

## Questions with Solutions

Time: 3 Hours

Total Marks: 720

**General Instructions:**

1. The test is of **3 hours** duration.
2. The Test Paper contains **180** questions. There are **three** parts in the question paper consisting of **Physics and Chemistry** having **45** questions each and **Biology** with **90 questions**.
3. Each question carries **4 marks**. For each correct response, the candidate will get **4 marks**. For each incorrect response, **1 mark** will be deducted from the total scores. The maximum marks are **720**.
4. Out of the four options given for each question, only one option is the correct answer. If more than one response is marked in any question, it will be treated as wrong response and marked up for wrong response will be deducted.
5. No deduction from the total score will be made if no response is indicated for an item in the answer box.
6. Use of Electronic/Manual Calculator is prohibited.

**PHYSICS**

**Q 1. From a disc of a radius R and mass M, a circular hole of diameter R, whose rim passes through the centre is cut. What is the moment of inertia of the remaining part of the disc about a perpendicular axis, passing through the centre?**

Option A  $15 MR^2/32$ Option B  $13 MR^2/32$ Option C  $11 MR^2/32$ Option D  $9 MR^2/32$ **Correct Option B****Solution:**

$$I_{\text{remain}} = I - I_{\text{cut}}$$

$$I_{\text{cut}} = \frac{\frac{M}{\pi R^2} \times \frac{\pi R^2}{4} \times \left(\frac{R}{2}\right)^2}{2} + \frac{M}{4} \times \left(\frac{R}{2}\right)^2$$

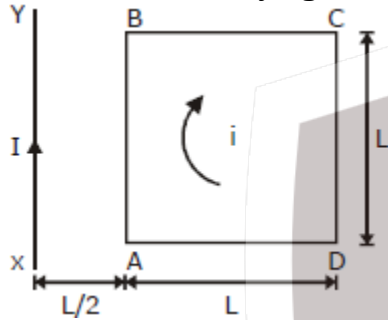
$$I = \frac{MR^2}{2}$$

$$= \frac{MR^2}{2} - \left[ \frac{\frac{M}{\pi R^2} \times \frac{\pi R^2}{4} \times \left(\frac{R}{2}\right)^2}{2} + \frac{M}{4} \times \left(\frac{R}{2}\right)^2 \right]$$

$$= \frac{MR^2}{2} - \left[ \frac{M}{32} + \frac{M}{16} \right]$$

$$= MR^2 \left( \frac{1}{2} - \frac{3}{32} \right) = \frac{13MR^2}{32}$$

**Q 2. A square loop ABCD carrying a current  $i$ , is placed near and coplanar with a long straight conductor XY, carrying a current  $I$ , the net force on the loop will be:**



- Option A  $\frac{2\mu_0 i I}{3\pi}$
- Option B  $\frac{\mu_0 i I}{2\pi}$
- Option C  $\frac{2\mu_0 i I L}{3\pi}$
- Option D  $\frac{\mu_0 i I L}{2\pi}$

**Correct Option A**

**Solution:**

$$\frac{\mu_0 I}{2\pi(L/2)} \cdot iL - \frac{\mu_0 I}{2\pi\left(\frac{3L}{2}\right)} \cdot iL$$

$$; \frac{\mu_0 i I L}{2\pi L} \left[ 2 - \frac{2}{3} \right]; \frac{2\mu_0 i I}{3\pi}$$

**Q 3. The magnetic susceptibility is negative for:**

- Option A diamagnetic material only
- Option B paramagnetic material only
- Option C ferromagnetic material only
- Option D paramagnetic and ferromagnetic materials

**Correct Option A**

**Solution:** diamagnetic material only

**Q 4.** A siren emitting a sound of frequency 800 Hz moves away from an observer towards a cliff at a speed of  $15 \text{ ms}^{-1}$ . Then, the frequency of sound that the observer hears in the echo reflected from the cliff is: (Take velocity of sound in air =  $330 \text{ ms}^{-1}$ )

- Option A 765 Hz
- Option B 800 Hz
- Option C 838 Hz
- Option D 885 Hz

**Correct Option C**

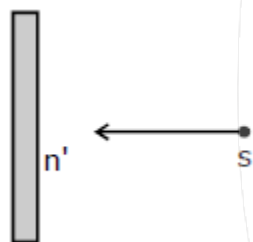
**Solution:**

$$f' = f_0 \left( \frac{v \pm v_0}{v \pm v_s} \right)$$

$$f' = f_0 \left( \frac{330 + 0}{330 - 15} \right)$$

frequency heard by the observer

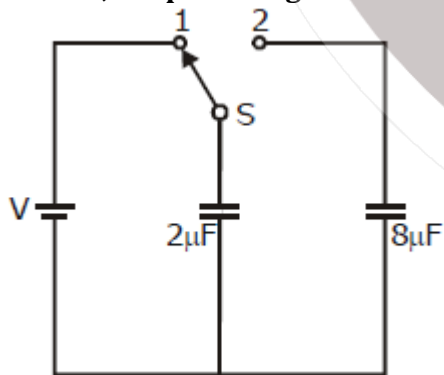
$$= 800 \times \frac{330}{315} = 838 \text{ Hz}$$



$\therefore$  Observer hears

$$f' = 838 \text{ Hz}$$

**Q 5.** A capacitor of  $2 \mu\text{F}$  is charged as shown in the diagram. When the switch S is turned to position 2, the percentage of its stored energy dissipated is:



- Option A 0%
- Option B 20%
- Option C 75%
- Option D 80%

**Correct Option D**

**Solution:**

$$U_{\text{initial}} = \frac{1}{2}cv^2 = \frac{1}{2} \times 2 \times 10^{-6} \times v^2 = 10^{-6} \times v^2 \text{V}$$

$$V_{\text{final}} = \frac{\text{Total charge}}{\text{total capacitance}} = \frac{2V \times 10^{-6}}{(2+8) \times 10^{-6}} = \frac{V}{5} \text{ volt}$$

$$U_{\text{final}} = \frac{1}{2}(2+8) \times 10^{-6} \left(\frac{V}{5}\right)^2 = \frac{V^2}{5} \times 10^{-6} \text{J}$$

$$\Delta U = \frac{10^{-6} \times V^2 - \frac{V^2}{5} \times 10^{-6}}{10^{-6} \times V^2}$$

$$\frac{\Delta U}{U_1} \times 100 = \frac{8}{10} \times 100 = 80\%$$

**Q 6. In a diffraction pattern due to a single slit of width 'a', the first minimum is observed at an angle  $30^\circ$  when light of wavelength  $5000\text{\AA}$  is incident on the slit. The first secondary maximum is observed at an angle of:**

Option A  $\sin^{-1}\left(\frac{1}{4}\right)$

Option B  $\sin^{-1}\left(\frac{2}{3}\right)$

Option C  $\sin^{-1}\left(\frac{1}{2}\right)$

Option D  $\sin^{-1}\left(\frac{3}{4}\right)$

**Correct Option D**

**Solution:**

For minima  $a \sin \theta = n\lambda$

$n = 1, 2, 3, \dots$

$$\sin \theta = \frac{\lambda}{a} = \frac{5000 \times 10^{-10}}{a} = \frac{1}{2}$$

$a = 10 \times 10^{-7}$

For maxima general condition is

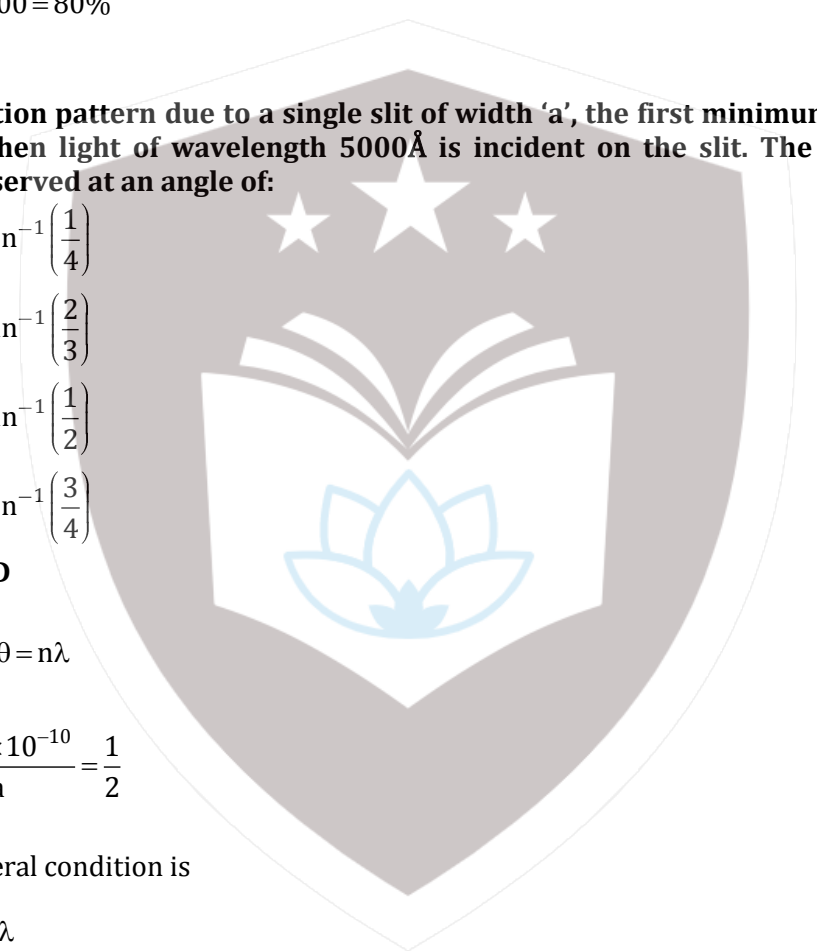
$$a \sin \theta = \left(\frac{2n+1}{2}\right)\lambda$$

For first secondary maxima

$$a \sin \theta = \frac{3\lambda}{2}$$

$$\sin \theta = \frac{3\lambda}{2a} = \frac{3}{4}$$

$$\theta = \sin^{-1}\left(\frac{3}{4}\right)$$



**Q 7. At what height from the surface of earth the gravitation potential and the value of g are -  $5.4 \times 10^7 \text{ J kg}^{-2}$  and  $6.0 \text{ ms}^{-2}$  respectively? Take the radius of earth as 6400 km.**

- Option A 2600 km
- Option B 1600 km
- Option C 1400 km
- Option D 2000 km

**Correct Option A**

**Solution:**

$$V_{\text{at height } h} = -\frac{GM_e}{R_e + h} \text{-----(1)}$$

$$g_h = \frac{GM_e}{(R_e + h)^2} = 6 \text{-----(2)}$$

$$\frac{V_{\text{at height } h}}{g_h} = R_e + h = \frac{5.4 \times 10^7}{6}$$

$$R_e + h = 9 \times 10^6$$

$$h = 9 \times 10^6 - 6.4 \times 10^6 \\ = 2600 \text{ km}$$

**Q 8. Out of the following options which one can be used to produce a propagating electromagnetic wave?**

- Option A A charge moving at constant velocity.
- Option B A stationary charge
- Option C A chargeless particle
- Option D An accelerating charge

**Correct Option D**

**Solution:** An accelerating charge is responsible for producing electromagnetic waves.

**Q 9. Two identical charged spheres suspended from a common point by two massless strings of lengths l, are initially at a distance d ( $d \ll l$ ) apart because of their mutual repulsion. The charges begin to leak from both the spheres at a constant rate. As a result, the spheres approach each other with a velocity v. Then v varies as a function of the distance x between the spheres, as:**

- Option A  $v \propto x^2$
- Option B  $v \propto x$
- Option C  $v \propto x^{-\frac{1}{2}}$
- Option D  $v \propto x^{-1}$

**Correct Option C**

**Solution:**

Horizontal forces

$$T \sin \theta = \frac{kq^2}{r^2} \text{-----(1)}$$

Vertical forces

$$T \cos \theta = mg \text{-----(2)}$$

$$\tan \theta = \frac{kq^2}{mgr^2}$$

$$\frac{d}{l} = \frac{kq^2}{mgr^2}$$

$$q^2 \propto r^3$$

$$q \propto r^{-3/2}$$

Now

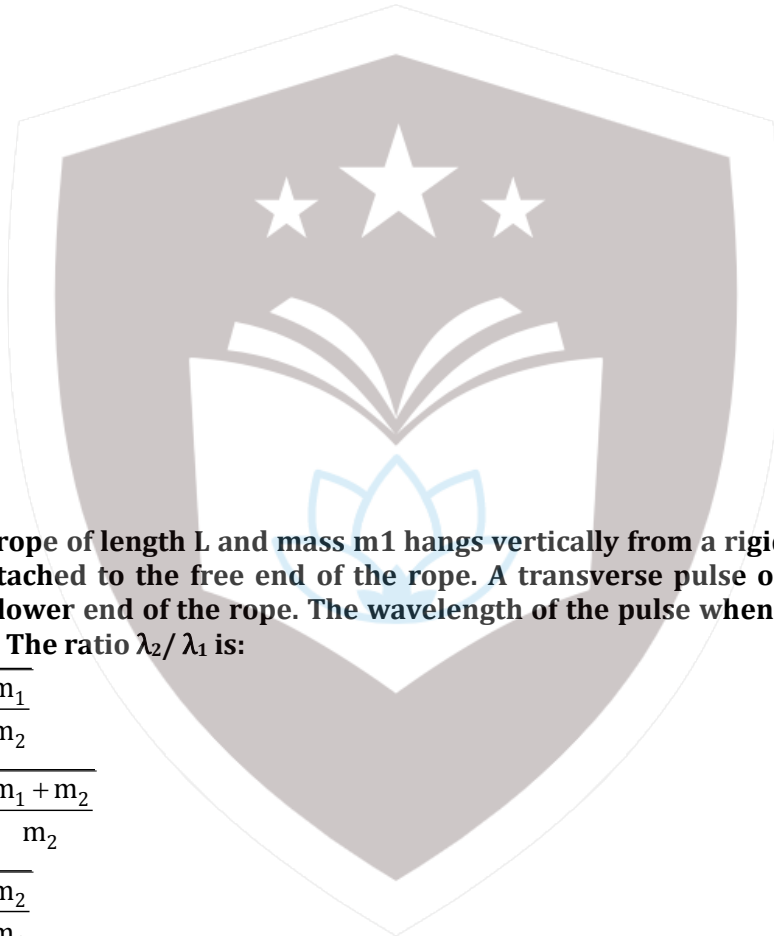
$$\frac{dq}{dt} \propto \frac{3}{2} \sqrt{r} \cdot \frac{dr}{dt}$$

$$\frac{dq}{dt} = \text{constant}$$

$$v \propto \frac{1}{\sqrt{r}}$$

Hence

$$\therefore v \propto x^{-1/2}$$



**Q 10. A uniform rope of length  $L$  and mass  $m_1$  hangs vertically from a rigid support. A block of mass  $m_2$  is attached to the free end of the rope. A transverse pulse of wavelength  $\lambda_1$  is produced at the lower end of the rope. The wavelength of the pulse when it reaches the top of the ropes is  $\lambda_2$ . The ratio  $\lambda_2 / \lambda_1$  is:**

Option A  $\sqrt{\frac{m_1}{m_2}}$

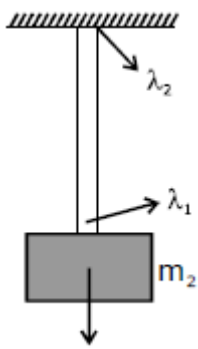
Option B  $\sqrt{\frac{m_1 + m_2}{m_2}}$

Option C  $\sqrt{\frac{m_2}{m_1}}$

Option D  $\sqrt{\frac{m_1 + m_2}{m_1}}$

**Correct Option B**

**Solution:**



Tension at the lower end =  $m_2g$

Tension at the upper end =  $(m_1 + m_2)g$

$$v = f\lambda = \sqrt{\frac{T}{\mu}}$$

Thus

$$\lambda \propto \sqrt{T}$$

$$\frac{\lambda_1}{\lambda_2} = \sqrt{\frac{T_1}{T_2}} = \sqrt{\frac{m_2g}{(m_1 + m_2)g}}$$

$$\frac{\lambda_1}{\lambda_2} = \sqrt{\frac{m_2}{m_1 + m_2}}$$

$$\frac{\lambda_2}{\lambda_1} = \sqrt{\frac{m_2 + m_1}{m_2}}$$

**Q 11. A refrigerator works between  $4^\circ\text{C}$  and  $30^\circ\text{C}$ . It is required to remove 600 calories of heat every second in order to keep the temperature of the refrigerated space constant. The power required is: (Take 1 cal = 4.2 Joules)**

Option A 2.365 W

Option B 23.65W

Option C 236.5W

Option D 2365W

**Correct Option C**

**Solution:**

$$T_1 = 303 \quad T_2 = 277$$

Coefficient of performance

$$\beta = \frac{Q_2}{W} = \frac{Q_2}{Q_1 - Q_2} = \frac{T_2}{T_1 - T_2} \quad (Q_1 = W + Q_2)$$

$$\frac{Q_2}{W} = \frac{277}{26}$$

$$W = Q_2 \frac{26}{277} = \frac{600 \times 4.2 \times 26}{277}$$

$$= 236.5\text{J}$$

**Q 12.** An air column, closed at one end and open at the other, resonates with a tuning fork when the smallest length of the column is 50 cm, the next larger length of the column resonating with the same tuning fork is:

- Option A 66.7 cm
- Option B 100 cm
- Option C 150 cm
- Option D 200 cm

**Correct Option C**

**Solution:**

The smallest length of the air column

$$l_1 = \frac{\lambda}{4} \text{-----(1)}$$

The next higher length would be

$$l_2 = \frac{\lambda}{4} + \frac{\lambda}{2} = \frac{3\lambda}{4} \text{-----(2)}$$

$$\frac{(1)}{(2)}$$

$$\frac{\frac{\lambda}{4}}{\frac{3\lambda}{4}} = \frac{l_1}{l_2}$$

$$\frac{l_1}{l_2} = \frac{1}{3} \Rightarrow l_2 = 3l_1$$

$$l_2 = 3 \times 50 = 150 \text{ cm}$$

**Q 13.** Consider the junction diode as ideal. The value of current flowing through AB is:



- Option A 0 A
- Option B  $10^{-2}$  A
- Option C  $10^{-1}$  A
- Option D  $10^{-3}$  A

**Correct Option B**

**Solution:**

In this case the diode is forward biased hence it offers no resistance

$$V_A - iR = V_B$$

$$V_A - V_B = iR$$

$$i = \frac{V_A - V_B}{R}$$

$$i = \frac{4 - (-6)}{1000} = \frac{10}{1000} = 10^{-2} \text{ A}$$



**Q 14. The charge flowing through a resistance R varies with time t as  $Q = at - bt^2$ , where a and b are positive constants. The total heat produced in R is:**

