DATE : 04/05/2025

Test Booklet Code

45

ARMADAN

Answers & Solutions for NEET (UG)-2025

Time : 3 hrs.

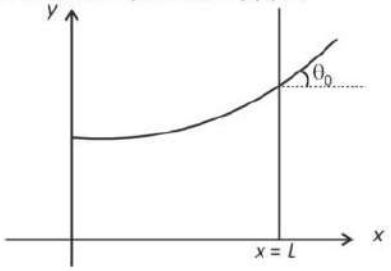
M.M.: 720

Important Instructions:

1. The test is of **3 hours** duration and the Test Booklet contains **180** multiple choice questions (Four options with a single correct answer) from **Physics, Chemistry and Biology (Botany and Zoology)**.
2. Each question carries **4 marks**. For each correct response, the candidate will get **4 marks**. For every wrong response **1 mark** shall be deducted from the total scores. The maximum marks are **720**.
3. Use **Blue / Black Ball Point Pen only** for writing particulars on this page / marking responses on Answer Sheet.
4. Rough work is to be done in the space provided for this purpose in the Test Booklet only.
5. On completion of the test, the candidate **must hand over the Answer Sheet (ORIGINAL and OFFICE Copy)** to the Invigilator before leaving the Room / Hall. The candidates are allowed to take away this Test Booklet with them.
6. The CODE for this Booklet is **45**.
7. The candidates should ensure that the Answer Sheet is not folded. Do not make any stray marks on the Answer Sheet. Do not write your Roll No. anywhere else except in the specified space in the Test Booklet/Answer Sheet. Use of white fluid for correction is **NOT** permissible on the Answer Sheet.
8. Each candidate must show on-demand his/her Admit Card to the Invigilator.
9. No candidate, without special permission of the Centre Superintendent or Invigilator, would leave his/her seat.
10. Use of Electronic/Manual Calculator is prohibited.
11. The candidates are governed by all Rules and Regulations of the examination with regard to their conduct in the Examination Room/Hall. All cases of unfair means will be dealt with as per Rules and Regulations of this examination along with Public Examinations (Prevention of unfair means act 2024).
12. **No part of the Test Booklet and Answer Sheet shall be detached under any circumstances.**
13. The candidates will write the Correct Test Booklet Code as given in the Test Booklet / Answer Sheet in the Attendance Sheet.

PHYSICS

1. Consider a water tank shown in the figure. It has one wall at $x = L$ and can be taken to be very wide in the z direction. When filled with a liquid of surface tension S and density ρ, the liquid surface makes angle θ_0 ($\theta_0 << 1$) with the x-axis at $x = L$. If $y(x)$ is the height of the surface then the equation for $y(x)$ is:



(take $\theta(x) = \sin\theta(x) = \tan\theta(x) = \frac{dy}{dx}$, g is the acceleration due to gravity)

(1) $\frac{d^2y}{dx^2} = \frac{\rho g}{S}x$

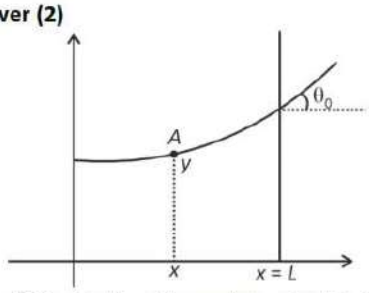
(2) $\frac{d^2y}{dx^2} = \frac{\rho g}{S}y$

(3) $\frac{d^2y}{dx^2} = \sqrt{\frac{\rho g}{S}}$

(4) $\frac{dy}{dx} = \sqrt{\frac{\rho g}{S}}x$

Answer (2)

Sol.



ROC = Radius of curvature at point A

$$\text{Curvature} = \frac{1}{ROC} = \frac{\left|\frac{d^2y}{dx^2}\right|}{\left(1+\left(\frac{dy}{dx}\right)^2\right)^{\frac{3}{2}}} = \frac{\left|\frac{d^2y}{dx^2}\right|}{(1+0)^{\frac{3}{2}}} = \frac{d^2y}{dx^2} \qquad \left[\because \frac{dy}{dx} = \tan\theta \simeq 0\right]$$

$\Delta P = S \times$ curvature

$$\Rightarrow \rho g y = S\frac{d^2y}{dx^2}$$

$$\therefore \frac{d^2y}{dx^2} = \frac{\rho g y}{S}$$

2. A microscope has an objective of focal length 2 cm, eyepiece of focal length 4 cm and the tube length of 40 cm. If the distance of distinct vision of eye is 25 cm, the magnification in the microscope is

(1) 100

(2) 125

(3) 150

(4) 250

Answer (2)

Sol. $m = \frac{L}{f_o} \times \frac{D}{f_e}$

$$= \frac{40}{2} \times \frac{25}{4}$$

$m = 125$

3. An electron (mass 9×10^{-31} kg and charge 1.6×10^{-19} C) moving with speed $c/100$ (c = speed of light) is injected into a magnetic field $\vec{B}$ of magnitude 9×10^{-4} T perpendicular to its direction of motion. We wish to apply an uniform electric field $\vec{E}$ together with the magnetic field so that the electron does not deflect from its path. Then (speed of light $c = 3 \times 10^8$ ms^{-1})

(1) $\vec{E}$ is perpendicular to $\vec{B}$ and its magnitude is 27×10^4 V m^{-1}

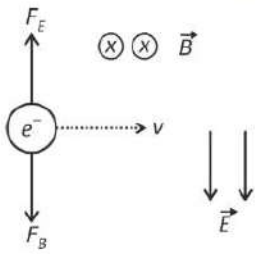
(2) $\vec{E}$ is perpendicular to $\vec{B}$ and its magnitude is 27×10^2 V m^{-1}

(3) $\vec{E}$ is parallel to $\vec{B}$ and its magnitude is 27×10^2 V m^{-1}

(4) $\vec{E}$ is parallel to $\vec{B}$ and its magnitude is 27×10^4 V m^{-1}

Answer (2)

Sol. For no deflection of electron, $\vec{F}_B = \vec{F}_E$



$$-e(\vec{v} \times \vec{B}) = -e\vec{E}$$

$$\Rightarrow \vec{E} = \vec{v} \times \vec{B} \quad \Rightarrow \vec{E} \perp \vec{B}$$

$$E = vB = \frac{c}{100} \times 9 \times 10^{-4}$$

$$= \frac{3 \times 10^8}{100} \times 9 \times 10^{-4}$$

$= 27 \times 10^2$ V m^{-1}

4. There are two inclined surfaces of equal length (L) and same angle of inclination 45° with the horizontal. One of them is rough and the other is perfectly smooth. A given body takes 2 times as much time to slide down on rough surface than on the smooth surface. The coefficient of kinetic friction (μ_k) between the object and the rough surface is close to

(1) 0.25 (2) 0.40

(3) 0.5 (4) 0.75

Answer (4)

Sol. $t_{rough} = 2t_{smooth}$

$a_{smooth} = g\sin\theta$

$$t \propto \frac{1}{\sqrt{a}} \Rightarrow t_{smooth} \propto \frac{1}{\sqrt{g\sin\theta}}$$

$a_{rough} = g\sin\theta - \mu_k g\cos\theta$

$$\frac{t_{rough}}{t_{smooth}} = \frac{\sqrt{\sin\theta}}{\sqrt{\sin\theta - \mu_k \cos\theta}} = 2$$

Squaring both sides

$$\frac{\sin\theta}{\sin\theta-\mu_k\cos\theta}=4 \Rightarrow \frac{\frac{1}{\sqrt{2}}}{\frac{1}{\sqrt{2}}-\mu_k\times\frac{1}{\sqrt{2}}}=4$$

$$\Rightarrow 1-\mu_k=\frac{1}{4}$$

$$\mu_k=\frac{3}{4}$$

$$=0.75$$

5. The kinetic energies of two similar cars A and B are 100 J and 225 J respectively. On applying breaks, car A stops after 1000 m and car B stops after 1500 m. If F_A and F_B are the forces applied by the breaks on cars A and B respectively, then the ratio of $\frac{F_A}{F_B}$ is

(1) $\frac{3}{2}$ (2) $\frac{2}{3}$

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

Answer (2)

Sol. By work-energy theorem,

$FS = \Delta K{\cdot}E$

$\Rightarrow -FS = k_f - k_i$

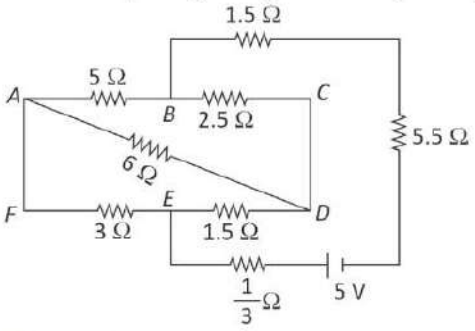
$\Rightarrow FS = k_i - k_f$

$$\Rightarrow \frac{F_A}{F_B}=\frac{k_A}{k_B}\times\frac{S_B}{S_A}$$

$$=\frac{100}{225}\times\frac{1500}{1000}$$

$$=\frac{150}{225}=\frac{2}{3}$$

6. The current passing through the battery in the given circuit, is:



(1) 2.0 A

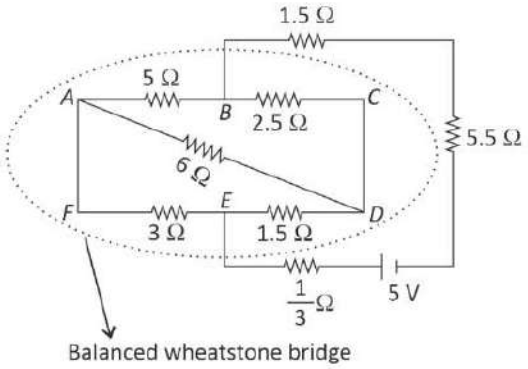
(2) 0.5 A

(3) 2.5 A

(4) 1.5 A

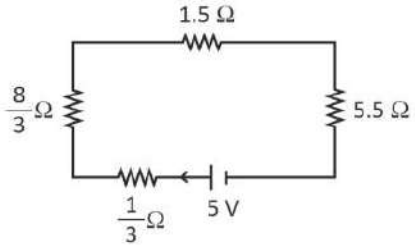
Answer (2)

Sol.



$\therefore$ its equivalent $R' = \frac{4\times 8}{12} = \frac{8}{3}\Omega$

Circuit can be redrawn as

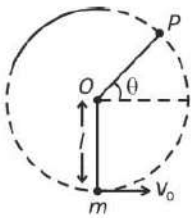


$R_{eq} = \frac{8}{3} + \frac{1}{3} + 1.5 + 5.5$

$= 10\ \Omega$

$i = \frac{V}{R_{eq}} = \frac{5}{10} = 0.5\,A$

7. A bob of heavy mass m is suspended by a light string of length l. The bob is given a horizontal velocity v_0 as shown in figure. If the string gets slack at some point P making an angle θ from the horizontal, the ratio of the speed v of the bob at point P to its initial speed v_0 is:



(1) $(\sin\theta)^{\frac{1}{2}}$

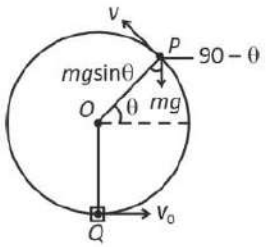
(2) $\left(\frac{1}{2+3\sin\theta}\right)^{\frac{1}{2}}$

(3) $\left(\frac{\cos\theta}{2+3\sin\theta}\right)^{\frac{1}{2}}$

(4) $\left(\frac{\sin\theta}{2+3\sin\theta}\right)^{\frac{1}{2}}$

Answer (4)

Sol.



At Point *P*, $mg\sin\theta = \dfrac{mv^2}{l}$ ...(1)

By conservation of mechanical energy at point $P \in Q$

$$\frac{1}{2}mv_0^2 = \frac{1}{2}mv^2 + mg(l + l\sin\theta)$$

$$\frac{v_0^2}{2} = \frac{v^2}{2} + gl(1 + \sin\theta)$$

Put $gl = \dfrac{v^2}{\sin\theta}$ using (1)

$$\frac{v_0^2}{2} = \frac{v^2}{2} + \frac{v^2}{\sin\theta}(1 + \sin\theta)$$

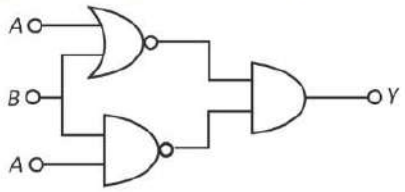
$$\frac{v_0^2}{2} = \frac{v^2}{2} + \frac{v^2}{\sin\theta} + v^2$$

$$\frac{v_0^2}{2} = \frac{3}{2}v^2 + \frac{2v^2}{2\sin\theta}$$

$$v_0^2 = v^2\left[3 + \frac{2}{\sin\theta}\right]$$

$$\frac{v}{v_0} = \left(\frac{\sin\theta}{3\sin\theta + 2}\right)^{\frac{1}{2}}$$

8. The output (Y) of the given logic implementation is similar to the output of an/a _____ gate.

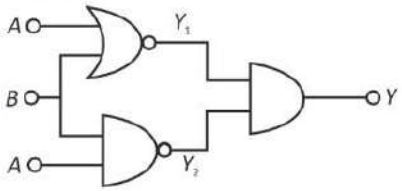


(1) AND (2) NAND

(3) OR (4) NOR

Answer (4)

Sol.



$Y_1 = \overline{A+B}$

$Y_2 = \overline{A \cdot B}$

$Y = Y_1 \cdot Y_2$

$= \overline{A+B} \cdot \overline{A \cdot B}$

$= \overline{(A+B) + A \cdot B}$

$= \overline{A + B(1+A)}$

$= \overline{A+B}$ NOR gate

9. The electric field in a plane electromagnetic wave is given by

$E_z = 60 \cos (5x + 1.5 \times 10^9 t)$ V/m.

Then expression for the corresponding magnetic field is (here subscripts denote the direction of the field) :

(1) $B_y = 2 \times 10^{-7} \cos (5x + 1.5 \times 10^9 t)T$

(2) $B_x = 2 \times 10^{-7} \cos (5x + 1.5 \times 10^9 t)T$

(3) $B_z = 60\cos (5x + 1.5 \times 10^9 t)T$

(4) $B_y = 60 \sin (5x + 1.5 \times 10^9 t)T$

Answer (1)

Sol. In electromagnetic wave, E and B are in same phase and $B_0 = \frac{E_0}{c}$; their planes are perpendicular to each other.

$\therefore\ B_y = \frac{60}{c}\cos(5x + 1.5 \times 10^9 t)$ T

$= \frac{60}{3 \times 10^8}\cos(5x + 1.5 \times 10^9 t)$ T

$B_y = 2 \times 10^{-7} \cos(5x + 1.5 \times 10^9 t)$ T

10. A ball of mass 0.5 kg is dropped from a height of 40 m. The ball hits the ground and rises to a height of 10 m. The impulse imparted to the ball during its collision with the ground is (Take $g = 9.8$ m/s^2)

(1) 21 NS

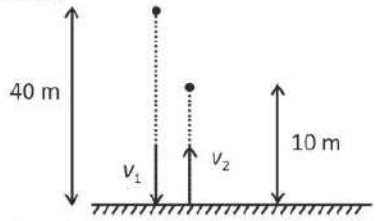
(2) 7 NS

(3) 0

(4) 84 NS

Answer (1)

Sol.



$v_1 = \sqrt{2gh_1}$

$= \sqrt{2 \times 9.8 \times 40}$

$v_1 = \sqrt{784} = 28\ \text{m s}^{-1}$

and $v_2 = \sqrt{2gh_2} = \sqrt{2 \times 9.8 \times 10}$

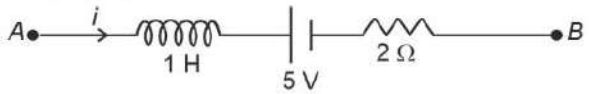
$= \sqrt{196} = 14\ \text{m s}^{-1}$

Impulse $= \Delta\vec{p} = m\left(\vec{v}_f - \vec{v}_i\right) = m\left(\vec{v}_2 - \vec{v}_1\right)$

$= \frac{1}{2}(14 - (-28))$

= 21 NS

11. AB is a part of an electrical circuit (see figure). The potential difference "$V_A - V_B$", at the instant when current i = 2 A and is increasing at a rate of 1 amp/second is:

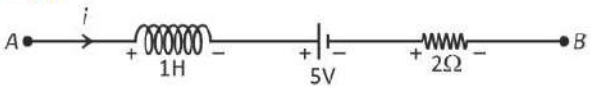


(1) 5 volt (2) 6 volt

(3) 9 volt (4) 10 volt

Answer (4)

Sol.



Given, I = 2A and $\frac{di}{dt} = +1A/s$

$V_A - L\frac{di}{dt} - 5 - i \times 2 = V_B$

$\Rightarrow$ $V_A - 1 \times 1 - 5 - 2 \times 2 = V_B$

$\Rightarrow$ $V_A - V_B$ = 10 volt

12. A 2 amp current is flowing through two different small circular copper coils having radii ratio 1 : 2. The ratio of their respective magnetic moments will be

(1) 1 : 4 (2) 1 : 2

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

Answer (1)

Sol. Magnetic moment of current carrying circular loop = IA

$M = IA$

$M \propto A$ [I–Same]

$$\frac{M_1}{M_2} = \frac{A_1}{A_2} = \frac{\pi r_1^2}{\pi r_2^2} = \left(\frac{1}{2}\right)^2 = \frac{1}{4}$$

13. In a certain camera, a combination of four similar thin convex lenses are arranged axially in contact. Then the power of the combination and the total magnification in comparison to the power (p) and magnification (m) for each lens will be, respectively

(1) $4p$ and $4m$ (2) p^4 and $4m$

(3) $4p$ and m^4 (4) p^4 and m^4

Answer (3)

Sol. For series combination of lens

$p_{eff} = p_1 + p_2 + p_3 + p_4 = 4p$

$m_{eff} = m_1 \times m_2 \times m_3 \times m_4 = m^4$

14. An oxygen cylinder of volume 30 litre has 18.20 moles of oxygen. After some oxygen is withdrawn from the cylinder, its gauge pressure drops to 11 atmospheric pressure at temperature 27°C. The mass of the oxygen withdrawn from the cylinder is nearly equal to:

[Given, $R = \frac{100}{12}\,\text{J mol}^{-1}\text{K}^{-1}$, and molecular mass of O_2 = 32, 1 atm pressure = 1.01×10^5 N/m]

(1) 0.125 kg (2) 0.144 kg

(3) 0.116 kg (4) 0.156 kg

Answer (3)

Sol. Number of moles left

$$n = \frac{PV}{RT} = \frac{12 \times 1.01 \times 10^5 \text{N/m}^2 \times 30 \times 10^{-3} \text{m}^3}{\frac{100}{12} \times 300}$$

$$n = \frac{12 \times 1.01 \times 12}{10} = 14.54 \text{ moles}$$

Moles removed = 18.2 – 14.54

= 3.656 moles

Mass removed = 3.656 × 32 = 116.99 g = 0.116 kg

15. In some appropriate units, time (t) and position (x) relation of a moving particle is given by $t = x^2 + x$. The acceleration of the particle is

(1) $-\frac{2}{(x+2)^3}$

(2) $-\frac{2}{(2x+1)^3}$

(3) $+\frac{2}{(x+1)^3}$

(4) $+\frac{2}{2x+1}$

Answer (2)

Sol. $t = x^2 + x$

$$\frac{dt}{dx} = 2x + 1$$

$$v = \frac{dx}{dt} = \frac{1}{(2x+1)}$$

$$\frac{dv}{dx} = \frac{-2}{(2x+1)^2}$$

$$a = v\frac{dv}{dx} = \frac{1}{(2x+1)}\left[\frac{-2}{(2x+1)^2}\right]$$

$$= -\frac{2}{(2x+1)^3}$$

16. To an ac power supply of 220 V at 50 Hz, a resistor of 20 Ω, a capacitor of reactance 25 Ω and an inductor of reactance 45 Ω are connected in series. The corresponding current in the circuit and the phase angle between the current and the voltage is, respectively

(1) 7.8 A and 30°

(2) 7.8 A and 45°

(3) 15.6 A and 30°

(4) 15.6 A and 45°

Answer (2)

Sol. X_L = 45 W , X_C = 25 W, R = 20 W

$$I = \frac{220}{\sqrt{(X_L - X_C)^2 + R^2}} = \frac{220}{\sqrt{(45-25)^2 + 20^2}}$$

$$= \frac{220}{2\sqrt{2}} = \frac{11}{\sqrt{2}} = 7.779 \text{ A}$$

$$\tan\phi = \frac{X_L - X_C}{R} = \frac{45-25}{20} = 1$$

$f = 45°$

17. The Sun rotates around its centre once in 27 days. What will be the period of revolution if the Sun were to expand to twice its present radius without any external influence? Assume the Sun to be a sphere of uniform density.

(1) 100 days (2) 105 days

(3) 115 days (4) 108 days

Answer (4)

Sol. Assuming the Sun to be a solid sphere, $I = \frac{2}{5}mR^2$

Using conservation of angular momentum, $I'\omega' = I\omega$

$\Rightarrow \frac{2}{5}m(2R)^2 \times \frac{2\pi}{T'} = \frac{2}{5}mR^2 \times \frac{2\pi}{T}$

$\Rightarrow T' = 4T = 4 \times 27 = 108$ days

18. A model for quantized motion of an electron in a uniform magnetic field B states that the flux passing through the orbit of the electron is $n(hle)$ where n is an integer, h is Planck's constant and e is the magnitude of electron's charge. According to the model, the magnetic moment of an electron in its lowest energy state will be (m is the mass of the electron)

(1) $\frac{he}{\pi m}$ (2) $\frac{he}{2\pi m}$

(3) $\frac{heB}{\pi m}$ (4) $\frac{heB}{2\pi m}$

Answer (2)

Sol. Magnetic force = $\frac{mv^2}{r}$

$evB = \frac{mv^2}{r}$

$v = \frac{eBr}{m}$

$\phi = BA$

$\frac{nh}{e} = B\pi r^2$

$Br^2 = \frac{nh}{e\pi}$

$\mu = IA$

$= \frac{e}{T}\pi r^2$

$= \frac{e \times v}{2\pi r}\pi r^2$

$\mu = \frac{evr}{2}$

$= \frac{1}{2}e \times \frac{eBr}{m}r$

$\mu = \frac{1}{2}e^2\frac{Br^2}{m}$

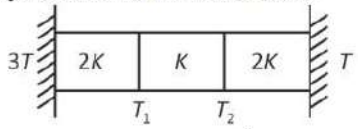
$\mu = \frac{1}{2}e^2\frac{nh}{e\pi m}$

$\mu = \frac{neh}{2\pi m}$

for $n = 1$

$\mu = \frac{eh}{2\pi m}$

19. Three identical heat conducting rods are connected in series as shown in the figure. The rods on the sides have thermal conductivity $2K$ while that in the middle has thermal conductivity K. The left end of the combination is maintained at temperature $3T$ and the right end at T. The rods are thermally insulated from outside. In steady state, temperature at the left junction is T_1 and that at the right junction is T_2. The ratio T_1/T_2 is



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

(3) $\frac{5}{3}$ (4) $\frac{5}{4}$

Answer (3)

Sol. In series, $R_{eq.} = R_1 + R_2 + R_3$

$$= \frac{l}{2KA} + \frac{l}{KA} + \frac{l}{2KA}$$

$$= \frac{4l}{2KA}$$

$$R_{eq.} = \frac{2l}{KA}$$

In series rate of heat flow is same

$$\therefore \quad \frac{3T - T_1}{R_1} = \frac{3T - T}{R_{eq.}}$$

$$\frac{(3T - T_1)2KA}{l} = \frac{(2T)KA}{2l}$$

$$\Rightarrow \quad 6T - 2T_1 = T$$

$$\Rightarrow \quad 2T_1 = 5T$$

$$\Rightarrow \quad T_1 = \frac{5T}{2} \quad ...(1)$$

Now, equate heat flow rate in 3rd section & total section

$$\frac{T_2 - T}{R_3} = \frac{3T - T}{R_{eq.}}$$

$$\Rightarrow \quad \frac{(T_2 - T)(2KA)}{l} = \frac{2T(KA)}{2l}$$

$$\Rightarrow \quad 2T_2 - 2T = T$$

$$\Rightarrow \quad T_2 = \frac{3T}{2} \quad ...(2)$$

By equation (1) and equation (2)

$$\frac{T_1}{T_2} = \frac{5T \times 2}{2 \times 3T} = \frac{5}{3}$$

20. The plates of a parallel plate capacitor are separated by d. Two slabs of different dielectric constant K_1 and K_2 with thickness $\frac{3}{8}d$ and $\frac{d}{2}$, respectively are inserted in the capacitor. Due to this, the capacitance becomes two times larger than when there is nothing between the plates.

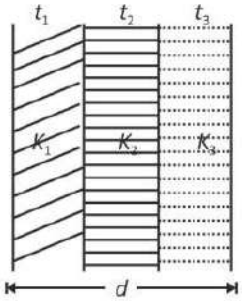
If $K_1 = 1.25\ K_2$, the value of K_1 is:

(1) 2.66 (2) 2.33

(3) 1.60 (4) 1.33

Answer (1)

Sol.



Using $C_{eq} = \dfrac{\varepsilon_0 A}{\dfrac{t_1}{K_1} + \dfrac{t_2}{K_2} + \dfrac{t_3}{K_3}}$

here $C_0 = \dfrac{\varepsilon_0 A}{d}, t_1 = \dfrac{3d}{8}, t_2 = \dfrac{d}{2}, t_3 = \dfrac{d}{8}$

$K_1 = K_1,\ \ K_2 = \dfrac{K_1}{1.25}$ and $K_3 = 1$

Given $C_{eq} = 2C_0$

$$\Rightarrow 2C_0 = \frac{\varepsilon_0 A}{\dfrac{3d}{8K_1} + \dfrac{d \times 1.25}{2K_1} + \dfrac{d}{8}}$$

$$\Rightarrow \frac{2\varepsilon_0 A}{d} = \frac{\varepsilon_0 A}{\dfrac{3d}{8K_1} + \dfrac{d}{2K_1} \times \dfrac{5}{4} + \dfrac{d}{8}}$$

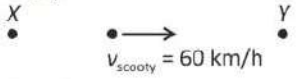
$$\Rightarrow 2 = \frac{1}{\dfrac{3}{8K_1} + \dfrac{5}{8K_1} + \dfrac{1}{8}} \Rightarrow K_1 = \frac{8}{3} = 2.66$$

21. Two cities X and Y are connected by a regular bus service with a bus leaving in either direction every T min. A girl is driving scooty with a speed of 60 km/h in the direction X to Y notices that a bus goes past her every 30 minutes in the direction of her motion, and every 10 minutes in the opposite direction. Choose the correct option for the period T of the bus service and the speed (assumed constant) of the buses.

(1) 9 min, 40 km/h
(2) 25 min, 100 km/h
(3) 10 min, 90 km/h
(4) 15 min, 120 km/h

Answer (4)

Sol.



$X \to Y$

Let velocity of bus = v km/hr

Relative velocity of bus w.r.t. scooty = $(v - 60)$

Distance between 2 consecutive buses = vT

$(v - 60)30 = vT$ ...(i)

$Y \to X$

$(v + 60)10 = vT$ ...(ii)

Equating (1) and (2)

$(v - 60)30 = (v + 60)10$

$\therefore\ \ v = 120$ km/hr

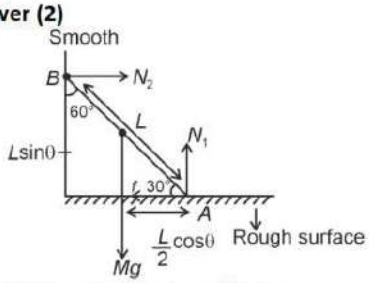
$T = 15$ min

22. A uniform rod of mass 20 kg and length 5 m leans against a smooth vertical wall making an angle of 60° with it. The other end rests on a rough horizontal floor. The friction force that the floor exerts on the rod is (Take g = 10 m/s^2)

(1) 100 N
(2) $100\sqrt{3}$ N
(3) 200 N
(4) $200\sqrt{3}$ N

Answer (2)

Sol.



For translational equilibrium

$N_1 = Mg$

$N_2 = f$

For rotational equilibrium

Torque about A, $Mg\frac{L}{2}\cos\theta = N_2 L\sin\theta$

$$\frac{Mg}{2}\cot\theta = N_2 = f$$

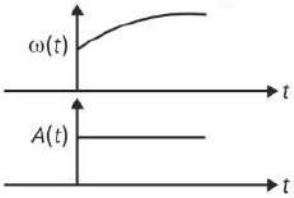
$$\frac{Mg}{2}\cot 30^\circ = f$$

$$\frac{Mg}{2}\sqrt{3} = N_2$$

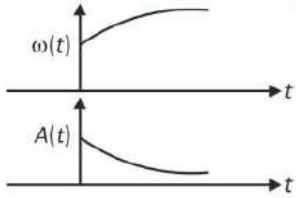
$$100\sqrt{3} = f$$

23. In an oscillating spring mass system, a spring is connected to a box filled with sand. As the box oscillates, sand leaks slowly out of the box vertically so that the average frequency $\omega(t)$ and average amplitude $A(t)$ of the system change with time t. Which one of the following options schematically depicts these changes correctly?

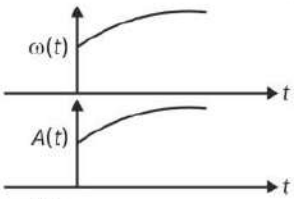
(1)



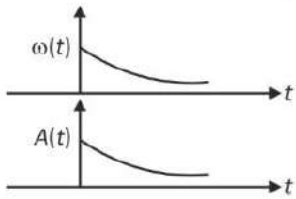
(2)



(3)



(4)



Answer (2)

Sol. At any point of time, time period is given by

$$T = 2\pi\sqrt{\frac{m}{k}}$$

Here m is decreasing, so time period T will be decreasing

Since $\omega = \frac{2\pi}{T}$

Hence as mass leaks, ω will increase

Now, at any instant

$mg = kx_0$

So, equilibrium length $x_0 = \frac{mg}{k}$, where m is decreasing

So, equilibrium length will decrease.

So, amplitude also go on decreasing.

24. A balloon is made of a material of surface tension S and its inflation outlet (from where gas is filled in it) has small area A. It is filled with a gas of density ρ and takes a spherical shape of radius R. When the gas is allowed to flow freely out of it, its radius r changes from R to 0 (zero) in time T. If the speed $v(r)$ of gas coming out of the balloon depends on r as r^a and $T \propto S^\alpha A^\beta \rho^\gamma R^\delta$ then

(1) $a = \frac{1}{2}, \alpha = \frac{1}{2}, \beta = -1, \gamma = +1, \delta = \frac{3}{2}$

(2) $a = -\frac{1}{2}, \alpha = -\frac{1}{2}, \beta = -1, \gamma = -\frac{1}{2}, \delta = \frac{5}{2}$

(3) $a = -\frac{1}{2}, \alpha = -\frac{1}{2}, \beta = -1, \gamma = \frac{1}{2}, \delta = \frac{7}{2}$

(4) $a = \frac{1}{2}, \alpha = \frac{1}{2}, \beta = -\frac{1}{2}, \gamma = \frac{1}{2}, \delta = \frac{7}{2}$

Answer (3)

Sol. $T \propto S^\alpha A^\beta \rho^\gamma R^\delta$

$M^0L^0T^1 = K(MT^{-2})^\alpha (L^2)^\beta (ML^{-3})^\gamma L^\delta$

$M^0L^0T^1 = K[M^{\alpha+\gamma} L^{2\beta-3\gamma+\delta} T^{-2\alpha}]$

$-2\alpha = 1 \quad \alpha = -\frac{1}{2}$

$\alpha + \gamma = 0 \quad \gamma = \frac{1}{2}$

$2\beta - 3\gamma + \delta = 0$

$2\beta - 3\left(\frac{1}{2}\right) + \delta = 0$

By hit and trial (using option (1))

Put $\beta = -1$

$2(-1) - \frac{3}{2} + \delta = 0 \quad \therefore \delta = \frac{7}{2}$

25. Consider the diameter of a spherical object being measured with the help of a Vernier callipers. Suppose its 10 Vernier Scale Divisions (V.S.D.) are equal to its 9 Main Scale Divisions (M.S.D.). The least division in the M.S. is 0.1 cm and the zero of V.S. is at $x = 0.1$ cm when the jaws of Vernier callipers are closed.

If the main scale reading for the diameter is $M = 5$ cm and the number of coinciding vernier division is 8, the measured diameter after zero error correction, is

(1) 5.18 cm

(2) 5.08 cm

(3) 4.98 cm

(4) 5.00 cm

Answer (3)

Sol. Least count = 1MSD – 1VSD

$= 1\,\text{MSD} - \frac{9}{10}\text{MSD}$

$= \frac{1}{10}\text{MSD}$

$= \frac{1}{10} \times 0.1\text{ cm} = 0.01\text{ cm}$

Zero error = +0.1 cm

Main scale reading = 5 cm

Vernier scale reading = 8 × 0.01 = 0.08 cm

Final measurement of diameter

= 5 + 0.08 – 0.1 = 4.98 cm

26. A parallel plate capacitor made of circular plates is being charged such that the surface charge density on its plates is increasing at a constant rate with time. The magnetic field arising due to displacement current is:

(1) Zero at all places

(2) Constant between the plates and zero outside the plates

(3) Non-zero everywhere with maximum at the imaginary cylindrical surface connecting peripheries of the plates

(4) Zero between the plates and non-zero outside

Answer (3)

Sol. Let the surface charge density be $\sigma = \frac{q}{A}$

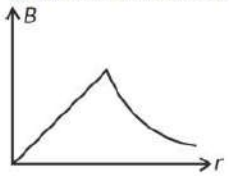
Given $\frac{d\sigma}{dt}$ = constant

$\therefore \quad \frac{d}{dt}\left(\frac{q}{A}\right)$ = constant $\Rightarrow \frac{I}{A} i$ = constant

It means displacement current is constant.

This system will act like a cylindrical wire.

The graph of magnetic field (B) vs r is



27. An unpolarized light beam travelling in air is incident on a medium of refractive index 1.73 at Brewster's angle. Then

(1) Reflected light is completely polarized and the angle of reflection is close to 60°

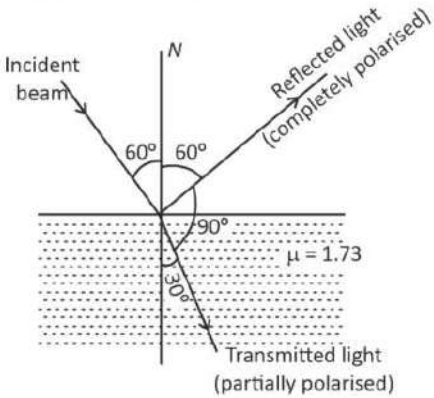
(2) Reflected light is partially polarized and the angle of reflection is close to 30°

(3) Both reflected and transmitted light are perfectly polarized with angles of reflection and refraction close to 60° and 30°, respectively

(4) Transmitted light is completely polarized with angle of refraction close to 30°

Answer (1)

Sol. Using Brewster law



$\mu = \tan\theta_P$

$\Rightarrow 1.73 = \tan\theta_P$

$\Rightarrow \sqrt{3} = \tan\theta_P$

$\Rightarrow \theta_P = 60°$

At this polarising angle, reflected light is perfectly polarized and transmitted light is partially polarised.

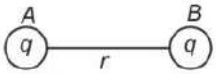
28. Two identical charged conducting spheres *A* and *B* have their centres separated by a certain distance. Charge on each sphere is *q* and the force of repulsion between them is *F*. A third identical uncharged conducting sphere is brought in contact with sphere *A* first and then with *B* and finally removed from both. New force of repulsion between spheres *A* and *B* (Radii of *A* and *B* are negligible compared to the distance of separation so that for calculating force between them they can be considered as point charges) is best given as:

(1) $\frac{3F}{5}$ (2) $\frac{2F}{3}$

(3) $\frac{F}{2}$ (4) $\frac{3F}{8}$

Answer (4)

Sol.



$F = \frac{Kqq}{r^2}$

$F' = \frac{Kq\frac{3q}{2\ 4}}{r^2}$

$F' = \frac{3F}{8}$

29. A container has two chambers of volumes V_1 = 2 litres and V_2 = 3 litres separated by a partition made of a thermal insulator. The chambers contain n_1 = 5 and n_2 = 4 moles of ideal gas at pressures p_1 = 1 atm and p_2 = 2 atm, respectively. When the partition is removed, the mixture attains an equilibrium pressure of

(1) 1.3 atm (2) 1.6 atm

(3) 1.4 atm (4) 1.8 atm

Answer (2)

Sol. $P_1V_1 + P_2V_2 = P(V_1 + V_2)$

$1(2) + 2(3) = P(2 + 3)$

$\frac{8}{5} = P$

$\Rightarrow$ 1.6 atm

30. A particle of mass *m* is moving around the origin with a constant force *F* pulling it towards the origin. If Bohr model is used to describe its motion, the radius of the nth orbit and the particle's speed ν in the orbit depend on *n* as

(1) $r \propto n^{1/3}; \nu \propto n^{1/3}$ (2) $r \propto n^{1/3}; \nu \propto n^{2/3}$

(3) $r \propto n^{2/3}; \nu \propto n^{1/3}$ (4) $r \propto n^{4/3}; \nu \propto n^{-1/3}$

Answer (3)

Sol. Given, force is constant

$F = \frac{mv^2}{r}$

$\Rightarrow \frac{v^2}{r}$ = constant

$\Rightarrow r \propto v^2$ ...(1)

& $L = mvr = \frac{nh}{2\pi}$ ...(2)

$\Rightarrow$ on solving equation (1) and equation (2)

$v \propto n^{1/3}$ and $r \propto n^{2/3}$

31. The radius of Martian orbit around the Sun is about 4 times the radius of the orbit of Mercury. The Martian year is 687 Earth days. Then which of the following is the length of 1 year on Mercury?

(1) 88 earth days
(2) 225 earth days
(3) 172 earth days
(4) 124 earth days

Answer (1)

Sol. Applying Kepler's 3rd law : $T^2 \propto R^3$

Radius of Martian orbit, $R' = 4R$

$$\left(\frac{T'}{T}\right)^2 = \left(\frac{R'}{R}\right)^3 = \left(\frac{4R}{R}\right)^3 = 4^3 = 64 \Rightarrow \frac{T'}{T} = 8$$

$\therefore$ Length of 1 year on Mercury = $T = \frac{T'}{8} = \frac{687}{8} = 85.88$ days

32. A body weighs 48 N on the surface of the earth. The gravitational force experienced by the body due to the earth at a height equal to one-third the radius of the earth from its surface is :

(1) 16 N
(2) 27 N
(3) 32 N
(4) 36 N

Answer (2)

Sol. $W = mg$ and $g = \frac{GM}{R^2}$, $g_h = \frac{GM}{(R+h)^2}$

$$\Rightarrow \frac{W_h}{W} = \frac{mg_h}{mg} = \frac{g_h}{g} = \frac{R^2}{(R+h)^2} \quad \left(h = \frac{R}{3}\right)$$

$$\Rightarrow \frac{W_h}{W} = \frac{R^2}{\left(R + \frac{R}{3}\right)^2} = \frac{R^2}{\left(\frac{4R}{3}\right)^2} = \frac{9}{16}$$

$$\Rightarrow W_h = \frac{9}{16}W = \frac{9}{16} \times 48 \quad [W = 48\text{ N}]$$

$= 27$ N

33. A wire of resistance R is cut into 8 equal pieces. From these pieces two equivalent resistances are made by adding four of these together in parallel. Then these two sets are added in series. The net effective resistance of the combination is:

(1) $\frac{R}{64}$
(2) $\frac{R}{32}$
(3) $\frac{R}{16}$
(4) $\frac{R}{8}$

Answer (3)

Sol. After being cut into 8 equal pieces,

$\Rightarrow$ Resistance of each piece = $R' = \frac{R}{8}$

Each set has 4 pieces in parallel combination

$\Rightarrow$ Resistance of each set = $R'' = \frac{R'}{4} = \frac{R}{32}$

Both sets are connected in series

$\therefore \quad R_{eq} = R'' + R'' = 2 \times \frac{R}{32} = \frac{R}{16}$

34. De-Broglie wavelength of an electron orbiting in the n = 2 state of hydrogen atom is close to (Given Bohr radius = 0.052 nm)

(1) 0.067 nm
(2) 0.67 nm
(3) 1.67 nm
(4) 2.67 nm

Answer (2)

Sol. $r = 0.052\, n^2$

For $n = 2$

$r = 0.052 \times 4$

$= 0.208$ nm

$Mvr = \frac{nh}{2\pi}$

$\lambda = \frac{h}{Mv} = \pi r$

$= 3.14 \times 0.208$ nm

$= 0.65317$ nm

≈ 0.67 nm

35. An electric dipole with dipole moment 5×10^{-6} Cm is aligned with the direction of a uniform electric field of magnitude 4×10^5 N/C. The dipole is then rotated through an angle of 60° with respect to the electric field. The change in the potential energy of the dipole is:

(1) 0.8 J
(2) 1.0 J
(3) 1.2 J
(4) 1.5 J

Answer (2)

Sol. Given

$|\vec{P}| = 5 \times 10^{-6}$ C m

$|\vec{E}| = 4 \times 10^5$ N/C

$\theta_i = 0°$ and $\theta_f = 60°$

$\Delta U = U_f - U_i$

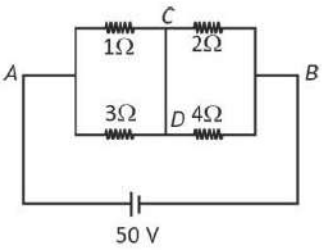
$= -PE\cos\theta_f + PE\cos\theta_i$

$= PE[\cos\theta_i - \cos\theta_f]$

$= 5 \times 10^{-6} \times 4 \times 10^5 \left[1 - \frac{1}{2}\right]$

$= 10 \times 10^{-6} \times 10^5 = 1$ J

36. A constant voltage of 50 V is maintained between the points *A* and *B* of the circuit shown in the figure. The current through the branch *CD* of the circuit is:



(1) 1.5 A

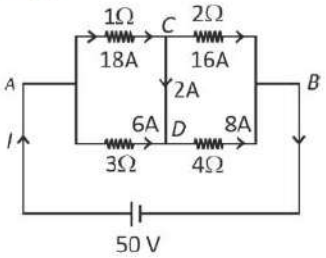
(2) 2.0 A

(3) 2.5 A

(4) 3.0 A

Answer (2)

Sol.



R_{AB} = (1Ω/3Ω) in series with (2Ω/4Ω)

$$=\frac{3\times1}{3+1}+\frac{2\times4}{2+4}$$

$$=\frac{3}{4}+\frac{8}{6}=\frac{9+16}{12}=\frac{25}{12}\Omega$$

Now total current through cell

$$I=\frac{50}{25/12}=24\text{A}$$

$$I_{1\Omega}=\frac{3}{4}\times24=18\text{A},\ I_{3\Omega}=\frac{1}{4}\times24=6\text{A}$$

$$I_{2\Omega}=\frac{4}{6}\times24=16\text{A},\ I_{4\Omega}=\frac{2}{6}\times24=8\text{A}$$

Using junction rule at *C*, I_{CD} = 18 – 16 = 2A (From *C* to *D*)

37. A photon and an electron (mass *m*) have the same energy *E*. The ratio ($\lambda_{photon}/\lambda_{electron}$) of their de Broglie wavelengths is: (*c* is the speed of light)

(1) $\sqrt{E/2m}$

(2) $c\sqrt{2mE}$

(3) $c\sqrt{\frac{2m}{E}}$

(4) $\frac{1}{c}\sqrt{E/2m}$

Answer (3)

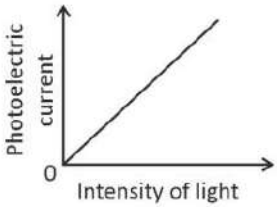
Sol. For photon, $E=\frac{hc}{\lambda_{Ph}}\ \Rightarrow\ \lambda_{Ph}=\frac{hc}{E}$

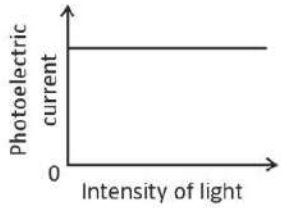
For electron, p = momentum and $E = \frac{p^2}{2m} = \left(\frac{h}{\lambda_e}\right)^2 \times \frac{1}{2m}$

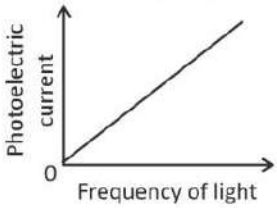
$$\Rightarrow \lambda_e = \frac{h}{\sqrt{2mE}}$$

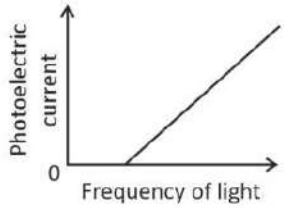
$$\therefore \frac{\lambda_{Ph}}{\lambda_e} = \frac{\frac{hc}{E}}{\frac{h}{\sqrt{2mE}}} = c\sqrt{\frac{2m}{E}}$$

38. Which of the following options represent the variation of photoelectric current with property of light shown on the x-axis?

A.


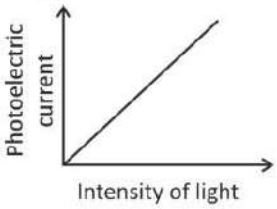
B.


C.


D.


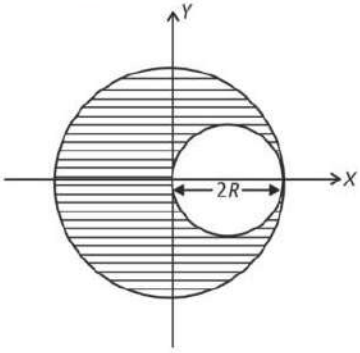
(1) A only
(2) A and C
(3) A and D
(4) B and D

Answer (1)

Sol.


Photoelectric current is directly proportional to intensity of light.

39. A sphere of radius R is cut from a larger solid sphere of radius $2R$ as shown in the figure. The ratio of the moment of inertia of the smaller sphere to that of the rest part of the sphere about the Y-axis is:



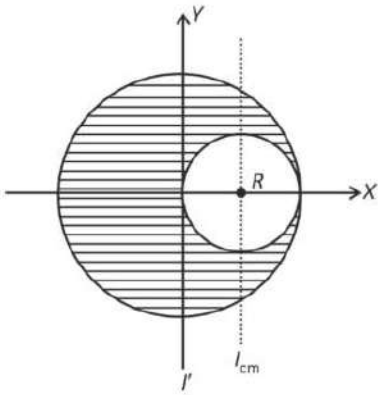
(1) $\frac{7}{8}$ (2) $\frac{7}{40}$

(3) $\frac{7}{57}$ (4) $\frac{7}{64}$

Answer (3)

Sol. For larger solid sphere about diameter *Y*-axis,

$$I_{\text{whole}} = \frac{2}{5}M(2R)^2 = \frac{8}{5}MR^2$$



Density of sphere is uniform

$$\Rightarrow \frac{M}{V_{\text{whole}}} = \frac{M_{\text{smaller}}}{V_{\text{smaller}}} \Rightarrow \frac{M}{\frac{4}{3}\pi(2R)^3} = \frac{M'}{\frac{4}{3}\pi R^3}$$

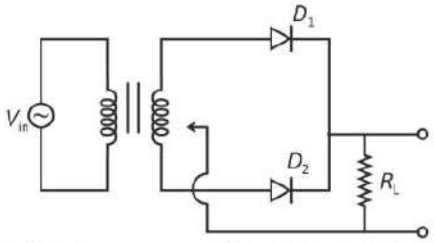
$$\Rightarrow M' = \frac{M}{8}$$

Using parallel axis theorem for smaller sphere,

$$I' = I_{\text{cm}} + M'R^2 = \frac{2}{5}\frac{MR^2}{8} + \frac{MR^2}{8} = \frac{7}{40}MR^2$$

$$\therefore \text{ Ratio} = \frac{I_{\text{smaller}}}{I_{\text{remaining}}} = \frac{I'}{I_{\text{whole}} - I'} = \frac{\frac{7}{40}MR^2}{\left(\frac{8}{5} - \frac{7}{40}\right)MR^2} = \frac{7}{64-7} = \frac{7}{57}$$

40. A full wave rectifier circuit with diodes (D_1) and (D_2) is shown in the figure. If input supply voltage $V_{in} = 220\sin(100\pi t)$ volt, then at t = 15 msec



(1) D_1 is forward biased, D_2 is reverse biased (2) D_1 is reverse biased, D_2 is forward biased.

(3) D_1 and D_2 both are forward biased (4) D_1 and D_2 both are reverse biased

Answer (2)

Sol. $V_{in} = 220\sin(100\pi t)$ volt

$t = 15$ ms

$t = 0.015$ s

$\omega = 100\pi$

$$\frac{2\pi}{T} = 100\pi$$

$$T = \frac{1}{50} \text{ s}$$

$T = 0.02$ s

$$\therefore\ t = \frac{3T}{4}$$

i.e. negative half cycle.

So now negative half cycle is fed to circuit making D_1 as reverse biased and D_2 as forward biased.

41. Two gases A and B are filled at the same pressure in separate cylinders with movable pistons of radius r_A and r_B, respectively. On supplying an equal amount of heat to both the systems reversibly under constant pressure, the pistons of gas A and B are displaced by 16 cm and 9 cm, respectively. If the change in their internal energy is the same, then the ratio $\frac{r_A}{r_B}$ is equal to

(1) $\frac{4}{3}$

(2) $\frac{3}{4}$

(3) $\frac{2}{\sqrt{3}}$

(4) $\frac{\sqrt{3}}{2}$

Answer (2)

Sol. Using first law of thermodynamics

$\Delta Q = \Delta U + P\Delta V$

ΔQ is same

ΔU is also same

$W_A = W_B$

$\therefore\ (P\Delta V)_A = (P\Delta V)_B$

P is also same

$\therefore\ A_A d_A = A_B d_B$

$$\pi r_A^2 d_A = \pi r_B^2 d_B$$

$$\frac{r_A}{r_B} = \left(\frac{dB}{dA}\right)^{\frac{1}{2}} = \left(\frac{9}{16}\right)^{\frac{1}{2}}$$

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

42. A physical quantity P is related to four observations a, b, c and d as follows:

$$P = a^3 b^2 / c\sqrt{d}$$

The percentage errors of measurement in a, b, c and d are 1%, 3%, 2%, and 4% respectively. The percentage error in the quantity P is

(1) 10% (2) 2%

(3) 13% (4) 15%

Answer (3)

Sol. Maximum % error in $P = \frac{\Delta P}{P} \times 100 = 3\left(\frac{\Delta a}{a} \times 100\right) + 2\left(\frac{\Delta b}{b} \times 100\right) + \left(\frac{\Delta c}{c} \times 100\right) + \frac{1}{2}\left(\frac{\Delta d}{d} \times 100\right)$

$= 3 \times (1) + 2 \times (3) + (2) + \frac{1}{2} \times (4)$

= 13%

43. The intensity of transmitted light when a polaroid sheet, placed between two crossed polaroids at 22.5° from the polarization axis of one of the polaroids, is (I_0 is the intensity of polarised light after passing through the first polaroid):

(1) $\frac{I_0}{2}$

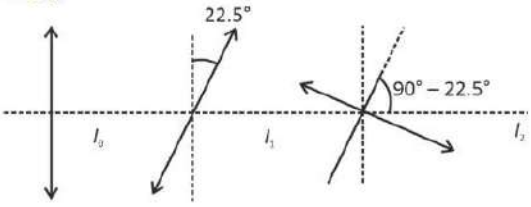
(2) $\frac{I_0}{4}$

(3) $\frac{I_0}{8}$

(4) $\frac{I_0}{16}$

Answer (3)

Sol.



$I_1 = I_0 \cos^2\left(\frac{45}{2}\right)$

$I_2 = I_1 \cos^2\left(90 - \frac{45}{2}\right)$

$= I_0 \cos^2\left(\frac{45}{2}\right)\sin^2\left(\frac{45}{2}\right)$

$= \frac{I_0}{4}\left(4\cos^2\left(\frac{45}{2}\right)\sin^2\left(\frac{45}{2}\right)\right)$

$= \frac{I_0}{4}\sin^2 45° = \frac{I_0}{8}$

44. Two identical point masses P and Q, suspended from two separate massless springs of spring constants k_1 and k_2, respectively, oscillate vertically. If their maximum speeds are the same, the ratio (A_Q/A_P) of the amplitude A_Q of mass Q to the amplitude A_P of mass P is

(1) $\frac{k_2}{k_1}$ (2) $\frac{k_1}{k_2}$

(3) $\sqrt{\frac{k_2}{k_1}}$ (4) $\sqrt{\frac{k_1}{k_2}}$

Answer (4)

Sol. Maximum velocity $V = A\omega$

$v_P = v_Q$

$A_P\omega_P = A_Q\omega_Q$

$\frac{A_Q}{A_P} = \frac{\omega_P}{\omega_Q}$ $\left(\omega = \sqrt{\frac{k}{m}}\right)$

$= \sqrt{\frac{k_P}{m_P}\frac{m_Q}{k_Q}}$

$= \sqrt{\frac{k_1}{k_2}}$

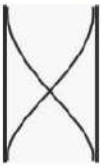
45. A pipe open at both ends has a fundamental frequency f in air. The pipe is now dipped vertically in a water drum to half of its length. The fundamental frequency of the air column is now equal to:

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

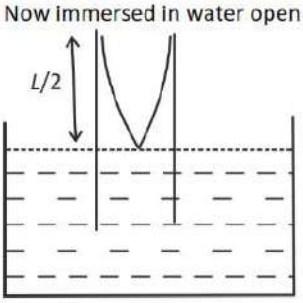
(3) $\frac{3f}{2}$ (4) $2f$

Answer (2)

Sol. Fundamental frequency of open pipe (at both ends) $f = \frac{v}{2L}$ ...(i)



Now immersed in water open pipe behaves as closed pipe.



$f' = \frac{v}{4\left(\frac{L}{2}\right)} = \frac{v}{2L}$ ...(ii)

$f = f'$

CHEMISTRY

46. The ratio of the wavelengths of the light absorbed by a Hydrogen atom when it undergoes n = 2 → n = 3 and n = 4 → n = 6 transitions, respectively, is

(1) $\frac{1}{36}$ (2) $\frac{1}{16}$

(3) $\frac{1}{9}$ (4) $\frac{1}{4}$

Answer (4)

Sol. $\Delta E = \frac{hc}{\lambda} = E_{final} - E_{initial} \quad \left(E_n = \frac{-R_H}{n^2}\right)$

$$\Delta E_{2\to3} = \frac{hc}{\lambda_{2\to3}} = E_3 - E_2 = \frac{-R_H}{3^2} - \left(\frac{-R_H}{2^2}\right)$$

$$= R_H\left(\frac{1}{4} - \frac{1}{9}\right)$$

$$= R_H \times \frac{5}{36}$$

$$\therefore \lambda_{2\to3} = \frac{hc \cdot 36}{R_H \cdot 5}$$

$$\Delta E_{4\to6} = E_6 - E_4 = \frac{-R_H}{36} + \frac{R_H}{16} = \frac{R_H \times 20}{36 \times 16}$$

$$\frac{hc}{\lambda_{4\to6}} = \frac{R_H \times 20}{36 \times 16}$$

$$\lambda_{4\to6} = \frac{hc \times 36 \times 16}{R_H \cdot 20}$$

$$\frac{\lambda_{2\to3}}{\lambda_{4\to6}} = \frac{\frac{hc \cdot 36}{R_H \cdot 5}}{\frac{hc \times 36 \times 16}{R_H \cdot 20}}$$

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

47. Which of the following statements are true?

A. Unlike Ga that has a very high melting point, Cs has a very low melting point.

B. On Pauling scale, the electronegativity values of N and Cl are not the same.

C. Ar, K^+, Cl^-, Ca^{2+}, and S^{2-} are all isoelectronic species.

D. The correct order of the first ionization enthalpies of Na, Mg, Al, and Si is Si >Al > Mg > Na.

E. The atomic radius of Cs is greater than that of Li and Rb.

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

(1) A, B, and E only (2) C and E only

(3) C and D only (4) A, C, and E only

Answer (2)

Sol. Both Ga and Cs have low melting points.

