmental processes.
- Zinc (Zn) is a component of nitrate reductase, an enzyme involved in nitrogen metabolism.
- Boron (B) is an activator of catalase, an enzyme that helps break down hydrogen peroxide in plant cells.
- Molybdenum (Mo) is required for cell elongation and differentiation in plants.

Therefore, the correct matching is:

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

**Question 140.** Which of the following combinations is required for chemiosmosis?

- (1) Proton pump, electron gradient, NADP synthase
- (2) Membrane, proton pump, proton gradient, ATP synthase**
- (3) Membrane, proton pump, proton gradient, NADP synthase
- (4) Proton pump, electron gradient, ATP synthase

**Answer. (2) Membrane, proton pump, proton gradient, ATP synthase**

**Solution.** The correct combination required for chemiosmosis is:

(2) Membrane, proton pump, proton gradient, ATP synthase.

Chemiosmosis is the process by which ATP is synthesized using the energy stored in an electrochemical gradient of protons ( $H^+$ ) across a membrane. In this process, a proton pump actively transports protons across the membrane, creating a proton gradient. The membrane, which can be the inner mitochondrial membrane or thylakoid membrane in chloroplasts, provides the barrier necessary for the establishment of the gradient. ATP synthase, located on the membrane, utilizes the proton gradient to produce ATP.

Option 2 correctly includes all the necessary components: membrane, proton pump, proton gradient, and ATP synthase.

**Question 141.** Main steps in the formation of Recombinant DNA are given below. Arrange these steps in a correct sequence. A. Insertion of recombinant DNA into the host cell B. Cutting of DNA at specific location by restriction enzyme C. Isolation of desired DNA fragment D. Amplification of gene of interest using PCR Choose the correct answer from the options given below :

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

**Answer. (2) B, C, D, A**

**Solution.** The correct sequence of steps in the formation of recombinant DNA is:

- (2) B, C, D, A

Here's a breakdown of each step:

B. Cutting of DNA at specific location by restriction enzyme: In this step, the DNA containing the gene of interest and the vector DNA are cut at specific locations using restriction enzymes. This generates compatible sticky ends or blunt ends.

C. Isolation of desired DNA fragment: The desired DNA fragment containing the gene of interest is isolated from a source, such as genomic DNA or a cDNA library. This can be done using techniques like PCR, gel electrophoresis, or DNA extraction methods.

D. Amplification of gene of interest using PCR: The isolated DNA fragment containing the gene of interest is amplified using the polymerase chain reaction (PCR) technique. PCR allows for the selective amplification of specific DNA sequences.

A. Insertion of recombinant DNA into the host cell: The amplified DNA fragment (gene of interest) is inserted into the host cell (such as a bacterial cell) using techniques like transformation, electroporation, or microinjection. The recombinant DNA is then taken up and integrated into the host cell's genome.

Therefore, option (2) B, C, D, A is the correct sequence.

**Question 142.** Which one of the following statements is NOT correct?

- (1) The amount of some toxic substances of industrial waste water increases in the organisms at successive trophic levels
- (2) The micro-organisms involved in biodegradation of organic matter in a sewage polluted water body consume a lot of oxygen causing the death of aquatic organisms

**(3) Algal blooms caused by excess of organic matter in water improve water quality and promote fisheries**

(4) Water hyacinth grows abundantly in eutrophic water bodies and leads to an imbalance in the ecosystem dynamics of the water body

**Answer. (3) Algal blooms caused by excess of organic matter in water improve water quality and promote fisheries**

**Solution.** The correct answer is:

(3) Algal blooms caused by excess of organic matter in water improve water quality and promote fisheries

This statement is not correct. Algal blooms caused by an excess of organic matter, such as nutrients from sewage or agricultural runoff, can actually have negative effects on water quality. These blooms can deplete oxygen levels in the water, leading to hypoxic or anoxic conditions that are harmful to aquatic organisms. Additionally, algal blooms can disrupt the natural balance of ecosystems and lead to the decline of certain species, including fish. Therefore, algal blooms caused by excess organic matter are generally considered detrimental to water quality and can have negative impacts on fisheries.

**Question 143.** Which of the following statements are correct about Klinefelter's Syndrome?

- A. This disorder was first described by Langdon Down (1866).
- B. Such an individual has overall masculine development. However, the feminine development is also expressed.
- C. The affected individual is short statured.
- D. Physical, psychomotor and mental development is retarded.
- E. Such individuals are sterile.

Choose the correct answer from the options given below:

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

**Answer. (4) B and E only**

**Solution.** The correct answer is:

(4) B and E only

Statement A is incorrect. Klinefelter's syndrome was first described by Harry Klinefelter in 1942, not by Langdon Down.