Option A  $\frac{a^3R}{6b}$

Option B  $\frac{a^3R}{3b}$

Option C  $\frac{a^3R}{2b}$

Option D  $\frac{a^3R}{b}$

**Correct Option A**

**Solution:**

$$Q = at - bt^2$$

$$I = \frac{dQ}{dt} = a - 2bt$$

$$\text{At } I = 0$$

$$t = \frac{a}{2b}$$

$$\text{Heat produced} = I^2Rt$$

$$dH = I^2Rdt$$

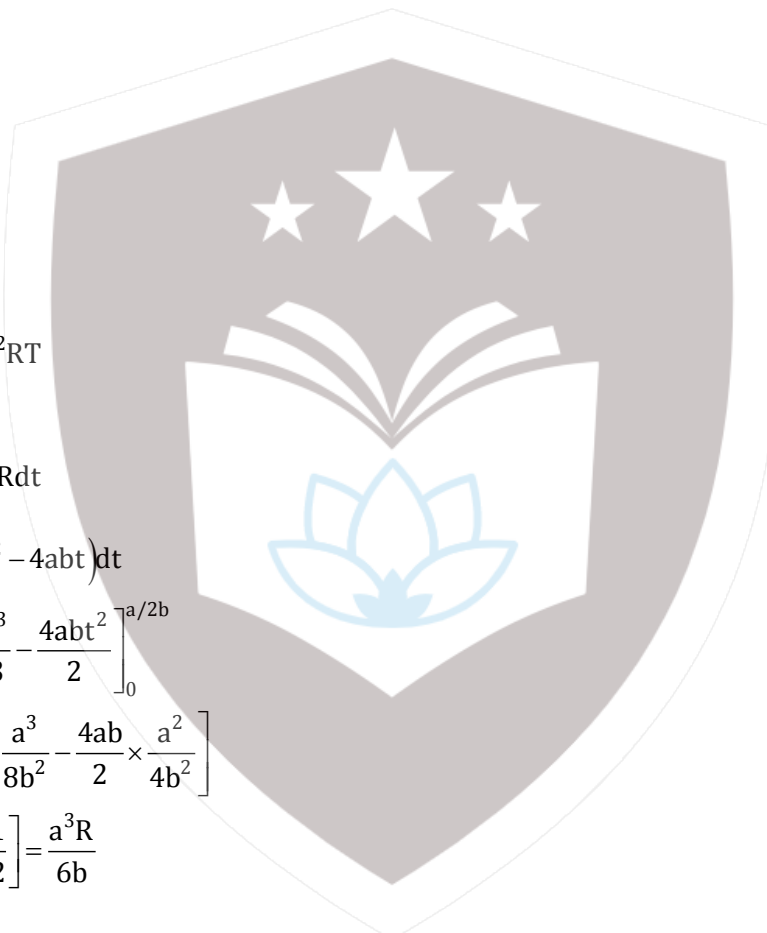
$$dH = \int_0^{a/2b} (a - 2bt)^2 R dt$$

$$dH = R \int (a^2 + 4b^2t^2 - 4abt) dt$$

$$dH = R \left[ a^2t + 4b^2 \frac{t^3}{3} - \frac{4abt^2}{2} \right]_0^{a/2b}$$

$$dH = R \left[ \frac{a^3}{2b} + \frac{4b^2}{3} \times \frac{a^3}{8b^2} - \frac{4ab}{2} \times \frac{a^2}{4b^2} \right]$$

$$dH = \frac{a^3R}{b} \left[ \frac{1}{2} + \frac{1}{6} - \frac{1}{2} \right] = \frac{a^3R}{6b}$$



**Q 15. A black body is at a temperature of 5760 K. The energy of radiation emitted by the body at wavelength 250 nm is  $U_1$ , at wavelength 500 nm is  $U_2$  and that at 1000 nm is  $U_3$ . Wien's constant,  $b = 2.88 \times 10^6$  nmK. Which of the following is correct?**

Option A  $U_1 = 0$

Option B  $U_3 = 0$

Option C  $U_1 > U_2$

Option D  $U_2 > U_1$

**Correct Option D**

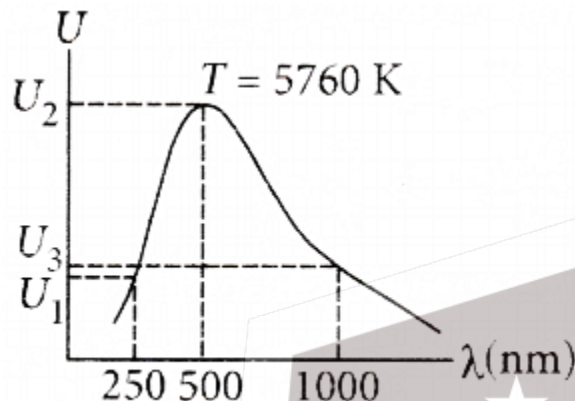
**Solution:**

According to Wien's displacement law

$$\lambda_{\min} = \frac{b}{T}$$

$$= \frac{2.88 \times 10^6}{5760}$$

$$= 500 \text{ nm}$$



From the graph we can see that  $U_2$  is maximum.

**Q 16.** Coefficient of linear expansion of brass and steel rods are  $\alpha_1$  and  $\alpha_2$ . Length of brass and steel rods are  $l_1$  and  $l_2$  respectively. If  $(l_2 - l_1)$  is maintained same at all temperatures, which one of the following relations holds good?

- Option A  $\alpha_1 l_2 = \alpha_2 l_1$   
 Option B  $\alpha_1 l_2^2 = \alpha_2 l_1^2$   
 Option C  $\alpha_1^2 l_2 = \alpha_2^2 l_1$   
 Option D  $\alpha_2 l_2 = \alpha_1 l_1$

**Correct Option D**

**Solution:**

The change in length is given by

$$\Delta l = l \alpha \Delta T$$

As difference between the lengths is same at all temperatures

Therefore

$$\Delta l_1 = \Delta l_2$$

$$l_1 \alpha_1 \Delta T = l_2 \alpha_2 \Delta T$$

Hence

$$l_1 \alpha_1 = l_2 \alpha_2$$

**Q 17.** A npn transistor is connected in common emitter configuration in a given amplifier. A load resistance of  $800 \Omega$  is connected in the collector circuit and the voltage drop across it is  $0.8V$ . If the current amplification factor is  $0.96$  and the input resistance of the circuit is  $192\Omega$ , the voltage gain and the power gain of the amplifier will respectively be:

- Option A 4, 3.84  
 Option B 3.69, 3.84  
 Option C 4, 4  
 Option D 4, 3.69

**Correct Option A**

**Solution:**

Voltage gain = Current gain × Resistance gain

$$\text{Voltage gain} = 0.96 \times \frac{800}{192} = 4V$$

$$\text{Power gain} = VI = 4 \times 0.96 = 3.84W$$

**Q 18.** The intensity at the maximum in a Young's double slit experiment is  $I_0$ . Distance between two slits is  $d = 5\lambda$ , where  $\lambda$  is the wavelength of light used in the experiment. What will be the intensity in front of one of the slits on the screen placed at a distance  $D = 10d$ ?

Option A  $I_0$

Option B  $\frac{I_0}{4}$

Option C  $\frac{3}{4}I_0$

Option D  $\frac{I_0}{2}$

**Correct Option D**

**Solution:**

Intensity at any point is given by

$$I = I_0 \cos^2\left(\frac{\phi}{2}\right)$$

Where  $\theta$  is the phase difference

$$\Delta x = d \sin \theta$$

$$\sin \theta \sim \tan \theta$$

$$\phi = \frac{2\pi}{\lambda} \Delta x$$

$$\phi = \frac{2\pi}{\lambda} d \tan \theta$$

$$\phi = \frac{2\pi}{\lambda} \times 5\lambda \tan \theta$$

$$\phi = \frac{2\pi}{\lambda} \times 5\lambda \frac{y}{D}$$

$$\phi = \frac{2\pi}{\lambda} \times 5\lambda \frac{5\lambda/2}{10 \times 5\lambda}$$

$$\phi = \frac{\pi}{2}$$

$$I = I_0 \cos^2\left(\frac{\pi}{4}\right)$$

$$= I_0 \times \left(\frac{1}{\sqrt{2}}\right)^2 = \frac{I_0}{2}$$



**Q 19. A uniform circular disc of radius 50 cm at rest is free to turn about an axis which is perpendicular to its plane and passes through its centre. It is subjected to a torque which produces a constant angular acceleration of  $2.0 \text{ rad s}^{-2}$ . Its net acceleration in  $\text{ms}^{-2}$  at the end of 2.0 s is approximately:**

- Option A 8.0  
 Option B 7.0  
 Option C 6.0  
 Option D 3.0

**Correct Option A**

**Solution:**

$$\text{Torque } \tau = I\alpha$$

$$\alpha = 2 \text{ rad/s}^2$$

Tangential acceleration

$$a = r\alpha$$

$$a_t = \frac{1}{2} \times 2 = 1 \text{ ms}^{-2}$$

$$a_t = 1 \text{ ms}^{-2}$$

$$v = u + at$$

$$= 0 + 2$$

$$v = 2 \text{ m/s}$$

Radial acceleration

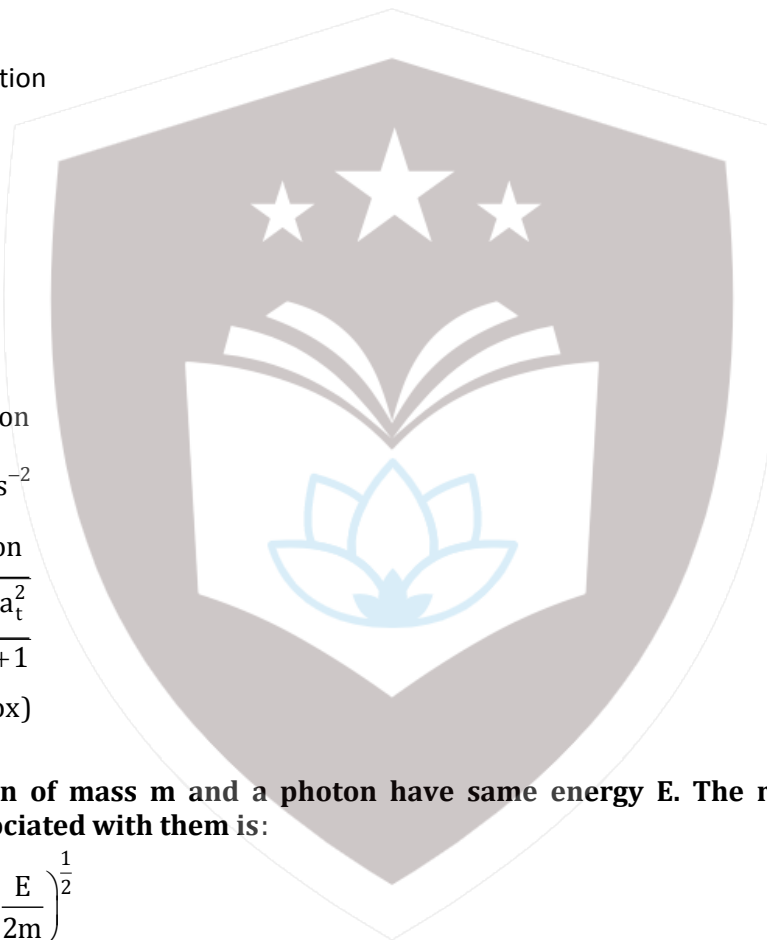
$$a_r = \frac{v^2}{r} = \frac{4}{0.5} = 8 \text{ ms}^{-2}$$

net acceleration

$$a = \sqrt{a_r^2 + a_t^2}$$

$$= \sqrt{64 + 1}$$

$$= 8 \text{ ms}^{-2} \text{ (approx)}$$



**Q 20. An electron of mass  $m$  and a photon have same energy  $E$ . The ratio of de-Broglie wavelengths associated with them is:**

- Option A  $\frac{1}{c} \left( \frac{E}{2m} \right)^{\frac{1}{2}}$   
 Option B  $\left( \frac{E}{2m} \right)^{\frac{1}{2}}$   
 Option C  $c(2mE)^{\frac{1}{2}}$   
 Option D  $\frac{1}{c} \left( \frac{2m}{E} \right)^{1/2}$

**(being velocity of light)**

**Correct Option A**

**Solution:**

$$\lambda_e = \frac{h}{p} = \frac{h}{\sqrt{2m_e E}} \quad \dots(1)$$

For photon

$$E = \frac{hc}{\lambda_p}$$

$$\lambda_p = \frac{hc}{E} \quad \dots(2)$$

$$\therefore \lambda_{\text{photon}} = \frac{hc}{E}$$

$$\therefore \frac{\lambda_e}{\lambda_p} = \frac{h}{\sqrt{2mE}} \times \frac{E}{hc}$$

$$\frac{\lambda_e}{\lambda_p} = \frac{1}{c} \left( \frac{E}{2m} \right)^{\frac{1}{2}}$$

**Q 21. A disk and a sphere of same radius but different masses roll off on two inclined planes of the same altitude and length. Which one of the two objects gets to the bottom of the plane first?**

- Option A      Disk  
 Option B      Sphere  
 Option C      Both reach at the same time  
 Option D      Depends on their masses

**Correct Option B**

**Solution:**

Time taken by body to roll down an inclined plane is

$$t = \sqrt{\frac{2l(1+k^2/r^2)}{g \sin \theta}}$$

$$\frac{t_{\text{disk}}}{t_{\text{sphere}}} = \sqrt{\frac{(1+k_d^2/R^2)}{(1+k_s^2/R^2)}}$$

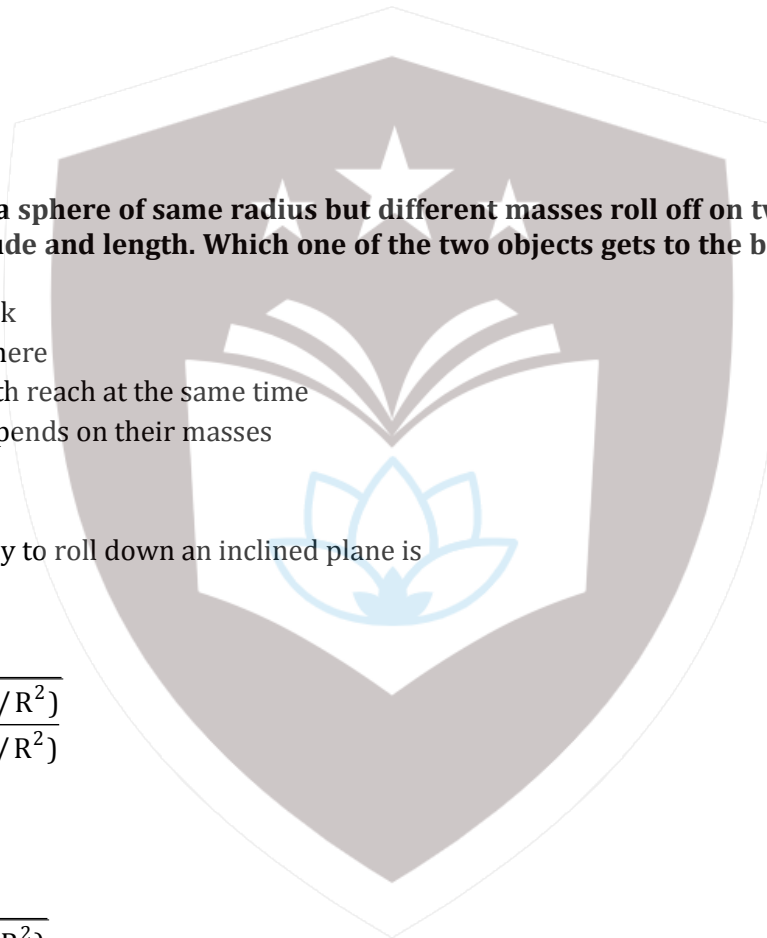
$$k_d = \frac{R}{\sqrt{2}}, k_s = \sqrt{\frac{2}{5}}R$$

therefore

$$\frac{t_{\text{disk}}}{t_{\text{sphere}}} = \sqrt{\frac{(1+1/2R^2)}{(1+2/5R^2)}}$$

$$\frac{t_{\text{disk}}}{t_{\text{sphere}}} = \sqrt{\frac{15}{14}}$$

Time taken by sphere is less

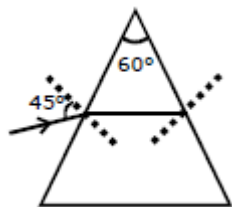


**Q 22.** The angle of incidence for a ray of light at a refracting surface of a prism is  $45^\circ$ . The angle of prism is  $60^\circ$ . If the ray suffers minimum deviation through the prism, the angle of minimum deviation and refractive index of the material of the prism respectively, are:

- Option A  $45^\circ; \frac{1}{\sqrt{2}}$   
 Option B  $30^\circ; \sqrt{2}$   
 Option C  $45^\circ; \sqrt{2}$   
 Option D  $30^\circ; \frac{1}{\sqrt{2}}$

**Correct Option B**

**Solution:**



$$\delta = i + e - A$$

For minimum deviation,  $i = e$

$$\delta_{\min} = 2i - A = 2 \times 45^\circ - 60^\circ = 30^\circ$$

The refractive index is

$$\mu = \frac{\sin\left(\frac{A + \delta_{\min}}{2}\right)}{\sin A / 2}$$

$$\mu = \frac{\sin\left(\frac{60 + 30}{2}\right)}{\sin 30}$$

$$\mu = \frac{\sin 45}{\sin 30}$$

$$\mu = \frac{1 \times 2}{\sqrt{2} \times 1} = \sqrt{2}$$

**Q 23.** When an  $\alpha$ -particle of mass 'm' moving with velocity 'v' bombards on a heavy nucleus of charge 'Ze' its distance of closest approach from the nucleus depends on m as:

- Option A  $\frac{1}{m}$   
 Option B  $\frac{1}{\sqrt{m}}$   
 Option C  $\frac{1}{m^2}$   
 Option D m

**Correct Option A**

**Solution:**

$$U_i + K_i = U_f + K_f$$

$$0 + \frac{1}{2}mv^2 = \frac{(KZe)(2e)}{d}$$

$$d = \frac{k4Ze^2}{mv^2}$$

$$d \propto \frac{1}{m}$$

**Q 24. A particle of mass 10 g moves along a circle of radius 6.4 cm with a constant tangential acceleration. What is the magnitude of this acceleration if the kinetic energy of the particle becomes equal to  $8 \times 10^{-4}$  J by the end of the second revolution after the beginning of the motion?**

- Option A      0.1 m/s<sup>2</sup>  
 Option B      0.15 m/s<sup>2</sup>  
 Option C      0.18 m/s<sup>2</sup>  
 Option D      0.2 m/s<sup>2</sup>

