

## NEET 2022 (Re-Exam)

04 Aug 2022

## Question Paper with Solution

## Physics

1. An energy of 484 J is spent in increasing the speed of a flywheel from 60 rpm to 360 rpm. The moment of inertia of the flywheel is

- (1) 0.07 kg-m<sup>2</sup>                      (2) 0.7 kg-m<sup>2</sup>  
 (3) 3.22 kg-m<sup>2</sup>                      (4) 30.8 kg-m<sup>2</sup>

Sol. Answer (2)

$$\omega_i = 60 \text{ rpm} = 60 \times \frac{2\pi}{60} = 2\pi \text{ rad/s}$$

$$\omega_f = 360 \text{ rpm} = 360 \times \frac{2\pi}{60} = 12\pi \text{ rad/s}$$

$$\text{Energy spent} = \Delta KE = \frac{1}{2} I (\omega_f^2 - \omega_i^2)$$

$$486 = \frac{1}{2} \times I \times [(12\pi)^2 - (2\pi)^2]$$

$$I = \frac{2 \times 486}{140\pi^2} \approx 0.7 \text{ kg-m}^2$$

2. Let  $R_1$  be the radius of the second stationary and  $R_2$  be the radius of the fourth stationary orbit of an electron in Bohr's model. The ratio  $\frac{R_1}{R_2}$  is :

$$\frac{R_1}{R_2} \text{ is :}$$

- (1) 4                                      (2) 0.25  
 (3) 0.5                                      (4) 2

Sol. Answer (2)

$$R = 0.529 \times \frac{n^2}{Z} \text{ \AA}$$

$$\frac{R_1}{R_2} = \frac{2^2}{4^2} = \frac{1}{4}$$

3. During a cloudy day, a primary and a secondary rainbow may be created, then the :

- (1) secondary rainbow is due to single reflection and is formed above the primary one.  
 (2) primary rainbow is due to double internal reflection and is formed above the secondary one,  
 (3) primary rainbow is due to double internal reflection and is formed below the secondary one.  
 (4) secondary rainbow is due to double internal reflection and is formed above the primary one.

Sol. Answer (4)

Primary rainbow is formed due to 1st TIR while secondary rainbow is formed after 2nd TIR.

Secondary rainbow form above the primary rainbow

4. The reciprocal of resistance is :

- (1) conductance                      (2) reactance  
 (3) mobility                              (4) conductivity

Sol. Answer (1)

5. Two copper vessels A and B have the same base area but of different shapes. A take twice the volume of water as that B requires to fill upto a particular common height. Then the correct statement among the following is :

- (1) Vessel B weighs twice that of A.  
 (2) Pressure on the base area of vessels A and B is same.  
 (3) Pressure on the base area of A and B is not same.  
 (4) Both vessels A and B weigh the same.

Sol. Answer (2)

Since water is filled upto same height so pressure at the bottom will be same.

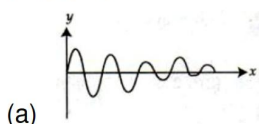
6. Match List - I with List - II:

**List - I**

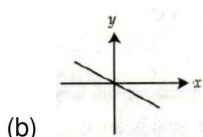
**(x-y graphs)**

**List-II**

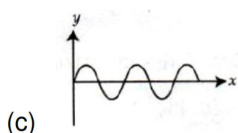
**(Situations)**



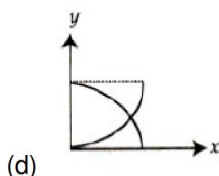
(i) Total mechanical energy is conserved



(ii) Bob of a pendulum is oscillating under negligible air friction



(iii) Restoring force of a spring



(iv) Bob of a pendulum is oscillating along with air friction

Choose the correct answer from the options given below:

- (1) (a) - (iii), (b) - (ii), (c) - (i), (d) - (iv)
- (2) (a) - (iv), (b) - (ii), (c) - (iii), (d) - (i)
- (3) (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)
- (4) (a) - (i), (b) - (iv), (c) - (iii), (d) - (ii)

Sol. Answer (3)

Graph (a) represents damped oscillation

$a \longrightarrow$  (iv)

Graph (b) represents restoring force of spring

$$F = -kx$$

$b \longrightarrow$  (iii)

Graph (c) represents undamped oscillations

$c \longrightarrow$  (ii)

Graph (d) represents total mechanical energy conservation

$d \longrightarrow$  (i)

7. The distance covered by a body of mass 5 g having linear momentum 0.3 kg m/s in 5 s is:

- (1) 0.3 m
- (2) 300 m
- (3) 30 m
- (4) 3 m

Sol. Answer (2)

$$P = mv$$

$$0.3 = \frac{5}{1000} \times v \Rightarrow v = 60 \text{ m/s}$$

$$\begin{aligned} \text{Distance travelled in 5s} &= 60 \times 5 \\ &= 300 \text{ m} \end{aligned}$$

8. The distance between the two plates of a parallel plate capacitor is doubled and the area of each plate is halved. If C is its initial capacitance, its final capacitance is equal to:

- (1)  $\frac{C}{4}$
- (2) 2 C
- (3)  $\frac{C}{2}$
- (4) 4 C

Sol. Answer (1)

$$C = \frac{A\epsilon_0}{d}$$

$$C' = \frac{\frac{A}{2}\epsilon_0}{2d} = \frac{C}{4}$$

9. A closely packed coil having 1000 turns has an average radius of 62.8 cm. If current carried by 62.8 cm the wire of the coil is 1 A the value of magnetic field produced at the centre of the coil will be (permeability of free space =  $4\pi \times 10^{-7}$  H/m) nearly .

- (1)  $10^{-3}$  T
- (2)  $10^{-1}$  T
- (3)  $10^{-2}$  T
- (4)  $10^2$  T

Sol. Answer (1)

$$B = \frac{\mu_0 n I}{2R}$$

$$= \frac{4\pi \times 10^{-7} \times 1000 \times 1}{2 \times 62.8 \times 10^{-2}}$$

$$10^{-3} \text{ T}$$

10. The magnetic field of a plane electromagnetic wave is given by

$$\vec{B} = 3 \times 10^{-5} \cos(1.6 \times 10^3 x + 48 \times 10^{10} t) \hat{j},$$

then the associated electric field will be:

- (1)  $9\cos(1.6 \times 10^3 x + 48 \times 10^{10} t) \hat{k} \text{ V/m}$   
 (2)  $3 \times 10^{-8} \cos(1.6 \times 10^3 x + 48 \times 10^{10} t) \hat{i} \text{ V/m}$   
 (3)  $3 \times 10^{-8} \sin(1.6 \times 10^3 x + 48 \times 10^{10} t) \hat{i} \text{ V/m}$   
 (4)  $9 \sin(1.6 \times 10^3 x - 48 \times 10^{10} t) \hat{k} \text{ V/m}$

Sol. Answer (1)

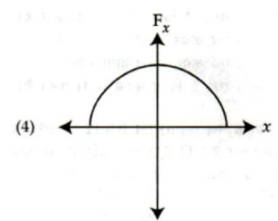
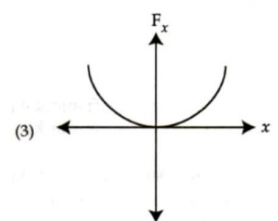
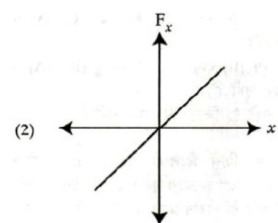
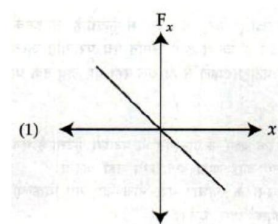
$$\begin{aligned} \frac{E_0}{B_0} &= C \Rightarrow E_0 = B_0 C \\ &= 3 \times 10^{-8} \times 3 \times 10^8 \\ &= 9 \text{ V/m} \end{aligned}$$

Phase of magnetic and electric field is same of travelling EM wave

$$\begin{aligned} \hat{E} &= \hat{B} \times \hat{C} \\ &= \hat{j} \times (-\hat{i}) = \hat{k} \end{aligned}$$

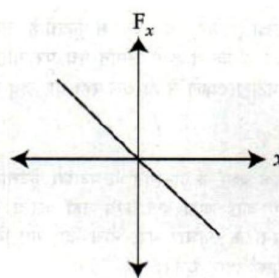
$$\vec{E} = 9\cos(1.6 \times 10^3 x + 48 \times 10^{10} t) \hat{k} \text{ V/m}$$

11. The restoring force of a spring with a block attached to the free end of the spring is represented by



Sol. Answer (1)

$$F = -kx$$



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

**Assertion (A) :**

When a fire cracker (rocket) explodes in mid air, its fragments fly in such a way that they continue moving in the same path, which the fire cracker would have followed, had it not exploded.

**Reason (R) :**

Explosion of cracker (rocket) occurs due to internal forces only and no external force acts for this explosion.

In the light of the above statements, choose the most appropriate answer from the 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

Sol. Answer (1)

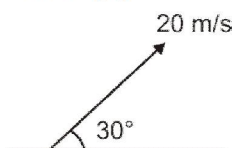
CoM of rocket follows the same path not the fragments. It is because the explosion takes place due to internal forces.

13. A cricket ball is thrown by a player at a speed of 20 m / s in a direction  $30^\circ$  above the horizontal. The maximum height attained by the ball during its motion is .

$$(g = 10 \text{ m/s}^2)$$

- (1) 25 m                      (2) 5 m  
 (3) 10 m                    (4) 20 m

Sol. Answer (2)





$$H = \frac{u^2 \sin^2 \theta}{2g}$$

$$= 5 \text{ m}$$

14. Given below are two statements .

**Statement I :**

In an ac circuit, the current through a capacitor leads the voltage across it.

**Statement II :**

In a.c circuits containing pure capacitance only, the phase difference between the current and the voltage is  $\pi$ .

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

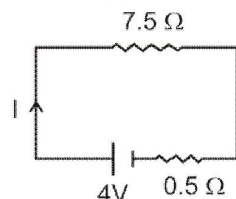
Sol. Answer (4)

In AC circuit current through the capacitor leads the potential difference across it by a phase  $\frac{\pi}{2}$ .

15. A cell of emf 4 V and internal resistance  $0.5 \Omega$  is connected to a  $7.5 \Omega$  external resistance. The terminal potential difference of the cell is .

- (1) 0.375 V
- (2) 3.75 V
- (3) 4.25 V
- (4) 4 V

Sol. Answer (2)



$$I = \frac{4}{7.5 + 0.5}$$

$$= 0.5 \text{ A}$$

$$\begin{aligned} \text{Terminal voltage} &= E - ir \\ &= 4 - 0.5 \times 0.5 \\ &= 3.75 \text{ V} \end{aligned}$$

16. An ideal gas follows a process described by the equation  $PV^2 = C$  from the initial  $(P_1, V_1, T_1)$  to final  $(P_2, V_2, T_2)$  thermodynamic states, where  $C$  is a constant. Then :

- (1) If  $P_1 > P_2$  then  $V_1 > V_2$
- (2) If  $P_1 > P_2$  then  $T_1 < T_2$
- (3) If  $V_2 > V_1$  then  $T_2 > T_1$
- (4) If  $V_2 > V_1$  then  $T_2 < T_1$

Sol. Answer (4)

$$PV^2 = C \Rightarrow TV = \text{const and } \frac{T^2}{P} = \text{const}$$

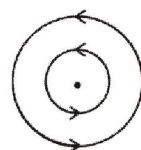
$$P \uparrow \Rightarrow V \downarrow \quad T \uparrow \Rightarrow V \downarrow \quad T \uparrow = P \uparrow$$

$$P_1 > P_2 \Rightarrow V_2 > V_1 \quad V_2 > V_1 \Rightarrow T_1 > T_2 \quad P_1 > P_2 = T_1 > T_2$$

17. The shape of the magnetic field lines due to an infinite long, straight current carrying conductor is :

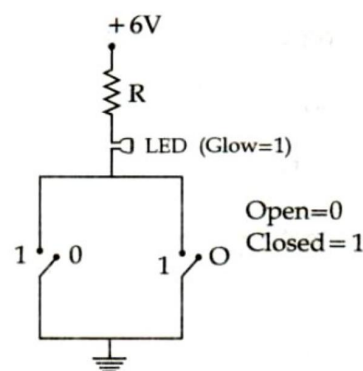
- (1) a plane
- (2) a straight line
- (3) circular
- (4) elliptical

Sol. Answer (3)



For infinite current carrying conductor MF lines are concentric circles.

- 18.



Identify the equivalent logic gate represented by the given circuit :

- (1) NAND
- (2) OR
- (3) NOR
- (4) AND

Sol. Answer (2)

When both inputs given as "O" means open circuit, no current flows through LED means "O".



If the inputs given as 0, 1 & 1, 0 & 1, 1 current flows through LED, it means "1".

Truth table same as "OR" gate.

19. The light rays having photons of energy 4.2 eV are falling on a metal surface having a work function of 2.2 eV. The stopping potential of the surface is :

- (1) 6.4 V (2) 2 eV  
(3) 2 V (4) 1.1 V

Sol. Answer (3)

Given  $h\nu = 4.2 \text{ eV}$

$w = 2.2 \text{ eV}$

$V_s = ?$

By Einstein's equation

$$h\nu = w + eV_s$$

$$4.2 \text{ eV} = 2.2 \text{ eV} + e \times V_s$$

$$2 \text{ eV} = eV_s$$

$$2 \times 1.6 \times 10^{-19} = 1.6 \times 10^{-19} \times V_s$$

$$V_s = 2 \text{ V}$$

20. Identify the function which represents a non periodic motion.

- (1)  $\sin(\omega t + \pi/4)$  (2)  $e^{-\omega t}$   
(3)  $\sin \omega t$  (4)  $\sin \omega t + \cos \omega t$

Sol. Answer (2)

Periodic motion is represented by sin & cosine (harmonic functions) functions.

$e^{-\omega t}$  is not harmonic function

21. An inductor of inductance 2 mH is connected to a 220 V, 50 Hz a.c. source. Let the inductive reactance in the circuit is  $X_1$ . If a 220 V dc source replaces the ac source in the circuit, then the inductive reactance in the circuit is  $X_2$ .  $X_1$  and  $X_2$  respectively are

- (1) 0.628  $\Omega$ , infinity (2) 6.28  $\Omega$ , zero  
(3) 6.28  $\Omega$ , infinity (4) 0.628  $\Omega$ , zero

Sol. Answer (4)

Given  $L = 2 \text{ mH}$ ,  $f = 50 \text{ Hz}$

when A. C. source is applied

$$X_1 = \omega L = 2\pi fL$$

$$= 2\pi \times 50 \times 2 \times 10^{-3}$$

$$= .628 \Omega$$

when D. C. source is applied

$$X_2 = \omega L = 2\pi fL$$

$$(\because f = 0)$$

$$X_2 = 0$$

22. The ratio of the magnitude of the magnetic field and electric field intensity of a plane electromagnetic wave in free space of permeability  $\mu_0$  and permittivity  $\epsilon_0$  is (Given that C - velocity of light in free space)

(1)  $\frac{\sqrt{\mu_0 \epsilon_0}}{c}$  (2)  $c$

(3)  $\frac{1}{c}$  (4)  $\frac{c}{\sqrt{\mu_0 \epsilon_0}}$

Sol. Answer (3)

We know  $|E| = C|B|$

$$\Rightarrow \frac{|B|}{|E|} = \frac{1}{C}$$

23. The threshold frequency of a photoelectric metal is  $\nu_0$ . If light of frequency  $4\nu_0$  is incident on this metal, then the maximum kinetic energy of emitted electrons will be

- (1)  $4 h\nu_0$  (2)  $h\nu_0$   
(3)  $2 h\nu_0$  (4)  $3 h\nu_0$

Sol. Answer (4)

Given  $\nu = 4\nu_0$

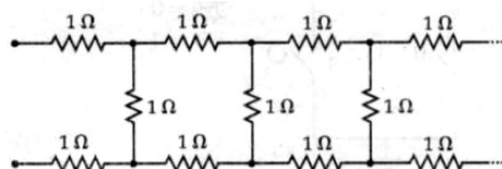
By photo electric equation

$$h\nu = h\nu_0 + K.E_{\max}$$

$$h \times 4\nu_0 = h\nu_0 + K.E_{\max}$$

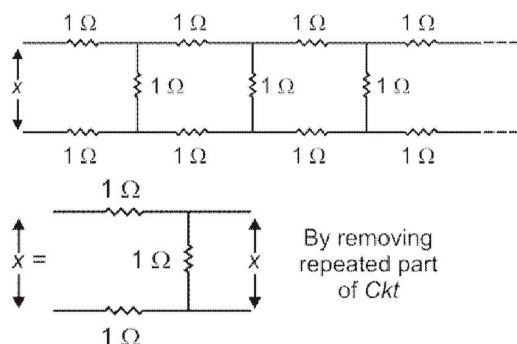
$$K.E_{\max} = 3h\nu_0$$

24. The equivalent resistance of the infinite network given below is :



- (1)  $(1 + \sqrt{5}) \Omega$  (2)  $2 \Omega$   
(3)  $(1 + \sqrt{2}) \Omega$  (4)  $(1 + \sqrt{3}) \Omega$

Sol. Answer (4)



$$\Rightarrow \frac{x \times 1}{x+1} + 2 = x$$

$$\Rightarrow x^2 - 2x - 2 = 0$$

$$\Rightarrow x = \frac{2 \pm 2\sqrt{3}}{2}$$

$$\Rightarrow x = 1 + \sqrt{3} \quad (\text{By neglecting } -ve \text{ resistance})$$

25. If the screen is moved away from the plane of the slits in a Young's double slit experiment, then the :

- (1) linear separation of the fringes decreases
- (2) angular separation of the fringes increases
- (3) angular separation of the fringes decreases
- (4) linear separation of the fringes increases

Sol. Answer (4)

We know fringe width

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

As  $D$  increases  $B$  increases.

i.e., Linear separation of fringes increases.

26. If  $\vec{F} = 2\hat{i} + \hat{j} - \hat{k}$  and  $\vec{r} = 3\hat{i} + 2\hat{j} - 2\hat{k}$ , then the scalar and vector products of  $\vec{F}$  and  $\vec{r}$  have the magnitudes respectively as :

- (1) 10, 2
- (2) 5,  $\sqrt{3}$
- (3) 4,  $\sqrt{5}$
- (4) 10,  $\sqrt{2}$

Sol. Answer (4)

$$\text{Given } \vec{F} = 2\hat{i} + \hat{j} - \hat{k}, \quad \vec{r} = 3\hat{i} + 2\hat{j} - 2\hat{k},$$

$$\text{Scalar product} = \vec{F} \cdot \vec{r}$$

$$= 2 \times 3 + 1 \times 2 + (-1) \times (-2)$$

$$= 6 + 2 + 2 = 10$$

$$\text{Vector product} = \vec{F} \times \vec{r}$$

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 1 & -1 \\ 3 & 2 & -2 \end{vmatrix} = \hat{i}(-2+2) - \hat{j}(-4+3) + \hat{k}(4-3)$$

$$\vec{F} \times \vec{r} = \hat{j} + \hat{k}$$

$$|\vec{F} \times \vec{r}| = \sqrt{2}$$

27. Given below are two statements:

**Statement I:** The law of radioactive decay states that the number of nuclei undergoing the decay per unit time is inversely proportional to the total number of nuclei in the sample.