Element	**Melting point/K**
Ga	303
Cs	302

- On Pauling scale, the electronegativity value of N and Cl have same (3.0).
- Ar, K^+, Cl^-, Ca^{2+} and S^{2-} have 18 electrons. So these are isoelectronic species.
- The correct order of first ionization enthalpy is Si > Mg > Al > Na
  First ionisation enthalpy of Mg is higher than Al because the penetration of a 3s-electron to the nucleus is more than that of a 2p-electron.
- Generally down the group atomic radii increases

Atom	**Atomic radius/pm**
Li	152
Rb	244
CS	262

48. Match **List I** with **List II**

	List-I (Ion)		**List-II (Group Number in Cation Analysis)**
A.	Co^{2+}	I.	Group-I
B.	Mg^{2+}	II.	Group-III
C.	Pb^{2+}	III.	Group-IV
D.	Al^{3+}	IV.	Group-VI

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

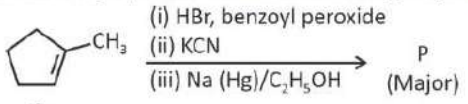
(1) A-III, B-IV, C-II, D-I
(2) A-III, B-IV, C-I, D-II
(3) A-III, B-II, C-IV, D-I
(4) A-III, B-II, C-I, D-IV

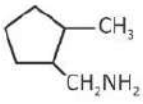
Answer (2)

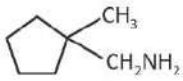
Sol.

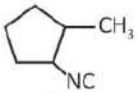
	Ion	**Group number in Cation Analysis**
A.	Co^{2+}	Group-IV
B.	Mg^{2+}	Group-VI
C.	Pb^{2+}	Group-I
D.	Al^{3+}	Group-III

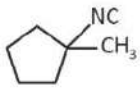
49. Predict the major product 'P' in the following sequence of reactions-



(1) 

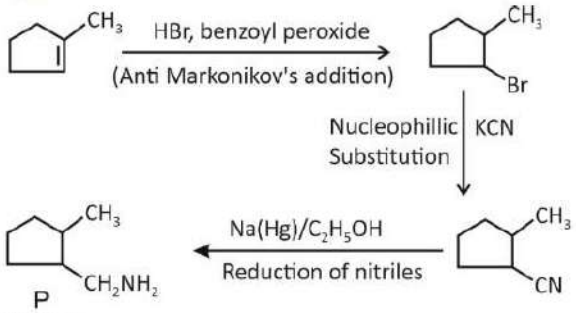
(2) 

(3) 

(4) 

Answer (1)

Sol.



50. Energy and radius of first Bohr orbit of He^+ and Li^{2+} are

[Given $R_H = 2.18 \times 10^{-18}$ J, $a_0 = 52.9$ pm]

(1) $E_n(Li^{2+}) = -19.62 \times 10^{-18}$ J;
$r_n(Li^{2+}) = 17.6$ pm
$E_n(He^+) = -8.72 \times 10^{-18}$ J;
$r_n(He^+) = 26.4$ pm

(2) $E_n(Li^{2+}) = -8.72 \times 10^{-18}$ J;
$r_n(Li^{2+}) = 26.4$ pm
$E_n(He^+) = -19.62 \times 10^{-18}$ J;
$r_n(He^+) = 17.6$ pm

(3) $E_n(Li^{2+}) = -19.62 \times 10^{-16}$ J;
$r_n(Li^{2+}) = 17.6$ pm
$E_n(He^+) = -8.72 \times 10^{-16}$ J;
$r_n(He^+) = 26.4$ pm

(4) $E_n(Li^{2+}) = -8.72 \times 10^{-16}$ J;
$r_n(Li^{2+}) = 17.6$ pm
$E_n(He^+) = -19.62 \times 10^{-16}$ J;
$r_n(He^+) = 17.6$ pm

Answer (1)

Sol. $E_n = \dfrac{-2.18 \times 10^{-18} \times z^2}{n^2}$ J; $r_n = \dfrac{52.9 \times n^2}{z}$ pm

For He^+

$E_{He^+} = -2.18 \times 10^{-18} \times 4 = -8.72 \times 10^{-18}$ J

$r_{He^+} = \dfrac{52.9 \times 1}{2} = 26.45$ pm

For Li^{2+}

$E_{Li^{2+}} = -2.18 \times 10^{-18} \times 9 = 19.62 \times 10^{-18}$ J

$r_{Li^{2+}} = \dfrac{52.9 \times 1}{3} = 17.63$ pm

51. Which of the following are paramagnetic?

A. $[NiCl_4]^{2-}$

B. $Ni(CO)_4$

C. $[Ni(CN)_4]^{2-}$

D. $[Ni(H_2O)_6]^{2+}$

E. $Ni(PPh_3)_4$

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

(1) A and C only (2) B and E only

(3) A and D only (4) A, D and E only

Answer (3)

Sol.

A. $[NiCl_4]^{2-}$; Ni^{+2}; $3d^8$; sp^3 hybridisation; 2 unpaired electrons; paramagnetic

B. $Ni(CO)_4$; Ni; $3d^8\ 4s^2$; sp^3 hybridisation; Zero unpaired electron; diamagnetic

C. $[Ni(CN)_4]^{2-}$; Ni^{+2}; $3d^8$; dsp^2 hybridisation; Zero unpaired electron; diamagnetic

D. $[Ni(H_2O)_6]^{2+}$; Ni^{2+}, $3d^8$; sp^3d^2 hybridisation; Two unpaired electron; paramagnetic

E. $Ni(PPh_3)_4$; Ni; $3d^8\ 4s^2$, sp^3 hybridisation; zero unpaired electron; Diamagnetic

52. Given below are two statements :

Statement I : Like nitrogen that can form ammonia, arsenic can form arsine.

Statement II : Antimony cannot form antimony pentoxide.

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

(1) Both Statement I and Statement II are correct (2) Both Statement I and Statement II are incorrect

(3) Statement I is correct but Statement II is incorrect (4) Statement I is incorrect but Statement II is correct

Answer (3)

Sol. All the elements of group 15 form hydrides of EH_3 type. Nitrogen forms ammonia (NH_3) while Arsenic forms Arsine (AsH_3)

All the elements of group 15 form two types of oxides : E_2O_3 and E_2O_5

Antimony forms antimony pentoxide Sb_2O_5

Hence, statement I is correct and statement II is incorrect

53. Which among the following electronic configurations belong to main group elements?

A. $[Ne]3s^1$ B. $[Ar]3d^3 4s^2$

C. $[Kr]4d^{10}\ 5s^2 5p^5$ D. $[Ar]3d^{10} 4s^1$

E. $[Rn]5f^0 6d^2 7s^2$

Choose the correct answer from the option given below :

(1) B and E only

(2) A and C only

(3) D and E only

(4) A, C and D only

Answer (2)

Sol. (A) $[Ne]3s^1$; Na (s-block)

(B) $[Ar]3d^3 4s^2$; V (d-block)

(C) $[Kr]4d^{10}5s^2 5p^5$; I (p-block)

(D) $[Ar]3d^{10}4s^1$; Cu (d-block)

(E) $[Rn]5f^0 6d^2 7s^2$; Th (f-block)

Main group elements (A and C only)

54. Dalton's Atomic theory could not explain which of the following?

(1) Law of conservation of mass
(2) Law of constant proportion
(3) Law of multiple proportion
(4) Law of gaseous volume

Answer (4)

Sol. Dalton's theory could explain the laws of chemical combination. However, it could not explain the laws of gaseous volumes.

55. Consider the following compounds :

$\underline{K}O_2$, $H_2\underline{O}_2$ and $H_2\underline{S}O_4$

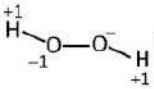
The oxidation state of the underlined elements in them are, respectively,

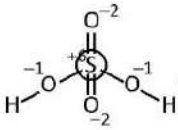
(1) +1, –1, and +6
(2) +2, –2, and +6
(3) +1, –2, and +4
(4) +4, –4, and +6

Answer (1)

Sol.

KO_2 → Alkali metal always shows +1 oxidation state. Therefore oxidation state of K is +1.

H_2O_2 →  Oxidation state of oxygen in H_2O_2 is –1.

H_2SO_4 →  Oxidation state of sulphur in H_2SO_4 is +6.

56. If the half-life ($t_{1/2}$) for a first order reaction is 1 minute, then the time required for 99.9% completion of the reaction is closest to :

(1) 2 minutes
(2) 4 minutes
(3) 5 minutes
(4) 10 minutes

Answer (4)

Sol. For 1st order reaction

$kt = 2.303 \log \frac{A_0}{A_t}$ A_0 = initial concentration

A_t = Final concentration

$t_{99.9\%} = 10\, t_{1/2}$

$t_{99.9\%} = 10 \times 1$ minute = 10 minutes

57. The correct order of the wavelength of light absorbed by the following complexes is,

A. $[Co(NH_3)_6]^{3+}$

B. $[Co(CN)_6]^{3-}$

C. $[Cu(H_2O)_4]^{2+}$

D. $[Ti(H_2O)_6]^{3+}$

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

(1) B < D < A < C

(2) B < A < D < C

(3) C < D < A < B

(4) C < A < D < B

Answer (2)

Sol. $\lambda \propto \dfrac{1}{\text{strength of ligand}}$

$\lambda \propto \dfrac{1}{\text{splitting}}$

A. $[Co(NH_3)_6]^{3+}$; 475 nm

B. $[Co(CN)_6]^{3-}$; 310 nm

C. $[Cu(H_2O)_4]^{2+}$; 600 nm

D. $[Ti(H_2O)_6]^{3+}$; 498 nm

Order of λ = C > D > A > B

58. Which one of the following compounds can exist as cis-trans isomers?

(1) Pent-1-ene

(2) 2-Methylhex-2-ene

(3) 1, 1-Dimethylcyclopropane

(4) 1, 2-Dimethylcyclohexane

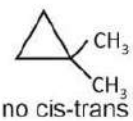
Answer (4)

Sol. Cis-trans isomers shown by :

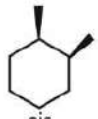
Condition: Restricted rotation around double bond

Or

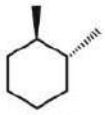
Different group around double bond



no cis-trans



cis



trans

$CH_3 - CH_2 - CH_2 - CH = CH_2$

no cis-trans

$CH_3 - CH_2 - CH_2 - CH = C(CH_3) - CH_3$

no cis-trans

59. Phosphoric acid ionizes in three steps with their ionization constant values K_{a_1}, K_{a_2} and K_{a_3}, respectively, while K is the overall ionization constant. Which of the following statements are true?

A. $\log K = \log K_{a_1} + \log K_{a_2} + \log K_{a_3}$

B. H_3PO_4 is a stronger acid than $H_2PO_4^-$ and HPO_4^{2-}

C. $K_{a_1} > K_{a_2} > K_{a_3}$

D. $K_{a_1} = \frac{K_{a_3} + K_{a_2}}{2}$

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

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

Answer (4)

Sol. H_3PO_4 is a stronger acid than $H_2PO_4^-$ and HPO_4^{2-}

$H_3PO_4(aq) \rightleftharpoons H^+(aq) + H_2PO_4^-(aq)$ $\quad K_{a_1} = 7.5\times10^{-3}$

$H_2PO_4^-(aq) \rightleftharpoons H^+(aq) + HPO_4^{2-}(aq)$ $\quad K_{a_2} = 6.2\times10^{-8}$

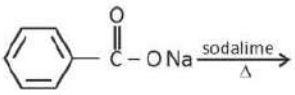
$HPO_4^{2-}(aq) \rightleftharpoons H^+(aq) + PO_4^{3-}(aq)$ $\quad K_{a_3} = 1.7\times10^{-12}$

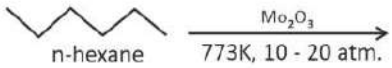
$K_{a_1} > K_{a_2} > K_{a_3}$

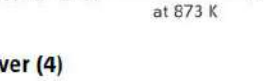
$\log K = \log K_{a_1} + \log K_{a_2} + \log K_{a_3}$

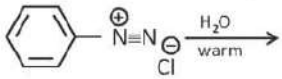
Ans. (A), (B) and (C) only

60. Which one of the following reactions does **NOT** give benzene as the product?

(1) 

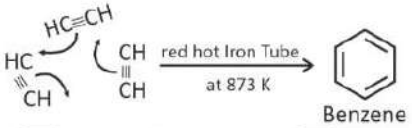
(2) 

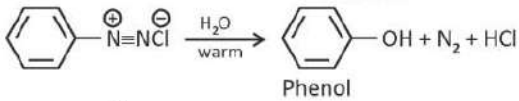
(3) 

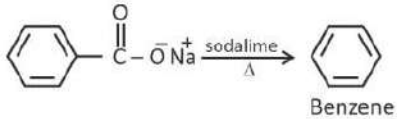
(4) 

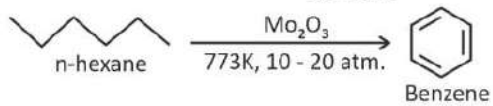
Answer (4)

Sol.

1. 

2. 

3. 

4. 

61. If the molar conductivity (Λ_m) of a 0.050 mol L^{-1} solution of a monobasic weak acid is 90 S cm^2 mol^{-1}, its extent (degree) of dissociation will be

[Assume Λ_+° = 349.6 S cm^2 mol^{-1} and Λ_-° = 50.4 S cm^2 mol^{-1}.]

(1) 0.115 (2) 0.125

(3) 0.225 (4) 0.215

Answer (3)

Sol. Degree of dissociation (α) is given as

$$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ}$$

$$\Lambda_m^\circ = \Lambda_+^\circ + \Lambda_-^\circ$$

= 349.6 + 50.4

= 400 S cm^2 mol^{-1}

$$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ} = \frac{90}{400} = 0.225$$

62. Given below are two statements :

Statement I : A hypothetical diatomic molecule with bond order zero is quite stable.

Statement II : As bond order increases, the bond length increases.

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

(1) Both Statement I and Statement II are true (2) Both Statement I and Statement II are false

(3) Statement I is true but Statement II is false (4) Statement I is false but Statement II is true

Answer (2)

Sol.
- A positive bond order means a stable molecule while a negative or zero bond order means an unstable molecule.
- When bond order increases, the bond length decreases.

63. Out of the following complex compounds, which of the compound will be having the minimum conductance in solution?

(1) $[Co(NH_3)_3Cl_3]$ (2) $[Co(NH_3)_4Cl_2]$

(3) $[Co(NH_3)_6]Cl_3$ (4) $[Co(NH_3)_5Cl]Cl$

Answer (1, 2)

Sol. Conductance of any complex depends on the following factor.

(1) Number of ions produced by complex.

(2) If number of ions are same then we will check charge on complex unit.

$$\left.\begin{array}{l}(1)\ \left[Co^{+3}(NH_3)_3Cl_3\right] \\ (2)\ \left[Co^{+2}(NH_3)_4Cl_2\right]\end{array}\right\}$$ Both complex units have no charge. Therefore both complex units have same conductance.

(3) $[Co(NH_3)_6]Cl_3 \rightarrow [Co(NH_3)_6]^{+3} + 3Cl^-$

(4) $[Co(NH_3)_5Cl]Cl \rightarrow [Co(NH_3)_5Cl]^+ + Cl^-$

64. Match **List-I** with **List-II**

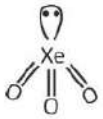
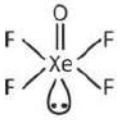
	List-I		List-II
A.	XeO_3	(I)	sp^3d; linear
B.	XeF_2	(II)	sp^3; pyramidal
C.	$XeOF_4$	(III)	sp^3d^3; distorted octahedral
D.	XeF_6	(IV)	sp^3d^2; square pyramidal

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

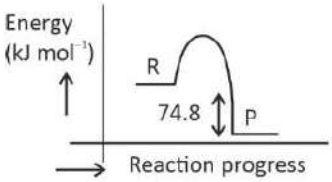
(1) A-II, B-I, C-IV, D-III
(2) A-II, B-I, C-III, D-IV
(3) A-IV, B-II, C-III, D-I
(4) A-IV, B-II, C-I, D-III

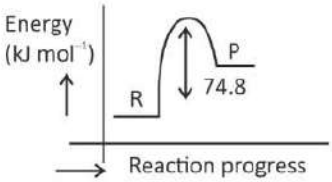
Answer (1)

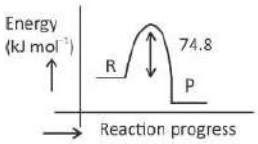
Sol.

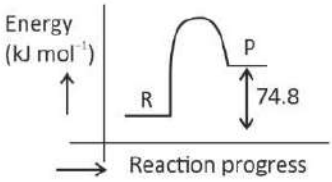
Molecule	Hybridisation	Shape
	sp^3	Pyramidal
	sp^3d	Linear
	sp^3d^2	Square Pyramidal
	sp^3d^3	Distorted Octahedral

65. $C(s) + 2H_2(g) \rightarrow CH_4(g)$; $\Delta H = -74.8$ kJ mol^{-1}. Which of the following diagrams gives an accurate representation of the above reaction? [R → reactants; P → products]

(1) 

(2) 

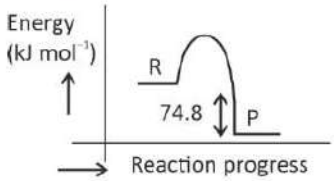
(3) 

(4) 

Answer (1)

Sol. $\Delta H = -74.8$ k J mol^{-1}, it is an exothermic reaction.

So, accurate representation is



66. Match List-I with List-II

	List-I (Example)		**List-II (Type of Solution)**
A.	Humidity	I.	Solid in solid
B.	Alloys	II.	Liquid in gas
C.	Amalgams	III.	Solid in gas
D.	Smoke	IV.	Liquid in solid

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

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

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

Answer (2)

Sol.

- Humidity is a solution of liquid in gas
- Alloy is a solution of solid in solid
- Amalgam is a solution of liquid in solid
- Smoke is a solution of solid in gas

67. The correct order of decreasing basic strength of the given amines is:

(1) N-methylaniline > benzenamine > ethanamine > N-ethylethanamine

(2) N-ethylethanamine > ethanamine > benzenamine > N-methylaniline

(3) N-ethylethanamine > ethanamine > N-methylaniline > benzenamine

(4) benzenamine > ethanamine > N-methylaniline > N-ethylethanamine

Answer (3)

Sol. Lower is the value of pK_b, higher is the basicity

Also aliphatic amines are stronger bases than aromatic amines.

pK_b : Benzenamine > N-Methylaniline > Ethanamine > N-Ethylethanamine

Basic strength : N-Ethylethanamine > Ethanamine > N-Methylaniline > Benzenamine

68. Among the following, choose the ones with equal number of atoms.

A. 212 g of $Na_2CO_3(s)$ [molar mass = 106 g]

B. 248 g of $Na_2O(s)$ [molar mass = 62 g]

C. 240 g of NaOH(s) [molar mass = 40 g]

D. 12 g of $H_2(g)$ [molar mass = 2 g]

E. 220 g of $CO_2(g)$ [molar mass = 44 g]

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

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

Answer (2)

Sol. Number of atoms = $\frac{\text{given mass}}{\text{molar mass}} \times \text{atomicity} \times N_A$

A. $\frac{212}{106} \times 6 \times N_A = 12\ N_A$

B. $\frac{248}{62} \times 3 \times N_A = 12\ N_A$

C. $\frac{240}{40} \times 3 \times N_A = 18\ N_A$

D. $\frac{12}{2} \times N_A \times 2 = 12\ N_A$

E. $\frac{220}{44} \times N_A \times 3 = 15\ N_A$

A, B and D have same number of atoms

69. Match **List-I** with **List-II.**

	List-I (Name of Vitamin)		**List-II (Deficiency disease)**
A.	Vitamin B_{12}	I.	Cheilosis
B.	Vitamin D	II.	Convulsions
C.	Vitamin B_2	III.	Rickets
D.	Vitamin B_6	IV.	Pernicious anaemia

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

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

Answer (2)

Sol.

	List-I (Name of Vitamin)	**List-II (Deficiency disease)**
A.	Vitamin B_{12}	Pernicious anaemia
B.	Vitamin D	Rickets
C.	Vitamin B_2	Cheilosis
D.	Vitamin B_6	Convulsions

70. The correct order of decreasing acidity of the following aliphatic acids is

(1) $(CH_3)_3CCOOH > (CH_3)_2CHCOOH > CH_3COOH > HCOOH$

(2) $CH_3COOH > (CH_3)_2CHCOOH > (CH_3)_3CCOOH > HCOOH$

(3) $HCOOH > CH_3COOH > (CH_3)_2CHCOOH > (CH_3)_3CCOOH$

(4) $HCOOH > (CH_3)_3CCOOH > (CH_3)_2CHCOOH > CH_3COOH$

Answer (3)

Sol. Electron donating group decreases the acidity of carboxylic acids.

So correct order is

$HCOOH > CH_3COOH > (CH_3)_2CHCOOH > (CH_3)_3CCOOH$

71. Given below are two statements :

Statement I : Ferromagnetism is considered as an extreme form of paramagnetism.

Statement II : The number of unpaired electrons in a Cr^{2+} ion (Z = 24) is the same as that of a Nd^{3+} ion (Z = 60).

In the light of the above statements, choose the **correct** answer from the options given below :

(1) Both Statement I and Statement II are true

(2) Both Statement I and Statement II are false

(3) Statement I is true but Statement II is false

(4) Statement I is false but Statement II is true

Answer (3)

Sol. Substances which are attracted very strongly in applied magnetic field are termed as ferromagnetic. Infact, ferromagnetism is an extreme form of paramagnetism.

Hence statement I is correct.

$Cr^{2+} = 3d^4 4s^0$

Unpaired electrons = 4

$Nd^{3+} = 4f^3\ 6s^0$

Unpaired electrons = 3

Hence, Statement II is incorrect

72. Match **List I** with **List II**

	List-I (Mixture)		**List-II (Method of separation)**
A.	$CHCl_3 + C_6H_5NH_2$	(I)	Distillation under reduced pressure
B.	Crude oil in petroleum industry	(II)	Steam distillation
C.	Glycerol from spent-lye	(III)	Fractional distillation
D.	Aniline - water	(IV)	Simple distillation

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

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

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

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

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

Answer (1)

Sol.

		(Method of separation)
(A)	$CHCl_3 + C_6H_5NH_2$	Simple distillation
(B)	Crude oil in petroleum industry	Fractional distillation
(C)	Glycerol from spent-lye	Distillation under reduced pressure
(D)	Aniline - water	Steam Distillation

73. For the reaction $A(g) \rightleftharpoons 2B(g)$, the backward reaction rate constant is higher than the forward reaction rate constant by a factor of 2500, at 1000 K.

[Given : R = 0.0831 L atm mol^{-1} K^{-1}]

K_P for the reaction at 1000 K is

(1) 83.1 (2) 2.077×10^5

(3) 0.033 (4) 0.021

Answer (3)

Sol. $K_C = \frac{k_f}{k_b} = \frac{1}{2500}$

$K_p = K_C (RT)^{\Delta n_g}$ $(\Delta n_g = 2 - 1 = 1)$

$= \frac{1}{2500} \times 0.0831 \times 1000$

= 0.033

74. Given below are two statements :

Statement-I : Benzenediazonium salt is prepared by the reaction of aniline with nitrous acid at 273 – 278 K. It decomposes easily in the dry state.

Statement-II : Insertion of iodine into the benzene ring is difficult and hence iodobenzene is prepared through the reaction of benzenediazonium salt with KI.

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

(1) Both Statement I and Statement II are correct (2) Both Statement I and Statement II are incorrect

(3) Statement I is correct but Statement II is incorrect (4) Statement I is incorrect but Statement II is correct

Answer (1)

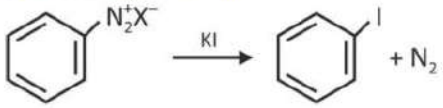
Sol. Benzene diazonium chloride is prepared by the reaction of aniline with nitrous acid at 273-278 K.

Nitrous acid is produced in the reaction mixture by reaction of $NaNO_2$ with HCl.

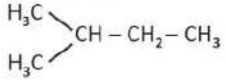
$C_6H_5NH_2 + NaNO_2 + 2HCl \xrightarrow{273-278\,K} C_6H_5\overset{+}{N_2}\overset{-}{Cl} + NaCl + 2H_2O$

Benzene diazonium chloride decomposes easily in the dry state

Iodobenzene is prepared by shaking benzene diazonium salt with KI because direct insertion of iodine into benzene ring is difficult



75. How many products (including stereoisomers) are expected from monochlorination of the following compound?

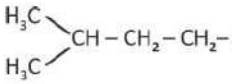


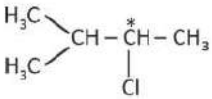
(1) 2 (2) 3

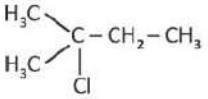
(3) 5 (4) 6

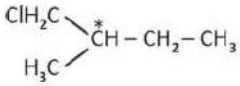
Answer (4)

Sol. Possible monochlorination products :


; One isomer

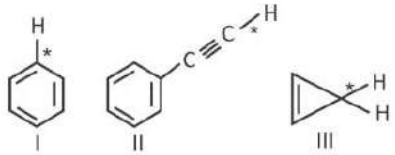

; Two isomers due to presence of chiral carbon


; One isomer


; Two isomers due to chiral carbon

Total 6 isomers

76. Among the given compounds I-III, the correct order of bond dissociation energy of C–H bond marked with * is :

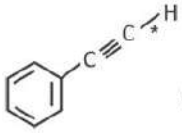


(1) II > I > III (2) I > II > III

(3) III > II > I (4) II > III > I

Answer (1)

Sol. I. carbon of this bond is sp^2 hybridised

II.  carbon of this bond is sp hybridised

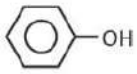
III. carbon of this bond is sp^3 hybridised

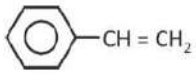
Higher the percentage s character, stronger is C–H bond. Correct order of bond dissociation energy of C–H bond:

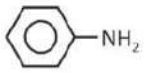
II > I > III

77. Which one of the following compounds **does not** decolourize bromine water?

(1)

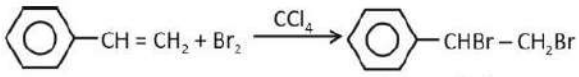
(2) 

(3) 

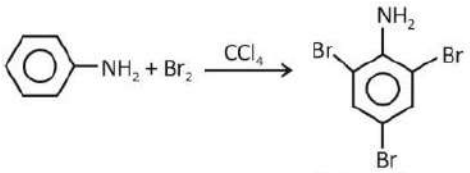
(4) 

Answer (1)

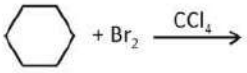
Sol. Test for unsaturation i.e. Bromine water Reddish orange colour of bromine solution in CCl_4 will discharge when bromine adds to an unsaturation site.



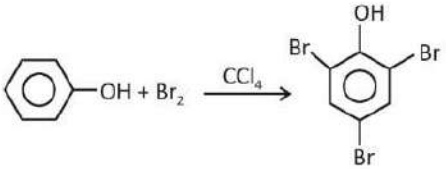
Colour discharge



Colour discharge

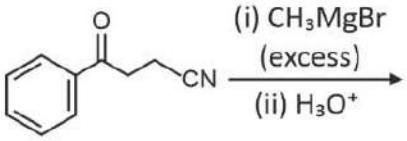


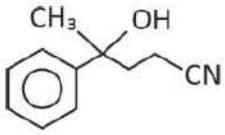
No reaction
No discharge of orange colour

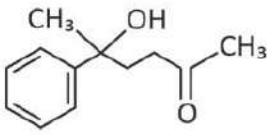


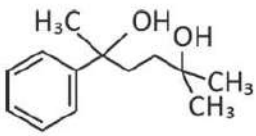
Colour discharge

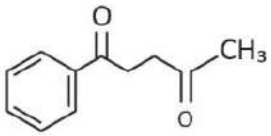
78. The major product of the following reaction is



(1) 

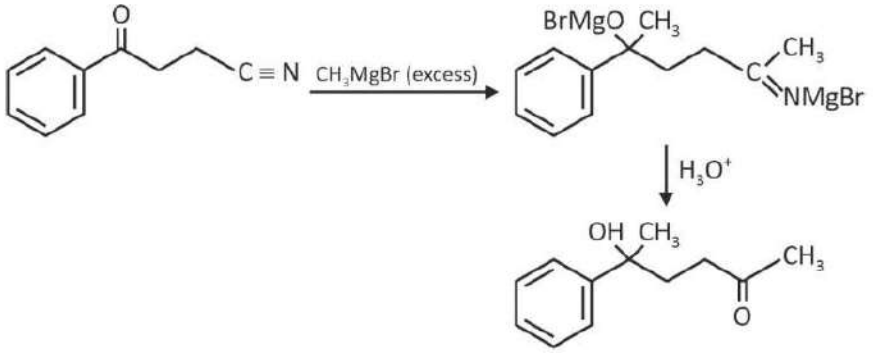
(2) 

(3) 

(4) 

Answer (2)

Sol.



79. Which of the following aqueous solution will exhibit highest boiling point?

(1) 0.01M Urea

(2) 0.01M KNO_3

(3) 0.01M Na_2SO_4

(4) 0.015M $C_6H_{12}O_6$

Answer (3)

Sol.

$\Delta T_b = iK_b \times m$

$\Delta T_b \propto i \times m$

By considering molarity same as molality

(1) 0.01M Urea $i \times m = 1 \times 0.01 = 0.01$

(2) 0.01 M KNO_3 $i \times m = 2 \times 0.01 = 0.02$

(3) 0.01M Na_2SO_4 $i \times m = 3 \times 0.01 = 0.03$

(4) 0.015M $C_6H_{12}O_6$ $i \times m = 1 \times 0.015 = 0.015$

$T_b' = T_b^* + \Delta T_b$

Higher the value of $(i \times m)$ more will be the boiling point.

80. Match **List-I** with **List-II**.

	List-I		List-II
A.	Haber process	I.	Fe catalyst
B.	Wacker oxidation	II.	$PdCl_2$
C.	Wilkinson catalyst	III.	$[(PPh_3)_3RhCl]$
D	Ziegler catalyst	IV.	$TiCl_4$ with $Al(CH_3)_3$

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

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

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

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

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

Answer (3)

Sol.

	Process		Catalyst used
A.	Haber process	I.	Fe catalyst
B.	Wacker oxidation	II.	$PdCl_2$
C.	Wilkinson catalyst	III.	$[(PPh_3)_3RhCl]$
D	Ziegler catalyst	IV.	$TiCl_4$ with $Al(CH_3)_3$

81. 5 moles of liquid X and 10 moles of liquid Y make a solution having a vapour pressure of 70 torr. The vapour pressures of pure X and Y are 63 torr and 78 torr respectively. Which of the following is true regarding the described solution?

(1) The solution shows positive deviation.

(2) The solution shows negative deviation.

(3) The solution is ideal.

(4) The solution has volume greater than the sum of individual volumes.

Answer (2)

Sol. $P_{total} = X_x P_x^\circ + X_y P_y^\circ$

$= \frac{5}{15} \times 63 + \frac{10}{15} \times 78$

= 21 + 52

= 73 torr

Observed total pressure of solution is 70 torr.

It is less than calculated total pressure.

Hence, it shows negative deviation.

82. Sugar 'X'

A. is found in honey

B. is a keto sugar

C. exists in α and β – anomeric forms.

D. Is laevorotatory.

'X' is :

(1) D-Glucose

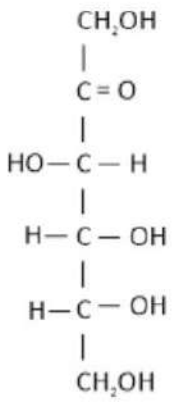
(2) D-Fructose

(3) Maltose

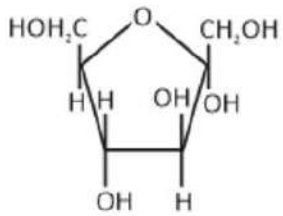
(4) Sucrose

Answer (2)

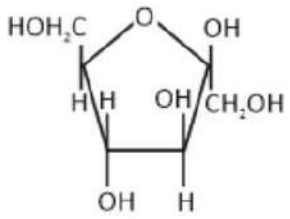
Sol. D-Fructose is found in honey and is a keto sugar.



D—(—) — Fructose

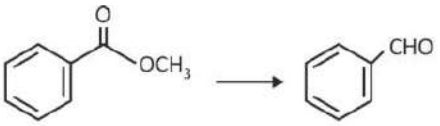


α–D–(–)–Fructofuranose



β–D–(–)–Fructofuranose

83. Identify the suitable reagent for the following conversion.



(1) (i) $LiAlH_4$, (ii) H^+/H_2O

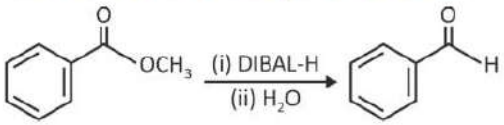
(2) (i) $AlH(iBu)_2$, (ii) H_2O

(3) (i) $NaBH_4$, (ii) H^+/H_2O

(4) $H_2/Pd\text{-}BaSO_4$

Answer (2)

Sol. Esters are reduced to aldehydes with DIBAL-H



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

Assertion (A) : undergoes S_N2 reaction faster than Cl.

Reason (R) : Iodine is a better leaving group because of its large size.

In the light of the above statements, choose the **correct** answer from the options given below:

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

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

(3) **A** is true but **R** is false

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

Answer (1)

Sol. Rate of S_N2 reaction of I is faster than Cl.

Because iodine is a good leaving group due to large size of iodine. Which stabilises the I^- ion.

85. The standard heat of formation, in kcal/mol of Ba^{2+} is :

[Given : standard heat of formation of SO_4^{2-} ion (aq) = –216 kcal/mol, standard heat of crystallisation of $BaSO_4(s)$ = –4.5 kcal/mol, standard heat of formation of $BaSO_4(s)$ = – 349 kcal/mol]

(1) – 128.5 (2) – 133.0

(3) + 133.0 (4) + 220.5

Answer (1)

Sol. $S + 2O_2 + 2e^- \longrightarrow SO_4^{2-}$ $\Delta H_f = -216$ kcal/mol ...(1)

$Ba^{2+}(g) + SO_4^{2-}(g) \longrightarrow BaSO_4(s)$ $\Delta H_{crystallisation} = -4.5$ kcal/mol ...(2)

$Ba + S + 2O_2 \longrightarrow BaSO_4(s)$ $\Delta H_{f(BaSO_4)} = -349$ kcal/mol ...(3)

$Ba(s) \longrightarrow Ba^{2+}(g) + 2e^-$ ...(4)

From equation (1),(2) and (3) we get equation (4). Applying equation (3) – (1) – (2)

So, –349 – (–4.5) – (–216)

So – 349 + 4.5 + 216

= –349 + 220.5

= – 128.5 kcal/mol

86. Total number of possible isomers (both structural as well as stereoisomers) of cyclic ethers of molecular formula C_4H_8O is :

(1) 6 (2) 8

(3) 10 (4) 11

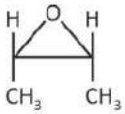
Answer (3)

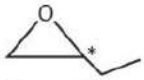
Sol. For cyclic ethers O should be in ring * carbon here is chiral

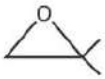
(1)
2(d, l pair)

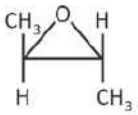
(2)
1

(3)
1

(4) 
(1)
Meso compound

(5) 
2(d, l pair)

(6) 
1

(7) 
2(d, l pair)

Total number of isomers = 2 + 1 + 1 + 1 + 2 + 1 + 2 = 10

87. Identify the correct orders against the property mentioned

A. $H_2O > NH_3 > CHCl_3$ – dipole moment

B. $XeF_4 > XeO_3 > XeF_2$ – number of lone pairs on central atom

C. O–H > C–H > N–O – bond length

D. $N_2 > O_2 > H_2$ – bond enthalpy

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

(1) A, D only (2) B, D only

(3) A, C only (4) B, C only

Answer (1)

Sol.

		μ(D)
A.	H_2O	1.85
	NH_3	1.47
	$CHCl_3$	1.04

B. XeF_4 : 2 lone pairs of electron

XeO_3 : 1 lone pair of electron

XeF_2 : 3 lone pairs of electron

C. Order of Bond length :- N–O > C–H > O–H

D. N_2 Bond order is 3

H_2 Bond order is 1

O_2 Bond order is 2

88. Higher yield of NO in $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ can be obtained at

[ΔH of the reaction = +180.7 kJ mol^{-1}]

A. Higher temperature

B. Lower temperature

C. Higher concentration of N_2

D. Higher concentration of O_2

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

(1) A, D only (2) B, C only

(3) B, C, D only (4) A, C, D only

Answer (4)

Sol. Yield of the product generally depends on

- Temperature
- Concentration of reactant(s) and product(s)
- Pressure

As this is an endothermic reaction ($\Delta H = +180.7$ kJ mol^{-1}), so, increase in temperature will shift equilibrium in forward direction to increase yield of NO.

Increase in concentration of reactants (N_2 and O_2) also shifts the equilibrium in forward direction and increase the yield of NO.

Hence, (A), (C) and (D) only will increase yield of NO.

89. If the rate constant of a reaction is 0.03 s^{-1}, how much time does it take for 7.2 mol L^{-1} concentration of the reactant to get reduced to 0.9 mol L^{-1}?

(Given: log 2 = 0.301)

(1) 69.3 s (2) 23.1 s

(3) 210 s (4) 21.0 s

Answer (1)

Sol. $k = 0.03\ s^{-1}$

$$t = \frac{2.303}{k}\log\frac{a}{a-x}$$

$$= \frac{2.303}{0.03}\log\frac{7.2}{0.9}$$

$$= \frac{2.303}{0.03}\log 8$$

$$= \frac{2.303}{0.03}\times 3\times\log 2$$

$$= \frac{2.303}{0.03}\times 3\times 0.301$$

$$= 69.3\ s$$

90. Which one of the following reactions does **NOT** belong to "Lassaigne's test"?

(1) $Na + C + N \xrightarrow[\Delta]{} NaCN$ (2) $2Na + S \xrightarrow[\Delta]{} Na_2S$

(3) $Na + X \xrightarrow[\Delta]{} + NaX$ (4) $2CuO + C \xrightarrow[\Delta]{} 2Cu + CO_2$

Answer (4)

Sol. Nitrogen, sulphur, halogens and phosphorus present in an organic compound are detected by "Lassaigne's test".

$$Na + C + N \xrightarrow{\Delta} NaCN$$

$$2Na + S \xrightarrow{\Delta} Na_2S$$

$$Na + X \xrightarrow{\Delta} \underset{(X=Cl, Br, I)}{NaX}$$

BIOLOGY

91. The complex II of mitochondrial electron transport chain is also known as

(1) Cytochrome bc_1
(2) Succinate dehydrogenase
(3) Cytochrome c oxidase
(4) NADH dehydrogenase

Answer (2)

Sol. Complex II of mitochondrial electron transport chain is also known as succinate dehydrogenase. Cytochrome c oxidase (complex IV), NADH dehydrogenase (complex I), cytochrome bc_1 (complex III).

92. Polymerase chain reaction (PCR) amplifies DNA following the equation.

(1) N^2
(2) 2^n
(3) $2n + 1$
(4) $2N^2$

Answer (2)

Sol. PCR *i.e.*, polymerase chain reaction amplifies DNA as per the equation 2^n, where '*n*' refers to number of cycles.

Thus, say, if 3 PCR cycles will run, then 2^3 *i.e.*, $2 \times 2 \times 2 \Rightarrow 8$ DNA fragments will be formed.

93. What are the potential drawbacks in adoption of the IVF method?

A. High fatality risk to mother
B. Expensive instruments and reagents
C. Husband/wife necessary for being donors
D. Less adoption of orphans
E. Not available in India
F. Possibility that the early embryo does not survive

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

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

Answer (1)

Sol. Statements B, D and F are correct while statements A, C and E are incorrect.

Husband/wife is not necessary for being donors. IVF is available in India.

94. What is the name of the blood vessel that carries deoxygenated blood from the body to the heart in a frog?

(1) Aorta
(2) Pulmonary artery
(3) Pulmonary vein
(4) Vena cava

Answer (4)

Sol. Frog's heart is a muscular structure with three chambers. It receives deoxygenated blood from body parts through the major veins called vena cava. Vena cava carries deoxygenated blood. Aorta and pulmonary vein carries oxygenated blood. Whereas, pulmonary artery will carry deoxygenated blood towards the lungs.

95. Which one of the following statements refers to Reductionist Biology?

(1) Physico-chemical approach to study and understand living organisms

(2) Physiological approach to study and understand living organisms

(3) Chemical approach to study and understand living organisms

(4) Behavioural approach to study and understand living organisms

Answer (1)

Sol. The physico-chemical approach to study and understand living organisms is called 'Reductionist Biology'.

96. Given below are two statements :

Statement I : In the RNA world, RNA is considered the first genetic material evolved to carry out essential life processes. RNA acts as a genetic material and also as a catalyst for some important biochemical reactions in living systems. Being reactive, RNA is unstable.

Statement II : DNA evolved from RNA and is a more stable genetic material. Its double helical strands being complementary, resist changes by evolving repairing mechanism.

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

(1) Both statement I and statement II are correct

(2) Both statement I and statement II are incorrect

(3) Statement I is correct but statement II is incorrect

(4) Statement I is incorrect but statement II is correct

Answer (1)

Sol. In RNA world, RNA was the first genetic material as there are enough evidences to suggest that essential life processes (such as metabolism, translation, splicing, etc) evolved around RNA. RNA used to act as a genetic material as well as catalyst (there are some important biochemical reaction in living systems that are catalysed by RNA catalysts not by protein enzymes) so, statement I is correct statement II is also correct as DNA being double stranded and having complementary strands further resists changes by evolving a process of repair.

97. Epiphytes that are growing on a mango branch is an example of which of the following?

(1) Commensalism

(2) Mutualism

(3) Predation

(4) Amensalism

Answer (1)

Sol. Commensalism is the type of interaction in which one-species benefits and another is neither harmed nor benefited. An orchid growing as an epiphyte on a mango branch is an example of commensalism.

98. From the statements given below choose the **correct** option :

A. The eukaryotic ribosomes are 80S and prokaryotic ribosomes are 70S.

B. Each ribosome has two sub-units.

C. The two sub-units of 80S ribosome are 60S and 40S while that of 70S are 50S and 30S.

D. The two sub-units of 80S ribosome are 60S and 20S and that of 70S are 50S and 20S.

E. The two sub-units of 80S are 60S and 30S and that of 70S are 50S and 30S.

(1) A, B, C are true

(2) A, B, D are true

(3) A, B, E are true

(4) B, D, E are true

Answer (1)

Sol. The eukaryotic ribosomes are 80S and prokaryotic ribosomes are 70S type.

Each ribosome has two sub-units.

The two sub-units of 80S ribosome are 60S and 40S while that of 70S are 50S and 30S.

99. Which one of the following is an example of ex-situ conservation?

(1) National Park
(2) Wildlife Sanctuary
(3) Zoos and botanical gardens
(4) Protected areas

Answer (3)

Sol. Zoological parks (Zoos), botanical gardens and wildlife safari parks are examples of ex-situ conservation. Sacred groves, biosphere reserves, national parks and wildlife sanctuaries are examples of in-situ conservation.

100. Given below are two statements:

Statement I : The primary source of energy in an ecosystem is solar energy.

Statement II : The rate of production of organic matter during photosynthesis in an ecosystem is called net primary productivity (NPP).

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

(1) Both statement I and statement II are correct

(2) Both statement I and statement II are incorrect

(3) Statement I is correct but statement II is incorrect

(4) Statement I is incorrect but statement II is correct

Answer (3)

Sol. Primary source of energy in the ecosystem is solar energy.

Gross primary productivity of an ecosystem is the rate of production of organic matter during photosynthesis. Hence, statement I is correct but statement II is incorrect.

101. Match **List-I** with **List-II**.

	List-I		List-II
A.	Emphysema	I.	Rapid spasms in muscle due to low Ca^{++} in body fluid
B.	Angina Pectoris	II.	Damaged alveolar walls and decreased respiratory surface
C.	Glomerulonephritis	III.	Acute chest pain when not enough oxygen is reaching to heart muscle
D.	Tetany	IV.	Inflammation of glomeruli of kidney

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

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

Answer (4)

Sol. Emphysema - Damaged alveolar walls and decreased respiratory surface

Angina pectoris - Acute chest pain when not enough oxygen is reaching to heart muscle

Glomerulonephritis - Inflammation of glomeruli of kidney

Tetany - Rapid spasms in muscle due to low Ca^{++} in body fluid

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

Assertion (A) : Both wind and water pollinated flowers are not very colourful and do not produce nectar.

Reason (R) : The flowers produce enormous amount of pollen grains in wind and water pollinated flowers.

In the light of the above statements, choose the **correct** answer from the options given below:

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

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

(3) **A** is true but **R** is false

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

Answer (2)

Sol. Both wind and water pollinated flowers are not very colourful and do not produce nectar, this is because they rely on wind and water to carry their pollen. Wind and water pollinated flower do not need to attract insect, so they did not evolve to produce bright coloured flower.

103. Which of the following is an example of non-distilled alcoholic beverage produced by yeast?

(1) Whisky (2) Brandy

(3) Beer (4) Rum

Answer (3)

Sol. Wine and beer are produced without distillation whereas whisky, brandy and rum are produced by distillation of fermented broth.

104. Given below are two statements:

Statement I: In a floral formula ⊕ stands for zygomorphic nature of the flower, and $\underline{G}$ stands for inferior ovary.

Statement II: In a floral formula ⊕ stands for actinomorphic nature of the flower and $\underline{G}$ stands for superior ovary.

In the light of the above statements, choose the **correct** answer from the options given below:

(1) Both Statement I and Statement II are correct (2) Both Statement I and Statement II are incorrect

(3) Statement I is correct but Statement II is incorrect (4) Statement I is incorrect but Statement II is correct

Answer (4)

Sol. The floral formula symbol ⊕ is used for actinomorphic flower, while % is used for zygomorphic flower.

The symbol G represents gynoecium and $\underline{G}$ symbol represent superior ovary, while inferior ovary is represented by $\bar{G}$.

Thus, statement I is incorrect and Statement II is correct.

105. Streptokinase produced by *bacterium Streptococcus* is used for

(1) Curd production (2) Ethanol production

(3) Liver disease treatment (4) Removing clots from blood vessels

Answer (4)

Sol. Streptokinase produced by the bacterium *Streptococcus* and modified by genetic engineering is used as a 'clot buster' for removing clots from blood vessels of patients who have undergone myocardial infarction leading to heart attack. Curd production is done by *Lactobacillus* and ethanol production is done by *Saccharomyces.*

106. Which chromosome in the human genome has the highest number of genes?

(1) Chromosome X

(2) Chromosome Y

(3) Chromosome 1

(4) Chromosome 10

Answer (3)

Sol. In human genome, Chromosome 1 has the highest number of genes, *i.e.*, 2968.

107. Which of the following statement is **correct** about location of the male frog copulatory pad?

(1) First and Second digit of fore limb

(2) First digit of hind limb

(3) Second digit of fore limb

(4) First digit of the fore limb

Answer (4)

Sol. In male frogs, copulatory pad is present on the first digit of the forelimbs which are absent in female frogs.

108. Which one of the following phytohormones promotes nutrient mobilization which helps in the delay of leaf senescence in plants?

(1) Ethylene

(2) Abscisic acid

(3) Gibberellin

(4) Cytokinin

Answer (4)

Sol. Cytokinins help to overcome apical dominance. They promote nutrient mobilisation which helps in the delay of leaf senescence.

109. While trying to find out the characteristic of a newly found animal, a researcher did the histology of adult animal and observed a cavity with presence of mesodermal tissue towards the body wall but no mesodermal tissue was observed towards the alimentary canal. What could be the possible coelome of that animal?

(1) Acoelomate

(2) Pseudocoelomate

(3) Schizocoelomate

(4) Spongocoelomate

Answer (2)

Sol. In pseudocoelomates, the body cavity is not entirely lined with mesoderm, instead, mesodermal tissue is present along the body wall but not towards the gut.

- Schizocoelomates are animals whose coelom or body cavity develops middle from a split in the mesoderm, the middle germ layer of the embryo.
- In acoelomates, coelom is absent.

Spongocoel is a central cavity found in Sponges.

110. Match **List - I** with **List - II.**

	List - I		List - II
A.	Head	(i)	Enzymes
B.	Middle piece	(ii)	Sperm motility
C.	Acrosome	(iii)	Energy
D.	Tail	(iv)	Genetic material

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

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

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

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

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

Answer (1)

Sol.
- The sperm head contains elongated nucleus which possesses the genetic material.
- The middle piece possesses numerous mitochondria, which produce energy for movement.
- Acrosome is a cap-like structure filled with enzymes that help in fertilization of ovum.
- The tail of sperm facilitates sperm motility essential for fertilisation.

111. Given below are the stages in the life cycle of pteridophytes. Arrange the following stages in the correct sequence.

A. Prothallus stage

B. Meiosis in spore mother cells

C. Fertilisation

D. Formation of archegonia and antheridia in gametophyte.

E. Transfer of antherozoids to the archegonia in presence of water.

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

(1) B, A, D, E, C

(2) B, A, E, C, D

(3) D, E, C, A, B

(4) E, D, C, B, A

Answer (1)

Sol. In a pteridophytes life cycle, the correct sequence of stages will be given as follows:

B $\rightarrow$ Meiosis in spore mother cells

A $\rightarrow$ Prothallus stage

D $\rightarrow$ Formation of archegonia and antheridia in gametophyte

E $\rightarrow$ Transfer of antherozoids to the archegonia in presence of water

C $\rightarrow$ Fertilisation will occur

So, the correct sequence is B $\rightarrow$ A $\rightarrow$ D $\rightarrow$ E $\rightarrow$ C

112. Cardiac activities of the heart are regulated by:

A. Nodal tissue

B. A special neural centre in the medulla oblongata

C. Adrenal medullary hormones

D. Adrenal cortical hormones

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

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

Answer (1)

Sol. Normal cardiac activities of the heart are regulated intrinsically, i.e., auto regulated by specialised muscles (nodal tissue), hence the heart is called myogenic. A special neural centre in the medulla oblongata can moderate the cardiac function through autonomic nervous system.

Sympathetic nervous system can increase the rate of heartbeat, ventricular contraction and thereby cardiac output.

Parasympathetic neural signals decrease the rate of heartbeat, speed of conduction of action potential and thereby the cardiac output. Adrenal medullary hormones can also increase the cardiac output.

113. Which of following organisms **cannot** fix nitrogen?

A. *Azotobacter*

B. *Oscillatoria*

C. *Anabaena*

D. *Volvox*

E. *Nostoc*

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

(1) A only
(2) D only
(3) B only
(4) E only

Answer (2)

Sol. *Azotobacter*, *Oscillatoria*, *Anabaena* and *Nostoc* can fix nitrogen but *Volvox* cannot fix nitrogen.

114. Given below are two statements :

Statement I : Transfer RNAs and ribosomal RNA do not interact with mRNA.

Statement II : RNA interference (RNAi) takes place in all eukaryotic organisms as a method of cellular defence.

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

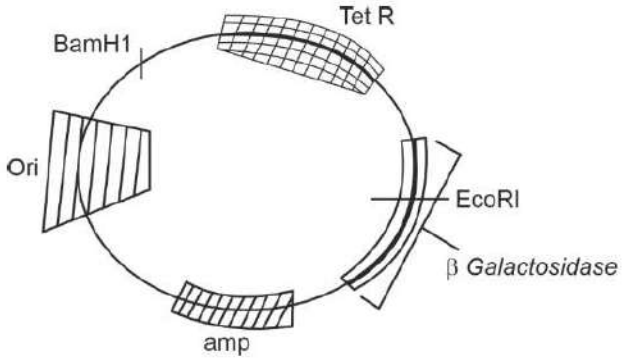
(1) Both statement I and statement II are correct
(2) Both statement I and statement II are incorrect
(3) Statement I is correct but statement II is incorrect
(4) Statement I is incorrect but statement II is correct

Answer (4)

Sol. Both transfer RNAs and ribosomal RNA interact with mRNA.

RNA interference (RNAi) takes place in all eukaryotic organisms as a method of cellular defence.

115.



In the above represented plasmid, an alien piece of DNA is inserted at EcoRI site. Which of the following strategies will be chosen to select the recombinant colonies?

(1) Using ampicillin & tetracycline containing medium plate.

(2) Blue color colonies will be selected.

(3) White color colonies will be selected.

(4) Blue color colonies grown on ampicillin plates can be selected.

Answer (3)

Sol. The correct answer is that white-colored colonies will be selected.

Since an alien piece of DNA is being inserted at *Eco*RI site, the gene β-galactosidase present here will undergo insertional inactivation.

This gene is responsible for producing blue-colored colonies, but since it has been insertionally inactivated, white colored colonies will be produced.

Ampicillin and tetracycline resistance genes present in the given DNA will remain intact. Thus, the given DNA will show amp^R and tet^R.

116. Which of the following genetically engineered organisms was used by Eli Lilly to prepare human insulin?

(1) Bacterium (2) Yeast

(3) Virus (4) Phage

Answer (1)

Sol. The correct answer is bacterium.

In 1983, Eli Lilly, an American company, prepared two DNA sequences corresponding to 'A' and 'B' chains of human insulin and introduced them in plasmids of *E.coli* (a gram negative bacterium) to produce insulin chains.

117. Name the class of enzyme that usually catalyze the following reaction :

$S - G + S^{\#} \rightarrow S + S^{\#} - G$

Where, $G \rightarrow$ a group other than hydrogen

$S \rightarrow$ a substrate

$S^{\#} \rightarrow$ another substrate

(1) Hydrolase (2) Lyase

(3) Transferase (4) Ligase

Answer (3)

Sol. Enzymes catalysing a transfer of G group, (other than hydrogen) between a pair of substrates, S and S' are known as transferases.

$S - G + S^{\#} \rightarrow S + S^{\#} - G$

- Ligases catalyse the linking together of 2 compounds such as C – O, C – S, C – N bonds *etc*
- Lyases catalyse removal of groups from substrates by mechanisms other than hydrolysis leaving double bonds

Hydrolases are enzymes that catalyse hydrolysis of ester, ether, peptide , glycosidic, C – C, C – halide or P – N bonds.

118. Find the statement that is **NOT** correct with regard to the structure of monocot stem.

(1) Hypodermis is parenchymatous.
(2) Vascular bundles are scattered.
(3) Vascular bundles are conjoint and closed.
(4) Phloem parenchyma is absent.

Answer (1)

Sol. In monocot stem, hypodermis is sclerenchymatous.

119. The correct sequence of events in the life cycle of bryophytes is

A. Fusion of antherozoid with egg.
B. Attachment of gametophyte to substratum.
C. Reduction division to produce haploid spores.
D. Formation of sporophyte.
E. Release of antherozoids into water.

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

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

Answer (3)

Sol. The correct sequence of events in the life cycle of bryophytes is

- Attachment of gametophyte to substratum.
- Release of antherozoids into water.
- Fusion of antherozoid with egg.
- Formation of sporophyte.
- Reduction division to produce haploid spores.

120. Which are correct:

A. Computed tomography and magnetic resonance imaging detect cancers of internal organs.
B. Chemotherapeutics drugs are used to kill non-cancerous cells.
C. α -interferon activate the cancer patients' immune system and helps in destroying the tumour.
D. Chemotherapeutic drugs are biological response modifiers.
E. In the case of leukaemia blood cell counts are decreased.

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

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

Answer (4)

Sol. Statements A and C are correct while statements B, D and E are incorrect.

Chemotherapeutic drugs are used to kill cancerous cells.

In case of leukaemia, blood cell counts are increased.

α-interferons are biological response modifiers.

121. Match **List-I** with **List- II**.

	List-I		**List-II**
A.	Centromere	I.	Mitochondrion
B.	Cilium	II.	Cell division
C.	Cristae	III.	Cell movement
D.	Cell membrane	IV.	Phospholipid Bilayer

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

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

Answer (4)

Sol. Centromere - Helps in cell division

Cilium - Helps in cell movement

Cristae - Finger like structures of mitochondria

Cell membrane - Is a phospholipid bilayer

122. Match **List I** with **List II**:

	List-I		**List-II**
A.	Chlorophyll a	(I)	Yellow-green
B.	Chlorophyll b	(II)	Yellow
C.	Xanthophylls	(III)	Blue-green
D.	Carotenoids	(IV)	Yellow to Yellow-orange

Choose the option with all **correct** matches.

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

Answer (2)

Sol. A chromatographic separation of the leaf pigments shows that the colour that we see in leaves is not due to single pigment but due to four pigments.

Chlorophyll a	–	Bright or blue-green in the chromatogram
Chlorophyll b	–	Yellow-green
Xanthophylls	–	Yellow
Carotenoids	–	Yellow to Yellow-orange

123. Find the correct statement :

(A) In human pregnancy, the major organ systems are formed at the end of 12 weeks.

(B) In human pregnancy the major organ systems are formed at the end of 8 weeks.

(C) In human pregnancy heart is formed after one month of gestation.

(D) In human pregnancy, limbs and digits develop by the end of second month.

(E) In human pregnancy the appearance of hair is usually observed in the fifth month.

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

(1) A and E only

(2) B and C only

(3) B, C, D and E only

(4) A, C, D and E only

Answer (4)

Sol. In a human female's pregnancy.