**Correct Option A**

**Solution:**

$$\frac{1}{2}mv^2 = 8 \times 10^{-4}; \frac{1}{2} \times 10^{-2}v^2 = 8 \times 10^{-4}$$

$$v^2 = 16 \times 10^{-12}$$

$$v = 0.4 \text{ m/s}$$

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

$$0.4 \times 0.4 = 2 \times a \times 2\pi \times 6.4 \times 10^{-2} \times 2$$

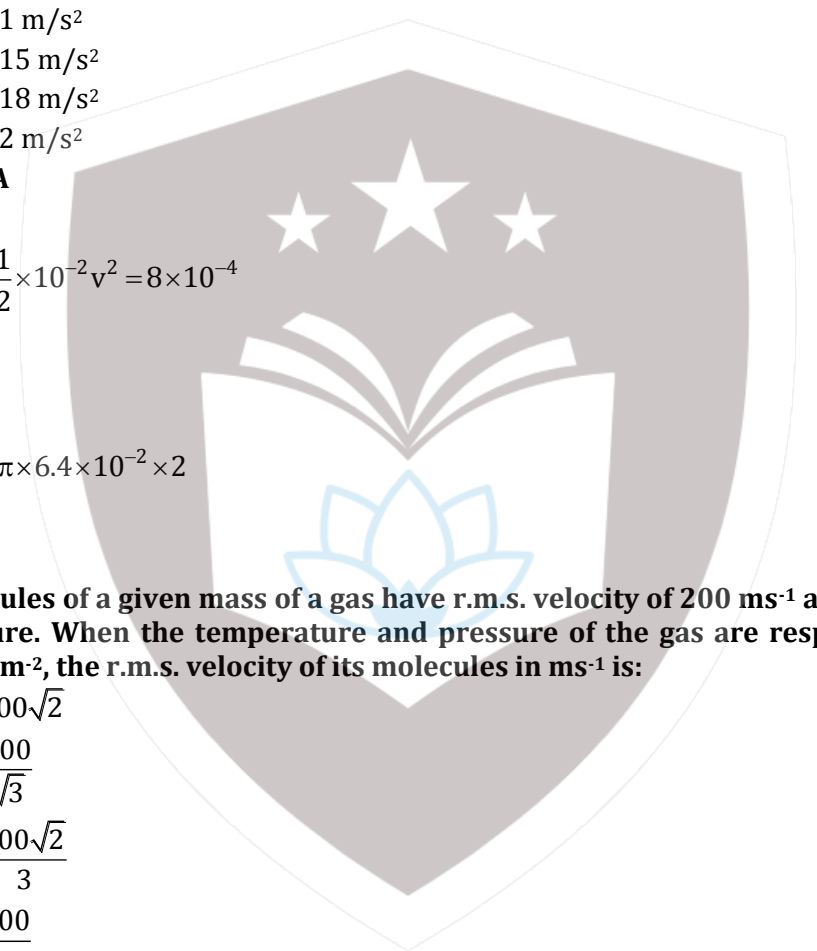
$$a = 0.1 \text{ ms}^{-2}$$

**Q 25. The molecules of a given mass of a gas have r.m.s. velocity of  $200 \text{ ms}^{-1}$  at  $27^\circ\text{C}$  and  $1.0 \times 10^5 \text{ Nm}^{-2}$  pressure. When the temperature and pressure of the gas are respectively,  $127^\circ\text{C}$  and  $0.05 \times 10^5 \text{ Nm}^{-2}$ , the r.m.s. velocity of its molecules in  $\text{ms}^{-1}$  is:**

- Option A       $100\sqrt{2}$   
 Option B       $\frac{400}{\sqrt{3}}$   
 Option C       $\frac{100\sqrt{2}}{3}$   
 Option D       $\frac{100}{3}$

**Correct Option B**

**Solution:**



$$V_{\text{rms}} \propto \sqrt{T}$$

$$\frac{V_{\text{rms at 300K}}}{V_{\text{rms at 400K}}} = \sqrt{\frac{300}{400}}$$

$$V_{\text{rms at 400K}} = \sqrt{\frac{400}{300}} \times V_{\text{rms at 300K}}$$

$$V_{\text{rms at 400K}} = \sqrt{\frac{400}{300}} \times 200$$

$$V_{\text{rms at 400K}} = \frac{400}{\sqrt{3}} \text{ m/s}$$

**Q 26. A long straight wire of radius  $a$  carries a steady current  $I$ . The current is uniformly distributed over its cross-section. The ratio of the magnetic fields  $B$  and  $B'$ , at radial distances  $\frac{a}{2}$  and  $2a$  respectively, from the axis of the wire is**

Option A  $\frac{1}{4}$

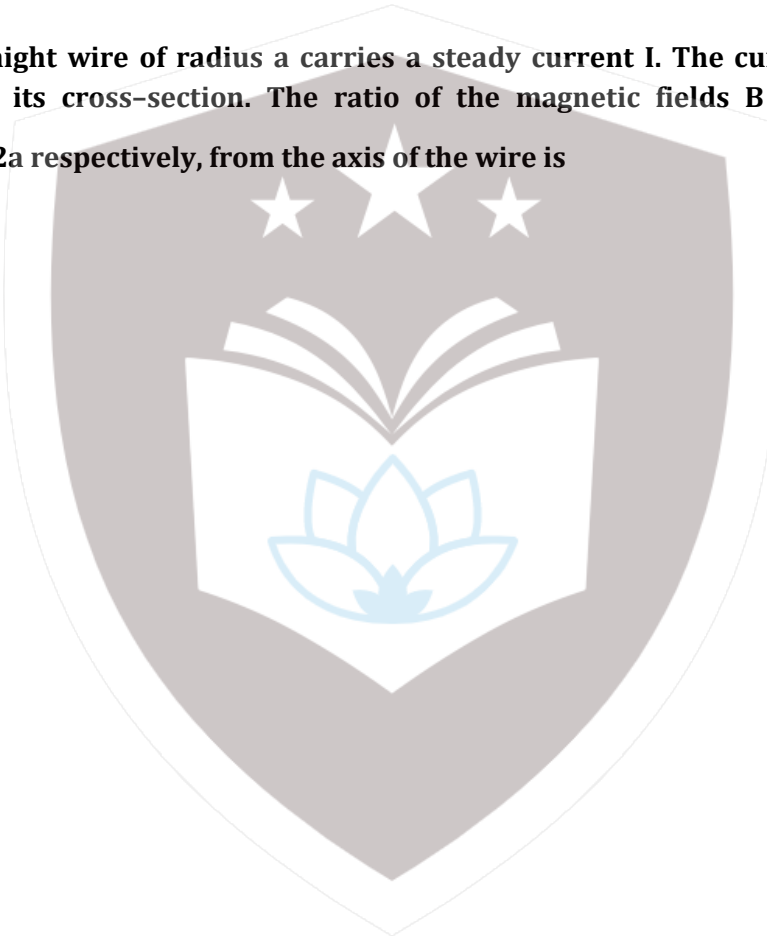
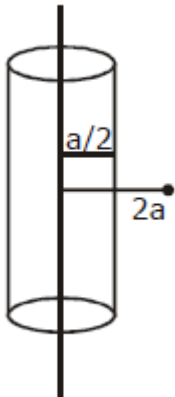
Option B  $\frac{1}{2}$

Option C 1

Option D 4

**Correct Option C**

**Solution:**





At  $r < a$

$$I = \frac{I_0}{\pi R^2} \times \pi r^2 = \frac{I_0 r^2}{R^2}$$

$$B_1 = \frac{\mu_0 I}{2\pi r} = \frac{\mu_0 I_0 r^2}{2\pi R^2} = \frac{\mu_0 I_0 \frac{a}{2}}{2\pi a^2} = \frac{\mu_0 I_0}{4\pi a}$$

At  $r > a$

$$I = I_0$$

$$B_2 = \frac{\mu_0 I}{2\pi r} = \frac{\mu_0 I}{2\pi(2a)} = \frac{\mu_0 I_0}{4\pi a}$$

$$\frac{B_1}{B_2} = \frac{\frac{\mu_0 I_0}{4\pi a}}{\frac{\mu_0 I_0}{4\pi a}} = 1$$

**Q 27. A particle moves so that its position vector is given by  $\vec{r} = \cos \omega t \hat{x} + \sin \omega t \hat{y}$  where  $\omega$  is a constant. Which of the following is true?**

- Option A Velocity and acceleration both are perpendicular to  $\vec{r}$   
Option B Velocity and acceleration both are parallel to  $\vec{r}$   
Option C Velocity is perpendicular to  $\vec{r}$  and acceleration is directed towards the origin.  
Option D Velocity is perpendicular to  $\vec{r}$  and acceleration is directed away from the origin.

**Correct Option C**

**Solution:**

$$r = \cos \omega t i + \sin \omega t j$$

$$\vec{v} = \frac{d\vec{r}}{dt} = -\omega \sin \omega t i + \omega \cos \omega t j$$

$$\vec{a} = \frac{d\vec{v}}{dt} = -\omega^2 \cos \omega t i - \omega^2 \sin \omega t j$$

$$\vec{r} \cdot \vec{v} = 0$$

$$\vec{a} = \frac{d\vec{v}}{dt} = -\omega^2 \cos \omega t i - \omega^2 \sin \omega t j$$

$$\vec{a} = \frac{d\vec{v}}{dt} = -\omega^2 (\cos \omega t i - \sin \omega t j)$$

$$\vec{a} = \frac{d\vec{v}}{dt} = -\omega^2 (\vec{r})$$

So acceleration is In the direction r

**Q 28. What is the minimum velocity with which a body of mass m must enter a vertical loop of radius R so that it can complete the loop?**

Option A  $\sqrt{gR}$

Option B  $\sqrt{2gR}$

Option C  $\sqrt{3gR}$

Option D  $\sqrt{5gR}$

**Correct Option D**

**Solution:**

$$\frac{1}{2}mv^2 = \frac{1}{2}mv_t^2 + 2mgR$$

$$\frac{1}{2}mv^2 = \frac{1}{2}m(\sqrt{gR})^2 + 2mgR$$

$$\frac{1}{2}mv^2 = \frac{1}{2}mgR + 2mgR$$

$$\frac{1}{2}mv^2 = \frac{5}{2}mgR$$

$$v = \sqrt{5gR}$$

**Q 29. When a metallic surface is illuminated with radiation of wavelength  $\lambda$ , the stopping potential is V. If the same surface is illuminated with radiation of wavelength  $2\lambda$ , the stopping potential is  $\frac{V}{4}$ . The threshold wavelength for the metallic surface is:**

Option A  $4\lambda$

Option B  $5\lambda$

Option C  $\frac{5}{2}\lambda$

Option D  $3\lambda$

**Correct Option D**

**Solution:**

According to Einstein's photoelectric equation

$$eV_s = \frac{hc}{\lambda} - \frac{hc}{\lambda_0}$$

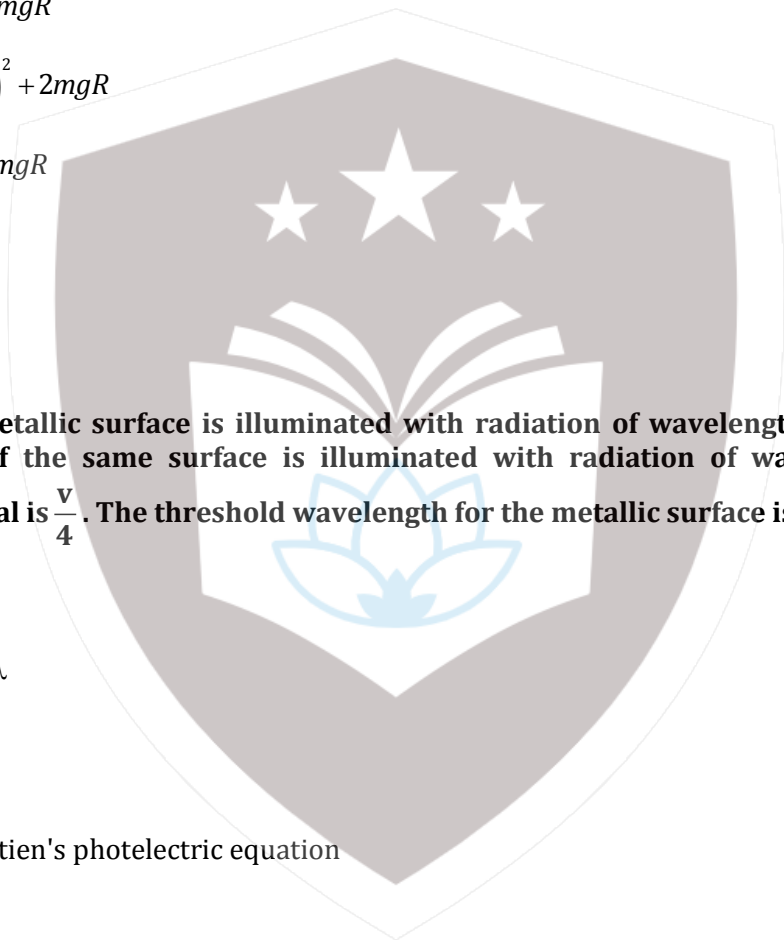
$$eV = \frac{hc}{\lambda} - \frac{hc}{\lambda_0} \text{-----(1)}$$

$$\frac{eV}{4} = \frac{hc}{2\lambda} - \frac{hc}{\lambda_0} \text{-----(2)}$$

On solving equation (1) and (2)

We get

$$\lambda_0 = 3\lambda$$

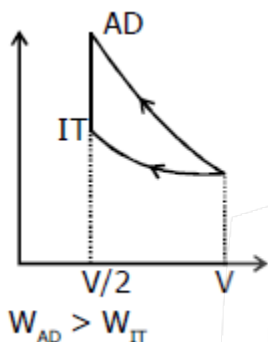


**Q 30. A gas is compressed isothermally to half its initial volume. The same gas is compressed separately through an adiabatic process until its volume is again reduced to half. Then:**

- Option A      Compressing the gas isothermally will require more work to be done.  
 Option B      Compressing the gas through adiabatic process will require more work to be done.  
 Option C      Compressing the gas isothermally or adiabatically will require the same amount of work.  
 Option D      which of the case (whether compression through isothermal or through adiabatic process) requires more work will depend upon the atomicity of the gas.

**Correct Option B**

**Solution:**



Adiabatic curve is steeper than isothermal curve hence magnitude of work done under adiabatic process is more as compared to isothermal process.

**Q 31. A potentiometer wire is 100 cm long and a constant potential difference is maintained across it. Two cells are connected in series first to support one another and then in opposite direction. The balance points are obtained at 50 cm and 10 cm from the positive end of the wire in the two cases. The ratio of emf's is:**

- Option A      5: 1  
 Option B      5: 4  
 Option C      3: 4  
 Option D      3: 2

**Correct Option D**

**Solution:**

As the potential difference applied is directly proportional to length

$$E \propto l$$

$$\frac{E_1 + E_2}{E_1 - E_2} = \frac{50}{10} = 5$$

$$E_1 + E_2 = 5E_1 - 5E_2$$

$$6E_2 = 4E_1$$

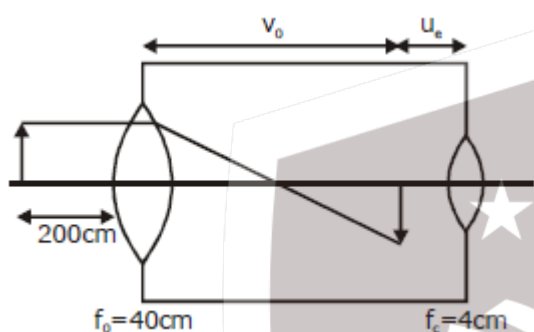
$$\frac{E_1}{E_2} = \frac{6}{4} = \frac{3}{2}$$

**Q 32. An astronomical telescope has objective and eyepiece of focal lengths 40 cm and 4 cm respectively. To view an object 200 cm away from the objective, the lenses must be separated by a distance:**

- Option A 37.3 cm
- Option B 46.0 cm
- Option C 50.0 cm
- Option D 54.0 cm

**Correct Option D**

**Solution:**



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

$$\frac{1}{v} - \frac{1}{-200} = \frac{1}{40}$$

$$\frac{1}{v} = \frac{1}{40} + \frac{1}{200}$$

$$v = 50\text{cm}$$

This image should be formed at 4cm from the eyepiece

$$\text{Distance} = 50\text{cm} + f_e$$

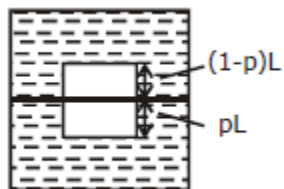
$$\text{Distance} = 50 + 4 = 54\text{cm}$$

**Q 33. Two non-mixing liquids of densities  $\rho$  and  $n\rho$  ( $n > 1$ ) are put in a container. The height of each liquid is  $h$ . A solid cylinder of length  $L$  and density  $d$  is put in this container. The cylinder floats with its axis vertical and length  $pL$  ( $p < 1$ ) in the denser liquid. The density  $d$  is equal to:**

- Option A  $\{1 + (n + 1) p\} \rho$
- Option B  $\{2 + (n + 1) p\} \rho$
- Option C  $\{2 + (n - 1) p\} \rho$
- Option D  $\{1 + (n - 1) p\} \rho$

**Correct Option D**

**Solution:**



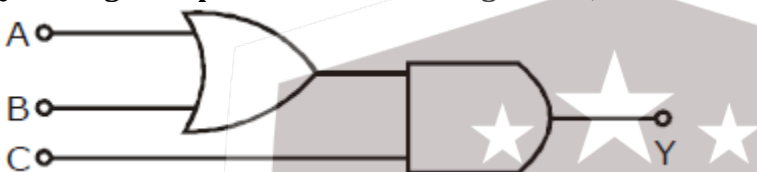
Weight of liquid displaced by the solid cylinder = weight of cylinder

$$L \times A \times d \times g = PL \times n\rho \times A \times g + (1 - P)L \times A \times \rho \times g$$

On solving this equation we get

$$d = \{1 + (n - 1) p\} \rho$$

**Q 34. To get output 1 for the following circuit, the correct choice for the input is:**



Option A      A = 0, B = 1, C = 0

Option B      A = 1, B = 0, C = 0

Option C      A = 1, B = 1, C = 0

Option D      A = 1, B = 0, C = 1

**Correct Option D**

**Solution:**

The Boolean expression for the logic circuit will be

$$Y = (A + B) \cdot C$$

$$Y = A \cdot C + B \cdot C$$

On trying all the combination the most appropriate choice is D

**Q 35. A piece of ice falls from a height h so that it melts completely. Only one-quarter of the heat produced is observed by the ice and all energy of ice gets converted into heat during its fall. The value of h is:**

[Latent heat of ice is  $3.4 \times 10^5$  J/kg and  $g = 10$  N/kg]

Option A      34 km

Option B      544 km

Option C      136 km

Option D      68 km

**Correct Option C**

**Solution:**

$$\text{Total energy} = mgh$$

$$\Delta Q = mL$$

$$\frac{1}{4} mgh = mL$$

$$h = \frac{4L}{g}$$

$$= \frac{4 \times 3.4 \times 10^5}{10}$$

$$= 136 \times 10^3$$

$$= 136 \text{ km}$$

**Q 36. The ratio of escape velocity at earth ( $v_e$ ) to the escape velocity at a planet ( $v_p$ ) whose radius and mean density are twice as that of earth is:**

Option A 1: 2

Option B 1:  $2\sqrt{2}$

Option C 1: 4

Option D 1:  $\sqrt{2}$

**Correct Option B**

**Solution:**

$$V_e = \sqrt{\frac{2GM}{R}} = \sqrt{\frac{2G}{R} \cdot \frac{4}{3} \pi R^3 \rho}$$

$$= \sqrt{\frac{8}{3} \pi G R^2 \rho}$$

$$R_{\text{new}} = 2R$$

$$\rho_{\text{new}} = 2\rho$$

$$V_{\text{new}} = 2\sqrt{2} V$$

**Q 37. If the magnitude of sum of two vectors is equal to the magnitude of difference of the two vectors, the angle between these vectors is:**

