

# NATIONAL ELIGIBILITY CUM ENTRANCE TEST

## Phase-2 (Code:AA-PP-WW)

### Answers & Solutions

#### Physics

1. Planck's constant ( $h$ ), speed of light in vacuum ( $c$ ) and Newton's gravitational constant ( $G$ ) are three fundamental constants. Which of the following combinations of these has the dimension of length?

(A)  $\frac{\sqrt{hG}}{\frac{3}{c^2}}$

(B)  $\frac{\sqrt{hG}}{\frac{5}{c^2}}$

(C)  $\sqrt{\frac{hc}{G}}$

(D)  $\sqrt{\frac{Gc}{\frac{3}{h^2}}}$

**Solution: (A)**

$$L \propto h^a c^b G^c$$

$$[L]^1 = [M^1 L^2 T^{-1}]^a [L T^{-1}]^b [M^{-1} L^3 T^{-2}]^c$$

Solving,

$$a = \frac{1}{2}, c = \frac{1}{2}, b = -\frac{3}{2}$$

$$\Rightarrow L = \frac{\sqrt{hG}}{\frac{3}{c^2}}$$

2. Two cars P and Q start from a point at the same time in a straight line and their positions are represented by  $X_P(t) = at + bt^2$  and  $X_Q(t) = ft - t^2$ . At what time do the cars have the same velocity?

(A)  $\frac{a-f}{1+b}$

(B)  $\frac{a+f}{2(b-1)}$

(C)  $\frac{a+f}{2(1+b)}$

(D)  $\frac{f-a}{2(1+b)}$

**Solution: (D)**

$$v_P = \frac{dx_P}{dt} = a + 2bt$$

$$v_Q = \frac{dx_Q}{dt} = f - 2t$$

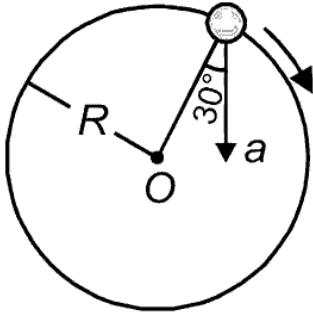
$$v_P = v_Q$$

$$\Rightarrow a + 2bt = f - 2t$$

$$2t + 2bt = f - a$$

$$\Rightarrow t = \frac{f-a}{2(b+1)}$$

3. In the given figure,  $a = 15 \text{ m/s}^2$  represents the total acceleration of a particle moving in the clockwise direction in a circle of radius  $R = 2.5 \text{ m}$  at a given instant of time. The speed of the particle is



- (A) 4.5 m/s  
 (B) 5.0 m/s  
 (C) 5.7 m/s  
 (D) 6.2 m/s

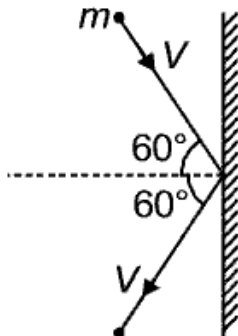
**Solution: (C)**

$$a \cos 30^\circ = \frac{v^2}{r}$$

$$\Rightarrow 15 \frac{\sqrt{3}}{2} = \frac{v^2}{2.5}$$

$$\Rightarrow v = 5.7 \text{ m/s}$$

4. A rigid ball of mass  $m$  strikes a rigid wall at  $60^\circ$  and gets reflected without loss of speed as shown in the figure below. The value of impulse imparted by the wall on the ball will be



- (A)  $mV$   
 (B)  $2mV$   
 (C)  $\frac{mV}{2}$

$$(D) \frac{mV}{3}$$

**Solution: (A)**

$$|\vec{j}| = |\vec{P}_2 - \vec{P}_1| = 2mV \cos \theta = mV$$

5. A bullet of mass 10 g moving horizontally with a velocity of  $400 \text{ ms}^{-1}$  strikes a wood block of mass 2 kg which is suspended by light inextensible string of length 5 m. As a result, the centre of gravity of the block found to rise a vertical distance of 10 cm. The speed of the bullet after it emerges out horizontally from the block will be

(A)  $100 \text{ ms}^{-1}$

(B)  $80 \text{ ms}^{-1}$

(C)  $120 \text{ ms}^{-1}$

(D)  $160 \text{ ms}^{-1}$

**Solution: (C)**

Apply conservation of linear momentum.

CM rises through height  $h$ , so its velocity after collision =  $\sqrt{2gh}$

$$0.01 \times 400 = 2 \times \sqrt{2gh} + 0.01 \times v$$

$$\Rightarrow v = 120 \text{ m/s}$$

6. Two identical balls A and B having velocities of 0.5 m/s and  $-0.3 \text{ m/s}$  respectively collide elastically in one dimension. The velocities of B and A after the collision respectively will be

(A)  $-0.5 \text{ m/s}$  and  $0.3 \text{ m/s}$

(B)  $0.5 \text{ m/s}$  and  $-0.3 \text{ m/s}$

(C)  $-0.3 \text{ m/s}$  and  $0.5 \text{ m/s}$

(D)  $0.3 \text{ m/s}$  and  $0.5 \text{ m/s}$

**Solution: (B)**

They will exchange their velocity, so

$$v_B = 0.5 \text{ m/s} \text{ and } v_A = -0.3 \text{ m/s}$$

7. A particle moves from a point  $(-2\hat{i} + 5\hat{j})$  to  $(4\hat{j} + 3\hat{k})$  when a force of  $(4\hat{i} + 3\hat{j})\text{N}$  is applied. How much work has been done by the force?

(A) 8 J

(B) 11 J

(C) 5 J

(D) 2 J

**Solution: (C)**

$$\vec{S} = \vec{r}_2 - \vec{r}_1 = (4\hat{j} + 3\hat{k}) - (-2\hat{i} + 5\hat{j})$$

$$= 2\hat{i} - \hat{j} + 3\hat{k}$$

$$\vec{F} = 4\hat{i} + 3\hat{j}$$

$$W = \vec{F} \cdot \vec{S} = 8 - 3 = 5 \text{ J}$$

8. Two rotating bodies A and B of masses  $m$  and  $2m$  with moments of inertia  $I_A$  and  $I_B$  ( $I_B > I_A$ ) have equal kinetic energy of rotation. If  $L_A$  and  $L_B$  be their angular momenta respectively, then

(A)  $L_A = \frac{L_B}{2}$

(B)  $L_A = 2L_B$

(C)  $L_B > L_A$

(D)  $L_A > L_B$

**Solution: (C)**

$$E = \frac{L^2}{2I}$$

$$\Rightarrow E_A = E_B$$

$$\Rightarrow \frac{L_A^2}{2I_A} = \frac{L_B^2}{2I_B}$$

$$I_B > I_A \Rightarrow L_B > L_A$$

9. A solid sphere of mass  $m$  and radius  $R$  is rotating about its diameter. A solid cylinder of the same mass and same radius is also rotating about its geometrical axis with an angular speed twice that of the sphere. The ratio of their kinetic energies of rotation  $\left(\frac{E_{\text{sphere}}}{E_{\text{cylinder}}}\right)$  will be

(A) 2 : 3

(B) 1 : 5

(C) 1 : 4

(D) 3 : 1

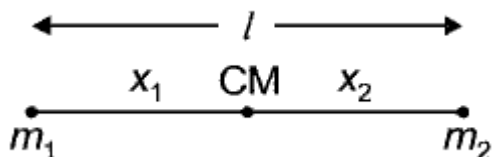
**Solution: (B)**

$$\frac{E_{\text{sphere}}}{E_{\text{cylinder}}} = \frac{\frac{1}{2} \left( \frac{2}{5} mR^2 \right) \omega^2}{\frac{1}{2} \left( \frac{1}{2} mR^2 \right) (2\omega)^2} = \frac{1}{5}$$

10. A light rod of length  $l$  has two masses  $m_1$  and  $m_2$  attached to its two ends. The moment of inertia of the system about an axis perpendicular to the rod and passing through the centre of mass is

- (A)  $\frac{m_1 m_2}{m_1 + m_2} l^2$   
 (B)  $\frac{m_1 + m_2}{m_1 m_2} l^2$   
 (C)  $(m_1 + m_2) l^2$   
 (D)  $\sqrt{m_1 m_2} l^2$

**Solution: (A)**

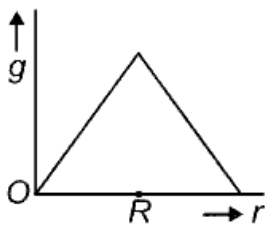


$$x_1 = \frac{m_2 l}{m_1 + m_2} \text{ and } x_2 = \frac{m_1 l}{m_1 + m_2}$$

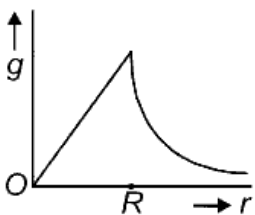
$$I = m_1 x_1^2 + m_2 x_2^2 = \frac{m_1 m_2}{m_1 + m_2} l^2$$

11. Starting from the centre of the earth having radius  $R$ , the variation of  $g$  (acceleration due to gravity) is shown by

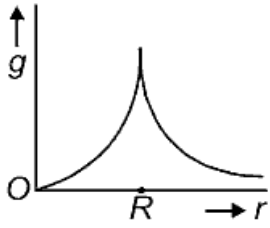
(A)



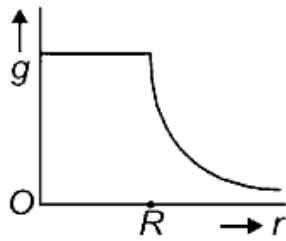
(B)



(C)



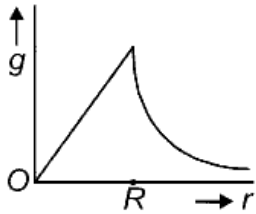
(D)



**Solution: (B)**

$$g_{\text{in}} = \frac{GMr}{R^3} \Rightarrow g_{\text{in}} \propto r$$

$$g_{\text{out}} = \frac{GM}{r^2} \Rightarrow g_{\text{out}} \propto \frac{1}{r^2}$$



12. A satellite of mass  $m$  is orbiting the earth (of radius  $R$ ) at a height  $h$  from its surface. The total energy of the satellite in terms of  $g_0$ , the value of acceleration due to gravity at the earth's surface, is

(A)  $\frac{mg_0R^2}{2(R+h)}$

(B)  $-\frac{mg_0R^2}{2(R+h)}$

(C)  $\frac{2m_0R^2}{R+h}$

(D)  $-\frac{2m_0R^2}{R+h}$

**Solution: (B)**

$$\text{Total energy} = -\frac{GMm}{2r}$$

Here,  $r = R + h$  and  $GM = g_0R^2$

$$\Rightarrow E = -\frac{mg_0R^2}{2(R+h)}$$

13. A rectangular film of liquid is extended from (4 cm × 2 cm) to (5 cm × 4 cm). If the work done is  $3 \times 10^{-4}$  J, the value of the surface tension of the liquid is

- (A)  $0.250 \text{ Nm}^{-1}$
- (B)  $0.125 \text{ Nm}^{-1}$
- (C)  $0.2 \text{ Nm}^{-1}$
- (D)  $8.0 \text{ Nm}^{-1}$

**Solution: (B)**

$$W = 2(A_f - A_i)T$$

$$\Rightarrow T = \frac{W}{(A_f - A_i) \times 2}$$

$$= \frac{3 \times 10^{-4} \text{ J}}{2[5 \times 4 \times 10^{-4} - 4 \times 2 \times 10^{-4}]}$$

$$= 0.125 \text{ Nm}^{-1}$$

14. Three liquids of densities  $\rho_1, \rho_2$  and  $\rho_3$  (with  $\rho_1 > \rho_2 > \rho_3$ ), having the same value of surface tension  $T$ , rise to the same height in three identical capillaries. The angles of contact  $\theta_1, \theta_2$  and  $\theta_3$  obey

- (A)  $\frac{\pi}{2} > \theta_1 > \theta_2 > \theta_3 \geq 0$
- (B)  $0 \leq \theta_1 < \theta_2 < \theta_3 < \frac{\pi}{2}$
- (C)  $\frac{\pi}{2} < \theta_1 < \theta_2 < \theta_3 < \pi$
- (D)  $\pi > \theta_1 > \theta_2 > \theta_3 > \frac{\pi}{2}$

**Solution: (B)**

$$h = \frac{2T \cos \theta}{r\rho g}$$

$$\Rightarrow r \propto \cos \theta \text{ (as } T, h \text{ and } r \text{ are constants)}$$

$$\rho \uparrow \Rightarrow \theta \downarrow$$

$$\theta_1 < \theta_2 < \theta_3$$

$$\text{Its rise so } 0 \leq \theta_1 < \theta_2 < \theta_3 < \frac{\pi}{2}$$

One of these is at  $100^{\circ}\text{C}$ , while the other one is at  $0^{\circ}\text{C}$ . If the two bodies are brought into contact, then assuming no heat loss, the final common temperature is