**Statement II :** The half life of a radionuclide is the sum of the life time of all nuclei, divided by the initial concentration of the nuclei at time  $t = 0$ .

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

Sol. Answer (3)

According to Radioactive decay law,

$$-\frac{dN}{dt} \propto N \quad (\Rightarrow \text{Rate is directly proportional})$$

Half life is the duration in which half of the active nuclei decayed.

28. The physical quantity that has the same dimensional formula as pressure is:

- (1) Coefficient of viscosity
- (2) Force
- (3) Momentum
- (4) Young's modulus of elasticity

Sol. Answer (4)

$$\text{Pressure} = \frac{F}{A}$$

$$[P] = \frac{MLT^{-2}}{L^2} = ML^{-1}T^{-2}$$

$$\text{Young's modulus } Y = \frac{\text{Stress}}{\text{Strain}}$$

$$[Y] = \frac{\frac{F}{A}}{\frac{\Delta L}{L}} = \frac{MLT^{-2}}{L^2} = ML^{-1}T^{-2}$$

29. The effective capacitances of two capacitors are  $3 \mu F$  and  $16 \mu F$ , when they are connected in series and parallel respectively. The capacitance of two capacitors are:

- (1)  $1.2 \mu F$ ,  $1.8 \mu F$   
 (2)  $10 \mu F$ ,  $6 \mu F$   
 (3)  $8 \mu F$ ,  $8 \mu F$   
 (4)  $12 \mu F$ ,  $4 \mu F$

Sol. Answer (4)

Let the capacitances are  $C_1$  and  $C_2$

In series  $C_{\text{eff}} = 3 \mu F$

$$\Rightarrow \frac{C_1 C_2}{C_1 + C_2} = 3 \mu F \quad \dots (i)$$

In parallel  $C_{\text{eff}} = 16 \mu F$

$$\Rightarrow C_1 + C_2 = 16 \mu F \quad \dots (ii)$$

From (i) & (ii)

$$C_1 C_2 = 48 \mu F$$

$$(C_1 - C_2)^2 = (C_1 + C_2)^2 - 4C_1 C_2$$

$$C_1 - C_2 = 8 \mu F \quad \dots (iii)$$

From (ii) & (iii)

$$C_1 = 12 \mu F, C_2 = 4 \mu F$$

30. After passing through a polariser a linearly polarised light of intensity  $I$  is incident on an analyser making an angle of  $30^\circ$  with that of the polariser. The intensity of light emitted from the analyser will be:

- (1)  $\frac{2I}{3}$  (2)  $\frac{I}{2}$   
 (3)  $\frac{I}{3}$  (4)  $\frac{3I}{4}$

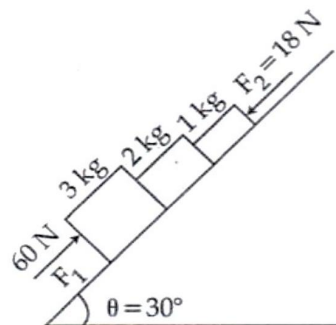
Sol. Answer (4)

By law of Malus, Intensity after analyser

$$I' = I \cos^2 30^\circ = I \times \frac{3}{4}$$

$$I' = \frac{3I}{4}$$

31. In the diagram shown, the normal reaction force between  $2 \text{ kg}$  and  $1 \text{ kg}$  is (Consider the surface, to be smooth) : Given  $g = 10 \text{ ms}^{-2}$

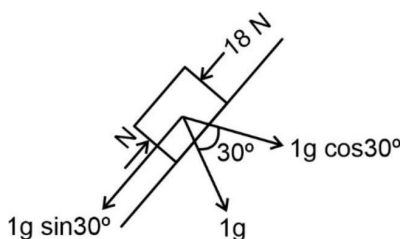


- (1)  $10 \text{ N}$  (2)  $25 \text{ N}$   
 (3)  $39 \text{ N}$  (4)  $6 \text{ N}$

Sol. Answer (2)

$$a = \frac{\text{Net pulling force}}{M_{\text{total}}} \quad (\text{up the inclined})$$

$$a = \frac{60 - 18 - (3 + 2 + 1)g \sin 30^\circ}{3 + 2 + 1} = \frac{12}{6} = 2 \text{ m/s}^2$$



By taking F.B.D. of  $1 \text{ kg}$

$$ma = N - 18 - 1 \times 10 \times \frac{1}{2}$$

$$\Rightarrow 2 = N - 23$$

$$\Rightarrow N = 25 \text{ N}$$

32. The incorrect statement about the property of a Zener diode is:

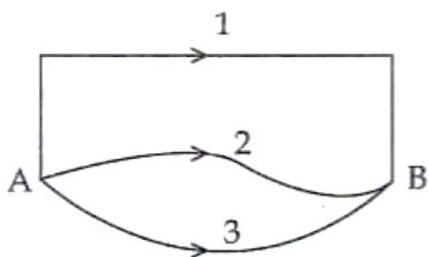
- (1) p and n regions of zener diode are heavily doped  
 (2) Zener voltage remains constant at breakdown  
 (3) It is designed to operate under reverse bias  
 (4) Depletion region formed is very wide

Sol. Answer (4)

Depletion region of Zener diode is not very wide.

33. A gravitational field is present in a region and a mass is shifted from A to B through different paths as shown. If  $W_1$ ,  $W_2$  and  $W_3$  represent the work done by the gravitational force along the respective paths, then:





- (1)  $W_1 < W_2 < W_3$   
 (2)  $W_1 = W_2 = W_3$   
 (3)  $W_1 > W_2 > W_3$   
 (4)  $W_1 > W_3 > W_2$

Sol. Answer (2)

Gravitational force is a conservative force work done by conservative force is path independent.

Hence,  $\therefore W_1 = W_2 = W_3$

34. A standard filament lamp consumes 100 W when connected to 200 V ac mains supply. The peak current through the bulb will be:

- (1) 2 A (2) 0.707 A  
 (3) 1 A (4) 1.414

Sol. Answer (2)

Given,  $P = 100 \text{ W}$

$V_{\text{rms}} = 200 \text{ V}$

$$i_{\text{rms}} = \frac{P}{V_{\text{rms}}} = \frac{1}{2}$$

$$i_0 = i_{\text{rms}} \times \sqrt{2} = \frac{1}{\sqrt{2}}$$

$$i_0 = 0.707 \text{ A}$$

35. A The terminal velocity of a copper ball of radius 5 mm falling through a tank of oil at room temperature is  $10 \text{ cm s}^{-1}$ . If the viscosity of oil at room temperature is  $0.9 \text{ kg m}^{-1} \text{ s}^{-1}$ , the viscous drag force is:

- (1)  $4.23 \times 10^{-6} \text{ N}$   
 (2)  $8.48 \times 10^{-3} \text{ N}$   
 (3)  $8.48 \times 10^{-5} \text{ N}$   
 (4)  $4.23 \times 10^{-3} \text{ N}$

Sol. Answer (2)

Given,  $r = 5 \text{ mm} = 5 \times 10^{-3} \text{ m}$

$V_t = 10 \text{ cm s}^{-1} = 10 \times 10^{-2} \text{ m s}^{-1}$

Viscous drag force

$$F = 6\pi\eta rV_t$$

$$F = 6 \times \pi \times 0.9 \times 5 \times 10^{-3} \times 10 \times 10^{-2}$$

$$F = 84.78 \times 10^{-4}$$

$$F = 8.478 \times 10^{-3} \text{ N}$$

36. In a gravitational field, the gravitational potential is given by,  $V = -\frac{K}{x} (\text{J/kg})$ .

The gravitational field intensity at point (2, 0, 3)m is :

- (1)  $+\frac{K}{4}$  (2)  $+\frac{K}{2}$   
 (3)  $-\frac{K}{2}$  (4)  $-\frac{K}{4}$

Sol. Answer (4)

$$v(x) = -\frac{K}{x}$$

$$E_g = -\frac{dv}{dx} = -\frac{d}{dx}\left(-\frac{K}{x}\right)$$

$$\vec{E}_g = -\frac{K}{x^2} \hat{i}$$

$$\text{Now } |\vec{E}_g(2,0,3)| = \frac{-K}{(2)^2} = \frac{-K}{4}$$

37. The percentage error in the measurement of  $g$  is :

(Given that  $g = \frac{4\pi^2 L}{T^2}$ ,  $L = (10 \pm 0.1) \text{ cm}$ ,

$T = (100 \pm 1) \text{ s}$ )

- (1) 7% (2) 2%  
 (3) 5% (4) 3%

Sol. Answer (4)

$$g = \frac{4\pi^2 L}{T^2}$$

$$\frac{\Delta g}{g} \times 100 = \frac{\Delta L}{L} \times 100 + 2 \frac{\Delta T}{T} \times 100$$

$$= \left(\frac{0.1}{10} \times 100\right) + 2 \left[\frac{1}{100} \times 100\right]$$

$$\frac{\Delta g}{g} \times 100 = 1 + 2 = 3\%$$

38. Two very long, straight, parallel conductors A and B carry current of 5 A and 10 A respectively and are at a distance of 10 cm from each other. The direction of current in two conductors is same. The force acting

per unit length between two conductors is:  
( $\mu_0 = 4\pi \times 10^{-7}$  SI unit)

- (1)  $1 \times 10^{-4} \text{ Nm}^{-1}$  and is repulsive
- (2)  $2 \times 10^{-4} \text{ Nm}^{-1}$  and is attractive
- (3)  $2 \times 10^{-4} \text{ Nm}^{-1}$  and is repulsive
- (4)  $1 \times 10^{-4} \text{ Nm}^{-1}$  and is attractive

Sol. Answer (4)

Two parallel wires carrying current in same direction will attract each other.

$$\frac{F}{l} = \frac{\mu_0 i_1 i_2}{2\pi d} = \frac{2 \times 10^{-7} \times 5 \times 10}{10 \times 10^{-2}} = 10^{-4} \text{ N/m}$$

39. The magnetic field on the axis of a circular loop of radius 100 cm carrying current  $I = \sqrt{2} \text{ A}$ , at point 1 m away from the centre of the loop is given by:

- (1)  $6.28 \times 10^{-4} \text{ T}$
- (2)  $3.14 \times 10^{-7} \text{ T}$
- (3)  $6.28 \times 10^{-7} \text{ T}$
- (4)  $3.14 \times 10^{-4} \text{ T}$

Sol. Answer (2)

$$\text{On axis of wire } B = \frac{\mu_0 I R^2}{2(R^2 + x^2)^{3/2}}$$

$$= \frac{4\pi \times 10^{-7} \times \sqrt{2} \times 1^2}{2(1^2 + 1^2)^{3/2}}$$

$$= \frac{4\pi \times 10^{-7} \times \sqrt{2}}{2 \times 2\sqrt{2}} = \pi \times 10^{-7} \text{ T}$$

$$= 3.14 \times 10^{-7} \text{ T}$$

40. At any instant, two elements  $X_1$  and  $X_2$  have same number of radioactive atoms. If the decay constant of  $X_1$  and  $X_2$  are  $10\lambda$  and  $\lambda$  respectively, then the time when the ratio of their atoms becomes  $\frac{1}{e}$  respectively will be :

- (1)  $\frac{1}{5\lambda}$
- (2)  $\frac{1}{11\lambda}$
- (3)  $\frac{1}{9\lambda}$
- (4)  $\frac{1}{6\lambda}$

Sol. Answer (3)

$$N_x = N_0 e^{-\lambda_x t}$$

$$N_y = N_0 e^{-\lambda_y t}$$

$$\frac{N_x}{N_y} = e^{-(\lambda_x - \lambda_y)t}$$

$$\frac{1}{e} = e^{-(\lambda_x - \lambda_y)t}$$

$$\Rightarrow e^{-1} = e^{-(\lambda_x - \lambda_y)t}$$

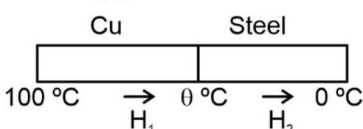
$$(\lambda_x - \lambda_y)t = 1$$

$$t = \frac{1}{\lambda_x - \lambda_y} = \frac{1}{10\lambda - 1\lambda} = \frac{1}{9\lambda}$$

41. Two rods one made of copper and other made of steel of the same length and same cross sectional area are joined together. The thermal conductivity of copper and steel are  $385 \text{ J s}^{-1} \text{ K}^{-1} \text{ m}^{-1}$  and  $50 \text{ J s}^{-1} \text{ K}^{-1} \text{ m}^{-1}$  respectively. The free ends of copper and steel are held at  $100^\circ\text{C}$  and  $0^\circ\text{C}$  respectively. The temperature at the junction is, nearly:

- (1)  $88.5^\circ\text{C}$
- (2)  $12^\circ\text{C}$
- (3)  $50^\circ\text{C}$
- (4)  $73^\circ\text{C}$

Sol. Answer (1)



$$H_1 = H_2$$

$$\frac{K_{Cu} A [100 - \theta]}{l} = \frac{K_{steel} A [\theta - 0]}{l}$$

$$385 [100 - \theta] = 50 [\theta - 0]$$

$$\Rightarrow \theta = 88.5^\circ\text{C} \text{ [junction temperature]}$$

42. The ratio of Coulomb's electrostatic force to the gravitational force between an electron and a proton separated by some distance is  $2.4 \times 10^{39}$ . The ratio of the proportionality constant,  $K = \frac{1}{4\pi\epsilon_0}$  to the Gravitational

constant  $G$  is nearly (Given that the charge of the proton and electron each =  $1.6 \times 10^{-19} \text{ C}$ , the mass of the electron =  $9.11 \times 10^{-31} \text{ kg}$ , the mass of the proton =  $1.67 \times 10^{-27} \text{ kg}$ ) :

- (1) 10
- (2)  $10^{20}$
- (3)  $10^{30}$
- (4)  $10^{40}$

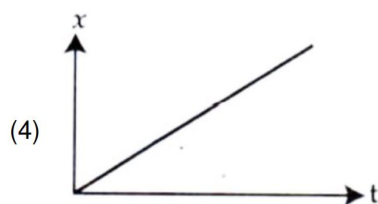
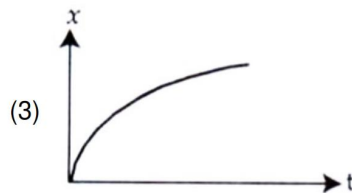
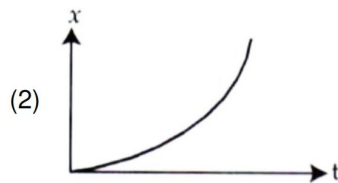
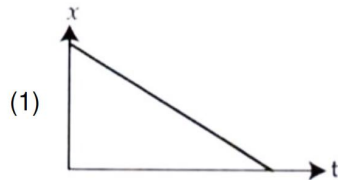
Sol. Answer (2)

$$\frac{F_G}{F_e} = \frac{\frac{kq_1 q_2}{r^2}}{\frac{Gm_1 m_2}{r^2}} = \frac{k}{G} \frac{(1.6 \times 10^{-19})^2}{(1.67 \times 9.11) \times 10^{-58}}$$

$$2.4 \times 10^{39} = \frac{k}{G} \frac{1.6 \times 1.6 \times 10^{-38}}{(1.67 \times 9.11) \times 10^{-58}}$$

$$\frac{k}{G} \approx 10^{20}$$

43. The position-time ( $x-t$ ) graph for positive acceleration is :

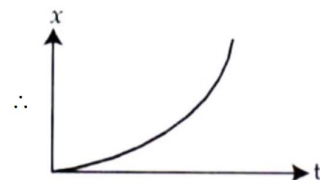


Sol. Answer (2)

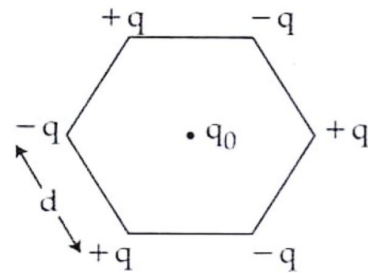
+ve acceleration

$$\frac{dv}{dt} > 0 \text{ so, velocity is increasing}$$

$\Rightarrow$  slop of  $x-t$  graph is increasing



44. Six charges  $+q, -q, +q, -q, +q$  and  $-q$  are fixed at the corners of a hexagon of side  $d$  as shown in the figure. The work done in bringing a charge  $q_0$  to the centre of the hexagon from infinity is : ( $\epsilon_0$  - permittivity of free space)



(1)  $\frac{-q^2}{4\pi\epsilon_0 d} \left( 6 - \frac{1}{\sqrt{2}} \right)$

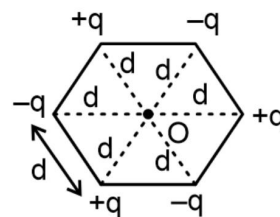
(2) Zero

(3)  $\frac{-q^2}{4\pi\epsilon_0 d}$

(4)  $\frac{-q^2}{4\pi\epsilon_0 d} \left( 3 - \frac{1}{\sqrt{2}} \right)$

Sol. Answer (2)

Potential at the centre of hexagon is zero.



$$V_0 = 0$$

$$\therefore w_{\infty \rightarrow 0} = q\Delta v = q_0(0)$$

$$= 0$$

45. An astronomical refracting telescope is being used by an observer to observe planets in normal adjustment. The focal lengths of the objective and eye piece used in the construction of the telescope are 20 m and 2 cm respectively. Consider the following statements about the telescope :

- The distance between the objective and eyepiece is 20.02 m
- The magnification of the telescope is  $(-)$  1000
- The image of the planet is erect and diminished
- The aperture of eye piece is smaller than that of objective

The correct statements are :

- (1) (a), (b) and (d)
- (2) (a), (b) and (c)
- (3) (b), (c) and (d)



(4) (c), (d) and (a)

Sol. Answer (1)

In normal adjustment of Astronomical Telescope final image is formed at infinity & inverted image is formed.

$$m = -\frac{f_o}{f_e} = -\frac{20}{2 \times 10^{-2}} = -1000$$

$$L = f_o + f_e = 20 + 0.02 = 20.02$$

Aperture of eye piece is smaller than that of objective.

So, statement (a), (b) & (d) are correct.