Option A  $0^\circ$

Option B  $90^\circ$

Option C  $45^\circ$

Option D  $180^\circ$

**Correct Option**

**Solution: B**

$$|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$$

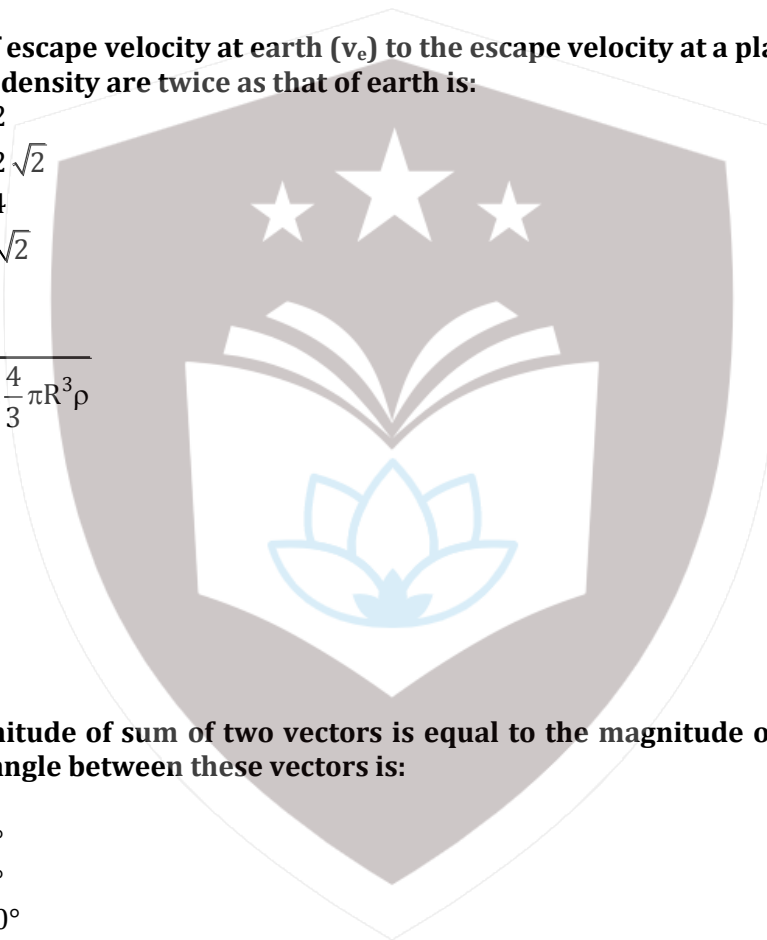
$$\sqrt{A^2 + B^2 + 2AB\cos\theta} = \sqrt{A^2 + B^2 - 2AB\cos\theta}$$

squaring both the side and rearranging terms

we get

$$4AB\cos\theta = 0$$

$$\theta = 90^\circ$$



**Q 38. Given the value of Rydberg constant is  $10^7 \text{ m}^{-1}$  the wave number of the last line of the Balmer series in hydrogen spectrum will be:**

Option A  $0.025 \times 10^4 \text{ m}^{-1}$

Option B  $0.5 \times 10^7 \text{ m}^{-1}$

Option C  $0.25 \times 10^7 \text{ m}^{-1}$

Option D  $2.5 \times 10^7 \text{ m}^{-1}$

**Correct Option C**

**Solution:**

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

$R = 10$  per meter

$$\frac{1}{\lambda} = 0.25 \times 10^7 \text{ m}^{-1}$$

**Q 39. A body of mass 1 kg begins to move under the action of a time dependent force  $\vec{F} = (2t\hat{i} + 3t^2\hat{j}) \text{ N}$ , where  $\hat{i}$  and  $\hat{j}$  are unit vectors along x and y axis. What power will be**

**developed by the force at the time t?**

Option A  $(2t^2 + 3t^3) \text{ W}$

Option B  $(2t^2 + 4t^4) \text{ W}$

Option C  $(2t^3 + 3t^4) \text{ W}$

Option D  $(2t^3 + 3t^5) \text{ W}$

**Correct Option D**

**Solution:**

$$F = 2ti + 3t^2j \quad \dots (1)$$

$$F = ma$$

$$F = m \frac{dv}{dt}$$

$$m \frac{dv}{dt} = 2ti + 3t^2j$$

$$\frac{dv}{dt} = \frac{2ti + 3t^2j}{1}$$

$$v = \frac{2t^2}{2}i + \frac{3t^3}{3}j \quad \dots(2)$$

$$P = \vec{F} \cdot \vec{V}$$

$$P = (2ti + 3t^2j) \cdot (t^2i + t^3j)$$

**Q 40. An inductor 20 mH, a capacitor 50  $\mu\text{F}$  and a resistor 40  $\Omega$  are connected in series across a source of emf  $V = 10 \sin 340 t$ . The power loss in A.C. circuit is:**

Option A 0.51 W

Option B 0.67 W

Option C 0.76 W

Option D 0.89 W

**Correct Option A**

**Solution:**

$$X_L = \omega L = 340 \times 20 \times 10^{-3} \\ = 6.8 \Omega$$

$$X_c = \frac{1}{\omega_c} = \frac{1}{340 \times 50 \times 10^{-6}}$$

$$= \frac{10000}{170} = 58.8 \Omega$$

Impedence is given by

$$Z = \sqrt{R^2 + X_c - X_L^2}$$

$$\therefore Z = \sqrt{40^2 + 58.8 - 6.8^2}$$

$$= \sqrt{40^2 + 52^2} = 65.6$$

$$P = \sqrt{40^2 + 52^2}$$

$$P = \frac{v_{\text{rms}}^2 R}{Z^2}$$

$$P = \frac{\left(\frac{10}{\sqrt{2}}\right)^2 \times 40}{65.6 \times 65}$$

$$P = \frac{100 \times 40}{2 \times 4303.7} = 0.46 \approx 0.51 \text{ W}$$

**Q 41. If the velocity of a particle is  $v = At + Bt^2$ , where A and B are constants, then the distance travelled by it between 1s and 2s is:**

Option A  $\frac{3}{2}A + 4B$

Option B  $3A + 7B$

Option C  $\frac{3}{2}A + \frac{7}{3}B$

Option D  $\frac{A}{2} + \frac{B}{3}$

**Correct Option C**

**Solution:**

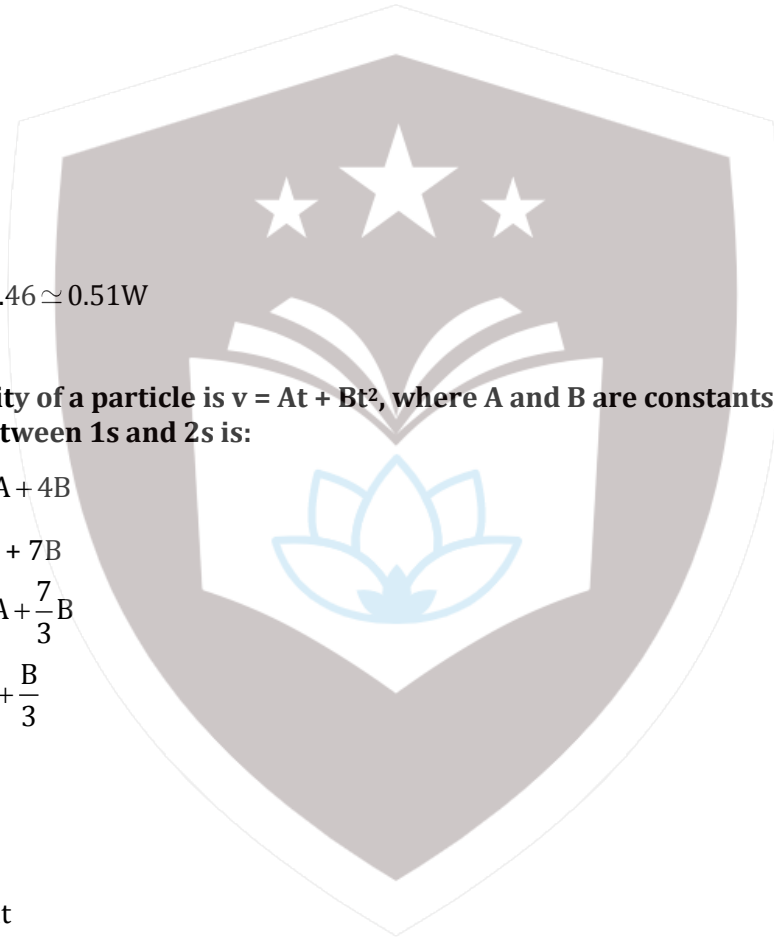
$$V = At + Bt^2$$

$$x = \left| \int At + Bt^2 dt \right.$$

$$\left[ \frac{At^2}{2} + \frac{Bt^3}{3} \right]_1$$

$$= A \left[ \frac{4-1}{2} \right] + B \left[ \frac{8-3}{3} \right]$$

$$= \frac{3}{2}A + \frac{7}{3}B$$





**Q 42. A long solenoid has 1000 turns. When a current of 4A flows through it, the magnetic flux linked with each turn of the solenoid is  $4 \times 10^{-3}$  Wb. The self-inductance of the solenoid is:**

- Option A 4H
- Option B 3H
- Option C 2H
- Option D 1H

**Correct Option D**

**Solution:**

$$\phi = LI$$

Therefore

$$L = \frac{\phi}{I} = \frac{1000 \times 4 \times 10^{-3}}{4} = 1\text{H}$$

**Q 43. A small signal voltage  $V(t) = V_0 \sin \omega t$  is applied across an ideal capacitor C:**

- Option A Current I (t), lags voltage V (t) by  $90^\circ$
- Option B Over a full cycle the capacitor C does not consume any energy from the voltage source.
- Option C Current I (t) is in phase with voltage V (t).
- Option D Current I (t) leads voltage V (t) by  $180^\circ$ .

**Correct Option B**

**Solution:** In ac circuit the power is given by

$$P = VI \cos \phi$$

And phase difference in case of pure capacitive circuit is 90 degree hence the power consume is zero.

**Q 44. Match the corresponding entries of column 1 with column 2. [Where m is the magnification produced by the mirror]**

**Column 1**

**Column 2**

- |                    |                |
|--------------------|----------------|
| $m = -2$           | Convex mirror  |
| $m = -\frac{1}{2}$ | Concave mirror |
| $m = +2$           | Real image     |
| $m = +\frac{1}{2}$ | Virtual image  |

- Option A A  $\rightarrow$  b and c; B  $\rightarrow$  b and c; C  $\rightarrow$  b and d; D  $\rightarrow$  a and d
- Option B A  $\rightarrow$  a and c; B  $\rightarrow$  a and d; C  $\rightarrow$  a and b; D  $\rightarrow$  c and d
- Option C A  $\rightarrow$  a and d; B  $\rightarrow$  b and c; C  $\rightarrow$  b and d; D  $\rightarrow$  b and c
- Option D A  $\rightarrow$  c and d; B  $\rightarrow$  b and d; C  $\rightarrow$  b and c; D  $\rightarrow$  a and d

**Correct Option A**

**Solution:**

**Magnification in mirror  $= -u/v$**

- A. M negative and greater than 1 so image is real (only concave mirror forms real image) and larger than object**
- B. M negative and smaller than 1 so image is real (only concave mirror forms real image) and smaller than object**
- C. M is positive and greater than 1 so image is virtual and erect and greater than object**

D.  $M$  is positive and smaller than 1 so image is virtual and smaller than object. All images formed by convex mirror are smaller than object.

Q 45. A car is negotiating a curved road of radius  $r$ . The road is banked at an angle  $\theta$ . The coefficient of friction between the tyres of the car and the road is  $\mu_s$ . The maximum safe velocity on this road is:

Option A  $\sqrt{gR^2 \frac{\mu_s + \tan \theta}{1 - \mu_s \tan \theta}}$

Option B  $\sqrt{gR \frac{\mu_s + \tan \theta}{1 - \mu_s \tan \theta}}$

Option C  $\sqrt{\frac{g}{R} \frac{\mu_s + \tan \theta}{1 - \mu_s \tan \theta}}$

Option D  $\sqrt{\frac{g}{R^2} \frac{\mu_s + \tan \theta}{1 - \mu_s \tan \theta}}$

**Correct Option B**

**Solution:**

For vertical equilibrium

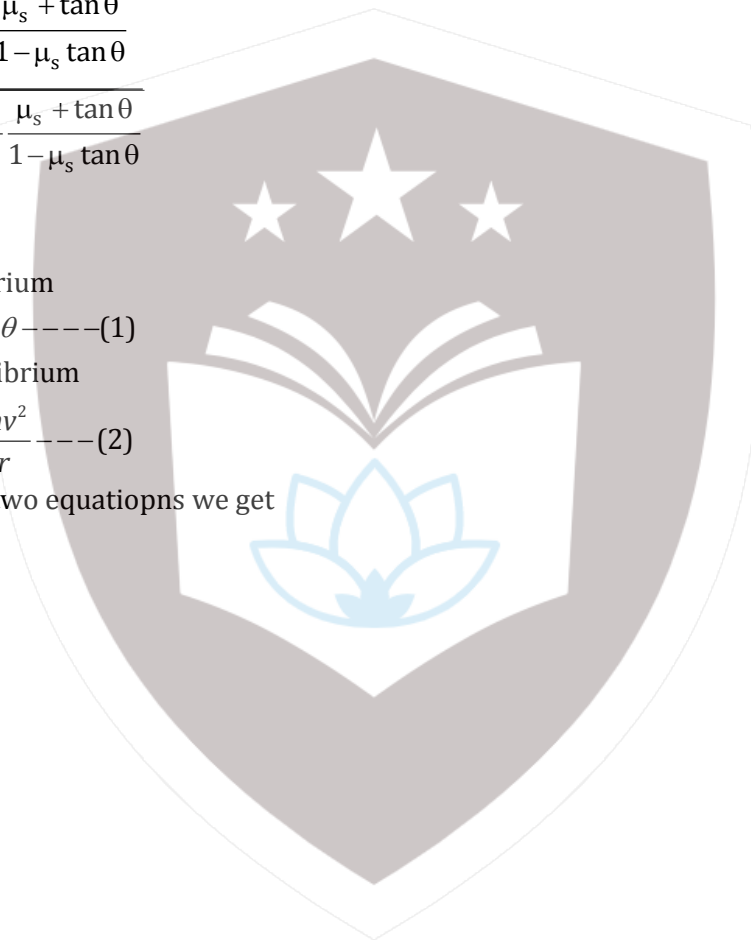
$$N \cos \theta = mg + f_1 \sin \theta \text{ ---- (1)}$$

For horizontal equilibrium

$$N \sin \theta + f_1 \cos \theta = \frac{mv^2}{r} \text{ ---- (2)}$$

Now solving these two equations we get

$$\sqrt{gR \frac{\mu_s + \tan \theta}{1 - \mu_s \tan \theta}}$$



# CHEMISTRY

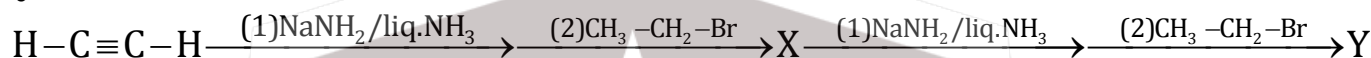
**Q 1. Consider the molecules CH<sub>4</sub>, NH<sub>3</sub> and H<sub>2</sub>O. Which of the given statements is false?**

- Option A The H - C - H bond angle in CH<sub>4</sub>, the H - N - H bond angle in NH<sub>3</sub>, and the H - O - H bond angle in H<sub>2</sub>O are all greater than 90°.
- Option B The H - O - H bond angle in H<sub>2</sub>O is larger than the H - C - H bond angle in CH<sub>4</sub>
- Option C The H - O - H bond angle in H<sub>2</sub>O is smaller than the H - N - H bond angle in NH<sub>3</sub>
- Option D The H - C - H bond angle in CH<sub>4</sub> is larger than the H - N - H bond angle in NH<sub>3</sub>

**Correct Option B**

**Solution:** The H - O - H bond angle in H<sub>2</sub>O is 104.5°, the H - C - H bond angle in CH<sub>4</sub> is 109°28' and the H - N - H bond angle in NH<sub>3</sub> is 107°28'. Being sp<sup>3</sup> hybridised bond angle of H<sub>2</sub>O is smaller than NH<sub>3</sub>.

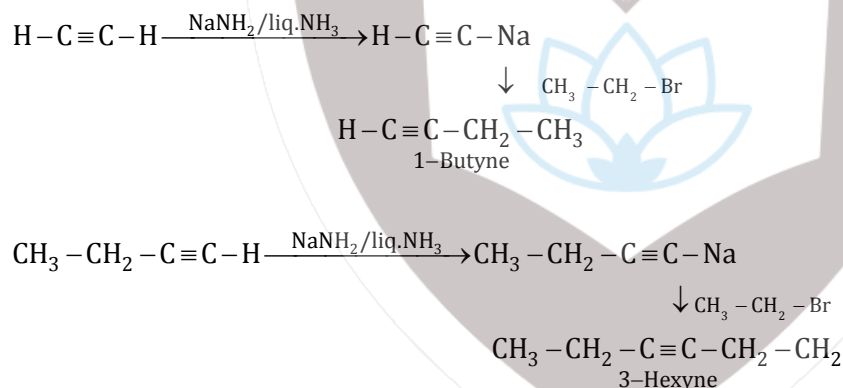
**Q 2. In the reaction**



- Option A X = 1- Butyne ; Y = 3- Hexyne
- Option B X = 2- Butyne ; Y = 3- Hexyne
- Option C X = 2- Butyne ; Y = 2- Hexyne
- Option D X = 1- Butyne ; Y = 2- Hexyne

**Correct Option A**

**Solution:**



**Q 3. Among the following the correct order of acidity is:**

- Option A HClO<sub>3</sub> < HClO<sub>4</sub> < HClO<sub>2</sub> < HClO
- Option B HClO < HClO<sub>2</sub> < HClO<sub>3</sub> < HClO<sub>4</sub>
- Option C HClO<sub>2</sub> < HClO < HClO<sub>3</sub> < HClO<sub>4</sub>
- Option D HClO<sub>4</sub> < HClO<sub>2</sub> < HClO < HClO<sub>3</sub>

**Correct Option B**

**Solution:** Oxidation state of chlorine is directly proportional to acidity of oxo-acids. Hence the correct order of acidity is HClO < HClO<sub>2</sub> < HClO<sub>3</sub> < HClO<sub>4</sub>

**Q 4. The rate of first-order reaction is  $0.04 \text{ mol l}^{-1} \text{ s}^{-1}$  at 10 second and  $0.03 \text{ mol l}^{-1} \text{ s}^{-1}$  at 20 second after initiation of the reaction. The half-life period of the reaction is:**

- Option A 24.1 s
- Option B 34.1 s
- Option C 44.1 s
- Option D 54.1 s

**Correct Option A**

**Solution:**

$$kt = 2.303 \log \frac{a}{a-x}$$

$$\frac{t_{10}}{t_{50\%}} = \frac{\log 0.04}{\frac{0.03}{\log \frac{100}{50}}}$$

$$\frac{10}{t_{1/2}} = \frac{\log 4 - \log 3}{\log 2} = \frac{0.60 - 0.48}{0.3} = \frac{0.12}{0.30} = \frac{1}{3}$$

$$t_{1/2} = \frac{10 \times 30}{12} = \frac{300}{12} = 25(24.1) \text{ sec.}$$

**Q 5. Which one of the following characteristics is associated with adsorption?**

- Option A  $\Delta G$  is negative but  $\Delta H$  and  $\Delta S$  are positive
- Option B  $\Delta G$ ,  $\Delta H$  and  $\Delta S$  all the negative
- Option C  $\Delta G$  and  $\Delta H$  are negative but  $\Delta S$  is positive
- Option D  $\Delta G$  and  $\Delta S$  are negative but  $\Delta H$  is positive

**Correct Option B**

**Solution:** in adsorption  $\Delta G < 0$  (Feasible),  $\Delta H < 0$  (exothermic) and  $\Delta S$  (decrease in entropy) = (-)

**Q 6. In which of the following options the order of arrangement does not agree with the variation of property indicated against it?**

- Option A  $\text{Al}^{3+} < \text{Mg}^{2+} < \text{Na}^{+} < \text{F}^{-}$  (Increasing ionic size)
- Option B  $\text{B} < \text{C} < \text{O} < \text{N}$  (Increasing first ionization enthalpy)
- Option C  $\text{I} < \text{Br} < \text{Cl} < \text{F}$  (Increasing electron gain enthalpy)
- Option D  $\text{Li} < \text{Na} < \text{K} < \text{Rb}$  (Increasing metallic radius)

**Correct Option C**

**Solution:** The order of increasing electron gain enthalpy is  $\text{I} < \text{Na} < \text{K} < \text{Rb}$ .

**Q 7. Which of the following statements is false?**

- Option A  $\text{Mg}^{2+}$  ions form a complex with ATP
- Option B  $\text{Ca}^{2+}$  ions are important in blood clotting
- Option C  $\text{Ca}^{2+}$  ions are not important in maintaining the regular beating of the heart
- Option D  $\text{Mg}^{2+}$  ions are important in the green parts of plants

**Correct Option C**

**Solution:**  $\text{Ca}^{2+}$  ions play an important role in muscle contraction.  $\text{Ca}^{2+}$  ions are required to trigger the contraction of muscles and to maintain the regular heart beating.