- (A)  $50^{\circ}\text{C}$
- (B) More than  $50^{\circ}\text{C}$
- (C) Less than  $50^{\circ}\text{C}$  but greater than  $0^{\circ}\text{C}$
- (D)  $0^{\circ}\text{C}$

**Solution: (B)**

Loss of heat by hot body = Gain of heat by cold body

$$T_{c_1} \Delta\theta_1 = T_{c_2} \Delta\theta_2$$

$$T_{c_1} > T_{c_2} \Rightarrow \Delta\theta_1 < \Delta\theta_2$$

16. A body cools from a temperature  $3T$  to  $2T$  in 10 minutes. The room temperature is  $T$ . Assume that Newton's law of cooling is applicable. The temperature of the body at the end of next 10 minutes will be

- (A)  $\frac{7}{4}T$
- (B)  $\frac{3}{2}T$
- (C)  $\frac{4}{3}T$
- (D)  $T$

**Solution: (B)**

$$\frac{T_1 - T_2}{\Delta t} = K \left( \frac{T_1 + T_2}{2} - T_0 \right)$$

$$\frac{3T - 2T}{10} = K(2.5T - T)$$

$$\Rightarrow \frac{T}{10} = K(1.5)T$$

$$K = \frac{1}{15}$$

$$\text{Now, } \frac{T-x}{10} = K \left( \frac{T+x}{2} - T \right)$$

$$\text{Solving } x = \frac{3T}{2}$$

17. One mole of an ideal monatomic gas undergoes a process described by the equation  $PV^3 = \text{constant}$ . The heat capacity of the gas during this process is

- (A)  $\frac{3}{2}R$



- (B)  $\frac{5}{2}R$   
 (C)  $2R$   
 (D)  $R$

**Solution: (D)**

$PV^3 = \text{constant}$  polytropic process with  $n = 3$

$$\begin{aligned} C &= C_v + \frac{R}{1-n} \\ &= \frac{R}{\gamma-1} + \frac{R}{1-n} \\ &= \frac{R}{\frac{5}{3}-1} + \frac{R}{1-3} = R \end{aligned}$$

18. The temperature inside a refrigerator is  $t_2$  °C and the room temperature is  $t_1$  °C. The amount of heat delivered to the room for each joule of electrical energy consumed ideally will be

- (A)  $\frac{t_1}{t_1-t_2}$   
 (B)  $\frac{t_1+273}{t_1-t_2}$   
 (C)  $\frac{t_2+273}{t_1-t_2}$   
 (D)  $\frac{t_1+t_2}{t_1+273}$

**Solution: (B)**

$$K = \frac{Q_2}{W} = \frac{1}{\frac{t_1}{t_2}-1}$$

$$Q_2 = \frac{t_2 W}{t_1-t_2}$$

$$Q_1 = Q_2 + W = \frac{t_2 W}{t_1-t_2} + W$$

$$= \frac{t_1 W}{t_1-t_2} = \frac{t_1+273}{t_1-t_2}$$

19. A given sample of an ideal gas occupies a volume  $V$  at a pressure  $P$  and absolute temperature  $T$ . The mass of each molecule of the gas is  $m$ . Which of the following gives the density of the gas?

- (A)  $\frac{P}{(kT)}$

- (B)  $\frac{Pm}{(kT)}$   
 (C)  $\frac{P}{(kTV)}$   
 (D)  $mkT$

**Solution: (B)**

$$\frac{P}{\rho} = \frac{kT}{m}$$

$$\rho = \frac{Pm}{kT}$$

20. A body of mass  $m$  is attached to the lower end of a spring whose upper end is fixed. The spring has negligible mass. When the mass  $m$  is slightly pulled down and released, it oscillates with a time period of 3 s. When the mass  $m$  is increased by 1 kg, the time period of oscillations becomes 5 s. The value of  $m$  in kg is

- (A)  $\frac{3}{4}$   
 (B)  $\frac{4}{3}$   
 (C)  $\frac{16}{9}$   
 (D)  $\frac{9}{16}$

**Solution: (D)**

$$T_1 = 3 = 2\pi\sqrt{\frac{m}{K}}$$

$$\text{Then, } T_2 = 5 = 2\pi\sqrt{\frac{m+1}{K}}$$

$$\text{Dividing, } \frac{3}{5} = \sqrt{\frac{m}{m+1}}$$

$$\frac{9}{25} = \frac{m}{m+1}$$

$$9m + 9 = 25m$$

$$16m = 9$$

$$m = \frac{9}{16}$$

21. The second overtone of an open organ pipe has the same frequency as the first overtone of a closed pipe  $L$  metre long. The length of the open pipe will be

- (A)  $L$

- (B)  $2L$
- (C)  $\frac{L}{2}$
- (D)  $4L$

**Solution: (B)**

$$\frac{3V}{2L_1} = \frac{3V}{4L}$$

$$\Rightarrow L_1 = 2L$$

22. Three sound waves of equal amplitudes have frequencies  $(n - 1)$ ,  $n$ ,  $(n + 1)$ . They superimpose to give beats. The number of beats produced per second will be

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

**Solution: (D)**

$(n - 1)$  and  $(n + 1)$  suppose to form frequency  $n$

$n$  and  $n$  will be at resonance

$n - 1$  and  $n \rightarrow$  produce 1 beat

$n + 1$  and  $n \rightarrow$  produce 1 beat

Number of beats formed are '2'.

23. An electric dipole is placed at an angle of  $30^\circ$  with an electric field intensity  $2 \times 10^5$  N/C. It experiences a torque equal to 4 N m. The charge on the dipole, if the dipole length is 2 cm, is

- (A) 8 mC
- (B) 2 mC
- (C) 5 mC
- (D)  $7 \mu\text{C}$

**Solution: (B)**

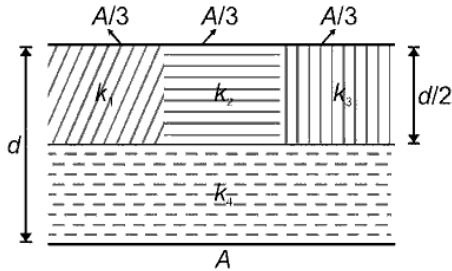
$$\tau = PE \sin \theta$$

$$\Rightarrow \tau = qIE \sin \theta$$

$$\Rightarrow q = \frac{\tau}{IE \sin \theta}$$

$$= \frac{4}{2 \times 10^{-2} \times 0.5 \times 2 \times 10^5} = 2 \text{ mC}$$

24. A parallel-plate capacitor of area  $A$ , plate separation  $d$  and capacitance  $C$  is filled with four dielectric materials having dielectric constants  $k_1, k_2, k_3$  and  $k_4$  as shown in the figure below. If a single dielectric material is to be used to have the same capacitance  $C$  in this capacitor, then its dielectric constant  $k$  is given by



- (A)  $k = k_1 + k_2 + k_3 + 3k_4$   
 (B)  $k = \frac{2}{3}(k_1 + k_2 + k_3) + 2k_4$   
 (C)  $\frac{2}{k} = \frac{3}{k_1 + k_2 + k_3} + \frac{1}{k_4}$   
 (D)  $\frac{1}{k} = \frac{1}{k_1} + \frac{1}{k_2} + \frac{1}{k_3} + \frac{3}{2k_4}$

**Solution: (C)**

$k_1, k_2$  and  $k_3$  are in parallel so Arithmetic mean.

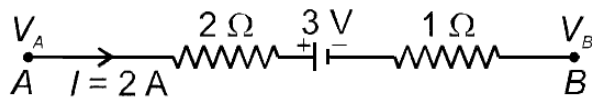
$$k_{eq} = \frac{k_1 + k_2 + k_3}{3}$$

$k_{eq}$  is in series with  $k_4$ . So harmonic mean.

$$\Rightarrow \frac{2}{k} = \frac{1}{k_{eq}} + \frac{1}{k_4}$$

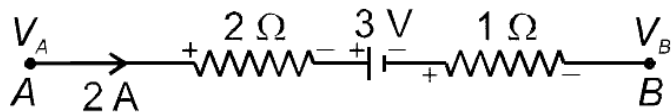
$$\Rightarrow \frac{2}{k} = \frac{3}{k_1 + k_2 + k_3} + \frac{1}{k_4}$$

25. The potential difference ( $V_A - V_B$ ) between the points A and B in the given figure is



- (A)  $-3V$   
 (B)  $+3V$   
 (C)  $+6V$   
 (D)  $+9V$

**Solution: (D)**



$$\begin{aligned}
 V_A - V_B &= (2 \times 2) + 3 + (2 \times 1) \\
 &= 4 + 3 + 2 \\
 &= 9V
 \end{aligned}$$

26. A filament bulb (500 W, 100 V) is to be used in a 230 V main supply. When a resistance R is connected in series, it works perfectly and the bulb consumes 500 W. The value of R is

- (A) 230  $\Omega$
- (B) 46  $\Omega$
- (C) 26  $\Omega$
- (D) 13  $\Omega$

**Solution: (C)**

$$I = \frac{P}{V} = \frac{500}{100} = 5 \text{ A}$$

Voltage across resistance R will be

$$230 - 100 = 130 \text{ V}$$

$$R = \frac{130}{5} = 26 \Omega$$

27. A long wire carrying a steady current is bent into a circular loop of one turn. The magnetic field at the centre of the loop is B. It is then bent into a circular coil of n turns. The magnetic field at the centre of this coil of n turns will be

- (A) nB
- (B)  $n^2B$
- (C) 2nB
- (D)  $2n^2B$

**Solution: (B)**

$$B = \frac{\mu_0 I}{2r}, \text{ when made } n \text{ turns radius becomes } r'$$

$$n \times 2\pi r' = 2\pi r \Rightarrow r' = \frac{r}{n}$$

$$\text{Now, } B' = \frac{\mu_0 n I}{2r'} = n^2 \frac{\mu_0 I}{2r} = n^2 B$$

28. A bar magnet is hung by a thin cotton thread in a uniform horizontal magnetic field and is in equilibrium state. The energy required to rotate it by  $60^\circ$  is  $W$ . Now the torque required to keep the magnet in this new position is

- (A)  $\frac{W}{\sqrt{3}}$
- (B)  $\sqrt{3}W$
- (C)  $\frac{\sqrt{3}W}{2}$
- (D)  $\frac{2W}{\sqrt{3}}$

**Solution: (B)**

$$W = PE(\cos \theta_1 - \cos \theta_2)$$

$$W = PE(\cos 0 - \cos 60^\circ)$$

$$= \frac{PE}{2}$$

$$\Rightarrow PE = 2W$$

$$\tau = PE \sin \theta = 2W \sin 60^\circ = \sqrt{3}W$$

29. An electron is moving in a circular path under the influence of a transverse magnetic field of  $3.57 \times 10^{-2}$  T. If the value of  $e/m$  is  $1.76 \times 10^{11}$  C/kg, the frequency of revolution of the electron is

- (A) 1 GHz
- (B) 100 MHz
- (C) 62.8 MHz
- (D) 6.28 MHz

**Solution: (A)**

$$f = \frac{qB}{2\pi m} = \frac{1.76 \times 10^{11} \times 3.57 \times 10^{-2}}{2 \times 3.14}$$

$$= 10^9 \text{ Hz} = 1 \text{ GHz}$$

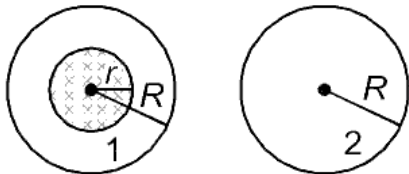
30. Which of the following combinations should be selected for better tuning of an L-C-R circuit used for communication?

- (A)  $R = 20 \Omega, L = 1.5 \text{ H}, C = 35 \mu\text{F}$
- (B)  $R = 25 \Omega, L = 2.5 \text{ H}, C = 45 \mu\text{F}$
- (C)  $R = 15 \Omega, L = 3.5 \text{ H}, C = 30 \mu\text{F}$
- (D)  $R = 25 \Omega, L = 1.5 \text{ H}, C = 45 \mu\text{F}$

**Solution: (C)**

Better tuning means low bandwidth =  $\frac{R}{L}$

31. A uniform magnetic field is restricted within a region of radius  $r$ . The magnetic field changes with time at a rate  $\frac{d\vec{B}}{dt}$ . Loop 1 of radius  $R > r$  encloses the region  $r$  and loop 2 of radius  $R$  is outside the region of magnetic field as shown in the figure below. Then the e.m.f. generated is



- (A) Zero in loop 1 and zero in loop 2  
(B)  $-\frac{d\vec{B}}{dt} \pi r^2$  in loop 1 and  $-\frac{d\vec{B}}{dt} \pi R^2$  in loop 2  
(C)  $-\frac{d\vec{B}}{dt} \pi r^2$  in loop 1 and zero in loop 2  
(D)  $-\frac{d\vec{B}}{dt} \pi R^2$  in loop 1 and zero in loop 2

**Solution: (D)**

Magnetic flux linked with area of loop 1 is  $\pi r^2$

So emf in loop 1 is  $-\frac{d\vec{B}}{dt} \pi r^2$ .