- By the end of 12 weeks (1st trimester), most of major organ systems are formed (not by end of 8 weeks).
- After one month of pregnancy, the embryo's heart is formed.
- By the end of second month of pregnancy, the foetus develops limbs and digits.
- The first movements of foetus and appearance of hair on head are usually observed during the fifth month.

124. In the seeds of cereals, the outer covering of endosperm separates the embryo by a protein-rich layer called :

(1) Coleoptile

(2) Coleorhiza

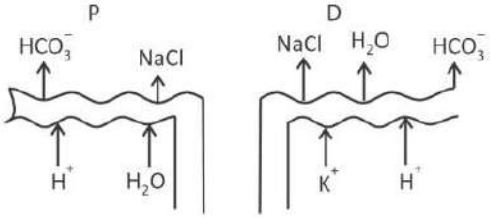
(3) Integument

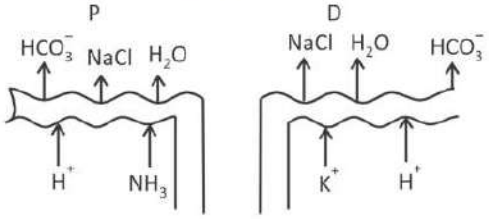
(4) Aleurone layer

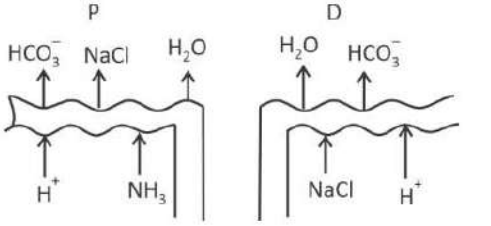
Answer (4)

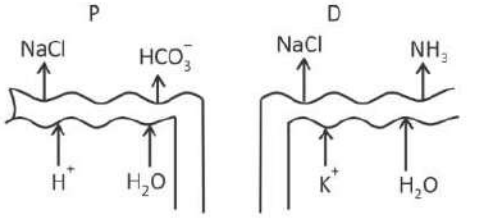
Sol. In monocot seeds, the outer covering of endosperm separates the embryo by a proteinous layer called aleurone layer.

125. Which of the following diagrams is correct with regard to the proximal (P) and distal (D) tubule of the Nephron.

(1)


(2)


(3)


(4)


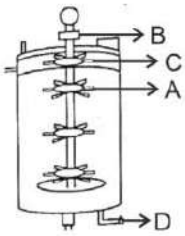
Answer (2)

Sol. During urine formation, the tubular cells secrete substances like H^+, K^+ and ammonia into the filtrate. Tubular secretion is also an important step in urine formation as it helps in the maintenance of ionic and acid base balance of body fluids.

PCT $\rightarrow$ Selective secretion of H^+, ammonia and K^+ into the filtrate.

DCT $\rightarrow$ Capable of reabsorption of HCO_3^- and selective secretion of H^+, K^+ and NH_3.

126. Identify the part of a bio-reactor which is used as a foam braker from the given figure.



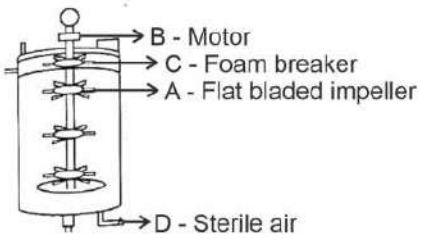
(1) A

(2) B

(3) D

(4) C

Answer (4)

Sol.


$\therefore$ Part labelled as C is foam breaker.

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

Assertion (A) : A typical unfertilised, angiosperm embryo sac at maturity is 8 nucleate and 7-celled.

Reason (R) : The egg apparatus has 2 polar nuclei.

In the light of the above statements, choose the **correct** answer from the options given below :

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

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

(3) **A** is true but **R** is false

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

Answer (3)

Sol. A typical Angiosperm embryo sac, at maturity is 7-celled and 8 nucleate.

Polar nuclei are situated below the egg apparatus in the large central cell.

Three cells are grouped together at micropylar end and constitute the egg apparatus.

Hence, A is true but R is false.

128. A specialised membranous structure in a prokaryotic cell which helps in cell well wall formation, DNA replication and respiration is

(1) Mesosome

(2) Chromatophores

(3) Cristae

(4) Endoplasmic Reticulum

Answer (1)

Sol. Mesosome is membranous extension in bacterial cell that helps in cell wall formation, DNA replication and contains enzymes for respiration.

129. Which of the following are the post-transcriptional events in an eukaryotic cell?

A. Transport of pre-mRNA to cytoplasm prior to splicing.

B. Removal of introns and joining of exons.

C. Addition of methyl group at 5' end of hnRNA.

D. Addition of adenine residues at 3' end of hnRNA.

E. Base pairing of two complementary RNAs.

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

(1) A, B, C only

(2) B, C, D only

(3) B, C, E only

(4) C, D, E only

Answer (2)

Sol. The process of copying genetic information from one strand of the DNA into RNA is known as transcription. It occurs in the cytoplasm with the help of transcripting enzyme.

Transport of pre-mRNA to cytoplasm prior to splicing is a part of transcription.

The primary transcript is converted into functional mRNA after post transcriptional processing involves 3 steps as follows-

- Modification of 5' end by capping,
- Tailing,
- Splicing.

Base pairing of two complementary RNA is not on event of post-transcription. Hence, statements B, C, D are post-transcriptional modification events in eukaryotic cell.

130. What is the pattern of inheritance for polygenic trait?

(1) Mendelian inheritance pattern
(2) Non-mendelian inheritance pattern
(3) Autosomal dominant pattern
(4) X-linked recessive inheritance pattern

Answer (2)

Sol. Polygenic inheritance refers to the inheritance of a trait controlled by two or more genes. When human disorders are determined by mutation in the single gene then they are transmitted to the offspring as per Mendelian principle. Polygenic trait shows non-Mendelian inheritance pattern.

131. Which one of the following enzymes contains 'Haem' as the prosthetic group?

(1) RuBisCo
(2) Carbonic anhydrase
(3) Succinate dehydrogenase
(4) Catalase

Answer (4)

Sol. In peroxidase and catalase, which catalyze the breakdown of hydrogen peroxide to water and oxygen, haem is the prosthetic group and it is part of the active site of the enzymes.

Zinc is the cofactor in enzyme carbonic anhydrase.

RuBisCo is the most abundant protein in whole of the biosphere.

Succinate is the substrate of enzyme succinic dehydrogenase.

132. Each of the following characteristics represent a Kingdom proposed by Whittaker. Arrange the following in increasing order of complexity of body organization.

A. Multicellular heterotrophs with cell wall made of chitin.
B. Heterotrophs with tissue/organ/organ system level of body organization.
C. Prokaryotes with cell wall made of polysaccharides and amino acids.
D. Eukaryotic autotrophs with tissue/organ level of body organization.
E. Eukaryotes with cellular body organization.

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

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

Answer (2)

Sol. Increasing order of complexity of body organisation in the kingdom given by R.H. Whittaker is as follows-

C. Monera-Prokaryotes with cell wall made up of polysaccharide.

↓

E. Protista - Unicellular eukaryotes.

↓

A. Fungi -Multicellular heterotrophic with cell wall made up of chitin.

↓

D. Plantae - Eukaryotes autotrophs with tissue body organisation.

↓

B. Animalia - Heterotrophs with tissue organ/system of body organisation

Correct sequence is C, E, A, D, B.

133. Who is known as the father of Ecology in India?

(1) S.R. Kashyap
(2) Ramdeo Misra
(3) Ram Udar
(4) Birbal Sahni

Answer (2)

Sol. Ramdeo Misra is known as the father of Ecology in India.

134. Match **List I** with **List II**:

	List-I		**List-II**
A.	Alfred Hershey and Martha Chase	I.	Streptococcus pneumoniae
B.	Euchromatin	II.	Densely packed and dark-stained
C.	Frederick Griffith	III.	Loosely packed and light-stained
D.	Heterochromatin	IV.	DNA as genetic material confirmation

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

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

Answer (3)

Sol. The unequivocal proof that DNA is the genetic material came from the experiment of Alfred Hershey and Martha Chase.

Euchromatin are lightly stained region with loosely packed chromatin fibre.

Frederick Griffith performed series of experiments by selecting the different strains of *Streptococcus pneumoniae*.

Heterochromatin are darkly stained region with tightly packed chromatin fibre.

135. Neoplastic characteristics of cells refer to :

A. A mass of proliferating cell

B. Rapid growth of cells

C. Invasion and damage to the surrounding tissue

D. Those confined to original location

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

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

Answer (2)

Sol. The correct answer will include : A, B and C only.

A neoplasm is a general term for any abnormal growth of tissue.

Neoplastic characteristics of cells refer to

(1) A mass of proliferating cell.
(2) Rapid growth of cells.
(3) Invasion and damage to the surrounding tissue.

Cancer specifically refers to malignant neoplasms, which are cancerous and invasive.

Benign tumours remain confined to their original location. Thus, D is not included in the answer.

The malignant tumours, on the other hand are a mass of proliferating cells called neoplastic or tumour cells. These cells grow very rapidly, invading and damaging the surrounding normal tissues.

136. Given below are two statements :

Statement I : The DNA fragments extracted from gel electrophoresis can be used in construction of recombinant DNA.

Statement II : Smaller size DNA fragments are observed near anode while larger fragments are found near the wells in an agarose gel.

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

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

Answer (1)

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

The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece. This step is known as elution. The DNA fragments purified in this way are used in constructing rDNA by joining them with cloning vectors.

- In gel electrophoresis, the DNA fragments separate (resolve) according to their size through sieving effect provided by the agarose gel. Hence, the smaller the fragment size, the farther it moves from cathode towards anode.

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

	List-I		List-II
A.	Adenosine	I.	Nitrogen base
B.	Adenylic acid	II.	Nucleotide
C.	Adenine	III.	Nucleoside
D.	Alanine	IV.	Amino acid

Choose the option with all **correct** matches.

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

Answer (3)

Sol. The correct answer is A-III, B-II, C-I, D-IV

- Adenosine – It is a nucleoside which is composed of nitrogen base and sugar only.
- Adenylic acid – It is a nucleotide which is composed of nitrogen base, sugar and a phosphate group is esterified to the sugar.
- Adenine – Nitrogen base (Purine)

Alanine – An amino acid that contains a methyl group as the 'R' group.

138. Consider the following :

A. The reductive division for the human female gametogenesis starts earlier than that of the male gametogenesis.

B. The gap between the first meiotic division and the second meiotic division is much shorter for males compared to females.

C. The first polar body is associated with the formation of the primary oocyte.

D. Luteinizing Hormone (LH) surge leads to disintegration of the endometrium and onset of menstrual bleeding.

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

(1) A and B are true
(2) A and C are true
(3) B and D are true
(4) B and C are true

Answer (1)

Sol. Statements A and B are true while statements C and D are false.

The first polar body is associated with the formation of the secondary oocyte LH surge leads to ovulation. Decreased levels of progesterone during late luteal phase leads to degeneration of the endometrium and onset of menstrual bleeding.

139. All living members of the class Cyclostomata are :

(1) Free living
(2) Endoparasite
(3) Symbiotic
(4) Ectoparasite

Answer (4)

Sol. All living members of class Cyclostomata are ectoparasites.

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

Assertion (A) : The primary function of the Golgi apparatus is to package the materials made by the endoplasmic reticulum and deliver it to intracellular targets and outside the cell.

Reason (R) : Vesicles containing materials made by the endoplasmic reticulum fuse with the cis face of the Golgi apparatus, and they are modified and released from the trans face of the Golgi apparatus.

In the light of the above statements, choose the **correct** answer from the options given below :

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

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

(3) **A** is true but **R** is false

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

Answer (2)

Sol. The primary function of Golgi apparatus is to package the materials made by endoplasmic reticulum and deliver it to intracellular targets and outside the cell, this statement is correct and the reason statement is also correct. Golgi apparatus remains in close association with endoplasmic reticulum. Here, assertion and reason statements both are correct but reason is not correctly explaining assertion.

141. Match **List I** with **List II** :

	List I		List II
A.	Scutellum	I.	Persistent nucellus
B.	Non-albuminous seed	II.	Cotyledon of Monocot seed
C.	Epiblast	III.	Groundnut
D.	Perisperm	IV.	Rudimentary cotyledon

Choose the option with all **correct** matches.

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

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

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

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

Answer (1)

Sol. Scutellum is cotyledon of monocot seed.

Groundnut seed is non-albuminous seed.

Epiblast is rudimentary cotyledon in monocot seed.

Perisperm is persistent nucellus.

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

Assertion (A) : All vertebrates are chordates but all chordates are not vertebrate.

Reason (R) : The members of subphylum vertebrata possess notochord during the embryonic period, the notochord is replaced by cartilaginous or bony vertebral column in adults.

In the light of the above statements, choose the **correct** answer from the options given below:

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

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

(3) **(A)** is true but **(R)** is false

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

Answer (1)

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

The members of subphylum vertebrata possess notochord during the embryonic period. The notochord is replaced by a cartilaginous or bony vertebral column in the adult.

Thus, all vertebrates are chordates but all chordates are not vertebrates.

143. Identify the statement that is **NOT** correct.

(1) Each antibody has two light and two heavy chains.

(2) The heavy and light chains are held together by disulfide bonds.

(3) Antigen binding site is located at C-terminal region of antibody molecules.

(4) Constant region of heavy and light chains are located at C-terminus of antibody molecules

Answer (3)

Sol. Each antibody molecule has four peptide chains, two small called light chains and two longer called heavy chains. Hence, an antibody is represented as H_2L_2.

In an antibody molecule, antigen binding site is located at N-terminal region.

144. Silencing of specific mRNA is possible via RNAi because of

(1) Complementary dsRNA

(2) Inhibitory ssRNA

(3) Complementary tRNA

(4) Non-complementary ssRNA

Answer (1)

Sol. RNAi (RNA interference) takes place in all eukaryotic organisms as a method of cellular defense. This method involves silencing of a specific mRNA due to a complementary dsRNA molecule that binds to and prevents translation of the mRNA.

145. Genes R and Y follow independent assortment. If RRYY produce round yellow seeds and rryy produce wrinkled green seeds, what will be the phenotypic ratio of the F2 generation?

(1) Phenotypic ratio - 1 : 2 : 1

(2) Phenotypic ratio - 3 : 1

(3) Phenotypic ratio - 9 : 3 : 3 : 1

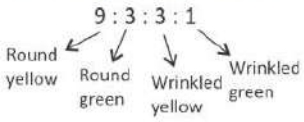
(4) Phenotypic ratio - 9 : 7

Answer (3)

Sol. A classical dihybrid cross performed by Mendel involves.

A cross which was made between a pure round yellow seeded pea plant (RRYY) with wrinkled green seeded plant (rryy). Yellow colour is dominant over green and round seed shape over wrinkled seed shape.

Phenotypic ratio in F2 generation



146. Histones are enriched with -

(1) Lysine & Arginine

(2) Leucine & Lysine

(3) Phenylalanine & Leucine

(4) Phenylalanine & Arginine

Answer (1)

Sol. In eukaryotes, packaging of DNA is much more complex. There is a set of positively charged, basic proteins called histones.

Histones are organised to form a unit of light molecules called histone octamer.

They are rich in the basic amino acid residues lysine and arginine.

147. The first menstruation is called :

(1) Menopause (2) Menarche

(3) Diapause (4) Ovulation

Answer (2)

Sol. The first menstruation begins at puberty and is called menarche.

- Ovulation is the process that deals with the release of secondary oocyte from the mature Graafian follicle.
- In human beings, menstrual cycles ceases around 50 years of age; that is termed as menopause.
- Diapause is a state of dormancy or developmental arrest in an organism.

148. Match **List-I** with **List-II.**

	List-I		List-II
A.	Heart	I.	Erythropoietin
B.	Kidney	II.	Aldosterone
C.	Gastro-intestinal tract	III.	Atrial natriuretic factor
D.	Adrenal Cortex	IV.	Secretin

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

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

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

Answer (4)

Sol.

Organ Name	-	Hormone Secreted
Heart	-	Atrial natriuretic factor
Kidney	-	Erythropoietin
Gastro-intestinal tract	-	Secretin
Adrenal cortex	-	Aldosterone

149. The protein portion of an enzyme is called:

(1) Cofactor

(2) Coenzyme

(3) Apoenzyme

(4) Prosthetic group

Answer (3)

Sol. There are number of cases in which non-protein constituents called co-factors are bound to the enzyme to make the enzyme catalytically active.

In these instances, the protein portion of the enzymes is called the apoenzyme.

Three kinds of co-factors are identified prosthetic groups, co-enzymes and metal ions. Prosthetic groups are organic compounds and they are tightly bound with apoenzyme. Co-enzymes are also organic compounds but their association with apoenzyme is only transient.

150. Which of the following is the unit of productivity of an Ecosystem?

(1) gm^{-2}

(2) $KCal\ m^{-2}$

(3) $KCal\ m^{-3}$

(4) $(KCal\ m^{-2})yr^{-1}$

Answer (4)

Sol. The rate of biomass production is called productivity. It is expressed in terms of $gm^{-2}yr^{-1}$ or $(KCal\ m^{-2})yr^{-1}$ to compare the productivity of different ecosystems.

151. Sweet potato and potato represent a certain type of evolution. Select the correct combination of terms to explain the evolution.

(1) Analogy, convergent

(2) Homology, divergent

(3) Homology, convergent

(4) Analogy, divergent

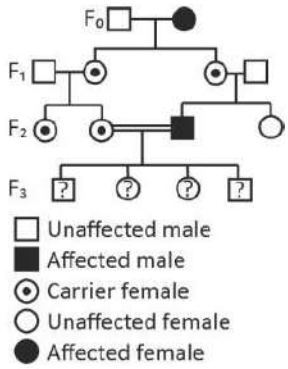
Answer (1)

Sol. Sweet potato is a root modification while potato is a stem modification but both of them have same function. Analogous structures are not anatomically similar structures though they perform similar functions.

Analogous structures are the result of convergent evolution.

- Homologous organs are anatomically similar but they do not perform similar function. Homologous organs are the result of divergent evolution.

152. With the help of given pedigree, find out the probability for the birth of a child having no disease and being a carrier (has the disease mutation in one allele of the gene) in F_3 generation.



(1) 1/4

(2) 1/2

(3) 1/8

(4) Zero

Answer (1)

Sol. As in the F_1 generation the carrier female and non-affected (normal, not carrier) had affected male child that means the genetic disorder is sex-linked recessive.

The consanguineous mating between female (X^cX) and male (X^cY)

♀ \ ♂	X^c	Y
X^c	X^cX^c	X^cY
X	X^cX	XY

Out of 4 child only one is carrier i.e. $\frac{1}{4}$.

153. Given below are two statements : One is labelled as **Assertion (A)** and other is labelled as **Reason (R)**.

Assertion (A) : Cells of the tapetum possess dense cytoplasm and generally have more than one nucleus.

Reason (R) : Presence of more than one nucleus in the tapetum increases the efficiency of nourishing the developing microspore mother cells.

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

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

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

(3) **A** is true but **R** is false

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

Answer (3)

Sol. Cell of the tapetum possess dense cytoplasm and generally have more than one nucleus because the presence of more than one nucleus in the tapetal cells increases the efficiency of nourishing the develpoing pollen grains.

154. How many meiotic and mitotic divisions need to occur for the development of a mature female gametophyte from the megaspore mother cell in an angiosperm plant?

(1) 2 Meiosis and 3 Mitosis

(2) 1 Meiosis and 2 Mitosis

(3) 1 Meiosis and 3 Mitosis

(4) No Meiosis and 2 Mitosis

Answer (3)

Sol. Development of a mature female gametophyte, i.e., embryo sac from a megaspore mother cell in an angiosperm plant requires 1 meiotic and 3 mitotic divisions.

155. Which of the following is an example of a zygomorphic flower?

(1) Petunia

(2) Datura

(3) Pea

(4) Chilli

Answer (3)

Sol. Zygomorphic flowers can be divided into two equal halves by only a single vertical plane and shows bilateral symmetry.

Pea possess zygomorphic flowers.

Chilli, Petunia and Datura possess actinomorphic flowers.

156. After maturation, in primary lymphoid organs, the lymphocytes migrate for interaction with antigens to secondary lymphoid organ(s) / tissue(s) like

A. thymus

B. bone marrow

C. spleen

D. lymph nodes

E. Peyer's patches

Choose the *correct* answer from the options given below

(1) B, C, D only

(2) A, B, C only

(3) E, A, B only

(4) C, D, E only

Answer (4)

Sol. The primary lymphoid organs are bone marrow and thymus where immature lymphocytes differentiate into antigen-sensitive lymphocytes.

After maturation, the lymphocytes migrate into secondary lymphoid organs like spleen, lymph nodes, Peyer's patches of small intestine and appendix.

These secondary lymphoid organ provide the sites for interaction of lymphocytes with the antigen.

157. Given below are two statements :

Statement I : Fig fruit is a non-vegetarian fruit as it has enclosed fig wasps in it.

Statement II : Fig wasp and fig tree exhibit mutual relationship as fig wasp completes its life cycle in fig fruit and fig fruit gets pollinated by fig wasp.

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

(1) Both statement I and statement II are correct

(2) Both statement I and statement II are incorrect

(3) Statement I is correct but statement II is incorrect

(4) Statement I is incorrect but statement II is correct

Answer (2)

Sol. Fig fruit is a vegetarian fruit as it only gets pollinated by wasp. Fig tree and fig wasps shows mutualism in which both species are benefitted. So, statement I is incorrect. Statement II is also not correct as fig inflorescence/flower gets pollinated by fig wasp.

158. What is the main function of the spindle fibers during mitosis?

(1) To separate the chromosomes

(2) To synthesize new DNA

(3) To repair damaged DNA

(4) To regulate cell growth

Answer (1)

Sol. During mitosis, spindle fibre get attach to the kinetochores of the chromosome and help in the separation of the chromosome.

159. Which one of the following is the characteristic feature of gymnosperms?

(1) Seeds are enclosed in fruits

(2) Seeds are naked

(3) Seeds are absent

(4) Gymnosperms have flowers for reproduction

Answer (2)

Sol. The gymnosperms (*Gymnos* : naked, *sperma* seed) are plants in which the ovules are not enclosed by an ovary wall and remains exposed, both before and after fertilization. The seeds that develop post-fertilization, are not covered, *i.e.*, naked.

160. Consider the following statements regarding function of adrenal medullary hormones :

(A) It causes pupilary constriction.

(B) It is a hyperglycemic hormone.

(C) It causes piloerection.

(D) It increases strength of heart contraction.

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

(1) C and D only

(2) B, C and D only

(3) A, C and D only

(4) D only

Answer (2)

Sol. Adrenal medulla secretes two hormones called adrenaline or epinephrine and noradrenaline or norepinephrine (also called emergency hormones).

Both the hormones -

- Cause pupillary dilation (not constriction)
- Stimulate breakdown of glycogen resulting in increased concentration of glucose in blood *i.e.*, cause hyperglycemia.
- Cause piloerection (raising of hair).
- Increase strength of heart contraction *i.e.*, heartbeat.

161. Why can't insulin be given orally to diabetic patients?

(1) Human body will elicit strong immune response
(2) It will be digested in Gastro-Intestinal (GI) tract
(3) Because of structural variation
(4) Its bioavailability will be increased

Answer (2)

Sol. Insulin can't be administered orally to diabetic patients as being the proteinaceous molecule, it will be digested in gastro-intestinal tract.

162. Match **List-I** with **List-II**.

	List-I		List-II
A.	Pteridophyte	I.	*Salvia*
B.	Bryophyte	II.	*Ginkgo*
C.	Angiosperm	III.	*Polytrichum*
D.	Gymnosperm	IV.	*Salvinia*

Choose the option with all **correct** matches.

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

Answer (2)

Sol. Pteridophyte - *Salvinia*

Bryophyte - *Polytrichum*

Angiosperm - *Salvia*

Gymnosperm - *Ginkgo*

163. Who proposed that the genetic code for amino acids should be made up of three nucleotides?

(1) George Gamow
(2) Francis Crick
(3) Jacque Monod
(4) Franklin Stahl

Answer (1)

Sol. George Gamow, a physicist proposed that genetic code for amino acids should be made up of three nucleotides.

164. Match **List I** with **List II**:

	List I		List II
A.	The Evil Quartet	I.	Cryopreservation
B.	Ex situ conservation	II.	Alien species invasion
C.	*Lantana camara*	III.	Causes of biodiversity losses
D.	Dodo	IV.	Extinction

Choose the option with all correct matches.

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

Answer (2)

Sol. The Evil Quartet – Causes of biodiversity losses

Ex situ conservation – Cryopreservation

Lantana camara – Alien species invasion

Dodo – Extinction

165. Which of the following hormones released from the pituitary is actually synthesized in the hypothalamus?

(1) Luteinizing hormone (LH)
(2) Anti-diuretic hormone (ADH)
(3) Follicle-stimulating hormone (FSH)
(4) Adrenocorticotropic hormone (ACTH)

Answer (2)

Sol. Neurohypophysis *i.e.*, posterior pituitary (Pars nervosa) stores and releases two hormones called oxytocin and vasopressin (Also called ADH *i.e.*, antidiuretic hormone) which are actually synthesised by hypothalamus and are transported axonally to neurohypophysis. The pars distalis (anterior pituitary) produces follicle stimulating hormone (FSH), adrenocorticotropic hormone (ACTH) and luteinizing hormone (LH).

166. Role of the water vascular system in Echinoderms is :

A. Respiration and Locomotion

B. Excretion and Locomotion

C. Capture and transport of food

D. Digestion and Respiration

E. Digestion and Excretion

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

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

Answer (2)

Sol. Water vascular system in Echinoderms helps in locomotion, capture and transport of food and respiration.

Excretory system is absent in echinoderms. Excretion takes place through general body surface.

167. Which of the following type of immunity is present at the time of birth and is a non-specific type of defence in the human body?

(1) Acquired Immunity
(2) Innate Immunity
(3) Cell-mediated Immunity
(4) Humoral Immunity

Answer (2)

Sol. Innate immunity is non-specific type of defence, that is present at the time of birth. This is accomplished by providing different types of barriers to the entry of the foreign agents into our body. Acquired immunity is pathogen specific, characterised by memory cells.

Immune response mediated by B-lymphocytes is humoral immunity and other immune response mediated by T-lymphocytes is called cell-mediated immunity.

168. In bryophytes, the gemmae help in which one of the following?

(1) Sexual reproduction
(2) Asexual reproduction
(3) Nutrient absorption
(4) Gaseous exchange

Answer (2)

Sol. Gemmae are green, multicellular, asexual buds which develop in small receptacles called gemma cups and help in asexual reproduction in bryophytes.

169. In frog, the Renal portal system is a special venous connection that acts to link :

(1) Liver and intestine
(2) Liver and kidney
(3) Kidney and intestine
(4) Kidney and lower part of body

Answer (4)

Sol. In frogs, special venous connection between liver and intestine as well as the kidney and lower parts of the body are present in frogs. The former is called hepatic portal system and the latter is called renal portal system.

170. Given below are two statements:

Statement I: In ecosystem, there is unidirectional flow of energy of sun from producers to consumers.

Statement II: Ecosystems are exempted from 2nd law of thermodynamics.

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

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

Answer (3)

Sol. Sun is the only source of energy for all ecosystems on Earth, except for deep sea-hydro-thermal ecosystem.

The energy flow is unidirectional from the sun to producers and then to consumers.

Ecosystems are not exempted from the second law of thermodynamics. They need a constant supply of energy to synthesise the molecules they require to counteract the universal tendency towards increasing disorderliness.

171. Which of the following statements about RuBisCO is true?

(1) It is active only in the dark

(2) It has higher affinity for oxygen than carbon dioxide

(3) It is an enzyme involved in the photolysis of water

(4) It catalyzes the carboxylation of RuBP

Answer (4)

Sol. Carboxylation is the most crucial step of the Calvin cycle where CO_2 is utilised for the carboxylation of RuBP. This reaction is catalysed by enzyme RuBP carboxylase. Since this enzyme also has an oxygenase activity, RuBisCO has higher affinity for carbon dioxide than oxygen.

172. Which of the following enzyme(s) are **NOT** essential for gene cloning?

A. Restriction enzymes

B. DNA ligase

C. DNA mutase

D. DNA recombinase

E. DNA polymerase

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

(1) C and D only

(2) A and B only

(3) D and E only

(4) B and C only

Answer (1)

Sol. Gene cloning is a process where a specific gene or DNA sequence is isolated and replicated, creating multiple identical copies.

In gene cloning, restriction enzymes, DNA ligase and DNA polymerase are primarily used.

173. Read the following statements on plant growth and development.

(A) Parthenocarpy can be induced by auxins.

(B) Plant growth regulators can be involved in promotion as well as inhibition of growth.

(C) Dedifferentiation is a pre-requisite for re-differentiation.

(D) Abscisic acid is a plant growth promoter.

(E) Apical dominance promotes the growth of lateral buds.

(1) A, B, C only (2) A, C, E only

(3) A, D, E only (4) B, D, E only

Answer (1)

Sol. ABA is a plant growth inhibitor and an inhibitor of plant metabolism.

Apical dominance promotes growth of apical bud.

Statements A, B and C are correct.

174. Which factor is important for termination of transcription?

(1) α (alpha) (2) σ (sigma)

(3) ρ (rho) (4) γ (gamma)

Answer (3)

Sol. In prokaryotes the RNA polymerase is only capable of catalysing the process of elongation. It associates transiently with initiation factor (σ) and termination factor (ρ) to initiate and terminate the transcription respectively.

175. Frogs respire in water by skin and buccal cavity and on land by skin, buccal cavity and lungs.

Choose the **correct** answer from the following :

(1) The statement is true for water but false for land

(2) The statement is true for both the environment

(3) The statement is false for water but true for land

(4) The statement is false for both the environment

Answer (3)

Sol.
- In water, frogs respire through skin and not through buccal cavity *i.e.,* undergo cutaneous respiration only.
- On land, the buccal cavity, skin and lungs act as respiratory organs *i.e.,* undergo buccopharyngeal, cutaneous and pulmonary respiration.

176. Twins are born to a family that lives next door to you. The twins are a boy and a girl. Which of the following must be true?

(1) They are monozygotic twins.

(2) They are fraternal twins.

(3) They were conceived through in vitro fertilization.

(4) They have 75% identical genetic content.

Answer (2)

Sol. Fraternal twins or dizygotic twins are 2 separate fertilized eggs, they usually develop 2 separate amniotic sacs, placentas and supporting structures.

If twins are a boy and a girl, this indicates they are fraternal twins.

177. Which of the following microbes is **NOT** involved in the preparation of household products?

A. *Aspergillus niger*

B. *Lactobacillus*

C. *Trichoderma polysporum*

D. *Saccharomyces cerevisiae*

E. *Propionibacterium sharmanii*

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

(1) A and B only

(2) A and C only

(3) C and D only

(4) C and E only

Answer (2)

Sol. *Lactobacillus* is used for production of curd.

Saccharomyces cerevisiae is used for the fermentation of palm sap to obtain toddy drink.

Propionibacterium sharmanii is used for production of swiss cheese.

Aspergillus niger is used for the commercial production of citric acid.

Trichoderma polysporum is used for the production of cyclosporin A and also act as a biocontrol agent.

A, C are used in industrial production of citric acid and cyclosporin-A.

178. Match **List-I** with **List-II**.

	List-I		**List-II**
A.	Progesterone	I.	Pars intermedia
B.	Relaxin	II.	Ovary
C.	Melanocyte stimulating hormone	III.	Adrenal Medulla
D.	Catecholamines	IV.	Corpus luteum

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

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

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

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

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

Answer (1)

Sol. The correct answer is [A-IV, B-II, C-I, D-III]

- Progesterone – A steroidal hormone which is secreted by the corpus luteum
- Relaxin – A proteinaceous hormone which is secreted by the ovaries in the later stage of pregnancy
- Melanocyte stimulating hormone – A proteinaceous hormone released by the pars intermedia
- Catecholamines – An amino-acid derived hormone released from the adrenal medulla during emergency conditions

179. The blue and white selectable markers have been developed which differentiate recombinant colonies from non-recombinant colonies on the basis of their ability to produce colour in the presence of a chromogenic substrate.

Given below are two statements about this method:

Statement I : The blue coloured colonies have DNA insert in the plasmid and they are identified as recombinant colonies.

Statement II : The colonies without blue colour have DNA insert in the plasmid and are identified as recombinant colonies.

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

(1) Both **Statement I** and **Statement II** are correct

(2) Both **Statement I** and **Statement II** are incorrect

(3) **Statement I** is correct but **Statement II** is incorrect

(4) **Statement I** is incorrect but **Statement II** is correct

Answer (4)

Sol. Statement I is incorrect but statement II is correct as a recombinant DNA is inserted within the coding sequence of an enzyme, β-galactosidase. This results into inactivation of the gene for synthesis of this enzyme. Thus, presence of insert results into insertional inactivation of the β-galactosidase gene and the colonies do not produce any colour and identified as recombinant colonies. Whereas non-recombinant transformants will produce blue colour in presence of chromogenic substrate.

180. Which one of the following equations represents the Verhulst-Pearl Logistic Growth of population?

(1) $\frac{dN}{dt} = r\left(\frac{K-N}{K}\right)$

(2) $\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$

(3) $\frac{dN}{dt} = rN\left(\frac{N-K}{N}\right)$

(4) $\frac{dN}{dt} = N\left(\frac{r-K}{K}\right)$

Answer (2)

Sol. Logistic growth is described by Verhulst-Pearl logistic growth equation $\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$.

DATE : 04/05/2025

Test Booklet Code

46

NARMADA

Answers & Solutions for NEET (UG)-2025

Time : 3 hrs.

M.M.: 720

Important Instructions:

1. The test is of **3 hours** duration and the Test Booklet contains **180** multiple choice questions (Four options with a single correct answer) from **Physics, Chemistry and Biology (Botany and Zoology)**.
2. Each question carries **4 marks**. For each correct response, the candidate will get **4 marks**. For every wrong response **1 mark** shall be deducted from the total scores. The maximum marks are **720**.
3. Use **Blue / Black Ball Point Pen only** for writing particulars on this page / marking responses on Answer Sheet.
4. Rough work is to be done in the space provided for this purpose in the Test Booklet only.
5. On completion of the test, the candidate **must hand over the Answer Sheet (ORIGINAL and OFFICE Copy)** to the Invigilator before leaving the Room / Hall. The candidates are allowed to take away this Test Booklet with them.
6. The CODE for this Booklet is **46**.
7. The candidates should ensure that the Answer Sheet is not folded. Do not make any stray marks on the Answer Sheet. Do not write your Roll No. anywhere else except in the specified space in the Test Booklet/Answer Sheet. Use of white fluid for correction is **NOT** permissible on the Answer Sheet.
8. Each candidate must show on-demand his/her Admit Card to the Invigilator.
9. No candidate, without special permission of the Centre Superintendent or Invigilator, would leave his/her seat.
10. Use of Electronic/Manual Calculator is prohibited.
11. The candidates are governed by all Rules and Regulations of the examination with regard to their conduct in the Examination Room/Hall. All cases of unfair means will be dealt with as per Rules and Regulations of this examination along with Public Examinations (Prevention of unfair means act 2024).
12. **No part of the Test Booklet and Answer Sheet shall be detached under any circumstances.**
13. The candidates will write the Correct Test Booklet Code as given in the Test Booklet / Answer Sheet in the Attendance Sheet.

PHYSICS

1. A physical quantity P is related to four observations a, b, c and d as follows:

$P = a^3 b^2 / c\sqrt{d}$

The percentage errors of measurement in a, b, c and d are 1%, 3%, 2%, and 4% respectively. The percentage error in the quantity P is

(1) 2% (2) 13%

(3) 15% (4) 10%

Answer (2)

Sol. Maximum % error in $P = \frac{\Delta P}{P} \times 100 = 3\left(\frac{\Delta a}{a} \times 100\right) + 2\left(\frac{\Delta b}{b} \times 100\right) + \left(\frac{\Delta c}{c} \times 100\right) + \frac{1}{2}\left(\frac{\Delta d}{d} \times 100\right)$

$= 3 \times (1) + 2 \times (3) + (2) + \frac{1}{2} \times (4)$

= 13%

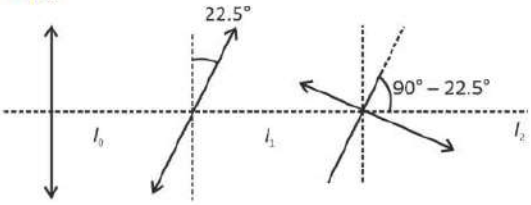
2. The intensity of transmitted light when a polaroid sheet, placed between two crossed polaroids at 22.5° from the polarization axis of one of the polaroids, is (I_0 is the intensity of polarised light after passing through the first polaroid):

(1) $\frac{I_0}{4}$ (2) $\frac{I_0}{8}$

(3) $\frac{I_0}{16}$ (4) $\frac{I_0}{2}$

Answer (2)

Sol.



$I_1 = I_0 \cos^2\left(\frac{45}{2}\right)$

$I_2 = I_1 \cos^2\left(90 - \frac{45}{2}\right)$

$= I_0 \cos^2\left(\frac{45}{2}\right)\sin^2\left(\frac{45}{2}\right)$

$= \frac{I_0}{4}\left(4\cos^2\left(\frac{45}{2}\right)\sin^2\left(\frac{45}{2}\right)\right)$

$= \frac{I_0}{4}\sin^2 45° = \frac{I_0}{8}$

3. A 2 amp current is flowing through two different small circular copper coils having radii ratio 1 : 2. The ratio of their respective magnetic moments will be

(1) 1 : 2 (2) 2 : 1

(3) 4 : 1 (4) 1 : 4

Answer (4)

Sol. Magnetic moment of current carrying circular loop = IA

$M = IA$

$M \propto A$ [I–Same]

$$\frac{M_1}{M_2} = \frac{A_1}{A_2} = \frac{\pi r_1^2}{\pi r_2^2} = \left(\frac{1}{2}\right)^2 = \frac{1}{4}$$

4. Consider the diameter of a spherical object being measured with the help of a Vernier callipers. Suppose its 10 Vernier Scale Divisions (V.S.D.) are equal to its 9 Main Scale Divisions (M.S.D.). The least division in the M.S. is 0.1 cm and the zero of V.S. is at $x = 0.1$ cm when the jaws of Vernier callipers are closed.

If the main scale reading for the diameter is $M = 5$ cm and the number of coinciding vernier division is 8, the measured diameter after zero error correction, is

(1) 5.08 cm (2) 4.98 cm

(3) 5.00 cm (4) 5.18 cm

Answer (2)

Sol. Least count = 1MSD – 1VSD

$$= 1\,\text{MSD} - \frac{9}{10}\text{MSD}$$

$$= \frac{1}{10}\text{MSD}$$

$$= \frac{1}{10} \times 0.1\text{ cm} = 0.01\text{ cm}$$

Zero error = +0.1 cm

Main scale reading = 5 cm

Vernier scale reading = 8 × 0.01 = 0.08 cm

Final measurement of diameter

= 5 + 0.08 – 0.1 = 4.98 cm

5. A photon and an electron (mass m) have the same energy E. The ratio ($\lambda_{photon}/\lambda_{electron}$) of their de Broglie wavelengths is: (c is the speed of light)

(1) $c\sqrt{2mE}$ (2) $c\sqrt{\frac{2m}{E}}$

(3) $\frac{1}{c}\sqrt{E/2m}$ (4) $\sqrt{E/2m}$

Answer (2)

Sol. For photon, $E = \frac{hc}{\lambda_{Ph}} \Rightarrow \lambda_{Ph} = \frac{hc}{E}$

For electron, p = momentum and $E = \frac{p^2}{2m} = \left(\frac{h}{\lambda_e}\right)^2 \times \frac{1}{2m}$

$$\Rightarrow \lambda_e = \frac{h}{\sqrt{2mE}}$$

$$\therefore \frac{\lambda_{Ph}}{\lambda_e} = \frac{\frac{hc}{E}}{\frac{h}{\sqrt{2mE}}} = c\sqrt{\frac{2m}{E}}$$

6. De-Broglie wavelength of an electron orbiting in the $n = 2$ state of hydrogen atom is close to (Given Bohr radius = 0.052 nm)

(1) 0.67 nm

(2) 1.67 nm

(3) 2.67 nm

(4) 0.067 nm

Answer (1)

Sol. $r = 0.052\, n^2$

For $n = 2$

$r = 0.052 \times 4$

$= 0.208$ nm

$$Mvr = \frac{nh}{2\pi}$$

$$\lambda = \frac{h}{Mv} = \pi r$$

$= 3.14 \times 0.208$ nm

$= 0.65317$ nm

≈ 0.67 nm

7. An unpolarized light beam travelling in air is incident on a medium of refractive index 1.73 at Brewster's angle. Then

(1) Reflected light is partially polarized and the angle of reflection is close to 30°

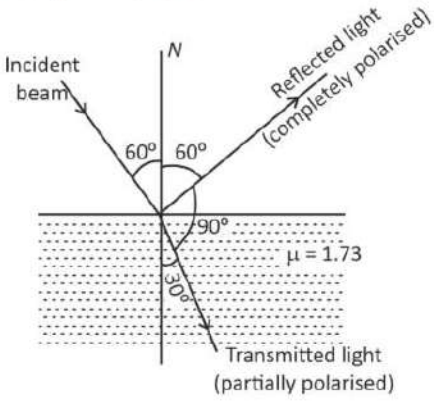
(2) Both reflected and transmitted light are perfectly polarized with angles of reflection and refraction close to 60° and 30°, respectively

(3) Transmitted light is completely polarized with angle of refraction close to 30°

(4) Reflected light is completely polarized and the angle of reflection is close to 60°

Answer (4)

Sol. Using Brewster law



$\mu = \tan\theta_P$

$\Rightarrow 1.73 = \tan\theta_P$

$\Rightarrow \sqrt{3} = \tan\theta_P$

$\Rightarrow \theta_P = 60°$

At this polarising angle, reflected light is perfectly polarized and transmitted light is partially polarised.

8. The kinetic energies of two similar cars A and B are 100 J and 225 J respectively. On applying breaks, car A stops after 1000 m and car B stops after 1500 m. If F_A and F_B are the forces applied by the breaks on cars A and B respectively, then the ratio of $\frac{F_A}{F_B}$ is

(1) $\frac{2}{3}$ (2) $\frac{1}{3}$

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

Answer (1)

Sol. By work-energy theorem,

$FS = \Delta K \cdot E$

$\Rightarrow -FS = k_f - k_i$

$\Rightarrow FS = k_i - k_f$

$\Rightarrow \frac{F_A}{F_B} = \frac{k_A}{k_B} \times \frac{S_B}{S_A}$

$= \frac{100}{225} \times \frac{1500}{1000}$

$= \frac{150}{225} = \frac{2}{3}$

9. A wire of resistance R is cut into 8 equal pieces. From these pieces two equivalent resistances are made by adding four of these together in parallel. Then these two sets are added in series. The net effective resistance of the combination is:

(1) $\frac{R}{32}$ (2) $\frac{R}{16}$

(3) $\frac{R}{8}$ (4) $\frac{R}{64}$

Answer (2)

Sol. After being cut into 8 equal pieces,

$\Rightarrow$ Resistance of each piece = $R' = \frac{R}{8}$

Each set has 4 pieces in parallel combination

$\Rightarrow$ Resistance of each set = $R'' = \frac{R'}{4} = \frac{R}{32}$

Both sets are connected in series

$\therefore \quad R_{eq} = R'' + R'' = 2 \times \frac{R}{32} = \frac{R}{16}$

10. An oxygen cylinder of volume 30 litre has 18.20 moles of oxygen. After some oxygen is withdrawn from the cylinder, its gauge pressure drops to 11 atmospheric pressure at temperature 27°C. The mass of the oxygen withdrawn from the cylinder is nearly equal to:

[Given, $R = \frac{100}{12}\ \text{J mol}^{-1}\text{K}^{-1}$, and molecular mass of O_2 = 32, 1 atm pressure = 1.01×10^5 N/m]

(1) 0.144 kg (2) 0.116 kg

(3) 0.156 kg (4) 0.125 kg

Answer (2)

Sol. Number of moles left

$$n = \frac{PV}{RT} = \frac{12 \times 1.01 \times 10^5 \text{N/m}^2 \times 30 \times 10^{-3} \text{m}^3}{\frac{100}{12} \times 300}$$

$$n = \frac{12 \times 1.01 \times 12}{10} = 14.54 \text{ moles}$$

Moles removed = 18.2 – 14.54

= 3.656 moles

Mass removed = 3.656 × 32 = 116.99 g = 0.116 kg

11. In a certain camera, a combination of four similar thin convex lenses are arranged axially in contact. Then the power of the combination and the total magnification in comparison to the power (p) and magnification (m) for each lens will be, respectively

(1) p^4 and $4m$
(2) $4p$ and m^4
(3) p^4 and m^4
(4) $4p$ and $4m$

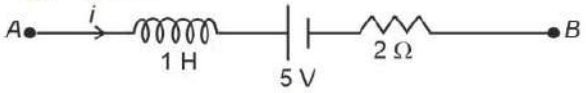
Answer (2)

Sol. For series combination of lens

$p_{eff} = p_1 + p_2 + p_3 + p_4 = 4p$

$m_{eff} = m_1 \times m_2 \times m_3 \times m_4 = m^4$

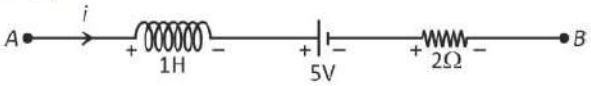
12. AB is a part of an electrical circuit (see figure). The potential difference "$V_A - V_B$", at the instant when current i = 2 A and is increasing at a rate of 1 amp/second is:



(1) 6 volt
(2) 9 volt
(3) 10 volt
(4) 5 volt

Answer (3)

Sol.



Given, I = 2A and $\frac{di}{dt} = +1\text{A/s}$

$$V_A - L\frac{di}{dt} - 5 - i \times 2 = V_B$$

$\Rightarrow$ $V_A - 1 \times 1 - 5 - 2 \times 2 = V_B$

$\Rightarrow$ $V_A - V_B = 10$ volt

13. A body weighs 48 N on the surface of the earth. The gravitational force experienced by the body due to the earth at a height equal to one-third the radius of the earth from its surface is :

(1) 27 N
(2) 32 N
(3) 36 N
(4) 16 N

Answer (1)

Sol. $W = mg$ and $g = \frac{GM}{R^2}$, $g_h = \frac{GM}{(R+h)^2}$

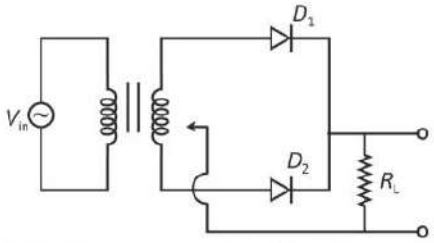
$$\Rightarrow \frac{W_h}{W} = \frac{mg_h}{mg} = \frac{g_h}{g} = \frac{R^2}{(R+h)^2} \quad \left(h = \frac{R}{3}\right)$$

$$\Rightarrow \frac{W_h}{W} = \frac{R^2}{\left(R+\frac{R}{3}\right)^2} = \frac{R^2}{\left(\frac{4R}{3}\right)^2} = \frac{9}{16}$$

$$\Rightarrow W_h = \frac{9}{16}W = \frac{9}{16} \times 48 \quad [W = 48\text{ N}]$$

$$= 27\text{ N}$$

14. A full wave rectifier circuit with diodes (D_1) and (D_2) is shown in the figure. If input supply voltage $V_{in} = 220\sin(100\pi t)$ volt, then at $t = 15$ msec



(1) D_1 is reverse biased, D_2 is forward biased.
(2) D_1 and D_2 both are forward biased
(3) D_1 and D_2 both are reverse biased
(4) D_1 is forward biased, D_2 is reverse biased

Answer (1)

Sol. $V_{in} = 220\sin(100\pi t)$ volt

$t = 15$ ms

$t = 0.015$ s

$\omega = 100\pi$

$$\frac{2\pi}{T} = 100\pi$$

$$T = \frac{1}{50}\text{ s}$$

$T = 0.02$ s

$$\therefore\ t = \frac{3T}{4}$$

i.e. negative half cycle.

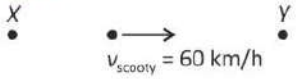
So now negative half cycle is fed to circuit making D_1 as reverse biased and D_2 as forward biased.

15. Two cities X and Y are connected by a regular bus service with a bus leaving in either direction every T min. A girl is driving scooty with a speed of 60 km/h in the direction X to Y notices that a bus goes past her every 30 minutes in the direction of her motion, and every 10 minutes in the opposite direction. Choose the correct option for the period T of the bus service and the speed (assumed constant) of the buses.

(1) 25 min, 100 km/h
(2) 10 min, 90 km/h
(3) 15 min, 120 km/h
(4) 9 min, 40 km/h

Answer (3)

Sol.



$X \rightarrow Y$

Let velocity of bus = v km/hr

Relative velocity of bus w.r.t. scooty = $(v - 60)$

Distance between 2 consecutive buses = vT

$(v - 60)30 = vT$ ...(i)

$Y \rightarrow X$

$(v + 60)10 = vT$ ...(ii)

Equating (1) and (2)

$(v - 60)30 = (v + 60)10$

$\therefore \quad v = 120$ km/hr

$T = 15$ min

16. The Sun rotates around its centre once in 27 days. What will be the period of revolution if the Sun were to expand to twice its present radius without any external influence? Assume the Sun to be a sphere of uniform density.

(1) 105 days (2) 115 days

(3) 108 days (4) 100 days

Answer (3)

Sol. Assuming the Sun to be a solid sphere, $I = \frac{2}{5}mR^2$

Using conservation of angular momentum, $I'\omega' = I\omega$

$\Rightarrow \frac{2}{5}m(2R)^2 \times \frac{2\pi}{T'} = \frac{2}{5}mR^2 \times \frac{2\pi}{T}$

$\Rightarrow T' = 4T = 4 \times 27 = 108$ days

17. The electric field in a plane electromagnetic wave is given by

$E_z = 60 \cos(5x + 1.5 \times 10^9 t)$ V/m.

Then expression for the corresponding magnetic field is (here subscripts denote the direction of the field) :

(1) $B_x = 2 \times 10^{-7} \cos(5x + 1.5 \times 10^9 t)T$

(2) $B_z = 60\cos(5x + 1.5 \times 10^9 t)T$

(3) $B_y = 60 \sin(5x + 1.5 \times 10^9 t)T$

(4) $B_y = 2 \times 10^{-7} \cos(5x + 1.5 \times 10^9 t)T$

Answer (4)

Sol. In electromagnetic wave, E and B are in same phase and $B_0 = \frac{E_0}{c}$; their planes are perpendicular to each other.

$\therefore \; B_y = \frac{60}{c}\cos(5x + 1.5 \times 10^9 t)$ T

$= \frac{60}{3 \times 10^8}\cos(5x + 1.5 \times 10^9 t)$ T

$B_y = 2 \times 10^{-7}\cos(5x + 1.5 \times 10^9 t)$ T

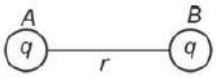
18. Two identical charged conducting spheres A and B have their centres separated by a certain distance. Charge on each sphere is q and the force of repulsion between them is F. A third identical uncharged conducting sphere is brought in contact with sphere A first and then with B and finally removed from both. New force of repulsion between spheres A and B (Radii of A and B are negligible compared to the distance of separation so that for calculating force between them they can be considered as point charges) is best given as:

(1) $\frac{2F}{3}$ (2) $\frac{F}{2}$

(3) $\frac{3F}{8}$ (4) $\frac{3F}{5}$

Answer (3)

Sol.



$$F = \frac{Kqq}{r^2}$$

$$F' = \frac{K\frac{q}{2}\frac{3q}{4}}{r^2}$$

$$F' = \frac{3F}{8}$$

19. An electric dipole with dipole moment 5×10^{-6} Cm is aligned with the direction of a uniform electric field of magnitude 4×10^5 N/C. The dipole is then rotated through an angle of 60° with respect to the electric field. The change in the potential energy of the dipole is:

(1) 1.0 J (2) 1.2 J

(3) 1.5 J (4) 0.8 J

Answer (1)

Sol. Given

$$|\vec{P}| = 5 \times 10^{-6} \text{ C m}$$

$$|\vec{E}| = 4 \times 10^{5} \text{ N/C}$$

$\theta_i = 0°$ and $\theta_f = 60°$

$\Delta U = U_f - U_i$

$= -PE\cos\theta_f + PE\cos\theta_i$

$= PE[\cos\theta_i - \cos\theta_f]$

$= 5 \times 10^{-6} \times 4 \times 10^5 \left[1 - \frac{1}{2}\right]$

$= 10 \times 10^{-6} \times 10^5 = 1$ J

20. A microscope has an objective of focal length 2 cm, eyepiece of focal length 4 cm and the tube length of 40 cm. If the distance of distinct vision of eye is 25 cm, the magnification in the microscope is

(1) 125 (2) 150

(3) 250 (4) 100

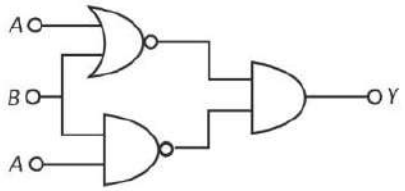
Answer (1)

Sol. $m = \frac{L}{f_o} \times \frac{D}{f_e}$

$= \frac{40}{2} \times \frac{25}{4}$

$m = 125$

21. The output (Y) of the given logic implementation is similar to the output of an/a _____ gate.

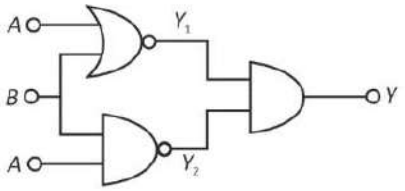


(1) NAND (2) OR

(3) NOR (4) AND

Answer (3)

Sol.



$Y_1 = \overline{A+B}$

$Y_2 = \overline{A \cdot B}$

$Y = Y_1 \cdot Y_2$

$= \overline{A+B} \cdot \overline{A \cdot B}$

$= \overline{(A+B) + A \cdot B}$

$= \overline{A + B(1+A)}$

$= \overline{A+B}$ NOR gate

22. A uniform rod of mass 20 kg and length 5 m leans against a smooth vertical wall making an angle of 60° with it. The other end rests on a rough horizontal floor. The friction force that the floor exerts on the rod is (Take g = 10 m/s^2)

(1) $100\sqrt{3}$ N

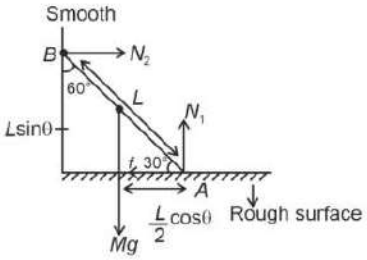
(2) 200 N

(3) $200\sqrt{3}$ N

(4) 100 N

Answer (1)

Sol.



For translational equilibrium

$N_1 = Mg$

$N_2 = f$

For rotational equilibrium

Torque about A, $Mg\frac{L}{2}\cos\theta = N_2 L\sin\theta$

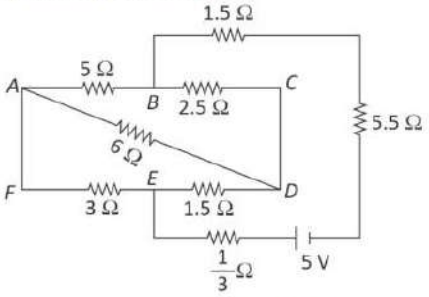
$\frac{Mg}{2}\cot\theta = N_2 = f$

$\frac{Mg}{2}\cot 30° = f$

$\frac{Mg}{2}\sqrt{3} = N_2$

$100\sqrt{3} = f$

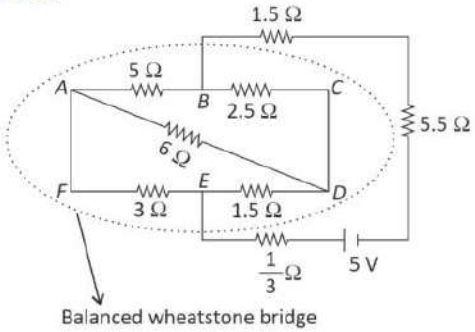
23. The current passing through the battery in the given circuit, is:



(1) 0.5 A
(2) 2.5 A
(3) 1.5 A
(4) 2.0 A

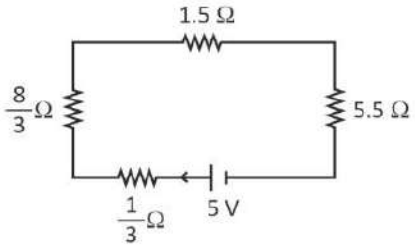
Answer (1)

Sol.