**Q 8. Which of the following statements about hydrogen is incorrect?**

- Option A Hydrogen has three isotopes of which tritium is the most common  
Option B Hydrogen never acts as cation in ionic salts  
Option C Hydronium ion,  $\text{H}_3\text{O}^+$  exists freely in solution  
Option D Dihydrogen acts as a reducing agent

**Correct Option B**

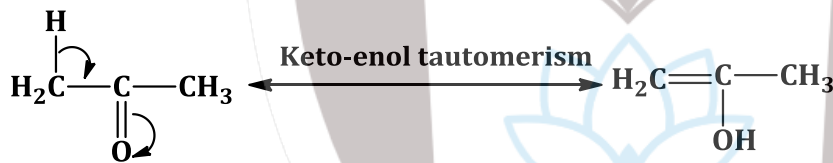
**Solution:** Hydrogen has three isotopes. Protium, Deuterium and tritium. Protium is the most abundance of 99.98%.

**Q 9. The correct statement regarding a carbonyl compound with a hydrogen atom on its alphacarbon is:**

- Option A a carbonyl compound with a hydrogen atom on its alpha-carbon never equilibrates with its corresponding enol.  
Option B a carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as aldehyde-ketone equilibration.  
Option C a carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as carbonylation.  
Option D a carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as keto-enol tautomerism.

**Correct Option D**

**Solution:**



**Q 10. MY and  $\text{NY}_3$  two nearly insoluble salts, have the same  $K_{sp}$  value of  $6.2 \times 10^{-13}$  at room temperature. Which statements would be true in regard to MY and  $\text{NY}_3$ ?**

- Option A The molar solubility of MY and  $\text{NY}_3$  in water are identical  
Option B The molar solubility of MY in water is less than that of  $\text{NY}_3$   
Option C The salts MY and  $\text{NY}_3$  are more soluble in 0.5 M KY than in pure water.  
Option D The addition of the salt of KY to solution of MY and  $\text{NY}_3$  will have no effect on their solubilities.

**Correct Option B**

**Solution:**

In MY,

$$S = \sqrt{K_{SP}} = \sqrt{6.2 \times 10^{-13}} = \sqrt{6.2 \times 10^{-13}}$$
$$S_1 = 8 \times 10^{-7}$$

In  $\text{NY}_3$ ,

$$K_{SP} = S(3S)^3 = 27S^4 = 6.2 \times 10^{-13}$$
$$S_2 = 10^{-3.5}$$

$$S_2 > S_1$$

Solubility of  $\text{NY}_3$  is greater than MY.

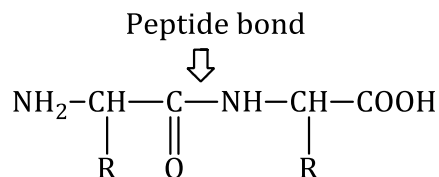
**Q 11. In a protein molecule various amino acids are linked together by:**

- Option A  $\alpha$ -glycosidic bond
- Option B  $\beta$ - glycosidic bond
- Option C peptide bond
- Option D dative bond

**Correct Option C**

**Solution:**

Peptide bonds

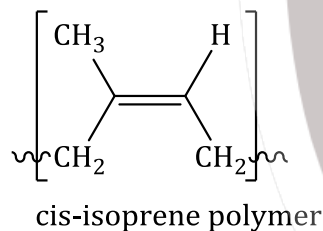


**Q 12. Natural rubber has:**

- Option A All cis-configuration
- Option B All trans-configuration
- Option C Alternate cis-and trans-configuration
- Option D Random cis-and trans-configuration

**Correct Option A**

**Solution:** Natural rubber  $\rightarrow$  cis configuration



**Q 13. Match items of Column I with the items of Column II assign the correct code:**

Column I	Column II
(a) Cyanide process	(i) Ultrapure Ge
(b) Forth floatation process	(ii) Dressing of ZnS
(c) Electrolytic reduction	(iii) Extraction of Al
(d) Zone refining	(iv) Extraction of Au
	(v) Purification of Ni

- |          |       |       |       |      |
|----------|-------|-------|-------|------|
|          | (a)   | (b)   | (c)   | (d)  |
| Option A | (iv)  | (ii)  | (iii) | (i)  |
| Option B | (ii)  | (iii) | (i)   | (iv) |
| Option C | (i)   | (ii)  | (iii) | (iv) |
| Option D | (iii) | (iv)  | (v)   | (i)  |

**Correct Option A**

**Solution:**

Column I	Column II
(a) Cyanide process	(iv) Extraction of Au

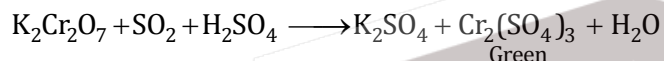
(b) Forth floatation process	(ii) Dressing of ZnS
(c) Electrolytic reduction	(iii) Extraction of Al
(d) Zone refining	(i) Ultrapure Ge

**Q 14. Which one of the following statements is correct when SO<sub>2</sub> is passed through acidified K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> Solution?**

- Option A The solution turns blue  
 Option B The solution is decolourized  
 Option C SO<sub>2</sub> is reduced  
 Option D Green Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> is formed

**Correct Option D**

**Solution:** When SO<sub>2</sub> is passed through acidified K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> Solution a green Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> is formed.



**Q 15. The electronic configurations of Eu (Atomic No.63), Gd (Atomic No. 64) and Tb (Atomic No.65) are:**

- Option A [Xe]4 f<sup>7</sup> 6s<sup>2</sup>, [Xe]4 f<sup>8</sup> 6s<sup>2</sup> and [Xe] 4 f<sup>8</sup> 5d<sup>1</sup> 6s<sup>2</sup>  
 Option B [Xe]4 f<sup>6</sup> 5d<sup>1</sup> 6s<sup>2</sup>, [Xe]4 f<sup>7</sup> 5d<sup>1</sup> 6s<sup>2</sup> and [Xe] 4 f<sup>9</sup>6s<sup>2</sup>  
 Option C [Xe]4 f<sup>6</sup> 5d<sup>1</sup> 6s<sup>2</sup>, [Xe]4 f<sup>7</sup> 5d<sup>1</sup> 6s<sup>2</sup> and [Xe] 4 f<sup>8</sup>6s<sup>2</sup>  
 Option D [Xe]4 f<sup>7</sup>6s<sup>2</sup>, [Xe]4 f<sup>7</sup> 5d<sup>1</sup> 6s<sup>2</sup> and [Xe] 4 f<sup>9</sup>6s<sup>2</sup>

**Correct Option D**

**Solution:**

Eu (63) : [Xe] 4f<sup>7</sup> 6s<sup>2</sup>

Gd (64) : [Xe] 4f<sup>7</sup> 5d<sup>1</sup> 6s<sup>2</sup>

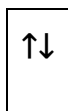
Tb (65) : [Xe] 4f<sup>9</sup> 6s<sup>2</sup>

**Q 16. Two electrons occupying the same orbital are distinguished by:**

- Option A Principal quantum number  
 Option B Magnetic quantum number  
 Option C Azimuthal quantum number  
 Option D Spin quantum number

**Correct Option D**

**Solution:** Two electrons occupying the same orbital are distinguished by spin quantum number.



Both electrons have opposite spins

**Q 17. When copper is heated with conc.  $\text{HNO}_3$  it produces:**

- Option A  $\text{Cu}(\text{NO}_3)_2$  and  $\text{NO}_2$
- Option B  $\text{Cu}(\text{NO}_3)_2$  and  $\text{NO}$
- Option C  $\text{Cu}(\text{NO}_3)_2, \text{NO}$  and  $\text{NO}_2$
- Option D  $\text{Cu}(\text{NO}_3)_2$  and  $\text{N}_2\text{O}$

**Correct Option A**

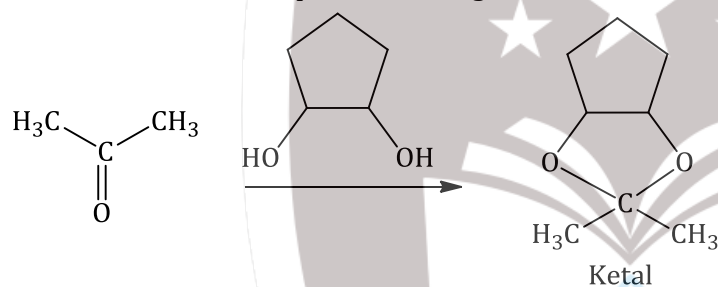
**Solution:**  $\text{Cu} + \text{conc. HNO}_3 \rightarrow \text{Cu}(\text{NO}_3)_2 + \text{NO}_2$

**Q 18. Which of the following reagents would distinguish cis-cyclopenta-1, 2-diol from the trans-isomer?**

- Option A Acetone
- Option B Ozone
- Option C  $\text{MnO}_2$
- Option D Aluminium isopropoxide

**Correct Option A**

**Solution:** Acetone as a protective reagent for diols.



**Q 19. The correct thermodynamic conditions for the spontaneous reaction at all temperature is:**

- Option A  $\Delta H < 0$  and  $\Delta S = 0$
- Option B  $\Delta H > 0$  and  $\Delta S < 0$
- Option C  $\Delta H < 0$  and  $\Delta S > 0$
- Option D  $\Delta H < 0$  and  $\Delta S < 0$

**Correct Option C**

**Solution:**

$$\Delta G = \Delta H - T\Delta S$$

$$= [(-) - (+)] = (-) \text{ always } = (-)$$

$$\Delta H < 0, \Delta S > 0$$

**Q 20. Lithium has a bcc structure. Its density is  $530 \text{ kgm}^{-3}$  and its atomic mass is  $6.94 \text{ gmol}^{-1}$ . Calculate the edge length of a unit cell of Lithium metal. ( $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$ )**

- Option A 154 pm
- Option B 352 pm
- Option C 527 pm
- Option D 264 pm

**Correct Option B**

**Solution:**



$$d = \frac{M \times z}{N_A \times a^3}$$

$$0.530 = \frac{6.94 \times 2}{6 \times 10^{23} \times a^3}$$

$$a^3 = \frac{6.94 \times 2}{6 \times 10^{23} \times 0.53}$$

$$a^3 = 4.36 \times 10^{-23} \times \frac{10}{10}$$

$$a^3 = 43.6 \times 10^{-24}$$

$$a = (43.6)^{1/3} \times 10^{-8} \text{ cm}$$

$$= 3.52 \times 10^{-8} \text{ cm}$$

$$= 352 \text{ pm}$$

**Q 21. Which one of the following orders is correct for the bond dissociation enthalpy of halogen molecules?**

Option A  $I_2 > Br_2 > Cl_2 > F_2$

Option B  $Cl_2 > Br_2 > F_2 > I_2$

Option C  $Br_2 > I_2 > F_2 > Cl_2$

Option D  $F_2 > Cl_2 > Br_2 > I_2$

**Correct Option B**

**Solution:** Decreasing order of bond energy is  $Cl_2 > Br_2 > F_2 > I_2$ .

**Q 22. Which of the following is an analgesic?**

Option A Novalgin

Option B Penicillin

Option C Streptomycin

Option D Chloromycetin

**Correct Option A**

**Solution:** Novalgin is an analgesic as well as antipyretic.

Penicillin and Streptomycin are antibiotics.

Chloromycetin is used for infection treatment.

**Q 23. Equal moles of hydrogen and oxygen gases are placed in a container with a pin-hole through which both can escape. What fraction of the oxygen escapes in the time required for one-half of the hydrogen to escape?**

Option A  $1/8$

Option B  $1/4$

Option C  $3/8$

Option D  $1/2$

**Correct Option A**

**Solution:**

$$\frac{r_{H_2}}{r_{O_2}} = \frac{\frac{V_{H_2}}{t_{H_2}}}{\frac{V_{O_2}}{t_{H_2}}} = \sqrt{\frac{32}{2}}$$

$$= \frac{1}{\frac{2}{\sqrt{2}}} = 4$$

$$V_{O_2} = \frac{1}{8}$$

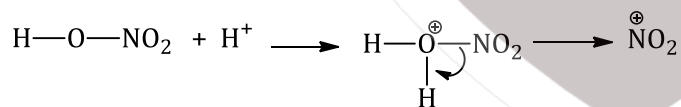
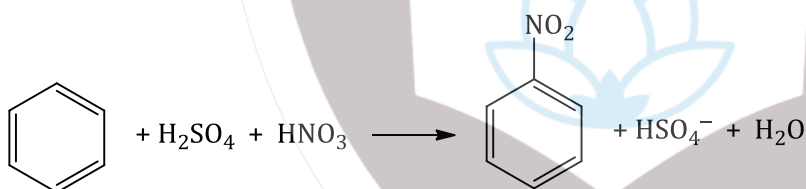
$V \propto \text{moles}$

**Q 24. Consider the nitration of benzene using mixed conc.  $H_2SO_4$  and  $HNO_3$ . If a larger amount of  $KHSO_4$  is added to the mixture, the rate of nitration will be:**

- Option A faster  
 Option B slower  
 Option C unchanged  
 Option D doubled

**Correct Option B**

**Solution:**



If we add the  $KHSO_4$  then rate decreases.

**Q 25. Predict the correct order among the following:**

- Option A lone pair – lone pair > lone pair – bond pair > bond pair – bond pair  
 Option B lone pair – lone pair > bond pair – bond pair > lone pair – bond pair  
 Option C bond pair – bond pair > lone pair – bond pair > lone pair – lone pair  
 Option D lone pair – bond pair > bond pair – bond pair > lone pair – lone pair

**Correct Option A**

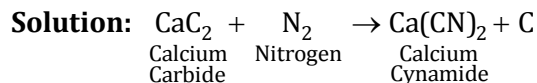
**Solution:** According to VSEPR theory, the correct order of repulsion is as follows:

Lone pair – lone pair > lone pair – bond pair > bond pair – bond pair

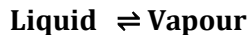
**Q 26. The product obtained as a results of a reaction of nitrogen with  $\text{CaC}_2$  is:**

- Option A  $\text{Ca}(\text{CN})_2$   
 Option B  $\text{CaCN}$   
 Option C  $\text{Ca}(\text{CN})_2$   
 Option D  $\text{Ca}_2\text{CN}$

**Correct Option C**



**Q 27. Consider the following liquid - vapour equilibrium.**

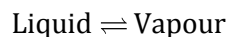


**Which of the following relations is correct?**

- Option A  $\frac{d \ln G}{dT^2} = \frac{\Delta H_v}{RT^2}$   
 Option B  $\frac{d \ln P}{dT} = \frac{-\Delta H_v}{RT}$   
 Option C  $\frac{-\Delta H_v}{Rt} = \frac{-\Delta H_v}{T^2}$   
 Option D  $\frac{d \ln P}{dT} = \frac{\Delta H_v}{RT^2}$

**Correct Option D**

**Solution:**



$$\log \frac{r_2}{r_1} = \frac{\Delta H_v (T_2 - T_1)}{2.3RT_1 T_2}$$

$$\log_2 P = \frac{\Delta H_v}{RT} + \log K$$

$$\frac{d \ln P}{dT} = \frac{\Delta H_v}{RT^2}$$

**Q 28. Match the compounds given in column I with the hybridization and shape given in column II and mark the correct option.**

Column I	Column II
$\text{XeF}_6$	Distorted octahedral
$\text{XeO}_3$	Square planar
$\text{XeOF}_4$	Pyramidal
$\text{XeF}_4$	Square pyramidal

- |          |      |       |      |       |
|----------|------|-------|------|-------|
|          | (a)  | (b)   | (c)  | (d)   |
| Option A | (i)  | (iii) | (iv) | (ii)  |
| Option B | (i)  | (ii)  | (iv) | (iii) |
| Option C | (iv) | (iii) | (i)  | (ii)  |
| Option D | (iv) | (i)   | (ii) | (iii) |

**Correct Option A****Solution:**

Column I	Column II
XeF <sub>6</sub>	Distorted octahedral
XeO <sub>3</sub>	(iii) Pyramidal
XeOF <sub>4</sub>	(iv) Square pyramidal
XeF <sub>4</sub>	(ii) Square planar

**Q 29. Which of the following has longest C - O bond length? (Free C - O bond length in CO is 1.128 Å.)**

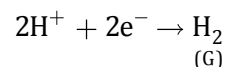
- Option A Ni(CO)<sub>4</sub>  
 Option B [Co(CO)<sub>4</sub>]<sup>2-</sup>  
 Option C [Fe(CO)<sub>4</sub>]<sup>2-</sup>  
 Option D [Mn(CO)<sub>6</sub>]<sup>+</sup>

**Correct Option C**

**Solution:** [Fe(CO)<sub>4</sub>]<sup>2-</sup>, since metal atom is carrying maximum -ve charge therefore it would show maximum synergic bonding as a resultant C-O bond length would be maximum.