Magnetic flux linked with area of loop 2 is zero

So emf in loop 2 = 0

32. The potential differences across the resistance, capacitance and inductance are 80 V, 40 V and 100 V respectively in an L-C-R circuit. The power factor of this circuit is

- (A) 0.4  
(B) 0.5  
(C) 0.8  
(D) 1.0

**Solution: (C)**

$$\begin{aligned} \cos \phi &= \frac{R}{Z} = \frac{V_R}{V} = \frac{80}{\sqrt{80^2 + (100 - 40)^2}} \\ &= \frac{80}{100} = 0.8 \end{aligned}$$

33. A  $100 \Omega$  resistance and a capacitor of  $100 \Omega$  reactance are connected in series across a  $220 \text{ V}$  source. When the capacitor is 50% charged, the peak value of the displacement current is

- (A)  $2.2 \text{ A}$
- (B)  $11 \text{ A}$
- (C)  $4.4 \text{ A}$
- (D)  $11\sqrt{2} \text{ A}$

**Solution: (A)**

$$R = 100 \Omega, X_c = 100 \Omega$$

$$I_{\max} = \frac{200 \text{ V}}{100} = \frac{220 \text{ V}}{100 \Omega} = 2.2 \text{ A}$$

34. Two identical glass ( $\mu_g = \frac{3}{2}$ ) equiconvex lenses of focal length  $f$  each are kept in contact. The space between the two lenses is filled with water ( $\mu_w = \frac{4}{3}$ ). The focal length of the combination is

- (A)  $\frac{f}{3}$
- (B)  $f$
- (C)  $\frac{4f}{3}$
- (D)  $\frac{3f}{4}$

**Solution: (D)**

$$\frac{1}{f} = (\mu_g - 1) \frac{2}{R} = \frac{1}{R}, \left(\mu_g = \frac{3}{2}\right), R = f$$

$$\frac{1}{f_1} = -(\mu_w - 1) \frac{2}{R} = -\frac{2}{3R} = -\frac{2}{3f}$$

$$\frac{1}{f_{\text{eq}}} = \frac{1}{f} + \frac{1}{f} + \frac{1}{f_1} = \frac{1}{R} + \frac{1}{R} - \frac{2}{3R}$$

$$\frac{1}{f_{\text{eq}}} = \frac{1}{f} + \frac{1}{f} = \frac{2}{3f}$$

$$\frac{1}{f_{\text{eq}}} = \frac{2}{f} - \frac{2}{3f}$$

$$\frac{1}{f_{\text{eq}}} = \frac{4}{3f}$$

$$f_{\text{eq}} = \frac{3f}{4}$$



35. An air bubble in a glass slab with refractive index 1.5 (near normal incidence) is 5 cm deep when viewed from one surface and 3 cm deep when viewed from the opposite face. The thickness (in cm) of the slab is

- (A) 8
- (B) 10
- (C) 12
- (D) 16

**Solution: (C)**

$$d = (d_1 + d_2)\mu$$
$$= 1.5(5 + 3) = 12 \text{ cm}$$

36. The interference pattern is obtained with two coherent light sources of intensity ratio  $n$ . In the interference pattern, the ratio  $\frac{I_{\max} - I_{\min}}{I_{\max} + I_{\min}}$  will be

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

**Solution: (B)**

$$\frac{I_1}{I_2} = n$$

$$I_{\max} = (\sqrt{I_1} + \sqrt{I_2})^2 = (\sqrt{n} + 1)^2 I_2$$

$$I_{\min} = (\sqrt{I_1} - \sqrt{I_2})^2 = (\sqrt{n} - 1)^2 I_2$$

$$\frac{I_{\max} - I_{\min}}{I_{\max} + I_{\min}} = \frac{4\sqrt{n}}{2(n+1)} = \frac{2\sqrt{n}}{n+1}$$

37. A person can see clearly objects only when they lie between 50 cm and 400 cm from his eyes. In order to increase the maximum distance of distinct vision to infinity, the type and power of the correcting lens, the person has to use, will be

- (A) Convex, +2.25 diopter
- (B) Concave,  $- 0.25$  diopter

- (C) Concave,  $-0.2$  diopter  
 (D) Convex,  $+0.15$  diopter

**Solution: (B)**

Maximum distance of distinct vision =  $400$  cm. So image of object at infinity is to be formed at  $400$  cm.

Use lens formula

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$\frac{1}{-40} - \frac{1}{\infty} = \frac{1}{f}$$

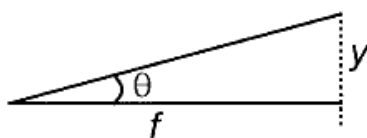
$$P = -0.25 \text{ D}$$

38. A linear aperture whose width is  $0.02$  cm is placed immediately in front of a lens of focal length  $60$  cm. The aperture is illuminated normally by a parallel beam of wavelength  $5 \times 10^{-5}$  cm. The distance of the first dark band of the diffraction pattern from the centre of the screen is

- (A)  $0.10$  cm  
 (B)  $0.25$  cm  
 (C)  $0.20$  cm  
 (D)  $0.15$  cm

**Solution: (D)**

$$\theta = \frac{\lambda}{a} = \frac{y}{f}$$



$$y = \frac{f\lambda}{a}$$

39. Electrons of mass  $m$  with de-Broglie wavelength  $\lambda$  fall on the target in an X-ray tube. The cutoff wavelength ( $\lambda_0$ ) of the emitted X-ray is

- (A)  $\lambda_0 = \frac{2mc\lambda^2}{h}$   
 (B)  $\lambda_0 = \frac{2h}{mc}$   
 (C)  $\lambda_0 = \frac{2m^2c^2\lambda^3}{h^2}$   
 (D)  $\lambda_0 = \lambda$

**Solution: (A)**

$$\text{Momentum } P = \frac{h}{\lambda} \Rightarrow E = \frac{p^2}{2m} \Rightarrow \frac{h^2}{2m\lambda^2} = \frac{hc}{\lambda_0}$$

$$\Rightarrow \lambda_0 = \frac{hc}{h^2} 2m\lambda^2$$

$$= \frac{2mc\lambda^2}{h}$$

40. Photons with energy 5 eV are incident on a cathode C in a photoelectric cell. The maximum energy of emitted photoelectrons is 2 eV. When photons of energy 6 eV are incident on C, no photoelectrons will reach the anode A, if the stopping potential of A relative to C is

(A) +3 V

(B) +4 V

(C) -1 V

(D) -3 V

**Solution: (D)**

$$E_{\max} = E - \phi$$

$$2 \text{ eV} = 5 \text{ eV} - \phi \Rightarrow \phi = 3 \text{ eV}$$

$$\text{Now } eV_0 = E - \phi$$

$$= 6 \text{ eV} - 3 \text{ eV} = 3 \text{ eV}$$

So stopping potential is -3 V

41. If an electron in a hydrogen atom jumps from the 3rd orbit to the 2nd orbit, it emits a photon of wavelength  $\lambda$ . When it jumps from the 4th orbit to the 3rd orbit, the corresponding wavelength of the photon will be

(A)  $\frac{16}{25} \lambda$

(B)  $\frac{9}{16} \lambda$

(C)  $\frac{20}{7} \lambda$

(D)  $\frac{20}{13} \lambda$

**Solution: (C)**

$$\lambda = \frac{1}{R\left(\frac{1}{2^2} - \frac{1}{3^2}\right)}$$

$$\lambda' = \frac{1}{R\left(\frac{1}{3^2} - \frac{1}{4^2}\right)}$$

$$\frac{\lambda'}{\lambda} = \frac{\left(\frac{1}{2^2} - \frac{1}{3^2}\right)}{\left(\frac{1}{3^2} - \frac{1}{4^2}\right)} \Rightarrow \lambda' = \frac{20\lambda}{7}$$

42. The half-life of a radioactive substance is 30 minutes. The time (in minutes) taken between 40% decay and 85% decay of the same radioactive substance is

- (A) 15
- (B) 30
- (C) 45
- (D) 60

**Solution: (D)**

Number of active nuclei falls from 60% to 15%

So sample becomes  $\frac{1}{4}$ th

$$= \frac{1}{2^2} \text{th}$$

So number of half-lives = 2

$$\text{Time } t = 2 \times 30 = 60 \text{ minute}$$

43. For CE transistor amplifier, the audio signal voltage across the collector resistance of  $2 \text{ k}\Omega$  is  $4 \text{ V}$ . If the current amplification factor of the transistor is 100 and the base resistance is  $1 \text{ k}\Omega$  then the input signal voltage is

- (A) 10 mV
- (B) 20 mV
- (C) 30 mV
- (D) 15 mV

**Solution: (B)**

$$R_C = 2 \text{ k}\Omega \quad V_0 = 4 \text{ V}$$

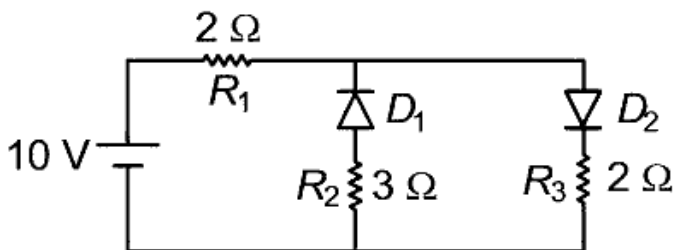
$$I_C = \frac{4\text{V}}{R_C} = \frac{4\text{V}}{2\text{k}} = 2 \text{ mA}$$

$$\beta = \frac{I_C}{I_B} = 100$$

$$\Rightarrow I_B = \frac{I_C}{100} = 2 \times 10^{-5} \text{ A}$$

$$V_{\text{in}} = I_B R_i = 2 \times 10^{-5} \times 1 \text{ k}\Omega = 20 \text{ mV}$$

44. The given circuit has two ideal diodes connected as shown in the figure below. The current flowing through the resistance  $R_1$  will be



- (A) 2.5 A  
 (B) 10.0 A  
 (C) 1.43 A  
 (D) 3.13 A

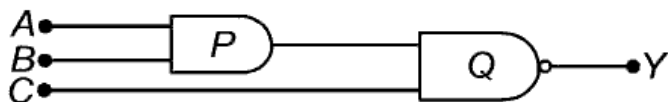
**Solution: (A)**

$D_1$  is reverse biased

$D_2$  is forward biased

$$I = \frac{10V}{(2 + 2)\Omega} = 2.5 \text{ A}$$

45. What is the output Y in the following circuit, when all the three inputs A, B, C are first 0 and then 1?



- (A) 0, 1  
 (B) 0, 0  
 (C) 1, 0  
 (D) 1, 1

**Solution: (C)**

$$\text{Output } Y = \overline{(A \cdot B) \cdot C} = \bar{A} + \bar{B} + \bar{C}$$

When A, B, C are 0  $\rightarrow Y = 1$

When A, B, C are 1  $\rightarrow Y = 0$

## Chemistry

46. Which one of the following compounds shows the presence of intramolecular hydrogen bond?

- (A)  $\text{H}_2\text{O}_2$
- (B) HCN
- (C) Cellulose
- (D) Concentrated acetic acid

**Solution: (C)**

Fact.