Statement B is correct. Individuals with Klinefelter's syndrome typically have overall masculine development, but there may be some feminine characteristics expressed due to the presence of an extra X chromosome.

Statement C is incorrect. Short stature is not a characteristic feature of Klinefelter's syndrome. In fact, individuals with Klinefelter's syndrome may have a taller than average stature.

Statement D is incorrect. Physical, psychomotor, and mental development in individuals with Klinefelter's syndrome is typically within the normal range. There may be some learning difficulties or developmental delays in some cases, but mental retardation is not a characteristic feature.

Statement E is correct. Individuals with Klinefelter's syndrome are usually sterile, meaning they are unable to father children naturally due to the impaired function of their testes.

**Question 144.** Match List I with List II :

List I (Interaction)	List II (Species A and B)
A. Mutualism	I. $+(A), 0(B)$
B. Commensalism	II. $-(A), 0(B)$
C. Amensalism	III. $+(A), -(B)$



D. Parasitism            IV. +(A), +(B)

Choose the correct answer from the options given below:

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

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

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

List I (Interaction)	List II (Species A and B)
A. Mutualism	IV. +(A), +(B)
B. Commensalism	I. +(A), 0(B)
C. Amensalism	II. -(A), 0(B)
D. Parasitism	III. +(A), -(B)

So, the correct answer is:

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

**Question 145.** Given below are two statements : One is labelled as Assertion A and the other is labelled as Reason R : Assertion A : A flower is defined as modified shoot wherein the shoot apical meristem changes to floral meristem. Reason R : Internode of the shoot gets condensed to produce different floral appendages laterally at successive node instead of leaves. 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 but R is NOT the correct explanation of A

(4) A is true but R is false

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

**Solution.** The correct answer is:

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

Explanation: The assertion A is true, as a flower is indeed a modified shoot where the shoot apical meristem transforms into a floral meristem. The reason R is also true, as the internode of the shoot becomes condensed, leading to the development of floral appendages at successive nodes instead of leaves. Therefore, the reason R provides the correct explanation for assertion A.

**Question 146.** How many different proteins does the ribosome consist of?  
(1) 20 (2) 80 (3) 60 (4) 40

**Answer. (2) 80**

**Solution.** The ribosome consists of multiple proteins, and the specific number can vary between prokaryotes and eukaryotes. In prokaryotes, the ribosome is composed of approximately 55 different proteins, while in eukaryotes, it consists of about 80 different proteins.

Therefore, the correct answer to your question is:

(2) 80

**Question 147.** Match List I with List II :

List I

List II

- |                    |   |
|--------------------|---|
| A. Cohesion        | I. More attraction in liquid phase          |
| B. Adhesion        | II. Mutual attraction among water molecules |
| C. Surface tension | III. Water loss in liquid phase             |
| D. Guttation       | IV. Attraction towards polar surfaces       |

Choose the correct answer from the options given below :

(1) A – II, B – I, C – IV, D – III

**(2) A – II, B – IV, C – I, D – III**

(3) A – IV, B – III, C – II, D – I

(4) A – III, B – I, C – IV, D – II

**Answer. (2) A – II, B – IV, C – I, D – III**

**Solution.** The correct match between List I and List II is:

(2) A – II, B – IV, C – I, D – III

Explanation:

A. Cohesion refers to the mutual attraction among water molecules, which is described in List II as "II. Mutual attraction among water molecules."

B. Adhesion refers to the attraction of water molecules to polar surfaces, which is described in List II as "IV. Attraction towards polar surfaces."

C. Surface tension is a result of the cohesive forces between water molecules, as described in List II as "I. More attraction in liquid phase."

D. Guttation refers to the loss of water from leaves in liquid form, which is described in List II as "III. Water loss in liquid phase."

Therefore, option (2) A – II, B – IV, C – I, D – III is the correct answer.

**Question 148.** Match List I with List II :

List I

- A. Oxidative decarboxylation
- B. Glycolysis
- C. Oxidative phosphorylation
- D. Tricarboxylic acid cycle

List II

- I. Citrate synthase
- II. Pyruvate dehydrogenase
- III. Electron transport system
- IV. EMP pathway

Choose the correct answer from the options given below :

**(1) A – II, B – IV, C – III, D – I**

(2) A – III, B – IV, C – II, D – I

(3) A – II, B – IV, C – I, D – III

(4) A – III, B – I, C – II, D – IV

**Answer. (1) A – II, B – IV, C – III, D – I**

**Solution.** The correct match between List I and List II is:

(1) A – II, B – IV, C – III, D – I

Explanation:

A. Oxidative decarboxylation refers to the conversion of pyruvate to acetyl-CoA in the presence of oxygen and the removal of a carboxyl group. This process is catalyzed by the enzyme pyruvate dehydrogenase, as mentioned in List II as "II. Pyruvate dehydrogenase."