**Q 30. The pressure of H<sub>2</sub> required to make the potential of H<sub>2</sub> - electrode zero in pure water at 298 K is:**

- Option A 10<sup>-14</sup> atm  
 Option B 10<sup>-12</sup> atm  
 Option C 10<sup>-10</sup> atm  
 Option D 10<sup>-4</sup> atm

**Correct Option A****Solution:**

$$E_R = E_R^0 - \frac{0.0591}{2} \log \frac{P_{\text{H}_2}}{[\text{H}^+]^2}$$

$$0 = 0 - 0.0295 \log \frac{P_{\text{H}_2}}{10^{-7}} = 0$$

$$\frac{P_{\text{H}_2}}{10^{-14}} = 1$$

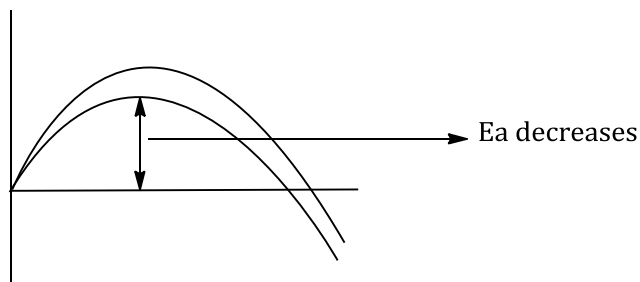
$$P_{\text{H}_2} = 10^{-14} \text{ atm}$$

**Q 31. The addition of a catalyst during a chemical reaction alters which of the following quantities?**

- Option A Entropy  
 Option B Internal energy  
 Option C Enthalpy  
 Option D Activation energy

**Correct Option D**

**Solution:** A catalyst provides an alternate path to the reaction which has lower activation energy.



**Q 32. The ionic radii of  $A^+$  and  $B^-$  ions are  $0.98 \times 10^{-10} \text{ m}$  and  $1.81 \times 10^{-10} \text{ m}$ . The coordination number of each ion in AB is:**

- Option A      6  
 Option B      4  
 Option C      8  
 Option D      2

**Correct Option A**

**Solution:**

$$\frac{r^{A^+}}{r^{B^-}} = \frac{0.98 \times 10^{-10}}{1.81 \times 10^{-10}} = 0.54$$

If the radius is between 0.414 to 0.732 then Co-ordination number is 6.

**Q 33. Which is the correct statement for the given acids?**

- Option A      phosphinic acid is a diprotic acid while phosphonic acid is a monoprotic acid.  
 Option B      phosphinic acid is a monoprotic acid while phosphonic acid is a diprotic acid.  
 Option C      Both are triprotic acids  
 Option D      Both are diprotic acids.

**Correct Option**

**Solution:**

Phosphinic acid	Phosphonic acid
Hypophosphorous acid	Phosphorous acid
Monobasic	dibasic
$H_3PO_2$	$H_3PO_3$
$\begin{array}{c} \text{O} \\    \\ \text{H}-\text{P}-\text{H} \\   \\ \text{OH} \end{array}$	$\begin{array}{c} \text{O} \\    \\ \text{H}-\text{P}-\text{OH} \\   \\ \text{OH} \end{array}$
Phosphinic acid	phosphonic acid

**Q 34. Fog is a colloidal solution of:**

- Option A      Liquid in gas  
Option B      Gas in liquid  
Option C      Solid is gas  
Option D      Gas in gas

**Correct Option A**

**Solution:** Fog is a colloidal solution of dispersed droplets of Liquid in gas.

**Q 35. Which of the following statements about the composition of the vapour over an ideal 1:1 mol mixture of benzene and toluene is correct at 25° C. (Given Vapour Pressure Data is 25° C, benzene = 12.8 kJ toluene = 3.85 kPa)**

- Option A      The vapour will contain a higher percentage of benzene.  
Option B      The vapour will contain a higher percentage of toluene.  
Option C      The vapour will contain a equal amounts benzene and toluene.  
Option D      Not enough information is given to make prediction.

**Correct Option A**

**Solution:**

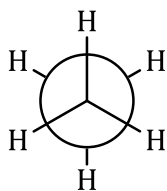
$$y_A = \frac{P_A}{P_S} = \frac{P_A^0 x_A}{P_A^0 x_A + P_B^0 x_B}$$
$$= \frac{12.8 \times 0.5}{12.8 \times 0.5 + 3.85 \times 0.5}$$
$$= \frac{6.4}{6.4 + 1.92} = \frac{6.4}{6.3} = 0.76$$
$$y_A = 0.76$$
$$y_B = 0.24$$

**Q 36. The correct statement regarding the comparison staggered and eclipsed conformation of ethane,**

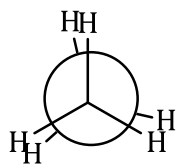
- Option A      The staggered conformation of ethane is low stable than eclipsed conformation, because staggered conformation has torsional strain  
Option B      The eclipsed conformation of ethane is more stable than staggered conformation, because eclipsed conformation has no torsional strain  
Option C      The eclipsed conformation of ethane is more stable than staggered conformation even though the eclipsed conformation has torsional strain.  
Option D      The staggerd conformation of ethane is more stable than eclipsed conformation, because staggered conformation has no torsional strain.

**Correct Option D**

**Solution:**

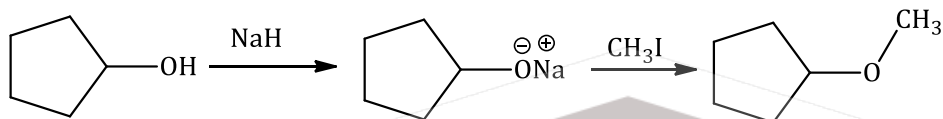


Staggered conformation  
More stable



Eclipsed conformation

**Q 37. The reaction**



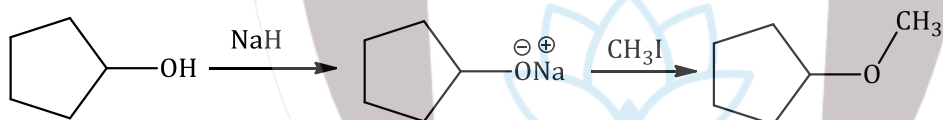
Can be classified as:

- Option A Williamson ether synthesis reaction
- Option B Alcohol formation reaction
- Option C Dehydration reaction
- Option D Williamson alcohol synthesis reaction

**Correct Option A**

**Solution:**

**Williamson ether synthesis reaction**

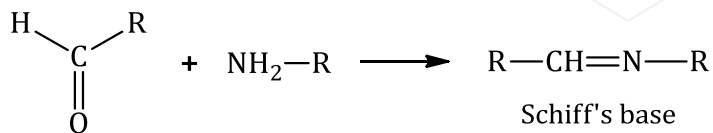


**Q 38. The product formed by the reaction of an aldehyde with a primary amine is:**

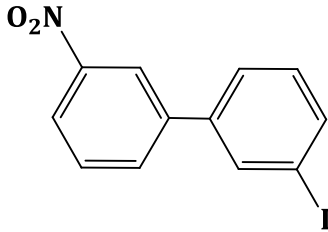
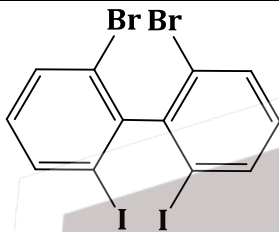
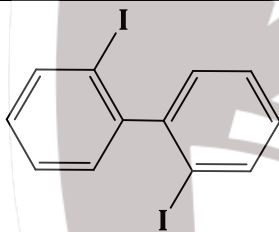
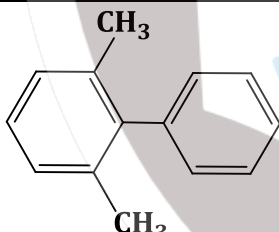
- Option A Schiff base
- Option B Ketone
- Option C Carboxylic acid
- Option D Aromatic acid

**Correct Option A**

**Solution:**

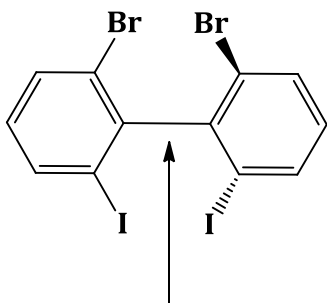


Q 39. Which of the following biphenyl is optically active?

Option A	 <p>Structure of biphenyl with a nitro group (<math>\text{O}_2\text{N}</math>) at the 2-position and an iodine atom (<math>\text{I}</math>) at the 4-position.</p>
Option B	 <p>Structure of biphenyl with bromine atoms (<math>\text{Br}</math>) at the 3-positions and iodine atoms (<math>\text{I}</math>) at the 2-positions.</p>
Option C	 <p>Structure of biphenyl with iodine atoms (<math>\text{I}</math>) at the 2-positions.</p>
Option D	 <p>Structure of biphenyl with methyl groups (<math>\text{CH}_3</math>) at the 2-positions.</p>

**Correct Option B**

**Solution:** POS is not present

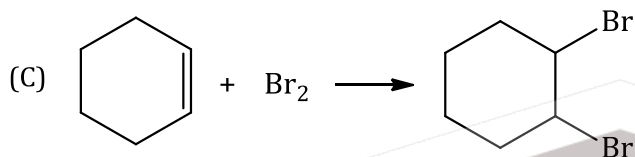
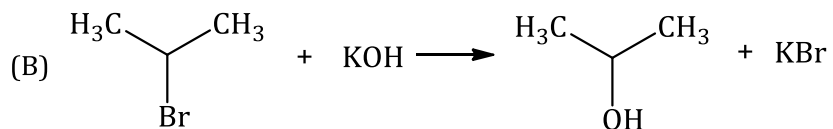
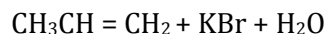
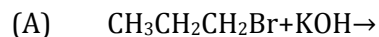


Restricted rotation  
around the bond

No non-superimposable mirror  
image hence optically active



**Q 40. For the following reaction**



**Which of the following statements is correct?**

Option A (A) and (B) are elimination reactions and (C) is addition reaction.

Option B (A) is elimination, (B) is substitution and (C) is addition reaction.

Option C (A) is elimination, (B) (C) are substitution reaction

Option D (A) is substitution, (B) and (C) are addition reaction

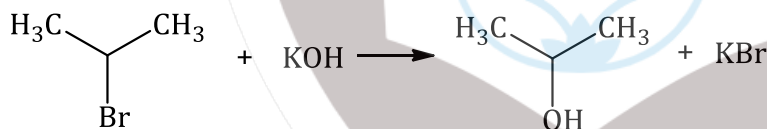
**Correct Option B**

**Solution:** (A) is elimination, (B) is substitution and (C) is addition reaction.

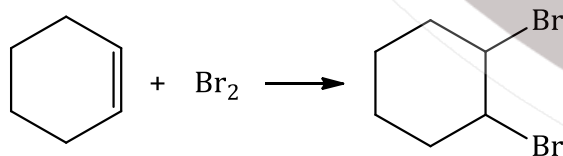
(A) Elimination reaction:



(B) Substitution Reaction:



(C) Addition Reaction:



**Q 41. At 100°C the vapour pressure of a solution of 6.5 g of a solute in 100 g water is 732 mm.**

**If  $K_b = 0.52$ , the boiling point of this solution will be:**

Option A 101°C

Option B 100°C

Option C 102°C

Option D 103°C

**Correct Option A**

**Solution:**

$$\Delta T_b = iK_b m$$

$$\Delta T_b = i \cdot 0.52 \frac{6.5 \times 1000}{mw \times 100}$$

$$= \frac{0.52 \times 65}{30.58}$$

$$\Delta T_b = 1.1052$$

$$T_b' = 101.1$$

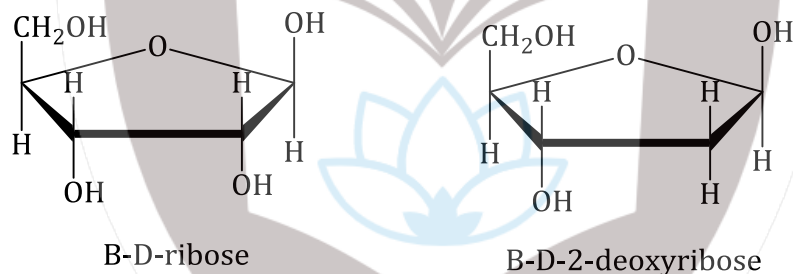
$$T_b' \simeq 101$$

**Q 42. The correct statement regarding RNA and DNA respectively is**

- Option A The sugar component in RNA is arabinose and the sugar component in DNA is 2-deoxyribose.
- Option B The sugar component in RNA is ribose and the sugar component in DNA is 2-deoxyribose.
- Option C The sugar component in RNA is arabinose and the sugar component in DNA ribose.
- Option D The sugar component in RNA is 2 deoxyribose and the sugar component in DNA is arabinose.

**Correct Option B**

**Solution:** The sugar component in RNA is ribose and the sugar component in DNA is 2- deoxyribose.

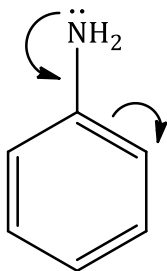


**Q 43. The correct statement regarding the basicity of arylamines is:**

- Option A Arylamines are generally less basis than alkyamines because the nitrogen lone-pair electrons are delocalized by interaction with the aromatic ring  $\pi$  electron system.
- Option B Arylamines are generally more basis than alkyamines because the nitrogen lone-pair electrons are not delocalized by interaction with the aromatic ring  $\pi$  electron system.
- Option C Arylamines are generally more basis than alkyamines because of aryl group.
- Option D Arylamines are generally more basis than alkyamines because the nitrogen atom in Arylamines is  $sp$ -hybridized.

**Correct Option A**

**Solution:**



Lone pair of nitrogen is in conjugation with the benzene ring which decreases the availability of electrons on nitrogen hence the basic strength decreases

Resonance

**Q 44. Which one given below is a non-reducing sugar?**

- Option A Maltose
- Option B Lactose
- Option C Glucose
- Option D Sucrose

**Correct Option D**

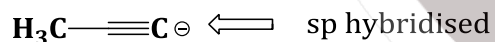
**Solution:** Sucrose is a non-reducing sugar.  
(anomeric part is not free)

**Q 45. The pair of electron in the given carbanion,  $\text{H}_3\text{C}\equiv\text{C}^\ominus$ , is present in which of the following orbitals?**

- Option A 2p
- Option B  $\text{sp}^3$
- Option C  $\text{sp}^2$
- Option D sp

**Correct Option D**

**Solution:**  $\text{H}_3\text{C}\equiv\text{C}^\ominus$  the carbanion carbon is bonded with carbon by 1 sigma and two pi bonds i.e., triple bond therefore carbanion carbon is sp hybridized.



## BIOLOGY

### **Q 1. Gause's principle of competitive exclusion states that:**

- Option A More abundant species will exclude the less abundant species through competition.
- Option B Competition for the same resources excludes species having different food preference.
- Option C No two species can occupy the same niche indefinitely for the same limiting resources.
- Option D Larger organism exclude smaller ones through competition.

#### **Correct Option C**

**Solution:** Gause demonstrated the principle of competitive exclusion which states that if two species happen to have the same niche in a community, a direct competition between the two will eliminate one of them.

### **Q 2. The two polypeptides of human insulin are linked together by:**

- Option A Hydrogen bonds
- Option B Phosphodiester bond
- Option C Covalent bond
- Option D Disulphide bridges

#### **Correct Option D**

**Solution:** The two polypeptides chains, A and B of human insulin were produced separately, extracted and linked together by disulphide bonds.

### **Q 3. The coconut water from tender coconut represents:**

- Option A Endocarp
- Option B Fleshy mesocarp
- Option C Free nuclear proembryo
- Option D Free nuclear endosperm

#### **Correct Option D**

**Solution:** The coconut water is a free nuclear endosperm in which the primary endosperm nucleus divides repeatedly without wall formation and produces a large number of free nuclei.

### **Q 4. Which of the following statements is wrong for viroids?**

- Option A They lack a protein coat.
- Option B They are smaller than viruses.
- Option C They cause infections.
- Option D Their RNA is of high molecular weight.

#### **Correct Option D**

**Solution:** Viroids lack a protein coat. They are smaller than viruses and cause infections in animals and humans. Viroids do not have RNA of high molecular weight.

**Q 5. Which of the following features is not present in the Phylum-Arthropoda?**

- Option A Chitinous exoskeleton
- Option B Metameric segmentation
- Option C Parapodia
- Option D Jointed appendages

**Correct Option C**

**Solution:** Parapodia are unjointed locomotory structures found in Phylum Annelida. These are not found in Phylum Arthropoda.

**Q 6. Which of the following most appropriately describes haemophilia?**

- Option A Recessive gene disorder
- Option B X-linked recessive gene disorder
- Option C Chromosomal disorder
- Option D Dominant gene disorder

**Correct Option B**

**Solution:** Haemophilia is a sex linked (X-linked) recessive disorder which is transmitted from an unaffected carrier female to male progeny.

**Q 7. Emerson's enhancement effect and Red drop have been instrumental in the discovery of:**

- Option A Photophosphorylation and non-cyclic electron transport
- Option B Two photosystems operating simultaneously
- Option C Photophosphorylation and cyclic electron transport
- Option D Oxidative phosphorylation

**Correct Option B**

**Solution:** Emerson found a sharp reduction in the rate of photosynthesis when monochromatic light of more than 680 nm was used. It is called red drop. Later, he provided synchronised light of 680 nm and 700 nm and observed the increase in the rate of photosynthesis known as enhancement effect. This experiment led to the discovery of two photosystems - PS-I and PS-II operating in photosynthesis.

**Q 8. In which of the following, all three are macronutrients?**

- Option A Boron, zinc, manganese
- Option B Iron, copper, molybdenum
- Option C Molybdenum, magnesium, manganese
- Option D Nitrogen, nickel, phosphorus

**Correct Option B**

**Solution:** Iron, copper, molybdenum are macronutrients present in plant tissues in large amounts (in excess of 10 mmole Kg<sup>-1</sup> of dry matter).

**Q 9. Name the chronic respiratory disorder caused mainly by cigarette smoking.**

- Option A Emphysema
- Option B Asthma
- Option C Respiratory acidosis
- Option D Respiratory alkalosis

**Correct Option A**

**Solution:** Emphysema is an inflation or abnormal distension of the bronchioles or alveolar sacs of the lungs. It is mainly caused by cigarette smoking.

**Q 10. A system of rotating crops with legume or grass pasture to improve soil structure and fertility is called:**

- Option A Ley farming
- Option B Contour farming
- Option C Strip farming
- Option D Shifting farming

**Correct Option A**

**Solution:** A system of rotating crops with legume or grass pasture to improve soil structure and fertility is called ley farming.

**Q 11. Mitochondria and chloroplast are:**

**(a) Semi-autonomous organelles**

**(b) Formed by the division of pre-existing organelle and they contain DNA but lack protein synthesising machinery.**

**Which one of the following options is correct?**

- Option A Both (a) and (b) are correct.
- Option B (b) is true but (a) is false.
- Option C (a) is true but (b) is false.
- Option D Both (a) and (b) are false.

**Correct Option C**

**Solution:** Mitochondria and chloroplast are semi-autonomous organelles, that is, they are capable of self-replication as they possess their own DNA. They contain protein making machinery called ribosomes.

**Q 12. In the context of amniocentesis, which of the following statement is incorrect?**

- Option A It is usually done when a woman is between 14-16 weeks pregnant.
- Option B It is used for prenatal sex determination.
- Option C It can be used for detection of Down's syndrome.
- Option D It can be used for detection of cleft palate.