47. The molar conductivity of a  $0.5 \frac{\text{mol}}{\text{dm}^3}$  solution of  $\text{AgNO}_3$  with electrolytic conductivity of  $5.76 \times 10^{-3} \text{ S cm}^{-1}$  at 298 K

- (A)  $2.88 \text{ S cm}^2/\text{mol}$
- (B)  $11.52 \text{ S cm}^2/\text{mol}$
- (C)  $0.086 \text{ S cm}^2/\text{mol}$
- (D)  $28.8 \text{ S cm}^2/\text{mol}$

**Solution: (B)**

$$\Lambda_m = \frac{\kappa \times 100}{M} = \frac{5.76 \times 10^{-3} \times 1000}{0.5}$$

$$= 11.52 \text{ S cm}^2/\text{mol}$$

48. The decomposition of phosphine ( $\text{PH}_3$ ) on tungsten at low pressure is a first-order reaction. It is because the

- (A) Rate is proportional to the surface coverage
- (B) Rate is inversely proportional to the surface coverage
- (C) Rate is independent of the surface coverage
- (D) Rate of decomposition is very slow

**Solution: (A)**

Rate is proportion to the surface coverage

49. The coagulation values in millimoles per litre of the electrolytes used for the coagulation of  $\text{As}_2\text{S}_3$  are given below :

- I.  $(\text{NaCl}) = 52$
- II.  $(\text{BaCl}_2) = 0.69$
- III.  $(\text{MgSO}_4) = 0.22$

The correct order of their coagulating power is

- (A)  $\text{I} > \text{II} > \text{III}$

- (B) II > I > III
- (C) III > II > I
- (D) III > I > II

**Solution: (C)**

$$\text{Coagulating power} \propto \frac{1}{\text{Coagulation value}}$$

50. During the electrolysis of molten sodium chloride, the time required to produce 0.10 mol of chlorine gas using a current of 3 amperes is

- (A) 55 minutes
- (B) 110 minutes
- (C) 220 minutes
- (D) 330 minutes

**Solution: (B)**

For 1 mole  $\text{Cl}_2$ , 2F electricity is required

$\therefore$  For 0.1 mole  $\text{Cl}_2$ , 0.2 F electricity will be required

$$\therefore Q = I \times t$$

$$\text{Or, } t = \frac{Q}{I} = \frac{0.2 \times 96500}{3 \times 60} \approx 110 \text{ min.}$$

51. How many electrons can fit in the orbital for which  $n = 3$  and  $l = 1$ ?

- (A) 2
- (B) 6
- (C) 10
- (D) 14

**Solution: (A)**

An orbital can accommodate maximum of 2 electrons with anti-parallel spins.

52. For a sample of perfect gas when its pressure is changed isothermally from  $p_i$  to  $p_f$ , the entropy change is given by

- (A)  $\Delta S = nR \ln \left( \frac{p_f}{p_i} \right)$
- (B)  $\Delta S = nR \ln \left( \frac{p_i}{p_f} \right)$
- (C)  $\Delta S = nRT \ln \left( \frac{p_f}{p_i} \right)$

$$(D) \Delta S = RT \ln \left( \frac{p_i}{p_f} \right)$$

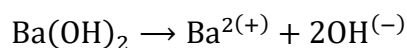
**Solution: (B)**

$$\Delta S = nR \ln \left( \frac{p_i}{p_f} \right)$$

53. The van't Hoff factor (i) for a dilute aqueous solution of the strong electrolyte barium hydroxide is

- (A) 0
- (B) 1
- (C) 2
- (D) 3

**Solution: (D)**

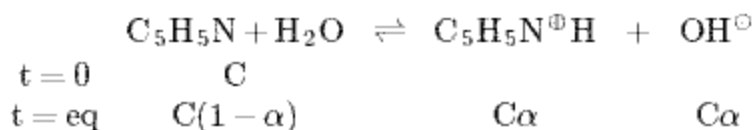


$$\therefore \text{van't Hoff factor} = 1 + 2 = 3$$

54. The percentage of pyridine ( $\text{C}_5\text{H}_5\text{N}$ ) that forms pyridinium ion ( $\text{C}_5\text{H}_5\text{N}^+\text{H}$ ) in a 0.10 M aqueous pyridine solution ( $K_b$  for  $\text{C}_5\text{H}_5\text{N} = 1.7 \times 10^{-9}$ ) is

- (A) 0.0060%
- (B) 0.013%
- (C) 0.77%
- (D) 1.6%

**Solution: (B)**



$$\therefore K_b = \frac{C\alpha^2}{1 - \alpha} \approx C\alpha^2$$

$$\therefore \alpha = \sqrt{\frac{K_b}{C}} = \sqrt{\frac{1.7 \times 10^{-9}}{0.1}}$$

$$\therefore \% \alpha = 1.3 \times 10^{-4} \times 100 = 0.013\%$$

55. In calcium fluoride, having the fluorite structure, the coordination numbers for calcium ion ( $\text{Ca}^{2+}$ ) and fluoride ion ( $\text{F}^-$ ) are



- (A) 4 and 2
- (B) 6 and 6
- (C) 8 and 4
- (D) 4 and 8

**Solution: (C)**

In  $\text{CaF}_2$ ,  $\text{Ca}^{2(+)}$  has fcc arrangement and  $\text{F}^{(-)}$  ions are present in all tetrahedral voids.

$\therefore$  Cp-ordination numbers for  $\text{Ca}^{2(+)}$  and  $\text{F}^{(-)}$  ions are 8 and 4.

56. If the  $E_{\text{cell}}^{\circ}$  for a given reaction has a negative value, which of the following gives the <b>correct</b> relationships for the values of  $\Delta G^{\circ}$  and  $K_{\text{eq}}$ ?

- (A)  $\Delta G^{\circ} > 0$ ;  $K_{\text{eq}} < 1$
- (B)  $\Delta G^{\circ} > 0$ ;  $K_{\text{eq}} > 1$
- (C)  $\Delta G^{\circ} < 0$ ;  $K_{\text{eq}} < 1$
- (D)  $\Delta G^{\circ} < 0$ ;  $K_{\text{eq}} < 1$

**Solution: (A)**

$$\therefore E_{\text{cell}}^{\circ} = -ve$$

$$\therefore \Delta G^{\circ} = +ve \ \& \ K_{\text{eq}} = -ve$$

$$\text{i.e., } \Delta G^{\circ} > 0 \ \& \ K_{\text{eq}} < 1$$

57. Which one of the following is <b>incorrect</b> for ideal solution?

- (A)  $\Delta H_{\text{mix}} = 0$
- (B)  $\Delta U_{\text{mix}} = 0$
- (C)  $\Delta P = P_{\text{obs}} - P_{\text{calculated by Raoult's law}} = 0$
- (D)  $\Delta G_{\text{mix}} = 0$

**Solution: (D)**

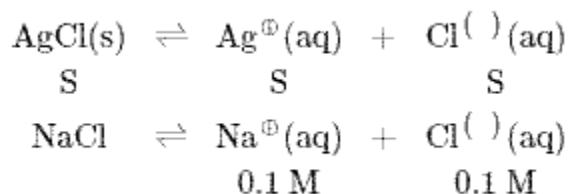
$\Delta G_{\text{mix}}$  for ideal solution is positive.

58. The solubility of  $\text{AgCl}(s)$  with solubility product  $1.6 \times 10^{-10}$  in 0.1 M NaCl solution would be

- (A)  $1.26 \times 10^{-5} \text{ M}$
- (B)  $1.6 \times 10^{-9} \text{ M}$
- (C)  $1.6 \times 10^{-11} \text{ M}$

(D) Zero

**Solution: (B)**



$$\therefore K_{\text{sp}}(\text{AgCl}) = S(S + 0.1)$$

$$\therefore S \ll 0.1$$

$$\therefore S + 0.1 \approx 0.1$$

$$\therefore 1.6 \times 10^{-10} = S \times 0.1$$

$$\therefore S = 1.6 \times 10^{-9} \text{ M}$$

59. Suppose the elements X and Y combine to form two compounds  $\text{XY}_2$  and  $\text{X}_3\text{Y}_2$ . When 0.1 mole of  $\text{XY}_2$  weighs 10 g and 0.05 mole of  $\text{X}_3\text{Y}_2$  weighs 9 g, the atomic weights of X and Y are

(A) 40, 30

(B) 60, 40

(C) 20, 30

(D) 30, 20

**Solution: (A)**

For  $\text{XY}_2$ ,

$$\therefore 0.1 \text{ mole } \text{XY}_2 \equiv 10 \text{ g}$$

$$\therefore 1 \text{ mole } \text{XY}_2 \equiv 100 \text{ g}$$

$$= X + 2Y = 100 \quad \dots(\text{i})$$

For  $\text{X}_3\text{Y}_2$ ,

$$\therefore 0.05 \text{ mole } \text{X}_3\text{Y}_2 \equiv 9 \text{ g}$$

$$\therefore 1 \text{ mole } \text{X}_3\text{Y}_2 \equiv 180 \text{ g} \quad \dots(\text{ii})$$

On solving,

$$X = 40$$

$$\text{And } Y = 30$$

60. The number of electrons delivered at the cathode during electrolysis by a current of 1 ampere in 60 seconds is (charge on electron =  $1.60 \times 10^{-19}$  C)

- (A)  $6 \times 10^{23}$
- (B)  $6 \times 10^{20}$
- (C)  $3.75 \times 10^{20}$
- (D)  $7.48 \times 10^{23}$

**Solution: (C)**

$$Q = I \times t$$

$$= 1 \text{ A} \times 60\text{s}$$

$$= 60 \text{ C}$$

$$\therefore \text{No. of electrons} = \frac{60}{1.602 \times 10^{-19}}$$

$$= 3.75 \times 10^{20}$$

61. Boric acid is an acid because its molecule

- (A) Contains replaceable  $H^+$  ion
- (B) Gives up a proton
- (C) Accepts  $OH^-$  from water releasing proton
- (D) Combines with proton from water molecule

**Solution: (C)**

Boric acid is an acid because its molecule accepts  $OH^-$  from water releasing proton.



62.  $AlF_3$  is soluble in HF only in presence of KF. It is due to the formation of

- (A)  $K_3[AlF_3H_3]$
- (B)  $K_3[AlF_6]$
- (C)  $AlH_3$
- (D)  $K(Al_3H)$

**Solution: (B)**

Fact

63. Zinc can be coated on iron to produce galvanized iron but the reverse is not possible. It is because

- (A) Zinc is lighter than iron
- (B) Zinc has lower melting point than iron
- (C) Zinc has lower negative electrode potential than iron
- (D) Zinc has higher negative electrode potential than iron

**Solution: (D)**

$$E_{\frac{Zn}{Zn^{2(+)}}}^{\circ} = -0.76 V$$

$$E_{\frac{Fe}{Fe^{2(+)}}}^{\circ} = -0.44 V$$

64. The suspension of slaked lime in water is known as

- (A) Limewater
- (B) Quicklime
- (C) Milk of lime
- (D) Aqueous solution of slaked lime

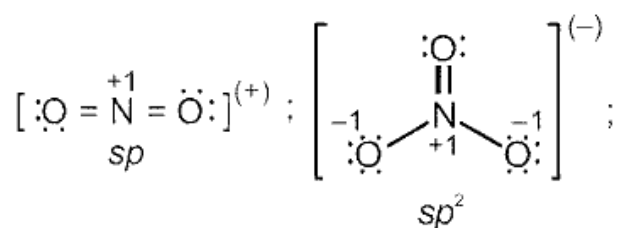
**Solution: (C)**

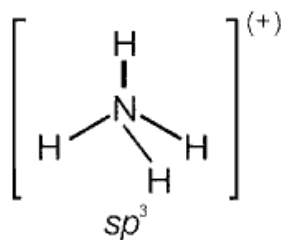
Fact

65. The hybridizations of atomic orbitals of nitrogen in  $NO_2^+$ ,  $NO_3^-$  and  $NH_4^+$  respectively are

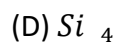
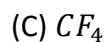
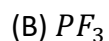
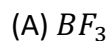
- (A)  $sp$ ,  $sp^2$  and  $sp^2$
- (B)  $sp^2$ ,  $sp^3$  and  $sp$
- (C)  $sp$ ,  $sp^2$  and  $sp^3$
- (D)  $sp^2$ ,  $sp$  and  $sp^3$

**Solution: (C)**





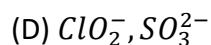
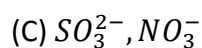
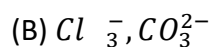
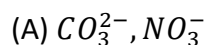
66. Which of the following fluoro – compounds is most likely to behave as a Lewis base?



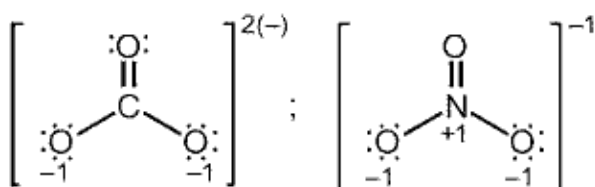
**Solution: (B)**

In  $PF_3$ , P has a lone pair of electrons.

67. Which of the following pairs of ions is isoelectronic and isostructural?



**Solution: (A)**



Both have 32 electrons with trigonal planar structure.