B. Glycolysis is the breakdown of glucose into pyruvate, and it occurs through a series of enzymatic steps known as the Embden-Meyerhof pathway (EMP pathway), as mentioned in List II as "IV. EMP pathway."

C. Oxidative phosphorylation is the process in which ATP is synthesized through the electron transport system and ATP synthase. This is described in List II as "III. Electron transport system."

D. Tricarboxylic acid cycle, also known as the citric acid cycle or Krebs cycle, is a series of chemical reactions that occur in the mitochondria to generate energy. The first step of this cycle is the condensation of acetyl-CoA with oxaloacetate to form citrate, which is catalyzed by the enzyme citrate synthase, as mentioned in List II as "I. Citrate synthase."

Therefore, option (1) A – II, B – IV, C – III, D – I is the correct answer.

**Question 149.** Melonate inhibits the growth of pathogenic bacteria by inhibiting the activity of

- (1) Dinitrogenase
- (2) Succinic dehy**
- (3) Amylase
- (4) Lipase

**Answer.**

**Solution.** Melonate inhibits the growth of pathogenic bacteria by inhibiting the activity of succinic dehydrogenase.

The correct answer is:

- (2) Succinic dehydrogenase

## **Zoology Questions and Solutions**

**Question 151.** Match List I with List II

**List I**

- A. Gene 'a'
- B. Gene 'y'
- C. Gene 'i'
- D. Gene 'z'

**List II**

- I. -galactosidase
- II. Transacetylase
- III. Permease
- IV. Repressor protein

Choose the correct answer from the options given below:

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

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

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

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

**Solution.** The correct answer is:

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

**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 is:

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

**Question 157.** 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.** The correct answer is:

(3) 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 158.** Which of the following is not a cloning vector?

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

**Answer. (1) Probe**

**Solution.** The correct answer is:

(1) 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 160.** Which of the following are NOT considered as the part of endomembrane system? A. Mitochondria B. Endoplasmic reticulum C. Chloroplasts D. Golgi complex E. Peroxisomes Choose the most appropriate answer from the options given below:

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

**Answer. (3) A, C and E only**

**Solution.** The most appropriate answer is (3) A, C and E only.

The endomembrane system includes several organelles involved in the synthesis, modification, and transport of proteins and lipids. These organelles include the endoplasmic reticulum, Golgi complex, and vesicles.

Mitochondria are not considered part of the endomembrane system. They have their own membrane and are responsible for cellular respiration.

Chloroplasts are also not part of the endomembrane system. They are found in plant cells and are responsible for photosynthesis.



Peroxisomes are another organelle not included in the endomembrane system. They are involved in various metabolic processes, including the breakdown of fatty acids and detoxification of harmful substances.

Therefore, the organelles that are not considered part of the endomembrane system are A. Mitochondria, C. Chloroplasts, and E. Peroxisomes.

**Question 162.** Once the undigested and unabsorbed substances enter the caecum, their backflow is prevented by

- (1) Pyloric sphincter
- (2) Sphincter of Oddi
- (3) Ileo-caecal valve**
- (4) Gastro-oesophageal sphincter

**Answer. (3) 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 (3) Ileo-caecal valve.

**Question 163.** Match List I with List II with respect to human eye.

**List I**

**List II**

- A. Fovea I. Visible coloured portion of eye that regulates diameter of pupil.
- B. Iris II. External layer of eye formed of dense connective tissue.
- C. Blind spot III. Point of greatest visual acuity or resolution.
- D. Sclera IV. Point where optic nerve leaves the eyeball and photoreceptor cells are absent.

Choose the correct answer from the options given below:

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

**Answer. (2) A-III, B-I, C-IV, D-II**

**Solution.** The correct match between List I and List II with respect to the human eye is:

- A. Fovea - III. Point of greatest visual acuity or resolution.
- B. Iris - I. Visible coloured portion of eye that regulates diameter of pupil.
- C. Blind spot - IV. Point where optic nerve leaves the eyeball and photoreceptor cells are absent.
- D. Sclera - II. External layer of eye formed of dense connective tissue.

Therefore, the correct answer is (2) A-III, B-I, C-IV, D-II.