**Correct Option D**

**Solution:** Amniocentesis is usually done when a woman is between 14-16 weeks pregnant. It is used for prenatal sex determination and can be used for detection of Down's syndrome. However, it cannot be used for the detection of cleft palate.

**Q 13. In a chloroplast the highest number of protons are found in:**

- Option A Stroma
- Option B Lumen of thylakoids
- Option c Inter membrane space
- Option D Antennae complex

**Correct Option B**

**Solution:** The water splitting complex is associated with PS II, which is located on the inner side of the membrane of the thylakoid. So, the proton concentration is higher in the lumen of thylakoid.

**Q 14. Photosensitive compound in human eye is made up of:**

- Option A Guanosine and retinol
- Option B Opsin and retinol
- Option C Opsin and retinol
- Option D Transducin and retinene

**Correct Option B**

**Solution:** The rods contain a purplish-red protein called rhodopsin is made up of opsin and retinol.

**Q 15. Spindle fibres attach on to:**

- Option A Telomere of the chromosome
- Option B Kinetochore of the chromosome
- Option C Centromere of the chromosome
- Option D Kinetosome of the chromosome

**Correct Option B**

**Solution:** Kinetochores of the chromosomes serves as the site of attachment of spindle fibres to the chromosomes that are moved into position at the centre of the cell.

**Q 16. Which is the National Aquatic Animal of India?**

- Option A Gangetic shark
- Option B River dolphin
- Option C Blue whale
- Option D Sea-horse

**Correct Option B**

**Solution:** River dolphin is the National Aquatic Animal of India and represents the purity of holy Ganga as it can only survive in pure and fresh water.

**Q 17. Which of the following is required as inducer (s) for the expression of lac operon?**

- Option A Glucose
- Option B Galactose
- Option C Lactose
- Option D Lactose and galactose

**Correct Option C**

**Solution:** In lac operon, the presence of lactose acts as an inducer. When an inducer lactose binds to the repressor to form a complex which is unable to bind to the operator, the RNA polymerase enzyme binds with the promoter and the operator is switched on. This initiates the transcription of the structural genes, producing three enzymes which bring about the metabolism of lactose into glucose and galactose.

**Q 18. Which of the following pairs of hormones are not antagonistic (having opposite effects) to each other?**

- Option A Parathormone – Calcitonin
- Option B Insulin – Glucagon
- Option C Aldosterone – Atrial Natriuretic Factor
- Option D Relaxin - Inhibin

**Correct Option D**

**Solution:** Relaxin is used for relaxing the pubic symphysis during parturition while inhibin is known for decreasing the FSH secretion from the anterior pituitary.

**Q 19. Microtubules are the constituents of:**

- Option A Cilia, flagella and peroxisomes
- Option B Spindle fibres, centrioles and cilia
- Option C Centrioles, spindle fibres and chromatin
- Option D Centrosome, nucleosome and centrioles

**Correct Option B**

**Solution:** Microtubules are the constituents of spindle fibres, centrioles and cilia.

**Q 20. A complex of ribosomes attached to a single strand of RNA is known as:**

- Option A Polysome
- Option B Polymer
- Option C Polypeptide
- Option D Okazaki fragment

**Correct Option A**

**Solution:** Polysome is a complex of several ribosomes attached to a single strand of RNA.

**Q 21. Fertilisation in humans is practically feasible only if:**

- Option A The sperms are transported into vagina just after the release of ovum in fallopian tube.
- Option B The ovum and sperms are transported simultaneously to ampullary-isthmic junction of the fallopian tube.
- Option C The ovum and sperms are transported simultaneously to ampullary-isthmic junction of the cervix.
- Option D The sperms are transported into the cervix within 48 hrs of release of ovum in the uterus.

**Correct Option B**

**Solution:** During copulation, semen is released by the penis into the vagina. The motile sperms swim rapidly, pass through the cervix, enter into the uterus and finally reach the ampullary-isthmic junction of the fallopian tube. The ovum released by the ovary is also transported to the ampullary-isthmic junction where fertilisation takes place.



**Q 22. Asthma may be attributed to:**

- Option A Bacterial infection of the lungs
- Option B Allergic reaction of the mast cells in the lungs
- Option C Inflammation of the trachea
- Option D Accumulation of fluid in the lungs

**Correct Option B**

**Solution:** Asthma may be attributed to allergic reaction of the mast cells that burst in the lungs.

**Q 23. The Avena curvature is used for bioassay of:**

- Option A ABD
- Option B  $GA_3$
- Option C IAA
- Option D Ethylene

**Correct Option C**

**Solution:** The Avena curvature is used for bioassay of auxins (IAA). The curvature is produced by auxin concentration of 150  $\mu\text{g/litre}$  at  $25^\circ\text{C}$  and 90% relative humidity.

**Q 24. The standard petal of a papilionaceous corolla is also called**

- Option A Carina
- Option B Pappus
- Option C Vexillum
- Option D Corona

**Correct Option C**

**Solution:** The papilionaceous corolla is a corolla with five petals, of which one largest petal or standard petal is called vexillum.

**Q 25. Tricarpellary, syncarpous gynoecium is found in flowers of:**

- Option A Liliaceae
- Option B Solanaceae
- Option c Fabaceae
- Option D Poaceae

**Correct Option A**

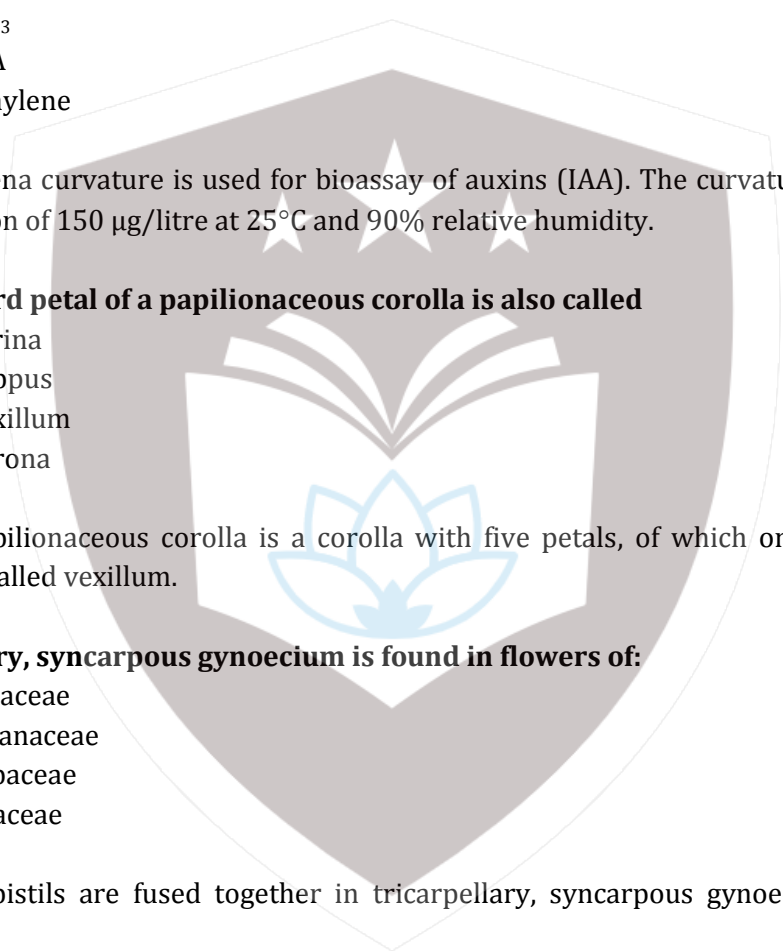
**Solution:** Three pistils are fused together in tricarpellary, syncarpous gynoecium. It occurs in Liliaceae flowers.

**Q 26. One of the major component of cell wall of most fungi is:**

- Option A Chitin
- Option B Peptidoglycan
- Option C Cellulose
- Option D Hemicellulose

**Correct Option A**

**Solution:** The major component of cell wall of most fungi is chitin. It also contains fungus cellulose along with other polysaccharides, proteins, lipids and other substances.



**Q 27. Select the incorrect statement:**

- Option A FSH stimulates the Sertoli cells which help in spermiogenesis.  
Option B LH triggers ovulation in ovary.  
Option C LH and FSH decrease gradually during the follicular phase.  
Option D LH triggers secretion of androgens from the Leydig cells.

**Correct Option C**

**Solution:** The production of LH from the anterior lobe of pituitary gland is reduced during the menstrual phase. LH and FSH do not decrease during the follicular phase. The FSH secreted by the anterior lobe of pituitary gland stimulates the ovarian follicles to secrete oestrogens.

**Q 28. In meiosis crossing over is initiated at**

- Option A Pachytene  
Option B Leptotene  
Option C Zygotene  
Option D Diplotene

**Correct Option A**

**Solution:** Crossing over occurs during pachytene stage of meiosis. Crossing over involves mutual exchange of the corresponding segments of non-sister chromatids of homologous chromosomes.

**Q 29. A tall true breeding garden pea plant is crossed with a dwarf true breeding garden pea plant. When the F<sub>1</sub> plants were selfed, the resulting genotypes were in the ratio of:**

- Option A 1 : 2 : 1 :: Tall homozygous : Tall heterozygous : Dwarf  
Option B 1 : 2 : 1 :: Tall heterozygous : Tall homozygous : Dwarf  
Option C 3 : 1 :: Tall : Dwarf  
Option D 3 : 1 :: Dwarf : Tall

**Correct Option A**

**Solution:**

Parents.... Tall × Dwarf  
Genes.... TT × tt  
Gametes..... T, T × t, t

F<sub>1</sub> generation: Tt (All heterozygous tall)

Tt × Tt (F<sub>1</sub> generation selfed)

	T	t
T	TT	Tt
t	Tt	tt

TT : Homozygous tall = 1

Tt: Heterozygous tall = 2

tt: Homozygous dwarf = 1

Therefore, the ratio of genotypes in F<sub>2</sub> generation = 1:2:1

**Q 30. Which of the following is the most important cause of animals and plants being driven to extinction?**

- Option A Over-exploitation
- Option B Alien species invasion
- Option C Habitat loss and fragmentation
- Option D Co-extinction

**Correct Option C**

**Solution:** Habitat loss and fragmentation lead to loss of biodiversity and may cause extinction of species.

**Q 31. Which one of the following is a characteristic feature of cropland ecosystem?**

- Option A Absence of soil organisms
- Option B Least genetic diversity
- Option C Absence of weeds
- Option D Ecological succession

**Correct Option B**

**Solution:** The cropland ecosystem is the largest anthropogenic ecosystem in which same type of crops are cultivated, so it has least genetic diversity.

**Q 32. Changes in GnRH pulse frequency in females is controlled by circulating level of:**

- Option A Estrogen and progesterone
- Option B Estrogen and inhibin
- Option C Progesterone only
- Option D Progesterone and inhibin

**Correct Option A**

**Solution:** GnRH is secreted by the hypothalamus which stimulates the anterior lobe of pituitary gland to secrete LH and FSH. However, with the depletion of follicular number, estrogen levels decrease with subsequent loss of negative feedback and resultant increase in GnRH secretion. Progesterone also decreases GnRH secretion at the level of the hypothalamus.

**Q 33. Which of the following is not a feature of plasmids?**

- Option A Independent replication
- Option B Circular structure
- Option C Transferable
- Option D Single-stranded

**Correct Option D**

**Solution:** Plasmids are small, double stranded, closed circular structures which are inherited from parent bacterial cell to daughter cells and are capable of self-replication in the cytoplasm of bacterial cell.

**Q 34. Which of the following features is not present in *Periplaneta americana*?**

- Option A Schizocoelom as body cavity
- Option B Indeterminate and radial cleavage during embryonic development
- Option C Exoskeleton composed of N-acetylglucosamine
- Option D Metamerically segmented body

**Correct Option B**

**Solution:** Cockroach has determinate cleavage during embryonic development and it develops into nymph, which resembles the adult cockroach in most of the characters, but are smaller in size than the adult one.

**Q 35. In higher vertebrates, the immune system can distinguish self-cells and non-self cells. If this property is lost due to genetic abnormality and it attacks self-cells, then it leads to:**

- Option A Allergic response
- Option B Graft rejection
- Option C Auto-immune disease
- Option D Active immunity

**Correct Option C**

**Solution:** When the immune response goes off track and turns against 'self' cells leading to diseases, it is termed as auto-immune diseases. Such diseases may occur due to loss of genetic abnormality which leads to attack of self-cells.

**Q 36. Match the terms in Column-I with their description in Column-II and choose the correct option:**

Column I	Column II
(a) Dominance	i. Many genes govern a single character
(b) Codominance	ii. In a heterozygous organism only one allele expresses itself
(c) Pleiotropy	iii. In a heterozygous organism both alleles express themselves fully
(d) Polygenic inheritance	iv. A single gene influences many characters

**Code:**

- |          |      |       |      |       |
|----------|------|-------|------|-------|
|          | (a)  | (b)   | (c)  | (d)   |
| Option A | (ii) | (i)   | (iv) | (iii) |
| Option B | (ii) | (iii) | (iv) | (i)   |
| Option C | (iv) | (i)   | (ii) | (iii) |
| Option D | (iv) | (iii) | (i)  | (ii)  |

**Correct Option B**

**Solution:**

Dominance - In a heterozygous organism only one allele expresses itself.

Codominance - In a heterozygous organism both alleles express themselves fully.

Pleiotropy - A single gene influence many characters.

Polygenic inheritance - Many genes govern a single character.

**Q 37. Joint Forest Management concept was introduced in India during:**

- Option A 1960s
- Option B 1970s
- Option C 1980s
- Option D 1990s

**Correct Option C**

**Solution:** Joint Forest Management concept was introduced in India during 1980s so as to work closely with the local communities for the protection and management of forests and the Joint Forest Management Guidelines were given in 1990 to the Government of India.

**Q 38. Pick out the correct statements:**

**(a) Haemophilia is a sex-linked recessive disease.**

**(b) Down's syndrome is due to aneuploidy.**

**(c) Phenylketonuria is an autosomal recessive gene disorder.**

**(d) Sickle cell anaemia is an X-linked recessive gene disorder.**

Option A (a) and (d) are correct.

Option B (b) and (d) are correct.

Option C (a), (c) and (d) are correct.

Option D (a), (b) and (c) are correct.

**Correct Option D**

**Solution:** Haemophilia is a sex-linked recessive disorder which is transmitted from unaffected carrier female to male progeny.

Down's syndrome occurs on 21<sup>st</sup> chromosome in humans due to aneuploidy.

Phenylketonuria is an autosomal recessive gene disorder.

Sickle cell anaemia is not an X-linked recessive gene disorder.

**Q 39. Which one of the following statements is wrong?**

Option A Cyanobacteria are also called blue-green algae.

Option B Golden algae are also called desmids.

Option C Eubacteria are also called false bacteria.

Option D Phycomycetes are also called algal fungi.

**Correct Option C**

**Solution:** Eubacteria are also called true bacteria.

**Q 40. Proximal end of the filament of stamen is attached to the:**

Option A Anther

Option B Connective

Option C Placenta

Option D Thalamus or petal

**Correct Option D**

**Solution:** Proximal end of the filament of stamen is attached to the thalamus or petal and the distal end is attached to the anther.

**Q 41. Which of the following approaches does not give the defined action of contraceptive?**

Option A Barrier methods prevent fertilisation

Option B Intra uterine devices increase phagocytosis of sperms, suppress sperm motility and fertilising capacity of sperms

Option C Hormonal contraceptives prevent/retard the entry of sperms, prevent ovulation and fertilisation

Option D Vasectomy prevents spermatogenesis

**Correct Option D**

**Solution:** Vasectomy does not prevent spermatogenesis. However, it prevents the movement of sperms to the site of fertilisation.

**Q 42. The *Taq* polymerase enzyme is obtained from:**

- Option A *Thermus aquaticus*
- Option B *Thiobacillus ferrooxidans*
- Option C *Bacillus subtilis*
- Option D *Pseudomonas putida*

**Correct Option A**

**Solution:** The *Taq* polymerase enzyme is obtained from *Thermus aquaticus*. It is a thermostable enzyme which can resist high temperature induced denaturation of double stranded DNA during polymerase chain reaction.

**Q 43. Identify the correct statement on 'inhibin':**

- Option A It inhibits the secretion of LH, FSH and prolactin.
- Option B It is produced by granulose cells in the ovary and inhibits the secretion of FSH.
- Option C It is produced by granulose cells in the ovary and inhibits the secretion of LH.
- Option D It is produced by nurse cells in testes and inhibits the secretion of LH.

**Correct Option B**

**Solution:** Inhibin hormone is secreted by granulose cells in the ovary and inhibits the secretion of FSH while in males, Sertoli cells secrete inhibin which suppresses FSH synthesis.

**Q 44. Which part of the tobacco plant is infected by *Meloidogyne incognita*?**

- Option A Flower
- Option B Leaf
- Option C Stem
- Option D Root

**Correct Option D**

**Solution:** *Meloidogyne incognita* is a nematode which infects the roots of tobacco plants and causes a great reduction in their yield.

**Q 45. Antivenom injection contains preformed antibodies while polio drops that are administered into the body contain:**

- Option A Activated pathogens
- Option B Harvested antibodies
- Option C Gamma globulin
- Option D Attenuated pathogens

**Correct Option D**

**Solution:** Oral polio vaccine consists of attenuated polio virus strains which are living viruses cultured under adverse conditions, leading to loss of their virulence. These organisms have the ability to induce protective immunity.

**Q 46. Which one of the following cell organelles is enclosed by a single membrane?**

- Option A Mitochondria
- Option B Chloroplasts
- Option C Lysosomes
- Option D Nuclei

**Correct Option C**

**Solution:** Mitochondria, chloroplasts and nuclei are enclosed by double membranes. Only lysosomes are enclosed by a single membrane.

**Q 47. Lack of relaxation between successive stimuli in sustained muscle contraction is known as:**

- Option A Spasm
- Option B Fatigue
- Option C Tetanus
- Option D Tonus

**Correct Option C**

**Solution:** Lack of relaxation between successive stimuli in sustained muscle contraction is known as tetanus. It results in sustained muscular spasms.

**Q 48. Which of the following is not a stem modification?**

- Option A Pitcher of *Nepenthes*
- Option B Thorns of citrus
- Option C Tendrils of cucumber
- Option D Flattened structures of *Opuntia*

**Correct Option A**

**Solution:** Pitcher of *Nepenthes* is a leaf modification to form a large pitcher.

**Q 49. Water soluble pigments found in plant cell vacuoles are:**

- Option A Xanthophylls
- Option B Chlorophylls
- Option C Carotenoids
- Option D Anthocyanins

**Correct Option D**

**Solution:** Anthocyanins are water soluble pigments that give red, purple, and blue colour to the plants depending on their pH.

**Q 50. Select the correct statement:**

- Option A Gymnosperms are both homosporous and heterosporous.
- Option B *Salvinia*, *Ginkgo* and *Pinus* all are gymnosperms.
- Option C *Sequoia* is one of the tallest trees.
- Option D The leaves of gymnosperms are not well adapted to extremes of climate.

**Correct Option C**

**Solution:** *Sequoia* is a gymnosperm and is one of the tallest tree species in the world.

**Q 51. Which of the following is not required for any of the techniques of DNA fingerprinting available at present?**

- Option A Polymerase chain reaction
- Option B Zinc finger analysis
- Option C Restriction enzymes
- Option D DNA-DNA hybridisation

**Correct Option B**

**Solution:** In DNA fingerprinting, PCR is used in the amplification of DNA. Restriction enzymes are used to cut DNA at specific sites.