68. In context with beryllium which one of the following statements is **incorrect**?

(A) It is rendered passive by nitric acid

(B) It forms  $Be_2C$

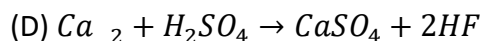
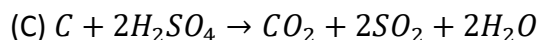
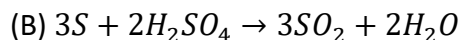
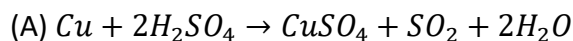
(C) Its salts rarely hydrolyze

(D) Its hydride is electron – deficient and polymeric

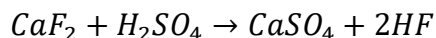
**Solution: (C)**

Salts of beryllium is readily hydrolysed due to presence of vacant p – orbital.

69. Hot concentrated sulphuric acid is a moderately strong oxidizing agent. Which of the following reactions does not show oxidizing behaviour?

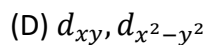
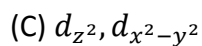
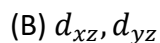
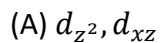


**Solution: (D)**

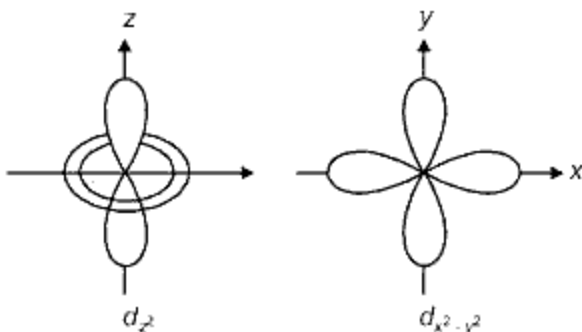


In this reaction there is no change in oxidation state of any atom.

70. Which of the following pairs of d – orbitals will have electron density along the axes?



**Solution: (C)**



71. The correct geometry and hybridization for  $XeF_4$  are



- (B) Trigonal bipyramidal,  $sp^3d$
- (C) Planar triangle,  $sp^3d^3$
- (D) Square planar,  $sp^3d^2$

**Solution: (A)**

$XeF_4$ , has octahedral geometry where hybridization of  $Xe$  is  $sp^3d^2$ .

72. Among the following, which one is a wrong statement ?

- (A)  $PH_5$  and  $BiCl_5$  do not exist
- (B)  $p\pi - d\pi$  bonds are present in  $SO_2$
- (C)  $SeF_4$  and  $CH_4$  have same shape
- (D)  $I_3^+$  has bent geometry

**Solution: (C)**

Shape of  $SeF_4$  would be see saw where as that of  $CH_4$  would be tetrahedral

73. The correct increasing order of trans – effect of the following species is

- (A)  $NH_3 > CN^- > Br^- > C_6H_5^-$
- (B)  $CN^- > C_6H_5^- > Br^- > NH_3$
- (C)  $Br^- > CN^- > NH_3 > C_6H_5^-$
- (D)  $CN^- > Br^- > C_6H_5^- > NH_3$

**Solution: (B)**

Fact

74. Which one of the following statements related to lanthanons is incorrect?

- (A) Europium shows + 2 oxidation state
- (B) The basicity decreases as the ionic radius decreases from Pr to Lu
- (C) All the lanthanons are much more reactive than aluminium
- (D)  $Ce(+4)$  solutions are widely used as oxidizing agent in volumetric analysis

**Solution: (C)**

Fact.

75. Jahn – Teller effect is not observed in high spin complexes of

(A)  $d^7$

(B)  $d^8$

(C)  $d^4$

(D)  $d^9$

**Solution: (B)**

Fact.

76. Which of the following can be used as the halide component for Friedel Crafts reaction?

(A) Chlorobenzene

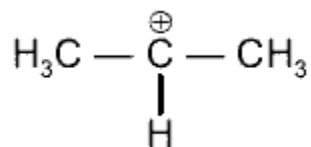
(B) Bromobenzene

(C) Chloroethene

(D) Isopropyl chloride

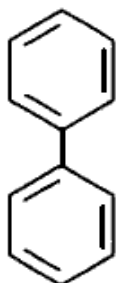
**Solution: (D)**

Isopropyl chloride would form stable carbocation



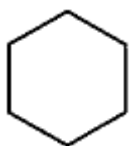
77. In which of the following molecules, all atoms are coplanar?

(A)

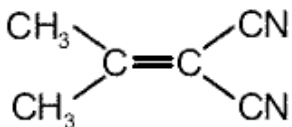


(B)

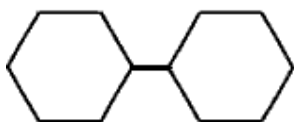




(C)



(D)

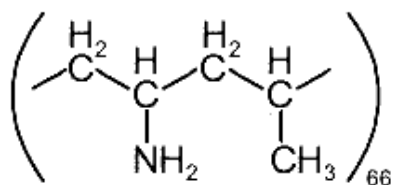


**Solution: (A)**

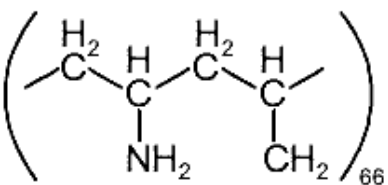
Biphenyl is a planar system, where all the carbon atoms and H – atoms are in same plane.

78. Which one of the following structures represents nylon 6,6 polymer ?

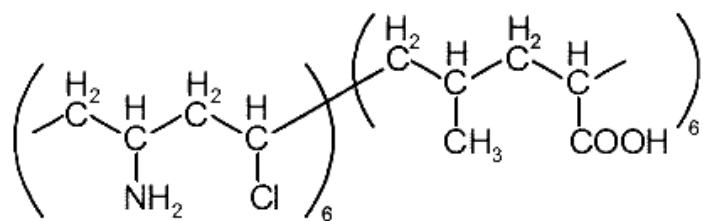
(A)



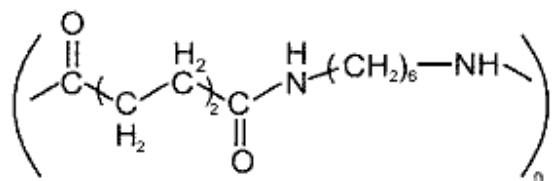
(B)



(C)

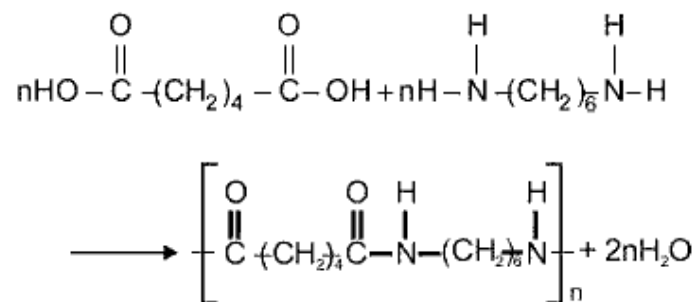


(D)

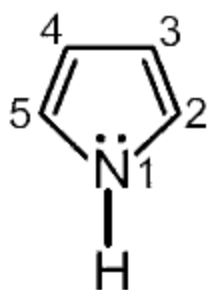


**Solution: (D)**

Nylon - 6, 6 is the co - polymer of adipic acid and hexamethylene diamine.



79. In pyrrole the electron density is maximum on



(A) 2 and 3

(B) 3 and 4

(C) 2 and 4

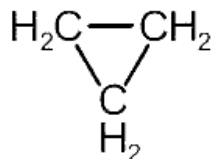
(D) 2 and 5

**Solution: (D)**

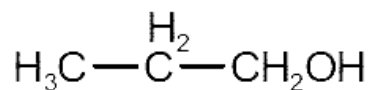
At 2 and 5 negative charge is more stable.

80. Which of the following compounds shall not produce propene by reaction with HBr followed by elimination or direct only elimination reaction ?

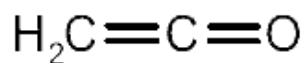
(A)



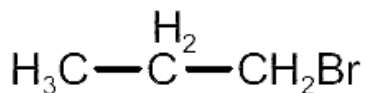
(B)



(C)



(D)

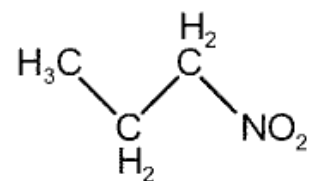


**Solution: (C)**

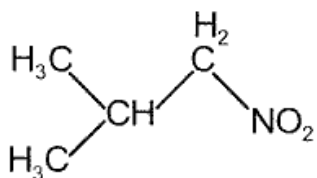
$\text{H}_2\text{C} = \text{C} = \text{O}$  has only two carbon atom, cannot be converted into propene as the conditions are given.

81. Which one of the following nitro – compounds does not react with nitrous acid ?

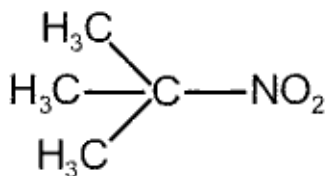
(A)



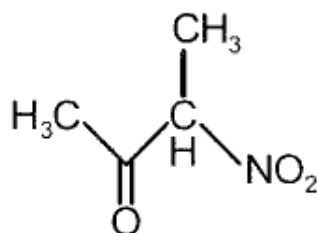
(B)



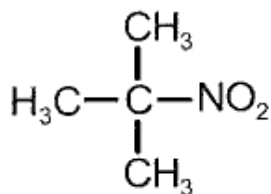
(C)



(D)



**Solution: (C)**



No acidic H – atom on the carbon atom having  $\text{NO}_2$  – group.

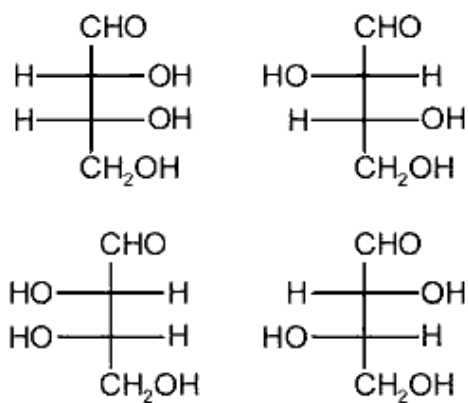
82. The central dogma of molecular genetics states that the genetic information flows from

- (A) Amino acids → Proteins → DNA
- (B) DNA → Carbohydrates → Proteins
- (C) DNA → RNA → Proteins
- (D) DNA → RNA → Carbohydrates

**Solution: (C)**

Fact.

83. The correct corresponding order of names of four aldoses with configuration given below respectively, is

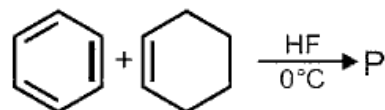


- (A) L – erythrose, L – threose, L – erythrose, D – threose  
 (B) D – threose, D – erythrose, L – threose, L – erythrose  
 (C) L – erythrose, L – threose, D – erythrose, D – threose  
 (D) D – erythrose, D – threose, L – erythrose, L – threose

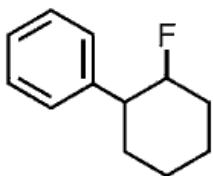
**Solution: (D)**

Fact.

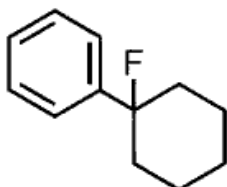
84. In the given reaction the product P is



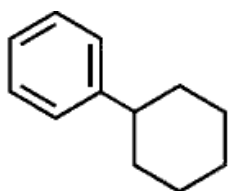
(A)



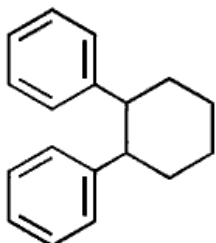
(B)



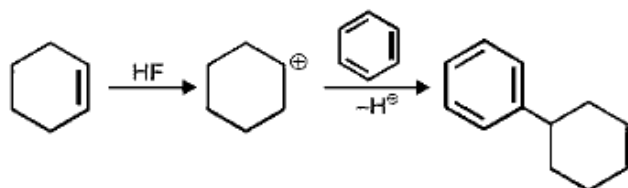
(C)



(D)

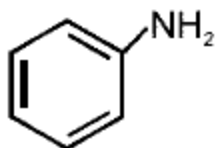


**Solution: (C)**

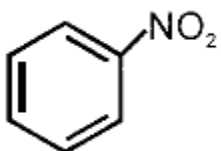


85. A given nitrogen – containing aromatic compound A reacts with Sn/HCl, followed by HNO<sub>2</sub> to give an unstable compound B. B, on treatment with phenol, forms a beautiful coloured compound C with the molecular formula C<sub>12</sub>H<sub>10</sub>N<sub>2</sub>O. The structure of compound A is

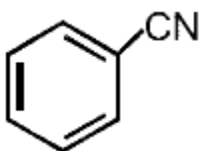
(A)



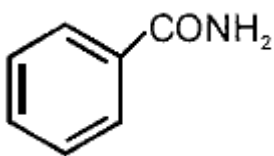
(B)



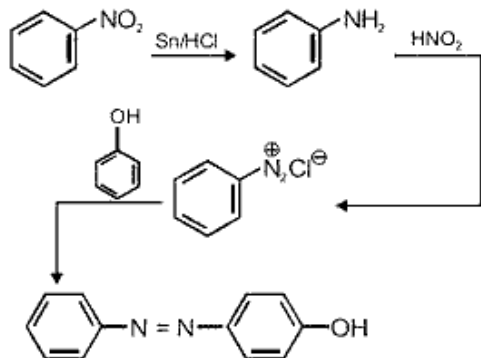
(C)



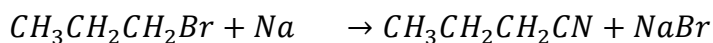
(D)



**Solution: (B)**



86. Consider the reaction



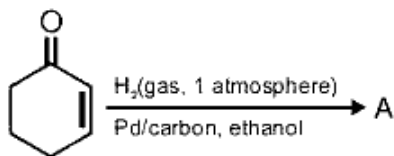
This reaction will be the fastest in

- (A) Ethanol
- (B) Methanol
- (C) N, N' – dimethylformamide (DMF)
- (D) Water

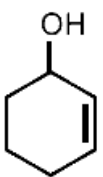
**Solution: (C)**

∴ The reaction is  $S_N2$ , most suitable solvent should be polar aprotic i.e., DMF.