**Question 165.** 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, C and D only**
- (2) A and D only
- (3) A and B only

(4) A, B and C only

**Answer. (1) 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 (1) A, C, and D only.

**Question 166.** 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) 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. (2) Both Statement I and Statement II are true.**

**Solution.** The correct answer is:

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

**Answer. (3) Hemichordata**

**Solution.** The correct answer is:

(3) 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 168. Match List I with List II.**

**List I**

- A. Vasectomy
- B. Coitus interruptus
- C. Cervical caps

**List II**

- I. Oral method
- II. Barrier method
- III. Surgical method

D. Saheli

IV. Natural method

Choose the correct answer from the options given below:

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

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

**Solution.** The correct answer is:

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

- A. Vasectomy is a surgical method of contraception.
- B. Coitus interruptus is a natural method of contraception.
- C. Cervical caps are a barrier method of contraception.
- D. Saheli is an oral method of contraception.

So the correct matching is A-III, B-IV, C-II, D-I.

**Question 169.** Match List I with List II

**List I**

**(Cells)**

A. Peptic cells

B. Goblet cells

C. Oxyntic cells

D. Hepatic cells

**List II**

**(Secretion)**

I. Mucus

II. Bile juice

III. Proenzyme pepsinogen

IV. HCl and intrinsic factor for absorption of vitamin B12

Choose the correct answer from the options given below:

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

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

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

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

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

**Solution.** The correct answer is:

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

A. Peptic cells secrete proenzyme pepsinogen.

B. Goblet cells secrete mucus.

C. Oxyntic cells secrete HCl and intrinsic factor for absorption of vitamin B12.

D. Hepatic cells secrete bile juice.

So the correct matching is A-III, B-I, C-IV, D-II.

**Question 170.** In which blood corpuscles, the HIV undergoes replication and produces progeny viruses?

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

**Answer. (2) 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:

(2) TH cells

**Question 171.** 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.** 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:

(1) IRV + ERV + TV

**Question 172.** Given below are two statements:

Statement I: A protein is imagined as a line, the left end represented by first amino acid (C-terminal) and the right end represented by last amino acid (N-terminal).

Statement II: Adult human haemoglobin, consists of 4 subunits (two subunits of  $\alpha$  type and two subunits of  $\beta$  type.) 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. (1) Statement I is false but Statement II is true.**

**Solution.** The correct answer is:

- (1) Statement I is false but Statement II is true.

Statement I is incorrect because a protein is not imagined as a line, but rather as a chain of amino acids where the N-terminal is represented by the first amino acid and the C-terminal is represented by the last amino acid.

Statement II is true, as adult human hemoglobin indeed consists of four subunits: two alpha ( $\alpha$ ) subunits and two beta ( $\beta$ ) subunits.

**Question 174.** 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 answer is:

- (3) 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.

**Question 175. Match List I with List II.**

**List I**

- A. Heroin
- B. Marijuana
- C. Cocaine
- D. Morphine

**List II**

- I. Effect on cardiovascular system
- II. Slow down body function
- III. Painkiller
- IV. Interfere with transport of dopamine

Choose the correct answer from the options given below:

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

**Answer. (2) A-II, B-I, C-IV, D-III**

**Solution.** The correct answer is:

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

- A. Heroin - II. Slow down body function
- B. Marijuana - I. Effect on cardiovascular system
- C. Cocaine - IV. Interfere with transport of dopamine
- D. Morphine - III. Painkiller

This matching correctly identifies the effects or characteristics associated with each substance. Heroin slows down body function, marijuana has

effects on the cardiovascular system, cocaine interferes with the transport of dopamine, and morphine is a painkiller.

**Question 179.** 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

The cytoskeleton is a network of protein filaments within a cell that provides structural support and is involved in various cellular functions. One of its primary functions is to provide motility to the cell. The cytoskeleton is responsible for cell movement, including the movement of the cell as a whole (cell motility) and the movement of organelles and other cellular components within the cell (cytoplasmic streaming). It achieves this through the interaction of its protein filaments, such as microtubules, microfilaments, and intermediate filaments.

While the cytoskeleton is involved in other cellular processes such as transportation, nuclear division, and protein synthesis indirectly by facilitating the movement of vesicles, chromosomes, and ribosomes, respectively, its direct role in motility makes option (4) the most accurate choice.

**Question 180.** Broad palm with single palm crease is visible in a person suffering from-

- (1) Thalassemia
- (2) Down's syndrome**
- (3) Turner's syndrome
- (4) Klinefelter's syndrome

**Answer. (2) Down's syndrome**

**Solution.** The correct answer is (2) Down's syndrome.

A single palmar crease, also known as a simian crease or a single transverse palmar crease, is a condition where the palm of the hand has a single crease instead of the usual two creases. This characteristic is commonly associated with Down's syndrome, a genetic disorder caused by the presence of an extra copy of chromosome 21.