DNA-DNA hybridisation, in which single stranded DNA anneal to complimentary DNA, is done in DNA fingerprinting. However, zinc finger analysis using zinc ions is not required for any of the techniques of DNA fingerprinting.

**Q 52. Which type of tissue correctly matches with its location?**

	<b>Tissue</b>	<b>Location</b>
<b>Option A</b>	<b>Smooth muscle</b>	<b>Wall of intestine</b>
<b>Option B</b>	<b>Areolar tissue</b>	<b>Tendons</b>
<b>Option C</b>	<b>Transitional epithelium</b>	<b>Tip of nose</b>
<b>Option D</b>	<b>Cuboidal epithelium</b>	<b>Lining of stomach</b>

**Correct Option A**

**Solution:** Smooth muscles are located in the inner walls of hollow visceral organs of the body like the alimentary canal and reproductive tract.

**Q 53. A plant in your garden avoids photorespiratory losses, has improved water use efficiency, shows high rates of photosynthesis at high temperatures and has improved efficiency of nitrogen utilisation. In which of the following physiological groups would you assign this plant?**

- Option A C<sub>3</sub>
- Option B C<sub>4</sub>
- Option C CAM
- Option D Nitrogen fixer

**Correct Option B**

**Solution:** C<sub>4</sub> plants have little photorespiration, have adapted to high temperature and intense radiation of tropics and has improved efficiency of nitrogen utilisation.

**Q 54. Which of the following structures is homologous to the wing of a bird?**

- Option A Dorsal fin of shark
- Option B Wing of moth
- Option C Hindlimb of rabbit
- Option D Flipper of whale

**Correct Option D**

**Solution:** Wings of bird and flippers of whale are modified forelimbs of two different organisms with same origin but perform different functions. The wings of birds help in flying and flippers of whale help in swimming, so they are homologous to each other.

**Q 55. Which of the following characteristic features always holds true for the corresponding group of animals?**

- Option A Cartilaginous endoskeleton : Chondrichthyes
- Option B Viviparous : Mammalia
- Option C Possess a mouth with an upper and a lower jaw : Chordata
- Option D 3- chambered heart with one incompletely divided ventricle : Reptilia

**Correct Option A**

**Solution:** Chondrichthyes always have cartilaginous endoskeleton.



**Q 56. Which of the following statements is not true for cancer cells in relation to mutations?**

- Option A Mutations in proto-oncogenes accelerate the cell cycle.
- Option B Mutations destroy telomerase inhibitor.
- Option C Mutations inactive the cell control.
- Option D Mutations inhibit the production of telomerase.

**Correct Option D**

**Solution:** Cancerous cells have high telomerase activity which makes them immortal. They do not inhibit the production of telomerase.

**Q 57. The amino acid tryptophan is the precursor for the synthesis of:**

- Option A Melatonin and serotonin
- Option B Thyroxine and triiodothyronine
- Option C Estrogen and progesterone
- Option D Cortisol and cortisone

**Correct Option A**

**Solution:** The amino acid tryptophan is the precursor for the synthesis of the epiphyseal hormone, melatonin and neurotransmitter, serotonin.

**Q 58. Following are the two statements regarding the origin of life:**

**(a) The earliest organism that appeared on the earth were non-green and presumably anaerobes.**

**(b) The first autotrophic organisms were chemoautotrophs that never released oxygen.**

**Of the above statements which one of the following options is correct?**

- Option A (a) is correct but (b) is false.
- Option B (b) is correct but (a) is false.
- Option C Both (a) and (b) are correct.
- Option D Both (a) and (b) are false.

**Correct Option C**

**Solution:** The earliest organisms that appeared on the earth were non-green and presumably anaerobes as oxygen was not available on earth at that time. They were prokaryotic chemoheterotrophs as they were dependent on chemicals for food.

**Q 59. Reduction in pH of blood will:**

- Option A Reduce the rate of heart beat
- Option B Reduce the blood supply to the brain
- Option C Decrease the affinity of haemoglobin with oxygen
- Option D Release bicarbonate ions by the liver

**Correct Option C**

**Solution:** Reduction in pH of blood will increase acidity which in turn will result in decrease in the affinity of hemoglobin with oxygen to form oxyhaemoglobin and thus, more oxygen will be available to cells.

**Q 60. Analogous structures are a result of:**

- Option A Divergent evolution
- Option B Convergent ancestry
- Option C Shared ancestry
- Option D Stabilising selection

**Correct Option B**

**Solution:** Analogous structures perform the same function and are superficially alike. These are developed in distantly related groups as an adaptation for the same function hence, analogous structures are a result of convergent ancestry.

**Q 61. Which of the following is a restriction endonuclease?**

- Option A HindII
- Option B Protease
- Option C DNaseI
- Option D RNase

**Correct option A**

**Solution:** HindII is a restriction endonuclease which cuts DNA molecule at a particular point by recognizing a specific sequence of six base pairs.

**Q 62. The term ecosystem was coined by:**

- Option A E. P. Odum
- Option B A. G. Tansley
- Option C E. Haeckel
- Option D E. Warming

**Correct Option B**

**Solution:** The term ecosystem was coined by A. G. Tansley in 1935.

**Q 63. Which of the following statements is wrong?**

- Option A Sucrose is a disaccharide.
- Option B Cellulose is a polysaccharide.
- Option C Uracil is a pyrimidine.
- Option D Glycine is a sulphur containing amino acid.

**Correct Option D**

**Solution:** Glycine is a neutral amino acid having one amino group and one carboxylic group with non-cyclic hydrocarbon chain.

**Q 64. In bryophytes and pteridophytes, transport of gametes requires:**

- Option A Wind
- Option B Insects
- Option C Birds
- Option D Water

**Correct Option D**

**Solution:** In bryophytes and pteridophytes, an external supply of water is required for the male gametes to reach the female archegonia.

**Q 65. When does the growth rate of a population following the logistic model equal zero? The logistic model given as  $dN/dt = rN(1-N/K)$ :**

- Option A when  $N/K$  is exactly one.
- Option B when  $N$  nears the carrying capacity of habitat.
- Option C when  $N/K$  equals zero.
- Option D when death rate is greater than birth date.

**Correct Option A**

**Solution:** A population growing in a habitat with limited resources initially show a lag phase, followed by phases of increase and decrease and finally population density reaches the carrying capacity (K) of their environment, causing their growth rate to slow nearly to zero. This happens when  $N/K$  is exactly one.

**Q 66. Which one of the following statements is not true?**

- Option A Tapetum helps in the dehiscence of anther.
- Option B Exine of pollen grains is made up of sporopollenin.
- Option C Pollen grains of many species cause severe allergies.
- Option D Stored pollen in liquid nitrogen can be used in the crop breeding programmes.

**Correct Option A**

**Solution:** The outer three layers of a microsporangium perform the function of protection in young anther and mechanism of dehiscence in the ripe anther. Tapetum do not help in the dehiscence of anther.

**Q 67. Which of the following would appear as the pioneer organism on bare rock?**

- Option A Lichens
- Option B Liverworts
- Option C Mosses
- Option D Green algae

**Correct Option A**

**Solution:** Lichens secrete acid which helps in weathering of rocks to form soil. Hence, lichens would appear as the pioneer organisms on bare rock.

**Q 68. Which one of the following is the starter codon?**

- Option A AUG
- Option B UGA
- Option C UAA
- Option D UAG

**Correct Option A**

**Solution:** AUG is the starter or initiation codon. UGA, UAA and UAG are termination or stop codons.

**Q 69. Which one of the following characteristics is not shared by birds and mammals?**

- Option A Ossified endoskeleton
- Option B Breathing using lungs
- Option C Viviparity
- Option D Warm blooded nature

**Correct Option C**

**Solution:** Birds are oviparous while mammals are viviparous.

**Q 70. Nomenclature is governed by certain universal rules. Which one of the following is contrary to the rules of?**

- Option A Biological names can be written in any language.
- Option B The first word in a biological name represents the genus name, and the second is a specific epithet.
- Option C The names are written in Latin and are italicised.
- Option D When written by hand, the names are to be underlined.

**Correct Option A**

**Solution:** Biological names can be written in any language is contrary to the rules of binomial nomenclature.

**Q 71. Blood pressure in the pulmonary artery is:**

- Option A Same as that in the aorta
- Option B More than that in the carotid
- Option C More than that in the pulmonary vein
- Option D Less than that in the venacavae

**Correct Option C**

**Solution:** As the ventricular pressure increases, the semilunar valves guarding the pulmonary artery and the aorta are forced open, allowing the blood in the ventricles to flow through these vessels and thus results in increased blood pressure. When the ventricles relax and the ventricular pressure falls, the semilunar valves close which prevents the backflow of blood into the ventricles and the tricuspid and bicuspid valves are pushed open by the pressure in the atria exerted by the blood which was being emptied into them by the veins.

**Q 72. Cotyledon of maize grain is called:**

- Option A Plumule
- Option B Coleorhiza
- Option C Coleoptile
- Option D Scutellum

**Correct Option D**

**Solution:** The maize grain has one large and shield shaped cotyledon known as scutellum.

**Q 73. In the stomach, gastric acid is secreted by the:**

- Option A Gastrin secreting cells
- Option B Parietal cells
- Option C Peptic cells
- Option D Acidic cells

**Correct Option B**

**Solution:** In the stomach, gastric acid, HCl is secreted by the parietal cells or oxyntic cells present in the gastric glands that line the mucosa of the stomach.

**Q 74. Depletion of which gas in the atmosphere can lead to an increased incidence of skin cancers?**

- Option A Nitrous oxide
- Option B Ozone
- Option C Ammonia
- Option D Methane

**Correct option B**

**Solution:** Ozone layer depletion in the atmosphere causes the UV rays to penetrate the Earth. These UV rays harm the skin and can lead to an increased incidence of skin cancers.

**Q 75. Chrysophytes/Euglenoids, Dinoflagellates and Slime moulds are included in the kingdom:**

- Option A Monera
- Option B Protista
- Option C Fungi
- Option D Animalia

**Correct Option B**

**Solution:** Chrysophytes/euglenoids, dinoflagellates and slime moulds are included in the kingdom Protista. They are microscopic, eukaryotic organisms and are surrounded by plasmalemma (cell membrane).

**Q 76. Water vapour comes out from the plant leaf through the stomatal opening. Through the same stomatal opening carbon dioxide diffuses into the plant during photosynthesis. Reason out the above statements using one of the following options:**

- Option A Both processes cannot happen simultaneously.
- Option B Both processes can happen together because the diffusion coefficient of water and CO<sub>2</sub> is different.
- Option C The above processes happen only during night time.
- Option D One process occurs during day time, and the other at night.

**Correct Option B**

**Solution:** Diffusion of water and carbon dioxide are different and are not dependent on each other. Moreover, both water and carbon dioxide have different diffusion coefficients, so both the processes can happen together.

**Q 77. In mammals, which blood vessel would normally carry largest amount of urea?**

- Option A Renal vein
- Option B Dorsal aorta
- Option C Hepatic vein
- Option D Hepatic portal vein

**Correct Option C**

**Solution:** The hepatic vein carries deoxygenated blood from the liver where digestion of proteins converts them into urea. Hence, hepatic vein carries large amount of urea.

**Q 78. Seed formation without fertilisation in flowering plants involves the process of:**

- Option A Sporulation
- Option B Budding
- Option C Somatic hybridisation
- Option D Apomixis

**Correct Option D**

**Solution:** The process of seed formation without fertilisation in flowering plants is called apomixes.

**Q 79. Which of the following is wrongly matched in the given table?**

	<b>Microbe</b>	<b>Product</b>	<b>Application</b>
Option A	<i>Trichoderma polysporum</i>	Cyclosporin A	Immunosuppressive drug
Option B	<i>Monascus purpureus</i>	Statins	Lowering of blood cholesterol
Option C	<i>Streptococcus</i>	Streptokinase	Removal of clot from blood vessel
Option D	<i>Clostridium butylicum</i>	Lipase	Removal of oil stains

**Correct Option D**

**Solution:** Lipases are obtained from *Candida lipolytica* and *Geotrichum candidum* and are added in detergents for removing oily stains from laundry.

**Q 80. In a test cross involving F<sub>1</sub> dihybrid flies, more parental-type offspring were produced than the recombinant-type offspring. This indicates:**

- Option A The two genes are located on two different chromosomes.
- Option B Chromosomes failed to separate during meiosis.
- Option C The two genes are linked and present on the same chromosome.
- Option D Both the characters are controlled by more than one gene.

**Correct Option C**

**Solution:** In a test cross, the two genes are linked and present on the same chromosome, so they are inherited together and produce more parental-type offspring than recombinant type.

**Q 81. It is much easier for a small animal to run uphill than for a large animal, because:**

- Option A It is easier to carry a small body weight.
- Option B Smaller animals have a higher metabolic rate.
- Option C Small animals have a lower O<sub>2</sub> requirement.
- Option D The efficiency of muscles in large animals is less than that in small animals.

**Correct Option B**

**Solution:** The metabolic rate of organisms is inversely proportional to their body size. Smaller animals have a higher metabolic rate, so it is much easier for them to run uphill as compared to larger animals.

**Q 82. Which of the following is not a characteristic feature during mitosis in somatic cells?**

- Option A Spindle fibres
- Option B Disappearance of nucleolus
- Option C Chromosome movement
- Option D Synapsis

**Correct Option D**

**Solution:** Synapsis is the process of attachment of the homologous chromosomes. It does not occur in mitosis.

**Q 83. Which of the following statements is not correct?**

- Option A Pollen grains of many species can germinate on the stigma of a flower, but only one pollen tube of the same species grows into the style.
- Option B Insects that consume pollen or nectar without bringing about pollination are called pollen/nectar robbers.
- Option C Pollen germination and pollen tube growth are regulated by chemical components of pollen interacting with those of the pistil.
- Option D Some reptiles have also been reported as pollinators in some plant species.

**Correct Option A**

**Solution:** Pollen grains of the same species can germinate into pollen tube which grows down into the style.

**Q 84. Specialised epidermal cells surrounding the guard cells are called:**

- Option A Complementary cells
- Option B Subsidiary cells
- Option C Bulliform cells
- Option D Lenticels

**Correct Option B**

**Solution:** Epidermal cells specialised in shape and size surrounding the guard cells are called subsidiary cells.

**Q 85. Which of the following guards the opening of hepatopancreatic duct into the duodenum?**

- Option A Semilunar valve
- Option B Ileocaecal valve
- Option C Pyloric sphincter
- Option D Sphincter of Oddi

**Correct Option D**

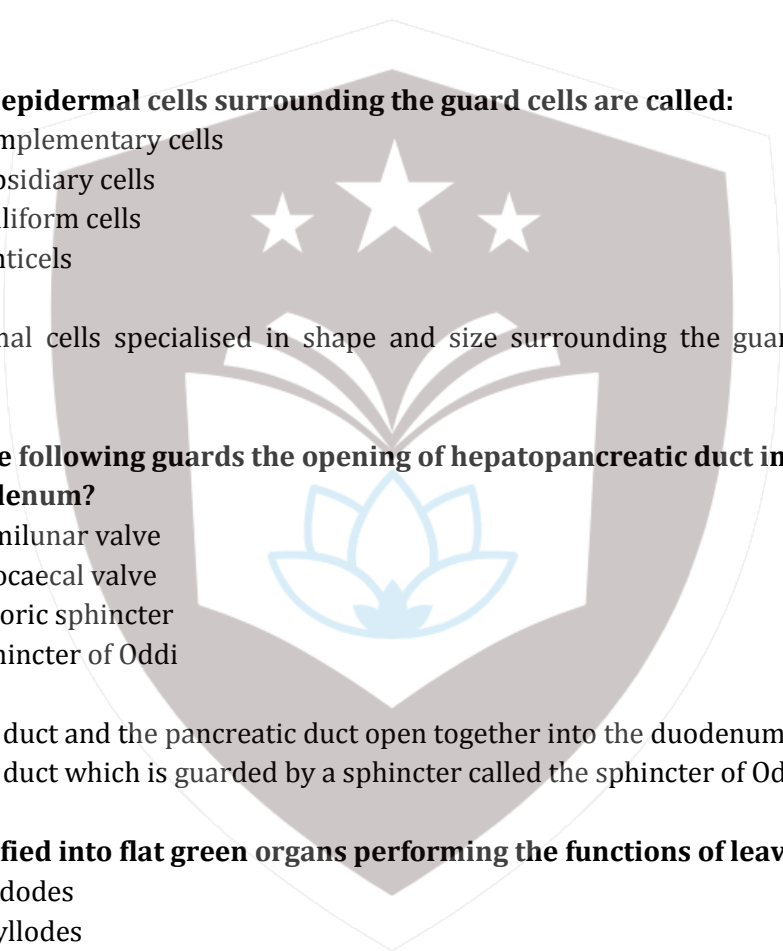
**Solution:** The bile duct and the pancreatic duct open together into the duodenum as the common hepato-pancreatic duct which is guarded by a sphincter called the sphincter of Oddi.

**Q 86. Stems modified into flat green organs performing the functions of leaves are known as:**

- Option A Cladodes
- Option B Phyllodes
- Option C Phylloclades
- Option D Scales

**Correct Option C**

**Solution:** Phylloclades are flattened or cylindrical green stems of unlimited growth which perform the function of photosynthesis.



**Q 87. The primitive prokaryotes responsible for the production of biogas from the dung of ruminant animals, include the:**

- Option A Halophiles
- Option B Thermoacidophiles
- Option C Methanogens
- Option D Eubacteria

**Correct Option C**

**Solution:** Methanogens grow anaerobically on cellulosic material and are responsible for the production of biogas from the dung of ruminant animals.

**Q 88. A river with an inflow of domestic sewage rich in organic waste may result in:**

- Option A Drying of the river very soon due to algal bloom.
- Option B Increased population of aquatic food web organism.
- Option C An increased production of fish due to biodegradable nutrients.
- Option D Death of fish due to lack of oxygen.

**Correct Option D**

**Solution:** The domestic sewage acts as nutrients and accelerates the growth of algae that form a mat on the water surface. This increased productivity of algae is called eutrophication which reduces the amount of dissolved oxygen available for fish and hence, leads to death of fish.

**Q 89. A cell at telophase stage is observed by a student in a plant brought from the field. He tells his teacher that this cell is not like other cells at telophase stage. There is no formation of cell plate and thus the cell is containing more number of chromosomes as compared to other dividing cells. This would result in:**

- Option A Aneuploidy
- Option B Polyploidy
- Option C Somaclonal variation
- Option D Polyteny

**Correct Option B**

**Solution:** Polyploidy is the state of a cell or organism having more than two paired (homologous) sets of chromosomes. Hence, such a cell would result in polyploidy.

**Q 90. A typical fat molecule is made up of:**

- Option A Three glycerol molecules and one fatty acid molecule
- Option B One glycerol and three fatty acid molecules
- Option C One glycerol and one fatty acid molecule
- Option D Three glycerol and three fatty acid molecules

**Correct Option B**

**Solution:** Fats are triglyceride formed by the esterification of one molecule of trihydric alcohol, glycerol and three fatty acids.