$\therefore$ its equivalent $R' = \frac{4\times 8}{12} = \frac{8}{3}\Omega$

Circuit can be redrawn as



$R_{eq} = \frac{8}{3} + \frac{1}{3} + 1.5 + 5.5$

$= 10\ \Omega$

$i = \frac{V}{R_{eq}} = \frac{5}{10} = 0.5\text{A}$

24. A model for quantized motion of an electron in a uniform magnetic field B states that the flux passing through the orbit of the electron is $n(hle)$ where n is an integer, h is Planck's constant and e is the magnitude of electron's charge. According to the model, the magnetic moment of an electron in its lowest energy state will be (m is the mass of the electron)

(1) $\frac{he}{2\pi m}$
(2) $\frac{heB}{\pi m}$
(3) $\frac{heB}{2\pi m}$
(4) $\frac{he}{\pi m}$

Answer (1)

Sol. Magnetic force = $\frac{mv^2}{r}$

$$evB = \frac{mv^2}{r}$$

$$v = \frac{eBr}{m}$$

$$\phi = BA$$

$$\frac{nh}{e} = B\pi r^2$$

$$Br^2 = \frac{nh}{e\pi}$$

$$\mu = IA$$

$$= \frac{e}{T}\pi r^2$$

$$= \frac{e \times v}{2\pi r}\pi r^2$$

$$\mu = \frac{evr}{2}$$

$$= \frac{1}{2}e \times \frac{eBr}{m}r$$

$$\mu = \frac{1}{2}e^2\frac{Br^2}{m}$$

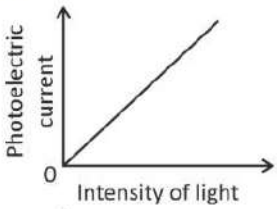
$$\mu = \frac{1}{2}e^2\frac{nh}{e\pi m}$$

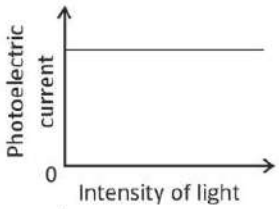
$$\mu = \frac{neh}{2\pi m}$$

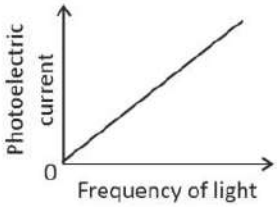
for $n = 1$

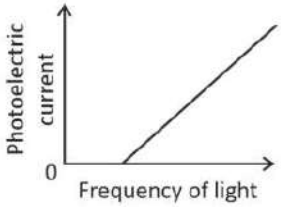
$$\mu = \frac{eh}{2\pi m}$$

25. Which of the following options represent the variation of photoelectric current with property of light shown on the x-axis?

A.


B.


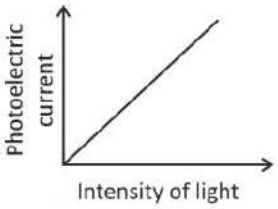
C.


D.


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

Answer (4)

Sol.



Photoelectric current is directly proportional to intensity of light.

26. An electron (mass 9×10^{-31} kg and charge 1.6×10^{-19} C) moving with speed $c/100$ (c = speed of light) is injected into a magnetic field $\vec{B}$ of magnitude 9×10^{-4} T perpendicular to its direction of motion. We wish to apply an uniform electric field $\vec{E}$ together with the magnetic field so that the electron does not deflect from its path. Then (speed of light $c = 3 \times 10^8$ ms^{-1})

(1) $\vec{E}$ is perpendicular to $\vec{B}$ and its magnitude is 27×10^2 V m^{-1}

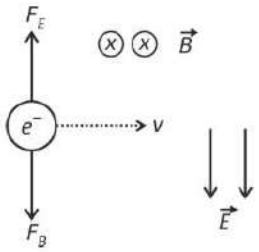
(2) $\vec{E}$ is parallel to $\vec{B}$ and its magnitude is 27×10^2 V m^{-1}

(3) $\vec{E}$ is parallel to $\vec{B}$ and its magnitude is 27×10^4 V m^{-1}

(4) $\vec{E}$ is perpendicular to $\vec{B}$ and its magnitude is 27×10^4 V m^{-1}

Answer (1)

Sol. For no deflection of electron, $\vec{F}_B = \vec{F}_E$



$$-e\left(\vec{v} \times \vec{B}\right) = -e\vec{E}$$

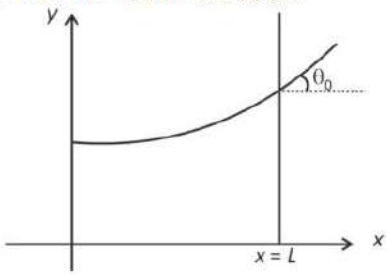
$$\Rightarrow \vec{E} = \vec{v} \times \vec{B} \quad \Rightarrow \vec{E} \perp \vec{B}$$

$$E = vB = \frac{c}{100} \times 9 \times 10^{-4}$$

$$= \frac{3 \times 10^8}{100} \times 9 \times 10^{-4}$$

$$= 27 \times 10^2 \text{ V m}^{-1}$$

27. Consider a water tank shown in the figure. It has one wall at $x = L$ and can be taken to be very wide in the z direction. When filled with a liquid of surface tension S and density ρ, the liquid surface makes angle θ_0 ($\theta_0 << 1$) with the x-axis at $x = L$. If $y(x)$ is the height of the surface then the equation for $y(x)$ is:



(take $\theta(x) = \sin\theta(x) = \tan\theta(x) = \frac{dy}{dx}$, g is the acceleration due to gravity)

(1) $\frac{d^2y}{dx^2}=\frac{\rho g}{S}y$

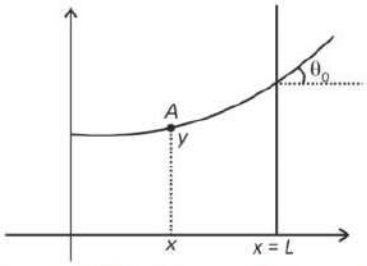
(2) $\frac{d^2y}{dx^2}=\sqrt{\frac{\rho g}{S}}$

(3) $\frac{dy}{dx}=\sqrt{\frac{\rho g}{S}}x$

(4) $\frac{d^2y}{dx^2}=\frac{\rho g}{S}x$

Answer (1)

Sol.



ROC = Radius of curvature at point *A*

$$\text{Curvature} = \frac{1}{ROC} = \frac{\left|\frac{d^2y}{dx^2}\right|}{\left(1+\left(\frac{dy}{dx}\right)^2\right)^{\frac{3}{2}}} = \frac{\left|\frac{d^2y}{dx^2}\right|}{(1+0)^{\frac{3}{2}}} = \frac{d^2y}{dx^2} \qquad \left[\because \frac{dy}{dx} = \tan\theta \simeq 0\right]$$

$\Delta P = S \times$ curvature

$$\Rightarrow \rho g y = S\frac{d^2y}{dx^2}$$

$$\therefore \frac{d^2y}{dx^2} = \frac{\rho g y}{S}$$

28. A pipe open at both ends has a fundamental frequency f in air. The pipe is now dipped vertically in a water drum to half of its length. The fundamental frequency of the air column is now equal to:

(1) f

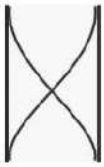
(2) $\frac{3f}{2}$

(3) $2f$

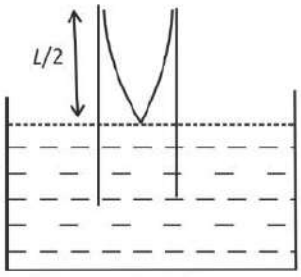
(4) $\frac{f}{2}$

Answer (1)

Sol. Fundamental frequency of open pipe (at both ends) $f = \frac{v}{2L}$ ...(i)



Now immersed in water open pipe behaves as closed pipe.



$$f' = \frac{v}{4\left(\frac{L}{2}\right)} = \frac{v}{2L} \quad \ldots(ii)$$

$f = f'$

29. A parallel plate capacitor made of circular plates is being charged such that the surface charge density on its plates is increasing at a constant rate with time. The magnetic field arising due to displacement current is:

(1) Constant between the plates and zero outside the plates

(2) Non-zero everywhere with maximum at the imaginary cylindrical surface connecting peripheries of the plates

(3) Zero between the plates and non-zero outside

(4) Zero at all places

Answer (2)

Sol. Let the surface charge density be $\sigma = \frac{q}{A}$

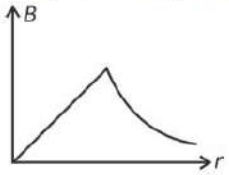
Given $\frac{d\sigma}{dt}$ = constant

$\therefore \quad \frac{d}{dt}\left(\frac{q}{A}\right)$ = constant $\Rightarrow \frac{I}{A} i$ = constant

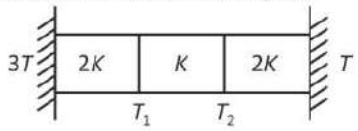
It means displacement current is constant.

This system will act like a cylindrical wire.

The graph of magnetic field (B) vs r is



30. Three identical heat conducting rods are connected in series as shown in the figure. The rods on the sides have thermal conductivity $2K$ while that in the middle has thermal conductivity K. The left end of the combination is maintained at temperature $3T$ and the right end at T. The rods are thermally insulated from outside. In steady state, temperature at the left junction is T_1 and that at the right junction is T_2. The ratio T_1/T_2 is



(1) $\frac{4}{3}$

(2) $\frac{5}{3}$

(3) $\frac{5}{4}$

(4) $\frac{3}{2}$

Answer (2)

Sol. In series, $R_{eq.} = R_1 + R_2 + R_3$

$$= \frac{l}{2KA} + \frac{l}{KA} + \frac{l}{2KA}$$

$$= \frac{4l}{2KA}$$

$$R_{eq.} = \frac{2l}{KA}$$

In series rate of heat flow is same

$$\therefore \quad \frac{3T - T_1}{R_1} = \frac{3T - T}{R_{eq.}}$$

$$\frac{(3T - T_1)2KA}{l} = \frac{(2T)KA}{2l}$$

$$\Rightarrow \quad 6T - 2T_1 = T$$

$$\Rightarrow \quad 2T_1 = 5T$$

$$\Rightarrow \quad T_1 = \frac{5T}{2} \quad ...(1)$$

Now, equate heat flow rate in 3rd section & total section

$$\frac{T_2 - T}{R_3} = \frac{3T - T}{R_{eq.}}$$

$$\Rightarrow \quad \frac{(T_2 - T)(2KA)}{l} = \frac{2T(KA)}{2l}$$

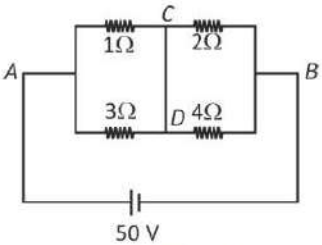
$$\Rightarrow \quad 2T_2 - 2T = T$$

$$\Rightarrow \quad T_2 = \frac{3T}{2} \quad ...(2)$$

By equation (1) and equation (2)

$$\frac{T_1}{T_2} = \frac{5T \times 2}{2 \times 3T} = \frac{5}{3}$$

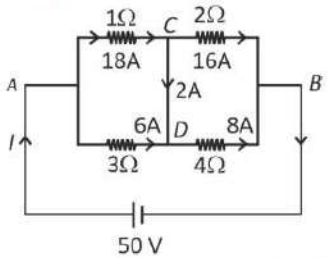
31. A constant voltage of 50 V is maintained between the points *A* and *B* of the circuit shown in the figure. The current through the branch *CD* of the circuit is:



(1) 2.0 A
(2) 2.5 A
(3) 3.0 A
(4) 1.5 A

Answer (1)

Sol.



R_{AB} = (1Ω/3Ω) in series with (2Ω/4Ω)

$$=\frac{3\times1}{3+1}+\frac{2\times4}{2+4}$$

$$=\frac{3}{4}+\frac{8}{6}=\frac{9+16}{12}=\frac{25}{12}\Omega$$

Now total current through cell

$$I=\frac{50}{25/12}=24\text{A}$$

$$I_{1\Omega}=\frac{3}{4}\times24=18\text{A},\ I_{3\Omega}=\frac{1}{4}\times24=6\text{A}$$

$$I_{2\Omega}=\frac{4}{6}\times24=16\text{A},\ I_{4\Omega}=\frac{2}{6}\times24=8\text{A}$$

Using junction rule at C, I_{CD} = 18 – 16 = 2A (From C to D)

32. In some appropriate units, time (t) and position (x) relation of a moving particle is given by $t = x^2 + x$. The acceleration of the particle is

(1) $-\frac{2}{(2x+1)^3}$

(2) $+\frac{2}{(x+1)^3}$

(3) $+\frac{2}{2x+1}$

(4) $-\frac{2}{(x+2)^3}$

Answer (1)

Sol. $t = x^2 + x$

$$\frac{dt}{dx}=2x+1$$

$$v=\frac{dx}{dt}=\frac{1}{(2x+1)}$$

$$\frac{dv}{dx}=\frac{-2}{(2x+1)^2}$$

$$a=v\frac{dv}{dx}=\frac{1}{(2x+1)}\left[\frac{-2}{(2x+1)^2}\right]$$

$$=-\frac{2}{(2x+1)^3}$$

33. Two gases A and B are filled at the same pressure in separate cylinders with movable pistons of radius r_A and r_B, respectively. On supplying an equal amount of heat to both the systems reversibly under constant pressure, the pistons of gas A and B are displaced by 16 cm and 9 cm, respectively. If the change in their internal energy is the same, then the ratio $\frac{r_A}{r_B}$ is equal to

(1) $\frac{3}{4}$

(2) $\frac{2}{\sqrt{3}}$

(3) $\frac{\sqrt{3}}{2}$

(4) $\frac{4}{3}$

Answer (1)

Sol. Using first law of thermodynamics

$\Delta Q = \Delta U + P\Delta V$

ΔQ is same

ΔU is also same

$W_A = W_B$

$\therefore\ (P\Delta V)_A = (P\Delta V)_B$

P is also same

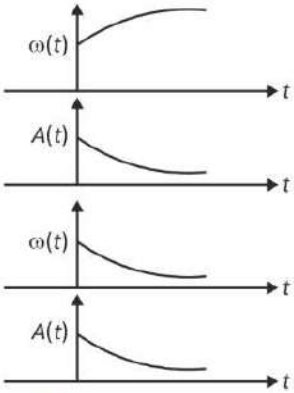
$\therefore\ A_A d_A = A_B d_B$

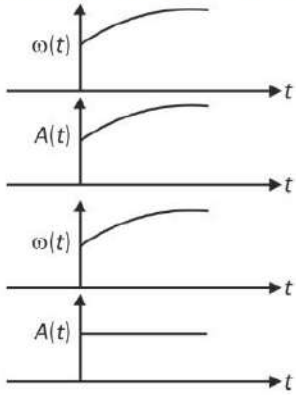
$\pi r_A^2 d_A = \pi r_B^2 d_B$

$$\frac{r_A}{r_B} = \left(\frac{dB}{dA}\right)^{\frac{1}{2}} = \left(\frac{9}{16}\right)^{\frac{1}{2}}$$

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

34. In an oscillating spring mass system, a spring is connected to a box filled with sand. As the box oscillates, sand leaks slowly out of the box vertically so that the average frequency $\omega(t)$ and average amplitude $A(t)$ of the system change with time t. Which one of the following options schematically depicts these changes correctly?

(1)


(2)


(3)

(4)

Answer (1)

Sol. At any point of time, time period is given by

$$T = 2\pi\sqrt{\frac{m}{k}}$$

Here m is decreasing, so time period T will be decreasing

Since $\omega = \frac{2\pi}{T}$

Hence as mass leaks, ω will increase

Now, at any instant

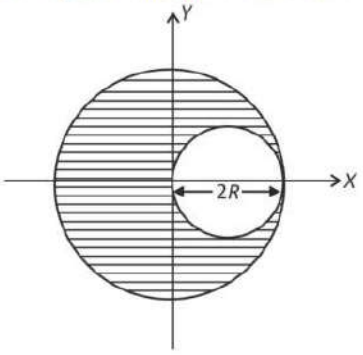
$mg = kx_0$

So, equilibrium length $x_0 = \frac{mg}{k}$, where m is decreasing

So, equilibrium length will decrease.

So, amplitude also go on decreasing.

35. A sphere of radius R is cut from a larger solid sphere of radius $2R$ as shown in the figure. The ratio of the moment of inertia of the smaller sphere to that of the rest part of the sphere about the Y-axis is:



(1) $\frac{7}{40}$

(2) $\frac{7}{57}$

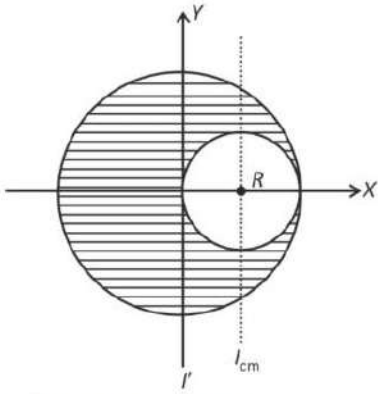
(3) $\frac{7}{64}$

(4) $\frac{7}{8}$

Answer (2)

Sol. For larger solid sphere about diameter Y-axis,

$$I_{\text{whole}} = \frac{2}{5}M(2R)^2 = \frac{8}{5}MR^2$$



Density of sphere is uniform

$$\Rightarrow \frac{M}{V_{\text{whole}}} = \frac{M_{\text{smaller}}}{V_{\text{smaller}}} \Rightarrow \frac{M}{\frac{4}{3}\pi(2R)^3} = \frac{M'}{\frac{4}{3}\pi R^3}$$

$$\Rightarrow M' = \frac{M}{8}$$

Using parallel axis theorem for smaller sphere,

$$I' = I_{\text{cm}} + M'R^2 = \frac{2}{5}\frac{MR^2}{8} + \frac{MR^2}{8} = \frac{7}{40}MR^2$$

$$\therefore \text{ Ratio} = \frac{I_{\text{smaller}}}{I_{\text{remaining}}} = \frac{I'}{I_{\text{whole}} - I'} = \frac{\frac{7}{40}MR^2}{\left(\frac{8}{5} - \frac{7}{40}\right)MR^2} = \frac{7}{64-7} = \frac{7}{57}$$

36. The plates of a parallel plate capacitor are separated by d. Two slabs of different dielectric constant K_1 and K_2 with thickness $\frac{3}{8}d$ and $\frac{d}{2}$, respectively are inserted in the capacitor. Due to this, the capacitance becomes two times larger than when there is nothing between the plates.

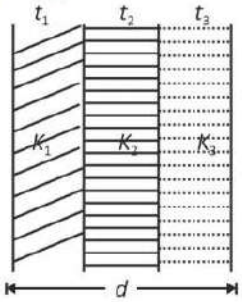
If $K_1 = 1.25\ K_2$, the value of K_1 is:

(1) 2.33 (2) 1.60

(3) 1.33 (4) 2.66

Answer (4)

Sol.



Using $C_{eq} = \dfrac{\varepsilon_0 A}{\dfrac{t_1}{K_1} + \dfrac{t_2}{K_2} + \dfrac{t_3}{K_3}}$

here $C_0 = \dfrac{\varepsilon_0 A}{d}, t_1 = \dfrac{3d}{8}, t_2 = \dfrac{d}{2}, t_3 = \dfrac{d}{8}$

$K_1 = K_1,\ K_2 = \dfrac{K_1}{1.25}$ and $K_3 = 1$

Given $C_{eq} = 2C_0$

$$\Rightarrow 2C_0 = \frac{\varepsilon_0 A}{\dfrac{3d}{8K_1} + \dfrac{d \times 1.25}{2K_1} + \dfrac{d}{8}}$$

$$\Rightarrow \frac{2\varepsilon_0 A}{d} = \frac{\varepsilon_0 A}{\dfrac{3d}{8K_1} + \dfrac{d}{2K_1} \times \dfrac{5}{4} + \dfrac{d}{8}}$$

$$\Rightarrow 2 = \frac{1}{\dfrac{3}{8K_1} + \dfrac{5}{8K_1} + \dfrac{1}{8}} \Rightarrow K_1 = \frac{8}{3} = 2.66$$

37. There are two inclined surfaces of equal length (L) and same angle of inclination 45° with the horizontal. One of them is rough and the other is perfectly smooth. A given body takes 2 times as much time to slide down on rough surface than on the smooth surface. The coefficient of kinetic friction (μ_k) between the object and the rough surface is close to

(1) 0.40 (2) 0.5

(3) 0.75 (4) 0.25

Answer (3)

Sol. $t_{rough} = 2t_{smooth}$

$a_{smooth} = g\sin\theta$

$$t \propto \frac{1}{\sqrt{a}} \Rightarrow t_{smooth} \propto \frac{1}{\sqrt{g\sin\theta}}$$

$a_{rough} = g\sin\theta - \mu_k g\cos\theta$

$$\frac{t_{rough}}{t_{smooth}} = \frac{\sqrt{\sin\theta}}{\sqrt{\sin\theta - \mu_k \cos\theta}} = 2$$

Squaring both sides

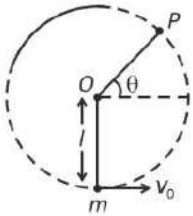
$$\frac{\sin\theta}{\sin\theta - \mu_k \cos\theta} = 4 \Rightarrow \frac{\frac{1}{\sqrt{2}}}{\frac{1}{\sqrt{2}} - \mu_k \times \frac{1}{\sqrt{2}}} = 4$$

$$\Rightarrow 1 - \mu_k = \frac{1}{4}$$

$$\mu_k = \frac{3}{4}$$

= 0.75

38. A bob of heavy mass m is suspended by a light string of length l. The bob is given a horizontal velocity v_0 as shown in figure. If the string gets slack at some point P making an angle θ from the horizontal, the ratio of the speed v of the bob at point P to its initial speed v_0 is:



(1) $\left(\frac{1}{2+3\sin\theta}\right)^{\frac{1}{2}}$

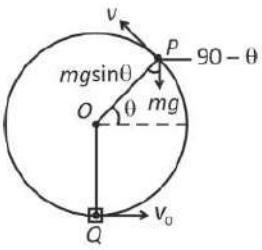
(2) $\left(\frac{\cos\theta}{2+3\sin\theta}\right)^{\frac{1}{2}}$

(3) $\left(\frac{\sin\theta}{2+3\sin\theta}\right)^{\frac{1}{2}}$

(4) $(\sin\theta)^{\frac{1}{2}}$

Answer (3)

Sol.



At Point *P*, $mg\sin\theta = \frac{mv^2}{l}$ ...(1)

By conservation of mechanical energy at point $P \in Q$

$$\frac{1}{2}mv_0^2 = \frac{1}{2}mv^2 + mg(l + l\sin\theta)$$

$$\frac{v_0^2}{2} = \frac{v^2}{2} + gl(1 + \sin\theta)$$

Put $gl = \frac{v^2}{\sin\theta}$ using (1)

$$\frac{v_0^2}{2}=\frac{v^2}{2}+\frac{v^2}{\sin\theta}(1+\sin\theta)$$

$$\frac{v_0^2}{2}=\frac{v^2}{2}+\frac{v^2}{\sin\theta}+v^2$$

$$\frac{v_0^2}{2}=\frac{3}{2}v^2+\frac{2v^2}{2\sin\theta}$$

$$v_0^2=v^2\left[3+\frac{2}{\sin\theta}\right]$$

$$\frac{v}{v_0}=\left(\frac{\sin\theta}{3\sin\theta+2}\right)^{\frac{1}{2}}$$

39. A container has two chambers of volumes V_1 = 2 litres and V_2 = 3 litres separated by a partition made of a thermal insulator. The chambers contain n_1 = 5 and n_2 = 4 moles of ideal gas at pressures p_1 = 1 atm and p_2 = 2 atm, respectively. When the partition is removed, the mixture attains an equilibrium pressure of

(1) 1.6 atm
(2) 1.4 atm
(3) 1.8 atm
(4) 1.3 atm

Answer (1)

Sol. $P_1V_1+P_2V_2=P(V_1+V_2)$

1(2) + 2(3) = P(2 + 3)

$\frac{8}{5}=P$

$\Rightarrow$ 1.6 atm

40. To an ac power supply of 220 V at 50 Hz, a resistor of 20 Ω, a capacitor of reactance 25 Ω and an inductor of reactance 45 Ω are connected in series. The corresponding current in the circuit and the phase angle between the current and the voltage is, respectively

(1) 7.8 A and 45°
(2) 15.6 A and 30°
(3) 15.6 A and 45°
(4) 7.8 A and 30°

Answer (1)

Sol. X_L = 45 W , X_C = 25 W, R = 20 W

$$I=\frac{220}{\sqrt{(X_L-X_C)^2+R^2}}=\frac{220}{\sqrt{(45-25)^2+20^2}}$$

$$=\frac{220}{2\sqrt{2}}=\frac{11}{\sqrt{2}}=7.779\text{ A}$$

$$\tan\phi=\frac{X_L-X_C}{R}=\frac{45-25}{20}=1$$

f = 45°

41. The radius of Martian orbit around the Sun is about 4 times the radius of the orbit of Mercury. The Martian year is 687 Earth days. Then which of the following is the length of 1 year on Mercury?

(1) 225 earth days
(2) 172 earth days
(3) 124 earth days
(4) 88 earth days

Answer (4)

Sol. Applying Kepler's 3rd law : $T^2 \propto R^3$

Radius of Martian orbit, $R' = 4R$

$$\left(\frac{T'}{T}\right)^2 = \left(\frac{R'}{R}\right)^3 = \left(\frac{4R}{R}\right)^3 = 4^3 = 64 \Rightarrow \frac{T'}{T} = 8$$

$\therefore$ Length of 1 year on Mercury = $T = \frac{T'}{8} = \frac{687}{8} = 85.88$ days

42. A balloon is made of a material of surface tension S and its inflation outlet (from where gas is filled in it) has small area A. It is filled with a gas of density ρ and takes a spherical shape of radius R. When the gas is allowed to flow freely out of it, its radius r changes from R to 0 (zero) in time T. If the speed $v(r)$ of gas coming out of the balloon depends on r as r^a and $T \propto S^\alpha A^\beta \rho^\gamma R^\delta$ then

(1) $a = -\frac{1}{2}, \alpha = -\frac{1}{2}, \beta = -1, \gamma = -\frac{1}{2}, \delta = \frac{5}{2}$

(2) $a = -\frac{1}{2}, \alpha = -\frac{1}{2}, \beta = -1, \gamma = \frac{1}{2}, \delta = \frac{7}{2}$

(3) $a = \frac{1}{2}, \alpha = \frac{1}{2}, \beta = -\frac{1}{2}, \gamma = \frac{1}{2}, \delta = \frac{7}{2}$

(4) $a = \frac{1}{2}, \alpha = \frac{1}{2}, \beta = -1, \gamma = +1, \delta = \frac{3}{2}$

Answer (2)

Sol. $T \propto S^\alpha A^\beta \rho^\gamma R^\delta$

$M^0L^0T^1 = K(MT^{-2})^\alpha (L^2)^\beta (ML^{-3})^\gamma L^\delta$

$M^0L^0T^1 = K[M^{\alpha+\gamma}L^{2\beta-3\gamma+\delta}T^{-2\alpha}]$

$-2\alpha = 1 \quad \alpha = -\frac{1}{2}$

$\alpha + \gamma = 0 \quad \gamma = \frac{1}{2}$

$2\beta - 3\gamma + \delta = 0$

$2\beta - 3\left(\frac{1}{2}\right) + \delta = 0$

By hit and trial (using option (1))

Put $\beta = -1$

$2(-1) - \frac{3}{2} + \delta = 0 \quad \therefore \delta = \frac{7}{2}$

43. A particle of mass m is moving around the origin with a constant force F pulling it towards the origin. If Bohr model is used to describe its motion, the radius of the nth orbit and the particle's speed v in the orbit depend on n as

(1) $r \propto n^{1/3}; v \propto n^{2/3}$

(2) $r \propto n^{2/3}; v \propto n^{1/3}$

(3) $r \propto n^{4/3}; v \propto n^{-1/3}$

(4) $r \propto n^{1/3}; v \propto n^{1/3}$

Answer (2)

Sol. Given, force is constant

$$F = \frac{mv^2}{r}$$

$\Rightarrow \frac{v^2}{r}$ = constant

$\Rightarrow r \propto v^2$ ...(1)

& $L = mvr = \frac{nh}{2\pi}$ ...(2)

$\Rightarrow$ on solving equation (1) and equation (2)

$v \propto n^{1/3}$ and $r \propto n^{2/3}$

44. Two identical point masses P and Q, suspended from two separate massless springs of spring constants k_1 and k_2, respectively, oscillate vertically. If their maximum speeds are the same, the ratio (A_Q/A_P) of the amplitude A_Q of mass Q to the amplitude A_P of mass P is

(1) $\frac{k_1}{k_2}$ (2) $\sqrt{\frac{k_2}{k_1}}$

(3) $\sqrt{\frac{k_1}{k_2}}$ (4) $\frac{k_2}{k_1}$

Answer (3)

Sol. Maximum velocity $V = A\omega$

$v_P = v_Q$

$A_P\omega_P = A_Q\omega_Q$

$$\frac{A_Q}{A_P} = \frac{\omega_P}{\omega_Q} \qquad \left(\omega = \sqrt{\frac{k}{m}}\right)$$

$$= \sqrt{\frac{k_P}{m_P}\frac{m_Q}{k_Q}}$$

$$= \sqrt{\frac{k_1}{k_2}}$$

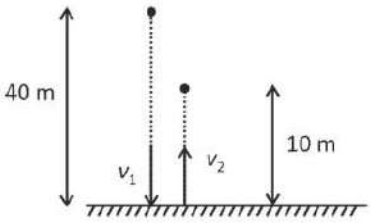
45. A ball of mass 0.5 kg is dropped from a height of 40 m. The ball hits the ground and rises to a height of 10 m. The impulse imparted to the ball during its collision with the ground is (Take g = 9.8 m/s^2)

(1) 7 NS (2) 0

(3) 84 NS (4) 21 NS

Answer (4)

Sol.



$v_1 = \sqrt{2gh_1}$

$= \sqrt{2 \times 9.8 \times 40}$

$v_1 = \sqrt{784} = 28\,\text{m s}^{-1}$

and $v_2 = \sqrt{2gh_2} = \sqrt{2 \times 9.8 \times 10}$

$= \sqrt{196} = 14\,\text{m s}^{-1}$

Impulse $= \Delta\vec{p} = m\left(\vec{v}_f - \vec{v}_i\right) = m\left(\vec{v}_2 - \vec{v}_1\right)$

$= \frac{1}{2}(14 - (-28))$

= 21 NS

CHEMISTRY

46. Given below are two statements :

Statement I : Ferromagnetism is considered as an extreme form of paramagnetism.

Statement II : The number of unpaired electrons in a Cr^{2+} ion (Z = 24) is the same as that of a Nd^{3+} ion (Z = 60).

In the light of the above statements, choose the **correct** answer from the options given below :

(1) Both Statement I and Statement II are false

(2) Statement I is true but Statement II is false

(3) Statement I is false but Statement II is true

(4) Both Statement I and Statement II are true

Answer (2)

Sol. Substances which are attracted very strongly in applied magnetic field are termed as ferromagnetic. Infact, ferromagnetism is an extreme form of paramagnetism.

Hence statement I is correct.

$Cr^{2+} = 3d^4 4s^0$

Unpaired electrons = 4

$Nd^{3+} = 4f^3\ 6s^0$

Unpaired electrons = 3

Hence, Statement II is incorrect

47. For the reaction $A(g) \rightleftharpoons 2B(g)$, the backward reaction rate constant is higher than the forward reaction rate constant by a factor of 2500, at 1000 K.

[Given : R = 0.0831 L atm mol^{-1} K^{-1}]

K_P for the reaction at 1000 K is

(1) 2.077×10^5

(2) 0.033

(3) 0.021

(4) 83.1

Answer (2)

Sol. $K_C = \frac{k_f}{k_b} = \frac{1}{2500}$

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

$= \frac{1}{2500} \times 0.0831 \times 1000$

= 0.033

48. Total number of possible isomers (both structural as well as stereoisomers) of cyclic ethers of molecular formula C_4H_8O is :

(1) 8 (2) 10

(3) 11 (4) 6

Answer (2)

Sol. For cyclic ethers O should be in ring * carbon here is chiral

(1)

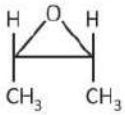
2(d, l pair)

(2)

1

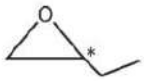
(3)

1

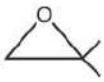
(4) 

(1)

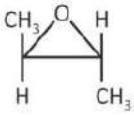
Meso compound

(5) 

2(d, l pair)

(6) 

1

(7) 

2(d, l pair)

Total number of isomers = 2 + 1 + 1 + 1 + 2 + 1 + 2 = 10

49. Given below are two statements :

Statement I : A hypothetical diatomic molecule with bond order zero is quite stable.

Statement II : As bond order increases, the bond length increases.

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

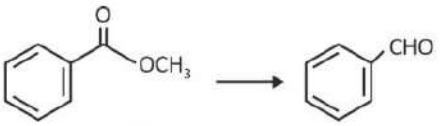
(1) Both Statement I and Statement II are false (2) Statement I is true but Statement II is false

(3) Statement I is false but Statement II is true (4) Both Statement I and Statement II are true

Answer (1)

Sol.
- A positive bond order means a stable molecule while a negative or zero bond order means an unstable molecule.
- When bond order increases, the bond length decreases.

50. Identify the suitable reagent for the following conversion.



(1) (i) $AlH(iBu)_2$, (ii) H_2O

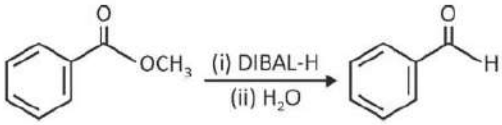
(2) (i) $NaBH_4$, (ii) H^+/H_2O

(3) $H_2/Pd\text{-}BaSO_4$

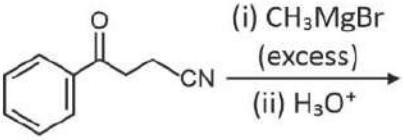
(4) (i) $LiAlH_4$, (ii) H^+/H_2O

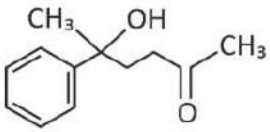
Answer (1)

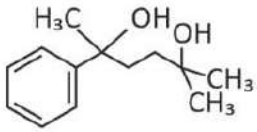
Sol. Esters are reduced to aldehydes with DIBAL-H

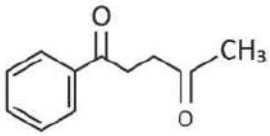


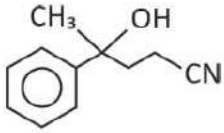
51. The major product of the following reaction is



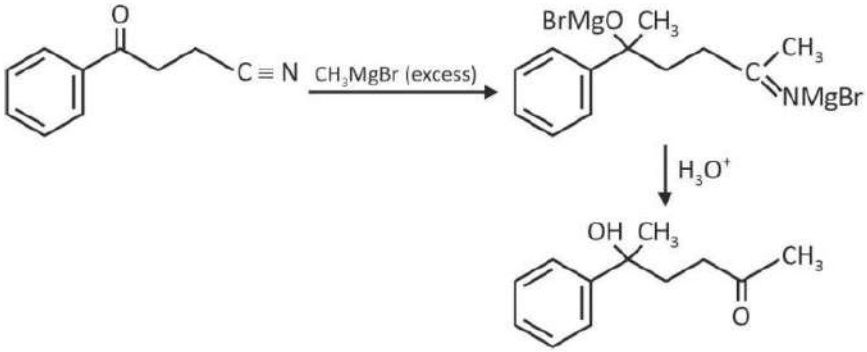
(1) 

(2) 

(3) 

(4) 

Answer (1)

Sol. 

52. If the molar conductivity (Λ_m) of a 0.050 mol L^{-1} solution of a monobasic weak acid is 90 S cm^2 mol^{-1}, its extent (degree) of dissociation will be

[Assume Λ_+° = 349.6 S cm^2 mol^{-1} and Λ_-° = 50.4 S cm^2 mol^{-1}.]

(1) 0.125 (2) 0.225

(3) 0.215 (4) 0.115

Answer (2)

Sol. Degree of dissociation (α) is given as

$$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ}$$

$$\Lambda_m^\circ = \Lambda_+^\circ + \Lambda_-^\circ$$

= 349.6 + 50.4

= 400 S cm^2 mol^{-1}

$$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ} = \frac{90}{400} = 0.225$$

53. Which one of the following reactions does **NOT** belong to "Lassaigne's test"?

(1) $2Na + S \xrightarrow[\Delta]{} Na_2S$

(2) $Na + X \xrightarrow[\Delta]{} + NaX$

(3) $2CuO + C \xrightarrow[\Delta]{} 2Cu + CO_2$

(4) $Na + C + N \xrightarrow[\Delta]{} NaCN$

Answer (3)

Sol. Nitrogen, sulphur, halogens and phosphorus present in an organic compound are detected by "Lassaigne's test".

$$Na + C + N \xrightarrow{\Delta} NaCN$$

$$2Na + S \xrightarrow{\Delta} Na_2S$$

$$Na + X \xrightarrow{\Delta} \underset{(X=Cl, Br, I)}{NaX}$$

54. The correct order of decreasing acidity of the following aliphatic acids is

(1) $CH_3COOH > (CH_3)_2CHCOOH > (CH_3)_3CCOOH > HCOOH$

(2) $HCOOH > CH_3COOH > (CH_3)_2CHCOOH > (CH_3)_3CCOOH$

(3) $HCOOH > (CH_3)_3CCOOH > (CH_3)_2CHCOOH > CH_3COOH$

(4) $(CH_3)_3CCOOH > (CH_3)_2CHCOOH > CH_3COOH > HCOOH$

Answer (2)

Sol. Electron donating group decreases the acidity of carboxylic acids.

So correct order is

$HCOOH > CH_3COOH > (CH_3)_2CHCOOH > (CH_3)_3CCOOH$

55. Match **List-I** with **List-II.**

	List-I (Name of Vitamin)		List-II (Deficiency disease)
A.	Vitamin B_{12}	I.	Cheilosis
B.	Vitamin D	II.	Convulsions
C.	Vitamin B_2	III.	Rickets
D.	Vitamin B_6	IV.	Pernicious anaemia

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

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

Answer (1)

Sol.

	List-I (Name of Vitamin)	List-II (Deficiency disease)
A.	Vitamin B_{12}	Pernicious anaemia
B.	Vitamin D	Rickets
C.	Vitamin B_2	Cheilosis
D.	Vitamin B_6	Convulsions

56. Out of the following complex compounds, which of the compound will be having the minimum conductance in solution?

(1) $[Co(NH_3)_4Cl_2]$
(2) $[Co(NH_3)_6]Cl_3$
(3) $[Co(NH_3)_5Cl]Cl$
(4) $[Co(NH_3)_3Cl_3]$

Answer (1, 4)

Sol. Conductance of any complex depends on the following factor.

(1) Number of ions produced by complex.

(2) If number of ions are same then we will check charge on complex unit.

$$\left.\begin{array}{l}(1)\ \left[Co^{+2}(NH_3)_4Cl_2\right]\\(4)\ \left[Co^{+3}(NH_3)_3Cl_3\right]\end{array}\right\}$$ Both complex units have no charge. Therefore both complex units have same conductance.

(2) $[Co(NH_3)_6]Cl_3 \rightarrow [Co(NH_3)_6]^{+3} + 3Cl^-$

(3) $[Co(NH_3)_5Cl]Cl \rightarrow [Co(NH_3)_5Cl]^+ + Cl^-$

57. Sugar 'X'

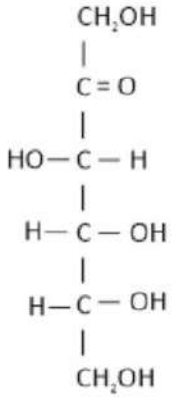
A. is found in honey
B. is a keto sugar
C. exists in α and β – anomeric forms.
D. Is laevorotatory.

'X' is :

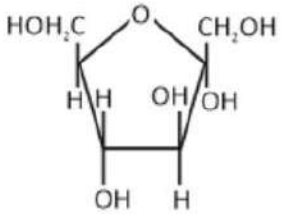
(1) D-Fructose
(2) Maltose
(3) Sucrose
(4) D-Glucose

Answer (1)

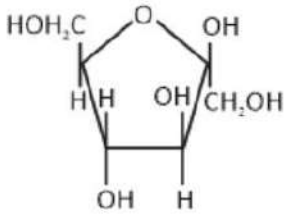
Sol. D-Fructose is found in honey and is a keto sugar.



D—(—) — Fructose

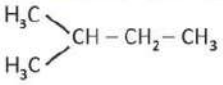


α–D–(–)–Fructofuranose



β–D–(–)–Fructofuranose

58. How many products (including stereoisomers) are expected from monochlorination of the following compound?

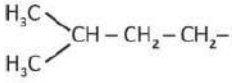


(1) 3 (2) 5

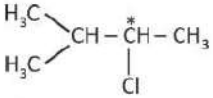
(3) 6 (4) 2

Answer (3)

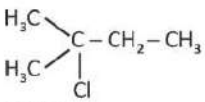
Sol. Possible monochlorination products :



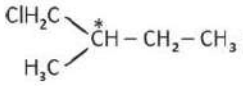
; One isomer



; Two isomers due to presence of chiral carbon



; One isomer



; Two isomers due to chiral carbon

Total 6 isomers

59. Which one of the following compounds can exist as cis-trans isomers?

(1) 2-Methylhex-2-ene (2) 1, 1-Dimethylcyclopropane

(3) 1, 2-Dimethylcyclohexane (4) Pent-1-ene

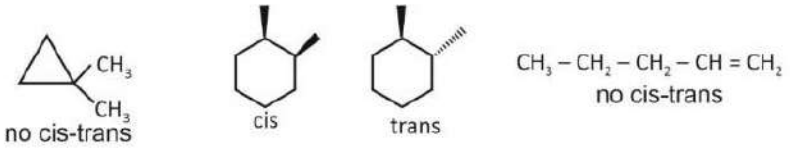
Answer (3)

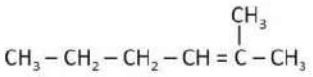
Sol. Cis-trans isomers shown by :

Condition: Restricted rotation around double bond

Or

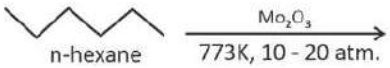
Different group around double bond

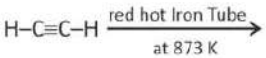


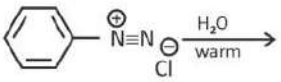


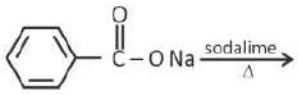
no cis-trans

60. Which one of the following reactions does **NOT** give benzene as the product?

(1) 

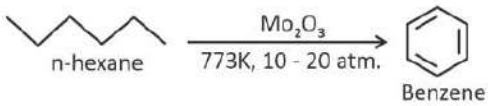
(2) 

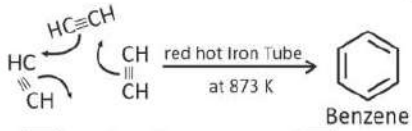
(3) 

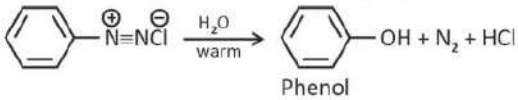
(4) 

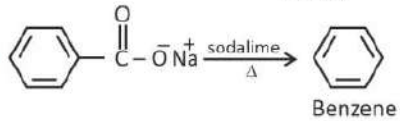
Answer (3)

Sol.

1. 

2. 

3. 

4. 

61. Phosphoric acid ionizes in three steps with their ionization constant values K_{a_1}, K_{a_2} and K_{a_3}, respectively, while K is the overall ionization constant. Which of the following statements are true?

A. $\log K = \log K_{a_1} + \log K_{a_2} + \log K_{a_3}$

B. H_3PO_4 is a stronger acid than $H_2PO_4^-$ and HPO_4^{2-}

C. $K_{a_1} > K_{a_2} > K_{a_3}$

D. $K_{a_1} = \frac{K_{a_3} + K_{a_2}}{2}$

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

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

Answer (3)

Sol. H_3PO_4 is a stronger acid than $H_2PO_4^-$ and HPO_4^{2-}

$H_3PO_4(aq) \rightleftharpoons H^+(aq) + H_2PO_4^-(aq)$ $\quad K_{a_1} = 7.5\times10^{-3}$

$H_2PO_4^-(aq) \rightleftharpoons H^+(aq) + HPO_4^{2-}(aq)$ $\quad K_{a_2} = 6.2\times10^{-8}$

$HPO_4^{2-}(aq) \rightleftharpoons H^+(aq) + PO_4^{3-}(aq)$ $\quad K_{a_3} = 1.7\times10^{-12}$

$K_{a_1} > K_{a_2} > K_{a_3}$

$\log K = \log K_{a_1} + \log K_{a_2} + \log K_{a_3}$

Ans. (A), (B) and (C) only

62. Among the following, choose the ones with equal number of atoms.

A. 212 g of $Na_2CO_3(s)$ [molar mass = 106 g]

B. 248 g of $Na_2O(s)$ [molar mass = 62 g]

C. 240 g of NaOH(s) [molar mass = 40 g]

D. 12 g of $H_2(g)$ [molar mass = 2 g]

E. 220 g of $CO_2(g)$ [molar mass = 44 g]

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

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

Answer (1)

Sol. Number of atoms = $\frac{\text{given mass}}{\text{molar mass}} \times \text{atomicity} \times N_A$

A. $\frac{212}{106} \times 6 \times N_A = 12\ N_A$

B. $\frac{248}{62} \times 3 \times N_A = 12\ N_A$

C. $\frac{240}{40} \times 3 \times N_A = 18\ N_A$

D. $\frac{12}{2} \times N_A \times 2 = 12\ N_A$

E. $\frac{220}{44} \times N_A \times 3 = 15\ N_A$

A, B and D have same number of atoms

63. Given below are two statements :

Statement I : Like nitrogen that can form ammonia, arsenic can form arsine.

Statement II : Antimony cannot form antimony pentoxide.

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

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

Answer (2)

Sol. All the elements of group 15 form hydrides of EH_3 type. Nitrogen forms ammonia (NH_3) while Arsenic forms Arsine (AsH_3)

All the elements of group 15 form two types of oxides : E_2O_3 and E_2O_5

Antimony forms antimony pentoxide Sb_2O_5

Hence, statement I is correct and statement II is incorrect

64. Dalton's Atomic theory could not explain which of the following?

(1) Law of constant proportion
(2) Law of multiple proportion
(3) Law of gaseous volume
(4) Law of conservation of mass

Answer (3)

Sol. Dalton's theory could explain the laws of chemical combination. However, it could not explain the laws of gaseous volumes.

65. The correct order of decreasing basic strength of the given amines is:

(1) N-ethylethanamine > ethanamine > benzenamine > N-methylaniline
(2) N-ethylethanamine > ethanamine > N-methylaniline > benzenamine
(3) benzenamine > ethanamine > N-methylaniline > N-ethylethanamine
(4) N-methylaniline > benzenamine > ethanamine > N-ethylethanamine

Answer (2)

Sol. Lower is the value of pK_b, higher is the basicity

Also aliphatic amines are stronger bases than aromatic amines.

pK_b : Benzenamine > N-Methylaniline > Ethanamine > N-Ethylethanamine

Basic strength : N-Ethylethanamine > Ethanamine > N-Methylaniline > Benzenamine

66. Which of the following statements are true?

A. Unlike Ga that has a very high melting point, Cs has a very low melting point.
B. On Pauling scale, the electronegativity values of N and Cl are not the same.
C. Ar, K^+, Cl^-, Ca^{2+}, and S^{2-} are all isoelectronic species.
D. The correct order of the first ionization enthalpies of Na, Mg, Al, and Si is Si >Al > Mg > Na.
E. The atomic radius of Cs is greater than that of Li and Rb.

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

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

Answer (1)

Sol. Both Ga and Cs have low melting points.

Element	Melting point/K
Ga	303
Cs	302

- On Pauling scale, the electronegativity value of N and Cl have same (3.0).
- Ar, K^+, Cl^-, Ca^{2+} and S^{2-} have 18 electrons. So these are isoelectronic species.
- The correct order of first ionization enthalpy is Si > Mg > Al > Na

  First ionisation enthalpy of Mg is higher than Al because the penetration of a 3s-electron to the nucleus is more than that of a 2p-electron.
- Generally down the group atomic radii increases

Atom	Atomic radius/pm
Li	152
Rb	244
CS	262

67. Match **List-I** with **List-II**

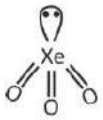
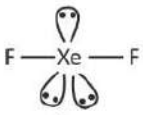
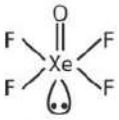
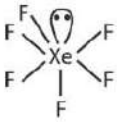
	List-I		List-II
A.	XeO_3	(I)	sp^3d; linear
B.	XeF_2	(II)	sp^3; pyramidal
C.	$XeOF_4$	(III)	sp^3d^3; distorted octahedral
D.	XeF_6	(IV)	sp^3d^2; square pyramidal

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

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

Answer (4)

Sol.

Molecule	Hybridisation	Shape
	sp^3	Pyramidal
	sp^3d	Linear
	sp^3d^2	Square Pyramidal
	sp^3d^3	Distorted Octahedral

68. The standard heat of formation, in kcal/mol of Ba^{2+} is :

[Given : standard heat of formation of SO_4^{2-} ion (aq) = –216 kcal/mol, standard heat of crystallisation of $BaSO_4(s)$ = –4.5 kcal/mol, standard heat of formation of $BaSO_4(s)$ = – 349 kcal/mol]

(1) – 133.0
(2) + 133.0
(3) + 220.5
(4) – 128.5

Answer (4)

Sol. $S + 2O_2 + 2e^- \longrightarrow SO_4^{2-}$ $\quad \Delta H_f = -216$ kcal/mol ...(1)

$Ba^{2+}(g) + SO_4^{2-}(g) \longrightarrow BaSO_4(s)$ $\quad \Delta H_{crystallisation} = -4.5$ kcal/mol ...(2)

$Ba + S + 2O_2 \longrightarrow BaSO_4(s)$ $\quad \Delta H_{f(BaSO_4)} = -349$ kcal/mol ...(3)

$Ba(s) \longrightarrow Ba^{2+}(g) + 2e^-$ ...(4)

From equation (1), (2) and (3) we get equation (4). Applying equation (3) – (1) – (2)

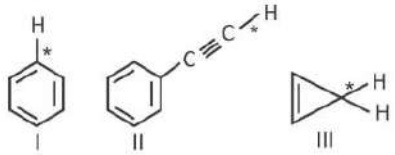
So, –349 – (–4.5) – (–216)

So – 349 + 4.5 + 216

= –349 + 220.5

= – 128.5 kcal/mol

69. Among the given compounds I-III, the correct order of bond dissociation energy of C–H bond marked with * is :



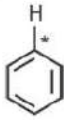
(1) I > II > III

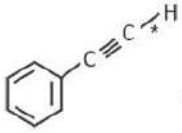
(2) III > II > I

(3) II > III > I

(4) II > I > III

Answer (4)

Sol. I.  carbon of this bond is sp^2 hybridised

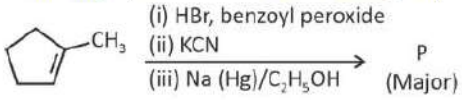
II.  carbon of this bond is sp hybridised

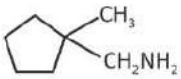
III. carbon of this bond is sp^3 hybridised

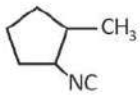
Higher the percentage s character, stronger is C–H bond. Correct order of bond dissociation energy of C–H bond:

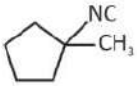
II > I > III

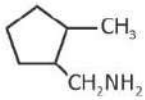
70. Predict the major product 'P' in the following sequence of reactions-



(1) 

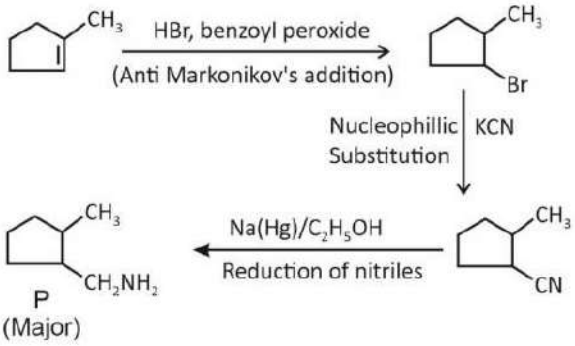
(2) 

(3) 

(4) 

Answer (4)

Sol.



71. Match **List-I** with **List-II**.

	List-I		List-II
A.	Haber process	I.	Fe catalyst
B.	Wacker oxidation	II.	$PdCl_2$
C.	Wilkinson catalyst	III.	$[(PPh_3)_3RhCl]$
D.	Ziegler catalyst	IV.	$TiCl_4$ with $Al(CH_3)_3$

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

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

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

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

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

Answer (2)

Sol.

	Process		Catalyst used
A.	Haber process	I.	Fe catalyst
B.	Wacker oxidation	II.	$PdCl_2$
C.	Wilkinson catalyst	III.	$[(PPh_3)_3RhCl]$
D	Ziegler catalyst	IV.	$TiCl_4$ with $Al(CH_3)_3$

72. Energy and radius of first Bohr orbit of He^+ and Li^{2+} are

[Given $R_H = 2.18 \times 10^{-18}$ J, $a_0 = 52.9$ pm]

(1) $E_n(Li^{2+}) = -8.72 \times 10^{-18}$ J;

$r_n(Li^{2+}) = 26.4$ pm

$E_n(He^+) = -19.62 \times 10^{-18}$ J;

$r_n(He^+) = 17.6$ pm

(2) $E_n(Li^{2+}) = -19.62 \times 10^{-16}$ J;

$r_n(Li^{2+}) = 17.6$ pm

$E_n(He^+) = -8.72 \times 10^{-16}$ J;

$r_n(He^+) = 26.4$ pm

(3) $E_n(Li^{2+}) = -8.72 \times 10^{-16}$ J;

$r_n(Li^{2+}) = 17.6$ pm

$E_n(He^+) = -19.62 \times 10^{-16}$ J;

$r_n(He^+) = 17.6$ pm

(4) $E_n(Li^{2+}) = -19.62 \times 10^{-18}$ J;

$r_n(Li^{2+}) = 17.6$ pm

$E_n(He^+) = -8.72 \times 10^{-18}$ J;

$r_n(He^+) = 26.4$ pm

Answer (4)

Sol. $E_n = \frac{-2.18 \times 10^{-18} \times z^2}{n^2}$ J; $r_n = \frac{52.9 \times n^2}{z}$ pm

For He^+

$E_{He^+} = -2.18 \times 10^{-18} \times 4 = -8.72 \times 10^{-18}$ J

$r_{He^+} = \frac{52.9 \times 1}{2} = 26.45$ pm

For Li^{2+}

$E_{Li^{2+}} = -2.18 \times 10^{-18} \times 9 = 19.62 \times 10^{-18}$ J

$r_{Li^{2+}} = \frac{52.9 \times 1}{3} = 17.63$ pm

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

Assertion (A) : undergoes S_N2 reaction faster than .

Reason (R) : Iodine is a better leaving group because of its large size.

In the light of the above statements, choose the **correct** answer from the options given below:

(1) Both **A** and **R** are true but **R** is **not** the correct explanation of **A**

(2) **A** is true but **R** is false

(3) **A** is false but **R** is true

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

Answer (4)

Sol. Rate of S_N2 reaction of is faster than .

Because iodine is a good leaving group due to large size of iodine. Which stabilises the I^- ion.

74. If the half-life ($t_{1/2}$) for a first order reaction is 1 minute, then the time required for 99.9% completion of the reaction is closest to :

(1) 4 minutes

(2) 5 minutes

(3) 10 minutes

(4) 2 minutes

Answer (3)

Sol. For 1st order reaction

$kt = 2.303 \log \frac{A_0}{A_t}$ A_0 = initial concentration

A_t = Final concentration

$t_{99.9\%} = 10\ t_{1/2}$

$t_{99.9\%} = 10 \times 1$ minute = 10 minutes

75. Which of the following aqueous solution will exhibit highest boiling point?

(1) 0.01M KNO_3 (2) 0.01M Na_2SO_4

(3) 0.015M $C_6H_{12}O_6$ (4) 0.01M Urea

Answer (2)

Sol. $\Delta T_b = iK_b \times m$

$\Delta T_b \propto i \times m$

By considering molarity same as molality

(1) 0.01 M KNO_3 $i \times m = 2 \times 0.01 = 0.02$

(2) 0.01M Na_2SO_4 $i \times m = 3 \times 0.01 = 0.03$

(3) 0.015M $C_6H_{12}O_6$ $i \times m = 1 \times 0.015 = 0.015$

(4) 0.01M Urea $i \times m = 1 \times 0.01 = 0.01$

$T_b' = T_b^* + \Delta T_b$

Higher the value of $(i \times m)$ more will be the boiling point.