Thalassemia, Turner's syndrome, and Klinefelter's syndrome do not typically exhibit a single palmar crease as a characteristic feature. Thalassemia is a blood disorder, Turner's syndrome is a genetic condition affecting females, and Klinefelter's syndrome is a chromosomal disorder affecting males. These conditions may have other physical characteristics and symptoms, but a single palmar crease is not typically associated with them.

**Question 183.** Which of the following statements is correct?

- (1) Algal Bloom decreases fish mortality
- (2) Eutrophication refers to increase in domestic sewage and waste water in lakes.
- (3) Biomagnification refers to increase in concentration of the toxicant at successive trophic levels.**
- (4) Presence of large amount of nutrients in water restricts 'Algal Bloom'

**Answer. (3) Biomagnification refers to increase in concentration of the toxicant at successive trophic levels.**

**Solution.** The correct statement is (3) Biomagnification refers to an increase in the concentration of a toxicant at successive trophic levels.

Biomagnification is the process by which certain substances, such as heavy metals or persistent organic pollutants, become increasingly concentrated in organisms as they move up the food chain. As predators consume multiple prey organisms, the accumulated toxins in those organisms are transferred and become more concentrated in the bodies of the predators.

Let's evaluate the other statements:

(1) Algal Bloom decreases fish mortality: This statement is incorrect. Algal blooms can actually increase fish mortality. When there is an excessive growth of algae due to high nutrient levels in the water (eutrophication), it can lead to oxygen depletion and the release of toxins, causing harm to fish and other aquatic organisms.

(2) Eutrophication refers to an increase in domestic sewage and wastewater in lakes: This statement is partially correct. Eutrophication refers to the excessive enrichment of water bodies, such as lakes or rivers, with nutrients, including those from domestic sewage and wastewater. However, it can also result from agricultural runoff and other sources of nutrient inputs.

(4) The presence of a large amount of nutrients in water restricts 'Algal Bloom': This statement is incorrect. Algal blooms are often triggered by an excess of nutrients, particularly nitrogen and phosphorus, in the water. The availability of these nutrients promotes the rapid growth and reproduction of algae, leading to an algal bloom.

**Question 184.** Given below are two statements:

Statement I: RNA mutates at a faster rate.

Statement II: Viruses having RNA genome and shorter life span mutate and evolve faster.

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

**Solution.** The correct answer is (2) Both Statement I and Statement II are true.

Statement I is true. RNA generally mutates at a faster rate compared to DNA. RNA molecules are single-stranded and typically less stable than DNA molecules, which can make them more prone to errors during replication or transcription. This higher mutation rate contributes to the genetic diversity and adaptability of RNA-based organisms or viruses.

Statement II is also true. Viruses with RNA genomes and shorter life spans tend to mutate and evolve faster. RNA viruses, such as influenza virus or HIV, have high mutation rates due to the lack of proofreading mechanisms during replication. This rapid mutation and evolution allow RNA viruses to adapt quickly to changes in their host environments, evade host immune responses, and potentially develop resistance to antiviral drugs.

Therefore, both statements are accurate and reflect the higher mutation rate of RNA and the faster evolution of RNA viruses with shorter life spans.

**Question 186.** The parts of human brain that helps in regulation of sexual behaviour, expression of excitement, pleasure, rage, fear etc. are:

- (1) Corpus callosum and thalamus
- (2) Limbic system and hypothalamus**
- (3) Corpora quadrigemina and hippocampus
- (4) Brain stem and epithalamus

**Answer. (2) Limbic system and hypothalamus**

**Solution.** The correct answer is (2) Limbic system and hypothalamus.

The limbic system and hypothalamus play crucial roles in the regulation of sexual behavior, expression of excitement, pleasure, rage, fear, and other emotions.

The limbic system is a complex network of structures within the brain that includes the amygdala, hippocampus, and parts of the cerebral cortex. It is involved in the processing and regulation of emotions, memory formation, and the reward system.

The hypothalamus, located at the base of the brain, is responsible for maintaining homeostasis in the body, including the regulation of various physiological and behavioral processes. It plays a significant role in controlling sexual behavior and the expression of emotions. The hypothalamus also regulates the release of hormones, including those involved in sexual arousal and reproduction.

The other options mentioned are not primarily associated with the regulation of sexual behavior, expression of excitement, pleasure, rage, fear, etc. The corpus callosum and thalamus are more involved in the communication between the two cerebral hemispheres and relaying

sensory information, respectively. The corpora quadrigemina are involved in visual and auditory reflexes, while the hippocampus is primarily associated with memory formation. The brain stem and epithalamus are involved in various basic functions and sleep regulation, respectively.