46. The magnetic flux linked to a circular coil of radius  $R$  is :

$$\phi = 2t^3 + 4t^2 + 2t + 5 \text{ Wb}$$

The magnitude of induced emf in the coil at  $t=5$  s is:

(1) 192 V

(2) 108 V

(3) 197 V

(4) 150 V

Sol. Answer (1)

$$\phi = 2t^3 + 4t^2 + 2t + 5$$

$$|e| = \left| \frac{d\phi}{dt} \right| = \frac{d}{dt} [2t^3 + 4t^2 + 2t + 5] = 6t^2 + 8t + 2$$

$$e(t) = 6t^2 + 8t + 2$$

$$e(t=5) = 6(5)^2 + 8(5) + 2$$

$$= 150 + 40 + 2$$

$$= 192 \text{ V}$$

47. Three vessels of equal capacity have gases at the same temperature and pressure. The first vessel contains helium (monoatomic), the second contains fluorine (diatomic) and the third contains sulfur hexafluoride (polyatomic). The correct statement, among the following is:

- (1) The root mean square speed of sulfur hexafluoride is the largest
- (2) All vessels contain unequal number of respective molecules
- (3) The root mean square speed of molecules is same in all three cases
- (4) The root mean square speed of helium is the largest

Sol. Answer (4)

$$v_{rms} = \sqrt{\frac{3RT}{M}}$$

Concept :  $v_{rms}$  is independent of degree of freedom.

$M_{\text{Helium}}$  is smallest among all given so,  $v_{rms}$  for Helium is maximum.

48. An organ pipe filled with a gas at  $27^\circ\text{C}$  resonates at 400 Hz in its fundamental mode. If it is filled with the same gas at  $90^\circ\text{C}$ , the resonance frequency at the same mode will be:

(1) 512 Hz

(2) 420 Hz

(3) 440 Hz

(4) 484 Hz

Sol. Answer (3)

We know

$$f = \frac{v}{\lambda}$$

Velocity of sound  $\propto \sqrt{T}$

$$\frac{f_1}{f_2} = \sqrt{\frac{T_1}{T_2}}$$

$$\frac{400}{f_2} = \sqrt{\frac{273+27}{273+90}} = \sqrt{\frac{300}{363}} = \frac{1}{1.1}$$

$$\Rightarrow f_2 = 440 \text{ Hz}$$

49. The collector current in a common base amplifier using n-p-n transistor is 24 mA. If 80% of the electrons released by the emitter is accepted by the collector, then the base current is numerically:

(1) 3 mA and entering the base

(2) 6 mA and leaving the base

(3) 3 mA and leaving the base

(4) 6 mA and entering the base

Sol. Answer (4)

$$I_c = 24 \text{ mA}$$

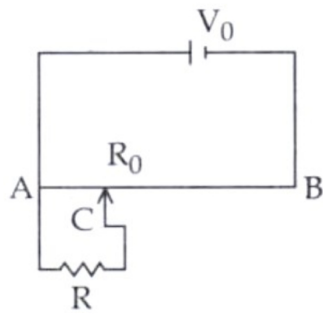
$$I_c = 80\% \text{ of } I_E$$

$$\therefore I_E = 30 \text{ mA}$$

$$\therefore I_B = 6 \text{ mA entering the base}$$

50. The sliding contact C is at one fourth of the length of the potentiometer wire (AB) from A as shown in the circuit diagram. If the resistance

of the wire AB is  $R_0$ , then the potential drop (V) across the resistor R is



- (1)  $\frac{2 V_0 R}{2 R_0 + 3 R}$       (2)  $\frac{4 V_0 R}{3 R_0 + 16 R}$   
 (3)  $\frac{4 V_0 R}{3 R_0 + R}$       (4)  $\frac{2 V_0 R}{4 R_0 + R}$

Sol. Answer (2)

$$R_{eq} = \frac{\frac{R_0}{4} \times R}{\frac{R_0}{4} + R} + \frac{3R_0}{4} = \frac{R_0(16R + 3R_0)}{4(R_0 + 4R)}$$

$$\left( I = \frac{V}{R_{eq}} \right)$$

$$\therefore V_R = I \frac{\frac{R_0}{4} \times R}{\frac{R_0}{4} + R} = \left( \frac{4V_0 R}{16R + 3R_0} \right)$$

## Chemistry

51. Match List - I with List - II :

| List - I<br>(quantum number) | List- II<br>(orbital) |
|------------------------------|-----------------------|
| (a) $n = 2, \ell = 1$        | (i) 2 s               |
| (b) $n = 3, \ell = 2$        | (ii) 3 s              |
| (c) $n = 3, \ell = 0$        | (iii) 2 p             |
| (d) $n = 2, \ell = 0$        | (iv) 3 d              |

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

- (1) (a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)
- (2) (a) - (iii), (b) - (iv), (c) - (i), (d) - (ii)
- (3) (a) - (iv), (b) - (iii), (c) - (i), (d) - (ii)
- (4) (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)

**Sol.** Answer (1)

$\ell = 0 \Rightarrow$  s-subshell

$\ell = 1 \Rightarrow$  p-subshell

$\ell = 2 \Rightarrow$  d-subshell

$\ell = 3 \Rightarrow$  f-subshell

$\therefore n = 2, \ell = 1 \Rightarrow 2 p$

$n = 3, \ell = 2 \Rightarrow 3 d$

$n = 3, \ell = 0 \Rightarrow 3 s$

$n = 2, \ell = 0 \Rightarrow 2 s$

52. The density of the solution is  $2.15 \text{ g mL}^{-1}$ , then mass of 2.5 mL solution in correct significant figures is :

- |             |                                     |
|-------------|-------------------------------------|
| (1) 53.75 g | (2) $5375 \times 10^{-3} \text{ g}$ |
| (3) 5.4 g   | (4) 5.38 g                          |

**Sol.** Answer (3)

In case of multiplication and division, the final result should be reported as having the same number of significant digits as the number with least number of significant digits.

$$\therefore \text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

So, Mass =  $2.15 \times 2.5$

= 5.375

$\approx 5.4 \text{ g}$

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

**Assertion (A) :**

Chlorine is an electron withdrawing group but it is ortho, para directing in electrophilic aromatic substitution.

**Reason (R) :**

Inductive effect of chlorine destabilises the intermediate carbocation formed during the electrophilic substitution, however due to the more pronounced resonance effect, the halogen stabilises the carbocation at ortho and para positions.

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

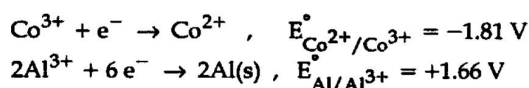
- (1) (A) is not correct but (R) is correct.
- (2) Both (A) and (R) are correct and (R) is the correct explanation of (A).
- (3) Both (A) and (R) are correct but (R) is not the correct explanation of (A).
- (4) (A) is correct but (R) is not correct.



**Sol.** Answer (4)

Halogen are electron withdrawing groups due to high electronegativity. They have high electron withdrawing inductive effect. In electrophilic substitution reaction it shows both electron withdrawing inductive effect and electron donating resonance effect, but inductive effect overpowers resonance effect so, it deactivates benzene ring and directs the incoming electrophile to ortho and para positions. So, here assertion is correct and Reason is false.

54. Two half cell reactions are given below.



The standard EMF of a cell with feasible redox reaction will be :

- (1)  $-3.47 \text{ V}$                       (2)  $+7.09 \text{ V}$   
 (3)  $+0.15 \text{ V}$                       (4)  $+3.47 \text{ V}$

**Sol.** Answer (4)

$$E_{\text{Cell}}^\circ = (E_c^\circ - E_a^\circ)_{\text{RP}}$$

$$= 1.81 - (-1.66)$$

$$= 1.81 + 1.66$$

$$= 3.47 \text{ V}$$

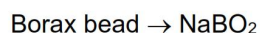
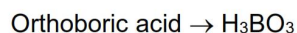
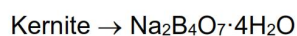
55. Match List - I with List - II :

| List - I<br>(Compounds) | List - II<br>(Molecular formula)                                   |
|-------------------------|--------------------------------------------------------------------|
| (a) Borax               | (i) $\text{NaBO}_2$                                                |
| (b) Kernite             | (ii) $\text{Na}_2\text{B}_4\text{O}_7 \cdot 4 \text{H}_2\text{O}$  |
| (c) Orthoboric acid     | (iii) $\text{H}_3\text{BO}_3$                                      |
| (d) Borax bead          | (iv) $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10 \text{H}_2\text{O}$ |

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

- (1) (a) - (i), (b) - (iii), (c) - (iv), (d) - (ii)  
 (2) (a) - (iv), (b) - (ii), (c) - (iii), (d) - (i)  
 (3) (a) - (ii), (b) - (iv), (c) - (iii), (d) - (i)  
 (4) (a) - (iii), (b) - (i), (c) - (iv), (d) - (ii)

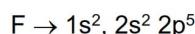
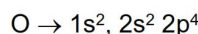
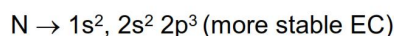
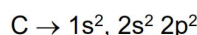
**Sol.** Answer (2)



56. The correct order of first ionization enthalpy for the given four elements is :

- (1)  $\text{C} < \text{F} < \text{N} < \text{O}$       (2)  $\text{C} < \text{N} < \text{F} < \text{O}$   
 (3)  $\text{C} < \text{N} < \text{O} < \text{F}$       (4)  $\text{C} < \text{O} < \text{N} < \text{F}$

**Sol.** Answer (4)



$\therefore$  order of first IE is  $\text{C} < \text{O} < \text{N} < \text{F}$

57. Match List - I with List - II :

| List - I<br>(Defects)   | List - II<br>(shown by)                                           |
|-------------------------|-------------------------------------------------------------------|
| (a) Frenkel defect      | (i) non-ionic solids<br>and density of the<br>solid decreases     |
| (b) Schottky defect     | (ii) non-ionic solids<br>and density of the<br>solid increases    |
| (c) Vacancy defect      | (iii) ionic solids and<br>density of the solid<br>decreases       |
| (d) Interstitial defect | (iv) ionic solids and<br>density of the solid<br>remains constant |

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

- (1) (a) - (iv), (b) - (iii), (c) - (i), (d) - (ii)  
 (2) (a) - (i), (b) - (ii), (c) - (iii), (d) - (iv)  
 (3) (a) - (i), (b) - (iii), (c) - (ii), (d) - (iv)  
 (4) (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)

**Sol.** Answer (1)

Schottky and Frenkel defects are shown by ionic solids and in this density decreases and remains same respectively.

Vacancy and Interstitial defects are shown by non-ionic solid and in this density decreases and increases respectively.

Hence (a) - (iv), (b) - (iii), (c) - (i), (d) - (ii)

58. Predict the order of reactivity of the following four isomers towards  $S_N2$  reaction.

- (I)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$   
 (II)  $\text{CH}_3\text{CH}_2\text{CH}(\text{Cl})\text{CH}_3$   
 (III)  $(\text{CH}_3)_2\text{CHCH}_2\text{Cl}$   
 (IV)  $(\text{CH}_3)_3\text{CCl}$   
 (1) (IV) > (II) > (III) > (I)  
 (2) (IV) > (III) > (II) > (I)  
 (3) (I) > (II) > (III) > (IV)  
 (4) (I) > (III) > (II) > (IV)

**Sol.** Answer (4)

Greater the steric hindrance, lesser will be the rate of  $S_N2$  reaction. So order of reactivity of  $S_N2$  reaction is- (I) > (III) > (II) > (IV)

59. Match List - I with List - II :

| List - I<br>(molecules) | List - II<br>(shape)      |
|-------------------------|---------------------------|
| (a) $\text{NH}_3$       | (i) square pyramidal      |
| (b) $\text{ClF}_3$      | (ii) trigonal bipyramidal |
| (c) $\text{PCl}_5$      | (iii) trigonal pyramidal  |
| (d) $\text{BrF}_5$      | (iv) T-shape              |

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

- (1) (a) - (iii), (b) - (iv), (c) - (i), (d) - (ii)  
 (2) (a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)  
 (3) (a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)  
 (4) (a) - (iv), (b) - (iii), (c) - (i), (d) - (ii)

**Sol.** Answer (3)

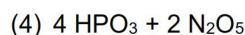
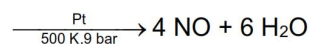
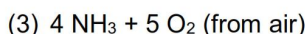
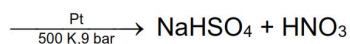
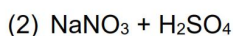
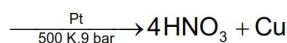
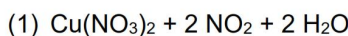
$\text{NH}_3 \rightarrow$  Trigonal pyramidal

$\text{ClF}_3 \rightarrow$  T-shape

$\text{PCl}_5 \rightarrow$  Trigonal bipyramidal

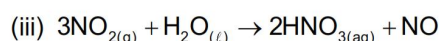
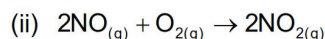
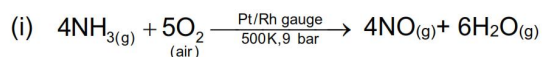
$\text{BrF}_5 \rightarrow$  Square pyramidal

60. Which of the following reactions is a part of the large scale industrial preparation of nitric acid



**Sol.** Answer (3)

On large scale, nitric acid is prepared by Ostwald's process.



61. Match List - I with List - II :

| List - I                             | List - II                |
|--------------------------------------|--------------------------|
| (a) Sodium laurylsulphate            | (i) Toilet soap          |
| (b) Cetyltrimethyl ammonium chloride | (ii) Non-ionic detergent |
| (c) Sodium stearate                  | (iii) Anionic detergent  |
| (d) Polyethyleneglycol stearate      | (iv) Cationic detergent  |

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

- (1) (a) - (iii), (b) - (i), (c) - (ii), (d) - (iv)  
 (2) (a) - (iv), (b) - (iii), (c) - (i), (d) - (ii)  
 (3) (a) - (i), (b) - (iv), (c) - (ii), (d) - (iii)  
 (4) (a) - (iii), (b) - (iv), (c) - (i), (d) - (ii)

**Sol.** Answer (4)

(a) Sodium laurylsulphate  $\rightarrow$  Anionic detergent

(b) Cetyltrimethylammonium chloride  $\rightarrow$  cationic detergent

(c) Sodium stearate  $\rightarrow$  Toilet soap

(d) Polyethyleneglycol stearate  $\rightarrow$  Non-ionic detergent

62. Which among the following is a thermoplastic polymer ?

- (1) Melamine polymer  
 (2) Bakelite  
 (3) Polythene  
 (4) Urea-formaldehyde resin

**Sol. Answer (3)**

Polythene, Polystyrene, polyvinyls etc. are thermoplastic polymers

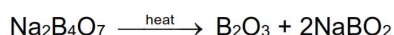


in the above reaction the product "X" is :

- (1)  $\text{NaB}_3\text{O}_5$  (2)  $\text{H}_3\text{BO}_3$   
(3)  $\text{B}_2\text{O}_3$  (4)  $\text{Na}_2\text{B}_2\text{O}_5$

**Sol. Answer (3)**

Borax on strong heating produces Boric anhydride and sodium metaborate



64. One mole of an ideal gas at 300 K is expanded isothermally from 1 L to 10 L volume.  $\Delta U$  for this process is :

(Use  $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ )

- (1) 0 J (2) 1260 J  
(3) 2520 J (4) 5040 J

**Sol. Answer (1)**

In isothermal expansion/compression of ideal gas

$\Delta U = nC_v\Delta T, (\Delta T = 0)$

$\therefore \Delta U = 0$

65. Match List - I with List - II :

**List - I** **List - II**  
**(Complexes)** **(Types)**

- (a)  $[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{Cl}_2$  (i) ionisation  
and  $[\text{Co}(\text{NH}_3)_5\text{ONO}]\text{Cl}_2$  isomerism  
(b)  $[\text{Cr}(\text{NH}_3)_6][\text{Co}(\text{CN})_6]$  (ii) coordination  
and  $[\text{Cr}(\text{CN})_6][\text{Co}(\text{NH}_3)_6]$  isomerism  
(c)  $[\text{Co}(\text{NH}_3)_5(\text{SO}_4)]\text{Br}$  (iii) linkage  
and  $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$  isomerism  
(d)  $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$  and (iv) solvate  
 $[\text{Cr}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}_2 \cdot \text{H}_2\text{O}$  isomerism

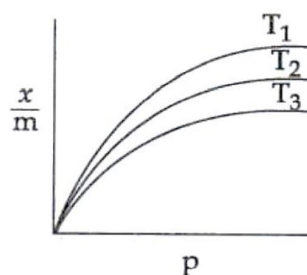
Choose the **correct answer** from the options given below :

- (1) (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)  
(2) (a) - (iii), (b) - (i), (c) - (ii), (d) - (iv)  
(3) (a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)  
(4) (a) - (iii), (b) - (ii), (c) - (i), (d) - (iv)

**Sol. Answer (4)**

- (a)  $[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{Cl}_2$  (iii) Linkage  
and  $[\text{Co}(\text{NH}_3)_5\text{ONO}]\text{Cl}_2$  isomerism due  
to ambidentate  
ligand  
(b)  $[\text{Cr}(\text{NH}_3)_6][\text{Co}(\text{CN})_6]$  (ii) coordination  
and  $[\text{Cr}(\text{CN})_6][\text{Co}(\text{NH}_3)_6]$  isomerism due  
to exchange of  
ligands between  
coordination  
spheres  
(c)  $[\text{Co}(\text{NH}_3)_5(\text{SO}_4)]\text{Br}$  (i) ionisation  
and  $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$  isomerism due  
to formation of  
different ions on  
ionisation  
(d)  $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$  and (iv) solvate  
 $[\text{Cr}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}_2 \cdot \text{H}_2\text{O}$  isomerism as  
no. of water  
molecules as  
ligand and  
water of  
crystallisation is  
different

66. Shown below are adsorption isotherms for a gas 'X' at temperatures  $T_1$ ,  $T_2$  and  $T_3$  :



$p$  and  $\frac{x}{m}$  represent pressure and extent of adsorption, respectively. The correct order of temperatures for the given, adsorption is :

- (1)  $T_1 = T_2 > T_3$   
(2)  $T_1 > T_2 > T_3$   
(3)  $T_3 > T_2 > T_1$   
(4)  $T_1 = T_2 = T_3$



**Sol.** Answer (3)

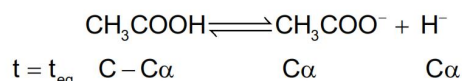
As the temperature increases the extent of adsorption of a gas on solid surfaces decreases.

$$(T_3 > T_2 > T_1)$$

67. 0.01 M acetic acid solution is 1% ionised, then pH of this acetic acid solution is :

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

**Sol.** Answer (4)



$$[\text{H}^+] = C\alpha$$

$$= 0.01 \times \frac{1}{100} = 10^{-4}$$

$$\text{pH} = -\log_{10}[\text{H}^+]$$

$$= 4$$

68. The half life of a first order reaction is 2000 years. If the concentration after 8000 years is 0.02 M, then the initial concentration was:

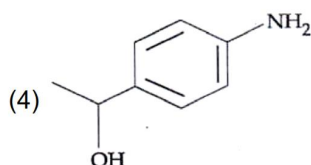
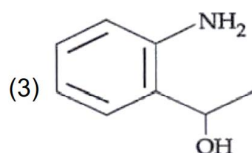
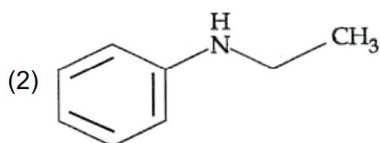
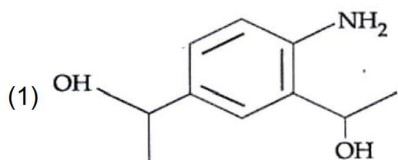
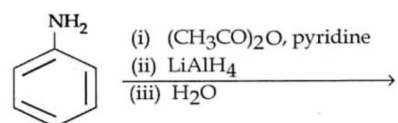
- (1) 0.04 M (2) 0.16 M  
(3) 0.32 M (4) 0.08 M

**Sol.** Answer (3)

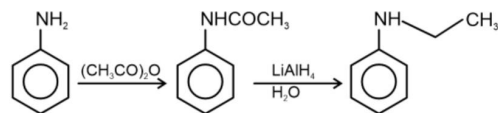
$$n = \frac{t}{t_{1/2}} = \frac{8000}{2000} = 4, \text{ (no. of half lives)}$$

$$\frac{[A_0]}{[A_t]} = 2^n, [A_0] = 0.02 \times 2^4 = 0.32 \text{ M}$$

69. The product formed from the following reaction sequence is :



**Sol.** Answer (2)



70. The decreasing order of boiling points of the following alkanes is :

- (a) heptane  
(b) butane  
(c) 2-methylbutane  
(d) 2-methylpropane  
(e) hexane

Choose the correct answer from the options given below :

- (1) (a) > (e) > (c) > (b) > (d)  
(2) (a) > (c) > (e) > (d) > (b)  
(3) (c) > (d) > (a) > (e) > (b)  
(4) (a) > (e) > (b) > (c) > (d)

**Sol.** Answer (1)

Boiling point of alkanes  $\propto$  molar mass.