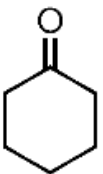
87. The correct structure of the product A formed in the reaction is



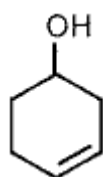
(A)



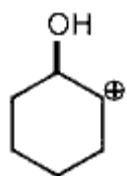
(B)



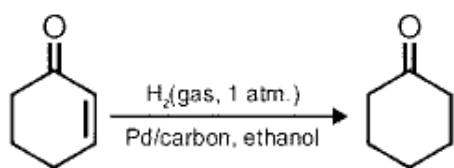
(C)



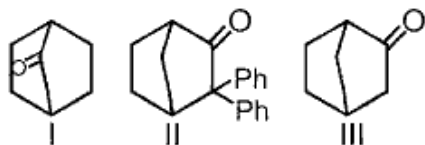
(D)



**Solution: (B)**



88. Which among the given molecules can exhibit tautomerism ?



(A) III Only

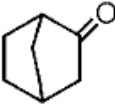
(B) Both I and III

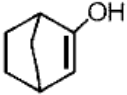
(C) Both I and II

(D) Both II and III

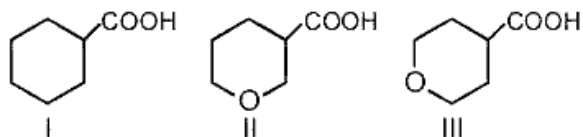
**Solution: (A)**



Bridge – head carbocation is unstable, therefore, tautomerism will be shown only by  and

the enolic form would be  .

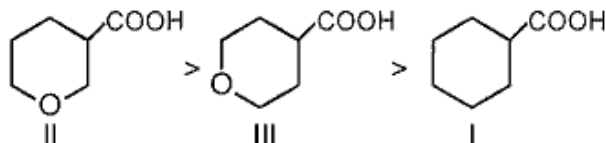
89. The correct order of strengths of the carboxylic acids is



- (A) I > II > III  
 (B) II > III > I  
 (C) III > II > I  
 (D) II > I > III

**Solution: (B)**

On the basis of  $-I$  effect, the correct acidic strength would be



90. The compound that will react most readily with gaseous bromine has the formula

- (A)  $C_3H_6$   
 (B)  $C_2H_2$   
 (C)  $C_4H_{10}$   
 (D)  $C_2H_4$

**Solution: (A)**

In gas phase allylic substitution takes place.

## Biology

91. Which one of the following is wrong for fungi?

- (A) They are eukaryotic
- (B) All fungi possess a purely cellulosic cell wall
- (C) They are heterotrophic
- (D) They are both unicellular and multicellular

**Solution: (B)**

Cell wall of fungi is made up of chitin and polysaccharides.

92. Methanogens belong to

- (A) Eubacteria
- (B) Archaeobacteria
- (C) Dinoflagellates
- (D) Slime moulds

**Solution: (B)**

Methanogens, halophiles and thermoacidophiles are archaeobacterial.

93. Select the wrong statement.

- (A) The walls of diatoms are easily destructible
- (B) 'Diatomaceous earth' is formed by the cell walls of diatoms
- (C) Diatoms are chief producers in the oceans
- (D) Diatoms are microscopic and float passively in water

**Solution: (A)**

The cell walls of diatoms are embedded with silica and thus the walls are indestructible.

94. The label of a herbarium sheet does not carry information on

- (A) Data of collection
- (B) Name of collector
- (C) Local names
- (D) Height of the plant

**Solution: (D)**

The herbarium sheets carry a label providing information about date and place of collection, English, local and botanical names, family, collector's name.

95. Conifers are adapted to tolerate extreme environmental conditions because of

- (A) Broad hardy leaves
- (B) Superficial stomata
- (C) Thick cuticle
- (D) Presence of vessels

**Solution: (C)**

In conifers, the needle like leaves, thick cuticle and sunken stomata help to reduce water loss.

96. Which one of the following statements is wrong?

- (A) Algae increase the level of dissolved oxygen in the immediate environment
- (B) Algin is obtained from red algae, and carrageenan from brown algae
- (C) Agar – agar is obtained from *Gelidium* and *Gracilaria*
- (D) *Laminaria* and *Sargassum* are used as food

**Solution: (B)**

Algin is obtained from brown algae, and carrageenan from red algae.

97. The term 'polyadelphous' is related to

- (A) Gynoecium
- (B) Androecium
- (C) Corolla
- (D) Calyx

**Solution: (B)**

The stamens may be united into one bundle (monadelphous), or two bundles (diadelphous) or into more than two bundles (polyadelphous).

98. How many plants among *Indigofera*, *Sesbania*, *Salvia*, *Allium*, *Aloe*, mustard, groundnut, radish, gram and turnip have stamens with different lengths in their flowers ?

- (A) Three
- (B) Four
- (C) Five
- (D) Six

**Solution: (B)**

Brassicaceae,  $A_{2+4}$  → Mustard, Radish, Turnip

Lamiaceae,  $A_{2+2}$  → Salvia

99. Radial symmetry is found in the flowers of

- (A) Brassica
- (B) Trifolium
- (C) Pisum
- (D) Cassia

**Solution: (A)**

Radial or actinomorphic symmetry is found in flowers like mustard, Datura, Chilli.

100. Free – central placentation is found in

- (A) Dianthus
- (B) Argemone
- (C) Brassica
- (D) Citrus

**Solution: (A)**

Dianthus, Primrose – Free central placentation.

Argemone – Parietal placentation.

Citrus – Axile placentation.

101. Cortex is the region found between

- (A) Epidermis and stele
- (B) Pericycle and endodermis

- (C) Endodermis and pith
- (D) Endodermis and vascular bundle

**Solution: (A)**

Cortex is the region present between epidermis and stele.

102. The balloon – shaped structures called tyloses

- (A) Originate in the lumen of vessels
- (B) Characterize the sapwood
- (C) Are extensions of xylem parenchyma cells into vessels
- (D) Are linked to the ascent of sap through xylem vessels

**Solution: (C)**

Tyloses are balloon – shaped structures in xylem vessels developed by xylem parenchyma cells.

103. A non – proteinaceous enzyme is

- (A) Lysozyme
- (B) Ribozyme
- (C) Ligase
- (D) Deoxyribonuclease

**Solution: (B)**

Ribozyme is RNA acting like an enzyme or biocatalyst.

104. Select the mismatch.

- (A) Gas vacuoles – Green bacteria
- (B) Large central vacuoles – Animal cells
- (C) Protists – Eukaryotes
- (D) Methanogens – Prokaryotes

**Solution: (B)**

Large central vacuole is present in plant cells.

105. Select the wrong statement

- (A) Bacteria cell wall is made up of peptidoglycan
- (B) Pili and fimbriae are mainly involved in motility of bacterial cells
- (C) Cyanobacteria lack flagellated cells
- (D) Mycoplasma is a wall – less microorganism

**Solution: (B)**

Pili and fimbriae are surface structures of the bacteria that do not play a role in motility.

106. A cell organelle containing hydrolytic enzymes is

- (A) Lysosome
- (B) Microsome
- (C) Ribosome
- (D) Mesosome

**Solution: (A)**

The isolated lysosomal vesicles have been found to be very rich in almost all types of hydrolytic enzymes.

107. During cell growth, DNA synthesis takes place in

- (A) S phase
- (B)  $G_1$  phase
- (C)  $G_2$  phase
- (D)  $M$  phase

**Solution: (A)**

DNA replication occurs in S – phase of cell cycle.

108. Which of the following biomolecules is common to respiration – mediated breakdown of fats, carbohydrates and proteins ?

- (A) Glucose – 6 – phosphate
- (B) Fructose 1, 6 – bisphosphate
- (C) Pyruvic acid

(D) Acetyl CoA

**Solution: (D)**

Acetyl CoA is common to fat, carbohydrate and protein catabolism.

109. A few drops of sap were collected by cutting across a plant stem by a suitable method. The sap was tested chemically. Which one of the following test results indicates that it is phloem sap ?

- (A) Acidic
- (B) Alkaline
- (C) Low refractive index
- (D) Absence of sugar

**Solution: (B)**

Alkaline pH (7.8 – 8.0) is present in phloem sap where as xylem sap is acidic.

110. You are given a tissue with its potential for differentiation in an artificial culture. Which of the following pairs of hormones would you add to the medium to secure shoots as well as roots ?

- (A) IAA and gibberellin
- (B) Auxin and cytokinin
- (C) Auxin and abscisic acid
- (D) Gibberellin and abscisic acid

**Solution: (B)**

Auxins and cytokine in induce development of root and shoot in a culture medium (respectively).

111. Phytochrome is a

- (A) Flavoprotein
- (B) Glycoprotein
- (C) Lipoprotein
- (D) Chromoprotein

**Solution: (D)**

Photochrome is a blue – green pigment which absorb red and far red light. It is a coloured protein i.e., chromoprotein.

112. Which is essential for the growth of root tip ?

- (A) Zn
- (B) Fe
- (C) Ca
- (D) Mn

**Solution: (C)**

Calcium is required by dividing and differentiating cells.

113. The process which makes major difference between  $C_3$  and  $C_4$  plants is

- (A) Glycolysis
- (B) Calvin cycle
- (C) Photorespiration
- (D) Respiration

**Solution: (C)**

Photorespiration is present in  $C_3$  plants but absent in  $C_4$  plants.

114. Which one of the following statements is not correct ?

- (A) Offspring produced by the asexual reproduction are called clone
- (B) Microscopic, motile asexual reproductive structures are called zoospores
- (C) In potato, banana and ginger, the plantlets arise from the internodes present in the modified stem
- (D) Water hyacinth, growing in the standing water, drains oxygen from water that leads to the death of fishes

**Solution: (C)**

In potato, banana and ginger, the plantlets arise from the nodes present on modified stem.

115. Which one of the following generates new genetic combinations leading to variation ?

- (A) Vegetative reproduction
- (B) Parthenogenesis



(C) Sexual reproduction

(D) Nucellar polyembryony

**Solution: (C)**

Sexual reproduction generates new genetic recombination leading to variations.

116. Match Column – I with Column – II and select the correct option using the codes given below

Column – I	Column – II
a. Pistils fused together	(i) Gametogenesis
b. Formation of gametes	(ii) Pistillate
c. Hyphae of higher	(iii) Syncarpous
d. Unisexual female flower	(iv) Dikaryotic

(A)

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

(B)

a	b	c	D
(ii)	(i)	(iv)	(iii)

(C)

a	b	c	D
(i)	(ii)	(iv)	(iii)

(D)

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

**Solution: (D)**

- Syncarpous – Pistils fused together.
- Gametogenesis – Formation of gamete,
- Dikaryotic hyphae – Hyphae of ascomycetes

- Pistillate flower – Unisexual female flower.

117. In majority of angiosperms

- (A) Egg has a filiform apparatus
- (B) There are numerous antipodal cells
- (C) Reduction division occurs in the megaspore
- (D) A small central cell is present in the embryo sac

**Solution: (C)**

Megaspore Mother Cell (MMC) undergoes meiosis to form megaspore.

118. Pollination in water hyacinth and water lily is brought about by the agency of

- (A) Water
- (B) Insects or wind
- (C) Birds
- (D) Bats

**Solution: (B)**

Water hyacinth and water lily are aquatic plants pollinated by insect or wind.