**Question 187.** Match List I with List II.

**List I**

- A. Logistic growth
- B. Exponential growth
- C. Expanding age pyramid
- D. Stable age pyramid

**List II**

- I. Unlimited resource availability condition
- II. Limited resource availability condition
- III. The percent individuals of pre-reproductive age is largest followed by reproductive and post reproductive age groups
- IV. The percent individuals of pre-reproductives and reproductive age group are same

Choose the correct answer from the options given below:

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

**Answer. (2) A-II, B-I, C-III, D-IV**

**Solution.** The correct answer is (2) A-II, B-I, C-III, D-IV.  
Let's match the statements:

- A. Logistic growth - II. Limited resource availability condition
- B. Exponential growth - I. Unlimited resource availability condition
- C. Expanding age pyramid - III. The percent individuals of pre-reproductive age is largest, followed by reproductive and post-reproductive age groups
- D. Stable age pyramid - IV. The percent individuals of pre-reproductive and reproductive age groups are the same

Therefore, the correct match is (2) A-II, B-I, C-III, D-IV.

**Question 188.** Which of the following statements are correct?

- A. An excessive loss of body fluid from the body switches off osmoreceptors.
- B. ADH facilitates water reabsorption to prevent diuresis.
- C. ANF causes vasodilation.
- D. ADH causes increase in blood pressure.
- E. ADH is responsible for decrease in GFR.

Choose the correct answer from the options given below:

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

**Answer. (3) B, C and D only**

**Solution.** The correct answer is (3) B, C, and D only.

Let's evaluate each statement:

A. An excessive loss of body fluid from the body switches off osmoreceptors.

This statement is incorrect. Osmoreceptors are specialized cells that detect changes in osmotic pressure and help regulate fluid balance in the body. An excessive loss of body fluid would result in dehydration and increased osmolarity, which would activate osmoreceptors, not switch them off.



B. ADH facilitates water reabsorption to prevent diuresis.

This statement is correct. ADH (antidiuretic hormone), also known as vasopressin, is released by the posterior pituitary gland. It acts on the kidneys to increase water reabsorption in the distal convoluted tubules and collecting ducts, thereby reducing the production of urine and preventing diuresis.

C. ANF causes vasodilation.

This statement is correct. ANF (atrial natriuretic peptide) is a hormone released by the atria of the heart in response to increased blood volume and pressure. It causes vasodilation, which leads to the relaxation of blood vessels and a decrease in blood pressure.

D. ADH causes an increase in blood pressure.

This statement is correct. ADH plays a role in regulating blood pressure. By promoting water reabsorption in the kidneys, ADH helps increase blood volume, which can lead to an increase in blood pressure.

E. ADH is responsible for a decrease in GFR (glomerular filtration rate).

This statement is incorrect. ADH does not directly affect the glomerular filtration rate. Its primary role is to regulate water reabsorption in the kidneys. The glomerular filtration rate is primarily influenced by factors such as blood pressure, blood flow to the kidneys, and the permeability of the glomerular membrane.

Therefore, the correct statements are B, C, and D.

**Question 190.** Which of the following is characteristic feature of cockroach regarding sexual dimorphism?

- (1) Presence of anal cerci
- (2) Dark brown body colour and anal cerci
- (3) Presence of anal styles**

(4) Presence of sclerites

**Answer. (3) Presence of anal styles**

**Solution.** The correct answer is (3) Presence of anal styles.

In cockroaches, sexual dimorphism refers to the physical differences between males and females of the species. One characteristic feature of sexual dimorphism in cockroaches is the presence of anal styles. Anal styles are modified appendages located at the tip of the abdomen in male cockroaches. They are used during mating to help stabilize the female during copulation.

Let's evaluate the other options:

(1) Presence of anal cerci: Anal cerci are sensory structures found at the posterior end of the abdomen in both male and female cockroaches. They are not specifically related to sexual dimorphism.

(2) Dark brown body color and anal cerci: Body coloration and the presence of anal cerci are not exclusive to one sex in cockroaches. Both male and female cockroaches can have dark brown body coloration and anal cerci.

(4) Presence of sclerites: Sclerites are hardened plates or segments in the exoskeleton of cockroaches. They are not specifically related to sexual dimorphism but are present in both male and female cockroaches.

Therefore, the presence of anal styles is the characteristic feature of cockroaches regarding sexual dimorphism.

**Question 192.** . Which of the following are NOT under the control of thyroid hormone?

- A. Maintenance of water and electrolyte balance
- B. Regulation of basal metabolic rate
- C. Normal rhythm of sleep-wake cycle
- D. Development of immune system
- E. Support the process of RBCs formation

Choose the correct answer from the options given below:

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

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

**Solution.** The correct answer is (4) C and D only.

Thyroid hormone plays a vital role in regulating various physiological processes in the body. Let's evaluate each option to determine which ones are NOT under the control of thyroid hormone:

A. Maintenance of water and electrolyte balance: This process is under the influence of thyroid hormone. Thyroid hormone helps regulate the balance of water and electrolytes in the body.