Straight chain alkanes have more boiling point than branched alkanes.

Heptane has high molar mass and 2-methylpropane has low molar mass and is branched.

71. The element used for welding metals with high melting points is :

- (1) He (2) Cl<sub>2</sub>  
(3) H<sub>2</sub> (4) Ne

**Sol.** Answer (3)

The oxy-hydrogen flame can produce the temperature of 4000 K. So atomic hydrogen is used for welding of metals with high melting point.

72. Decrease in size from left to right in actinoid series is greater and gradual than that in lanthanoid series due to :

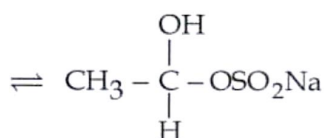
- (1) 5 f orbitals have greater shielding effect
- (2) 4 f orbitals are penultimate
- (3) 4 f orbitals have greater shielding effect
- (4) 5 f orbitals have poor shielding effect

Sol. Answer (4)

Due to large size of 5f orbitals their shielding effect is poor.

73. Which of the following reactions is not an example for nucleophilic addition - elimination reaction ?

- (1)  $\text{CH}_3\text{CHO} + \text{NH}_3 \rightleftharpoons \text{CH}_3\text{CH} = \text{NH} + \text{H}_2\text{O}$
- (2)  $\text{CH}_3\text{CHO} + \text{NaHSO}_3$



- (3)  $\text{CH}_3\text{CHO} + \text{NH}_2\text{OH}$   
 $\rightleftharpoons \text{CH}_3\text{CH} = \text{N} - \text{OH} + \text{H}_2\text{O}$

- (4)  $\text{CH}_3\text{CHO} + \text{C}_6\text{H}_5\text{NHNH}_2$   
 $\rightleftharpoons \text{CH}_3\text{CH} = \text{N} - \text{NHC}_6\text{H}_5 + \text{H}_2\text{O}$

Sol. Answer (2)

In nucleophilic addition-elimination reactions along with the product water molecule is eliminated.

But in reaction of  $\text{CH}_3\text{CHO}$  and  $\text{NaHSO}_3$  only addition takes place.

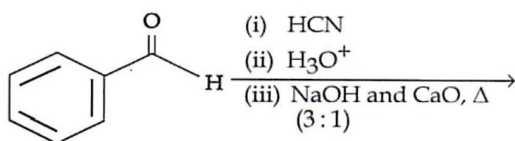
74.  $\text{CaCl}_2$  and  $\text{Ca}(\text{OCl})_2$  are components of :

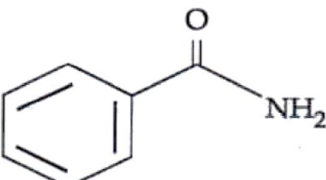
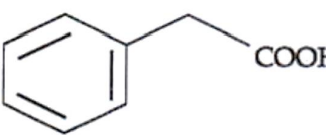
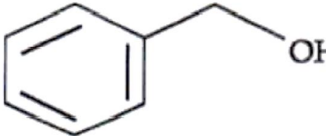
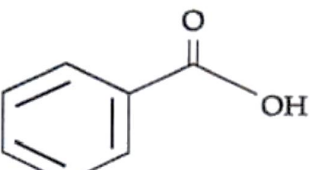
- (1) lime water                      (2) gypsum
- (3) Portland cement      (4) bleaching powder

Sol. Answer (4)

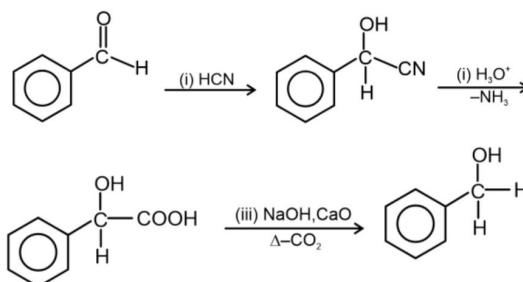
$\text{CaCl}_2$  and  $\text{Ca}(\text{OCl})_2$  are components of bleaching powder.

75. The product formed from the following reaction sequence is :



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

Sol. Answer (3)



(NaOH + CaO) Sodalime is a decarboxylating reagent.

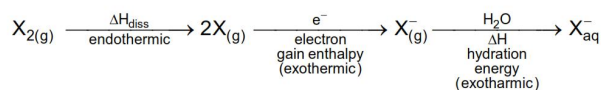
76. Fluorine is a stronger oxidising agent than chlorine because:

- (a) F-F bond has a low enthalpy of dissociation.
- (b) Fluoride ion ( $\text{F}^-$ ) has high hydration enthalpy.
- (c) Electron gain enthalpy of fluorine is less negative than chlorine.
- (d) Fluorine has a very small size.

Choose the **most appropriate** answer from the options given:

- (1) (b) and (c) only
- (2) (a) and (b) only
- (3) (a) and (c) only
- (4) (a) and (d) only

Sol. Answer (2)



By adding these values more energy is released for fluorine due to low bond dissociation enthalpy and high hydration enthalpy.

77.  $K_H$  value for some gases at the same temperature 'T' are given :

| gas    | $K_H/k \text{ bar}$   |
|--------|-----------------------|
| Ar     | 40.3                  |
| $CO_2$ | 1.67                  |
| HCHO   | $1.83 \times 10^{-5}$ |
| $CH_4$ | 0.413                 |

where  $K_H$  is Henry's Law constant in water. The order of their solubility in water is :

- (1)  $HCHO < CH_4 < CO_2 < Ar$
- (2)  $Ar < CO_2 < CH_4 < HCHO$
- (3)  $Ar < CO_2 < CH_4 < HCHO$
- (4)  $HCHO < CO_2 < CH_4 < Ar$

Sol. Answer (2)

$$\text{Solubility of a gas} \propto \frac{1}{K_H \text{ value}}$$

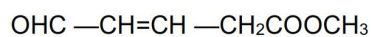
78. Which of the following reactions is a decomposition redox reaction ?

- (1)  $P_4(s) + 3OH^-(aq) + 3H_2O(l) \rightarrow PH_3(g) + 3H_2PO_2^-(aq)$
- (2)  $2Pb(NO_3)_2(s) \rightarrow 2PbO(s) + 4NO_2(g) + O_2(g)$
- (3)  $N_2(g) + O_2(g) \rightarrow 2NO(g)$
- (4)  $Cl_2(g) + 2OH^-(aq) \rightarrow ClO^-(aq) + Cl^-(aq) + 4H_2O(l)$

Sol. Answer (2)

Lead nitrate decomposed to give  $PbO$ ,  $NO_2$  and  $O_2$ . In this Nitrogen atom oxidation state changes from +5 to +4 and oxygen changes from -2 to zero.

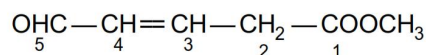
79. What is the hybridization shown by  $C_1$  and  $C_2$  carbons, respectively in the given compound?



- (1)  $sp^3$  and  $sp^3$
- (2)  $sp^2$  and  $sp^3$

- (3)  $sp^2$  and  $sp^2$
- (4)  $sp^3$  and  $sp^2$

Sol. Answer (2)



Ester group has more priority than aldehyde. So numbering should be done from left to right.  $C_1$  has double bond and is  $sp^2$  hybridised.

80. Match the reagents (List - I) with the product (List - II) obtained from phenol.

List-I

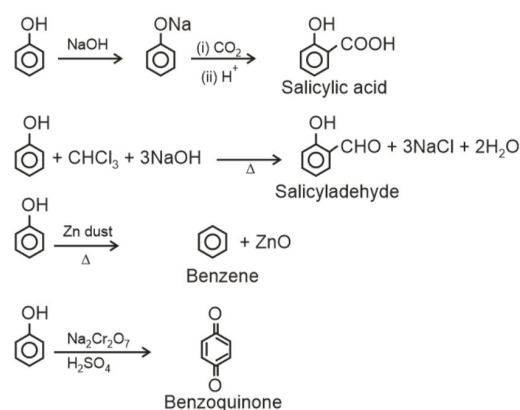
List - II

- |                                   |                        |
|-----------------------------------|------------------------|
| (a) (i) NaOH (ii) $CO_2$          | (i) Benzoquinone       |
| (iii) $H^+$                       |                        |
| (b) (i) Aqueous NaOH (ii) Benzene |                        |
| + $CHCl_3$ (ii) $H^+$             |                        |
| (c) Zn dust, $\Delta$             | (iii) Salicyl aldehyde |
| (d) $Na_2Cr_2O_7$ , $H_2SO_4$     | (iv) Salicylic acid    |

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

- (1) (a) - (iv), (b) - (ii), (c) - (i), (d) - (iii)
- (2) (a) - (iii), (b) - (iv), (c) - (i), (d) - (ii)
- (3) (a) - (ii), (b) - (i), (c) - (iv), (d) - (iii)
- (4) (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)

Sol. Answer (4)

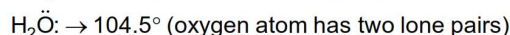
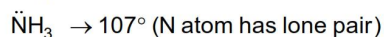
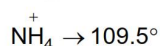
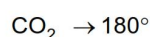


81. The correct order of bond angles in the following compounds/ species is :

- (1)  $CO_2 < NH_3 < H_2O < NH_4^+$
- (2)  $H_2O < NH_3 < NH_4^+ < CO_2$
- (3)  $H_2O < NH_4^+ < NH_3 < CO_2$
- (4)  $H_2O < NH_4^+ = NH_3 < CO_2$



Sol. Answer (2)



Due to lone pair-lone pair repulsions the bond angle in water decreases more.

82. Match List - I with List - II:

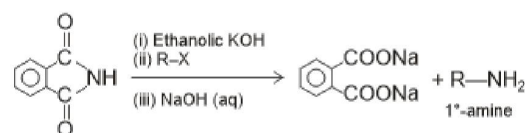
| List - I<br>(Reaction)   | List - II<br>(Product formed) |
|--------------------------|-------------------------------|
| (a) Gabriel synthesis    | (i) Benzaldehyde              |
| (b) Kolbe synthesis      | (ii) Ethers                   |
| (c) Williamson synthesis | (iii) Primary amines          |
| (d) Etard reaction       | (iv) Salicylic acid           |

Choose the correct answer from the options given below

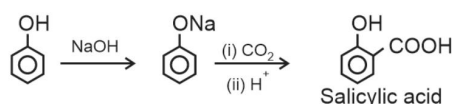
- (1) (a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)  
 (2) (a) - (iii), (b) - (i), (c) - (ii), (d) - (iv)  
 (3) (a) - (ii), (b) - (iii), (c) - (i), (d) - (iv)  
 (4) (a) - (iv), (b) - (iii), (c) - (i), (d) - (ii)

Sol. Answer (1)

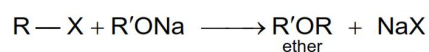
(a) Gabriel synthesis



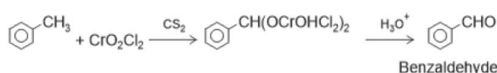
(b) Kolbe synthesis



(c) Williamson synthesis



(d) Etard reaction



83. If first ionization enthalpies of elements X and Y are 419 kJ mol<sup>-1</sup> and 590 kJ mol<sup>-1</sup>, respectively and second ionization enthalpies of X and Y are 3069 kJ mol<sup>-1</sup> and 1145 kJ mol<sup>-1</sup>, respectively.

Then **correct statement** is :

(1) Both X and Y are alkaline earth metals.

(2) X is an alkali metal and Y is an alkaline earth metal.

(3) X is an alkaline earth metal and Y is an alkali metal.

(4) Both X and Y are alkali metals.

Sol. Answer (2)

X is alkali metal as it has large size, its IE is less.

After loss of one electron, it gets inert gas configuration. So its IE<sub>2</sub> is very high.

Y is alkaline earth metal. Its IE is more than alkali metal due to stable ns<sup>2</sup> configuration. But its IE<sub>2</sub> is lower than alkali metal.

84. The **incorrect** statement about denaturation of proteins is :

- (1) Uncoiling of the helical structure takes place.  
 (2) It results due to change of temperature and/or pH  
 (3) It results in loss of biological activity of proteins.  
 (4) A protein is formed from amino acids linked by peptide bonds.

Sol. Answer (4)

Protein formation is not related to the denaturation of proteins.

85. Four gas cylinders containing He, N<sub>2</sub>, CO<sub>2</sub> and NH<sub>3</sub> gases separately are gradually cooled from a temperature of 500 K. Which gas will liquify first ?

(Given T<sub>c</sub> in K - He : 5.3, N<sub>2</sub> : 126, CO<sub>2</sub> : 304.1 and NH<sub>3</sub> : 405.5)

- (1) NH<sub>3</sub>  
 (2) He  
 (3) N<sub>2</sub>  
 (4) CO<sub>2</sub>

Sol. Answer (1)

Ease of Liquefaction ∝ Critical Temperature

So, NH<sub>3</sub> will liquify first.

**Chemistry: Section-B (Q. No. 86 to 100)**

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

**Assertion (A)** : The metal carbon bond in metal carbonyls possesses both  $\sigma$  and  $\pi$  character.

**Reason (R)**: The ligand to metal bond is a  $\pi$  bond and metal to ligand bond is a  $\sigma$  bond.

In the Light of the above statements, choose the **most appropriate** answer from the 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

Sol. Answer (4)

Metal-carbon bond in metal carbonyls possesses both  $\sigma$  and  $\pi$  character, So the assertion is correct.

The ligand to metal bond is  $\sigma$  bond and metal to ligand bond is  $\pi$  bond, So the reason is correct.

87. Match List - I with List - II:

| List - I                      | List - II                      |
|-------------------------------|--------------------------------|
| (a) Biochemical oxygen demand | (i) oxidising mixture          |
| (b) Photochemical smog        | (ii) polar stratospheric cloud |
| (c) Classical smog            | (iii) organic matter In water  |
| (d) Ozone layer depletion     | (iv) reducing mixture          |

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

- (1) (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)
- (2) (a) - (i), (b) - (iv), (c) - (ii), (d) - (iii)
- (3) (a) - (iii), (b) - (iv), (c) - (i), (d) - (ii)
- (4) (a) - (iii), (b) - (i), (c) - (iv), (d) - (ii)

Sol. Answer (4)

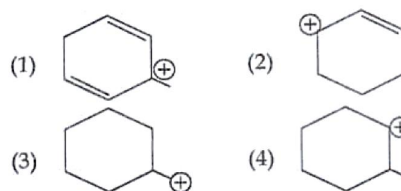
Biochemical oxygen demand – Organic matter in water

Photochemical smog – Oxidising in nature

Classical smog – Reducing in nature

Ozone layer depletion – Polar stratospheric cloud

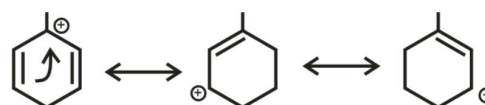
88. Which of the following is the most stable carbocation?



Sol. Answer (1)

Stability of carbocation  $\propto$  No of  $\alpha$ -H

$\propto$  No of resonating structures



89. Given below are two statements :

**Statement I** :  $\text{Cr}^{2+}$  is oxidising and  $\text{Mn}^{3+}$  is reducing in nature.

**Statement II**:  $\text{Sc}^{3+}$  compounds are repelled by the applied magnetic field.

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

Sol. Answer (1)

$\text{Cr}^{+2}$  :  $[\text{Ar}] 3d^4$

$\text{Cr}^{+2}$  is reducing as its configuration changes from  $d^4$  to  $d^3$  ( $t_{2g}^3$ )

$\text{Mn}^{+3}$  is oxidising in nature.

$\text{Mn}^{+2}$ :  $[\text{Ar}] 3d^5$  (extra stability)

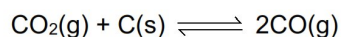
Statement I is incorrect

$\text{Sc}^{+3}$ :  $[\text{Ar}]$

diamagnetic – repelled by magnetic field.

Statement (II) is correct.

90.  $K_p$  for the following reaction is 3.0 at 1000 K.

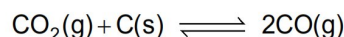


What will be the value of  $K_c$  for the reaction at the same temperature ?