76. Higher yield of NO in $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ can be obtained at

[ΔH of the reaction = +180.7 kJ mol^{-1}]

A. Higher temperature

B. Lower temperature

C. Higher concentration of N_2

D. Higher concentration of O_2

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

(1) B, C only (2) B, C, D only

(3) A, C, D only (4) A, D only

Answer (3)

Sol. Yield of the product generally depends on

- Temperature
- Concentration of reactant(s) and product(s)
- Pressure

As this is an endothermic reaction (ΔH = +180.7 kJ mol^{-1}), so, increase in temperature will shift equilibrium in forward direction to increase yield of NO.

Increase in concentration of reactants (N_2 and O_2) also shifts the equilibrium in forward direction and increase the yield of NO.

Hence, (A), (C) and (D) only will increase yield of NO.

77. Match **List I** with **List II**

	List-I (Ion)		List-II (Group Number in Cation Analysis)
A.	Co^{2+}	I.	Group-I
B.	Mg^{2+}	II.	Group-III
C.	Pb^{2+}	III.	Group-IV
D.	Al^{3+}	IV.	Group-VI

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

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

Answer (1)

Sol.

	Ion	Group number in Cation Analysis
A.	Co^{2+}	Group-IV
B.	Mg^{2+}	Group-VI
C.	Pb^{2+}	Group-I
D.	Al^{3+}	Group-III

78. The ratio of the wavelengths of the light absorbed by a Hydrogen atom when it undergoes n = 2 → n = 3 and n = 4 → n = 6 transitions, respectively, is

(1) $\frac{1}{16}$
(2) $\frac{1}{9}$
(3) $\frac{1}{4}$
(4) $\frac{1}{36}$

Answer (3)

Sol. $\Delta E = \frac{hc}{\lambda} = E_{final} - E_{initial} \quad \left(E_n = \frac{-R_H}{n^2}\right)$

$$\Delta E_{2\to3} = \frac{hc}{\lambda_{2\to3}} = E_3 - E_2 = \frac{-R_H}{3^2} - \left(\frac{-R_H}{2^2}\right)$$

$$= R_H\left(\frac{1}{4} - \frac{1}{9}\right)$$

$$= R_H \times \frac{5}{36}$$

$$\therefore \lambda_{2\to3} = \frac{hc \cdot 36}{R_H \cdot 5}$$

$$\Delta E_{4\to6} = E_6 - E_4 = \frac{-R_H}{36} + \frac{R_H}{16} = \frac{R_H \times 20}{36 \times 16}$$

$$\frac{hc}{\lambda_{4\to6}} = \frac{R_H \times 20}{36 \times 16}$$

$$\lambda_{4\to6} = \frac{hc \times 36 \times 16}{R_H \cdot 20}$$

$$\frac{\lambda_{2\to3}}{\lambda_{4\to6}} = \frac{\frac{hc \cdot 36}{R_H \cdot 5}}{\frac{hc \times 36 \times 16}{R_H \cdot 20}}$$

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

79. The correct order of the wavelength of light absorbed by the following complexes is,

A. $[Co(NH_3)_6]^{3+}$

B. $[Co(CN)_6]^{3-}$

C. $[Cu(H_2O)_4]^{2+}$

D. $[Ti(H_2O)_6]^{3+}$

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

(1) B < A < D < C

(2) C < D < A < B

(3) C < A < D < B

(4) B < D < A < C

Answer (1)

Sol. $\lambda \propto \frac{1}{\text{strength of ligand}}$

$$\lambda \propto \frac{1}{\text{splitting}}$$

A. $[Co(NH_3)_6]^{3+}$; 475 nm

B. $[Co(CN)_6]^{3-}$; 310 nm

C. $[Cu(H_2O)_4]^{2+}$; 600 nm

D. $[Ti(H_2O)_6]^{3+}$; 498 nm

Order of λ = C > D > A > B

80. Identify the correct orders against the property mentioned

A. $H_2O > NH_3 > CHCl_3$ – dipole moment

B. $XeF_4 > XeO_3 > XeF_2$ – number of lone pairs on central atom

C. O–H > C–H > N–O – bond length

D. $N_2 > O_2 > H_2$ – bond enthalpy

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

(1) B, D only

(2) A, C only

(3) B, C only

(4) A, D only

Answer (4)

Sol.

		μ(D)
A.	H_2O	1.85
	NH_3	1.47
	$CHCl_3$	1.04

B. XeF_4 : 2 lone pairs of electron

XeO_3 : 1 lone pair of electron

XeF_2 : 3 lone pairs of electron

C. Order of Bond length :- N–O > C–H > O–H

D. N_2 Bond order is 3

H_2 Bond order is 1

O_2 Bond order is 2

81. Match **List I** with **List II**

	List-I (Mixture)		**List-II (Method of separation)**
A.	$CHCl_3 + C_6H_5NH_2$	(I)	Distillation under reduced pressure
B.	Crude oil in petroleum industry	(II)	Steam distillation
C.	Glycerol from spent-lye	(III)	Fractional distillation
D.	Aniline - water	(IV)	Simple distillation

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

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

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

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

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

Answer (4)

Sol.

		(Method of separation)
(A)	$CHCl_3 + C_6H_5NH_2$	Simple distillation
(B)	Crude oil in petroleum industry	Fractional distillation
(C)	Glycerol from spent-lye	Distillation under reduced pressure
(D)	Aniline - water	Steam Distillation

82. If the rate constant of a reaction is 0.03 s^{-1}, how much time does it take for 7.2 mol L^{-1} concentration of the reactant to get reduced to 0.9 mol L^{-1}?

(Given: log 2 = 0.301)

(1) 23.1 s

(2) 210 s

(3) 21.0 s

(4) 69.3 s

Answer (4)

Sol. $k = 0.03\ s^{-1}$

$$t = \frac{2.303}{k}\log\frac{a}{a-x}$$

$$= \frac{2.303}{0.03}\log\frac{7.2}{0.9}$$

$$= \frac{2.303}{0.03}\log 8$$

$$= \frac{2.303}{0.03}\times 3\times\log 2$$

$$= \frac{2.303}{0.03}\times 3\times 0.301$$

$$= 69.3\ s$$

83. Which among the following electronic configurations belong to main group elements?

A. $[Ne]3s^1$ B. $[Ar]3d^3 4s^2$

C. $[Kr]4d^{10}\ 5s^2 5p^5$ D. $[Ar]3d^{10}4s^1$

E. $[Rn]5f^0 6d^2 7s^2$

Choose the correct answer from the option given below :

(1) A and C only (2) D and E only

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

Answer (1)

Sol. (A) $[Ne]3s^1$; Na (s-block)

(B) $[Ar]3d^3 4s^2$; V (d-block)

(C) $[Kr]4d^{10}5s^2 5p^5$; I (p-block)

(D) $[Ar]3d^{10}4s^1$; Cu (d-block)

(E) $[Rn]5f^0 6d^2 7s^2$; Th (f-block)

Main group elements (A and C only)

84. Match List-I with List-II

	List-I (Example)		**List-II (Type of Solution)**
A.	Humidity	I.	Solid in solid
B.	Alloys	II.	Liquid in gas
C.	Amalgams	III.	Solid in gas
D.	Smoke	IV.	Liquid in solid

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

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

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

Answer (1)

Sol.

- Humidity is a solution of liquid in gas
- Alloy is a solution of solid in solid
- Amalgam is a solution of liquid in solid
- Smoke is a solution of solid in gas

85. 5 moles of liquid X and 10 moles of liquid Y make a solution having a vapour pressure of 70 torr. The vapour pressures of pure X and Y are 63 torr and 78 torr respectively. Which of the following is true regarding the described solution?

(1) The solution shows negative deviation.

(2) The solution is ideal.

(3) The solution has volume greater than the sum of individual volumes.

(4) The solution shows positive deviation.

Answer (1)

Sol. $P_{total} = X_x P_x^{\circ} + X_y P_y^{\circ}$

$= \frac{5}{15} \times 63 + \frac{10}{15} \times 78$

$= 21 + 52$

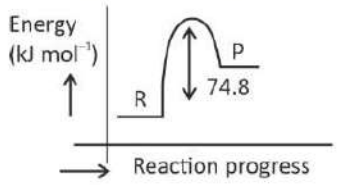
$= 73$ torr

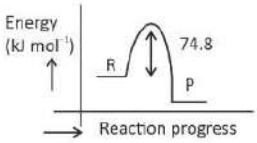
Observed total pressure of solution is 70 torr.

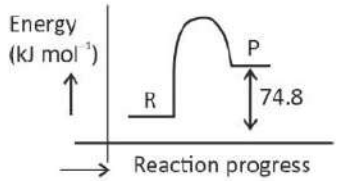
It is less than calculated total pressure.

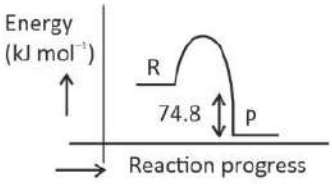
Hence, it shows negative deviation.

86. $C(s) + 2H_2(g) \rightarrow CH_4(g)$; $\Delta H = -74.8$ kJ mol^{-1}. Which of the following diagrams gives an accurate representation of the above reaction? [R $\rightarrow$ reactants; P $\rightarrow$ products]

(1)


(2)


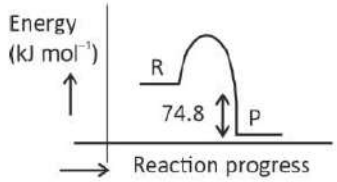
(3)


(4)


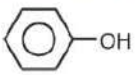
Answer (4)

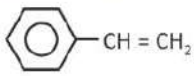
Sol. $\Delta H = -74.8$ k J mol^{-1}, it is an exothermic reaction.

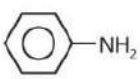
So, accurate representation is



87. Which one of the following compounds **does not** decolourize bromine water?

(1) 

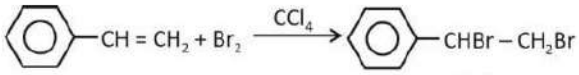
(2) 

(3) 

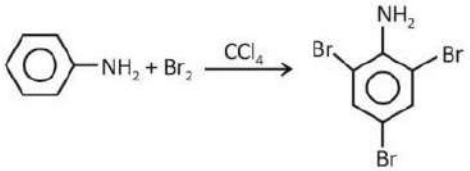
(4)

Answer (4)

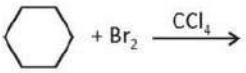
Sol. Test for unsaturation i.e. Bromine water Reddish orange colour of bromine solution in CCl_4 will discharge when bromine adds to an unsaturation site.



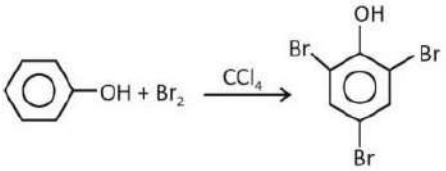
Colour discharge



Colour discharge



No reaction
No discharge of orange colour



Colour discharge

88. Consider the following compounds :

$\underline{K}O_2$, $H_2\underline{O}_2$ and $H_2\underline{S}O_4$

The oxidation state of the underlined elements in them are, respectively,

(1) +2, –2, and +6

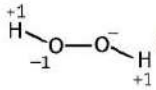
(2) +1, –2, and +4

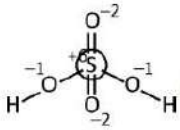
(3) +4, –4, and +6

(4) +1, –1, and +6

Answer (4)

Sol. KO_2 → Alkali metal always shows +1 oxidation state. Therefore oxidation state of K is +1.

H_2O_2 →  Oxidation state of oxygen in H_2O_2 is –1.

H_2SO_4 →  Oxidation state of sulphur in H_2SO_4 is +6.

89. Given below are two statements :

Statement-I : Benzenediazonium salt is prepared by the reaction of aniline with nitrous acid at 273 – 278 K. It decomposes easily in the dry state.

Statement-II : Insertion of iodine into the benzene ring is difficult and hence iodobenzene is prepared through the reaction of benzenediazonium salt with KI.

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

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

Answer (4)

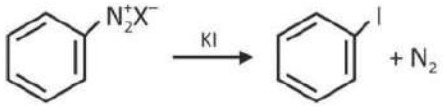
Sol. Benzene diazonium chloride is prepared by the reaction of aniline with nitrous acid at 273-278 K.

Nitrous acid is produced in the reaction mixture by reaction of $NaNO_2$ with HCl.

$$C_6H_5NH_2 + NaNO_2 + 2HCl \xrightarrow{273-278\,K} C_6H_5\overset{+}{N_2}\overset{-}{Cl} + NaCl + 2H_2O$$

Benzene diazonium chloride decomposes easily in the dry state

Iodobenzene is prepared by shaking benzene diazonium salt with KI because direct insertion of iodine into benzene ring is difficult



90. Which of the following are paramagnetic?

A. $[NiCl_4]^{2-}$

B. $Ni(CO)_4$

C. $[Ni(CN)_4]^{2-}$

D. $[Ni(H_2O)_6]^{2+}$

E. $Ni(PPh_3)_4$

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

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

Answer (2)

Sol.

A. $[NiCl_4]^{2-}$; Ni^{+2}; $3d^8$; sp^3 hybridisation; 2 unpaired electrons; paramagnetic

B. $Ni(CO)_4$; Ni; $3d^8\ 4s^2$; sp^3 hybridisation; Zero unpaired electron; diamagnetic

C. $[Ni(CN)_4]^{2-}$; Ni^{+2}; $3d^8$; dsp^2 hybridisation; Zero unpaired electron; diamagnetic

D. $[Ni(H_2O)_6]^{2+}$; Ni^{2+}, $3d^8$; sp^3d^2 hybridisation; Two unpaired electron; paramagnetic

E. $Ni(PPh_3)_4$; Ni; $3d^8\ 4s^2$, sp^3 hybridisation; zero unpaired electron; Diamagnetic

BIOLOGY

91. Match **List-I** with **List-II**.

	List-I		List-II
A.	Progesterone	I.	Pars intermedia
B.	Relaxin	II.	Ovary
C.	Melanocyte stimulating hormone	III.	Adrenal Medulla
D.	Catecholamines	IV.	Corpus luteum

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

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

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

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

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

Answer (4)

Sol. The correct answer is [A-IV, B-II, C-I, D-III]

- Progesterone – A steroidal hormone which is secreted by the corpus luteum
- Relaxin – A proteinaceous hormone which is secreted by the ovaries in the later stage of pregnancy
- Melanocyte stimulating hormone – A proteinaceous hormone released by the pars intermedia
- Catecholamines – An amino-acid derived hormone released from the adrenal medulla during emergency conditions

92. The blue and white selectable markers have been developed which differentiate recombinant colonies from non-recombinant colonies on the basis of their ability to produce colour in the presence of a chromogenic substrate.

Given below are two statements about this method:

Statement I : The blue coloured colonies have DNA insert in the plasmid and they are identified as recombinant colonies.

Statement II : The colonies without blue colour have DNA insert in the plasmid and are identified as recombinant colonies.

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

(1) Both **Statement I** and **Statement II** are incorrect

(2) **Statement I** is correct but **Statement II** is incorrect

(3) **Statement I** is incorrect but **Statement II** is correct

(4) Both **Statement I** and **Statement II** are correct

Answer (3)

Sol. Statement I is incorrect but statement II is correct as a recombinant DNA is inserted within the coding sequence of an enzyme, β-galactosidase. This results into inactivation of the gene for synthesis of this enzyme. Thus, presence of insert results into insertional inactivation of the β-galactosidase gene and the colonies do not produce any colour and identified as recombinant colonies. Whereas non-recombinant transformants will produce blue colour in presence of chromogenic substrate.

93. Given below are two statements : One is labelled as **Assertion (A)** and other is labelled as **Reason (R)**.

Assertion (A) : Cells of the tapetum possess dense cytoplasm and generally have more than one nucleus.

Reason (R) : Presence of more than one nucleus in the tapetum increases the efficiency of nourishing the developing microspore mother cells.

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

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

(2) **A** is true but **R** is false

(3) **A** is false but **R** is true

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

Answer (2)

Sol. Cell of the tapetum possess dense cytoplasm and generally have more than one nucleus because the presence of more than one nucleus in the tapetal cells increases the efficiency of nourishing the develpoing pollen grains.

94. Match **List-I** with **List-II**.

	List-I		**List-II**
A.	Pteridophyte	I.	*Salvia*
B.	Bryophyte	II.	*Ginkgo*
C.	Angiosperm	III.	*Polytrichum*
D.	Gymnosperm	IV.	*Salvinia*

Choose the option with all **correct** matches.

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

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

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

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

Answer (1)

Sol. Pteridophyte - *Salvinia*

Bryophyte - *Polytrichum*

Angiosperm - *Salvia*

Gymnosperm - *Ginkgo*

95. Match **List-I** with **List-II.**

	List-I		List-II
A.	Heart	I.	Erythropoietin
B.	Kidney	II.	Aldosterone
C.	Gastro-intestinal tract	III.	Atrial natriuretic factor
D.	Adrenal Cortex	IV.	Secretin

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

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

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

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

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

Answer (3)

Sol.

Organ Name	-	**Hormone Secreted**
Heart	-	Atrial natriuretic factor
Kidney	-	Erythropoietin
Gastro-intestinal tract	-	Secretin
Adrenal cortex	-	Aldosterone

96. Who proposed that the genetic code for amino acids should be made up of three nucleotides?

(1) Francis Crick (2) Jacque Monod

(3) Franklin Stahl (4) George Gamow

Answer (4)

Sol. George Gamow, a physicist proposed that genetic code for amino acids should be made up of three nucleotides.

97. Which of the following is the unit of productivity of an Ecosystem?

(1) KCal m^{-2} (2) KCal m^{-3}

(3) (KCal m^{-2})yr^{-1} (4) gm^{-2}

Answer (3)

Sol. The rate of biomass production is called productivity. It is expressed in terms of $gm^{-2}yr^{-1}$ or (KCal m^{-2})yr^{-1} to compare the productivity of different ecosystems.

98. Which of the following is an example of a zygomorphic flower?

(1) Datura (2) Pea

(3) Chilli (4) Petunia

Answer (2)

Sol. Zygomorphic flowers can be divided into two equal halves by only a single vertical plane and shows bilateral symmetry.

Pea possess zygomorphic flowers.

Chilli, Petunia and Datura possess actinomorphic flowers.

99. Match **List I** with **List II**:

	List I		List II
A.	The Evil Quartet	I.	Cryopreservation
B.	Ex situ conservation	II.	Alien species invasion
C.	*Lantana camara*	III.	Causes of biodiversity losses
D.	Dodo	IV.	Extinction

Choose the option with all correct matches.

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

Answer (1)

Sol. The Evil Quartet – Causes of biodiversity losses

Ex situ conservation – Cryopreservation

Lantana camara – Alien species invasion

Dodo – Extinction

100. Given below are two statements:

Statement I: In ecosystem, there is unidirectional flow of energy of sun from producers to consumers.

Statement II: Ecosystems are exempted from 2nd law of thermodynamics.

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

(1) Both statement I and statement II are incorrect

(2) Statement I is correct but statement II is incorrect

(3) Statement I is incorrect but statement II is correct

(4) Both statement I and statement II are correct

Answer (2)

Sol. Sun is the only source of energy for all ecosystems on Earth, except for deep sea-hydro-thermal ecosystem.

The energy flow is unidirectional from the sun to producers and then to consumers.

Ecosystems are not exempted from the second law of thermodynamics. They need a constant supply of energy to synthesise the molecules they require to counteract the universal tendency towards increasing disorderliness.

101. The protein portion of an enzyme is called:

(1) Coenzyme

(2) Apoenzyme

(3) Prosthetic group

(4) Cofactor

Answer (2)

Sol. There are number of cases in which non-protein constituents called co-factors are bound to the enzyme to make the enzyme catalytically active.

In these instances, the protein portion of the enzymes is called the apoenzyme.

Three kinds of co-factors are identified prosthetic groups, co-enzymes and metal ions. Prosthetic groups are organic compounds and they are tightly bound with apoenzyme. Co-enzymes are also organic compounds but their association with apoenzyme is only transient.

102. Twins are born to a family that lives next door to you. The twins are a boy and a girl. Which of the following must be true?

(1) They are fraternal twins.

(2) They were conceived through in vitro fertilization.

(3) They have 75% identical genetic content.

(4) They are monozygotic twins.

Answer (1)

Sol. Fraternal twins or dizygotic twins are 2 separate fertilized eggs, they usually develop 2 separate amniotic sacs, placentas and supporting structures.

If twins are a boy and a girl, this indicates they are fraternal twins.

103. After maturation, in primary lymphoid organs, the lymphocytes migrate for interaction with antigens to secondary lymphoid organ(s) / tissue(s) like

A. thymus

B. bone marrow

C. spleen

D. lymph nodes

E. Peyer's patches

Choose the *correct* answer from the options given below

(1) A, B, C only

(2) E, A, B only

(3) C, D, E only

(4) B, C, D only

Answer (3)

Sol. The primary lymphoid organs are bone marrow and thymus where immature lymphocytes differentiate into antigen-sensitive lymphocytes.

After maturation, the lymphocytes migrate into secondary lymphoid organs like spleen, lymph nodes, Peyer's patches of small intestine and appendix.

These secondary lymphoid organ provide the sites for interaction of lymphocytes with the antigen.

104. In frog, the Renal portal system is a special venous connection that acts to link :

(1) Liver and kidney

(2) Kidney and intestine

(3) Kidney and lower part of body

(4) Liver and intestine

Answer (3)

Sol. In frogs, special venous connection between liver and intestine as well as the kidney and lower parts of the body are present in frogs. The former is called hepatic portal system and the latter is called renal portal system.

105. Which of the following enzyme(s) are **NOT** essential for gene cloning?

A. Restriction enzymes

B. DNA ligase

C. DNA mutase

D. DNA recombinase

E. DNA polymerase

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

(1) A and B only

(2) D and E only

(3) B and C only

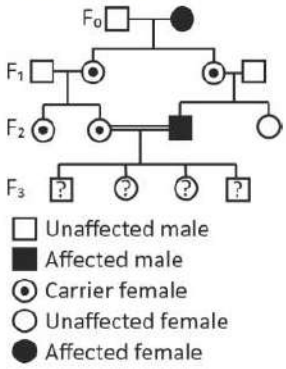
(4) C and D only

Answer (4)

Sol. Gene cloning is a process where a specific gene or DNA sequence is isolated and replicated, creating multiple identical copies.

In gene cloning, restriction enzymes, DNA ligase and DNA polymerase are primarily used.

106. With the help of given pedigree, find out the probability for the birth of a child having no disease and being a carrier (has the disease mutation in one allele of the gene) in F_3 generation.



(1) 1/2

(2) 1/8

(3) Zero

(4) 1/4

Answer (4)

Sol. As in the F_1 generation the carrier female and non-affected (normal, not carrier) had affected male child that means the genetic disorder is sex-linked recessive.

The consanguineous mating between female (X^cX) and male (X^cY)

♀ \ ♂	X^c	Y
X^c	X^cX^c	X^cY
X	X^cX	XY

Out of 4 child only one is carrier i.e. $\frac{1}{4}$.

107. Which one of the following is the characteristic feature of gymnosperms?

(1) Seeds are naked

(2) Seeds are absent

(3) Gymnosperms have flowers for reproduction

(4) Seeds are enclosed in fruits

Answer (1)

Sol. The gymnosperms (*Gymnos* : naked, *sperma* seed) are plants in which the ovules are not enclosed by an ovary wall and remains exposed, both before and after fertilization. The seeds that develop post-fertilization, are not covered, *i.e.*, naked.

108. The first menstruation is called :

(1) Menarche

(2) Diapause

(3) Ovulation

(4) Menopause

Answer (1)

Sol. The first menstruation begins at puberty and is called menarche.

- Ovulation is the process that deals with the release of secondary oocyte from the mature Graafian follicle.
- In human beings, menstrual cycles ceases around 50 years of age; that is termed as menopause.
- Diapause is a state of dormancy or developmental arrest in an organism.

109. In bryophytes, the gemmae help in which one of the following?

(1) Asexual reproduction

(2) Nutrient absorption

(3) Gaseous exchange

(4) Sexual reproduction

Answer (1)

Sol. Gemmae are green, multicellular, asexual buds which develop in small receptacles called gemma cups and help in asexual reproduction in bryophytes.

110. How many meiotic and mitotic divisions need to occur for the development of a mature female gametophyte from the megaspore mother cell in an angiosperm plant?

(1) 1 Meiosis and 2 Mitosis

(2) 1 Meiosis and 3 Mitosis

(3) No Meiosis and 2 Mitosis

(4) 2 Meiosis and 3 Mitosis

Answer (2)

Sol. Development of a mature female gametophyte, i.e., embryo sac from a megaspore mother cell in an angiosperm plant requires 1 meiotic and 3 mitotic divisions.

111. Role of the water vascular system in Echinoderms is :

A. Respiration and Locomotion

B. Excretion and Locomotion

C. Capture and transport of food

D. Digestion and Respiration

E. Digestion and Excretion

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

(1) A and C Only

(2) B and C Only

(3) B, D and E Only

(4) A and B Only

Answer (1)

Sol. Water vascular system in Echinoderms helps in locomotion, capture and transport of food and respiration.

Excretory system is absent in echinoderms. Excretion takes place through general body surface.

112. Read the following statements on plant growth and development.

(A) Parthenocarpy can be induced by auxins.

(B) Plant growth regulators can be involved in promotion as well as inhibition of growth.

(C) Dedifferentiation is a pre-requisite for re-differentiation.

(D) Abscisic acid is a plant growth promoter.

(E) Apical dominance promotes the growth of lateral buds.

Choose the option with all correct statements.

(1) A, C, E only

(2) A, D, E only

(3) B, D, E only

(4) A, B, C only

Answer (4)

Sol. ABA is a plant growth inhibitor and an inhibitor of plant metabolism.

Apical dominance promotes growth of apical bud.

Statements A, B and C are correct.

113. Which of the following type of immunity is present at the time of birth and is a non-specific type of defence in the human body?

(1) Innate Immunity
(2) Cell-mediated Immunity
(3) Humoral Immunity
(4) Acquired Immunity

Answer (1)

Sol. Innate immunity is non-specific type of defence, that is present at the time of birth. This is accomplished by providing different types of barriers to the entry of the foreign agents into our body. Acquired immunity is pathogen specific, characterised by memory cells.

Immune response mediated by B-lymphocytes is humoral immunity and other immune response mediated by T-lymphocytes is called cell-mediated immunity.

114. Why can't insulin be given orally to diabetic patients?

(1) It will be digested in Gastro-Intestinal (GI) tract
(2) Because of structural variation
(3) Its bioavailability will be increased
(4) Human body will elicit strong immune response

Answer (1)

Sol. Insulin can't be administered orally to diabetic patients as being the proteinaceous molecule, it will be digested in gastro-intestinal tract.

115. Which one of the following equations represents the Verhulst-Pearl Logistic Growth of population?

(1) $\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$
(2) $\frac{dN}{dt} = rN\left(\frac{N-K}{N}\right)$
(3) $\frac{dN}{dt} = N\left(\frac{r-K}{K}\right)$
(4) $\frac{dN}{dt} = r\left(\frac{K-N}{K}\right)$

Answer (1)

Sol. Logistic growth is described by Verhulst-Pearl logistic growth equation $\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$.

116. Silencing of specific mRNA is possible via RNAi because of

(1) Inhibitory ssRNA
(2) Complementary tRNA
(3) Non-complementary ssRNA
(4) Complementary dsRNA

Answer (4)

Sol. RNAi (RNA interference) takes place in all eukaryotic organisms as a method of cellular defense. This method involves silencing of a specific mRNA due to a complementary dsRNA molecule that binds to and prevents translation of the mRNA.

117. Match **List I** with **List II**:

	List-I		List-II
A.	Adenosine	I.	Nitrogen base
B.	Adenylic acid	II.	Nucleotide
C.	Adenine	III.	Nucleoside
D.	Alanine	IV.	Amino acid

Choose the option with all **correct** matches.

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

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

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

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

Answer (2)

Sol. The correct answer is A-III, B-II, C-I, D-IV

- Adenosine – It is a nucleoside which is composed of nitrogen base and sugar only.
- Adenylic acid – It is a nucleotide which is composed of nitrogen base, sugar and a phosphate group is esterified to the sugar.
- Adenine – Nitrogen base (Purine)

Alanine – An amino acid that contains a methyl group as the 'R' group.

118. Frogs respire in water by skin and buccal cavity and on land by skin, buccal cavity and lungs.

Choose the **correct** answer from the following :

(1) The statement is true for both the environment

(2) The statement is false for water but true for land

(3) The statement is false for both the environment

(4) The statement is true for water but false for land

Answer (2)

Sol.
- In water, frogs respire through skin and not through buccal cavity *i.e.,* undergo cutaneous respiration only.
- On land, the buccal cavity, skin and lungs act as respiratory organs *i.e.,* undergo buccopharyngeal , cutaneous and pulmonary respiration.

119. All living members of the class Cyclostomata are :

(1) Endoparasite

(2) Symbiotic

(3) Ectoparasite

(4) Free living

Answer (3)

Sol. All living members of class Cyclostomata are ectoparasites.

120. Identify the statement that is **NOT** correct.

(1) The heavy and light chains are held together by disulfide bonds.

(2) Antigen binding site is located at C-terminal region of antibody molecules.

(3) Constant region of heavy and light chains are located at C-terminus of antibody molecules

(4) Each antibody has two light and two heavy chains.

Answer (2)

Sol. Each antibody molecule has four peptide chains, two small called light chains and two longer called heavy chains. Hence, an antibody is represented as H_2L_2.

In an antibody molecule, antigen binding site is located at N-terminal region.

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

Assertion (A) : The primary function of the Golgi apparatus is to package the materials made by the endoplasmic reticulum and deliver it to intracellular targets and outside the cell.

Reason (R) : Vesicles containing materials made by the endoplasmic reticulum fuse with the cis face of the Golgi apparatus, and they are modified and released from the trans face of the Golgi apparatus.

In the light of the above statements, choose the **correct** answer from the options given below :

(1) Both **A** and **R** are true but **R** is **not** the correct explanation of **A**

(2) **A** is true but **R** is false

(3) **A** is false but **R** is true

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

Answer (1)

Sol. The primary function of Golgi apparatus is to package the materials made by endoplasmic reticulum and deliver it to intracellular targets and outside the cell, this statement is correct and the reason statement is also correct. Golgi apparatus remains in close association with endoplasmic reticulum. Here, assertion and reason statements both are correct but reason is not correctly explaining assertion.

122. Consider the following :

A. The reductive division for the human female gametogenesis starts earlier than that of the male gametogenesis.

B. The gap between the first meiotic division and the second meiotic division is much shorter for males compared to females.

C. The first polar body is associated with the formation of the primary oocyte.

D. Luteinizing Hormone (LH) surge leads to disintegration of the endometrium and onset of menstrual bleeding.

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

(1) A and C are true

(2) B and D are true

(3) B and C are true

(4) A and B are true

Answer (4)

Sol. Statements A and B are true while statements C and D are false.

The first polar body is associated with the formation of the secondary oocyte LH surge leads to ovulation. Decreased levels of progesterone during late luteal phase leads to degeneration of the endometrium and onset of menstrual bleeding.

123. Match **List I** with **List II** :

	List I		List II
A.	Scutellum	I.	Persistent nucellus
B.	Non-albuminous seed	II.	Cotyledon of Monocot seed
C.	Epiblast	III.	Groundnut
D.	Perisperm	IV.	Rudimentary cotyledon

Choose the option with all **correct** matches.

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

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

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

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

Answer (4)

Sol. Scutellum is cotyledon of monocot seed.

Groundnut seed is non-albuminous seed.

Epiblast is rudimentary cotyledon in monocot seed.

Perisperm is persistent nucellus.

124. What is the main function of the spindle fibers during mitosis?

(1) To synthesize new DNA

(2) To repair damaged DNA

(3) To regulate cell growth

(4) To separate the chromosomes

Answer (4)

Sol. During mitosis, spindle fibre get attach to the kinetochores of the chromosome and help in the separation of the chromosome.

125. Which of the following statements about RuBisCO is true?

(1) It has higher affinity for oxygen than carbon dioxide

(2) It is an enzyme involved in the photolysis of water

(3) It catalyzes the carboxylation of RuBP

(4) It is active only in the dark

Answer (3)

Sol. Carboxylation is the most crucial step of the Calvin cycle where CO_2 is utilised for the carboxylation of RuBP. This reaction is catalysed by enzyme RuBP carboxylase. Since this enzyme also has an oxygenase activity, RuBisCO has higher affinity for carbon dioxide than oxygen.

126. Given below are two statements :

Statement I : The DNA fragments extracted from gel electrophoresis can be used in construction of recombinant DNA.

Statement II : Smaller size DNA fragments are observed near anode while larger fragments are found near the wells in an agarose gel.

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

(1) Both statement I and statement II are incorrect

(2) Statement I is correct but statement II is incorrect

(3) Statement I is incorrect but statement II is correct

(4) Both statement I and statement II are correct

Answer (4)

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

The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece. This step is known as elution. The DNA fragments purified in this way are used in constructing rDNA by joining them with cloning vectors.

- In gel electrophoresis, the DNA fragments separate (resolve) according to their size through sieving effect provided by the agarose gel. Hence, the smaller the fragment size, the farther it moves from cathode towards anode.

127. Which factor is important for termination of transcription?

(1) σ (sigma)

(2) ρ (rho)

(3) γ (gamma)

(4) α (alpha)

Answer (2)

Sol. In prokaryotes the RNA polymerase is only capable of catalysing the process of elongation. It associates transiently with initiation factor (σ) and termination factor (ρ) to initiate and terminate the transcription respectively.

128. Consider the following statements regarding function of adrenal medullary hormones :

(A) It causes pupilary constriction.

(B) It is a hyperglycemic hormone.

(C) It causes piloerection.

(D) It increases strength of heart contraction.

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

(1) B, C and D only

(2) A, C and D only

(3) D only

(4) C and D only

Answer (1)

Sol. Adrenal medulla secretes two hormones called adrenaline or epinephrine and noradrenaline or norepinephrine (also called emergency hormones).

Both the hormones -

- Cause pupillary dilation (not constriction)
- Stimulate breakdown of glycogen resulting in increased concentration of glucose in blood *i.e.*, cause hyperglycemia.
- Cause piloerection (raising of hair).
- Increase strength of heart contraction *i.e.*, heartbeat.

129. Histones are enriched with -

(1) Leucine & Lysine
(2) Phenylalanine & Leucine
(3) Phenylalanine & Arginine
(4) Lysine & Arginine

Answer (4)

Sol. In eukaryotes, packaging of DNA is much more complex. There is a set of positively charged, basic proteins called histones.

Histones are organised to form a unit of light molecules called histone octamer.

They are rich in the basic amino acid residues lysine and arginine.

130. Genes R and Y follow independent assortment. If RRYY produce round yellow seeds and rryy produce wrinkled green seeds, what will be the phenotypic ratio of the F2 generation?

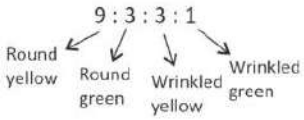
(1) Phenotypic ratio - 3 : 1
(2) Phenotypic ratio - 9 : 3 : 3 : 1
(3) Phenotypic ratio - 9 : 7
(4) Phenotypic ratio - 1 : 2 : 1

Answer (2)

Sol. A classical dihybrid cross performed by Mendel involves.

A cross which was made between a pure round yellow seeded pea plant (RRYY) with wrinkled green seeded plant (rryy). Yellow colour is dominant over green and round seed shape over wrinkled seed shape.

Phenotypic ratio in F2 generation



131. Which of the following hormones released from the pituitary is actually synthesized in the hypothalamus?

(1) Anti-diuretic hormone (ADH)
(2) Follicle-stimulating hormone (FSH)
(3) Adrenocorticotropic hormone (ACTH)
(4) Luteinizing hormone (LH)

Answer (1)

Sol. Neurohypophysis *i.e.*, posterior pituitary (Pars nervosa) stores and releases two hormones called oxytocin and vasopressin (Also called ADH *i.e.*, antidiuretic hormone) which are actually synthesised by hypothalamus and are transported axonally to neurohypophysis. The pars distalis (anterior pituitary) produces follicle stimulating hormone (FSH), adrenocorticotropic hormone (ACTH) and luteinizing hormone (LH).

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

Assertion (A) : All vertebrates are chordates but all chordates are not vertebrate.

Reason (R) : The members of subphylum vertebrata possess notochord during the embryonic period, the notochord is replaced by cartilaginous or bony vertebral column in adults.

In the light of the above statements, choose the **correct** answer from the options given below:

(1) Both **(A)** and **(R)** are true but **(R)** is **not** the correct explanation of **(A)**

(2) **(A)** is true but **(R)** is false

(3) **(A)** is false but **(R)** is true

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

Answer (4)

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

The members of subphylum vertebrata possess notochord during the embryonic period. The notochord is replaced by a cartilaginous or bony vertebral column in the adult.

Thus, all vertebrates are chordates but all chordates are not vertebrates.

133. Given below are two statements :

Statement I : Fig fruit is a non-vegetarian fruit as it has enclosed fig wasps in it.

Statement II : Fig wasp and fig tree exhibit mutual relationship as fig wasp completes its life cycle in fig fruit and fig fruit gets pollinated by fig wasp.

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

(1) Both statement I and statement II are incorrect

(2) Statement I is correct but statement II is incorrect

(3) Statement I is incorrect but statement II is correct

(4) Both statement I and statement II are correct

Answer (1)

Sol. Fig fruit is a vegetarian fruit as it only gets pollinated by wasp. Fig tree and fig wasps shows mutualism in which both species are benefitted. So, statement I is incorrect. Statement II is also not correct as fig inflorescence/flower gets pollinated by fig wasp.

134. Sweet potato and potato represent a certain type of evolution. Select the correct combination of terms to explain the evolution.

(1) Homology, divergent

(2) Homology, convergent

(3) Analogy, divergent

(4) Analogy, convergent

Answer (4)

Sol. Sweet potato is a root modification while potato is a stem modification but both of them have same function. Analogous structures are not anatomically similar structures though they perform similar functions.

Analogous structures are the result of convergent evolution.

- Homologous organs are anatomically similar but they do not perform similar function. Homologous organs are the result of divergent evolution.

135. Which of the following microbes is **NOT** involved in the preparation of household products?

A. *Aspergillus niger*

B. *Lactobacillus*

C. *Trichoderma polysporum*

D. *Saccharomyces cerevisiae*

E. *Propionibacterium sharmanii*

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

(1) A and C only

(2) C and D only

(3) C and E only

(4) A and B only

Answer (1)

Sol. *Lactobacillus* is used for production of curd.

Saccharomyces cerevisiae is used for the fermentation of palm sap to obtain toddy drink.

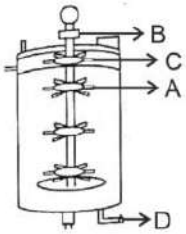
Propionibacterium sharmanii is used for production of swiss cheese.

Aspergillus niger is used for the commercial production of citric acid.

Trichoderma polysporum is used for the production of cyclosporin A and also act as a biocontrol agent.

A, C are used in industrial production of citric acid and cyclosporin-A.

136. Identify the part of a bio-reactor which is used as a foam braker from the given figure.



(1) B

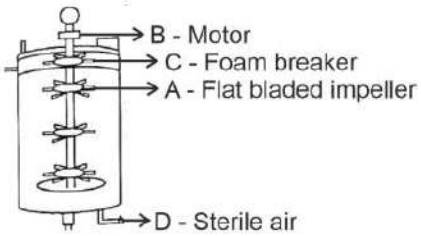
(2) D

(3) C

(4) A

Answer (3)

Sol.



∴ Part labelled as C is foam breaker.

137. Name the class of enzyme that usually catalyze the following reaction :

$S - G + S^{\#} \rightarrow S + S^{\#} - G$

Where, $G \rightarrow$ a group other than hydrogen

$S \rightarrow$ a substrate

$S^{\#} \rightarrow$ another substrate

(1) Lyase
(2) Transferase
(3) Ligase
(4) Hydrolase

Answer (2)

Sol. Enzymes catalysing a transfer of G group, (other than hydrogen) between a pair of substrates, S and S' are known as transferases.

$S - G + S^{\#} \rightarrow S + S^{\#} - G$

- Ligases catalyse the linking together of 2 compounds such as C – O, C – S, C – N bonds *etc*
- Lyases catalyse removal of groups from substrates by mechanisms other than hydrolysis leaving double bonds

Hydrolases are enzymes that catalyse hydrolysis of ester, ether, peptide , glycosidic, C – C, C – halide or P – N bonds.

138. Match **List I** with **List II**:

	List-I		List-II
A.	Chlorophyll a	(I)	Yellow-green
B.	Chlorophyll b	(II)	Yellow
C.	Xanthophylls	(III)	Blue-green
D.	Carotenoids	(IV)	Yellow to Yellow-orange

Choose the option with all **correct** matches.

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

Answer (1)

Sol. A chromatographic separation of the leaf pigments shows that the colour that we see in leaves is not due to single pigment but due to four pigments.

Chlorophyll a	–	Bright or blue-green in the chromatogram
Chlorophyll b	–	Yellow-green
Xanthophylls	–	Yellow
Carotenoids	–	Yellow to Yellow-orange

139. The correct sequence of events in the life cycle of bryophytes is

A. Fusion of antherozoid with egg.

B. Attachment of gametophyte to substratum.

C. Reduction division to produce haploid spores.

D. Formation of sporophyte.

E. Release of antherozoids into water.

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

(1) B, E, A, C, D

(2) B, E, A, D, C

(3) D, E, A, B, C

(4) D, E, A, C, B

Answer (2)

Sol. The correct sequence of events in the life cycle of bryophytes is

- Attachment of gametophyte to substratum.
- Release of antherozoids into water.
- Fusion of antherozoid with egg.
- Formation of sporophyte.
- Reduction division to produce haploid spores.

140. Match **List**-I with **List- II**.

	List-I		**List-II**
A.	Centromere	I.	Mitochondrion
B.	Cilium	II.	Cell division
C.	Cristae	III.	Cell movement
D.	Cell membrane	IV.	Phospholipid Bilayer

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

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

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

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

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

Answer (3)

Sol. Centromere - Helps in cell division

Cilium - Helps in cell movement

Cristae - Finger like structures of mitochondria

Cell membrane - Is a phospholipid bilayer

141. Find the correct statement :

(A) In human pregnancy, the major organ systems are formed at the end of 12 weeks.

(B) In human pregnancy the major organ systems are formed at the end of 8 weeks.

(C) In human pregnancy heart is formed after one month of gestation.

(D) In human pregnancy, limbs and digits develop by the end of second month.

(E) In human pregnancy the appearance of hair is usually observed in the fifth month.

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

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

Answer (3)

Sol. In a human female's pregnancy.

- By the end of 12 weeks (1st trimester), most of major organ systems are formed (not by end of 8 weeks).
- After one month of pregnancy, the embryo's heart is formed.
- By the end of second month of pregnancy, the foetus develops limbs and digits.
- The first movements of foetus and appearance of hair on head are usually observed during the fifth month.

142. Each of the following characteristics represent a Kingdom proposed by Whittaker. Arrange the following in increasing order of complexity of body organization.

A. Multicellular heterotrophs with cell wall made of chitin.

B. Heterotrophs with tissue/organ/organ system level of body organization.

C. Prokaryotes with cell wall made of polysaccharides and amino acids.

D. Eukaryotic autotrophs with tissue/organ level of body organization.

E. Eukaryotes with cellular body organization.

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

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

Answer (1)

Sol. Increasing order of complexity of body organisation in the kingdom given by R.H. Whittaker is as follows-

C. Monera-Prokaryotes with cell wall made up of polysaccharide.

↓

E. Protista - Unicellular eukaryotes.

↓

A. Fungi -Multicellular heterotrophic with cell wall made up of chitin.

↓

D. Plantae - Eukaryotes autotrophs with tissue body organisation.

↓

B. Animalia - Heterotrophs with tissue organ/system of body organisation

Correct sequence is C, E, A, D, B.

143. Which are correct:

A. Computed tomography and magnetic resonance imaging detect cancers of internal organs.

B. Chemotherapeutics drugs are used to kill non-cancerous cells.

C. α -interferon activate the cancer patients' immune system and helps in destroying the tumour.

D. Chemotherapeutic drugs are biological response modifiers.

E. In the case of leukaemia blood cell counts are decreased.

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

(1) D and E only

(2) C and D only

(3) A and C only

(4) B and D only

Answer (3)

Sol. Statements A and C are correct while statements B, D and E are incorrect.

Chemotherapeutic drugs are used to kill cancerous cells.

In case of leukaemia, blood cell counts are increased.

α-interferons are biological response modifiers.

144. Which of the following genetically engineered organisms was used by Eli Lilly to prepare human insulin?

(1) Yeast

(2) Virus

(3) Phage

(4) Bacterium

Answer (4)

Sol. The correct answer is bacterium.

In 1983, Eli Lilly, an American company, prepared two DNA sequences corresponding to 'A' and 'B' chains of human insulin and introduced them in plasmids of *E.coli* (a gram negative bacterium) to produce insulin chains.

145. What is the pattern of inheritance for polygenic trait?

(1) Non-mendelian inheritance pattern

(2) Autosomal dominant pattern

(3) X-linked recessive inheritance pattern

(4) Mendelian inheritance pattern

Answer (1)

Sol. Polygenic inheritance refers to the inheritance of a trait controlled by two or more genes. When human disorders are determined by mutation in the single gene then they are transmitted to the offspring as per Mendelian principle. Polygenic trait shows non-Mendelian inheritance pattern.

146. Which of the following are the post-transcriptional events in an eukaryotic cell?

A. Transport of pre-mRNA to cytoplasm prior to splicing.

B. Removal of introns and joining of exons.

C. Addition of methyl group at 5' end of hnRNA.

D. Addition of adenine residues at 3' end of hnRNA.

E. Base pairing of two complementary RNAs.

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

(1) B, C, D only

(2) B, C, E only

(3) C, D, E only

(4) A, B, C only

Answer (1)

Sol. The process of copying genetic information from one strand of the DNA into RNA is known as transcription. It occurs in the cytoplasm with the help of transcripting enzyme.

Transport of pre-mRNA to cytoplasm prior to splicing is a part of transcription.

The primary transcript is converted into functional mRNA after post transcriptional processing involves 3 steps as follows-

- Modification of 5' end by capping,
- Tailing,
- Splicing.

Base pairing of two complementary RNA is not on event of post-transcription. Hence, statements B, C, D are post-transcriptional modification events in eukaryotic cell.

147. Which one of the following phytohormones promotes nutrient mobilization which helps in the delay of leaf senescence in plants?

(1) Abscisic acid

(2) Gibberellin

(3) Cytokinin

(4) Ethylene

Answer (3)

Sol. Cytokinins help to overcome apical dominance. They promote nutrient mobilisation which helps in the delay of leaf senescence.

148. Which one of the following statements refers to Reductionist Biology?

(1) Physiological approach to study and understand living organisms

(2) Chemical approach to study and understand living organisms

(3) Behavioural approach to study and understand living organisms

(4) Physico-chemical approach to study and understand living organisms

Answer (4)

Sol. The physico-chemical approach to study and understand living organisms is called 'Reductionist Biology'.

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

	List-I		List-II
A.	Emphysema	I.	Rapid spasms in muscle due to low Ca^{++} in body fluid
B.	Angina Pectoris	II.	Damaged alveolar walls and decreased respiratory surface
C.	Glomerulonephritis	III.	Acute chest pain when not enough oxygen is reaching to heart muscle
D.	Tetany	IV.	Inflammation of glomeruli of kidney

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

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

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

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

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

Answer (3)

Sol. Emphysema - Damaged alveolar walls and decreased respiratory surface

Angina pectoris - Acute chest pain when not enough oxygen is reaching to heart muscle

Glomerulonephritis - Inflammation of glomeruli of kidney

Tetany - Rapid spasms in muscle due to low Ca^{++} in body fluid

150. Epiphytes that are growing on a mango branch is an example of which of the following?

(1) Mutualism

(2) Predation

(3) Amensalism

(4) Commensalism

Answer (4)

Sol. Commensalism is the type of interaction in which one-species benefits and another is neither harmed nor benefited. An orchid growing as an epiphyte on a mango branch is an example of commensalism.

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

	List-I		List-II
A.	Alfred Hershey and Martha Chase	I.	Streptococcus pneumoniae
B.	Euchromatin	II.	Densely packed and dark-stained
C.	Frederick Griffith	III.	Loosely packed and light-stained
D.	Heterochromatin	IV.	DNA as genetic material confirmation

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

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

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

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

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

Answer (2)

Sol. The unequivocal proof that DNA is the genetic material came from the experiment of Alfred Hershey and Martha Chase.

Euchromatin are lightly stained region with loosely packed chromatin fibre.

Frederick Griffith performed series of experiments by selecting the different strains of *Streptococcus pneumoniae.*

Heterochromatin are darkly stained region with tightly packed chromatin fibre.

152. Which chromosome in the human genome has the highest number of genes?

(1) Chromosome Y
(2) Chromosome 1
(3) Chromosome 10
(4) Chromosome X

Answer (2)

Sol. In human genome, Chromosome 1 has the highest number of genes, *i.e.*, 2968.

153. What are the potential drawbacks in adoption of the IVF method?

A. High fatality risk to mother

B. Expensive instruments and reagents

C. Husband/wife necessary for being donors

D. Less adoption of orphans

E. Not available in India

F. Possibility that the early embryo does not survive

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

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

Answer (4)

Sol. Statements B, D and F are correct while statements A, C and E are incorrect.

Husband/wife is not necessary for being donors. IVF is available in India.

154. Match **List - I** with **List - II.**

	List - I		List - II
A.	Head	(i)	Enzymes
B.	Middle piece	(ii)	Sperm motility
C.	Acrosome	(iii)	Energy
D.	Tail	(iv)	Genetic material

Choose the correct answer from the options given below :

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

Answer (4)

Sol.
- The sperm head contains elongated nucleus which possesses the genetic material.
- The middle piece possesses numerous mitochondria, which produce energy for movement.
- Acrosome is a cap-like structure filled with enzymes that help in fertilization of ovum.
- The tail of sperm facilitates sperm motility essential for fertilisation.

155. From the statements given below choose the **correct** option :

A. The eukaryotic ribosomes are 80S and prokaryotic ribosomes are 70S.

B. Each ribosome has two sub-units.

C. The two sub-units of 80S ribosome are 60S and 40S while that of 70S are 50S and 30S.

D. The two sub-units of 80S ribosome are 60S and 20S and that of 70S are 50S and 20S.

E. The two sub-units of 80S are 60S and 30S and that of 70S are 50S and 30S.

(1) A, B, D are true
(2) A, B, E are true
(3) B, D, E are true
(4) A, B, C are true

Answer (4)

Sol. The eukaryotic ribosomes are 80S and prokaryotic ribosomes are 70S type.

Each ribosome has two sub-units.

The two sub-units of 80S ribosome are 60S and 40S while that of 70S are 50S and 30S.

156. Which of the following is an example of non-distilled alcoholic beverage produced by yeast?

(1) Brandy
(2) Beer
(3) Rum
(4) Whisky

Answer (2)

Sol. Wine and beer are produced without distillation whereas whisky, brandy and rum are produced by distillation of fermented broth.

157. Who is known as the father of Ecology in India?

(1) Ramdeo Misra
(2) Ram Udar
(3) Birbal Sahni
(4) S.R. Kashyap

Answer (1)

Sol. Ramdeo Misra is known as the father of Ecology in India.

158. In the seeds of cereals, the outer covering of endosperm separates the embryo by a protein-rich layer called :

(1) Coleorhiza
(2) Integument
(3) Aleurone layer
(4) Coleoptile

Answer (3)

Sol. In monocot seeds, the outer covering of endosperm separates the embryo by a proteinous layer called aleurone layer.

159. Which of the following statement is **correct** about location of the male frog copulatory pad?

(1) First digit of hind limb

(2) Second digit of fore limb

(3) First digit of the fore limb

(4) First and Second digit of fore limb

Answer (3)

Sol. In male frogs, copulatory pad is present on the first digit of the forelimbs which are absent in female frogs.

160. A specialised membranous structure in a prokaryotic cell which helps in cell well wall formation, DNA replication and respiration is

(1) Chromatophores (2) Cristae

(3) Endoplasmic Reticulum (4) Mesosome

Answer (4)

Sol. Mesosome is membranous extension in bacterial cell that helps in cell wall formation, DNA replication and contains enzymes for respiration.

161. Given below are two statements :

Statement I : Transfer RNAs and ribosomal RNA do not interact with mRNA.

Statement II : RNA interference (RNAi) takes place in all eukaryotic organisms as a method of cellular defence.

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

(1) Both statement I and statement II are incorrect

(2) Statement I is correct but statement II is incorrect

(3) Statement I is incorrect but statement II is correct

(4) Both statement I and statement II are correct

Answer (3)

Sol. Both transfer RNAs and ribosomal RNA interact with mRNA.

RNA interference (RNAi) takes place in all eukaryotic organisms as a method of cellular defence.

162. What is the name of the blood vessel that carries deoxygenated blood from the body to the heart in a frog?

(1) Pulmonary artery (2) Pulmonary vein

(3) Vena cava (4) Aorta

Answer (3)

Sol. Frog's heart is a muscular structure with three chambers. It receives deoxygenated blood from body parts through the major veins called vena cava. Vena cava carries deoxygenated blood. Aorta and pulmonary vein carries oxygenated blood. Whereas, pulmonary artery will carry deoxygenated blood towards the lungs.

163. Given below are two statements :

Statement I : In the RNA world, RNA is considered the first genetic material evolved to carry out essential life processes. RNA acts as a genetic material and also as a catalyst for some important biochemical reactions in living systems. Being reactive, RNA is unstable.

Statement II : DNA evolved from RNA and is a more stable genetic material. Its double helical strands being complementary, resist changes by evolving repairing mechanism.

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

(1) Both statement I and statement II are incorrect

(2) Statement I is correct but statement II is incorrect

(3) Statement I is incorrect but statement II is correct

(4) Both statement I and statement II are correct

Answer (4)

Sol. In RNA world, RNA was the first genetic material as there are enough evidences to suggest that essential life processes (such as metabolism, translation, splicing, etc) evolved around RNA. RNA used to act as a genetic material as well as catalyst (there are some important biochemical reaction in living systems that are catalysed by RNA catalysts not by protein enzymes) so, statement I is correct statement II is also correct as DNA being double stranded and having complementary strands further resists changes by evolving a process of repair.

164. Which one of the following is an example of ex-situ conservation?

(1) Wildlife Sanctuary

(2) Zoos and botanical gardens

(3) Protected areas

(4) National Park

Answer (2)

Sol. Zoological parks (Zoos), botanical gardens and wildlife safari parks are examples of ex-situ conservation. Sacred groves, biosphere reserves, national parks and wildlife sanctuaries are examples of in-situ conservation.

165. Which one of the following enzymes contains 'Haem' as the prosthetic group?

(1) Carbonic anhydrase

(2) Succinate dehydrogenase

(3) Catalase

(4) RuBisCo

Answer (3)

Sol. In peroxidase and catalase, which catalyze the breakdown of hydrogen peroxide to water and oxygen, haem is the prosthetic group and it is part of the active site of the enzymes.

Zinc is the cofactor in enzyme carbonic anhydrase.

RuBisCo is the most abundant protein in whole of the biosphere.

Succinate is the substrate of enzyme succinic dehydrogenase.

166. Given below are the stages in the life cycle of pteridophytes. Arrange the following stages in the correct sequence.

A. Prothallus stage

B. Meiosis in spore mother cells

C. Fertilisation

D. Formation of archegonia and antheridia in gametophyte.

E. Transfer of antherozoids to the archegonia in presence of water.

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

(1) B, A, E, C, D

(2) D, E, C, A, B

(3) E, D, C, B, A

(4) B, A, D, E, C

Answer (4)

Sol. In a pteridophytes life cycle, the correct sequence of stages will be given as follows:

B $\rightarrow$ Meiosis in spore mother cells

A $\rightarrow$ Prothallus stage

D $\rightarrow$ Formation of archegonia and antheridia in gametophyte

E $\rightarrow$ Transfer of antherozoids to the archegonia in presence of water

C $\rightarrow$ Fertilisation will occur

So, the correct sequence is B $\rightarrow$ A $\rightarrow$ D $\rightarrow$ E $\rightarrow$ C

167. Which of following organisms **cannot** fix nitrogen?

A. *Azotobacter*

B. *Oscillatoria*

C. *Anabaena*

D. *Volvox*

E. *Nostoc*

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

(1) D only

(2) B only

(3) E only

(4) A only

Answer (1)

Sol. *Azotobacter*, *Oscillatoria*, *Anabaena* and *Nostoc* can fix nitrogen but *Volvox* cannot fix nitrogen.