119. The ovule of an angiosperm is technically equivalent to

- (A) Megasporangium
- (B) Megasporophyll
- (C) Megaspore mother cell
- (D) Megaspore

**Solution: (A)**

Integumented and stalked megasporangium is called ovule.

120. Taylor conducted the experiments to prove semiconservative mode of chromosome replication on

- (A) *Vinca rosea*
- (B) *Vicia faba*

(C) *Drosophila melanogaster*

(D) *E. coli*

**Solution: (B)**

Semiconservative mode of chromosome replication was proved by Taylor in *Vicia faba*.

121. The mechanism that causes a gene to move from one linkage group to another is called

(A) Inversion

(B) Duplication

(C) Translocation

(D) Crossing-over

**Solution: (C)**

Translocation is a phenomenon of transfer of a gene segment between non-homologous chromosome, i.e., different linkage group.

122. The equivalent of a structural gene is

(A) Muton

(B) Cistron

(C) Operon

(D) Recon

**Solution: (B)**

Cistron is a segment of DNA coding for a polypeptide.

Eukaryotic structural gene is monocistronic whereas prokaryotic structural gene is polycistronic.

123. A true breeding plant is

(A) One that is able to breed on its own

(B) Produced due to cross-pollination among unrelated plants

(C) Near homozygous and produces offspring of its own kind

(D) Always homozygous recessive in its genetic constitution

**Solution: (C)**

True breeding line is one that, having undergone continuous self pollination, shows the stable trait inheritance and expression for several generations. It is both homozygous recessive as well as dominant in genetic constitution.

124. Which of the following rRNAs acts as structural RNA as well as ribozyme in bacteria?

(A) 5 S rRNA

(B) 18 S rRNA

(C) 23 S rRNA

(D) 5.8 S rRNA

**Solution: (C)**

23S rRNA is a component of larger subunit of ribosome and it act as peptidyl transferase (ribozyme).

125. Stirred-tank bioreactors have been designed for

- (A) Purification of product
- (B) Addition of preservatives to the product
- (C) Availability of oxygen throughout the process
- (D) Ensuring anaerobic conditions in the culture vessel

**Solution: (C)**

Stirred-tank bioreactor is provided with stirrer for availability of oxygen throughout the process.

126. A foreign DNA and plasmid cut by the same restriction endonuclease can be joined to form a recombinant plasmid using

- (A) Eco RI
- (B) Taq polymerase
- (C) Polymerase III
- (D) Ligase

**Solution: (D)**

In DNA recombinant technology, linking of foreign DNA and plasmid is made possible by DNA ligase which is also called "molecular glue".

127. Which of the following is not a component of downstream processing?

- (A) Separation
- (B) Purification
- (C) Preservation
- (D) Expression

**Solution: (D)**

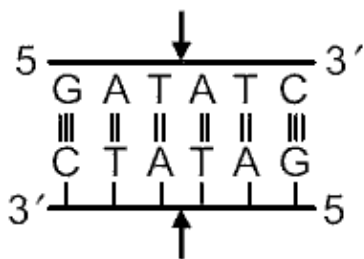
After the completion of biosynthetic pathway, downstream processing includes all the steps involved in isolation, purification and preservation of products. All the steps before the completion of pathway are included in upstreaming processing i.e., expression of genetic material.

128. Which of the following restriction enzymes produces blunt ends?

- (A) Sal I
- (B) Eco RV
- (C) Xho I
- (D) Hind III

**Solution: (B)**

Eco RV cuts the DNA in the centre of restriction sites forming blunt ends. The palindromic sequence for Eco RV is



129. Which kind of therapy was given in 1990 to a four-year-old girl with adenosine deaminase (ADA) deficiency?

- (A) Gene therapy

- (B) Chemotherapy
- (C) Immunotherapy
- (D) Radiation therapy

**Solution: (A)**

Gene therapy was given in 1990 to a four year old girl child with ADA deficiency.

130. How many hot spots of biodiversity in the world have been identified till date by Norman Myers?
- (A) 17
  - (B) 25
  - (C) 34
  - (D) 43

**Solution: (C)**

Today the number of hotspots identified by ecologists is 34 covering an area less than 2% of land surface with about 20% of human population living there.

131. The primary producers of the deep-sea hydrothermal vent ecosystem are
- (A) Green algae
  - (B) Chemosynthetic bacteria
  - (C) Blue-green algae
  - (D) Coral reefs

**Solution: (B)**

The primary producers of the deep sea hydrothermal vent ecosystem are Archaeobacteria, they have chemosynthetic mode of nutrition.

132. Which of the following is correct for r-selected species?
- (A) Large number of progeny with small size
  - (B) Large number of progeny with large size
  - (C) Small number of progeny with small size
  - (D) Small number of progeny with large size

**Solution: (A)**

R-selected species  $\Rightarrow$  Species whose population growth is function of biotic potential (r). They have large number of progeny with small size.

133. If '+' sign is assigned to beneficial interaction, '-' sign to detrimental and '0' sign to neutral interaction, then the population interaction represented by '+ -' refers to
- (A) Mutualism
  - (B) Amensalism
  - (C) Commensalism
  - (D) Parasitism

**Solution: (D)**

Parasitism  $\Rightarrow$  Parasite is benefitted (+) but host is harmed (-) so it is a (+, -) type of population interaction.

134. Which of the following is correctly matched?
- (A) Aerenchyma – Opuntia
  - (B) Age pyramid – Biome
  - (C) Parthenium hysterophorus – Threat to Biodiversity

(D) Stratification – Population

**Solution: (C)**

Parthenium hysterophorus is an exotic or alien species which causes extinction of native (or) indigenous species.

135. Red list contains data or information on

- (A) All economically important plants
- (B) Plants whose products are in international trade
- (C) Threatened species
- (D) Marine vertebrates only

**Solution: (C)**

IUCN [International Union Conservation of Nature and Natural Resources] (or) WCU [World Conservation Union] maintains red list which is a catalogue for threatened species.

136. Which of the following sets of diseases is caused by bacteria?

- (A) Cholera and tetanus
- (B) Typhoid and smallpox
- (C) Tetanus and mumps
- (D) Herpes and influenza

**Solution: (A)**

Cholera is caused by a bacterium *Vibrio cholera* and tetanus is caused by a bacterium *Clostridium tetani*.

137. Match Column-I with Column-II for housefly classification and select the correct option using the codes given below:

Column – I	Column – II
a. Family	(i) Diptera
b. Order	(ii) Arthropoda
c. Class	(iii) Muscidae
d. Phylum	(iv) Insecta

(A)

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

(B)

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

(C)

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

(D)

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

**Solution: (A)**

Housefly belongs to

- (i) Phylum - Arthropoda
- (ii) Class - Insecta
- (iii) Order - Diptera
- (iv) Family – Muscidae

138. Choose the correct statement.

- (A) All mammals are viviparous
- (B) All cyclostomes do not possess jaws and paired fins.
- (C) All reptiles have a three-chambered heart.
- (D) All pisces have gills covered by an operculum.

**Solution: (B)**

Cyclostomes belong to the division agnatha. They are jawless vertebrates without paired fins.

139. Study the four statements (A– D) given below and select the two correct ones out of them:

- A. Definition of biological species was given by Ernst Mayr.
- B. Photoperiod does not affect reproduction in plants.
- C. Binomial nomenclature system was given by R.H. Whittaker.
- D. In unicellular organisms, reproduction is synonymous with growth.

The two correct statements are

- (A) B and C
- (B) C and D
- (C) A and D
- (D) A and B

**Solution: (C)**

Photoperiod affect reproduction in plants. Binomial nomenclature system was given by Carolus Linnaeus

140. In male cockroaches, sperms are stored in which part of the reproductive system?

- (A) Seminal vesicles
- (B) Mushroom glands
- (C) Testes
- (D) Vas deferens

**Solution: (A)**

In male cockroach, sperms are stored in seminal vesicle.

141. Smooth muscles are

- (A) Involuntary, fusiform, non-striated
- (B) Voluntary, multinucleate, cylindrical
- (C) Involuntary, cylindrical, striated
- (D) Voluntary, spindle-shaped, uninucleate

**Solution: (A)**

Smooth muscles are involuntary, fusiform, nonstriated muscles.

142. Oxidative phosphorylation is

- (A) Formation of ATP by transfer of phosphate group from a substrate to ADP
- (B) Oxidation of phosphate group in ATP
- (C) Addition of phosphate group to ATP
- (D) Formation of ATP by energy released from electrons removed during substrate oxidation

**Solution: (D)**

Oxidative phosphorylation uses energy of oxidation reduction of substrate to generate ATP.

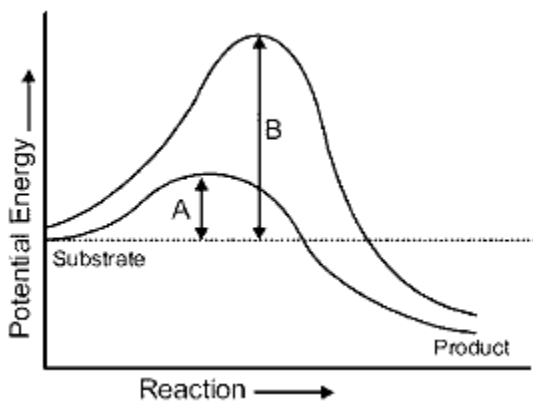
143. Which of the following is the least likely to be involved in stabilizing the three-dimensional folding of most proteins?

- (A) Hydrogen bonds
- (B) Electrostatic interaction
- (C) Hydrophobic interaction
- (D) Ester bonds

**Solution: (D)**

Ester bond is formed between sugar and phosphate in a nucleotide.

144. Which of the following describes the given graph correctly?



- (A) Endothermic reaction with energy A in presence of enzyme and B in absence of enzyme
- (B) Exothermic reaction with energy A in presence of enzyme and B in absence of enzyme
- (C) Endothermic reaction with energy A in absence of enzyme and B in presence of enzyme
- (D) Exothermic reaction with energy A in absence of enzyme and B in presence of enzyme

**Solution: (B)**

Potential energy of substrate is more than the product. So it is an exothermic reaction. 'A' represents the activation energy in the presence of enzyme while 'B' in the absence of enzyme i.e., enzyme lowers down the activation energy.

145. When cell has stalled DNA replication fork, which checkpoint should be predominantly activated?

- (A)  $G_1/S$
- (B)  $G_2/M$
- (C) M
- (D) Both  $G_2/M$  and M

**Solution: (A)**

$G_1/S$  check point of cell cycle is a major check point.



146. Match the stages of meiosis of Column-I to their characteristic features in Column-II and select the correct option using the codes given below:

Column - I		Column – II	
a.	Pachytene	(i)	Pairing of homologous chromosomes
b.	Metaphase I	(ii)	Terminalization of chiasmata
c.	Diakinesis	(iii)	Crossing-over takes place
d.	Zygotene	(iv)	Chromosomes align at equatorial plate

(A)

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

(B)

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

(C)

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

(D)

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

**Solution: (A)**

Pachytene - Stage of crossing over  
 Metaphase-I - Chromosome align at equatorial plate  
 Diakinesis - Terminalisation of chiasmata  
 Zygotene - Pairing of homologous chromosome

147. Which hormones do stimulate the production of pancreatic juice and bicarbonate?

- (A) Angiotensin and epinephrine
- (B) Gastrin and insulin
- (C) Cholecystokinin and secretin
- (D) Insulin and glucagon

**Solution: (C)**

Cholecystokinin and secretin both hormones increase the secretion of pancreatic juice.

148. The partial pressure of oxygen in the alveoli of the lungs is

- (A) Equal to that in the blood
- (B) More than that in the blood
- (C) Less than that in the blood
- (D) Less than that of carbon dioxide

**Solution: (B)**

Partial pressure of oxygen in alveoli of lungs is 104 mm of Hg that is more than that of blood in

pulmonary artery (40 mm of Hg).

149. Choose the correct statements.

- (A) Nociceptors respond to changes in pressure
- (B) Meissner's corpuscles are thermoreceptors
- (C) Photoreceptors in the human eye are depolarised during darkness and become hyperpolarized in response to the light stimulus
- (D) Receptors do not produce graded potentials

**Solution: (C)**

Photoreceptors (Rod cells) in human eye are depolarised during darkness and become hyperpolarised in response to the light stimulus

150. Graves' disease is caused due to

- (A) Hyposecretion of thyroid gland
- (B) Hypersecretion of thyroid gland
- (C) Hyposecretion of adrenal gland
- (D) Hypersecretion of adrenal gland

**Solution: (B)**

Grave's disease is due to the hypersecretion of thyroid gland.