(Given –  $R = 0.083 \text{ L bar K}^{-1} \text{ mol}^{-1}$ )

- (1) 3.6  
(2) 0.36  
(3)  $3.6 \times 10^{-2}$   
(4)  $3.6 \times 10^{-3}$

Sol. Answer (3)



$$K_P = K_c (RT)^{\Delta n_g} (\Delta n_g = 2 - 1)$$

$$3 = K_c (0.083 \times 1000)$$

$$K_c = \frac{3}{0.083 \times 1000} = 3.6 \times 10^{-2}$$

91. A vessel contains 3.2 g of dioxygen gas at STP (273.15 K and 1 atm pressure). The gas is now transferred to another vessel at constant temperature, where pressure becomes one third of the original pressure. The volume of new vessel in L is:

(Given - molar volume at STP is 22.4 L)

- (1) 67.2 (2) 6.72  
(3) 2.24 (4) 22.4

Sol. Answer (2)

$$\text{Moles of oxygen} = \frac{3.2}{32} = 10^{-1} \text{ mole}$$

$$\text{Volume at STP} = 10^{-1} \times 22.4 = 2.24 \text{ L}$$

$$P_1 = 1 \text{ atm } V_1 = 2.24 \text{ L}$$

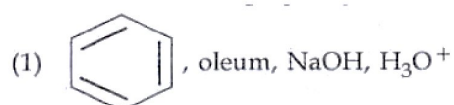
$$P_2 = \frac{1}{3} \text{ atm } V_2 = ?$$

$$P_1 V_1 = P_2 V_2$$

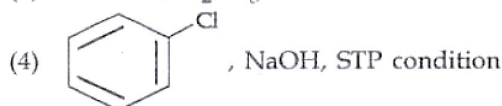
$$1 \times 2.24 \text{ L} = \frac{1}{3} \times V_2$$

$$V_2 = 3 \times 2.24 \text{ L} = 6.72 \text{ L}$$

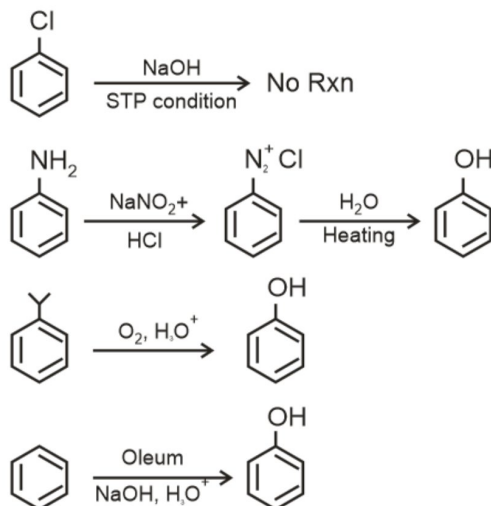
92. Which one of the following reaction sequence is **incorrect** method to prepare phenol?



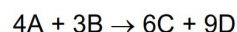
- (2) Aniline,  $\text{NaNO}_2 + \text{HCl}$ ,  $\text{H}_2\text{O}$ , heating  
(3) Cumene,  $\text{O}_2$ ,  $\text{H}_3\text{O}^+$



Sol. Answer (4)



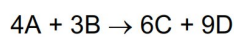
93. For a chemical reaction



rate of formation of C is  $6 \times 10^{-2} \text{ mol L}^{-1} \text{ s}^{-1}$  and rate of disappearance of A is  $4 \times 10^{-2} \text{ mol L}^{-1} \text{ s}^{-1}$ . The rate of reaction and amount of B consumed in interval of 10 seconds, respectively will be :

- (1)  $10 \times 10^{-2} \text{ mol L}^{-1} \text{ s}^{-1}$   
and  $30 \times 10^{-2} \text{ mol L}^{-1}$   
(2)  $1 \times 10^{-2} \text{ mol L}^{-1} \text{ s}^{-1}$   
and  $30 \times 10^{-2} \text{ mol L}^{-1}$   
(3)  $10 \times 10^{-2} \text{ mol L}^{-1} \text{ s}^{-1}$   
and  $10 \times 10^{-2} \text{ mol L}^{-1}$   
(4)  $1 \times 10^{-2} \text{ mol L}^{-1} \text{ s}^{-1}$   
and  $10 \times 10^{-2} \text{ mol L}^{-1}$

Sol. Answer (2)



$$r = -\frac{1}{4} \frac{d[\text{A}]}{dt} = +\frac{1}{6} \frac{d[\text{C}]}{dt}$$

$$r = \frac{1}{6} \times 6 \times 10^{-2} = 1 \times 10^{-2} \text{ mol L}^{-1} \text{ s}^{-1}$$

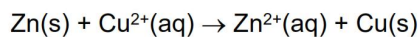
$$r = -\frac{1}{3} \frac{d[\text{B}]}{dt}$$



$$\frac{-d[B]}{dt} = 3 \times 10^{-2} \text{ mol L}^{-1} \text{ s}^{-1}$$

$$\begin{aligned} \text{B consumed in 10 sec} &= 3 \times 10^{-2} \times 10 \\ &= 30 \times 10^{-2} \text{ mol L}^{-1} \end{aligned}$$

94. Standard electrode potential for the cell with cell reaction

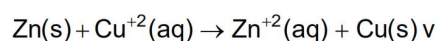


is 1.1 V. Calculate the standard Gibbs energy change for the cell reaction.

(Given  $F = 96487 \text{ C mol}^{-1}$ )

- (1)  $-200.27 \text{ J mol}^{-1}$  (2)  $-200.27 \text{ kJ mol}^{-1}$   
(3)  $-212.27 \text{ kJ mol}^{-1}$  (4)  $-212.27 \text{ J mol}^{-1}$

Sol. Answer (3)



$$E_{\text{cell}}^{\circ} = 1.1 \text{ V}$$

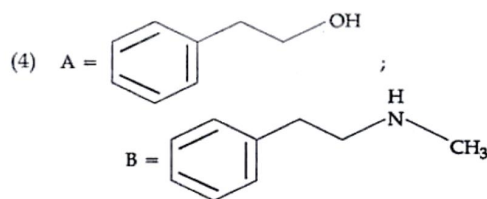
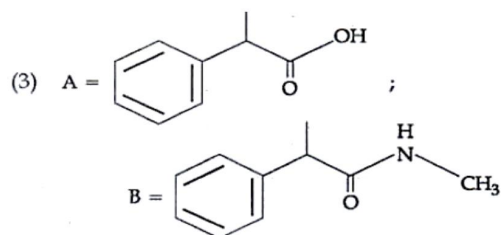
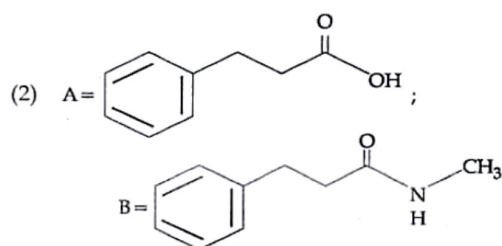
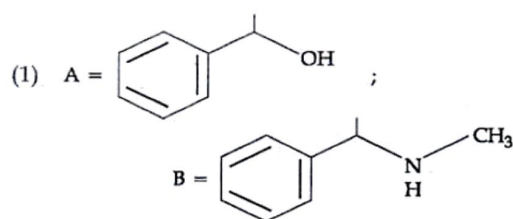
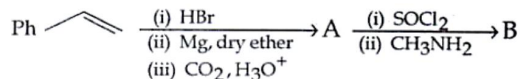
$$n = 2$$

$$\Delta G^{\circ} = -nFE_{\text{cell}}^{\circ}$$

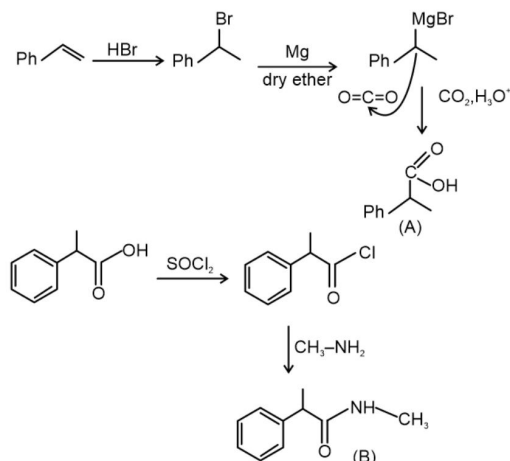
$$= -2 \times 96487 \times 1.1$$

$$= -212.27 \text{ kJ}$$

95. The products A and B in the following reaction sequence are :



Sol. Answer (3)

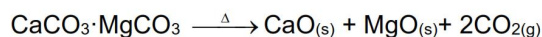
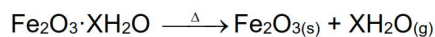
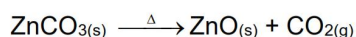


96. Which one of the following is not a calcination reaction?

- (1)  $\text{CaCO}_3 + 2\text{HCl} \xrightarrow{\Delta} \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$   
(2)  $\text{ZnCO}_3 \xrightarrow{\Delta} \text{ZnO} + \text{CO}_2$   
(3)  $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O} \xrightarrow{\Delta} \text{Fe}_2\text{O}_3 + x\text{H}_2\text{O}$   
(4)  $\text{CaCO}_3 \cdot \text{MgCO}_3 \xrightarrow{\Delta} \text{CaO} + \text{MgO} + 2\text{CO}_2$

Sol. Answer (1)

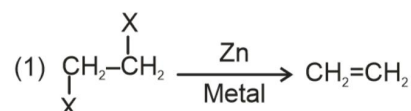
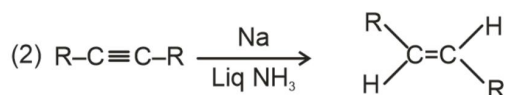
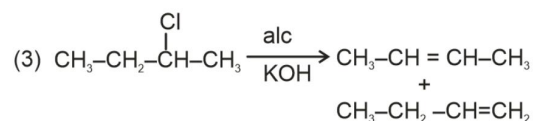
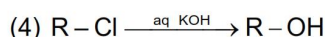
Calcination involves heating in absence of air and the volatile matter escaped leaving behind the metal oxide



97. The **incorrect** method for the synthesis of alkenes is :

- (1) treating vicinal dihalides with Zn metal  
(2) treatment of alkynes with Na in liquid  $\text{NH}_3$   
(3) heating alkyl halides with alcoholic KOH  
(4) treating alkyl halides in aqueous KOH solution

Sol. Answer (4)



98. When electromagnetic radiation of wavelength 300 nm falls on the surface of a metal, electrons are emitted with the kinetic energy of  $1.68 \times 10^5 \text{ J mol}^{-1}$ . What is the minimum energy needed to remove an electron from the metal ?

$$(h = 6.626 \times 10^{-34} \text{ Js}, c = 3 \times 10^8 \text{ ms}^{-1}, N_A = 6.022 \times 10^{23} \text{ mol}^{-1})$$

- (1)  $2.31 \times 10^5 \text{ J mol}^{-1}$   
 (2)  $2.31 \times 10^6 \text{ J mol}^{-1}$   
 (3)  $3.84 \times 10^4 \text{ J mol}^{-1}$   
 (4)  $3.84 \times 10^{-19} \text{ J mol}^{-1}$

Sol. Answer (1)

$$E_p = \phi + K.E$$

$$E_p - K.E = \phi$$

$$E_p = \frac{hc}{\lambda} = 3.975 \times 10^5 \text{ J mol}^{-1}$$

$$K.E = 1.68 \times 10^5 \text{ J mol}^{-1}$$

$$\phi = (3.975 - 1.68) \times 10^5 \\ = 2.295 \times 10^5 \approx 2.31 \times 10^5 \text{ J mol}^{-1}$$

99. What fraction of Fe exists as Fe(III) in  $\text{Fe}_{0.96}\text{O}$ ? (Consider  $\text{Fe}_{0.96}\text{O}$  to be made up of Fe(II) and Fe(III) only)

- (1)  $\frac{1}{20}$  (2)  $\frac{1}{12}$   
 (3) 0.08 (4)  $\frac{1}{16}$

Sol. Answer (2)

$$\text{Fe}_{0.96}\text{O} = \text{Fe}_{96}\text{O}_{100}$$

$$\text{Let us consider Fe in Fe}^{+2} = x$$

$$\text{Fe in Fe}^{+3} = (96 - x)$$

$$\text{Total +ve charge} = \text{total -ve charge}$$

$$(96 - x) \times 3 + 2x = 200$$

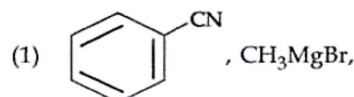
$$288 - 3x + 2x = 200$$

$$x = 88$$

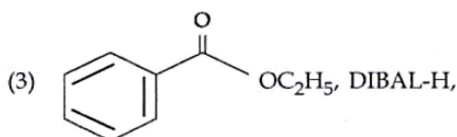
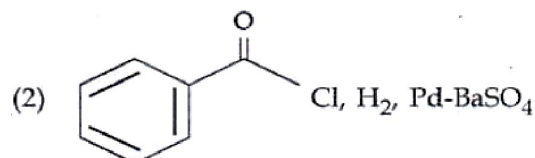
$$\text{Fe}^{+3} = 96 - 88 = 8$$

$$\text{Fraction of Fe}^{+3} = \frac{8}{96} = \frac{1}{12}$$

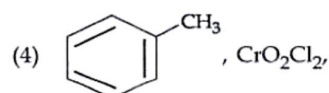
100. The incorrect method to synthesize benzaldehyde is :



followed by  $\text{H}_3\text{O}^+$

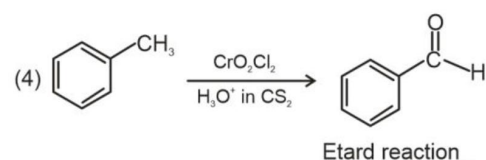
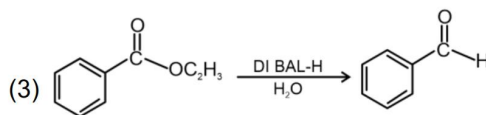
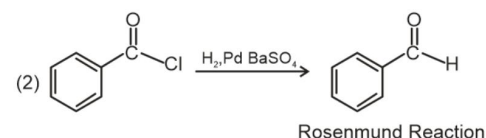
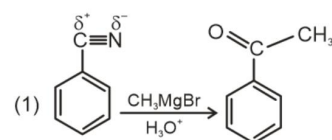


followed by  $\text{H}_2\text{O}$



followed by  $\text{H}_3\text{O}^+$  in  $\text{CS}_2$

Sol. Answer (1)



# Botany

## Section-A (Q. No. 101 to 135)

**101.** Given below are two statements :

Statement I :

Sickle cell anaemia and Haemophilia are autosomal dominant traits.

Statement II:

Sickle cell anaemia and Haemophilia are disorders of the blood.

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 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

Sol. Answer (1)

Sickle cell anaemia is an autosomal recessive trait whereas haemophilia is an X-linked recessive trait. Both the diseases are related to blood.

**102.** Which stage of meiosis can last for months or years in the oocytes of some vertebrates?

- (1) Diakinesis
- (2) Leptotene
- (3) Pachytene
- (4) Diplotene

Sol. Answer (4)

In oocytes of some vertebrates, diplotene lasts for months or years. It is called dictyotene state i.e., suspended diplotene stage.

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

Assertion (A) :

When a particular restriction enzyme cuts strand of DNA, overhanging stretches or sticky ends are formed.

Reason (R):

Some restriction enzymes cut the strand of DNA a little away from the centre of the palindromic site.

In the light of the above statements, choose the correct answer from the 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

Sol. Answer (2)

Both the statements are correct and Reason is the correct explanation of Assertion.

Sticky ends are produced by those restriction enzymes which cut the DNA strand a little away from the centre of the palindromic site, but between the same two bases of the opposite strand.

**104.** Give the correct descending order of organisms with reference to their estimated number found in Amazon forest.

- (a) Plants



(c) Fishes (d) Mammals

(e) Birds

Choose the correct answer from the options given below

(1) (b) > (a) > (c) > (e) > (d)

(2) (a) > (b) > (e) > (d) > (c)

(3) (a) > (c) > (d) > (b) > (e)

(4) (b) > (a) > (e) > (d) > (c)

Sol. Answer (1)

Insects count-2.5 million species

Plants species-50,000

Fishes- 3000

Birds – 1300

Mammals -430

105. In lac operon, z gene codes for :

(1) Transacetylase (2)  $\beta$ -galactosidase

(3) Permease (4) Repressor

Sol. Answer (2)

z-gene codes for Beta galactosidase enzyme, y-gene code for permease enzyme and a gene code for transacetylase.

106. The 5-C compound formed during TCA cycle is:

(1) Fumaric acid

(2)  $\alpha$ -ketoglutaric acid

(3) Oxalo succinic acid

(4) Succinic acid

Sol. Answer (2)

$\alpha$ -ketoglutaric acid is 5 carbon containing compound, fumaric acid is 4 carbon,

Oxalosuccinic acid is 6 carbon and

Succinic acid is 4 carbon.

107. In meiosis, crossing over and exchange of material between homologous chromosomes catalyzed by the enzyme:

(1) Polymerase

(2) Phosphorylase

(3) Recombinase

(4) Transferase

Sol. Answer (3)

The enzyme required during the process of crossing over and exchange of genetic material is recombinase enzyme.

108. All successions irrespective of the habitat proceed to which type of climax community?

(1) Edaphic

(2) Xeric

(3) Mesic

(4) Hydrophytic

Sol. Answer (3)

All successions irrespective of the habitat proceed to mesic type of climax community.

109. When a carrier protein facilitates the movement of two molecules across the membrane in same direction, it is called :

(1) Symport

(2) Uniport

(3) Transport

(4) Antiport

Sol. Answer (1)

Symport is the type of transportation where the two molecules move simultaneously in the same direction using carrier protein.

110. When one CO<sub>2</sub> molecule is fixed as one molecule of triose phosphate, which of the following photochemically made, high energy chemical intermediates are used in the reduction phase?

(1) 2 ATP + 2 NADPH

(2) 1 ATP + 1 NADPH

(3) 1 ATP + 2 NADPH

(4) 2 ATP + 1 NADPH

Sol. Answer (1)

2 ATPs and 2 NADPH are used to fix one molecule of CO<sub>2</sub> into one molecule of triose phosphate.

111. The ability of plants to follow different pathways in response to environment leading to formation of different kinds of structures is called :

(1) Differentiation (2) Redifferentiation

(3) Development (4) Plasticity

Sol. Answer (4)

Plasticity – it is the ability of the plants to follow different pathways in response to the environment leading to formation of different kinds of structures.

112. Match List -I with List -II :

| List-I                   | List-II           |
|--------------------------|-------------------|
| (a) <i>Chlamydomonas</i> | (i) Moss          |
| (b) <i>Cycas</i>         | (ii) Pteridophyte |
| (c) <i>Selaginella</i>   | (iii) Alga        |
| (d) <i>Sphagnum</i>      | (iv) Gymnosperm   |

Choose the correct answer from the options given below .

- (1) (a) - (ii), (b) - (iii), (c) - (i), (d) - (iv)  
 (2) (a) - (iii), (b) - (i), (c) - (ii), (d) - (iv)  
 (3) (a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)  
 (4) (a) - (iii), (b) - (ii), (c) - (i), (d) - (iv)

Sol. Answer (3)

*Chlamydomonas* is an unicellular alga.

*Cycas* belongs to gymnosperms.

*Selaginella* is a pteridophyte.

*Sphagnum* is a moss.

113. Interfascicular cambium is present between

- (1) Secondary xylem and secondary phloem  
 (2) Primary xylem and primary phloem  
 (3) Pericycle and endodermis Two vascular bundles  
 (4) Two vascular bundles

Sol. Answer (4)

Interfascicular cambium is present between the two vascular bundles.