168. While trying to find out the characteristic of a newly found animal, a researcher did the histology of adult animal and observed a cavity with presence of mesodermal tissue towards the body wall but no mesodermal tissue was observed towards the alimentary canal. What could be the possible coelome of that animal?

(1) Pseudocoelomate
(2) Schizocoelomate
(3) Spongocoelomate
(4) Acoelomate

Answer (1)

Sol. In pseudocoelomates, the body cavity is not entirely lined with mesoderm, instead, mesodermal tissue is present along the body wall but not towards the gut.

- Schizocoelomates are animals whose coelom or body cavity develops middle from a split in the mesoderm, the middle germ layer of the embryo.
- In acoelomates, coelom is absent.

Spongocoel is a central cavity found in Sponges.

169. Given below are two statements:

Statement I: In a floral formula ⊕ stands for zygomorphic nature of the flower, and $\underline{G}$ stands for inferior ovary.

Statement II: In a floral formula ⊕ stands for actinomorphic nature of the flower and $\underline{G}$ stands for superior ovary.

In the light of the above statements, choose the **correct** answer from the options given below:

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

Answer (3)

Sol. The floral formula symbol ⊕ is used for actinomorphic flower, while % is used for zygomorphic flower.

The symbol G represents gynoecium and $\underline{G}$ symbol represent superior ovary, while inferior ovary is represented by $\bar{G}$.

Thus, statement I is incorrect and Statement II is correct.

170. Given below are two statements:

Statement I : The primary source of energy in an ecosystem is solar energy.

Statement II : The rate of production of organic matter during photosynthesis in an ecosystem is called net primary productivity (NPP).

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

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

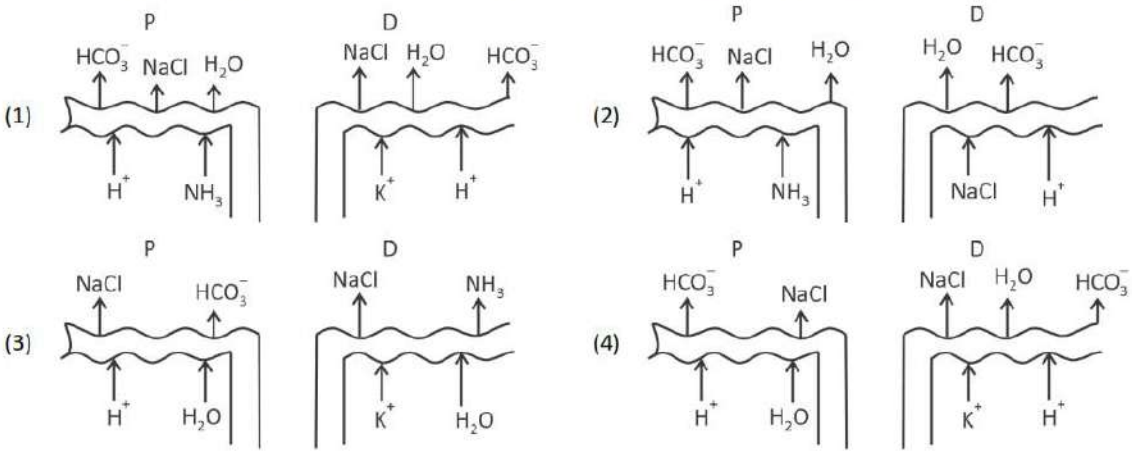
Answer (2)

Sol. Primary source of energy in the ecosystem is solar energy.

Gross primary productivity of an ecosystem is the rate of production of organic matter during photosynthesis.

Hence, statement I is correct but statement II is incorrect.

171. Which of the following diagrams is correct with regard to the proximal (P) and distal (D) tubule of the Nephron.



Answer (1)

Sol. During urine formation, the tubular cells secrete substances like H^+, K^+ and ammonia into the filtrate. Tubular secretion is also an important step in urine formation as it helps in the maintenance of ionic and acid base balance of body fluids.

PCT $\rightarrow$ Selective secretion of H^+, ammonia and K^+ into the filtrate.

DCT $\rightarrow$ Capable of reabsorption of HCO_3^- and selective secretion of H^+, K^+ and NH_3.

172. Streptokinase produced by *bacterium Streptococcus* is used for

(1) Ethanol production

(2) Liver disease treatment

(3) Removing clots from blood vessels

(4) Curd production

Answer (3)

Sol. Streptokinase produced by the bacterium *Streptococcus* and modified by genetic engineering is used as a 'clot buster' for removing clots from blood vessels of patients who have undergone myocardial infarction leading to heart attack. Curd production is done by *Lactobacillus* and ethanol production is done by *Saccharomyces.*

173. Cardiac activities of the heart are regulated by:

A. Nodal tissue

B. A special neural centre in the medulla oblongata

C. Adrenal medullary hormones

D. Adrenal cortical hormones

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

(1) A, B, C and D

(2) A, C and D Only

(3) A, B and D Only

(4) A, B and C Only

Answer (4)

Sol. Normal cardiac activities of the heart are regulated intrinsically, i.e., auto regulated by specialised muscles (nodal tissue), hence the heart is called myogenic. A special neural centre in the medulla oblongata can moderate the cardiac function through autonomic nervous system.

Sympathetic nervous system can increase the rate of heartbeat, ventricular contraction and thereby cardiac output.

Parasympathetic neural signals decrease the rate of heartbeat, speed of conduction of action potential and thereby the cardiac output. Adrenal medullary hormones can also increase the cardiac output.

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

Assertion (A) : A typical unfertilised, angiosperm embryo sac at maturity is 8 nucleate and 7-celled.

Reason (R) : The egg apparatus has 2 polar nuclei.

In the light of the above statements, choose the **correct** answer from the options given below :

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

(2) **A** is true but **R** is false

(3) **A** is false but **R** is true

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

Answer (2)

Sol. A typical Angiosperm embryo sac, at maturity is 7-celled and 8 nucleate.

Polar nuclei are situated below the egg apparatus in the large central cell.

Three cells are grouped together at micropylar end and constitute the egg apparatus.

Hence, A is true but R is false.

175. Find the statement that is **NOT** correct with regard to the structure of monocot stem.

(1) Vascular bundles are scattered.

(2) Vascular bundles are conjoint and closed.

(3) Phloem parenchyma is absent.

(4) Hypodermis is parenchymatous.

Answer (4)

Sol. In monocot stem, hypodermis is sclerenchymatous.

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

Assertion (A) : Both wind and water pollinated flowers are not very colourful and do not produce nectar.

Reason (R) : The flowers produce enormous amount of pollen grains in wind and water pollinated flowers.

In the light of the above statements, choose the **correct** answer from the options given below:

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

(2) **A** is true but **R** is false

(3) **A** is false but **R** is true

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

Answer (1)

Sol. Both wind and water pollinated flowers are not very colourful and do not produce nectar, this is because they rely on wind and water to carry their pollen. Wind and water pollinated flower do not need to attract insect, so they did not evolve to produce bright coloured flower.

177. Neoplastic characteristics of cells refer to :

A. A mass of proliferating cell

B. Rapid growth of cells

C. Invasion and damage to the surrounding tissue

D. Those confined to original location

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

(1) A, B, C only

(2) A, B, D only

(3) B, C, D only

(4) A, B only

Answer (1)

Sol. The correct answer will include : A, B and C only.

A neoplasm is a general term for any abnormal growth of tissue.

Neoplastic characteristics of cells refer to

(1) A mass of proliferating cell.
(2) Rapid growth of cells.
(3) Invasion and damage to the surrounding tissue.

Cancer specifically refers to malignant neoplasms, which are cancerous and invasive.

Benign tumours remain confined to their original location. Thus, D is not included in the answer.

The malignant tumours, on the other hand are a mass of proliferating cells called neoplastic or tumour cells. These cells grow very rapidly, invading and damaging the surrounding normal tissues.

178. The complex II of mitochondrial electron transport chain is also known as

(1) Succinate dehydrogenase

(2) Cytochrome c oxidase

(3) NADH dehydrogenase

(4) Cytochrome bc_1

Answer (1)

Sol. Complex II of mitochondrial electron transport chain is also known as succinate dehydrogenase. Cytochrome c oxidase (complex IV), NADH dehydrogenase (complex I), cytochrome bc_1 (complex III).

179. Polymerase chain reaction (PCR) amplifies DNA following the equation.

(1) 2^n (2) $2n + 1$

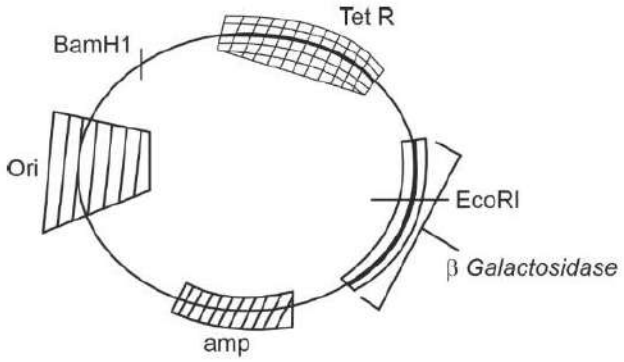
(3) $2N^2$ (4) N^2

Answer (1)

Sol. PCR *i.e.*, polymerase chain reaction amplifies DNA as per the equation 2^n, where '*n*' refers to number of cycles.

Thus, say, if 3 PCR cycles will run, then 2^3 *i.e.*, $2 \times 2 \times 2 \Rightarrow 8$ DNA fragments will be formed.

180.



In the above represented plasmid, an alien piece of DNA is inserted at EcoRI site. Which of the following strategies will be chosen to select the recombinant colonies?

(1) Blue color colonies will be selected.

(2) White color colonies will be selected.

(3) Blue color colonies grown on ampicillin plates can be selected.

(4) Using ampicillin & tetracycline containing medium plate.

Answer (2)

Sol. The correct answer is that white-colored colonies will be selected.

Since an alien piece of DNA is being inserted at *Eco*RI site, the gene β-galactosidase present here will undergo insertional inactivation.

This gene is responsible for producing blue-colored colonies, but since it has been insertionally inactivated, white colored colonies will be produced.

Ampicillin and tetracycline resistance genes present in the given DNA will remain intact. Thus, the given DNA will show amp^R and tet^R.

DATE : 04/05/2025

Test Booklet Code

47

NARMADA

Answers & Solutions for NEET (UG)-2025

Time : 3 hrs.

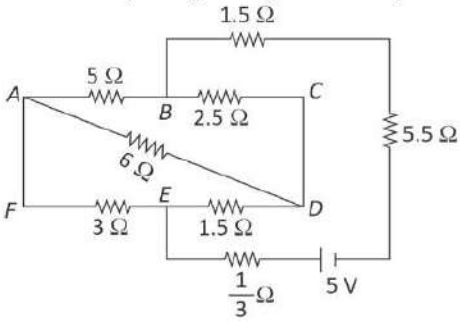
M.M.: 720

Important Instructions:

1. The test is of **3 hours** duration and the Test Booklet contains **180** multiple choice questions (Four options with a single correct answer) from **Physics, Chemistry and Biology (Botany and Zoology)**.
2. Each question carries **4 marks**. For each correct response, the candidate will get **4 marks**. For every wrong response **1 mark** shall be deducted from the total scores. The maximum marks are **720**.
3. Use **Blue / Black Ball Point Pen only** for writing particulars on this page / marking responses on Answer Sheet.
4. Rough work is to be done in the space provided for this purpose in the Test Booklet only.
5. On completion of the test, the candidate **must hand over the Answer Sheet (ORIGINAL and OFFICE Copy)** to the Invigilator before leaving the Room / Hall. The candidates are allowed to take away this Test Booklet with them.
6. The CODE for this Booklet is **47**.
7. The candidates should ensure that the Answer Sheet is not folded. Do not make any stray marks on the Answer Sheet. Do not write your Roll No. anywhere else except in the specified space in the Test Booklet/Answer Sheet. Use of white fluid for correction is **NOT** permissible on the Answer Sheet.
8. Each candidate must show on-demand his/her Admit Card to the Invigilator.
9. No candidate, without special permission of the Centre Superintendent or Invigilator, would leave his/her seat.
10. Use of Electronic/Manual Calculator is prohibited.
11. The candidates are governed by all Rules and Regulations of the examination with regard to their conduct in the Examination Room/Hall. All cases of unfair means will be dealt with as per Rules and Regulations of this examination along with Public Examinations (Prevention of unfair means act 2024).
12. **No part of the Test Booklet and Answer Sheet shall be detached under any circumstances.**
13. The candidates will write the Correct Test Booklet Code as given in the Test Booklet / Answer Sheet in the Attendance Sheet.

PHYSICS

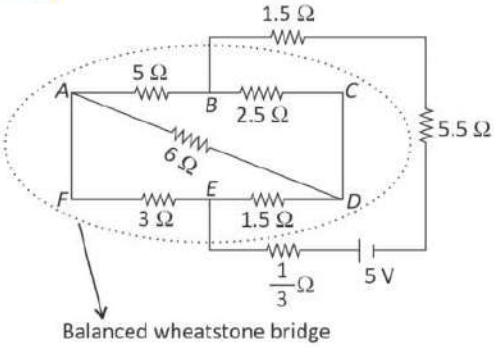
1. The current passing through the battery in the given circuit, is:



(1) 1.5 A
(2) 2.0 A
(3) 0.5 A
(4) 2.5 A

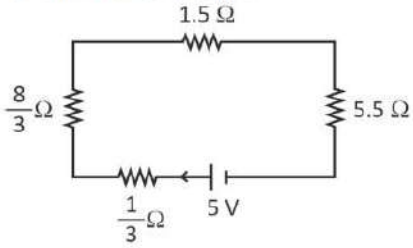
Answer (3)

Sol.



$\therefore$ its equivalent $R' = \frac{4 \times 8}{12} = \frac{8}{3}\Omega$

Circuit can be redrawn as



$R_{eq} = \frac{8}{3} + \frac{1}{3} + 1.5 + 5.5$

$= 10\ \Omega$

$i = \frac{V}{R_{eq}} = \frac{5}{10} = 0.5\,A$

2. The electric field in a plane electromagnetic wave is given by

$E_z = 60 \cos (5x + 1.5 \times 10^9\, t)$ V/m.

Then expression for the corresponding magnetic field is (here subscripts denote the direction of the field) :

(1) $B_y = 60 \sin (5x + 1.5 \times 10^9\, t)T$
(2) $B_y = 2 \times 10^{-7} \cos (5x + 1.5 \times 10^9\, t)T$
(3) $B_x = 2 \times 10^{-7} \cos (5x + 1.5 \times 10^9\, t)T$
(4) $B_z = 60\cos (5x + 1.5 \times 10^9\, t)T$

Answer (2)

Sol. In electromagnetic wave, E and B are in same phase and $B_0 = \frac{E_0}{c}$; their planes are perpendicular to each other.

$$\therefore\ B_y = \frac{60}{c}\cos(5x + 1.5\times10^9 t)\ \text{T}$$

$$= \frac{60}{3\times10^8}\cos(5x + 1.5\times10^9 t)\ \text{T}$$

$$B_y = 2\times10^{-7}\cos(5x + 1.5\times10^9 t)\ \text{T}$$

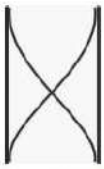
3. A pipe open at both ends has a fundamental frequency f in air. The pipe is now dipped vertically in a water drum to half of its length. The fundamental frequency of the air column is now equal to:

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

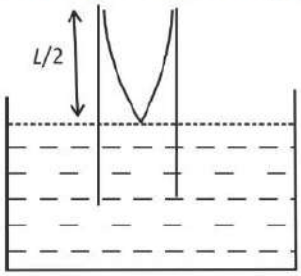
(3) f (4) $\frac{3f}{2}$

Answer (3)

Sol. Fundamental frequency of open pipe (at both ends) $f = \frac{v}{2L}$ ...(i)



Now immersed in water open pipe behaves as closed pipe.



$$f' = \frac{v}{4\left(\frac{L}{2}\right)} = \frac{v}{2L} \quad \text{...(ii)}$$

$f = f'$

4. An electron (mass 9×10^{-31} kg and charge 1.6×10^{-19} C) moving with speed $c/100$ (c = speed of light) is injected into a magnetic field $\vec{B}$ of magnitude 9×10^{-4} T perpendicular to its direction of motion. We wish to apply an uniform electric field $\vec{E}$ together with the magnetic field so that the electron does not deflect from its path. Then (speed of light $c = 3 \times 10^8$ ms^{-1})

(1) $\vec{E}$ is parallel to $\vec{B}$ and its magnitude is 27×10^4 V m^{-1}

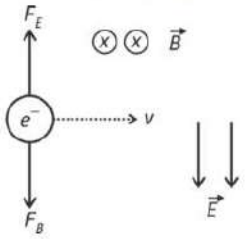
(2) $\vec{E}$ is perpendicular to $\vec{B}$ and its magnitude is 27×10^4 V m^{-1}

(3) $\vec{E}$ is perpendicular to $\vec{B}$ and its magnitude is 27×10^2 V m^{-1}

(4) $\vec{E}$ is parallel to $\vec{B}$ and its magnitude is 27×10^2 V m^{-1}

Answer (3)

Sol. For no deflection of electron, $\vec{F}_B = \vec{F}_E$



$-e\left(\vec{v}\times\vec{B}\right) = -e\vec{E}$

$\Rightarrow \vec{E} = \vec{v}\times\vec{B} \;\; \Rightarrow \vec{E}\perp\vec{B}$

$E = vB = \dfrac{c}{100}\times 9\times 10^{-4}$

$= \dfrac{3\times 10^{8}}{100}\times 9\times 10^{-4}$

$= 27\times 10^{2}\ \text{V m}^{-1}$

5. In a certain camera, a combination of four similar thin convex lenses are arranged axially in contact. Then the power of the combination and the total magnification in comparison to the power (p) and magnification (m) for each lens will be, respectively

(1) p^4 and m^4 (2) $4p$ and $4m$

(3) p^4 and $4m$ (4) $4p$ and m^4

Answer (4)

Sol. For series combination of lens

$p_{eff} = p_1 + p_2 + p_3 + p_4 = 4p$

$m_{eff} = m_1 \times m_2 \times m_3 \times m_4 = m^4$

6. A 2 amp current is flowing through two different small circular copper coils having radii ratio 1 : 2. The ratio of their respective magnetic moments will be

(1) 4 : 1 (2) 1 : 4

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

Answer (2)

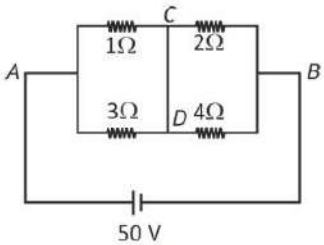
Sol. Magnetic moment of current carrying circular loop = IA

$M = IA$

$M \propto A$ [I–Same]

$\dfrac{M_1}{M_2} = \dfrac{A_1}{A_2} = \dfrac{\pi r_1^2}{\pi r_2^2} = \left(\dfrac{1}{2}\right)^2 = \dfrac{1}{4}$

7. A constant voltage of 50 V is maintained between the points A and B of the circuit shown in the figure. The current through the branch CD of the circuit is:

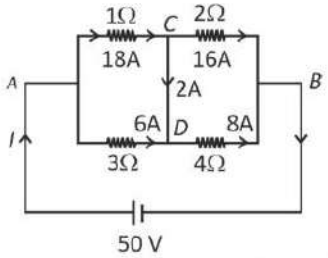


(1) 3.0 A (2) 1.5 A

(3) 2.0 A (4) 2.5 A

Answer (3)

Sol.



R_{AB} = (1Ω/3Ω) in series with (2Ω/4Ω)

$$=\frac{3\times1}{3+1}+\frac{2\times4}{2+4}$$

$$=\frac{3}{4}+\frac{8}{6}=\frac{9+16}{12}=\frac{25}{12}\Omega$$

Now total current through cell

$$I=\frac{50}{25/12}=24\text{A}$$

$$I_{1\Omega}=\frac{3}{4}\times24=18\text{A},\ I_{3\Omega}=\frac{1}{4}\times24=6\text{A}$$

$$I_{2\Omega}=\frac{4}{6}\times24=16\text{A},\ I_{4\Omega}=\frac{2}{6}\times24=8\text{A}$$

Using junction rule at C, I_{CD} = 18 – 16 = 2A (From C to D)

8. Two gases A and B are filled at the same pressure in separate cylinders with movable pistons of radius r_A and r_B, respectively. On supplying an equal amount of heat to both the systems reversibly under constant pressure, the pistons of gas A and B are displaced by 16 cm and 9 cm, respectively. If the change in their internal energy is the same, then the ratio $\frac{r_A}{r_B}$ is equal to

(1) $\frac{\sqrt{3}}{2}$ (2) $\frac{4}{3}$

(3) $\frac{3}{4}$ (4) $\frac{2}{\sqrt{3}}$

Answer (3)

Sol. Using first law of thermodynamics

$\Delta Q = \Delta U + P\Delta V$

ΔQ is same

ΔU is also same

$W_A = W_B$

$\therefore\ (P\Delta V)_A = (P\Delta V)_B$

P is also same

$\therefore\ A_A d_A = A_B d_B$

$$\pi r_A^2 d_A = \pi r_B^2 d_B$$

$$\frac{r_A}{r_B}=\left(\frac{dB}{dA}\right)^{\frac{1}{2}}=\left(\frac{9}{16}\right)^{\frac{1}{2}}$$

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

9. A container has two chambers of volumes V_1 = 2 litres and V_2 = 3 litres separated by a partition made of a thermal insulator. The chambers contain n_1 = 5 and n_2 = 4 moles of ideal gas at pressures p_1 = 1 atm and p_2 = 2 atm, respectively. When the partition is removed, the mixture attains an equilibrium pressure of

(1) 1.8 atm (2) 1.3 atm

(3) 1.6 atm (4) 1.4 atm

Answer (3)

Sol. $P_1V_1 + P_2V_2 = P(V_1 + V_2)$

$1(2) + 2(3) = P(2 + 3)$

$\frac{8}{5} = P$

$\Rightarrow$ 1.6 atm

10. The radius of Martian orbit around the Sun is about 4 times the radius of the orbit of Mercury. The Martian year is 687 Earth days. Then which of the following is the length of 1 year on Mercury?

(1) 124 earth days (2) 88 earth days

(3) 225 earth days (4) 172 earth days

Answer (2)

Sol. Applying Kepler's 3rd law : $T^2 \propto R^3$

Radius of Martian orbit, $R' = 4R$

$$\left(\frac{T'}{T}\right)^2 = \left(\frac{R'}{R}\right)^3 = \left(\frac{4R}{R}\right)^3 = 4^3 = 64 \Rightarrow \frac{T'}{T} = 8$$

$\therefore$ Length of 1 year on Mercury = $T = \frac{T'}{8} = \frac{687}{8} = 85.88$ days

11. To an ac power supply of 220 V at 50 Hz, a resistor of 20 Ω, a capacitor of reactance 25 Ω and an inductor of reactance 45 Ω are connected in series. The corresponding current in the circuit and the phase angle between the current and the voltage is, respectively

(1) 15.6 A and 45° (2) 7.8 A and 30°

(3) 7.8 A and 45° (4) 15.6 A and 30°

Answer (3)

Sol. X_L = 45 W , X_C = 25 W, R = 20 W

$$I = \frac{220}{\sqrt{(X_L - X_C)^2 + R^2}} = \frac{220}{\sqrt{(45-25)^2 + 20^2}}$$

$$= \frac{220}{2\sqrt{2}} = \frac{11}{\sqrt{2}} = 7.779 \text{ A}$$

$$\tan\phi = \frac{X_L - X_C}{R} = \frac{45-25}{20} = 1$$

f = 45°

12. A wire of resistance R is cut into 8 equal pieces. From these pieces two equivalent resistances are made by adding four of these together in parallel. Then these two sets are added in series. The net effective resistance of the combination is:

(1) $\frac{R}{8}$ (2) $\frac{R}{64}$

(3) $\frac{R}{32}$ (4) $\frac{R}{16}$

Answer (4)

Sol. After being cut into 8 equal pieces,

$\Rightarrow$ Resistance of each piece = $R' = \frac{R}{8}$

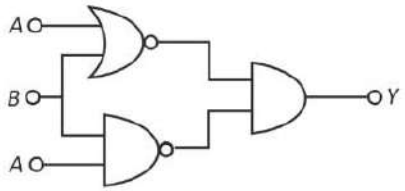
Each set has 4 pieces in parallel combination

$\Rightarrow$ Resistance of each set = $R'' = \frac{R'}{4} = \frac{R}{32}$

Both sets are connected in series

$\therefore \quad R_{eq} = R'' + R'' = 2 \times \frac{R}{32} = \frac{R}{16}$

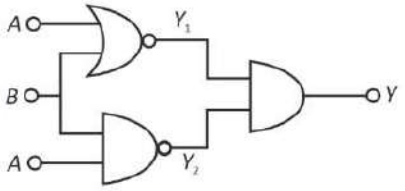
13. The output (Y) of the given logic implementation is similar to the output of an/a _____ gate.



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

Answer (1)

Sol.



$Y_1 = \overline{A+B}$

$Y_2 = \overline{A \cdot B}$

$Y = Y_1 \cdot Y_2$

$= \overline{A+B} \cdot \overline{A \cdot B}$

$= \overline{(A+B) + A \cdot B}$

$= \overline{A + B(1+A)}$

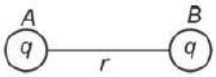
$= \overline{A+B}$ NOR gate

14. Two identical charged conducting spheres A and B have their centres separated by a certain distance. Charge on each sphere is q and the force of repulsion between them is F. A third identical uncharged conducting sphere is brought in contact with sphere A first and then with B and finally removed from both. New force of repulsion between spheres A and B (Radii of A and B are negligible compared to the distance of separation so that for calculating force between them they can be considered as point charges) is best given as:

(1) $\frac{3F}{8}$
(2) $\frac{3F}{5}$
(3) $\frac{2F}{3}$
(4) $\frac{F}{2}$

Answer (1)

Sol.



$$F = \frac{Kqq}{r^2}$$

$$F' = \frac{K\frac{q}{2}\frac{3q}{4}}{r^2}$$

$$F' = \frac{3F}{8}$$

15. Consider the diameter of a spherical object being measured with the help of a Vernier callipers. Suppose its 10 Vernier Scale Divisions (V.S.D.) are equal to its 9 Main Scale Divisions (M.S.D.). The least division in the M.S. is 0.1 cm and the zero of V.S. is at $x = 0.1$ cm when the jaws of Vernier callipers are closed.
If the main scale reading for the diameter is $M = 5$ cm and the number of coinciding vernier division is 8, the measured diameter after zero error correction, is

(1) 5.00 cm
(2) 5.18 cm
(3) 5.08 cm
(4) 4.98 cm

Answer (4)

Sol. Least count = 1MSD – 1VSD

$$= 1\text{MSD} - \frac{9}{10}\text{MSD} = \frac{1}{10}\text{MSD}$$

$$= \frac{1}{10} \times 0.1\text{ cm} = 0.01\text{ cm}$$

Zero error = +0.1 cm
Main scale reading = 5 cm
Vernier scale reading = 8 × 0.01 = 0.08 cm
Final measurement of diameter
= 5 + 0.08 – 0.1 = 4.98 cm

16. In some appropriate units, time (t) and position (x) relation of a moving particle is given by $t = x^2 + x$. The acceleration of the particle is

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

Answer (3)

Sol. $t = x^2 + x$

$$\frac{dt}{dx} = 2x + 1$$

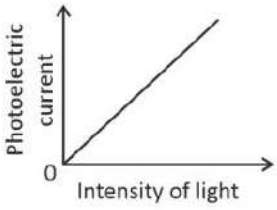
$$v = \frac{dx}{dt} = \frac{1}{(2x+1)}$$

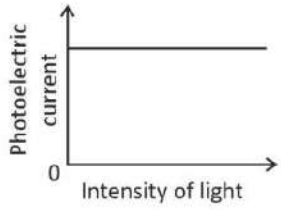
$$\frac{dv}{dx} = \frac{-2}{(2x+1)^2}$$

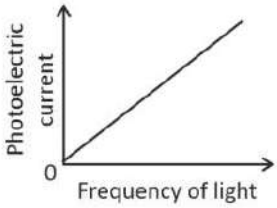
$$a = v\frac{dv}{dx} = \frac{1}{(2x+1)}\left[\frac{-2}{(2x+1)^2}\right]$$

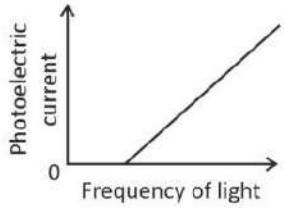
$$= -\frac{2}{(2x+1)^3}$$

17. Which of the following options represent the variation of photoelectric current with property of light shown on the x-axis?

A. 

B. 

C. 

D. 

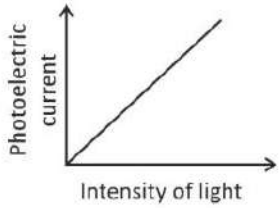
(1) B and D

(2) A only

(3) A and C

(4) A and D

Answer (2)

Sol. 

Photoelectric current is directly proportional to intensity of light.

18. A particle of mass m is moving around the origin with a constant force F pulling it towards the origin. If Bohr model is used to describe its motion, the radius of the nth orbit and the particle's speed v in the orbit depend on n as

(1) $r \propto n^{4/3}$; $v \propto n^{-1/3}$

(2) $r \propto n^{1/3}$; $v \propto n^{1/3}$

(3) $r \propto n^{1/3}$; $v \propto n^{2/3}$

(4) $r \propto n^{2/3}$; $v \propto n^{1/3}$

Answer (4)

Sol. Given, force is constant

$$F = \frac{mv^2}{r}$$

$$\Rightarrow \quad \frac{v^2}{r} = \text{constant}$$

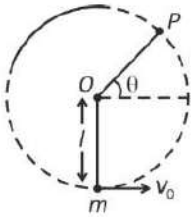
$$\Rightarrow \quad r \propto v^2 \qquad ...(1)$$

$$\& \quad L = mvr = \frac{nh}{2\pi} \qquad ...(2)$$

$\Rightarrow$ on solving equation (1) and equation (2)

$v \propto n^{1/3}$ and $r \propto n^{2/3}$

19. A bob of heavy mass m is suspended by a light string of length l. The bob is given a horizontal velocity v_0 as shown in figure. If the string gets slack at some point P making an angle θ from the horizontal, the ratio of the speed v of the bob at point P to its initial speed v_0 is:



(1) $\left(\dfrac{\sin\theta}{2+3\sin\theta}\right)^{\frac{1}{2}}$

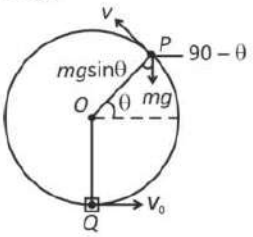
(2) $(\sin\theta)^{\frac{1}{2}}$

(3) $\left(\dfrac{1}{2+3\sin\theta}\right)^{\frac{1}{2}}$

(4) $\left(\dfrac{\cos\theta}{2+3\sin\theta}\right)^{\frac{1}{2}}$

Answer (1)

Sol.



At Point *P*, $mg\sin\theta = \dfrac{mv^2}{l}$ ...(1)

By conservation of mechanical energy at point $P \in Q$

$$\frac{1}{2}mv_0^2 = \frac{1}{2}mv^2 + mg(l + l\sin\theta)$$

$$\frac{v_0^2}{2} = \frac{v^2}{2} + gl(1+\sin\theta)$$

Put $gl = \dfrac{v^2}{\sin\theta}$ using (1)

$$\frac{v_0^2}{2} = \frac{v^2}{2} + \frac{v^2}{\sin\theta}(1+\sin\theta)$$

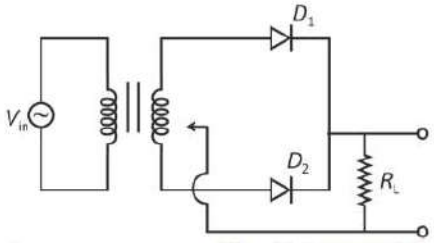
$$\frac{v_0^2}{2} = \frac{v^2}{2} + \frac{v^2}{\sin\theta} + v^2$$

$$\frac{v_0^2}{2} = \frac{3}{2}v^2 + \frac{2v^2}{2\sin\theta}$$

$$v_0^2 = v^2\left[3 + \frac{2}{\sin\theta}\right]$$

$$\frac{v}{v_0} = \left(\frac{\sin\theta}{3\sin\theta+2}\right)^{\frac{1}{2}}$$

20. A full wave rectifier circuit with diodes (D_1) and (D_2) is shown in the figure. If input supply voltage $V_{in} = 220\sin(100\pi t)$ volt, then at $t = 15$ msec



(1) D_1 and D_2 both are reverse biased
(2) D_1 is forward biased, D_2 is reverse biased
(3) D_1 is reverse biased, D_2 is forward biased.
(4) D_1 and D_2 both are forward biased

Answer (3)

Sol. $V_{in} = 220\sin(100\pi t)$ volt

$t = 15$ ms

$t = 0.015$ s

$\omega = 100\pi$

$$\frac{2\pi}{T} = 100\pi$$

$$T = \frac{1}{50}\text{ s}$$

$T = 0.02$ s

$$\therefore\ t = \frac{3T}{4}$$

i.e. negative half cycle.

So now negative half cycle is fed to circuit making D_1 as reverse biased and D_2 as forward biased.

21. A balloon is made of a material of surface tension S and its inflation outlet (from where gas is filled in it) has small area A. It is filled with a gas of density ρ and takes a spherical shape of radius R. When the gas is allowed to flow freely out of it, its radius r changes from R to 0 (zero) in time T. If the speed $v(r)$ of gas coming out of the balloon depends on r as r^a and $T \propto S^\alpha A^\beta \rho^\gamma R^\delta$ then

(1) $a = \frac{1}{2}, \alpha = \frac{1}{2}, \beta = -\frac{1}{2}, \gamma = \frac{1}{2}, \delta = \frac{7}{2}$
(2) $a = \frac{1}{2}, \alpha = \frac{1}{2}, \beta = -1, \gamma = +1, \delta = \frac{3}{2}$
(3) $a = -\frac{1}{2}, \alpha = -\frac{1}{2}, \beta = -1, \gamma = -\frac{1}{2}, \delta = \frac{5}{2}$
(4) $a = -\frac{1}{2}, \alpha = -\frac{1}{2}, \beta = -1, \gamma = \frac{1}{2}, \delta = \frac{7}{2}$

Answer (4)

Sol. $T \propto S^\alpha A^\beta \rho^\gamma R^\delta$

$M^0L^0T^1 = K(MT^{-2})^\alpha (L^2)^\beta (ML^{-3})^\gamma L^\delta$

$M^0L^0T^1 = K[M^{\alpha+\gamma}L^{2\beta-3\gamma+\delta}T^{-2\alpha}]$

$-2\alpha = 1 \quad \alpha = -\frac{1}{2}$

$\alpha + \gamma = 0 \quad \gamma = \frac{1}{2}$

$2\beta - 3\gamma + \delta = 0$

$2\beta - 3\left(\frac{1}{2}\right) + \delta = 0$

By hit and trial (using option (1))

Put $\beta = -1$

$2(-1) - \frac{3}{2} + \delta = 0 \quad \therefore \delta = \frac{7}{2}$

22. A microscope has an objective of focal length 2 cm, eyepiece of focal length 4 cm and the tube length of 40 cm. If the distance of distinct vision of eye is 25 cm, the magnification in the microscope is

(1) 250 (2) 100

(3) 125 (4) 150

Answer (3)

Sol. $m = \frac{L}{f_o} \times \frac{D}{f_e}$

$= \frac{40}{2} \times \frac{25}{4}$

$m = 125$

23. Two identical point masses P and Q, suspended from two separate massless springs of spring constants k_1 and k_2, respectively, oscillate vertically. If their maximum speeds are the same, the ratio (A_Q/A_P) of the amplitude A_Q of mass Q to the amplitude A_P of mass P is

(1) $\sqrt{\frac{k_1}{k_2}}$ (2) $\frac{k_2}{k_1}$

(3) $\frac{k_1}{k_2}$ (4) $\sqrt{\frac{k_2}{k_1}}$

Answer (1)

Sol. Maximum velocity $V = A\omega$

$v_P = v_Q$

$A_P\omega_P = A_Q\omega_Q$

$\frac{A_Q}{A_P} = \frac{\omega_P}{\omega_Q}$ $\left(\omega = \sqrt{\frac{k}{m}}\right)$

$= \sqrt{\frac{k_P}{m_P}\frac{m_Q}{k_Q}}$

$= \sqrt{\frac{k_1}{k_2}}$

24. A parallel plate capacitor made of circular plates is being charged such that the surface charge density on its plates is increasing at a constant rate with time. The magnetic field arising due to displacement current is:

(1) Zero between the plates and non-zero outside

(2) Zero at all places

(3) Constant between the plates and zero outside the plates

(4) Non-zero everywhere with maximum at the imaginary cylindrical surface connecting peripheries of the plates

Answer (4)

Sol. Let the surface charge density be $\sigma = \frac{q}{A}$

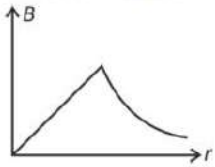
Given $\frac{d\sigma}{dt}$ = constant

$\therefore \frac{d}{dt}\left(\frac{q}{A}\right)$ = constant $\Rightarrow \frac{I}{A}i$ = constant

It means displacement current is constant.

This system will act like a cylindrical wire.

The graph of magnetic field (B) vs r is



25. An electric dipole with dipole moment 5×10^{-6} Cm is aligned with the direction of a uniform electric field of magnitude 4×10^5 N/C. The dipole is then rotated through an angle of 60° with respect to the electric field. The change in the potential energy of the dipole is:

(1) 1.5 J
(2) 0.8 J
(3) 1.0 J
(4) 1.2 J

Answer (3)

Sol. Given

$$|\vec{P}| = 5\times10^{-6}\ \text{C m}$$

$$|\vec{E}| = 4\times10^{5}\ \text{N/C}$$

$\theta_i = 0°$ and $\theta_f = 60°$

$\Delta U = U_f - U_i$

$= -PE\cos\theta_f + PE\cos\theta_i$

$= PE[\cos\theta_i - \cos\theta_f]$

$= 5 \times 10^{-6} \times 4 \times 10^5 \left[1 - \frac{1}{2}\right)$

$= 10 \times 10^{-6} \times 10^5 = 1$ J

26. There are two inclined surfaces of equal length (L) and same angle of inclination 45° with the horizontal. One of them is rough and the other is perfectly smooth. A given body takes 2 times as much time to slide down on rough surface than on the smooth surface. The coefficient of kinetic friction (μ_k) between the object and the rough surface is close to

(1) 0.75
(2) 0.25
(3) 0.40
(4) 0.5

Answer (1)

Sol. $t_{rough} = 2t_{smooth}$

$a_{smooth} = g\sin\theta$

$$t \propto \frac{1}{\sqrt{a}} \Rightarrow t_{smooth} \propto \frac{1}{\sqrt{g\sin\theta}}$$

$a_{rough} = g\sin\theta - \mu_k g\cos\theta$

$$\frac{t_{rough}}{t_{smooth}} = \frac{\sqrt{\sin\theta}}{\sqrt{\sin\theta - \mu_k\cos\theta}} = 2$$

Squaring both sides

$$\frac{\sin\theta}{\sin\theta - \mu_k\cos\theta} = 4 \Rightarrow \frac{\frac{1}{\sqrt{2}}}{\frac{1}{\sqrt{2}} - \mu_k \times \frac{1}{\sqrt{2}}} = 4$$

$$\Rightarrow 1 - \mu_k = \frac{1}{4}$$

$$\mu_k = \frac{3}{4}$$

$= 0.75$

27. De-Broglie wavelength of an electron orbiting in the $n = 2$ state of hydrogen atom is close to (Given Bohr radius = 0.052 nm)

(1) 2.67 nm
(2) 0.067 nm
(3) 0.67 nm
(4) 1.67 nm

Answer (3)

Sol. $r = 0.052\ n^2$

For $n = 2$

$r = 0.052 \times 4$

$= 0.208$ nm

$$Mvr = \frac{nh}{2\pi}$$

$$\lambda = \frac{h}{Mv} = \pi r$$

$= 3.14 \times 0.208$ nm

$= 0.65317$ nm

≈ 0.67 nm

28. The Sun rotates around its centre once in 27 days. What will be the period of revolution if the Sun were to expand to twice its present radius without any external influence? Assume the Sun to be a sphere of uniform density.

(1) 108 days
(2) 100 days
(3) 105 days
(4) 115 days

Answer (1)

Sol. Assuming the Sun to be a solid sphere, $I = \frac{2}{5}mR^2$

Using conservation of angular momentum, $I'\omega' = I\omega$

$$\Rightarrow \frac{2}{5}m(2R)^2 \times \frac{2\pi}{T'} = \frac{2}{5}mR^2 \times \frac{2\pi}{T}$$

$\Rightarrow T' = 4T = 4 \times 27 = 108$ days

29. A physical quantity P is related to four observations a, b, c and d as follows:

$$P = a^3b^2 / c\sqrt{d}$$

The percentage errors of measurement in a, b, c and d are 1%, 3%, 2%, and 4% respectively. The percentage error in the quantity P is

(1) 15%
(2) 10%
(3) 2%
(4) 13%

Answer (4)

Sol. Maximum % error in $P = \frac{\Delta P}{P} \times 100 = 3\left(\frac{\Delta a}{a} \times 100\right) + 2\left(\frac{\Delta b}{b} \times 100\right) + \left(\frac{\Delta c}{c} \times 100\right) + \frac{1}{2}\left(\frac{\Delta d}{d} \times 100\right)$

$$= 3 \times (1) + 2 \times (3) + (2) + \frac{1}{2} \times (4)$$

$= 13\%$

30. The plates of a parallel plate capacitor are separated by d. Two slabs of different dielectric constant K_1 and K_2 with thickness $\frac{3}{8}d$ and $\frac{d}{2}$, respectively are inserted in the capacitor. Due to this, the capacitance becomes two times larger than when there is nothing between the plates.

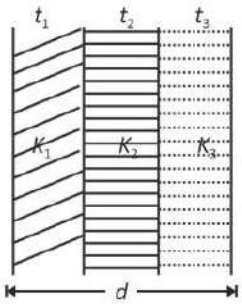
If $K_1 = 1.25\ K_2$, the value of K_1 is:

(1) 1.33 (2) 2.66

(3) 2.33 (4) 1.60

Answer (2)

Sol.



Using $C_{eq} = \dfrac{\varepsilon_0 A}{\dfrac{t_1}{K_1} + \dfrac{t_2}{K_2} + \dfrac{t_3}{K_3}}$

here $C_0 = \dfrac{\varepsilon_0 A}{d}, t_1 = \dfrac{3d}{8}, t_2 = \dfrac{d}{2}, t_3 = \dfrac{d}{8}$

$K_1 = K_1,\ \ K_2 = \dfrac{K_1}{1.25}$ and $K_3 = 1$

Given $C_{eq} = 2C_0$

$$\Rightarrow 2C_0 = \frac{\varepsilon_0 A}{\dfrac{3d}{8K_1} + \dfrac{d \times 1.25}{2K_1} + \dfrac{d}{8}}$$

$$\Rightarrow \frac{2\varepsilon_0 A}{d} = \frac{\varepsilon_0 A}{\dfrac{3d}{8K_1} + \dfrac{d}{2K_1} \times \dfrac{5}{4} + \dfrac{d}{8}}$$

$$\Rightarrow 2 = \frac{1}{\dfrac{3}{8K_1} + \dfrac{5}{8K_1} + \dfrac{1}{8}} \Rightarrow K_1 = \frac{8}{3} = 2.66$$

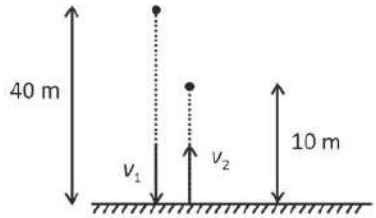
31. A ball of mass 0.5 kg is dropped from a height of 40 m. The ball hits the ground and rises to a height of 10 m. The impulse imparted to the ball during its collision with the ground is (Take $g = 9.8\ m/s^2$)

(1) 84 NS (2) 21 NS

(3) 7 NS (4) 0

Answer (2)

Sol.



$v_1 = \sqrt{2gh_1}$

$= \sqrt{2 \times 9.8 \times 40}$

$v_1 = \sqrt{784} = 28\ \text{m s}^{-1}$

and $v_2 = \sqrt{2gh_2} = \sqrt{2 \times 9.8 \times 10}$

$= \sqrt{196} = 14\ \text{m s}^{-1}$

Impulse $= \Delta\vec{p} = m\left(\vec{v}_f - \vec{v}_i\right) = m\left(\vec{v}_2 - \vec{v}_1\right)$

$= \frac{1}{2}(14 - (-28))$

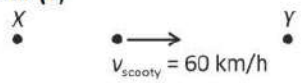
= 21 NS

32. Two cities X and Y are connected by a regular bus service with a bus leaving in either direction every T min. A girl is driving scooty with a speed of 60 km/h in the direction X to Y notices that a bus goes past her every 30 minutes in the direction of her motion, and every 10 minutes in the opposite direction. Choose the correct option for the period T of the bus service and the speed (assumed constant) of the buses.

(1) 15 min, 120 km/h
(2) 9 min, 40 km/h
(3) 25 min, 100 km/h
(4) 10 min, 90 km/h

Answer (1)

Sol.



$X \to Y$

Let velocity of bus = v km/hr

Relative velocity of bus w.r.t. scooty = $(v - 60)$

Distance between 2 consecutive buses = vT

$(v - 60)30 = vT$ ...(i)

$Y \to X$

$(v + 60)10 = vT$ ...(ii)

Equating (1) and (2)

$(v - 60)30 = (v + 60)10$

$\therefore\ v = 120$ km/hr

$T = 15$ min

33. An oxygen cylinder of volume 30 litre has 18.20 moles of oxygen. After some oxygen is withdrawn from the cylinder, its gauge pressure drops to 11 atmospheric pressures at temperature 27°C. The mass of the oxygen withdrawn from the cylinder is nearly equal to:

[Given, $R = \frac{100}{12}\ \text{J mol}^{-1}\text{K}^{-1}$, and molecular mass of O_2 = 32, 1 atm pressure = 1.01×10^5 N/m]

(1) 0.156 kg
(2) 0.125 kg
(3) 0.144 kg
(4) 0.116 kg

Answer (4)

Sol. Number of moles left

$$n = \frac{PV}{RT} = \frac{12 \times 1.01 \times 10^5 \text{N/m}^2 \times 30 \times 10^{-3} \text{m}^3}{\frac{100}{12} \times 300}$$

$$n = \frac{12 \times 1.01 \times 12}{10} = 14.54 \text{ moles}$$

Moles removed = 18.2 – 14.54

= 3.656 moles

Mass removed = 3.656 × 32 = 116.99 g = 0.116 kg

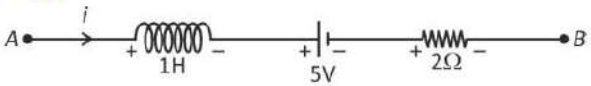
34. *AB* is a part of an electrical circuit (see figure). The potential difference "$V_A - V_B$", at the instant when current i = 2 A and is increasing at a rate of 1 amp/second is:

(1) 10 volt (2) 5 volt

(3) 6 volt (4) 9 volt

Answer (1)

Sol.



Given, I = 2A and $\frac{di}{dt} = +1\text{A/s}$

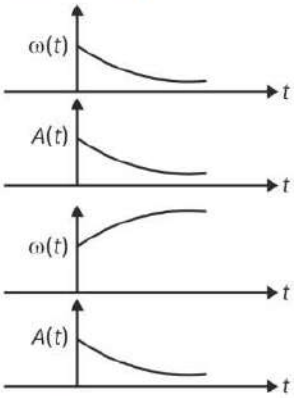
$$V_A - L\frac{di}{dt} - 5 - i \times 2 = V_B$$

$\Rightarrow$ $V_A - 1 \times 1 - 5 - 2 \times 2 = V_B$

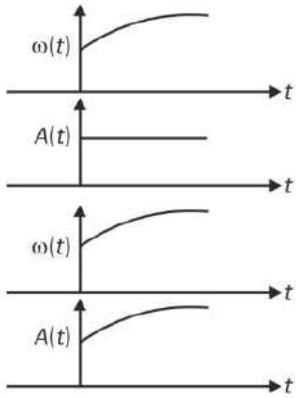
$\Rightarrow$ $V_A - V_B = 10$ volt

35. In an oscillating spring mass system, a spring is connected to a box filled with sand. As the box oscillates, sand leaks slowly out of the box vertically so that the average frequency $\omega(t)$ and average amplitude $A(t)$ of the system change with time t. Which one of the following options schematically depicts these changes correctly?

(1)



(2)



(3)

(4)

Answer (3)

Sol. At any point of time, time period is given by

$$T = 2\pi\sqrt{\frac{m}{k}}$$

Here m is decreasing, so time period T will be decreasing

Since $\omega = \frac{2\pi}{T}$

Hence as mass leaks, ω will increase

Now, at any instant

$mg = kx_0$

So, equilibrium length $x_0 = \frac{mg}{k}$, where m is decreasing

So, equilibrium length will decrease.

So, amplitude also go on decreasing.

36. A model for quantized motion of an electron in a uniform magnetic field B states that the flux passing through the orbit of the electron is $n(hle)$ where n is an integer, h is Planck's constant and e is the magnitude of electron's charge. According to the model, the magnetic moment of an electron in its lowest energy state will be (m is the mass of the electron)

(1) $\frac{heB}{2\pi m}$ (2) $\frac{he}{\pi m}$

(3) $\frac{he}{2\pi m}$ (4) $\frac{heB}{\pi m}$

Answer (3)

Sol. Magnetic force = $\frac{mv^2}{r}$

$$evB = \frac{mv^2}{r}$$

$$v = \frac{eBr}{m}$$

$$\phi = BA$$

$$\frac{nh}{e} = B\pi r^2$$

$$Br^2 = \frac{nh}{e\pi}$$

$$\mu = IA$$

$$= \frac{e}{T}\pi r^2$$

$$= \frac{e \times v}{2\pi r}\pi r^2$$

$$\mu = \frac{evr}{2}$$

$$= \frac{1}{2}e \times \frac{eBr}{m}r$$

$$\mu = \frac{1}{2}e^2\frac{Br^2}{m}$$

$$\mu = \frac{1}{2}e^2\frac{nh}{e\pi m}$$

$$\mu = \frac{neh}{2\pi m}$$

for $n = 1$

$$\mu = \frac{eh}{2\pi m}$$

37. A body weighs 48 N on the surface of the earth. The gravitational force experienced by the body due to the earth at a height equal to one-third the radius of the earth from its surface is :

(1) 36 N
(2) 16 N
(3) 27 N
(4) 32 N

Answer (3)

Sol. $W = mg$ and $g = \frac{GM}{R^2}$, $g_h = \frac{GM}{(R+h)^2}$

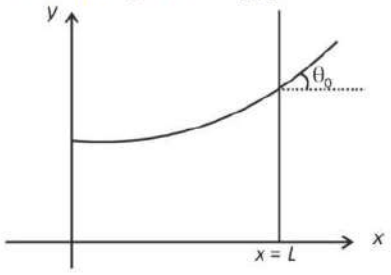
$$\Rightarrow \frac{W_h}{W} = \frac{mg_h}{mg} = \frac{g_h}{g} = \frac{R^2}{(R+h)^2} \quad \left(h = \frac{R}{3}\right)$$

$$\Rightarrow \frac{W_h}{W} = \frac{R^2}{\left(R+\frac{R}{3}\right)^2} = \frac{R^2}{\left(\frac{4R}{3}\right)^2} = \frac{9}{16}$$

$$\Rightarrow W_h = \frac{9}{16}W = \frac{9}{16} \times 48 \quad [W = 48\text{ N}]$$

$$= 27\text{ N}$$

38. Consider a water tank shown in the figure. It has one wall at $x = L$ and can be taken to be very wide in the z direction. When filled with a liquid of surface tension S and density ρ, the liquid surface makes angle θ_0 ($\theta_0 << 1$) with the x-axis at $x = L$. If $y(x)$ is the height of the surface then the equation for $y(x)$ is:

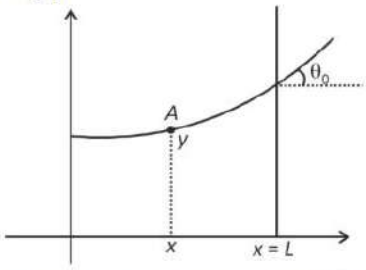


(take $\theta(x) = \sin\theta(x) = \tan\theta(x) = \frac{dy}{dx}$, g is the acceleration due to gravity)

(1) $\frac{dy}{dx} = \sqrt{\frac{\rho g}{S}}x$
(2) $\frac{d^2y}{dx^2} = \frac{\rho g}{S}x$
(3) $\frac{d^2y}{dx^2} = \frac{\rho g}{S}y$
(4) $\frac{d^2y}{dx^2} = \sqrt{\frac{\rho g}{S}}$

Answer (3)

Sol.



ROC = Radius of curvature at point A

$$\text{Curvature} = \frac{1}{ROC} = \frac{\left|\frac{d^2y}{dx^2}\right|}{\left(1+\left(\frac{dy}{dx}\right)^2\right)^{\frac{3}{2}}} = \frac{\left|\frac{d^2y}{dx^2}\right|}{(1+0)^{\frac{3}{2}}} = \frac{d^2y}{dx^2} \qquad \left[\because \frac{dy}{dx} = \tan\theta \simeq 0\right]$$

$\Delta P = S \times \text{curvature}$

$$\Rightarrow \rho g y = S\frac{d^2y}{dx^2}$$

$$\therefore \frac{d^2y}{dx^2} = \frac{\rho g y}{S}$$

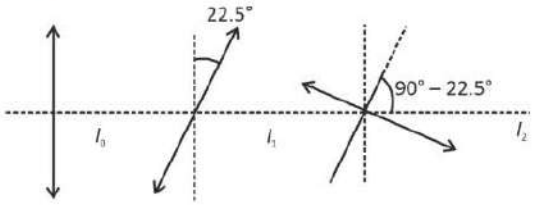
39. The intensity of transmitted light when a polaroid sheet, placed between two crossed polaroids at 22.5° from the polarization axis of one of the polaroids, is (I_0 is the intensity of polarised light after passing through the first polaroid):

(1) $\frac{I_0}{16}$ (2) $\frac{I_0}{2}$

(3) $\frac{I_0}{4}$ (4) $\frac{I_0}{8}$

Answer (4)

Sol.



$$I_1 = I_0\cos^2\left(\frac{45}{2}\right)$$

$$I_2 = I_1\cos^2\left(90 - \frac{45}{2}\right)$$

$$= I_0\cos^2\left(\frac{45}{2}\right)\sin^2\left(\frac{45}{2}\right)$$

$$= \frac{I_0}{4}\left(4\cos^2\left(\frac{45}{2}\right)\sin^2\left(\frac{45}{2}\right)\right)$$

$$= \frac{I_0}{4}\sin^2 45^\circ = \frac{I_0}{8}$$

40. A photon and an electron (mass m) have the same energy E. The ratio ($\lambda_{photon}/\lambda_{electron}$) of their de Broglie wavelengths is: (c is the speed of light)

(1) $\frac{1}{c}\sqrt{E/2m}$ (2) $\sqrt{E/2m}$

(3) $c\sqrt{2mE}$ (4) $c\sqrt{\frac{2m}{E}}$

Answer (4)

Sol. For photon, $E = \frac{hc}{\lambda_{Ph}} \Rightarrow \lambda_{Ph} = \frac{hc}{E}$

For electron, p = momentum and $E = \frac{p^2}{2m} = \left(\frac{h}{\lambda_e}\right)^2 \times \frac{1}{2m}$

$\Rightarrow \lambda_e = \frac{h}{\sqrt{2mE}}$

$\therefore \frac{\lambda_{Ph}}{\lambda_e} = \frac{\frac{hc}{E}}{\frac{h}{\sqrt{2mE}}} = c\sqrt{\frac{2m}{E}}$

41. An unpolarized light beam travelling in air is incident on a medium of refractive index 1.73 at Brewster's angle. Then

(1) Transmitted light is completely polarized with angle of refraction close to 30°

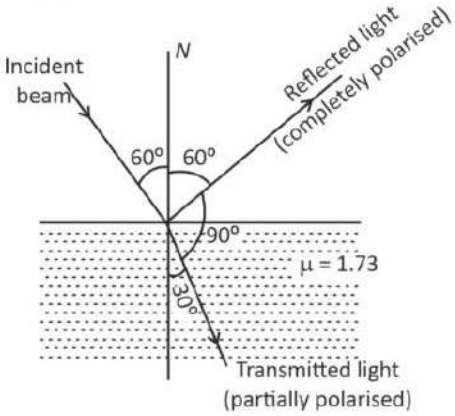
(2) Reflected light is completely polarized and the angle of reflection is close to 60°

(3) Reflected light is partially polarized and the angle of reflection is close to 30°

(4) Both reflected and transmitted light are perfectly polarized with angles of reflection and refraction close to 60° and 30°, respectively

Answer (2)

Sol. Using Brewster law



$\mu = \tan\theta_P$

$\Rightarrow 1.73 = \tan\theta_P$

$\Rightarrow \sqrt{3} = \tan\theta_P$

$\Rightarrow \theta_P = 60°$

At this polarising angle, reflected light is perfectly polarized and transmitted light is partially polarised.