151. Name the ion responsible for unmasking of active sites for myosin for cross-bridge activity during muscle contraction.

- (A) Calcium
- (B) Magnesium
- (C) Sodium
- (D) Potassium

**Solution: (A)**

Calcium ions bind with TpC unit of troponin which is responsible for unmasking of active sites for myosin for cross bridge activity during muscles contraction.

152. Name the blood cells, whose reduction in number can cause clotting disorder, leading to excessive loss of blood from the body.

- (A) Erythrocytes
- (B) Leucocytes
- (C) Neutrophils
- (D) Thrombocytes

**Solution: (D)**

Deduction in thrombocytes (platelets) can cause clotting disorder, leading to excessive loss of blood from the body.

153. Name a peptide hormone which acts mainly on hepatocytes, adipocytes and enhances cellular glucose uptake and utilization.

- (A) Insulin
- (B) Glucagon
- (C) Secretin
- (D) Gastrin

**Solution: (A)**

Insulin is a peptide hormone which acts mainly on hepatocytes, adipocytes and enhances cellular glucose uptake and utilization so it decreases the blood glucose level.

154. Osteoporosis, an age-related disease of skeletal system, may occur due to
- (A) Immune disorder affecting neuromuscular junction leading to fatigue
  - (B) High concentration of  $Ca^{++}$  and  $Na^+$
  - (C) Decreased level of estrogen
  - (D) Accumulation of uric acid leading to inflammation of joints

**Solution: (C)**

Osteoporosis in aged female after menopause is due to decreased level of estrogen.

155. Serum differs from blood in
- (A) Lacking globulins
  - (B) Lacking albumins
  - (C) Lacking clotting factors
  - (D) Lacking antibodies

**Solution: (C)**

Serum is plasma without clotting factors. It never clot.

156. Lungs do not collapse between breaths and some air always remains in the lungs which can never be expelled because
- (A) There is a negative pressure in the lungs
  - (B) There is a negative intrapleural pressure pulling at the lung walls
  - (C) There is a positive intrapleural pressure
  - (D) Pressure in the lungs is higher than the atmospheric pressure

**Solution: (B)**

Lungs do not collapse between breaths and some air always remains in the lung which can never be expelled because there is a negative intrapleural

157. The posterior pituitary gland is not a 'true' endocrine gland because
- (A) It is provided with a duct
  - (B) It only stores and releases hormones
  - (C) It is under the regulation of hypothalamus pressure pulling at the lung walls.
  - (D) It secretes enzymes

**Solution: (B)**

Posterior pituitary gland is not a true endocrine gland because it only stores and releases hormones.

158. The part of nephron involved in active reabsorption of sodium is
- (A) Distal convoluted tubule
  - (B) Proximal convoluted tubule
  - (C) Bowman's capsule
  - (D) Descending limb of Henle's loop

**Solution: (B)**

Proximal convoluted tubule is involved in active reabsorption of sodium.

159. Which of the following is hormone releasing IUD?
- (A) LNG-20

- (B) Multiload-375
- (C) Lippes loop
- (D) Cu7

**Solution: (A)**

LNG-20 (Levonorgestrel) is a hormone releasing IUDs.

160. Which of the following is incorrect regarding vasectomy?

- (A) No sperm occurs in seminal fluid
- (B) No sperm occurs in epididymis
- (C) Vasa deferentia is cut and tied
- (D) Irreversible sterility

**Solution: (B)**

In vasectomy, sperms occur in epididymis. In this, vas deferens are cut so sperms are not present in semen.

161. Embryo with more than 16 blastomeres formed due to in-vitro fertilization is transferred into

- (A) Uterus
- (B) Fallopian tube
- (C) Fimbriae
- (D) Cervix

**Solution: (A)**

In intrauterine transfer (IUT), embryo more than 8 blastomeres formed due to in-vitro fertilization is transferred in uterus.

162. Which of the following depicts the correct pathway of transport of sperms?

- (A) Rete testis → Efferent ductules → Epididymis → Vas deferens
- (B) Rate testis → Epididymis → Efferent ductules → Vas deferens
- (C) Rete testis → Vas deferens → Efferent ductules → Epididymis
- (D) Efferent ductules → Rete testis → Vas deferens → Epididymis

**Solution: (A)**

Pathway of transport of sperms in human male is

Rete testis → Efferent ductules (Vasa efferentia) → Epididymis → Vas deferens.

163. Match Column-I with Column-II and select the correct option using the codes given below:

Column – I		Column – II	
a.	Mons pubis	(i)	Embryo formation
b.	Antrum	(ii)	Antrum
c.	Trophectoderm	(iii)	Female external genitalia
d.	Nebenkern	(iv)	Graafian follicle

(A)

a.	b.	c.	d.
(iii)	(iv)	(ii)	(i)

(B)

a.	b.	c.	d.
----	----	----	----

(iii)	(iv)	(i)	(i)
-------	------	-----	-----

(C)

a.	b.	c.	d.
(iii)	(i)	(iv)	(ii)

(D)

a.	b.	c.	d.
(i)	(iv)	(iii)	(ii)

**Solution: (B)**

Correct matching is:

- (a) Mons pubis - Female external genitalia
- (b) Antrum - Graafian follicle
- (c) Trophoectoderm - Embryo formation
- (d) Nebenkern – Sperm

164. Several hormones like hCG, hPL, estrogen, progesterone are produced by

- (A) Ovary
- (B) Placenta
- (C) Fallopian tube
- (D) Pituitary

**Solution: (B)**

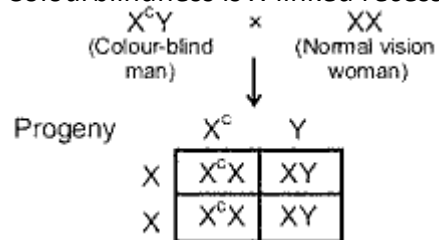
Hormones secreted by placenta are hCG, hPL, estrogen and progesterone.

165. If a colour-blind man marries a woman who is homozygous for normal colour vision, the probability of their son being colour-blind is

- (A) 0
- (B) 0.5
- (C) 0.75
- (D) 1

**Solution: (A)**

Colourblindness is X-linked recessive disease and shows criss-cross inheritance.



100% - carrier daughters (Phenotypically normal)

100% - Normal son

166. Genetic drift operates in

- (A) Small isolated population
- (B) Large isolated population
- (C) Non-reproductive population
- (D) Slow reproductive population

**Solution: (A)**

Genetic drift operates in small isolated inbreeding population.

167. In Hardy-Weinberg equation, the frequency of heterozygous individual is represented by

- (A)  $p^2$
- (B)  $2pq$
- (C)  $pq$
- (D)  $q^2$

**Solution: (B)**

In Hardy Weinberg equation,

$p^2$  = Homozygous dominant individuals

$2pq$  = Heterozygous individuals

$q^2$  = Homozygous recessive individuals

168. The chronological order of human evolution from early to the recent is

- (A) Australopithecus → Ramapithecus → Homo habilis → Homo erectus
- (B) Ramapithecus → Australopithecus → Homo habilis → Homo erectus
- (C) Ramapithecus → Homo habilis → Australopithecus → Homo erectus
- (D) Australopithecus → Homo habilis → Ramapithecus → Homo erectus

**Solution: (B)**

The chronological order of human evolution from early to the recent is

Ramapithecus → Australopithecus → Homo habilis → Homo erectus

169. Which of the following is the correct sequence of events in the origin of life?

- (i) Formation of protobionts
- (ii) Synthesis of organic monomers
- (iii) Synthesis of organic polymers
- (iv) Formation of DNA-based genetic systems

(A)

(i)	(ii)	(iii)	(iv)
-----	------	-------	------

(B)

(i)	(iii)	(ii)	(iv)
-----	-------	------	------

(C)

(ii)	(iii)	(i)	(iv)
------	-------	-----	------

(D)

(ii)	(iii)	(iv)	(i)
------	-------	------	-----

**Solution: (C)**

Correct sequence of events in the origin of life is

Synthesis of organic monomers

↓

Synthesis of organic polymers

↓

Formation of protobionts

Formation of DNA-based genetic systems

170. A molecule that can act as a genetic material must fulfill the traits given below, except
- (A) It should be able to express itself in the form of 'Mendelian characters'
  - (B) It should be able to generate its replica
  - (C) It should be unstable structurally and chemically
  - (D) It should provide the scope for slow changes that are required for evolution

**Solution: (C)**

A molecule which is unstable structurally and chemically cannot act as a genetic material.

171. DNA-dependent RNA polymerase catalyzes transcription on one strand of the DNA which is called the
- (A) Template strand
  - (B) Coding strand
  - (C) Alpha strand
  - (D) Antistrand

**Solution: (A)**

The DNA-dependent RNA polymerase catalyze the polymerisation in only one direction that is  $5 \rightarrow 3$ , the strand with polarity  $5 \rightarrow 3$  act as template and is called as template strand.

172. Interspecific hybridization is the mating of
- (A) Animals within same breed without having common ancestors
  - (B) Two different related species
  - (C) Superior males and females of different breeds
  - (D) More closely related individuals within same breed for 4–6 generations

**Solution: (B)**

Interspecific hybridization is mating of animals of two different related species.

173. Which of the following is correct regarding AIDS causative agent HIV?
- (A) HIV is enveloped virus containing one molecule of single-stranded RNA and one molecule of reverse transcriptase
  - (B) HIV is enveloped virus that contains two identical molecules of single-stranded RNA and two molecules of reverse transcriptase
  - (C) HIV is unenveloped retrovirus
  - (D) HIV does not escape but attacks the acquired immune response

**Solution: (B)**

Causative agent of AIDS is HIV which is enveloped virus that contains two identical molecules of ssRNA and two molecules of reverse transcriptase.

174. Among the following edible fishes, which one is a marine fish having rich source of omega-3 fatty acids?
- (A) Mystus
  - (B) Mangur
  - (C) Mrigala
  - (D) Mackerel

**Solution: (D)**

Mackerel is a marine fish having rich source of omega-3 fatty acids

175. Match Column-I with Column-II and select the correct option using the codes given below :

Column – I		Column – II	
a.	Citric acid	(i)	Trichoderma
b.	Cyclosporin A	(ii)	Clostridium
c.	Statins	(iii)	Aspergillus
d.	Butyric acid	(iv)	Monascus

(A)

a.	b.	c.	d.
(iii)	(i)	(ii)	(iv)

(B)

a.	b.	c.	d.
(iii)	(i)	(iv)	(ii)

(C)

a.	b.	c.	d.
(i)	(iv)	(ii)	(iii)

(D)

a.	b.	c.	d.
(iii)	(iv)	(i)	(ii)

**Solution: (B)**

Microbe	Product
Aspergillus niger	Citric acid
Trichoderma polysporum	Cyclosporin-A
Monascus purpureus	Statins
Clostridium butylicum	Butyric acid

176. Biochemical Oxygen Demand (BOD) may not be a good index for pollution for water bodies receiving effluents from

- (A) Domestic sewage
- (B) Dairy industry
- (C) Petroleum industry
- (D) Sugar industry

**Solution: (C)**

Biochemical oxygen demand (BOD) is not a good index for pollution for water bodies receiving effluents from petroleum industry as the generated waste is mostly non-biodegradable in nature.

177. The principle of competitive exclusion was stated by

- (A) C. Darwin
- (B) G. F. Gause



- (C) MacArthur
- (D) Verhulst and Pearl

**Solution: (B)**

The principle of competitive exclusion was stated by G. F. Gause.

178. Which of the following National Parks is home to the famous musk deer or hangul?

- (A) Keibul Lamjao National Park, Manipur
- (B) Bandhavgarh National Park, Madhya Pradesh
- (C) Eaglenest Wildlife Sanctuary, Arunachal Pradesh
- (D) Dachigam National Park, Jammu & Kashmir

**Solution: (D)**

Conservation of Musk deer or Hangul.

179. A lake which is rich in organic waste may result in

- (A) Increased population of aquatic organisms due to minerals
- (B) Drying of the lake due to algal bloom
- (C) Increased population of fish due to lots of nutrients
- (D) Mortality of fish due to lack of oxygen

**Solution: (D)**

Micro-organisms involved in biodegradation of organic matter consume oxygen as a result there is a sharp decline in oxygen causing mortality of fish and other aquatic creatures.

180. The highest DDT concentration in aquatic food chain shall occur in

- (A) Phytoplankton
- (B) Seagull
- (C) Crab
- (D) Eel

**Solution: (B)**

Maximum DDT concentration occurs in fish eating birds like *seagull* due to biomagnification. This happens because a toxic substance accumulated by an organism cannot be metabolised or excreted, thus passed to higher trophic level.