114. Which of the following growth regulators is an adenine derivative ?

- (1) Absciscic acid                      (2) Auxin  
 (3) Cytokinin                              (4) Ethylene

Sol. Answer (3)

Cytokinin is an adenine derivative.

Auxin is derived from tryptophan amino acid.

Absciscic acid is derived from violaxanthin.

Ethylene is a gaseous hormone derived from methionine.

115. The chromosomal theory of inheritance was proposed by

- (1) Robert Brown                      (2) Thomas Morgan

(3) Sutton and Boveri (4) Gregor Mendel

Sol. Answer (3)

The chromosomal theory of inheritance was proposed by Sutton and Boveri in 1902-1903.

116. Which of the following statements is not correct?

- (1) The rhizome is thick, prostrate and branched  
 (2) Rhizome is a condensed form of stem  
 (3) The apical bud in rhizome always remains above the ground  
 (4) The rhizome is aerial with no distinct nodes and internodes

Sol. Answer (4)

The rhizome is an underground stem modification with distinct nodes and internodes.

117. The phenomenon by which the undividing parenchyma cells start to divide mitotically during plant tissue culture is called as :

- (1) Secondary growth (2) Differentiation  
 (3) Dedifferentiation (4) Redifferentiation

Sol. Answer (3)

The phenomenon by which the undividing parenchyma cells start to divide mitotically during plant tissue culture is called Dedifferentiation.

118. Match List-I with List-II ;

| List-I          | List-II             |
|-----------------|---------------------|
| (a) Adenine     | (i) Pigment         |
| (b) Anthocyanin | (ii) Polysaccharide |
| (c) Chitin      | (iii) Alkaloid      |
| (d) Codeine     | (iv) Purine         |

Choose the correct answer from the options given below .

- (1) (a) - (i), (b) - (iv), (c) - (iii), (d) - (ii)  
 (2) (a) - (iv), (b) - (i), (c) - (ii), (d) - (iii)  
 (3) (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)  
 (4) (a) - (iii), (b) - (i), (c) - (iv), (d) - (ii)

Sol. Answer (2)

|             |                                                                     |
|-------------|---------------------------------------------------------------------|
| Adenine     | Purine (double ringed structure) found in both DNA and RNA)         |
| Anthocyanin | Pigment (secondary metabolite)                                      |
| Chitin      | Homopolysaccharide of N-acetylglucosamine found in fungal cell wall |



Codeine                      Alkaloid (secondary metabolite) and exoskeleton of Arthropods

**119.** The residual persistent part which forms the perisperm in the seeds of beet is :

- (1) Integument              (2) Calyx  
(3) Endosperm              (4) Nucellus

Sol. Answer (4)

Perispermic Seeds – Seeds in which remains of nucellus are seen. The residual, persistent nucellus is called perisperm.

Eg:- Black pepper, beet.

**120.** The World Summit on sustainable development held in 2002 in Johannesburg, South Africa pledged for :

- (1) Collection and preservation of seeds of different genetic strains of commercially important plants.  
(2) A significant reduction in the current rate of biodiversity loss.  
(3) Declaration of more biodiversity hotspots.  
(4) Increase in agricultural production.

Sol. Answer (2)

The World Summit on Sustainable Development held in 2002 in Johannesburg, South Africa, 190 countries pledged their commitment to achieve by 2010, a significant reduction in the current rate of biodiversity loss at global, regional and local levels.

**121.** The type of tissue commonly found in the fruit wall of nuts is

- (1) Sclereid                      (2) Parenchyma  
(3) Collenchyma              (4) Sclerenchyma

Sol. Answer (1)

Sclereids are present in

- (a) Fruit walls of nuts like walnuts, almonds, etc.  
(b) Pulp of fruits like guava, pear, sapota (cheeku), etc  
(c) Seed coats of legumes like peas, beans, etc.  
(d) Leaves of Tea.

**122.** The pioneer species in a hydrarch succession are :

- (1) Filamentous algae  
(2) Free-floating angiosperms  
(3) Submerged rooted plants  
(4) Phytoplanktons

Sol. Answer (4)

Hydrarch Succession is the succession in aquatic habitat like a freshly formed pond is hydrosere.

Pioneer species: It is formed by phytoplanktons i.e., minute microscopic autotrophic organisms like diatoms, unicellular colonial or filamentous green algae and blue green algae.

**123.** Which of the following protects nitrogenase inside the root nodule of a leguminous plant ?

- (1) Glutamate dehydrogenase  
(2) Catalase  
(3) leg haemoglobin  
(4) Transaminase

Sol. Answer (3)

The enzyme Nitrogenase is highly sensitive to the molecular oxygen □ It acquires anaerobic condition. The nodules have adaptations that ensure that the enzyme is protected from oxygen. To protect these enzymes, the nodule contains an oxygen scavenger called leg-haemoglobin.

**124.** Given below are two statements .

Statement I :

DNA polymerases catalyses polymerisation only in one direction, that is 5' → 3'

Statement II :

During replication of DNA, on one strand the replication is continuous while on the other strand it is discontinuous.

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

Sol. Answer (2)

The main enzyme for DNA replication is DNA Dependent DNA polymerase. It catalyses



polymerisation only in one direction, that is 5' → 3'

During DNA replication, replication on one strand is continuous with polarity 3' → 5' while other strand is discontinuous with polarity 5' → 3'.

125. The species that come to appear in bare area are called

- (1) Species of seral community
- (2) Pioneer species
- (3) Invasive species
- (4) Competitive species

Sol. Answer (2)

The first biotic species that develops in a bare area is termed as pioneer species. Eg. Lichens on rock, phytoplanktons and zooplanktons in ponds, etc.

126. Initiation of lateral roots and vascular cambium during secondary growth takes place in cells of

- |               |                |
|---------------|----------------|
| (1) Pericycle | (2) Epiblema   |
| (3) Cortex    | (4) Endodermis |

Sol. Answer (1)

Pericycle is a primary tissue of plant roots and is the site for initiation of lateral roots and the secondary meristems, the vascular cambium and cork cambium (phellogen).

127. Match List - I with List - II

- | List - I                           | List - II                    |
|------------------------------------|------------------------------|
| (a) In lac operon i gene codes for | (i) transacetylase           |
| (b) In lac operon z gene codes for | (ii) permease                |
| (c) In lac operon y gene codes for | (iii) $\beta$ -galactosidase |
| (d) In lac operon a gene codes for | (iv) Repressor               |

Choose the correct answer from the options given below.

- (1) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)
- (2) (a)-(iii), (b)-(ii), (c)-(i), (d)-(iv)
- (3) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)
- (4) (a)-(i), (b)-(i), (c)-(iii), (d)-(ii)

Sol. Answer (3)

Lac operon genes-

- (1) There are 3 structural genes
  - (a) Lac z → Codes for  $\beta$ -galactosidase
  - (b) Lac y → Codes for permease

(c) Lac a → codes for transacetylase

(2) Operator gene

(3) Promoter gene

(4) Regulator gene: It codes for a protein known as repressor protein

128. To ensure that only the desired pollens fall on the stigma in artificial hybridization process

- (a) the female flower buds of plant producing unisexual flowers need not be bagged.
- (b) there is no need to emasculate unisexual flowers of selected female parent
- (c) emasculated flowers are to be bagged immediately after cross pollination
- (d) emasculated flowers are to be bagged after removal of anthers bisexual flowers, showing protogyny are never selected for cross

Choose the correct answer from the options given below :

- (1) (a), (d) and (e) only
- (2) (a), (b) and (c) only
- (3) (b), (c) and (d) only
- (4) (b), (c) and (e) only

Sol. Answer (3)

In Bisexual flower :

- (1) Emasculation → Removal of anther from bisexual flower in immature stage.
- (2) Bagging → Emasculated flowers are covered by bags. It is done to prevent undesirable cross pollination
- (3) Desired pollination
- (4) Rebagging
- (5) Tagging

In unisexual flower all the steps are same but emasculation is not done because it is not required

129. The ascent of xylem sap in plants is mainly accomplished by the.

- (1) root pressure
- (2) size of the stomatal aperture
- (3) distribution of stomata on the upper and lower epidermis
- (4) cohesion and adhesion between water molecules

Sol. Answer (4)

The transpiration driven ascent of xylem sap depends mainly on following physical properties of water molecules

- (a) Cohesion-mutual attraction between water molecules
- (b) Adhesion-attraction of water molecules to polar surfaces
- (c) Surface tension-water molecules are attracted to each other in liquid phase more than to water in gas phase.

130. Match List - I with List - II :

| List - I      | List - II      |
|---------------|----------------|
| (a) Imbricate | (i) Calotropis |
| (b) Valvate   | (ii) Cassia    |
| (c) Vexillary | (iii) Cotton   |
| (d) Twisted   | (iv) Bean      |

Choose the correct answer from the options given below:

- (1) (a) - (i), (b) - (iii), (c) - (iv), (d) - (ii)
- (2) (a) - (ii), (b) - (i), (c) - (iii), (d) - (iv)
- (3) (a) - (ii), (b) - (i), (c) - (iv), (d) - (iii)
- (4) (a) - (ii), (b) - (iv), (c) - (iii), (d) - (i)

Sol. Answer (3)

Aestivation-Mode of arrangement of sepals or petals in a floral bud with respect to other member of same whorl is called aestivation. It is of following types-

- (a) Valvate-The margins of sepals or petals, present in whorl just touching each other. eg  $\rightarrow$  *Calotropis*.
- (b) Twisted- Margin of one petal or sepal overlaps the margin of adjacent one. Eg- china rose, ladyfinger, cotton.
- (c) Imbricate-Margins of petals or sepals overlaps each other but not in a particular direction. Eg-*Cassia*, Gulmohar.
- (d) Vexillary-Largest petal(standard) overlaps two smaller lateral petals (wings) which in turn overlaps two smallest anterior petals (Keel) eg  $\rightarrow$  Pea, bean flower.

131. The number of time(s) decarboxylation of isocitrate occurs during single TCA cycle is:

- (1) Four
- (2) One
- (3) Two
- (4) Three

Sol. Answer (2)

In single kreb's cycle, decarboxylation takes place at following two steps :

- (1) At 4<sup>th</sup> step, where isocitrate gives off a pair of H-atoms (oxidation) and a molecule of

CO<sub>2</sub> (decarboxylation) and becomes 5-C  $\alpha$  -Ketoglutarate.

- (2) 5<sup>th</sup> step-where coenzyme-A reacts with  $\alpha$  -Ketoglutarate forming 4-C Succinyl-Coenzyme A and releasing CO<sub>2</sub> and a pair hydrogen atoms.

The question is specifically asking for isocitrate so answer is (2)

132. Match List - I with List - II:

| List -I                         | List -II                                          |
|---------------------------------|---------------------------------------------------|
| (a) Porins                      | (i) Pink coloured nodules                         |
| (b) leg haemoglobin             | (ii) Lumen of thylakoid                           |
| (c) H <sup>+</sup> accumulation | (iii) Amphibolic pathway                          |
| (d) Respiration                 | (iv) Huge pores in outer membrane of mitochondria |

Choose the correct answer from the options given below :

- (1) (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)
- (2) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)
- (3) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)
- (4) (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)

Sol. Answer (3)

- (a) Porins-Types of proteins which forms pores of large size in the outer membranes of plastids such as chloroplast, mitochondria and membranes in bacteria.
- (b) Leg-Haemoglobin-Pink pigment in root nodules of leguminous plants, as soybean, that is essential for N<sub>2</sub> – fixation. It acts as O<sub>2</sub>-scavenger
- (c) H<sup>+</sup>-accumulation  $\rightarrow$  lumen of thylakoid.
- (d) Respiration–Amphibolic pathway  $\rightarrow$  a biochemical pathway that includes both anabolic and catabolic processes.

133. Separation of DNA fragments is done by a technique known as

- (1) Gel electrophoresis
- (2) Polymerase Chain Reaction
- (3) Recombinant technology
- (4) Southern blotting

Sol. Answer (1)

The cutting of DNA by restriction endonucleases results in the formation of fragments of DNA. These fragments can be separated by a technique known as gel electrophoresis.



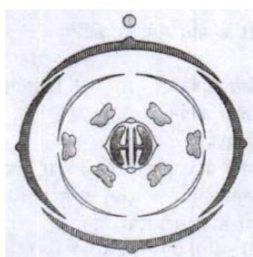
134. In general the egg apparatus of embryo sac in angiosperm consists of

- (1) One egg cell, two synergids, two antipodal cells, two Polar nuclei
- (2) One egg cell, two synergids, three antipodal cells, two Polar nuclei
- (3) One egg cell, two synergids, two antipodal cells, three Polar nuclei
- (4) One egg cell, three synergids, two antipodal cells, two Polar nuclei

Sol. Answer (0)

N/A

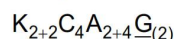
135. The Floral Diagram represents which one of the following families



- (1) Liliaceae
- (2) Fabaceae
- (3) Brassicaceae
- (4) Solanaceae

Sol. Answer (3)

The floral diagram represents Brassicaceae family.



**Botany : Section-B (Q. No. 136 to 150)**

136. Primary proteins are also called as polypeptides because :

- (1) They can assume many conformations
- (2) They are linear chains
- (3) They are polymers of peptide monomers
- (4) Successive amino acids are joined by peptide bonds

Sol. Answer (4)

Primary proteins are the linear chains of amino acids, joined by peptide bonds.

137. Match List-I with List-II :

- | List-I                        | List-II                            |
|-------------------------------|------------------------------------|
| (a) Bacteriophage $\phi$ X174 | (i) 48502 base pairs               |
| (b) Bacteriophage Lambda      | (ii) 5386 nucleotides              |
| (c) <i>Escherichia coli</i>   | (iii) $3.3 \times 10^9$ Base pairs |

(d) Haploid content (iv)  $4.6 \times 10^6$

Of human DNA base pairs

Choose the correct answer from the options given below :

- (1) (a)-(i), (b)-(ii), (c)-(iv), (d)-(iii)
- (2) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)
- (3) (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)
- (4) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

Sol. Answer (4)

Length of DNA is defined as number of nucleotides or as base pairs.

It is a characteristic feature of an organism

$\phi \times 174$  – ssDNA–5386 nucleotides.

Bacteriophage Lambda and Linear DNA – 48502 bp

E coli and circular DNA –  $4.6 \times 10^6$  bp

Haploid content of human DNA – 1 complete set of chromosomes –  $3.3 \times 10^9$  bp

138. Which type of substance would face difficulty to pass through the cell membrane?

- (1) Substance soluble in lipids
- (2) Substance with hydrophobic moiety
- (3) Substance with hydrophilic moiety
- (4) All substance irrespective of hydrophobic and hydrophilic moiety

Sol. Answer (3)

Diffusion of any substance across the membrane depends on its solubility in lipids. Since the cell membrane is majorly composed of lipids, substances having hydrophilic moiety find it difficult to pass through the membrane, their movement has to be facilitated.

139. What is the expected percentage of F<sub>2</sub> progeny with yellow and inflated pod in dihybrid cross experiment involving pea plants with green coloured, inflated pod and yellow coloured constricted pod?

- (1) 9%
- (2) 100%
- (3) 56.25%
- (4) 18.75%

Sol. Answer (4)



Green, Inflated Pod X yellow, constricted Pod

↓  
F<sub>1</sub> – All green, inflated

↓  
F<sub>2</sub> – 9 : 3 : 3 : 1 – Phenotypic ratio.

9 – Green inflated  
3 – Green, constricted  
3 – Yellow, inflated  
1 – Yellow, constricted

Since, yellow inflated (recombinants) are  
 $\frac{3}{16} = 18.75\%$

140. Match List-I with List-II :

- | List-I                                               | List-II                  |
|------------------------------------------------------|--------------------------|
| (a) Carbon dissolved                                 | (i) 55 billion tons      |
| (b) Annual fixation of Carbon through Photosynthesis | (ii) 71%                 |
| (c) PAR captured by Plants                           | (iii) $4 \times 10^3$ kg |
| (d) Productivity of oceans                           | (iv) 2 to 10%            |

Choose the correct answer from the options given below:

- (1) (a)-(iii), (b)-(ii), (c)-(i), (d)-(iv)  
(2) (a)-(ii), (b)-(iv), (c)-(iii), (d)-(i)  
(3) (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)  
(4) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

Sol. Answer (4)

71% of carbon found dissolved in oceans. Oceans acts as the largest carbon sink/reservoir and regulates amount of CO<sub>2</sub> in atmosphere.

Annual fixation of carbon through Photosynthesis –  $4 \times 10^{13}$  Kg – according to an estimate, out of the total incident light received by earth, only 50% is suitable for Photosynthesis – PAR (Photosynthetically active radiation)

Productivity of oceans is only 55 billion tons due to low nitrogen, organic nutrients.

141. If a female individual is with small round head, furrowed tongue, partially open mouth and broad palm with characteristic palm crease. Also the physical, psychomotor and mental

development is retarded. The karyotype analysis of such an individual will show

- (1) Trisomy of chromosome 21  
(2) 47 chromosomes with XXY sex chromosomes  
(3) 45 chromosomes with XO sex chromosomes  
(4) 47 Chromosomes with XYY sex chromosomes

Sol. Answer (1)

Karyotype is a preparation of complete set of metaphase chromosomes in an individual organism/cell.

Trisomy of 21/Down's syndrome is presence of an additional 21<sup>st</sup> chromosome. This is a type of Aneuploidy. [ $2n + 1$ ]

Aneuploidy is a result of failure of segregation of chromosomes (Non-disjunction) during gamete formation (meiosis I/II)

142. Read the following statements and identify the characters related to the alga shown in the diagram



- (a) It is a member of Chlorophyceae  
(b) Food is stored in the form of starch  
(c) It is a monoecious plant showing oogonium and antheridium  
(d) Food is stored in the form of laminarin or mannitol  
(e) It shows dominance of pigments Chlorophyll a, c and Fucoxanthin

Choose the correct answer from the options given below :

- (1) (c), (d) and (e) only  
(2) (a) and (b) only  
(3) (a), (b) and (c) only  
(4) (a), (c) and (d) only

Sol. Answer (3)

- Chara - is a member of chlorophyceae (green algae)
- Food is stored in Pyrenoid bodies. Pyrenoid body majorly contains starch around a protein axis.
- Chara is a monoecious plant. Male and female sex organs are located on the same plant body.
- Laminarin and mannitol are storage food of Brown algae.
- Chlorophyll a,c and fucoxanthin are predominant pigments in brown algae.

143. Match List - I with List - II :

| List-I              | List-II                                  |
|---------------------|------------------------------------------|
| (a) Sacred groves   | (i) Alien species                        |
| (b) Zoological park | (ii) Release of large quantity of oxygen |
| (c) Nile perch      | (iii) <i>Ex-situ</i> conservation        |
| (d) Amazon forest   | (iv) Khasi Hills in Meghalaya            |

Choose the correct answer from the options given below:

- (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)
- (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)
- (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)
- (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

Sol. Answer (2)

Sacred groves are tracts of forests conserved by people due to religions, cultural beliefs that emphasize protection of nature. Khasi hills, Meghalaya is one such area.