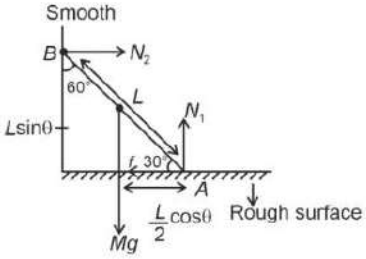
42. A uniform rod of mass 20 kg and length 5 m leans against a smooth vertical wall making an angle of 60° with it. The other end rests on a rough horizontal floor. The friction force that the floor exerts on the rod is (Take g = 10 m/s^2)

(1) $200\sqrt{3}$ N (2) 100 N

(3) $100\sqrt{3}$ N (4) 200 N

Answer (3)

Sol.



For translational equilibrium

$N_1 = Mg$

$N_2 = f$

For rotational equilibrium

Torque about A, $Mg\frac{L}{2}\cos\theta = N_2 L\sin\theta$

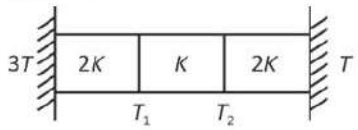
$$\frac{Mg}{2}\cot\theta = N_2 = f$$

$$\frac{Mg}{2}\cot 30^\circ = f$$

$$\frac{Mg}{2}\sqrt{3} = N_2$$

$$100\sqrt{3} = f$$

43. Three identical heat conducting rods are connected in series as shown in the figure. The rods on the sides have thermal conductivity $2K$ while that in the middle has thermal conductivity K. The left end of the combination is maintained at temperature $3T$ and the right end at T. The rods are thermally insulated from outside. In steady state, temperature at the left junction is T_1 and that at the right junction is T_2. The ratio T_1/T_2 is



(1) $\frac{5}{4}$ (2) $\frac{3}{2}$

(3) $\frac{4}{3}$ (4) $\frac{5}{3}$

Answer (4)

Sol. In series, $R_{eq.} = R_1 + R_2 + R_3$

$$= \frac{l}{2KA} + \frac{l}{KA} + \frac{l}{2KA}$$

$$= \frac{4l}{2KA}$$

$$R_{eq.} = \frac{2l}{KA}$$

In series rate of heat flow is same

$$\therefore \quad \frac{3T - T_1}{R_1} = \frac{3T - T}{R_{eq.}}$$

$$\frac{(3T - T_1)2KA}{l} = \frac{(2T)KA}{2l}$$

$$\Rightarrow \quad 6T - 2T_1 = T$$

$$\Rightarrow \quad 2T_1 = 5T$$

$$\Rightarrow \quad T_1 = \frac{5T}{2} \quad ...(1)$$

Now, equate heat flow rate in 3rd section & total section

$$\frac{T_2 - T}{R_3} = \frac{3T - T}{R_{eq.}}$$

$$\Rightarrow \quad \frac{(T_2 - T)(2KA)}{l} = \frac{2T(KA)}{2l}$$

$$\Rightarrow \quad 2T_2 - 2T = T$$

$$\Rightarrow \quad T_2 = \frac{3T}{2} \quad ...(2)$$

By equation (1) and equation (2)

$$\frac{T_1}{T_2} = \frac{5T \times 2}{2 \times 3T} = \frac{5}{3}$$

44. The kinetic energies of two similar cars A and B are 100 J and 225 J respectively. On applying breaks, car A stops after 1000 m and car B stops after 1500 m. If F_A and F_B are the forces applied by the breaks on cars A and B respectively, then the ratio of $\frac{F_A}{F_B}$ is

(1) $\frac{1}{2}$ (2) $\frac{3}{2}$

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

Answer (3)

Sol. By work-energy theorem,

$$FS = \Delta K \cdot E$$

$$\Rightarrow \quad -FS = k_f - k_i$$

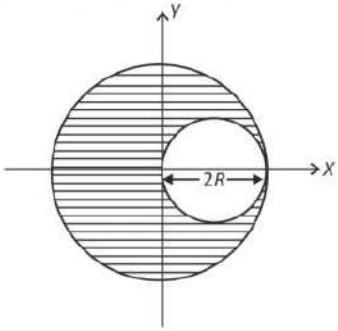
$$\Rightarrow \quad FS = k_i - k_f$$

$$\Rightarrow \quad \frac{F_A}{F_B} = \frac{k_A}{k_B} \times \frac{S_B}{S_A}$$

$$= \frac{100}{225} \times \frac{1500}{1000}$$

$$= \frac{150}{225} = \frac{2}{3}$$

45. A sphere of radius R is cut from a larger solid sphere of radius $2R$ as shown in the figure. The ratio of the moment of inertia of the smaller sphere to that of the rest part of the sphere about the Y-axis is:



(1) $\frac{7}{64}$

(2) $\frac{7}{8}$

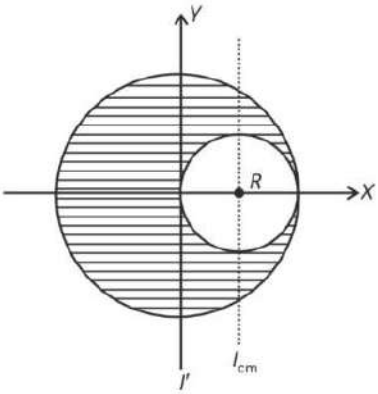
(3) $\frac{7}{40}$

(4) $\frac{7}{57}$

Answer (4)

Sol. For larger solid sphere about diameter Y-axis,

$$I_{\text{whole}} = \frac{2}{5}M(2R)^2 = \frac{8}{5}MR^2$$



Density of sphere is uniform

$$\Rightarrow \frac{M}{V_{\text{whole}}} = \frac{M_{\text{smaller}}}{V_{\text{smaller}}} \Rightarrow \frac{M}{\frac{4}{3}\pi(2R)^3} = \frac{M'}{\frac{4}{3}\pi R^3}$$

$$\Rightarrow M' = \frac{M}{8}$$

Using parallel axis theorem for smaller sphere,

$$I' = I_{cm} + M'R^2 = \frac{2}{5}\frac{MR^2}{8} + \frac{MR^2}{8} = \frac{7}{40}MR^2$$

$$\therefore \text{ Ratio} = \frac{I_{\text{smaller}}}{I_{\text{remaining}}} = \frac{I'}{I_{\text{whole}} - I'} = \frac{\frac{7}{40}MR^2}{\left(\frac{8}{5} - \frac{7}{40}\right)MR^2} = \frac{7}{64-7} = \frac{7}{57}$$

CHEMISTRY

46. If the molar conductivity (Λ_m) of a 0.050 mol L^{-1} solution of a monobasic weak acid is 90 S cm^2 mol^{-1}, its extent (degree) of dissociation will be

[Assume Λ_+° = 349.6 S cm^2 mol^{-1} and Λ_-° = 50.4 S cm^2 mol^{-1}.]

(1) 0.215 (2) 0.115

(3) 0.125 (4) 0.225

Answer (4)

Sol. Degree of dissociation (α) is given as

$$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ}$$

$$\Lambda_m^\circ = \Lambda_+^\circ + \Lambda_-^\circ$$

= 349.6 + 50.4

= 400 S cm^2 mol^{-1}

$$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ} = \frac{90}{400} = 0.225$$

47. Given below are two statements :

Statement I : A hypothetical diatomic molecule with bond order zero is quite stable.

Statement II : As bond order increases, the bond length increases.

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

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

(2) Both Statement I and Statement II are true

(3) Both Statement I and Statement II are false

(4) Statement I is true but Statement II is false

Answer (3)

Sol.
- A positive bond order means a stable molecule while a negative or zero bond order means an unstable molecule.
- When bond order increases, the bond length decreases.

48. The ratio of the wavelengths of the light absorbed by a Hydrogen atom when it undergoes n = 2 → n = 3 and n = 4 → n = 6 transitions, respectively, is

(1) $\frac{1}{4}$ (2) $\frac{1}{36}$

(3) $\frac{1}{16}$ (4) $\frac{1}{9}$

Answer (1)

Sol. $\Delta E = \frac{hc}{\lambda} = E_{final} - E_{initial} \quad \left(E_n = \frac{-R_H}{n^2}\right)$

$$\Delta E_{2\to3} = \frac{hc}{\lambda_{2\to3}} = E_3 - E_2 = \frac{-R_H}{3^2} - \left(\frac{-R_H}{2^2}\right)$$

$$= R_H\left(\frac{1}{4} - \frac{1}{9}\right)$$

$$= R_H \times \frac{5}{36}$$

$$\therefore\ \lambda_{2\to3} = \frac{hc \cdot 36}{R_H \cdot 5}$$

$$\Delta E_{4\to6} = E_6 - E_4 = \frac{-R_H}{36} + \frac{R_H}{16} = \frac{R_H \times 20}{36 \times 16}$$

$$\frac{hc}{\lambda_{4\to6}} = \frac{R_H \times 20}{36 \times 16}$$

$$\lambda_{4\to6} = \frac{hc \times 36 \times 16}{R_H \cdot 20}$$

$$\frac{\lambda_{2\to3}}{\lambda_{4\to6}} = \frac{\frac{hc \cdot 36}{R_H \cdot 5}}{\frac{hc \times 36 \times 16}{R_H \cdot 20}}$$

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

49. The correct order of the wavelength of light absorbed by the following complexes is,

A. $[Co(NH_3)_6]^{3+}$ B. $[Co(CN)_6]^{3-}$

C. $[Cu(H_2O)_4]^{2+}$ D. $[Ti(H_2O)_6]^{3+}$

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

(1) C < A < D < B

(2) B < D < A < C

(3) B < A < D < C

(4) C < D < A < B

Answer (3)

Sol. $\lambda \propto \frac{1}{\text{strength of ligand}}$

$\lambda \propto \frac{1}{\text{splitting}}$

A. $[Co(NH_3)_6]^{3+}$; 475 nm

B. $[Co(CN)_6]^{3-}$; 310 nm

C. $[Cu(H_2O)_4]^{2+}$; 600 nm

D. $[Ti(H_2O)_6]^{3+}$; 498 nm

Order of λ = C > D > A > B

50. If the rate constant of a reaction is 0.03 s^{-1}, how much time does it take for 7.2 mol L^{-1} concentration of the reactant to get reduced to 0.9 mol L^{-1}?

(Given: log 2 = 0.301)

(1) 21.0 s
(2) 69.3 s
(3) 23.1 s
(4) 210 s

Answer (2)

Sol. k = 0.03 s^{-1}

$$t = \frac{2.303}{k}\log\frac{a}{a-x}$$

$$= \frac{2.303}{0.03}\log\frac{7.2}{0.9}$$

$$= \frac{2.303}{0.03}\log 8$$

$$= \frac{2.303}{0.03}\times 3\times\log 2$$

$$= \frac{2.303}{0.03}\times 3\times 0.301$$

= 69.3 s

51. Match **List I** with **List II**

	List-I (Mixture)		**List-II (Method of separation)**
A.	$CHCl_3 + C_6H_5NH_2$	(I)	Distillation under reduced pressure
B.	Crude oil in petroleum industry	(II)	Steam distillation
C.	Glycerol from spent-lye	(III)	Fractional distillation
D.	Aniline - water	(IV)	Simple distillation

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

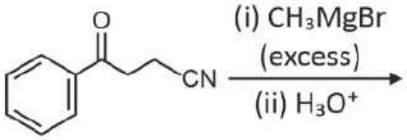
(1) A-III, B-IV, C-II, D-I
(2) A-IV, B-III, C-I, D-II
(3) A-IV, B-III, C-II, D-I
(4) A-III, B-IV, C-I, D-II

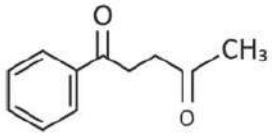
Answer (2)

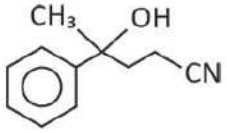
Sol.

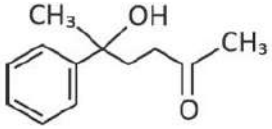
		(Method of separation)
(A)	$CHCl_3 + C_6H_5NH_2$	Simple distillation
(B)	Crude oil in petroleum industry	Fractional distillation
(C)	Glycerol from spent-lye	Distillation under reduced pressure
(D)	Aniline - water	Steam Distillation

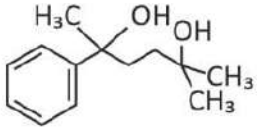
52. The major product of the following reaction is



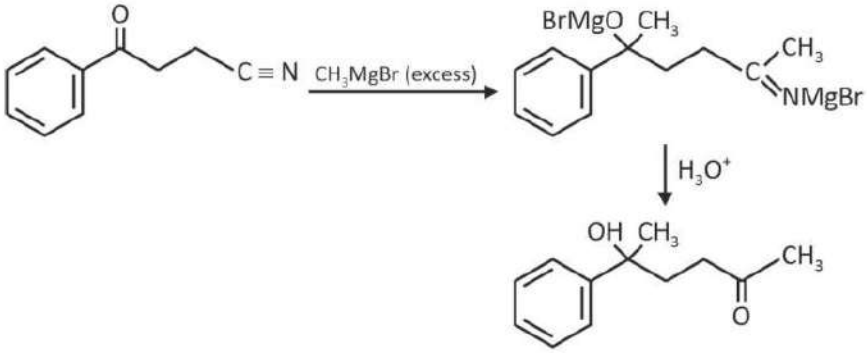
(1) 

(2) 

(3) 

(4) 

Answer (3)

Sol. 

53. Which one of the following compounds can exist as cis-trans isomers?

(1) 1, 2-Dimethylcyclohexane

(2) Pent-1-ene

(3) 2-Methylhex-2-ene

(4) 1, 1-Dimethylcyclopropane

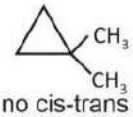
Answer (1)

Sol. Cis-trans isomers shown by :

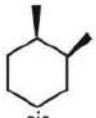
Condition: Restricted rotation around double bond

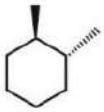
Or

Different group around double bond



no cis-trans


cis


trans

$CH_3 - CH_2 - CH_2 - CH = CH_2$
no cis-trans

$CH_3 - CH_2 - CH_2 - CH = C(CH_3) - CH_3$

no cis-trans

54. Among the following, choose the ones with equal number of atoms.

A. 212 g of $Na_2CO_3(s)$ [molar mass = 106 g]

B. 248 g of $Na_2O(s)$ [molar mass = 62 g]

C. 240 g of NaOH(s) [molar mass = 40 g]

D. 12 g of $H_2(g)$ [molar mass = 2 g]

E. 220 g of $CO_2(g)$ [molar mass = 44 g]

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

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

Answer (3)

Sol. Number of atoms = $\frac{\text{given mass}}{\text{molar mass}} \times \text{atomicity} \times N_A$

A. $\frac{212}{106} \times 6 \times N_A = 12\ N_A$

B. $\frac{248}{62} \times 3 \times N_A = 12\ N_A$

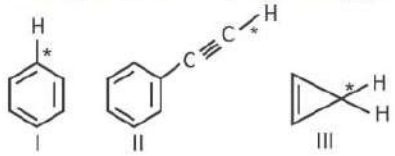
C. $\frac{240}{40} \times 3 \times N_A = 18\ N_A$

D. $\frac{12}{2} \times N_A \times 2 = 12\ N_A$

E. $\frac{220}{44} \times N_A \times 3 = 15\ N_A$

A, B and D have same number of atoms

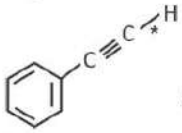
55. Among the given compounds I-III, the correct order of bond dissociation energy of C–H bond marked with * is :



(1) II > III > I
(2) II > I > III
(3) I > II > III
(4) III > II > I

Answer (2)

Sol. I. carbon of this bond is sp^2 hybridised

II.  carbon of this bond is sp hybridised

III. carbon of this bond is sp^3 hybridised

Higher the percentage s character, stronger is C–H bond. Correct order of bond dissociation energy of C–H bond:

II > I > III

56. The standard heat of formation, in kcal/mol of Ba^{2+} is :

[Given : standard heat of formation of SO_4^{2-} ion (aq) = –216 kcal/mol, standard heat of crystallisation of $BaSO_4(s)$ = –4.5 kcal/mol, standard heat of formation of $BaSO_4(s)$ = – 349 kcal/mol]

(1) + 220.5 (2) – 128.5

(3) – 133.0 (4) + 133.0

Answer (2)

Sol. $S + 2O_2 + 2e^- \longrightarrow SO_4^{2-}$ $\Delta H_f = -216$ kcal/mol ...(1)

$Ba^{2+}(g) + SO_4^{2-}(g) \longrightarrow BaSO_4(s)$ $\Delta H_{crystallisation} = -4.5$ kcal/mol ...(2)

$Ba + S + 2O_2 \longrightarrow BaSO_4(s)$ $\Delta H_{f(BaSO_4)} = -349$ kcal/mol ...(3)

$Ba(s) \longrightarrow Ba^{2+}(g) + 2e^-$ ...(4)

From equation (1),(2) and (3) we get equation (4). Applying equation (3) – (1) – (2)

So, –349 – (–4.5) – (–216)

So – 349 + 4.5 + 216

= –349 + 220.5

= – 128.5 kcal/mol

57. Consider the following compounds :

$\underline{K}O_2$, $H_2\underline{O}_2$ and $H_2\underline{S}O_4$

The oxidation state of the underlined elements in them are, respectively,

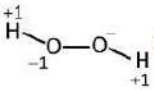
(1) +4, –4, and +6 (2) +1, –1, and +6

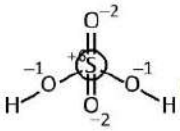
(3) +2, –2, and +6 (4) +1, –2, and +4

Answer (2)

Sol.

KO_2 → Alkali metal always shows +1 oxidation state. Therefore oxidation state of K is +1.

H_2O_2 →  Oxidation state of oxygen in H_2O_2 is –1.

H_2SO_4 →  Oxidation state of sulphur in H_2SO_4 is +6.

58. Out of the following complex compounds, which of the compound will be having the minimum conductance in solution?

(1) $[Co(NH_3)_5Cl]Cl$ (2) $[Co(NH_3)_3Cl_3]$

(3) $[Co(NH_3)_4Cl_2]$ (4) $[Co(NH_3)_6]Cl_3$

Answer (2, 3)

Sol. Conductance of any complex depends on the following factor.

(1) Number of ions produced by complex.

(2) If number of ions are same then we will check charge on complex unit.

(1) $[Co(NH_3)_5Cl]Cl \rightarrow [Co(NH_3)_5Cl]^+ + Cl^-$

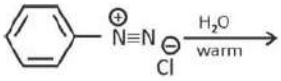
(2) $\left[Co^{+3}(NH_3)_3Cl_3\right]$

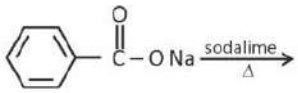
(3) $\left[Co^{+2}(NH_3)_4Cl_2\right]$

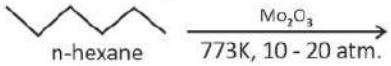
Both complex units have no charge. Therefore both complex units have same conductance.

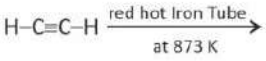
(4) $[Co(NH_3)_6]Cl_3 \rightarrow [Co(NH_3)_6]^{+3} + 3Cl^-$

59. Which one of the following reactions does **NOT** give benzene as the product?

(1) 

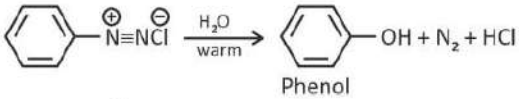
(2) 

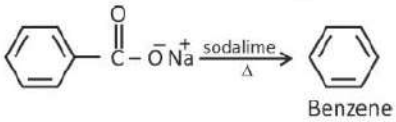
(3) 

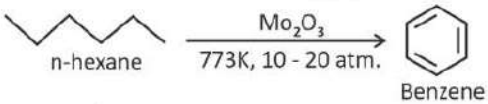
(4) 

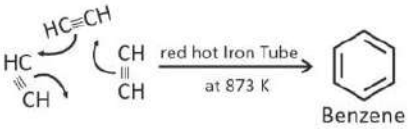
Answer (1)

Sol.

1. 

2. 

3. 

4. 

60. Which of the following are paramagnetic?

A. $[NiCl_4]^{2-}$

B. $Ni(CO)_4$

C. $[Ni(CN)_4]^{2-}$

D. $[Ni(H_2O)_6]^{2+}$

E. $Ni(PPh_3)_4$

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

(1) A, D and E only

(2) A and C only

(3) B and E only

(4) A and D only

Answer (4)

Sol.

A. $[NiCl_4]^{2-}$; Ni^{+2}; $3d^8$; sp^3 hybridisation; 2 unpaired electrons; paramagnetic

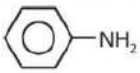
B. $Ni(CO)_4$; Ni; $3d^8\ 4s^2$; sp^3 hybridisation; Zero unpaired electron; diamagnetic

C. $[Ni(CN)_4]^{2-}$; Ni^{+2}; $3d^8$; dsp^2 hybridisation; Zero unpaired electron; diamagnetic

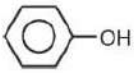
D. $[Ni(H_2O)_6]^{2+}$; Ni^{2+}, $3d^8$; sp^3d^2 hybridisation; Two unpaired electron; paramagnetic

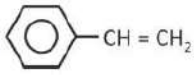
E. $Ni(PPh_3)_4$; Ni; $3d^8\ 4s^2$, sp^3 hybridisation; zero unpaired electron; Diamagnetic

61. Which one of the following compounds **does not** decolourize bromine water?

(1) 

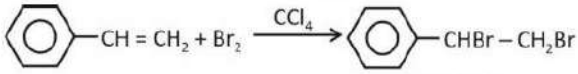
(2)

(3) 

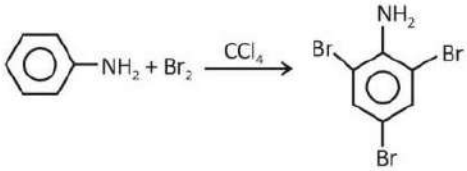
(4) 

Answer (2)

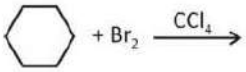
Sol. Test for unsaturation i.e. Bromine water Reddish orange colour of bromine solution in CCl_4 will discharge when bromine adds to an unsaturation site.



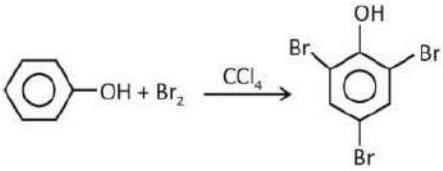
Colour discharge



Colour discharge



No reaction
No discharge of orange colour



Colour discharge

62. Match **List-I** with **List-II**.

	List-I		**List-II**
A.	Haber process	I.	Fe catalyst
B.	Wacker oxidation	II.	$PdCl_2$
C.	Wilkinson catalyst	III.	$[(PPh_3)_3RhCl]$
D	Ziegler catalyst	IV.	$TiCl_4$ with $Al(CH_3)_3$

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

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

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

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

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

Answer (4)

Sol.

	Process		Catalyst used
A.	Haber process	I.	Fe catalyst
B.	Wacker oxidation	II.	$PdCl_2$
C.	Wilkinson catalyst	III.	$[(PPh_3)_3RhCl]$
D	Ziegler catalyst	IV.	$TiCl_4$ with $Al(CH_3)_3$

63. Match **List-I** with **List-II.**

	List-I (Name of Vitamin)		List-II (Deficiency disease)
A.	Vitamin B_{12}	I.	Cheilosis
B.	Vitamin D	II.	Convulsions
C.	Vitamin B_2	III.	Rickets
D.	Vitamin B_6	IV.	Pernicious anaemia

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

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

Answer (3)

Sol.

	List-I (Name of Vitamin)	List-II (Deficiency disease)
A.	Vitamin B_{12}	Pernicious anaemia
B.	Vitamin D	Rickets
C.	Vitamin B_2	Cheilosis
D.	Vitamin B_6	Convulsions

64. Given below are two statements :

Statement I : Ferromagnetism is considered as an extreme form of paramagnetism.

Statement II : The number of unpaired electrons in a Cr^{2+} ion (Z = 24) is the same as that of a Nd^{3+} ion (Z = 60).

In the light of the above statements, choose the **correct** answer from the options given below :

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

Answer (4)

Sol. Substances which are attracted very strongly in applied magnetic field are termed as ferromagnetic. Infact, ferromagnetism is an extreme form of paramagnetism.

Hence statement I is correct.

$Cr^{2+} = 3d^4 4s^0$

Unpaired electrons = 4

$Nd^{3+} = 4f^3\ 6s^0$

Unpaired electrons = 3

Hence, Statement II is incorrect

65. If the half-life ($t_{1/2}$) for a first order reaction is 1 minute, then the time required for 99.9% completion of the reaction is closest to :

(1) 10 minutes (2) 2 minutes

(3) 4 minutes (4) 5 minutes

Answer (1)

Sol. For 1st order reaction

$kt = 2.303 \log \frac{A_0}{A_t}$ A_0 = initial concentration

A_t = Final concentration

$t_{99.9\%} = 10\ t_{1/2}$

$t_{99.9\%} = 10 \times 1$ minute = 10 minutes

66. The correct order of decreasing basic strength of the given amines is:

(1) benzenamine > ethanamine > N-methylaniline > N-ethylethanamine

(2) N-methylaniline > benzenamine > ethanamine > N-ethylethanamine

(3) N-ethylethanamine > ethanamine > benzenamine > N-methylaniline

(4) N-ethylethanamine > ethanamine > N-methylaniline > benzenamine

Answer (4)

Sol. Lower is the value of pK_b, higher is the basicity

Also aliphatic amines are stronger bases than aromatic amines.

pK_b : Benzenamine > N-Methylaniline > Ethanamine > N-Ethylethanamine

Basic strength : N-Ethylethanamine > Ethanamine > N-Methylaniline > Benzenamine

67. Match **List I** with **List II**

	List-I (Ion)		**List-II (Group Number in Cation Analysis)**
A.	Co^{2+}	I.	Group-I
B.	Mg^{2+}	II.	Group-III
C.	Pb^{2+}	III.	Group-IV
D.	Al^{3+}	IV.	Group-VI

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

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

Answer (3)

Sol.

	Ion	Group number in Cation Analysis
A.	Co^{2+}	Group-IV
B.	Mg^{2+}	Group-VI
C.	Pb^{2+}	Group-I
D.	Al^{3+}	Group-III

68. Phosphoric acid ionizes in three steps with their ionization constant values K_{a_1}, K_{a_2} and K_{a_3}, respectively, while K is the overall ionization constant. Which of the following statements are true?

A. $\log K = \log K_{a_1} + \log K_{a_2} + \log K_{a_3}$

B. H_3PO_4 is a stronger acid than $H_2PO_4^-$ and HPO_4^{2-}

C. $K_{a_1} > K_{a_2} > K_{a_3}$

D. $K_{a_1} = \frac{K_{a_3} + K_{a_2}}{2}$

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

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

Answer (1)

Sol. H_3PO_4 is a stronger acid than $H_2PO_4^-$ and HPO_4^{2-}

$H_3PO_4(aq) \rightleftharpoons H^+(aq) + H_2PO_4^-(aq)$ $\quad K_{a_1} = 7.5\times10^{-3}$

$H_2PO_4^-(aq) \rightleftharpoons H^+(aq) + HPO_4^{2-}(aq)$ $\quad K_{a_2} = 6.2\times10^{-8}$

$HPO_4^{2-}(aq) \rightleftharpoons H^+(aq) + PO_4^{3-}(aq)$ $\quad K_{a_3} = 1.7\times10^{-12}$

$K_{a_1} > K_{a_2} > K_{a_3}$

$\log K = \log K_{a_1} + \log K_{a_2} + \log K_{a_3}$

Ans. (A), (B) and (C) only

69. Which of the following statements are true?

A. Unlike Ga that has a very high melting point, Cs has a very low melting point.
B. On Pauling scale, the electronegativity values of N and Cl are not the same.
C. Ar, K^+, Cl^-, Ca^{2+}, and S^{2-} are all isoelectronic species.
D. The correct order of the first ionization enthalpies of Na, Mg, Al, and Si is Si >Al > Mg > Na.
E. The atomic radius of Cs is greater than that of Li and Rb.

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

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

Answer (3)

Sol. Both Ga and Cs have low melting points.

Element	Melting point/K
Ga	303
Cs	302

- On Pauling scale, the electronegativity value of N and Cl have same (3.0).
- Ar, K^+, Cl^-, Ca^{2+} and S^{2-} have 18 electrons. So these are isoelectronic species.
- The correct order of first ionization enthalpy is Si > Mg > Al > Na

  First ionisation enthalpy of Mg is higher than Al because the penetration of a 3s-electron to the nucleus is more than that of a 2p-electron.
- Generally down the group atomic radii increases

Atom	Atomic radius/pm
Li	152
Rb	244
CS	262

70. Given below are two statements :

Statement I : Like nitrogen that can form ammonia, arsenic can form arsine.

Statement II : Antimony cannot form antimony pentoxide.

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

(1) Statement I is incorrect but Statement II is correct

(2) Both Statement I and Statement II are correct

(3) Both Statement I and Statement II are incorrect

(4) Statement I is correct but Statement II is incorrect

Answer (4)

Sol. All the elements of group 15 form hydrides of EH_3 type. Nitrogen forms ammonia (NH_3) while Arsenic forms Arsine (AsH_3)

All the elements of group 15 form two types of oxides : E_2O_3 and E_2O_5

Antimony forms antimony pentoxide Sb_2O_5

Hence, statement I is correct and statement II is incorrect

71. Which of the following aqueous solution will exhibit highest boiling point?

(1) 0.015M $C_6H_{12}O_6$

(2) 0.01M Urea

(3) 0.01M KNO_3

(4) 0.01M Na_2SO_4

Answer (4)

Sol.

$\Delta T_b = iK_b \times m$

$\Delta T_b \propto i \times m$

By considering molarity same as molality

(1) 0.015 M $C_6H_{12}O_6$ $i \times m = 1 \times 0.015 = 0.015$

(2) 0.01 M Urea $i \times m = 1 \times 0.01 = 0.01$

(3) 0.01 M KNO_3 $i \times m = 2 \times 0.01 = 0.02$

(4) 0.01 M Na_2SO_4 $i \times m = 3 \times 0.01 = 0.03$

$T_b' = T_b^* + \Delta T_b$

Higher the value of $(i \times m)$ more will be the boiling point.

72. Given below are two statements :

Statement-I : Benzenediazonium salt is prepared by the reaction of aniline with nitrous acid at 273 – 278 K. It decomposes easily in the dry state.

Statement-II : Insertion of iodine into the benzene ring is difficult and hence iodobenzene is prepared through the reaction of benzenediazonium salt with KI.

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

(1) Statement I is incorrect but Statement II is correct

(2) Both Statement I and Statement II are correct

(3) Both Statement I and Statement II are incorrect

(4) Statement I is correct but Statement II is incorrect

Answer (2)

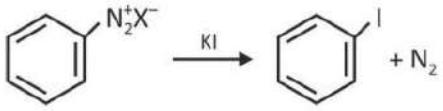
Sol. Benzene diazonium chloride is prepared by the reaction of aniline with nitrous acid at 273-278 K.

Nitrous acid is produced in the reaction mixture by reaction of $NaNO_2$ with HCl.

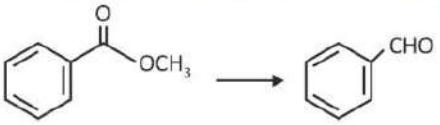
$$C_6H_5NH_2 + NaNO_2 + 2HCl \xrightarrow{273-278\,K} C_6H_5\overset{+}{N_2}\overset{-}{Cl} + NaCl + 2H_2O$$

Benzene diazonium chloride decomposes easily in the dry state

Iodobenzene is prepared by shaking benzene diazonium salt with KI because direct insertion of iodine into benzene ring is difficult



73. Identify the suitable reagent for the following conversion.



(1) $H_2/Pd\text{-}BaSO_4$

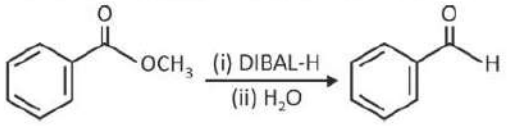
(2) (i) $LiAlH_4$, (ii) H^+/H_2O

(3) (i) $AlH(iBu)_2$, (ii) H_2O

(4) (i) $NaBH_4$, (ii) H^+/H_2O

Answer (3)

Sol. Esters are reduced to aldehydes with DIBAL-H



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

Assertion (A) : undergoes S_N2 reaction faster than .

Reason (R) : Iodine is a better leaving group because of its large size.

In the light of the above statements, choose the **correct** answer from the options given below:

(1) **A** is false but **R** is true

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

(3) Both **A** and **R** are true but **R** is **not** the correct explanation of **A**

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

Answer (2)

Sol. Rate of S_N2 reaction of is faster than .

Because iodine is a good leaving group due to large size of iodine. Which stabilises the I^- ion.

75. The correct order of decreasing acidity of the following aliphatic acids is

(1) $HCOOH > (CH_3)_3CCOOH > (CH_3)_2CHCOOH > CH_3COOH$

(2) $(CH_3)_3CCOOH > (CH_3)_2CHCOOH > CH_3COOH > HCOOH$

(3) $CH_3COOH > (CH_3)_2CHCOOH > (CH_3)_3CCOOH > HCOOH$

(4) $HCOOH > CH_3COOH > (CH_3)_2CHCOOH > (CH_3)_3CCOOH$

Answer (4)

Sol. Electron donating group decreases the acidity of carboxylic acids.

So correct order is

$HCOOH > CH_3COOH > (CH_3)_2CHCOOH > (CH_3)_3CCOOH$

76. Which one of the following reactions does **NOT** belong to "Lassaigne's test"?

(1) $2CuO + C \xrightarrow[\Delta]{} 2Cu + CO_2$

(2) $Na + C + N \xrightarrow[\Delta]{} NaCN$

(3) $2Na + S \xrightarrow[\Delta]{} Na_2S$

(4) $Na + X \xrightarrow[\Delta]{} + NaX$

Answer (1)

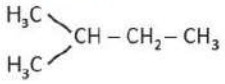
Sol. Nitrogen, sulphur, halogens and phosphorus present in an organic compound are detected by "Lassaigne's test".

$Na + C + N \xrightarrow{\Delta} NaCN$

$2Na + S \xrightarrow{\Delta} Na_2S$

$Na + X \xrightarrow{\Delta} \underset{(X=Cl, Br, I)}{NaX}$

77. How many products (including stereoisomers) are expected from monochlorination of the following compound?

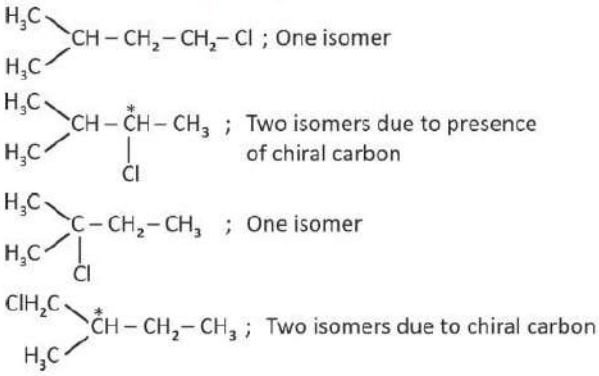


(1) 6 (2) 2

(3) 3 (4) 5

Answer (1)

Sol. Possible monochlorination products :



Total 6 isomers

78. Sugar 'X'

A. is found in honey

B. is a keto sugar

C. exists in α and β – anomeric forms.

D. Is laevorotatory.

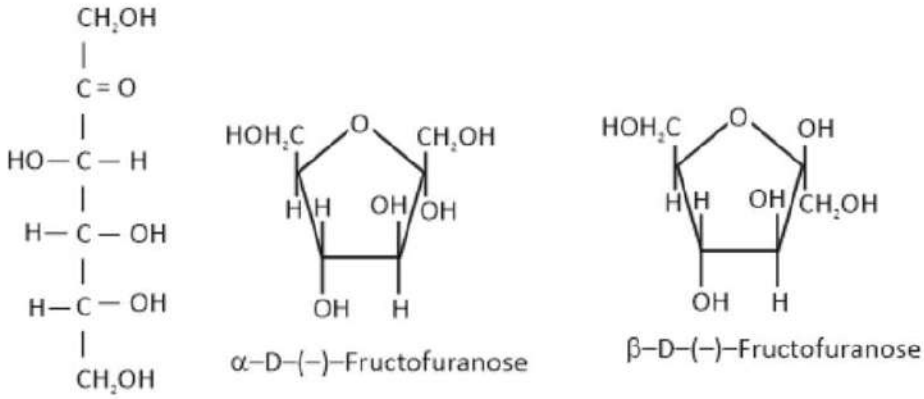
'X' is :

(1) Sucrose (2) D-Glucose

(3) D-Fructose (4) Maltose

Answer (3)

Sol. D-Fructose is found in honey and is a keto sugar.



D—(—) — Fructose

79. Dalton's Atomic theory could not explain which of the following?

(1) Law of gaseous volume
(2) Law of conservation of mass
(3) Law of constant proportion
(4) Law of multiple proportion

Answer (1)

Sol. Dalton's theory could explain the laws of chemical combination. However, it could not explain the laws of gaseous volumes.

80. Higher yield of NO in $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ can be obtained at

[ΔH of the reaction = +180.7 kJ mol^{-1}]

A. Higher temperature

B. Lower temperature

C. Higher concentration of N_2

D. Higher concentration of O_2

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

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

Answer (1)

Sol. Yield of the product generally depends on

- Temperature
- Concentration of reactant(s) and product(s)
- Pressure

As this is an endothermic reaction (ΔH = +180.7 kJ mol^{-1}), so, increase in temperature will shift equilibrium in forward direction to increase yield of NO.

Increase in concentration of reactants (N_2 and O_2) also shifts the equilibrium in forward direction and increase the yield of NO.

Hence, (A), (C) and (D) only will increase yield of NO.

81. Match **List-I** with **List-II**

	List-I		**List-II**
A.	XeO_3	(I)	sp^3d; linear
B.	XeF_2	(II)	sp^3; pyramidal
C.	$XeOF_4$	(III)	sp^3d^3; distorted octahedral
D.	XeF_6	(IV)	sp^3d^2; square pyramidal

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

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

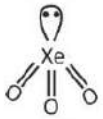
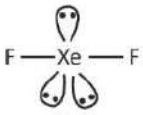
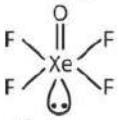
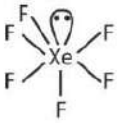
(2) A-II, B-I, C-IV, D-III

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

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

Answer (2)

Sol.

Molecule	Hybridisation	Shape
	sp^3	Pyramidal
	sp^3d	Linear
	sp^3d^2	Square Pyramidal
	sp^3d^3	Distorted Octahedral

82. Match List-I with List-II

	List-I (Example)		**List-II (Type of Solution)**
A.	Humidity	I.	Solid in solid
B.	Alloys	II.	Liquid in gas
C.	Amalgams	III.	Solid in gas
D.	Smoke	IV.	Liquid in solid

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

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

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

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

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

Answer (3)

Sol.

- Humidity is a solution of liquid in gas
- Alloy is a solution of solid in solid
- Amalgam is a solution of liquid in solid
- Smoke is a solution of solid in gas

83. Energy and radius of first Bohr orbit of He^+ and Li^{2+} are

[Given $R_H = 2.18 \times 10^{-18}$ J, $a_0 = 52.9$ pm]

(1) $E_n(Li^{2+}) = -8.72 \times 10^{-16}$ J;

$r_n(Li^{2+}) = 17.6$ pm

$E_n(He^+) = -19.62 \times 10^{-16}$ J;

$r_n(He^+) = 17.6$ pm

(2) $E_n(Li^{2+}) = -19.62 \times 10^{-18}$ J;

$r_n(Li^{2+}) = 17.6$ pm

$E_n(He^+) = -8.72 \times 10^{-18}$ J;

$r_n(He^+) = 26.4$ pm

(3) $E_n(Li^{2+}) = -8.72 \times 10^{-18}$ J;

$r_n(Li^{2+}) = 26.4$ pm

$E_n(He^+) = -19.62 \times 10^{-18}$ J;

$r_n(He^+) = 17.6$ pm

(4) $E_n(Li^{2+}) = -19.62 \times 10^{-16}$ J;

$r_n(Li^{2+}) = 17.6$ pm

$E_n(He^+) = -8.72 \times 10^{-16}$ J;

$r_n(He^+) = 26.4$ pm

Answer (2)

Sol. $E_n = \frac{-2.18 \times 10^{-18} \times z^2}{n^2}$ J; $r_n = \frac{52.9 \times n^2}{z}$ pm

For He^+

$E_{He^+} = -2.18 \times 10^{-18} \times 4 = -8.72 \times 10^{-18}$ J

$r_{He^+} = \frac{52.9 \times 1}{2} = 26.45$ pm

For Li^{2+}

$E_{Li^{2+}} = -2.18 \times 10^{-18} \times 9 = 19.62 \times 10^{-18}$ J

$r_{Li^{2+}} = \frac{52.9 \times 1}{3} = 17.63$ pm

84. Which among the following electronic configurations belong to main group elements?

A. $[Ne]3s^1$

B. $[Ar]3d^3 4s^2$

C. $[Kr]4d^{10} 5s^2 5p^5$

D. $[Ar]3d^{10} 4s^1$

E. $[Rn]5f^0 6d^2 7s^2$

Choose the correct answer from the option given below :

(1) A, C and D only

(2) B and E only

(3) A and C only

(4) D and E only

Answer (3)

Sol. (A) $[Ne]3s^1$; Na (s-block)

(B) $[Ar]3d^3 4s^2$; V (d-block)

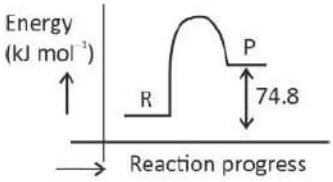
(C) $[Kr]4d^{10}5s^2 5p^5$; I (p-block)

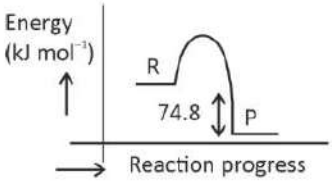
(D) $[Ar]3d^{10}4s^1$; Cu (d-block)

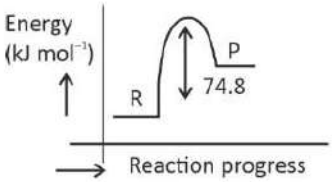
(E) $[Rn]5f^0 6d^2 7s^2$; Th (f-block)

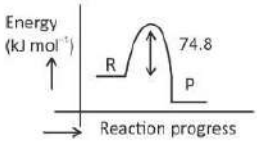
Main group elements (A and C only)

85. $C(s) + 2H_2(g) \rightarrow CH_4(g)$; $\Delta H = -74.8$ kJ mol^{-1}. Which of the following diagrams gives an accurate representation of the above reaction? [R → reactants; P → products]

(1)


(2)


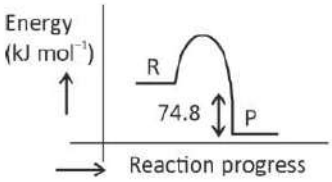
(3)


(4)


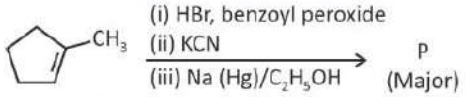
Answer (2)

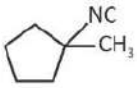
Sol. $\Delta H = -74.8$ k J mol^{-1}, it is an exothermic reaction.

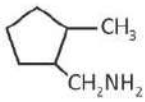
So, accurate representation is

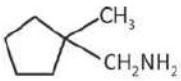


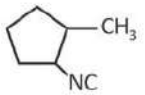
86. Predict the major product 'P' in the following sequence of reactions-



(1) 

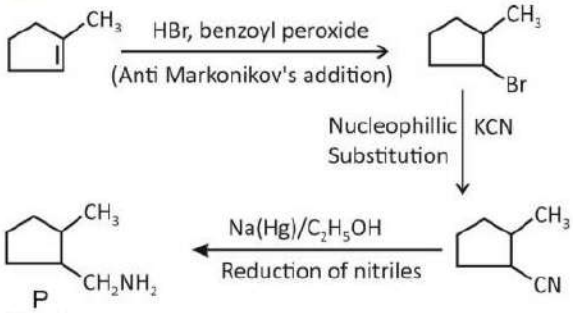
(2) 

(3) 

(4) 

Answer (2)

Sol.



P
(Major)

87. Identify the correct orders against the property mentioned

A. $H_2O > NH_3 > CHCl_3$ – dipole moment

B. $XeF_4 > XeO_3 > XeF_2$ – number of lone pairs on central atom

C. O–H > C–H > N–O – bond length

D. $N_2 > O_2 > H_2$ – bond enthalpy

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

(1) B, C only

(2) A, D only

(3) B, D only

(4) A, C only

Answer (2)

Sol.

		μ(D)
A.	H_2O	1.85
	NH_3	1.47
	$CHCl_3$	1.04

B. XeF_4 : 2 lone pairs of electron

XeO_3 : 1 lone pair of electron

XeF_2 : 3 lone pairs of electron

C. Order of Bond length :- N–O > C–H > O–H

D. N_2 Bond order is 3

H_2 Bond order is 1

O_2 Bond order is 2

88. Total number of possible isomers (both structural as well as stereoisomers) of cyclic ethers of molecular formula C_4H_8O is :

(1) 11

(2) 6

(3) 8

(4) 10

Answer (4)

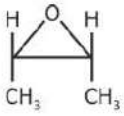
Sol. For cyclic ethers O should be in ring * carbon here is chiral

(1)

1

(2)

1

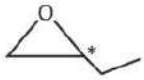
(3) 

(1)

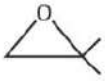
Meso compound

(4)

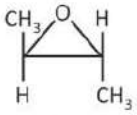
2(d, l pair)

(5) 

2(d, l pair)

(6) 

1

(7) 

2(d, l pair)

Total number of isomers = 2 + 1 + 1 + 1 + 2 + 1 + 2 = 10

89. For the reaction $A(g) \rightleftharpoons 2B(g)$, the backward reaction rate constant is higher than the forward reaction rate constant by a factor of 2500, at 1000 K.

[Given : R = 0.0831 L atm mol^{-1} K^{-1}]

K_P for the reaction at 1000 K is

(1) 0.021

(2) 83.1

(3) 2.077×10^5

(4) 0.033

Answer (4)

Sol. $K_C = \frac{k_f}{k_b} = \frac{1}{2500}$

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

$= \frac{1}{2500} \times 0.0831 \times 1000$

= 0.033

90. 5 moles of liquid X and 10 moles of liquid Y make a solution having a vapour pressure of 70 torr. The vapour pressures of pure X and Y are 63 torr and 78 torr respectively. Which of the following is true regarding the described solution?

(1) The solution has volume greater than the sum of individual volumes.

(2) The solution shows positive deviation.

(3) The solution shows negative deviation.

(4) The solution is ideal.

Answer (3)

Sol. $P_{total} = X_x P_x^\circ + X_y P_y^\circ$

$= \frac{5}{15} \times 63 + \frac{10}{15} \times 78$

= 21 + 52

= 73 torr

Observed total pressure of solution is 70 torr.

It is less than calculated total pressure.

Hence, it shows negative deviation.

BIOLOGY

91. Which of the following is the unit of productivity of an Ecosystem?

(1) $(KCal\ m^{-2})yr^{-1}$ (2) gm^{-2}

(3) $KCal\ m^{-2}$ (4) $KCal\ m^{-3}$

Answer (1)

Sol. The rate of biomass production is called productivity. It is expressed in terms of $gm^{-2}yr^{-1}$ or $(KCal\ m^{-2})yr^{-1}$ to compare the productivity of different ecosystems.

92. The first menstruation is called :

(1) Ovulation (2) Menopause

(3) Menarche (4) Diapause

Answer (3)

Sol. The first menstruation begins at puberty and is called menarche.

- Ovulation is the process that deals with the release of secondary oocyte from the mature Graafian follicle.
- In human beings, menstrual cycles ceases around 50 years of age; that is termed as menopause.
- Diapause is a state of dormancy or developmental arrest in an organism.

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

Assertion (A) : All vertebrates are chordates but all chordates are not vertebrate.

Reason (R) : The members of subphylum vertebrata possess notochord during the embryonic period, the notochord is replaced by cartilaginous or bony vertebral column in adults.

In the light of the above statements, choose the **correct** answer from the options given below:

(1) **(A)** is false but **(R)** is true

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

(3) Both **(A)** and **(R)** are true but **(R)** is **not** the correct explanation of **(A)**

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

Answer (2)

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

The members of subphylum vertebrata possess notochord during the embryonic period. The notochord is replaced by a cartilaginous or bony vertebral column in the adult.

Thus, all vertebrates are chordates but all chordates are not vertebrates.

94. Genes R and Y follow independent assortment. If RRYY produce round yellow seeds and rryy produce wrinkled green seeds, what will be the phenotypic ratio of the F2 generation?

(1) Phenotypic ratio - 9 : 7 (2) Phenotypic ratio - 1 : 2 : 1

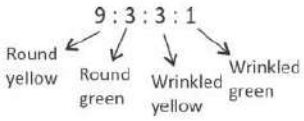
(3) Phenotypic ratio - 3 : 1 (4) Phenotypic ratio - 9 : 3 : 3 : 1

Answer (4)

Sol. A classical dihybrid cross performed by Mendel involves.

A cross which was made between a pure round yellow seeded pea plant (RRYY) with wrinkled green seeded plant (rryy). Yellow colour is dominant over green and round seed shape over wrinkled seed shape.

Phenotypic ratio in F2 generation



95. Given below are two statements :

Statement I : The DNA fragments extracted from gel electrophoresis can be used in construction of recombinant DNA.

Statement II : Smaller size DNA fragments are observed near anode while larger fragments are found near the wells in an agarose gel.

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

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

Answer (2)

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

The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece. This step is known as elution. The DNA fragments purified in this way are used in constructing rDNA by joining them with cloning vectors.

- In gel electrophoresis, the DNA fragments separate (resolve) according to their size through sieving effect provided by the agarose gel. Hence, the smaller the fragment size, the farther it moves from cathode towards anode.

96. What is the main function of the spindle fibers during mitosis?

(1) To regulate cell growth
(2) To separate the chromosomes
(3) To synthesize new DNA
(4) To repair damaged DNA

Answer (2)

Sol. During mitosis, spindle fibre get attach to the kinetochores of the chromosome and help in the separation of the chromosome.

97. How many meiotic and mitotic divisions need to occur for the development of a mature female gametophyte from the megaspore mother cell in an angiosperm plant?

(1) No Meiosis and 2 Mitosis
(2) 2 Meiosis and 3 Mitosis
(3) 1 Meiosis and 2 Mitosis
(4) 1 Meiosis and 3 Mitosis

Answer (4)

Sol. Development of a mature female gametophyte, i.e., embryo sac from a megaspore mother cell in an angiosperm plant requires 1 meiotic and 3 mitotic divisions.

98. Identify the statement that is **NOT** correct.

(1) Constant region of heavy and light chains are located at C-terminus of antibody molecules

(2) Each antibody has two light and two heavy chains.

(3) The heavy and light chains are held together by disulfide bonds.

(4) Antigen binding site is located at C-terminal region of antibody molecules.

Answer (4)

Sol. Each antibody molecule has four peptide chains, two small called light chains and two longer called heavy chains. Hence, an antibody is represented as H_2L_2.

In an antibody molecule, antigen binding site is located at N-terminal region.

99. Consider the following :

A. The reductive division for the human female gametogenesis starts earlier than that of the male gametogenesis.

B. The gap between the first meiotic division and the second meiotic division is much shorter for males compared to females.

C. The first polar body is associated with the formation of the primary oocyte.

D. Luteinizing Hormone (LH) surge leads to disintegration of the endometrium and onset of menstrual bleeding.

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

(1) B and C are true

(2) A and B are true

(3) A and C are true

(4) B and D are true

Answer (2)

Sol. Statements A and B are true while statements C and D are false.

The first polar body is associated with the formation of the secondary oocyte LH surge leads to ovulation. Decreased levels of progesterone during late luteal phase leads to degeneration of the endometrium and onset of menstrual bleeding.

100. Given below are two statements : One is labelled as **Assertion (A)** and other is labelled as **Reason (R)**.

Assertion (A) : Cells of the tapetum possess dense cytoplasm and generally have more than one nucleus.

Reason (R) : Presence of more than one nucleus in the tapetum increases the efficiency of nourishing the developing microspore mother cells.

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

(1) **A** is false but **R** is true

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

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

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

Answer (4)

Sol. Cell of the tapetum possess dense cytoplasm and generally have more than one nucleus because the presence of more than one nucleus in the tapetal cells increases the efficiency of nourishing the develpoing pollen grains.

101. The blue and white selectable markers have been developed which differentiate recombinant colonies from non-recombinant colonies on the basis of their ability to produce colour in the presence of a chromogenic substrate.

Given below are two statements about this method:

Statement I : The blue coloured colonies have DNA insert in the plasmid and they are identified as recombinant colonies.

Statement II : The colonies without blue colour have DNA insert in the plasmid and are identified as recombinant colonies.

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

(1) **Statement I** is incorrect but **Statement II** is correct

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

(3) Both **Statement I** and **Statement II** are incorrect

(4) **Statement I** is correct but **Statement II** is incorrect

Answer (1)

Sol. Statement I is incorrect but statement II is correct as a recombinant DNA is inserted within the coding sequence of an enzyme, β-galactosidase. This results into inactivation of the gene for synthesis of this enzyme. Thus, presence of insert results into insertional inactivation of the β-galactosidase gene and the colonies do not produce any colour and identified as recombinant colonies. Whereas non-recombinant transformants will produce blue colour in presence of chromogenic substrate.

102. In bryophytes, the gemmae help in which one of the following?

(1) Gaseous exchange

(2) Sexual reproduction

(3) Asexual reproduction

(4) Nutrient absorption

Answer (3)

Sol. Gemmae are green, multicellular, asexual buds which develop in small receptacles called gemma cups and help in asexual reproduction in bryophytes.

103. Match **List I** with **List II**:

	List-I		**List-II**
A.	Adenosine	I.	Nitrogen base
B.	Adenylic acid	II.	Nucleotide
C.	Adenine	III.	Nucleoside
D.	Alanine	IV.	Amino acid

Choose the option with all **correct** matches.

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

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

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

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

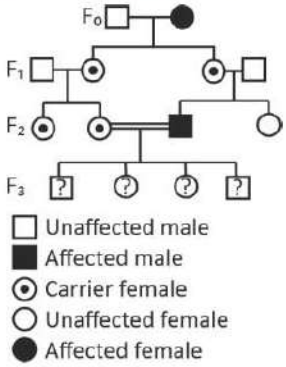
Answer (4)

Sol. The correct answer is A-III, B-II, C-I, D-IV

- Adenosine – It is a nucleoside which is composed of nitrogen base and sugar only.
- Adenylic acid – It is a nucleotide which is composed of nitrogen base, sugar and a phosphate group is esterified to the sugar.
- Adenine – Nitrogen base (Purine)

Alanine – An amino acid that contains a methyl group as the 'R' group.

104. With the help of given pedigree, find out the probability for the birth of a child having no disease and being a carrier (has the disease mutation in one allele of the gene) in F_3 generation.



(1) Zero (2) 1/4

(3) 1/2 (4) 1/8

Answer (2)

Sol. As in the F_1 generation the carrier female and non-affected (normal, not carrier) had affected male child that means the genetic disorder is sex-linked recessive.

The consanguineous mating between female (X^cX) and male (X^cY)

♀ \ ♂	X^c	Y
X^c	X^cX^c	X^cY
X	X^cX	XY

Out of 4 child only one is carrier i.e. $\frac{1}{4}$.

105. Consider the following statements regarding function of adrenal medullary hormones :

(A) It causes pupilary constriction.

(B) It is a hyperglycemic hormone.

(C) It causes piloerection.

(D) It increases strength of heart contraction.