B. Regulation of basal metabolic rate: This is one of the primary functions of thyroid hormone. It plays a crucial role in determining the basal metabolic rate (BMR) and overall energy metabolism in the body.

C. Normal rhythm of sleep-wake cycle: This process is not directly controlled by thyroid hormone. The sleep-wake cycle is regulated by the circadian rhythm, which is primarily influenced by the suprachiasmatic nucleus in the brain.

D. Development of immune system: This process is not primarily under the control of thyroid hormone. The development and regulation of the immune system involve various other factors and mechanisms.

E. Support the process of RBC formation: This process is under the influence of thyroid hormone. Thyroid hormone plays a role in supporting erythropoiesis, the process of red blood cell formation.

Based on the evaluations above, the options (3) B and C only, and (4) C and D only are incorrect.

Therefore, the correct answer is (1) D and E only, as the development of the immune system is not primarily under the control of thyroid hormone.

**Question 193.** Which one of the following is the sequence on corresponding coding strand, if the sequence on mRNA formed is as follows 5'AUCGAUCGAUCGAUCGAUCG AUCG 3'?

- (1) 3' ATCGATCGATCGATCGATCGATCG 5'
- (2) 5' UAGCUAGCUAGCUAGCUAGCUAGC 3'
- (3) 3' UAGCUAGCUAGCUAGCUAGCUAGC 5'**
- (4) 5' ATCGATCGATCGATCGATCGATCG 3'

**Answer. (3) 3' UAGCUAGCUAGCUAGCUAGCUAGC 5'**

**Solution.** To determine the corresponding coding strand sequence, we need to remember the base pairing rules in DNA and RNA. In RNA, adenine (A) pairs with uracil (U), cytosine (C) pairs with guanine (G), and thymine (T) pairs with adenine (A) in DNA.

The given mRNA sequence is:

5' AUCGAUCGAUCGAUCGAUCG AUCG 3'

To find the corresponding coding strand sequence, we replace each base with its complementary base.

So, the corresponding coding strand sequence would be:

3' TAGCTAGCTAGCTAGCTAGC TAGC 5'

Therefore, the correct answer is (3) 3'  
UAGCUAGCUAGCUAGCUAGCUAGCUAGC 5'.

**Question 194.** The unique mammalian characteristics are:

- (1) pinna, monocondylic skull and mammary glands
- (2) hairs, tympanic membrane and mammary glands
- (3) hairs, pinna and mammary glands**
- (4) hairs, pinna and indirect development

**Answer. (3) hairs, pinna and mammary glands**

**Solution.** The correct answer is (3) hairs, pinna, and mammary glands.

The unique mammalian characteristics include:

1. Hairs: Mammals are characterized by the presence of hair, which is a unique feature among vertebrates. Hair provides insulation, protection, and sensory functions.
2. Pinna: The pinna refers to the external, visible part of the mammalian ear. It helps in collecting and funneling sound waves into the ear canal.
3. Mammary glands: Mammary glands are present in female mammals and produce milk for nourishing their young. They are a defining characteristic of mammals and play a vital role in reproductive and parental care.

Therefore, the combination of hairs, pinna, and mammary glands represents the unique mammalian characteristics.

**Question 196.** Which of the following statements are correct?

- A. Basophils are most abundant cells of the total WBCs
- B. Basophils secrete histamine, serotonin and heparin
- C. Basophils are involved in inflammatory response
- D. Basophils have kidney shaped nucleus
- E. Basophils are agranulocytes

Choose the correct answer from the options given below:

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

**Answer. (4) B and C only**

**Solution.** The correct answer is (4) B and C only.

Let's evaluate each statement:

A. Basophils are the most abundant cells of the total white blood cells (WBCs).

This statement is incorrect. Basophils are actually one of the least abundant types of white blood cells. Neutrophils are the most abundant type of WBCs.

B. Basophils secrete histamine, serotonin, and heparin.

This statement is correct. Basophils are involved in allergic reactions and immune responses. They release substances such as histamine, serotonin, and heparin, which play roles in inflammation, vasodilation, and blood clotting.

C. Basophils are involved in the inflammatory response.

This statement is correct. Basophils play a role in the body's inflammatory response. They release inflammatory mediators and recruit other immune cells to the site of inflammation.

D. Basophils have a kidney-shaped nucleus.

This statement is incorrect. Basophils have a lobed or irregularly shaped nucleus, not a kidney-shaped nucleus. The kidney-shaped nucleus is characteristic of monocytes.