Threatened animals, taken out from natural habitats are given special care at a special setting- *Ex-situ* conservation.

Zoological park is one such way of conservation.

Nile perch(fish) introduced in lake Victoria, Africa-led to extinction of more than 200 species of native, cichlid fish. So, Nile perch is example of Alien species invasion. Amazon forest covering more than 14% of earth's land surface, release large amount of O<sub>2</sub>.

144. The enzyme (a) is needed for isolating genetic material from plant cells and enzyme (b) for isolating genetic material from fungus. Choose the correct pair of options from the following:

- (a) Cellulase (b) Lipase
- (a) Cellulase (b) Protease
- (a) Cellulase (b) Chitinase
- (a) Chitinase (b) Lipase

Sol. Answer (3)

The genetic material from cells can be separated by lysing the cell wall, if present. The cell wall in plant cells is digested by cellulase and in fungal cells by chitinase enzyme.

145. Identify the correct sequence of events during Prophase I of meiosis :

- Synapsis of homologous chromosomes
- Chromosomes become gradually visible under microscope
- Crossing over between non-sister chromatids of homologous chromosomes
- Terminalisation of chiasmata
- Dissolution of synaptonemal complex

Choose the correct answer from the options given below:

- (a), (c), (d), (e), (b)
- (a), (b), (c), (d), (e)
- (b), (c), (d), (e), (a)
- (b), (a), (c), (e), (d)

Sol. Answer (4)

During meiosis-I, in prophase I, firstly chromatin network condenses gradually which is visible as chromosomes under microscope.

Homologous chromosomes pair up in a process called synapsis.

Crossing over is the exchange of genetic material between non-sister chromatids of homologous chromosomes.

The paired chromosomes move apart due to dissolution of the protein laden-synaptonemal complex.

The actual point at which crossing over takes place is visualized as 'X' shaped structure called chiasmata.



**146.** Which of the following pair represents free living nitrogen fixing aerobic bacteria?

- (1) *Pseudomonas* and *Thiobacillus*
- (2) *Rhizobium* and *Beijernickia*
- (3) *Azotobacter* and *Beijernickia*
- (4) *Anabaena* and *Rhodospirillum*

Sol. Answer (3)

Atmospheric  $N_2$  cannot be utilized by living organisms. Few prokaryotes can reduce nitrogen ( $N_2$ ) into ammonia-Biological Nitrogen Fixation.

$N_2$  fixing bacteria can be free living or symbiotic.

*Azotobacter*, *Beijernickia* - Free living  $N_2$  fixers.

**147.** Frugivorous birds are found in large numbers in tropical forests mainly because of :

- (1) temperature conducive for their breeding
- (2) lack of niche specialisation
- (3) higher annual rainfall
- (4) availability of fruits throughout the year

Sol. Answer (4)

Tropical environments are less seasonal, more constant or predictable. This promotes Niche specialization, greater species diversity. Moreover, high solar energy contributes to high productivity.

**148.** Identify the correct statements regarding chemiosmotic hypothesis:

- (a) Splitting of the water molecule takes place on the inner side of the membrane.
- (b) Protons accumulate within the lumen of the thylakoids.
- (c) Primary acceptor of electron transfers the electrons to an electron carrier.
- (d) NADP reductase enzyme is located on the stroma side of the membrane.
- (e) Protons increase in number in stroma.

Choose the correct answer from the options given below :

- (1) (b), (c) and (e)
- (2) (a), (b) and (e)
- (3) (a), (b) and (d)
- (4) (b), (c) and (d)

Sol. Answer (3)

During light reactions, Statement (c) is incorrect because the electron from primary acceptor is transferred to a proton carrier (PQ) but not an electron carrier. Statement (e) is incorrect as the proton concentration relatively increases in the lumen of thylakoid and decreases on the stromal side.

**149.** Match List-I with List-II :

| List-I           | List-II                                                      |
|------------------|--------------------------------------------------------------|
| (a) Gene gun     | (i) Replacement of a faulty gene by a normal healthy gene    |
| (b) Gene therapy | (ii) Used for transfer of Gene                               |
| (c) Gene cloning | (iii) Total DNA in the cells of an organism                  |
| (d) Genome       | (iv) To obtain identical copies of a particular DNA molecule |

Choose the correct answer from the options given below :

- (1) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)
- (2) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)
- (3) (a)-(i), (b)-(iii), (c)-(ii), (d)-(iv)
- (4) (a)-(iv), (b)-(i), (c)-(iii), (d)-(ii)

Sol. Answer (2)

|              |                                                                       |
|--------------|-----------------------------------------------------------------------|
| Gene gun     | Used to transfer DNA in plant cells                                   |
| Gene therapy | Replacement of defective gene a faulty gene by normal functional gene |
| Gene cloning | To obtain identical copies of desired gene                            |
| Genome       | Total DNA content in the cell of an organism                          |

**150.** Which of the following can be expected if scientists succeed in introducing apomictic gene varieties of crops

- (1) There will be segregation of the desired characters only in the progeny
- (2) Polyembryony will be seen and each seed will produce many plantlets
- (3) Seeds of hybrid plants will show longer dormancy
- (4) Farmers can keep on using the seeds produced by the hybrids to raise new crop year after year

Sol. Answer (4)

Apomixis is a phenomenon in which seeds are formed from unfertilized nucleus or egg cell, such seeds produce plantlets identical to parent plant (hybrid plant) So, farmers can keep using these apomictic seeds to raise new crops year after year.



## Zoology

### Section-A (Q. No. 151 to 185)

151. Which of the following animals has three chambered heart?

- (1) *Pteropus*                      (2) *Scoliodon*  
(3) *Hippocampus*                (4) *Chelone*

Sol. Answer (4)

- *Pteropus* (Flying fox) belongs to Class Mammalia having four chambered heart.
- *Scoliodon* (Dog fish) belongs to Superclass Pisces having two chambered heart.
- *Hippocampus* (Sea horse) belongs to Superclass Pisces having two chambered heart
- *Chelone* (Turtle) belongs to Class Reptilia having three chambered heart.

152. Which of the following types of epithelium is present in the bronchioles and Fallopian tubes?

- (1) Stratified squamous epithelium  
(2) Simple squamous epithelium  
(3) Simple columnar epithelium  
(4) Ciliated epithelium

Sol. Answer (4)

Ciliated epithelium is mainly present in the inner surface of hollow organs like bronchioles and Fallopian tubes.

153. Which of the following is **not** an Intra Uterine Device?

- (1) Progestasert  
(2) Progestogens  
(3) Multiload 375  
(4) Lippes loop

Sol. Answer (2)

Intra Uterine Devices are presently available as the non-medicated IUDs (e.g. Lippes loop), copper releasing IUDs (CuT, Cu7, Multiload 375) and the hormone releasing IUDs (Progestasert, LNG-20).

154. Match List - I with List - II :

| List - I | List - II |
|----------|-----------|
|----------|-----------|

- |                          |                |
|--------------------------|----------------|
| (a) <i>Chlamydomonas</i> | (i) Conidia    |
| (b) <i>Penicillium</i>   | (ii) Zoospores |
| (c) <i>Hydra</i>         | (iii) Gemmules |
| (d) Sponge               | (iv) Buds      |

Choose the correct answer from the options given below :

- (1) (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)  
(2) (a) - (i), (b) - (iv), (c) - (iii), (d) - (ii)  
(3) (a) - (ii), (b) - (i), (c) - (iv), (d) - (iii)  
(4) (a) - (iii), (b) - (ii), (c) - (i), (d) - (iv)

Sol. Answer (3)

Different ways of asexual reproduction are seen in different organisms.

- |                      |             |
|----------------------|-------------|
| <i>Chlamydomonas</i> | – Zoospores |
| <i>Penicillium</i>   | – Conidia   |
| <i>Hydra</i>         | – Buds      |
| Sponge               | – Gemmules  |

155. Which of the following reasons is mainly responsible for graft rejection in transplantation of organs?

- (1) Cell-mediated response  
(2) Inability of recipient to differentiate between 'self' and 'non-self' tissues/cells  
(3) Humoral immune response only

- (4) Auto-immune response

Sol. Answer (1)

Any tissue or organ used for transplantation is commonly called graft. Tissue matching, blood group matching are essential before undertaking any graft/transplant. Cell mediated immune response is responsible for graft rejection.

**156.** Bivalent or Tetrad formation is a characteristic feature observed during:

- (1) Chiasmata in zygotene stage
- (2) Synaptonemal complex in zygotene stage
- (3) Chiasmata in Diplotene stage
- (4) Synaptonemal complex in Pachytene stage

Sol. Answer (2)

Bivalent or tetrad formation is a characteristic feature observed during zygotene stage when the homologous chromosomes undergo synapsis (pairing).

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

**Assertion (A):**

FSH which interacts with membrane bound receptors does not enter the target cell.

**Reason (R):**

Binding of FSH to its receptors generates second messenger (cyclic AMP) for its biochemical and physiological responses.

In the light of the above statements, choose the most appropriate answer from the 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

Sol. Answer (3)

Option (3) is the correct answer as FSH is a peptide hormone, which is a lipid insoluble hormone. Lipid insoluble hormones cannot directly pass through the membranes and usually require membrane bound receptors for carrying out their activity.

Binding of hormones to membrane bound receptors generate second messenger for its biochemical and physiological responses.

**158.** Choose the correct statement about a muscular tissue:

- (1) Smooth muscles are multinucleated and involuntary.

- (2) Skeletal muscle fibres are uninucleated and found in parallel bundles.

- (3) Intercalated discs allow the cardiac muscle cells to contract as a unit.

- (4) The walls of blood vessels are made up of columnar epithelium.

Sol. Answer (3)

Smooth muscles are uninucleated and involuntary.

Skeletal muscle fibres are multinucleated and bundled together in a parallel fashion.

Communication junctions (Gap junctions) in the intercalated discs of cardiac muscles at some fusion points allow the cells to contract as a unit.

Wall of blood vessels is lined by simple squamous epithelial tissue.

**159.** Identify the region of human brain which has pneumotaxic centre that alters respiratory rate by reducing the duration of inspiration.

- (1) Cerebrum
- (2) Medulla
- (3) Pons
- (4) Thalamus

Sol. Answer (3)

Pneumotaxic centre present in the pons region of the brain can moderate the functions of the respiratory rhythm centre. Neural signal from this centre can reduce the duration of inspiration and thereby alter the respiratory rate.

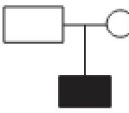
**160.** The amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis is called:

- (1) Net primary production
- (2) Secondary production
- (3) Primary production
- (4) Gross primary production

Sol. Answer (3)

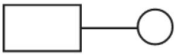
The amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis is called primary production.

**161.** Select the incorrect match regarding the symbols used in Pedigree analysis

- (1)  Parent with male child affected with disease
- (2)  Sex unspecified



(3)  Affected individual

(4)  Consanguineous mating

Sol. Answer (4)



Mating between Relative (consanguineous mating)

**162.** If the pH in lysosomes is increased to alkaline, what will be the outcome?

- (1) Lysosomal enzymes will be more active
- (2) Hydrolytic enzymes will function more efficiently
- (3) Hydrolytic enzymes will become inactive
- (4) Lysosomal enzymes will be released into the cytoplasm

Sol. Answer (3)

Lysosomal enzymes are activated at acidic pH only and get deactivated at alkaline pH.

**163.** According to the sliding filament theory

- (1) The actin filaments slide away from A-band resulting in shortening of sarcomere.
- (2) Actin and myosin filaments slide over each other to increase the length of the sarcomere.
- (3) Length of A-band does not change.
- (4) I-band increases in length.

Sol. Answer (3)

- In sliding filament theory, skeletal muscle shortens during contraction because the thin filaments (Actin) slide past over the thick filaments (Myosin)
- Thus, the I band gets reduced and the A band retains its length.
- As the thin filaments slide inwards the Z discs come close together, and sarcomere shortens.

**164.** Pathogenic bacteria gain resistance to antibiotics due to changes in their :

- (1) Nucleoid
- (2) Cosmids
- (3) Plasmids
- (4) Nucleus

Sol. Answer (3)

R-plasmid or resistance plasmids allow specific bacteria to gain resistance against antibiotics.

**165.** Panspermia, an idea that is still a favourite for some astronomers, means

- (1) Transfer of spores as unit of life from other planets to Earth
- (2) Creation of life from dead and decaying matter
- (3) Creation of life from chemicals
- (4) Origin of sperm in human testes

Sol. Answer (1)

Early Greek thinkers thought units of life called spores were transferred to different planets including Earth, which formed the Theory of Panspermia.

**166.** Why CNG is considered better fuel than diesel?

- (a) It can not be adulterated.
- (b) It takes less time to fill the fuel tank.
- (c) It burns more efficiently.
- (d) It is cheaper.
- (e) It is less inflammable.

Choose the most appropriate answer from the options given below:

- (1) (c), (d), (e) only
- (2) (a), (b), (c), (e) only
- (3) (a), (c), (d) only
- (4) (a), (b), (d), (e) only

Sol. Answer (3)

CNG :

→ Cannot be adulterated

→ It burns more efficiently

→ it is cheaper

(e) is incorrect because CNG is less flammable not inflammable.

**167.** Which of the following statements are correct with respect to vital capacity?

- (a) It includes ERV, TV and IRV.
- (b) Total volume of air a person can inspire after a normal expiration.
- (c) The maximum volume of air a person can breathe in after forced expiration.
- (d) It includes ERV, RV and IRV.
- (e) The maximum volume of air a person can breathe out after a forced inspiration.

Choose the most appropriate answer from the options given below.

- (1) (a) and (e)
- (2) (b), (d) and (e)
- (3) (a), (c) and (d)
- (4) (a), (c) and (e)

Sol. Answer (4)

Vital capacity (VC): The maximum volume of air a person can breathe in after a forced expiration or the maximum volume of air a person can breathe out after a forced inspiration. This includes ERV, TV and IRV.



**168.** How many secondary spermatocytes are required to form 400 million spermatozoa?

- (1) 400 million                      (2) 50 million  
(3) 100 million                      (4) 200 million

Sol. Answer (4)

During spermatogenesis, each secondary spermatocyte undergoes Meiosis II and forms two spermatids that in turn differentiate to form two spermatozoa. So, the number of spermatozoa is twice that of secondary spermatocytes. Therefore, 200 million secondary spermatocytes are required to form 400 million spermatozoa.

**169.** Mad cow disease in cattle and Cr Jacob disease in humans are due to infection by \_\_\_\_\_.

- (1) Prion  
(2) Bacterium  
(3) Virus  
(4) Viroid

Sol. Answer (1)

Mad cow disease in cattle and Cr Jacob disease in humans are due to infection by Prions which are abnormally folded proteins.

**170.** Arrange the components of mammary gland. (from proximal to distal).

- (a) Mammary duct                      (b) Lactiferous duct  
(c) Alveoli                                  (d) Mammary ampulla  
(e) Mammary tubules

Choose the most appropriate answer from the options given below .

- (1) (e) → (c) → (d) → (b) → (a)  
(2) (c) → (a) → (d) → (e) → (b)  
(3) (b) → (c) → (e) → (d) → (a)  
(4) (c) → (e) → (a) → (d) → (b)

Sol. Answer (4)

Alveoli → Mammary tubules → Mammary duct → Mammary ampulla → Lactiferous duct

**171.** Western Ghats have a large number of plants and animal species that are not found anywhere else. Which of the following term is used to notify such species?

- (1) Vulnerable species  
(2) Threatened species  
(3) Keystone species  
(4) Endemic species

Sol. Answer (4)

Endemism is distribution of a taxon limited to a small geographic area and found nowhere else.

**172.** Match List - I with List - II regarding the organs of Cockroach :

List - I

List - II

- |                        |                                    |
|------------------------|------------------------------------|
| (a) Crop               | (i) grinding the food particles    |
| (b) Proventriculus     | (ii) secretion of digestive juice  |
| (c) Hepatic caecae     | (iii) removal of nitrogenous waste |
| (d) Malpighian tubules | (iv) storage of food               |

Choose the correct answer from the options given below .

- (1) (a) - (i), (b) - (iv), (c) - (iii), (d) - (ii)  
(2) (a) - (iv), (b) - (i), (c) - (ii), (d) - (iii)  
(3) (a) - (iii), (b) - (ii), (c) - (i), (d) - (iv)  
(4) (a) - (ii), (b) - (iv), (c) - (i), (d) - (iii)

Sol. Answer (2)

- |                    |                                 |
|--------------------|---------------------------------|
| Crop               | - storage of food               |
| Proventriculus     | - grinding of food              |
| Hepatic caecae     | - secretion of digestive juices |
| Malpighian tubules | - Removal of excretory products |

**173.** Two butterfly species are competing for the same nectar of a flower in a garden. To survive and coexist together, they may avoid competition in the same garden by

- (1) predating on each other  
(2) feeding at the same time  
(3) choosing different foraging patterns  
(4) increasing time spent on attacking each other

Sol. Answer (3)

Two butterfly species are competing for same nectar of a flower. To survive and co-exist together they can choose different foraging patterns.

**174.** Role of enamel is to :

- (1) Give basic shape to the teeth  
(2) Connect crown of tooth with its root  
(3) Masticate the food  
(4) Form bolus

Sol. Answer (3)

Enamel is present on the outer side of the crown in teeth and is involved in mastication of the food.

175. Choose the incorrect enzymatic reaction.

- (1) Dipeptides  $\xrightarrow{\text{Dipeptidases}}$  Amino acids  
 (2) Maltose  $\xrightarrow{\text{Maltase}}$  Glucose + Galactose  
 (3) Sucrose  $\xrightarrow{\text{Sucrase}}$  Glucose + Fructose  
 (4) Lactase  $\xrightarrow{\text{Lactase}}$  Glucose + Galactose

Sol. Answer (2)

Maltase enzyme converts maltose into two glucose molecules

Dipeptidase converts dipeptides into two amino acid molecules.

Sucrase converts sucrose into glucose and fructose.

Lactase converts lactose into glucose and galactose

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

Assertion (A) :

During pregnancy the level of thyroxine is increased in the maternal blood.

Reason (R) :

Pregnancy is characterised by metabolic changes in the mother.

In the light of the above statements, choose the most appropriate answer from the 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

Sol. Answer (2)

During pregnancy, the metabolic rate in the mother is increased to fulfil the increased requirements of the mother and the developing foetus by increase in thyroxine

Both assertion and reason are correct and reason is the correct explanation of the assertion.

177. Choose the correct statements :

- (a) Bones support and protect softer tissues and organs

(b) Weight bearing function is served by limb bones

(c) Ligament is the site of production of blood

(d) Adipose tissue is specialised to store fats.