E. Basophils are agranulocytes.

This statement is incorrect. Basophils are actually granulocytes. They have granules in their cytoplasm that contain various substances involved in immune responses.

Therefore, the correct answer is (4) B and C only, as both statements B and C are correct.

**Question 197.** Select the correct statements.

- A. Tetrad formation is seen during Leptotene.
- B. During Anaphase, the centromeres split and chromatids separate.
- C. Terminalization takes place during Pachytene.
- D. Nucleolus, Golgi complex and ER are reformed during Telophase.
- E. Crossing over takes place between sister chromatids of homologous chromosome.

Choose the correct answer from the options given below:

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

**Answer. (3) B and D only**

**Solution.** The correct answer is (3) B and D only.

Let's evaluate each statement:

A. Tetrad formation is seen during Leptotene.

This statement is incorrect. Tetrad formation, also known as synapsis, occurs during the zygotene stage of prophase I of meiosis, not during leptotene.

B. During Anaphase, the centromeres split and chromatids separate.

This statement is correct. During anaphase of both mitosis and meiosis II, the centromeres split, and the sister chromatids separate and move towards opposite poles of the cell.

C. Terminalization takes place during Pachytene.

This statement is incorrect. Terminalization, also known as chiasma formation, occurs during the pachytene stage of prophase I of meiosis. It is the process of crossing over between non-sister chromatids of homologous chromosomes.

D. Nucleolus, Golgi complex, and ER are reformed during Telophase.

This statement is correct. During telophase of both mitosis and meiosis, the nuclear envelope reforms around the separated chromosomes, and the nucleolus, Golgi complex, and endoplasmic reticulum (ER) reassemble.

E. Crossing over takes place between sister chromatids of homologous chromosomes.

This statement is incorrect. Crossing over occurs between non-sister chromatids of homologous chromosomes during prophase I of meiosis. It is the exchange of genetic material between homologous chromosomes, contributing to genetic diversity.

Therefore, the correct answer is (3) B and D only, as statements B and D are correct.

**Question 198.** In cockroach, excretion is brought about by



- A. Phallic gland
- B. Urecose gland
- C. Nephrocytes
- D. Fat body
- E. Collateral glands

Choose the correct answer from the options given below :

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

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

**Solution.** The correct answer is (4) B, C, and D only.

In cockroaches, excretion is brought about by multiple structures and organs. Let's evaluate each option:

A. Phallic gland: The phallic gland in cockroaches is not involved in excretion but is associated with the reproductive system.

B. Urecose gland: The urecose gland, also known as the Malpighian tubules, is responsible for excretion in cockroaches. These tubules remove metabolic waste products, such as nitrogenous compounds, from the hemolymph (the insect equivalent of blood) and excrete them as uric acid.

C. Nephrocytes: Nephrocytes are specialized cells found in insects that perform filtration and reabsorption functions similar to the kidneys in vertebrates. They are involved in excretory processes, including filtration and osmoregulation.

D. Fat body: The fat body in insects serves multiple functions, including energy storage, nutrient metabolism, and immune responses. While it has

some excretory functions related to waste management, it is not the primary excretory organ in cockroaches.

E. Collateral glands: The collateral glands in cockroaches are associated with the reproductive system and are involved in the production of sperm.

Therefore, the correct answer is (4) B, C, and D only, as the urecose gland, nephrocytes, and fat body are involved in excretion in cockroaches.

**Question 199. Match List I with List II.**

List I

- A. Mast cells
- B. Inner surface of bronchiole
- C. Blood
- D. Tubular parts of nephron

List II

- I. Ciliated epithelium
- II. Areolar connective tissue
- III. Cuboidal epithelium
- IV. Specialised connective tissue

Choose the correct answer from the options give below:

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

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

**Solution.** The correct answer is (4) A-II, B-I, C-IV, D-III.

Let's match the items from List I with the corresponding items from List II:

A. Mast cells - II. Areolar connective tissue

Mast cells are found in areolar connective tissue and play a role in immune responses, particularly allergic reactions.

B. Inner surface of bronchiole - I. Ciliated epithelium

The inner surface of the bronchioles is lined with ciliated epithelium, which helps in the movement of mucus and particles out of the respiratory tract.

C. Blood - IV. Specialised connective tissue

Blood is a type of specialized connective tissue that consists of cells (red and white blood cells) suspended in a liquid matrix called plasma.

D. Tubular parts of nephron - III. Cuboidal epithelium

The tubular parts of the nephron, such as the proximal convoluted tubule and distal convoluted tubule, are lined with cuboidal epithelium.

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