(e) Tendons attach one bone to another. Choose the most appropriate answer from the options given below

- (1) (a), (b) and (e) only  
 (2) (a), (b) and (d) only  
 (3) (b), (c) and (e) only  
 (4) (a), (c) and (d) only

Sol. Answer (2)

C---Ligament is the site of production of blood cells (false statement).... should be bone marrow

D---Tendons join one bone to another bone (False statement)...should be ligament

178. If DNA contained sulfur instead of phosphorus and proteins contained phosphorus instead of sulfur, what would have been the outcome of Hershey and Chase experiment?

- (1) Radioactive phosphorus in bacterial cells  
 (2) No radioactive sulfur in bacterial cells  
 (3) Both radioactive sulfur and phosphorus in bacterial cells  
 (4) Radioactive sulfur in bacterial cells

Sol. Answer (4)

If DNA contains sulphur

Protein contains Phosphorous

Then, Radioactive sulphur will be found in bacterial cells.

179. Select the incorrect statements with respect to Cyclostomes .

- (a) They lack scales and paired fins.  
 (b) They have circular mouth with jaws.  
 (c) They bear 6-15 pairs of gills.  
 (d) They migrate to deep sea for spawning.

Choose the most appropriate answer from the options given below :

- (1) (a) and (d) only      (2) (a) and (b) only  
 (3) (b) and (c) only      (4) (b) and (d) only

Sol. Answer (4)

(a) Correct

(b) False (as the jaws are absent)

(c) Correct

(d) False (as they migrate to fresh water or shallow water for spawning)



**180.** A unique vascular connection between the digestive tract and liver is called

- (1) Hepato-cystic system
- (2) Hepato-pancreatic system
- (3) Hepatic portal system
- (4) Renal portal system

**Sol.** Answer (3)

Hepatic portal system is a specialised system that connects the digestive tract with the liver.

**181.** Milk of transgenic 'Cow Rosie' was nutritionally more balanced product for human babies than natural cow milk because it contained :

- (1) Human enzyme Adenosine Deaminase (ADA)
- (2) Human protein  $\alpha$ -1-antitrypsin
- (3) Human alpha-lactalbumin
- (4) Human insulin-like growth factor

**Sol.** Answer (3)

Alpha-lactalbumin is the human milk protein produced by the transgenic cow 'Rosie'.

**182.** Gout is a type of disorder which leads to :

- (1) Weakening of bones due to low calcium level
- (2) Inflammation of joints due to accumulation of uric acid crystals
- (3) Weakening of bones due to decreased bone mass
- (4) Inflammation of joints due to cartilage degeneration

**Sol.** Answer (2)

Gout is a metabolic disease characterised by increased production of uric acid and deposition of uric acid crystals in the joints leading to inflammation of the joints.

**183.** Which of the following methods is not commonly used for introducing foreign DNA into the plant cell?

- (1) Bacteriophages
- (2) Agrobacterium mediated transformation
- (3) Gene gun
- (4) 'Disarmed pathogen' vectors

**Sol.** Answer (1)

Bacteriophages are used to insert foreign DNA into the bacteria(not into the plants).

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

**Statement I :**

Amino acids have a property of ionizable nature of  $\text{—NH}_2$  and  $\text{—COOH}$  groups, hence have different structures at different pH.

**Statement II :**

Amino acids can exist as Zwitterionic form at acidic and basic pH.

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

**Sol.** Answer (2)

Statement I :Correct

Statement II: Correct, Zwitterion formation takes place at isoelectric point that can be at acidic or basic pH.

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

**Assertion (A) :**

*Spirulina* is a microbe that can be used for reducing environmental pollution.

**Reason (R) :**

*Spirulina* is a rich source of protein, carbohydrates, fats, minerals and vitamins.

In the light of the above statements, choose the most appropriate answer from the 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

**Sol.** Answer (3)

*Spirulina* is a blue green algae as it performs photosynthesis. It enriches the surrounding environment with oxygen.

It can be cultivated on starch rich waste waters from potato processing industry, straw, molasses etc.

Large amounts of *Spirulina* can be grown this way as it can also serve as a rich source of protein, carbohydrates, fats, minerals and vitamins.

**Zoology : Section-B (Q. No. 186 to 200)**

**186.** With respect to metaphase, which of the following statements is incorrect?

- (1) Chromosomes lie at the equator of the cell



- (2) Complete disintegration of nuclear envelope takes place
- (3) Chromosomes are highly condensed
- (4) Metaphase chromosomes are made up of four sister chromatids held together by centromere

**Sol.** Answer (4)

Each chromosome is made up of 2 sister chromatids.

**187.** Against the codon 5' UAC 3', what would be the sequence of anticodon on tRNA?

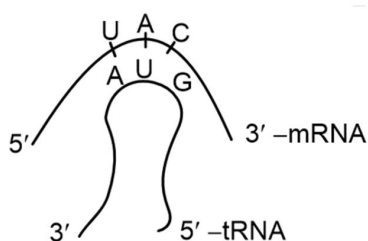
- (1) 5' GUA 3'                      (2) 5' AUG 3'
- (3) 5' ATG 3'                      (4) 5' GTA 3'

**Sol.** Answer (1)

mRNA codon : 5' UAC 3'

tRNA Anticodon : 3' AUG 5'

The sequence of anticodon on tRNA would be 5' GUA 3'



**188.** Arrange the following formed elements in the decreasing order of their abundance in blood in humans :

- (a) Platelets                      (b) Neutrophils
- (c) Erythrocytes.              (d) Eosinophils
- (e) Monocytes

Choose the most appropriate answer from the options given below :

- (1) (a), (c), (b), (d), (e)
- (2) (c), (a), (b), (e), (d)
- (3) (c), (b), (a), (e), (d)
- (4) (d), (e), (b), (a), (c)

**Sol.** Answer (2)

- Erythrocytes/RBCs : 5 – 5.5 million/mm<sup>3</sup>
- Platelets : 1,50,000 – 3,50,000/mm<sup>3</sup>
- WBCs/Leukocytes : 6,000 – 8,000/mm<sup>3</sup>
  - Neutrophils : 60 to 65%
  - Lymphocytes : 20 to 25%
  - Monocytes : 6 to 8%

- Eosinophils : 2 to 3%
- Basophils : 0.5 to 1%

**189.** Which of the following are true about the taxonomical aid 'key'?

- (a) Keys are based on the similarities and dissimilarities.
- (b) Key is analytical in nature.
- (c) Keys are based on the contrasting characters in pair called Couplet.
- (d) Same key can be used for all taxonomic categories.
- (e) Each statement in the key is called Lead. Choose the most appropriate answer from the options given below :

- (1) (a), (c), (d) and (e) only
- (2) (a), (b) and (c) only
- (3) (b), (c) and (d) only
- (4) (a), (b), (c) and (e) only

**Sol.** Answer (4)

Keys are a type of taxonomical aid. They are analytical in nature. Different keys are used for different taxonomic categories.

**190.** A normal girl, whose mother is haemophilic marries a male with no ancestral history of haemophilia. What will be the possible phenotypes of the offsprings?

- (a) Haemophilic son and haemophilic daughter.
- (b) Haemophilic son and carrier daughter.
- (c) Normal daughter and normal son.
- (d) Normal son and haemophilic daughter.

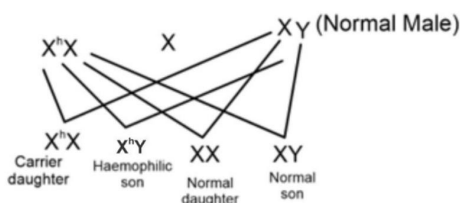
Choose the most appropriate answer from the options given below :

- (1) (b) and (d) only
- (2) (a) and (b) only
- (3) (b) and (c) only
- (4) (a) and (d) only

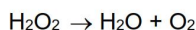
**Sol.** Answer (3)

Normal girls whose mother was Haemophilic. Haemophilia is a X linked Recessive disease

X<sup>h</sup>X is genotype of daughter as she receives one X<sup>h</sup> from mother



191. In the enzyme which catalyses the breakdown of:



the prosthetic group is:

- (1) Niacin
- (2) Nicotinamide adenine dinucleotide
- (3) Haem
- (4) Zinc

Sol. Answer (3)

Peroxidase and catalase enzymes catalyze the breakdown of Hydrogen peroxide to water and oxygen, Haem is the prosthetic group.

192. Select the incorrect statement with respect to inbreeding of animals.

- (1) It exposes harmful recessive genes that are eliminated by selection.
- (2) It is used for evolving pure lines in cattle.
- (3) It helps in accumulation of superior genes and elimination of less desirable genes.
- (4) It decreases homozygosity.

Sol. Answer (4)

Inbreeding refers to the mating of more closely related individuals within the same breed for 4-6 generations.

Hence, Inbreeding increases Homozygosity.

193. IUDs are small objects made up of plastic or copper that are inserted in the uterine cavity. Which of the following statements are correct about IUDs?

- (a) IUDs decrease phagocytosis of sperm within the uterus.
- (b) The released copper ions suppress the sperm motility.
- (c) IUDs do not make the cervix hostile to the sperm.
- (d) IUDs suppress the fertilization capacity of sperm.
- (e) The IUDs require surgical intervention for their insertion in the uterine cavity.

Choose the most appropriate answer from the options given below:

- (1) (d) only
- (2) (a), (d) and (e) only
- (3) (b) and (c) only
- (4) (b) and (d) only

Sol. Answer (4)

IUDs - Inserted by doctors or expert nurses in the uterus through vagina.

- Increase phagocytosis of sperms within the uterus
- Release Cu ions which suppress sperm motility & the fertilizing capacity of sperms
- Make the uterus unsuitable for implantation & the cervix hostile to the sperms.
- The IUDs require no surgical intervention for their insertion in the uterine cavity.

194. Select the correct statement regarding mutation theory of evolution.

- (1) Large differences due to mutations arise gradually in a population
- (2) This theory was proposed by Alfred Wallace
- (3) Variations are small directional changes
- (4) Single step large mutation is a cause of speciation

Sol. Answer (4)

- Mutation theory was given by Hugo de Vries.
- Mutation is the large difference arising suddenly in population.
- Mutations are random and directionless.

195. Excretion in cockroach is performed by all, EXCEPT:

- (1) Hepatic caeca
- (2) Ureose glands
- (3) Malpighian tubules
- (4) Fat body

Sol. Answer (1)

A ring of 6-8 blind tubules called Hepatic or gastric caeca is present at the junction of foregut and midgut, which secrete digestive juice.

196. Select the **correct** statements.

- (a) Angiotensin II activates the cortex of adrenal gland to release aldosterone.
- (b) Aldosterone leads to increase in blood pressure.



- (c) ANF acts as a check on renin-angiotensin mechanism.
- (d) ADH causes vasodilation.
- (e) Vasopressin is released from adenohypophysis.

Choose the **most appropriate** answer from the options given below:

- (1) (a), (b) and (c) only
- (2) (a), (b) and (e) only
- (3) (c), (d) and (e) only
- (4) (b), (c) and (d) only

Sol. Answer (1)

- Hypothalamus release ADH or vasopressin through the neurohypophysis.
- ADH affects the kidney function by its constrictory effect on blood vessels.

**197.** If A and C make 30% and 20% of DNA, respectively, what will be the percentage composition of T. and G ?

- (1) T : 20%, G : 20%
- (2) T : 20%, G : 30%
- (3) T : 30%, G : 20%
- (4) T : 30%, G : 30%

Sol. Answer (3)

According to the Chargaff's rule, the DNA should have an equal ratio of Purine (Adenine & Guanine) and Pyrimidine (Thymine & Cytosine).

It means the number of Adenine is equal to Thymine and the number of Guanine is equal to Cytosine molecules.

**198.** Refer to the following statements for agarose-gel electrophoresis :

- (a) Agarose is a natural polymer obtained from sea-weed.
- (b) The separation of DNA molecules in agarose-gel electrophoresis depends on the size of DNA.
- (c) The DNA migrates from negatively-charged electrode to the positively-charged electrode
- (d) The DNA migrates from positively-charged electrode to the negatively-charged electrode.

Choose the **most appropriate** answer from the options given below

- (1) (b), (c) and (d) only
- (2) (a) and (b) only
- (3) (a), (b) and (c) only
- (4) (a), (b) and (d) only

Sol. Answer (3)

Fragments of DNA after the action of restriction endonuclease can be separated by a technique known as gel electrophoresis.

DNA fragments are negatively charged molecules they can be separated by forcing them to move towards the anode (positively charged) under electric field.

**199.** Match List - I with List - II :

| List - I                     | List - II                 |
|------------------------------|---------------------------|
| (a) Multipolar neuron        | (i) Somatic neural system |
| (b) Bipolar neuron           | (ii) Cerebral cortex      |
| (c) Myelinated nerve fibre   | (iii) Retina of Eye       |
| (d) Unmyelinated nerve fibre | (iv) Spinal nerves        |

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

- (1) (a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)
- (2) (a) - (iii), (b) - (i), (c) - (iv), (d) - (ii)
- (3) (a) - (ii), (b) - (iv), (c) - (iii), (d) - (i)
- (4) (a) - (ii), (b) - (iii), (c) - (i), (d) - (iv)

Sol. Answer (1)

Multipolar Neurons (with one axon and two or more dendrites ; found in the cerebral cortex)

Bipolar (with one axon and one dendrite , found in the retina of eye)

Myelinated nerve fibres - found in spinal and cranial nerves

Unmyelinated nerve fibres - found in autonomous and the somatic neural system

**200.** Match List - I with List - II :

| List - I                  | List - II                 |
|---------------------------|---------------------------|
| (a) Cellular barrier      | (i) Interferons           |
| (b) Cytokine barrier      | (ii) Mucus                |
| (c) Physical barrier      | (iii) Neutrophils         |
| (d) Physiological barrier | (iv) HCl in gastric juice |

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

- (1) (a) - (iii), (b) - (i), (c) - (ii), (d) - (iv)
- (2) (a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)



(3) (a) - (ii), (b) - (iii), (c) - (i), (d) - (iv)

(4) (a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)

Sol. Answer (1)

Innate immunity consists of four barriers:

1. Physical barriers - e.g. Mucus coating of the epithelium lining the respiratory, gastrointestinal and urogenital tracts.

2. Physiological barrier - e.g. Acid (HCl) in stomach

3. Cellular barriers - e.g. Polymorpho-nuclear leukocytes (PMNL-Neutrophils)

4. Cytokine barrier - e.g. Interferons (secreted by virus infected cells to protect non infected cells from further viral infection)

## Answer Key

|     |     |     |     |      |     |      |      |      |     |      |     |
|-----|-----|-----|-----|------|-----|------|------|------|-----|------|-----|
| 1.  | (1) | 35. | (2) | 69.  | (2) | 103. | (2)  | 137. | (4) | 171. | (4) |
| 2.  | (2) | 36. | (4) | 70.  | (1) | 104. | (1)  | 138. | (3) | 172. | (2) |
| 3.  | (4) | 37. | (4) | 71.  | (3) | 105. | (2)  | 139. | (4) | 173. | (3) |
| 4.  | (1) | 38. | (4) | 72.  | (4) | 106. | (2)  | 140. | (4) | 174. | (3) |
| 5.  | (2) | 39. | (2) | 73.  | (2) | 107. | (3)  | 141. | (1) | 175. | (2) |
| 6.  | (3) | 40. | (3) | 74.  | (4) | 108. | (3)  | 142. | (3) | 176. | (2) |
| 7.  | (2) | 41. | (1) | 75.  | (3) | 109. | (1)  | 143. | (2) | 177. | (2) |
| 8.  | (1) | 42. | (2) | 76.  | (2) | 110. | (4)  | 144. | (3) | 178. | (4) |
| 9.  | (1) | 43. | (2) | 77.  | (2) | 111. | (4)  | 145. | (4) | 179. | (4) |
| 10. | (1) | 44. | (2) | 78.  | (2) | 112. | (3)  | 146. | (3) | 180. | (3) |
| 11. | (1) | 45. | (1) | 79.  | (2) | 113. | (4)  | 147. | (4) | 181. | (3) |
| 12. | (1) | 46. | (1) | 80.  | (4) | 114. | (3)  | 148. | (3) | 182. | (2) |
| 13. | (2) | 47. | (4) | 81.  | (2) | 115. | (3)  | 149. | (2) | 183. | (1) |
| 14. | (4) | 48. | (3) | 82.  | (1) | 116. | (4)  | 150. | (4) | 184. | (2) |
| 15. | (2) | 49. | (4) | 83.  | (2) | 117. | (3)  | 151. | (4) | 185. | (3) |
| 16. | (4) | 50. | (2) | 84.  | (4) | 118. | (2)  | 152. | (4) | 186. | (4) |
| 17. | (3) | 51. | (1) | 85.  | (1) | 119. | (4)  | 153. | (2) | 187. | (1) |
| 18. | (2) | 52. | (3) | 86.  | (4) | 120. | (2)  | 154. | (3) | 188. | (2) |
| 19. | (3) | 53. | (4) | 87.  | (4) | 121. | (1)  | 155. | (1) | 189. | (4) |
| 20. | (2) | 54. | (4) | 88.  | (1) | 122. | (4)  | 156. | (4) | 190. | (3) |
| 21. | (4) | 55. | (2) | 89.  | (1) | 123. | (3)  | 157. | (2) | 191. | (3) |
| 22. | (3) | 56. | (4) | 90.  | (3) | 124. | (2)  | 158. | (3) | 192. | (4) |
| 23. | (4) | 57. | (1) | 91.  | (2) | 125. | (2)  | 159. | (3) | 193. | (4) |
| 24. | (4) | 58. | (4) | 92.  | (4) | 126. | (1)  | 160. | (4) | 194. | (4) |
| 25. | (4) | 59. | (3) | 93.  | (2) | 127. | (3)  | 161. | (4) | 195. | (1) |
| 26. | (4) | 60. | (3) | 94.  | (3) | 128. | (3)  | 162. | (3) | 196. | (1) |
| 27. | (3) | 61. | (4) | 95.  | (3) | 129. | (4)  | 163. | (3) | 197. | (3) |
| 28. | (4) | 62. | (3) | 96.  | (1) | 130. | (3)  | 164. | (3) | 198. | (3) |
| 29. | (4) | 63. | (3) | 97.  | (4) | 131. | (2)  | 165. | (1) | 199. | (1) |
| 30. | (4) | 64. | (1) | 98.  | (1) | 132. | (3)  | 166. | (3) | 200. | (1) |
| 31. | (2) | 65. | (4) | 99.  | (2) | 133. | (1)  | 167. | (4) |      |     |
| 32. | (4) | 66. | (3) | 100. | (1) | 134. | (NA) | 168. | (4) |      |     |
| 33. | (2) | 67. | (4) | 101. | (1) | 135. | (3)  | 169. | (1) |      |     |
| 34. | (2) | 68. | (3) | 102. | (4) | 136. | (4)  | 170. | (4) |      |     |