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

(1) D only

(2) C and D only

(3) B, C and D only

(4) A, C and D only

Answer (3)

Sol. Adrenal medulla secretes two hormones called adrenaline or epinephrine and noradrenaline or norepinephrine (also called emergency hormones).

Both the hormones -

- Cause pupillary dilation (not constriction)
- Stimulate breakdown of glycogen resulting in increased concentration of glucose in blood *i.e.*, cause hyperglycemia.
- Cause piloerection (raising of hair).
- Increase strength of heart contraction *i.e.*, heartbeat.

106. Which of the following is an example of a zygomorphic flower?

(1) Chilli (2) Petunia

(3) Datura (4) Pea

Answer (4)

Sol. Zygomorphic flowers can be divided into two equal halves by only a single vertical plane and shows bilateral symmetry.

Pea possess zygomorphic flowers.

Chilli, Petunia and Datura possess actinomorphic flowers.

107. Who proposed that the genetic code for amino acids should be made up of three nucleotides?

(1) Franklin Stahl

(2) George Gamow

(3) Francis Crick

(4) Jacque Monod

Answer (2)

Sol. George Gamow, a physicist proposed that genetic code for amino acids should be made up of three nucleotides.

108. Given below are two statements:

Statement I: In ecosystem, there is unidirectional flow of energy of sun from producers to consumers.

Statement II: Ecosystems are exempted from 2nd law of thermodynamics.

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

(1) Statement I is incorrect but statement II is correct

(2) Both statement I and statement II are correct

(3) Both statement I and statement II are incorrect

(4) Statement I is correct but statement II is incorrect

Answer (4)

Sol. Sun is the only source of energy for all ecosystems on Earth, except for deep sea-hydro-thermal ecosystem.

The energy flow is unidirectional from the sun to producers and then to consumers.

Ecosystems are not exempted from the second law of thermodynamics. They need a constant supply of energy to synthesise the molecules they require to counteract the universal tendency towards increasing disorderliness.

109. Sweet potato and potato represent a certain type of evolution. Select the correct combination of terms to explain the evolution.

(1) Analogy, divergent
(2) Analogy, convergent
(3) Homology, divergent
(4) Homology, convergent

Answer (2)

Sol. Sweet potato is a root modification while potato is a stem modification but both of them have same function. Analogous structures are not anatomically similar structures though they perform similar functions.

Analogous structures are the result of convergent evolution.

- Homologous organs are anatomically similar but they do not perform similar function. Homologous organs are the result of divergent evolution.

110. All living members of the class Cyclostomata are :

(1) Ectoparasite
(2) Free living
(3) Endoparasite
(4) Symbiotic

Answer (1)

Sol. All living members of class Cyclostomata are ectoparasites.

111. Histones are enriched with -

(1) Phenylalanine & Arginine
(2) Lysine & Arginine
(3) Leucine & Lysine
(4) Phenylalanine & Leucine

Answer (2)

Sol. In eukaryotes, packaging of DNA is much more complex. There is a set of positively charged, basic proteins called histones.

Histones are organised to form a unit of light molecules called histone octamer.

They are rich in the basic amino acid residues lysine and arginine.

112. Which one of the following equations represents the Verhulst-Pearl Logistic Growth of population?

(1) $\frac{dN}{dt} = N\left(\frac{r-K}{K}\right)$

(2) $\frac{dN}{dt} = r\left(\frac{K-N}{K}\right)$

(3) $\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$

(4) $\frac{dN}{dt} = rN\left(\frac{N-K}{N}\right)$

Answer (3)

Sol. Logistic growth is described by Verhulst-Pearl logistic growth equation $\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$.

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

Assertion (A) : The primary function of the Golgi apparatus is to package the materials made by the endoplasmic reticulum and deliver it to intracellular targets and outside the cell.

Reason (R) : Vesicles containing materials made by the endoplasmic reticulum fuse with the cis face of the Golgi apparatus, and they are modified and released from the trans face of the Golgi apparatus.

In the light of the above statements, choose the **correct** answer from the options given below :

(1) **A** is false but **R** is true

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

(3) Both **A** and **R** are true but **R** is **not** the correct explanation of **A**

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

Answer (3)

Sol. The primary function of Golgi apparatus is to package the materials made by endoplasmic reticulum and deliver it to intracellular targets and outside the cell, this statement is correct and the reason statement is also correct. Golgi apparatus remains in close association with endoplasmic reticulum. Here, assertion and reason statements both are correct but reason is not correctly explaining assertion.

114. Which of the following statements about RuBisCO is true?

(1) It catalyzes the carboxylation of RuBP

(2) It is active only in the dark

(3) It has higher affinity for oxygen than carbon dioxide

(4) It is an enzyme involved in the photolysis of water

Answer (1)

Sol. Carboxylation is the most crucial step of the Calvin cycle where CO_2 is utilised for the carboxylation of RuBP. This reaction is catalysed by enzyme RuBP carboxylase. Since this enzyme also has an oxygenase activity, RuBisCO has higher affinity for carbon dioxide than oxygen.

115. Match **List-I** with **List-II**.

	List-I		**List-II**
A.	Progesterone	I.	Pars intermedia
B.	Relaxin	II.	Ovary
C.	Melanocyte stimulating hormone	III.	Adrenal Medulla
D.	Catecholamines	IV.	Corpus luteum

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

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

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

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

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

Answer (2)

Sol. The correct answer is [A-IV, B-II, C-I, D-III]

- Progesterone – A steroidal hormone which is secreted by the corpus luteum
- Relaxin – A proteinaceous hormone which is secreted by the ovaries in the later stage of pregnancy
- Melanocyte stimulating hormone – A proteinaceous hormone released by the pars intermedia
- Catecholamines – An amino-acid derived hormone released from the adrenal medulla during emergency conditions

116. The protein portion of an enzyme is called:

(1) Prosthetic group
(2) Cofactor
(3) Coenzyme
(4) Apoenzyme

Answer (4)

Sol. There are number of cases in which non-protein constituents called co-factors are bound to the enzyme to make the enzyme catalytically active.

In these instances, the protein portion of the enzymes is called the apoenzyme.

Three kinds of co-factors are identified prosthetic groups, co-enzymes and metal ions. Prosthetic groups are organic compounds and they are tightly bound with apoenzyme. Co-enzymes are also organic compounds but their association with apoenzyme is only transient.

117. Which of the following enzyme(s) are **NOT** essential for gene cloning?

A. Restriction enzymes
B. DNA ligase
C. DNA mutase
D. DNA recombinase
E. DNA polymerase

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

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

Answer (2)

Sol. Gene cloning is a process where a specific gene or DNA sequence is isolated and replicated, creating multiple identical copies.

In gene cloning, restriction enzymes, DNA ligase and DNA polymerase are primarily used.

118. Which of the following type of immunity is present at the time of birth and is a non-specific type of defence in the human body?

(1) Humoral Immunity
(2) Acquired Immunity
(3) Innate Immunity
(4) Cell-mediated Immunity

Answer (3)

Sol. Innate immunity is non-specific type of defence, that is present at the time of birth. This is accomplished by providing different types of barriers to the entry of the foreign agents into our body. Acquired immunity is pathogen specific, characterised by memory cells.

Immune response mediated by B-lymphocytes is humoral immunity and other immune response mediated by T-lymphocytes is called cell-mediated immunity.

119. Which factor is important for termination of transcription?

(1) γ (gamma) (2) α (alpha)

(3) σ (sigma) (4) ρ (rho)

Answer (4)

Sol. In prokaryotes the RNA polymerase is only capable of catalysing the process of elongation. It associates transiently with initiation factor (σ) and termination factor (ρ) to initiate and terminate the transcription respectively.

120. Which of the following hormones released from the pituitary is actually synthesized in the hypothalamus?

(1) Adrenocorticotropic hormone (ACTH) (2) Luteinizing hormone (LH)

(3) Anti-diuretic hormone (ADH) (4) Follicle-stimulating hormone (FSH)

Answer (3)

Sol. Neurohypophysis *i.e.*, posterior pituitary (Pars nervosa) stores and releases two hormones called oxytocin and vasopressin (Also called ADH *i.e.*, antidiuretic hormone) which are actually synthesised by hypothalamus and are transported axonally to neurohypophysis. The pars distalis (anterior pituitary) produces follicle stimulating hormone (FSH), adrenocorticotropic hormone (ACTH) and luteinizing hormone (LH).

121. Which of the following microbes is **NOT** involved in the preparation of household products?

A. *Aspergillus niger*

B. *Lactobacillus*

C. *Trichoderma polysporum*

D. *Saccharomyces cerevisiae*

E. *Propionibacterium sharmanii*

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

(1) C and E only (2) A and B only

(3) A and C only (4) C and D only

Answer (3)

Sol. *Lactobacillus* is used for production of curd.

Saccharomyces cerevisiae is used for the fermentation of palm sap to obtain toddy drink.

Propionibacterium sharmanii is used for production of swiss cheese.

Aspergillus niger is used for the commercial production of citric acid.

Trichoderma polysporum is used for the production of cyclosporin A and also act as a biocontrol agent.

A, C are used in industrial production of citric acid and cyclosporin-A.

122. Given below are two statements :

Statement I : Fig fruit is a non-vegetarian fruit as it has enclosed fig wasps in it.

Statement II : Fig wasp and fig tree exhibit mutual relationship as fig wasp completes its life cycle in fig fruit and fig fruit gets pollinated by fig wasp.

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

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

Answer (3)

Sol. Fig fruit is a vegetarian fruit as it only gets pollinated by wasp. Fig tree and fig wasps shows mutualism in which both species are benefitted. So, statement I is incorrect. Statement II is also not correct as fig inflorescence/flower gets pollinated by fig wasp.

123. Role of the water vascular system in Echinoderms is :

A. Respiration and Locomotion

B. Excretion and Locomotion

C. Capture and transport of food

D. Digestion and Respiration

E. Digestion and Excretion

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

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

Answer (3)

Sol. Water vascular system in Echinoderms helps in locomotion, capture and transport of food and respiration.

Excretory system is absent in echinoderms. Excretion takes place through general body surface.

124. After maturation, in primary lymphoid organs, the lymphocytes migrate for interaction with antigens to secondary lymphoid organ(s) / tissue(s) like

A. thymus
B. bone marrow
C. spleen
D. lymph nodes
E. Peyer's patches

Choose the *correct* answer from the options given below

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

Answer (1)

Sol. The primary lymphoid organs are bone marrow and thymus where immature lymphocytes differentiate into antigen-sensitive lymphocytes.

After maturation, the lymphocytes migrate into secondary lymphoid organs like spleen, lymph nodes, Peyer's patches of small intestine and appendix.

These secondary lymphoid organ provide the sites for interaction of lymphocytes with the antigen.

125. Match **List I** with **List II**:

	List I		List II
A.	The Evil Quartet	I.	Cryopreservation
B.	Ex situ conservation	II.	Alien species invasion
C.	*Lantana camara*	III.	Causes of biodiversity losses
D.	Dodo	IV.	Extinction

Choose the option with all correct matches.

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

Answer (3)

Sol. The Evil Quartet – Causes of biodiversity losses
Ex situ conservation – Cryopreservation
Lantana camara – Alien species invasion
Dodo – Extinction

126. Read the following statements on plant growth and development.

(A) Parthenocarpy can be induced by auxins.
(B) Plant growth regulators can be involved in promotion as well as inhibition of growth.
(C) Dedifferentiation is a pre-requisite for re-differentiation.
(D) Abscisic acid is a plant growth promoter.
(E) Apical dominance promotes the growth of lateral buds.

Choose the option with all correct statements.

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

Answer (2)

Sol. ABA is a plant growth inhibitor and an inhibitor of plant metabolism.
Apical dominance promotes growth of apical bud.
Statements A, B and C are correct.

127. Match **List-I** with **List-II**.

	List-I		List-II
A.	Pteridophyte	(I)	*Salvia*
B.	Bryophyte	(II)	*Ginkgo*
C.	Angiosperm	(III)	*Polytrichum*
D.	Gymnosperm	(IV)	*Salvinia*

Choose the option with all **correct** matches.

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

Answer (3)

Sol. Pteridophyte - *Salvinia*

Bryophyte - *Polytrichum*

Angiosperm - *Salvia*

Gymnosperm - *Ginkgo*

128. Why can't insulin be given orally to diabetic patients?

(1) Its bioavailability will be increased

(2) Human body will elicit strong immune response

(3) It will be digested in Gastro-Intestinal (GI) tract

(4) Because of structural variation

Answer (3)

Sol. Insulin can't be administered orally to diabetic patients as being the proteinaceous molecule, it will be digested in gastro-intestinal tract.

129. Which one of the following is the characteristic feature of gymnosperms?

(1) Gymnosperms have flowers for reproduction

(2) Seeds are enclosed in fruits

(3) Seeds are naked

(4) Seeds are absent

Answer (3)

Sol. The gymnosperms (*Gymnos* : naked, *sperma* seed) are plants in which the ovules are not enclosed by an ovary wall and remains exposed, both before and after fertilization. The seeds that develop post-fertilization, are not covered, *i.e.*, naked.

130. Frogs respire in water by skin and buccal cavity and on land by skin, buccal cavity and lungs.

Choose the **correct** answer from the following :

(1) The statement is false for both the environment

(2) The statement is true for water but false for land

(3) The statement is true for both the environment

(4) The statement is false for water but true for land

Answer (4)

Sol.
- In water, frogs respire through skin and not through buccal cavity *i.e.,* undergo cutaneous respiration only.
- On land, the buccal cavity, skin and lungs act as respiratory organs *i.e.,* undergo buccopharyngeal, cutaneous and pulmonary respiration.

131. Silencing of specific mRNA is possible via RNAi because of

(1) Non-complementary ssRNA

(2) Complementary dsRNA

(3) Inhibitory ssRNA

(4) Complementary tRNA

Answer (2)

Sol. RNAi (RNA interference) takes place in all eukaryotic organisms as a method of cellular defense. This method involves silencing of a specific mRNA due to a complementary dsRNA molecule that binds to and prevents translation of the mRNA.

132. Twins are born to a family that lives next door to you. The twins are a boy and a girl. Which of the following must be true?

(1) They have 75% identical genetic content.

(2) They are monozygotic twins.

(3) They are fraternal twins.

(4) They were conceived through in vitro fertilization.

Answer (3)

Sol. Fraternal twins or dizygotic twins are 2 separate fertilized eggs, they usually develop 2 separate amniotic sacs, placentas and supporting structures.

If twins are a boy and a girl, this indicates they are fraternal twins.

133. Match **List I** with **List II** :

	List I		**List II**
A.	Scutellum	I.	Persistent nucellus
B.	Non-albuminous seed	II.	Cotyledon of Monocot seed
C.	Epiblast	III.	Groundnut
D.	Perisperm	IV.	Rudimentary cotyledon

Choose the option with all **correct** matches.

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

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

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

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

Answer (2)

Sol. Scutellum is cotyledon of monocot seed.

Groundnut seed is non-albuminous seed.

Epiblast is rudimentary cotyledon in monocot seed.

Perisperm is persistent nucellus.

134. In frog, the Renal portal system is a special venous connection that acts to link :

(1) Kidney and lower part of body

(2) Liver and intestine

(3) Liver and kidney

(4) Kidney and intestine

Answer (1)

Sol. In frogs, special venous connection between liver and intestine as well as the kidney and lower parts of the body are present in frogs. The former is called hepatic portal system and the latter is called renal portal system.

135. Match **List-I** with **List-II.**

	List-I		List-II
A.	Heart	(I)	Erythropoietin
B.	Kidney	(II)	Aldosterone
C.	Gastro-intestinal tract	(III)	Atrial natriuretic factor
D.	Adrenal Cortex	(IV)	Secretin

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

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

Answer (1)

Sol.

Organ Name	-	**Hormone Secreted**
Heart	-	Atrial natriuretic factor
Kidney	-	Erythropoietin
Gastro-intestinal tract	-	Secretin
Adrenal cortex	-	Aldosterone

136. Cardiac activities of the heart are regulated by:

A. Nodal tissue

B. A special neural centre in the medulla oblongata

C. Adrenal medullary hormones

D. Adrenal cortical hormones

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

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

Answer (2)

Sol. Normal cardiac activities of the heart are regulated intrinsically, i.e., auto regulated by specialised muscles (nodal tissue), hence the heart is called myogenic. A special neural centre in the medulla oblongata can moderate the cardiac function through autonomic nervous system.

Sympathetic nervous system can increase the rate of heartbeat, ventricular contraction and thereby cardiac output.

Parasympathetic neural signals decrease the rate of heartbeat, speed of conduction of action potential and thereby the cardiac output. Adrenal medullary hormones can also increase the cardiac output.

137. Streptokinase produced by *bacterium Streptococcus* is used for

(1) Removing clots from blood vessels

(2) Curd production

(3) Ethanol production

(4) Liver disease treatment

Answer (1)

Sol. Streptokinase produced by the bacterium *Streptococcus* and modified by genetic engineering is used as a 'clot buster' for removing clots from blood vessels of patients who have undergone myocardial infarction leading to heart attack. Curd production is done by *Lactobacillus* and ethanol production is done by *Saccharomyces*.

138. Who is known as the father of Ecology in India?

(1) Birbal Sahni

(2) S.R. Kashyap

(3) Ramdeo Misra

(4) Ram Udar

Answer (3)

Sol. Ramdeo Misra is known as the father of Ecology in India.

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

Assertion (A) : A typical unfertilised, angiosperm embryo sac at maturity is 8 nucleate and 7-celled.

Reason (R) : The egg apparatus has 2 polar nuclei.

In the light of the above statements, choose the **correct** answer from the options given below :

(1) **A** is false but **R** is true

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

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

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

Answer (4)

Sol. A typical Angiosperm embryo sac, at maturity is 7-celled and 8 nucleate.

Polar nuclei are situated below the egg apparatus in the large central cell.

Three cells are grouped together at micropylar end and constitute the egg apparatus.

Hence, A is true but R is false.

140. Neoplastic characteristics of cells refer to :

A. A mass of proliferating cell

B. Rapid growth of cells

C. Invasion and damage to the surrounding tissue

D. Those confined to original location

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

(1) B, C, D only

(2) A, B only

(3) A, B, C only

(4) A, B, D only

Answer (3)

Sol. The correct answer will include : A, B and C only.

A neoplasm is a general term for any abnormal growth of tissue.

Neoplastic characteristics of cells refer to

(1) A mass of proliferating cell.

(2) Rapid growth of cells.

(3) Invasion and damage to the surrounding tissue.

Cancer specifically refers to malignant neoplasms, which are cancerous and invasive.

Benign tumours remain confined to their original location. Thus, D is not included in the answer.

The malignant tumours, on the other hand are a mass of proliferating cells called neoplastic or tumour cells. These cells grow very rapidly, invading and damaging the surrounding normal tissues.

141. Given below are the stages in the life cycle of pteridophytes. Arrange the following stages in the correct sequence.

A. Prothallus stage

B. Meiosis in spore mother cells

C. Fertilisation

D. Formation of archegonia and antheridia in gametophyte.

E. Transfer of antherozoids to the archegonia in presence of water.

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

(1) E, D, C, B, A

(2) B, A, D, E, C

(3) B, A, E, C, D

(4) D, E, C, A, B

Answer (2)

Sol. In a pteridophytes life cycle, the correct sequence of stages will be given as follows:

B $\rightarrow$ Meiosis in spore mother cells

A $\rightarrow$ Prothallus stage

D $\rightarrow$ Formation of archegonia and antheridia in gametophyte

E $\rightarrow$ Transfer of antherozoids to the archegonia in presence of water

C $\rightarrow$ Fertilisation will occur

So, the correct sequence is B $\rightarrow$ A $\rightarrow$ D $\rightarrow$ E $\rightarrow$ C

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

Assertion (A) : Both wind and water pollinated flowers are not very colourful and do not produce nectar.

Reason (R) : The flowers produce enormous amount of pollen grains in wind and water pollinated flowers.

In the light of the above statements, choose the **correct** answer from the options given below:

(1) **A** is false but **R** is true

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

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

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

Answer (3)

Sol. Both wind and water pollinated flowers are not very colourful and do not produce nectar, this is because they rely on wind and water to carry their pollen. Wind and water pollinated flower do not need to attract insect, so they did not evolve to produce bright coloured flower.

143. Which one of the following enzymes contains 'Haem' as the prosthetic group?

(1) Catalase

(2) RuBisCo

(3) Carbonic anhydrase

(4) Succinate dehydrogenase

Answer (1)

Sol. In peroxidase and catalase, which catalyze the breakdown of hydrogen peroxide to water and oxygen, haem is the prosthetic group and it is part of the active site of the enzymes.

Zinc is the cofactor in enzyme carbonic anhydrase.

RuBisCo is the most abundant protein in whole of the biosphere.

Succinate is the substrate of enzyme succinic dehydrogenase.

144. Match **List-I** with **List-II**.

	List-I		**List-II**
A.	Emphysema	I.	Rapid spasms in muscle due to low Ca^{++} in body fluid
B.	Angina Pectoris	II.	Damaged alveolar walls and decreased respiratory surface
C.	Glomerulonephritis	III.	Acute chest pain when not enough oxygen is reaching to heart muscle
D.	Tetany	IV.	Inflammation of glomeruli of kidney

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

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

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

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

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

Answer (1)

Sol. Emphysema - Damaged alveolar walls and decreased respiratory surface

Angina pectoris - Acute chest pain when not enough oxygen is reaching to heart muscle

Glomerulonephritis - Inflammation of glomeruli of kidney

Tetany - Rapid spasms in muscle due to low Ca^{++} in body fluid

145. Find the statement that is **NOT** correct with regard to the structure of monocot stem.

(1) Phloem parenchyma is absent.

(2) Hypodermis is parenchymatous.

(3) Vascular bundles are scattered.

(4) Vascular bundles are conjoint and closed.

Answer (2)

Sol. In monocot stem, hypodermis is sclerenchymatous.

146. Which of the following statement is **correct** about location of the male frog copulatory pad?

(1) First digit of the fore limb
(2) First and Second digit of fore limb
(3) First digit of hind limb
(4) Second digit of fore limb

Answer (1)

Sol. In male frogs, copulatory pad is present on the first digit of the forelimbs which are absent in female frogs.

147. Given below are two statements:

Statement I : The primary source of energy in an ecosystem is solar energy.

Statement II : The rate of production of organic matter during photosynthesis in an ecosystem is called net primary productivity (NPP).

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

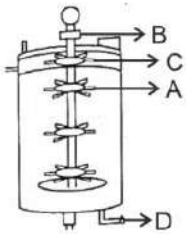
(1) Statement I is incorrect but statement II is correct
(2) Both statement I and statement II are correct
(3) Both statement I and statement II are incorrect
(4) Statement I is correct but statement II is incorrect

Answer (4)

Sol. Primary source of energy in the ecosystem is solar energy.

Gross primary productivity of an ecosystem is the rate of production of organic matter during photosynthesis. Hence, statement I is correct but statement II is incorrect.

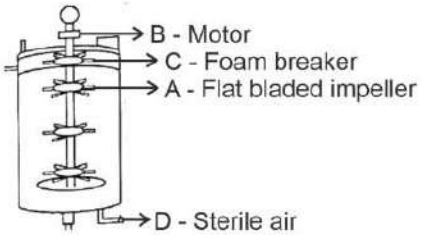
148. Identify the part of a bio-reactor which is used as a foam braker from the given figure.



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

Answer (1)

Sol.



∴ Part labelled as C is foam breaker.

149. Polymerase chain reaction (PCR) amplifies DNA following the equation.

(1) $2N^2$
(2) N^2
(3) 2^n
(4) $2n + 1$

Answer (3)

Sol. PCR *i.e.*, polymerase chain reaction amplifies DNA as per the equation 2^n, where '*n*' refers to number of cycles.

Thus, say, if 3 PCR cycles will run, then 2^3 *i.e.*, $2 \times 2 \times 2 \Rightarrow 8$ DNA fragments will be formed.

150. Match **List - I** with **List - II.**

	List - I		List - II
A.	Head	(I)	Enzymes
B.	Middle piece	(II)	Sperm motility
C.	Acrosome	(III)	Energy
D.	Tail	(IV)	Genetic material

Choose the correct answer from the options given below :

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

Answer (2)

Sol.
- The sperm head contains elongated nucleus which possesses the genetic material.
- The middle piece possesses numerous mitochondria, which produce energy for movement.
- Acrosome is a cap-like structure filled with enzymes that help in fertilization of ovum.
- The tail of sperm facilitates sperm motility essential for fertilisation.

151. Given below are two statements:

Statement I: In a floral formula ⊕ stands for zygomorphic nature of the flower, and $\underline{G}$ stands for inferior ovary.

Statement II: In a floral formula ⊕ stands for actinomorphic nature of the flower and $\underline{G}$ stands for superior ovary.

In the light of the above statements, choose the **correct** answer from the options given below:

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

Answer (1)

Sol. The floral formula symbol ⊕ is used for actinomorphic flower, while % is used for zygomorphic flower.

The symbol G represents gynoecium and $\underline{G}$ symbol represent superior ovary, while inferior ovary is represented by $\bar{G}$.

Thus, statement I is incorrect and Statement II is correct.

152. From the statements given below choose the **correct** option :

A. The eukaryotic ribosomes are 80S and prokaryotic ribosomes are 70S.

B. Each ribosome has two sub-units.

C. The two sub-units of 80S ribosome are 60S and 40S while that of 70S are 50S and 30S.

D. The two sub-units of 80S ribosome are 60S and 20S and that of 70S are 50S and 20S.

E. The two sub-units of 80S are 60S and 30S and that of 70S are 50S and 30S.

(1) B, D, E are true
(2) A, B, C are true
(3) A, B, D are true
(4) A, B, E are true

Answer (2)

Sol. The eukaryotic ribosomes are 80S and prokaryotic ribosomes are 70S type.

Each ribosome has two sub-units.

The two sub-units of 80S ribosome are 60S and 40S while that of 70S are 50S and 30S.

153. Each of the following characteristics represent a Kingdom proposed by Whittaker. Arrange the following in increasing order of complexity of body organization.

A. Multicellular heterotrophs with cell wall made of chitin.

B. Heterotrophs with tissue/organ/organ system level of body organization.

C. Prokaryotes with cell wall made of polysaccharides and amino acids.

D. Eukaryotic autotrophs with tissue/organ level of body organization.

E. Eukaryotes with cellular body organization.

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

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

Answer (3)

Sol. Increasing order of complexity of body organisation in the kingdom given by R.H. Whittaker is as follows-

C. Monera-Prokaryotes with cell wall made up of polysaccharide.

↓

E. Protista - Unicellular eukaryotes.

↓

A. Fungi -Multicellular heterotrophic with cell wall made up of chitin.

↓

D. Plantae - Eukaryotes autotrophs with tissue body organisation.

↓

B. Animalia - Heterotrophs with tissue organ/system of body organisation

Correct sequence is C, E, A, D, B.

154. The correct sequence of events in the life cycle of bryophytes is

A. Fusion of antherozoid with egg.

B. Attachment of gametophyte to substratum.

C. Reduction division to produce haploid spores.

D. Formation of sporophyte.

E. Release of antherozoids into water.

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

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

Answer (4)

Sol. The correct sequence of events in the life cycle of bryophytes is

- Attachment of gametophyte to substratum.
- Release of antherozoids into water.
- Fusion of antherozoid with egg.
- Formation of sporophyte.
- Reduction division to produce haploid spores.

155. Which are correct:

A. Computed tomography and magnetic resonance imaging detect cancers of internal organs.

B. Chemotherapeutics drugs are used to kill non-cancerous cells.

C. α -interferon activate the cancer patients' immune system and helps in destroying the tumour.

D. Chemotherapeutic drugs are biological response modifiers.

E. In the case of leukaemia blood cell counts are decreased.

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

(1) A and C only

(2) B and D only

(3) D and E only

(4) C and D only

Answer (1)

Sol. Statements A and C are correct while statements B, D and E are incorrect.

Chemotherapeutic drugs are used to kill cancerous cells.

In case of leukaemia, blood cell counts are increased.

α-interferons are biological response modifiers.

156. Name the class of enzyme that usually catalyze the following reaction :

$S - G + S^{\#} \rightarrow S + S^{\#} - G$

Where, $G \rightarrow$ a group other than hydrogen

$S \rightarrow$ a substrate

$S^{\#} \rightarrow$ another substrate

(1) Ligase

(2) Hydrolase

(3) Lyase

(4) Transferase

Answer (4)

Sol. Enzymes catalysing a transfer of G group, (other than hydrogen) between a pair of substrates, S and S' are known as transferases.

$S - G + S^{\#} \rightarrow S + S^{\#} - G$

- Ligases catalyse the linking together of 2 compounds such as C – O, C – S, C – N bonds *etc*
- Lyases catalyse removal of groups from substrates by mechanisms other than hydrolysis leaving double bonds

Hydrolases are enzymes that catalyse hydrolysis of ester, ether, peptide , glycosidic, C – C, C – halide or P – N bonds.

157. Find the correct statement :

(A) In human pregnancy, the major organ systems are formed at the end of 12 weeks.

(B) In human pregnancy the major organ systems are formed at the end of 8 weeks.

(C) In human pregnancy heart is formed after one month of gestation.

(D) In human pregnancy, limbs and digits develop by the end of second month.

(E) In human pregnancy the appearance of hair is usually observed in the fifth month.

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

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

Answer (1)

Sol. In a human female's pregnancy.

- By the end of 12 weeks (1st trimester), most of major organ systems are formed (not by end of 8 weeks).
- After one month of pregnancy, the embryo's heart is formed.
- By the end of second month of pregnancy, the foetus develops limbs and digits.
- The first movements of foetus and appearance of hair on head are usually observed during the fifth month.

158. Which of the following is an example of non-distilled alcoholic beverage produced by yeast?

(1) Rum
(2) Whisky
(3) Brandy
(4) Beer

Answer (4)

Sol. Wine and beer are produced without distillation whereas whisky, brandy and rum are produced by distillation of fermented broth.

159. Given below are two statements :

Statement I : In the RNA world, RNA is considered the first genetic material evolved to carry out essential life processes. RNA acts as a genetic material and also as a catalyst for some important biochemical reactions in living systems. Being reactive, RNA is unstable.

Statement II : DNA evolved from RNA and is a more stable genetic material. Its double helical strands being complementary, resist changes by evolving repairing mechanism.

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

(1) Statement I is incorrect but statement II is correct

(2) Both statement I and statement II are correct

(3) Both statement I and statement II are incorrect

(4) Statement I is correct but statement II is incorrect

Answer (2)

Sol. In RNA world, RNA was the first genetic material as there are enough evidences to suggest that essential life processes (such as metabolism, translation, splicing, etc) evolved around RNA. RNA used to act as a genetic material as well as catalyst (there are some important biochemical reaction in living systems that are catalysed by RNA catalysts not by protein enzymes) so, statement I is correct statement II is also correct as DNA being double stranded and having complementary strands further resists changes by evolving a process of repair.

160. Given below are two statements :

Statement I : Transfer RNAs and ribosomal RNA do not interact with mRNA.

Statement II : RNA interference (RNAi) takes place in all eukaryotic organisms as a method of cellular defence.

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

(1) Statement I is incorrect but statement II is correct

(2) Both statement I and statement II are correct

(3) Both statement I and statement II are incorrect

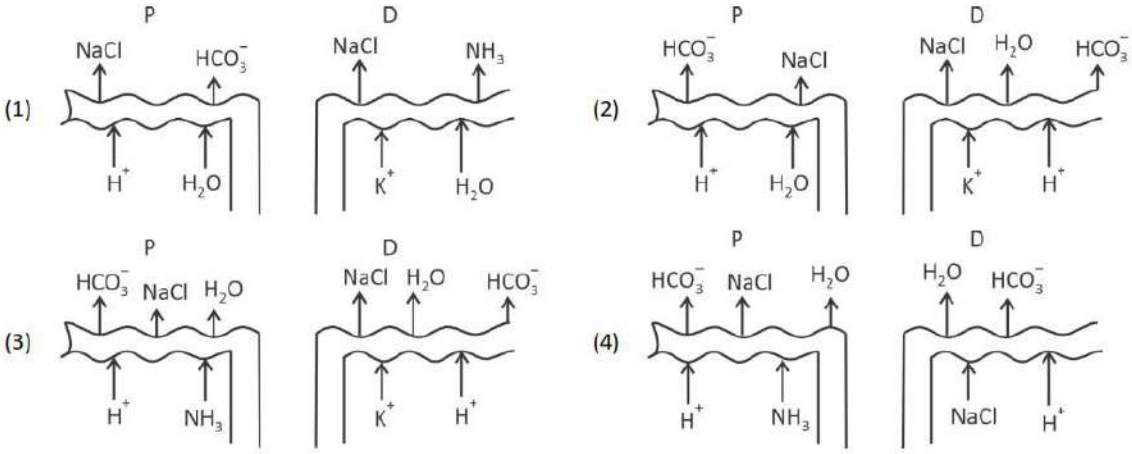
(4) Statement I is correct but statement II is incorrect

Answer (1)

Sol. Both transfer RNAs and ribosomal RNA interact with mRNA.

RNA interference (RNAi) takes place in all eukaryotic organisms as a method of cellular defence.

161. Which of the following diagrams is correct with regard to the proximal (P) and distal (D) tubule of the Nephron.



Answer (3)

Sol. During urine formation, the tubular cells secrete substances like H^+, K^+ and ammonia into the filtrate. Tubular secretion is also an important step in urine formation as it helps in the maintenance of ionic and acid base balance of body fluids.

PCT $\rightarrow$ Selective secretion of H^+, ammonia and K^+ into the filtrate.

DCT $\rightarrow$ Capable of reabsorption of HCO_3^- and selective secretion of H^+, K^+ and NH_3.

162. What is the pattern of inheritance for polygenic trait?

(1) X-linked recessive inheritance pattern

(2) Mendelian inheritance pattern

(3) Non-mendelian inheritance pattern

(4) Autosomal dominant pattern

Answer (3)

Sol. Polygenic inheritance refers to the inheritance of a trait controlled by two or more genes. When human disorders are determined by mutation in the single gene then they are transmitted to the offspring as per Mendelian principle. Polygenic trait shows non-Mendelian inheritance pattern.

163. In the seeds of cereals, the outer covering of endosperm separates the embryo by a protein-rich layer called :

(1) Aleurone layer
(2) Coleoptile
(3) Coleorhiza
(4) Integument

Answer (1)

Sol. In monocot seeds, the outer covering of endosperm separates the embryo by a proteinous layer called aleurone layer.

164. Match **List I** with **List II**:

	List-I		List-II
A.	Chlorophyll a	(I)	Yellow-green
B.	Chlorophyll b	(II)	Yellow
C.	Xanthophylls	(III)	Blue-green
D.	Carotenoids	(IV)	Yellow to Yellow-orange

Choose the option with all **correct** matches.

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

Answer (3)

Sol. A chromatographic separation of the leaf pigments shows that the colour that we see in leaves is not due to single pigment but due to four pigments.

Chlorophyll a	–	Bright or blue-green in the chromatogram
Chlorophyll b	–	Yellow-green
Xanthophylls	–	Yellow
Carotenoids	–	Yellow to Yellow-orange

165. Which of the following genetically engineered organisms was used by Eli Lilly to prepare human insulin?

(1) Phage
(2) Bacterium
(3) Yeast
(4) Virus

Answer (2)

Sol. The correct answer is bacterium.

In 1983, Eli Lilly, an American company, prepared two DNA sequences corresponding to 'A' and 'B' chains of human insulin and introduced them in plasmids of *E.coli* (a gram negative bacterium) to produce insulin chains.

166. Which of the following are the post-transcriptional events in an eukaryotic cell?

A. Transport of pre-mRNA to cytoplasm prior to splicing.

B. Removal of introns and joining of exons.

C. Addition of methyl group at 5' end of hnRNA.

D. Addition of adenine residues at 3' end of hnRNA.

E. Base pairing of two complementary RNAs.

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

(1) C, D, E only

(2) A, B, C only

(3) B, C, D only

(4) B, C, E only

Answer (3)

Sol. The process of copying genetic information from one strand of the DNA into RNA is known as transcription. It occurs in the cytoplasm with the help of transcripting enzyme.

Transport of pre-mRNA to cytoplasm prior to splicing is a part of transcription.

The primary transcript is converted into functional mRNA after post transcriptional processing involves 3 steps as follows-

- Modification of 5' end by capping,
- Tailing,
- Splicing.

Base pairing of two complementary RNA is not on event of post-transcription. Hence, statements B, C, D are post-transcriptional modification events in eukaryotic cell.

167. Match **List-I** with **List- II**.

	List-I		**List-II**
A.	Centromere	I.	Mitochondrion
B.	Cilium	II.	Cell division
C.	Cristae	III.	Cell movement
D.	Cell membrane	IV.	Phospholipid Bilayer

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

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

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

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

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

Answer (1)

Sol. Centromere - Helps in cell division

Cilium - Helps in cell movement

Cristae - Finger like structures of mitochondria

Cell membrane - Is a phospholipid bilayer

168. Match **List I** with **List II**:

	List-I		List-II
A.	Alfred Hershey and Martha Chase	I.	Streptococcus pneumoniae
B.	Euchromatin	II.	Densely packed and dark-stained
C.	Frederick Griffith	III.	Loosely packed and light-stained
D.	Heterochromatin	IV.	DNA as genetic material confirmation

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

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

Answer (4)

Sol. The unequivocal proof that DNA is the genetic material came from the experiment of Alfred Hershey and Martha Chase.

Euchromatin are lightly stained region with loosely packed chromatin fibre.

Frederick Griffith performed series of experiments by selecting the different strains of *Streptococcus pneumoniae.*

Heterochromatin are darkly stained region with tightly packed chromatin fibre.

169. Which chromosome in the human genome has the highest number of genes?

(1) Chromosome 10
(2) Chromosome X
(3) Chromosome Y
(4) Chromosome 1

Answer (4)

Sol. In human genome, Chromosome 1 has the highest number of genes, *i.e.*, 2968.

170. What are the potential drawbacks in adoption of the IVF method?

A. High fatality risk to mother

B. Expensive instruments and reagents

C. Husband/wife necessary for being donors

D. Less adoption of orphans

E. Not available in India

F. Possibility that the early embryo does not survive

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

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

Answer (2)

Sol. Statements B, D and F are correct while statements A, C and E are incorrect.

Husband/wife is not necessary for being donors. IVF is available ins India.

171. Which one of the following is an example of ex-situ conservation?

(1) Protected areas
(2) National Park
(3) Wildlife Sanctuary
(4) Zoos and botanical gardens

Answer (4)

Sol. Zoological parks (Zoos), botanical gardens and wildlife safari parks are examples of ex-situ conservation. Sacred groves, biosphere reserves, national parks and wildlife sanctuaries are examples of in-situ conservation.

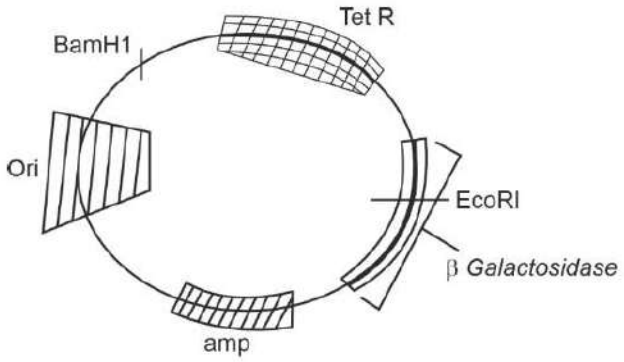
172. A specialised membranous structure in a prokaryotic cell which helps in cell well wall formation, DNA replication and respiration is

(1) Endoplasmic Reticulum
(2) Mesosome
(3) Chromatophores
(4) Cristae

Answer (2)

Sol. Mesosome is membranous extension in bacterial cell that helps in cell wall formation, DNA replication and contains enzymes for respiration.

173.



In the above represented plasmid, an alien piece of DNA is inserted at EcoRI site. Which of the following strategies will be chosen to select the recombinant colonies?

(1) Blue color colonies grown on ampicillin plates can be selected.
(2) Using ampicillin & tetracycline containing medium plate.
(3) Blue color colonies will be selected.
(4) White color colonies will be selected.

Answer (4)

Sol. The correct answer is that white-colored colonies will be selected.

Since an alien piece of DNA is being inserted at *Eco*RI site, the gene β-galactosidase present here will undergo insertional inactivation.

This gene is responsible for producing blue-colored colonies, but since it has been insertionally inactivated, white colored colonies will be produced.

Ampicillin and tetracycline resistance genes present in the given DNA will remain intact. Thus, the given DNA will show amp^R and tet^R.

174. What is the name of the blood vessel that carries deoxygenated blood from the body to the heart in a frog?

(1) Vena cava
(2) Aorta
(3) Pulmonary artery
(4) Pulmonary vein

Answer (1)

Sol. Frog's heart is a muscular structure with three chambers. It receives deoxygenated blood from body parts through the major veins called vena cava. Vena cava carries deoxygenated blood. Aorta and pulmonary vein carries oxygenated blood. Whereas, pulmonary artery will carry deoxygenated blood towards the lungs.

175. Which of following organisms **cannot** fix nitrogen?

A. *Azotobacter*
B. *Oscillatoria*
C. *Anabaena*
D. *Volvox*
E. *Nostoc*

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

(1) E only
(2) A only
(3) D only
(4) B only

Answer (3)

Sol. *Azotobacter*, *Oscillatoria*, *Anabaena* and *Nostoc* can fix nitrogen but *Volvox* cannot fix nitrogen.

176. While trying to find out the characteristic of a newly found animal, a researcher did the histology of adult animal and observed a cavity with presence of mesodermal tissue towards the body wall but no mesodermal tissue was observed towards the alimentary canal. What could be the possible coelome of that animal?

(1) Spongocoelomate
(2) Acoelomate
(3) Pseudocoelomate
(4) Schizocoelomate

Answer (3)

Sol. In pseudocoelomates, the body cavity is not entirely lined with mesoderm, instead, mesodermal tissue is present along the body wall but not towards the gut.

- Schizocoelomates are animals whose coelom or body cavity develops middle from a split in the mesoderm, the middle germ layer of the embryo.
- In acoelomates, coelom is absent.

Spongocoel is a central cavity found in Sponges.

177. Which one of the following statements refers to Reductionist Biology?

(1) Behavioural approach to study and understand living organisms
(2) Physico-chemical approach to study and understand living organisms
(3) Physiological approach to study and understand living organisms
(4) Chemical approach to study and understand living organisms

Answer (2)

Sol. The physico-chemical approach to study and understand living organisms is called 'Reductionist Biology'.

178. Epiphytes that are growing on a mango branch is an example of which of the following?

(1) Amensalism

(2) Commensalism

(3) Mutualism

(4) Predation

Answer (2)

Sol. Commensalism is the type of interaction in which one-species benefits and another is neither harmed nor benefited. An orchid growing as an epiphyte on a mango branch is an example of commensalism.

179. Which one of the following phytohormones promotes nutrient mobilization which helps in the delay of leaf senescence in plants?

(1) Cytokinin

(2) Ethylene

(3) Abscisic acid

(4) Gibberellin

Answer (1)

Sol. Cytokinins help to overcome apical dominance. They promote nutrient mobilisation which helps in the delay of leaf senescence.

180. The complex II of mitochondrial electron transport chain is also known as

(1) NADH dehydrogenase

(2) Cytochrome bc_1

(3) Succinate dehydrogenase

(4) Cytochrome c oxidase

Answer (3)

Sol. Complex II of mitochondrial electron transport chain is also known as succinate dehydrogenase. Cytochrome c oxidase (complex IV), NADH dehydrogenase (complex I), cytochrome bc_1 (complex III).

DATE : 04/05/2025

Test Booklet Code

48

NARMADA

Answers & Solutions for NEET (UG)-2025

Time : 3 hrs.

M.M.: 720

Important Instructions:

1. The test is of **3 hours** duration and the Test Booklet contains **180** multiple choice questions (Four options with a single correct answer) from **Physics, Chemistry and Biology (Botany and Zoology)**.
2. Each question carries **4 marks**. For each correct response, the candidate will get **4 marks**. For every wrong response **1 mark** shall be deducted from the total scores. The maximum marks are **720**.
3. Use **Blue / Black Ball Point Pen only** for writing particulars on this page / marking responses on Answer Sheet.
4. Rough work is to be done in the space provided for this purpose in the Test Booklet only.
5. On completion of the test, the candidate **must hand over the Answer Sheet (ORIGINAL and OFFICE Copy)** to the Invigilator before leaving the Room / Hall. The candidates are allowed to take away this Test Booklet with them.
6. The CODE for this Booklet is **48**.
7. The candidates should ensure that the Answer Sheet is not folded. Do not make any stray marks on the Answer Sheet. Do not write your Roll No. anywhere else except in the specified space in the Test Booklet/Answer Sheet. Use of white fluid for correction is **NOT** permissible on the Answer Sheet.
8. Each candidate must show on-demand his/her Admit Card to the Invigilator.
9. No candidate, without special permission of the Centre Superintendent or Invigilator, would leave his/her seat.
10. Use of Electronic/Manual Calculator is prohibited.
11. The candidates are governed by all Rules and Regulations of the examination with regard to their conduct in the Examination Room/Hall. All cases of unfair means will be dealt with as per Rules and Regulations of this examination along with Public Examinations (Prevention of unfair means act 2024).
12. **No part of the Test Booklet and Answer Sheet shall be detached under any circumstances.**
13. The candidates will write the Correct Test Booklet Code as given in the Test Booklet / Answer Sheet in the Attendance Sheet.

PHYSICS

1. A parallel plate capacitor made of circular plates is being charged such that the surface charge density on its plates is increasing at a constant rate with time. The magnetic field arising due to displacement current is:

(1) Non-zero everywhere with maximum at the imaginary cylindrical surface connecting peripheries of the plates

(2) Zero between the plates and non-zero outside

(3) Zero at all places

(4) Constant between the plates and zero outside the plates

Answer (1)

Sol. Let the surface charge density be $\sigma = \frac{q}{A}$

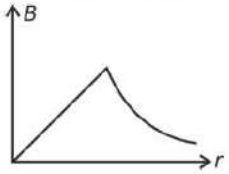
Given $\frac{d\sigma}{dt}$ = constant

$\therefore \quad \frac{d}{dt}\left(\frac{q}{A}\right)$ = constant $\Rightarrow \frac{I}{A}i$ = constant

It means displacement current is constant.

This system will act like a cylindrical wire.

The graph of magnetic field (B) vs r is



2. An electric dipole with dipole moment 5×10^{-6} Cm is aligned with the direction of a uniform electric field of magnitude 4×10^5 N/C. The dipole is then rotated through an angle of 60° with respect to the electric field. The change in the potential energy of the dipole is:

(1) 1.2 J

(2) 1.5 J

(3) 0.8 J

(4) 1.0 J

Answer (4)

Sol. Given

$|\vec{P}| = 5 \times 10^{-6}$ C m

$|\vec{E}| = 4 \times 10^5$ N/C

$\theta_i = 0°$ and $\theta_f = 60°$

$\Delta U = U_f - U_i$

$= -PE\cos\theta_f + PE\cos\theta_i$

$= PE[\cos\theta_i - \cos\theta_f]$

$= 5 \times 10^{-6} \times 4 \times 10^5 \left[1 - \frac{1}{2}\right]$

$= 10 \times 10^{-6} \times 10^5 = 1$ J

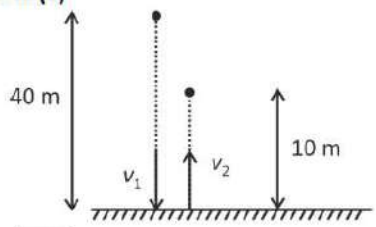
3. A ball of mass 0.5 kg is dropped from a height of 40 m. The ball hits the ground and rises to a height of 10 m. The impulse imparted to the ball during its collision with the ground is (Take g = 9.8 m/s^2)

(1) 0 (2) 84 NS

(3) 21 NS (4) 7 NS

Answer (3)

Sol.



$v_1 = \sqrt{2gh_1}$

$= \sqrt{2 \times 9.8 \times 40}$

$v_1 = \sqrt{784} = 28\,\text{m s}^{-1}$

and $v_2 = \sqrt{2gh_2} = \sqrt{2 \times 9.8 \times 10}$

$= \sqrt{196} = 14\,\text{m s}^{-1}$

Impulse $= \Delta\vec{p} = m\left(\vec{v}_f - \vec{v}_i\right) = m\left(\vec{v}_2 - \vec{v}_1\right)$

$= \frac{1}{2}(14 - (-28))$

= 21 NS

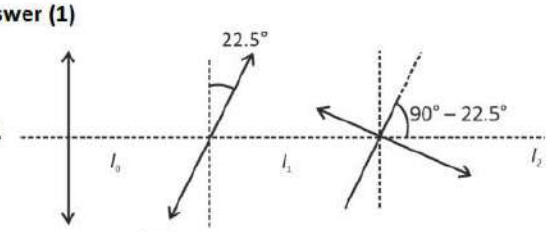
4. The intensity of transmitted light when a polaroid sheet, placed between two crossed polaroids at 22.5° from the polarization axis of one of the polaroids, is (I_0 is the intensity of polarised light after passing through the first polaroid):

(1) $\frac{I_0}{8}$ (2) $\frac{I_0}{16}$

(3) $\frac{I_0}{2}$ (4) $\frac{I_0}{4}$

Answer (1)

Sol.



$I_1 = I_0 \cos^2\left(\frac{45}{2}\right)$

$I_2 = I_1 \cos^2\left(90 - \frac{45}{2}\right)$

$= I_0 \cos^2\left(\frac{45}{2}\right)\sin^2\left(\frac{45}{2}\right)$

$= \frac{I_0}{4}\left(4\cos^2\left(\frac{45}{2}\right)\sin^2\left(\frac{45}{2}\right)\right)$

$= \frac{I_0}{4}\sin^2 45^\circ = \frac{I_0}{8}$

5. The kinetic energies of two similar cars A and B are 100 J and 225 J respectively. On applying breaks, car A stops after 1000 m and car B stops after 1500 m. If F_A and F_B are the forces applied by the breaks on cars A and B respectively, then the ratio of $\frac{F_A}{F_B}$ is

(1) $\frac{1}{3}$ (2) $\frac{1}{2}$

(3) $\frac{3}{2}$ (4) $\frac{2}{3}$

Answer (4)

Sol. By work-energy theorem,

$FS = \Delta K \cdot E$

$\Rightarrow \quad -FS = k_f - k_i$

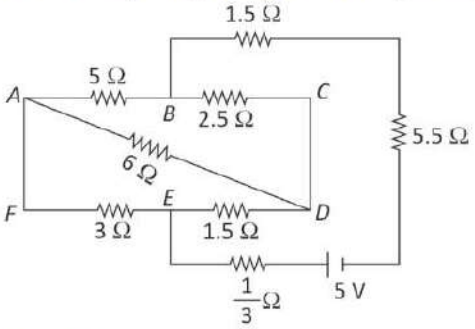
$\Rightarrow \quad FS = k_i - k_f$

$\Rightarrow \quad \frac{F_A}{F_B} = \frac{k_A}{k_B} \times \frac{S_B}{S_A}$

$= \frac{100}{225} \times \frac{1500}{1000}$

$= \frac{150}{225} = \frac{2}{3}$

6. The current passing through the battery in the given circuit, is:

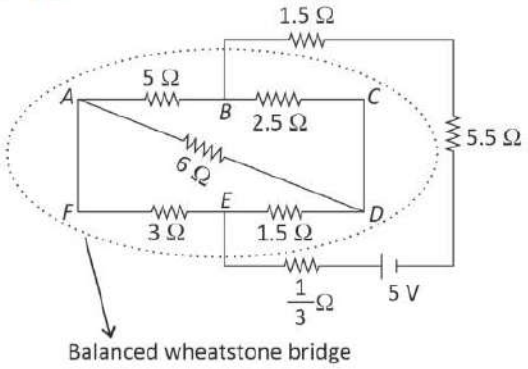


(1) 2.5 A (2) 1.5 A

(3) 2.0 A (4) 0.5 A

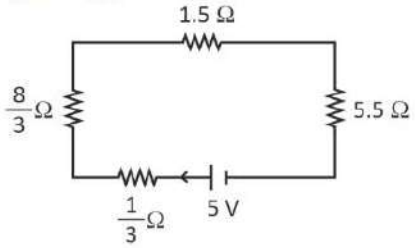
Answer (4)

Sol.



$\therefore$ its equivalent $R' = \frac{4 \times 8}{12} = \frac{8}{3}\Omega$

Circuit can be redrawn as

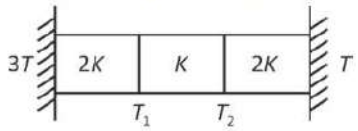


$$R_{eq} = \frac{8}{3} + \frac{1}{3} + 1.5 + 5.5$$

$= 10\ \Omega$

$$i = \frac{V}{R_{eq}} = \frac{5}{10} = 0.5\,A$$

7. Three identical heat conducting rods are connected in series as shown in the figure. The rods on the sides have thermal conductivity $2K$ while that in the middle has thermal conductivity K. The left end of the combination is maintained at temperature $3T$ and the right end at T. The rods are thermally insulated from outside. In steady state, temperature at the left junction is T_1 and that at the right junction is T_2. The ratio T_1/T_2 is



(1) $\frac{5}{3}$ (2) $\frac{5}{4}$

(3) $\frac{3}{2}$ (4) $\frac{4}{3}$

Answer (1)

Sol. In series, $R_{eq.} = R_1 + R_2 + R_3$

$$= \frac{l}{2KA} + \frac{l}{KA} + \frac{l}{2KA}$$

$$= \frac{4l}{2KA}$$

$$R_{eq.} = \frac{2l}{KA}$$

In series rate of heat flow is same

$$\therefore \quad \frac{3T - T_1}{R_1} = \frac{3T - T}{R_{eq.}}$$

$$\frac{(3T - T_1)2KA}{l} = \frac{(2T)KA}{2l}$$

$\Rightarrow \quad 6T - 2T_1 = T$

$\Rightarrow \quad 2T_1 = 5T$

$\Rightarrow \quad T_1 = \frac{5T}{2} \quad ...(1)$

Now, equate heat flow rate in 3rd section & total section

$$\frac{T_2 - T}{R_3} = \frac{3T - T}{R_{eq.}}$$

$$\Rightarrow \quad \frac{(T_2 - T)(2KA)}{I} = \frac{2T(KA)}{2I}$$

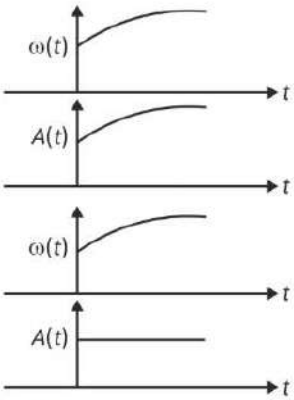
$$\Rightarrow \quad 2T_2 - 2T = T$$

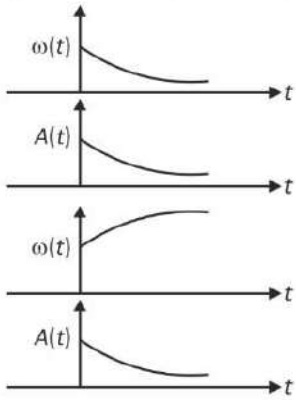
$$\Rightarrow \quad T_2 = \frac{3T}{2} \quad ...(2)$$

By equation (1) and equation (2)

$$\frac{T_1}{T_2} = \frac{5T \times 2}{2 \times 3T} = \frac{5}{3}$$

8. In an oscillating spring mass system, a spring is connected to a box filled with sand. As the box oscillates, sand leaks slowly out of the box vertically so that the average frequency $\omega(t)$ and average amplitude $A(t)$ of the system change with time t. Which one of the following options schematically depicts these changes correctly?

(1)


(2)


(3)

(4)

Answer (4)

Sol. At any point of time, time period is given by

$$T = 2\pi\sqrt{\frac{m}{k}}$$

Here m is decreasing, so time period T will be decreasing

Since $\omega = \frac{2\pi}{T}$

Hence as mass leaks, ω will increase

Now, at any instant

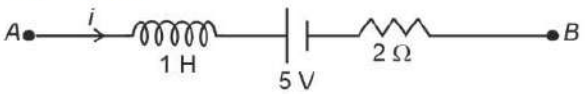
$mg = kx_0$

So, equilibrium length $x_0 = \frac{mg}{k}$, where m is decreasing

So, equilibrium length will decrease.

So, amplitude also go on decreasing.

9. AB is a part of an electrical circuit (see figure). The potential difference "$V_A - V_B$", at the instant when current i = 2 A and is increasing at a rate of 1 amp/second is:



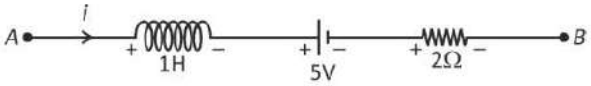
(1) 9 volt

(2) 10 volt

(3) 5 volt

(4) 6 volt

Answer (2)

Sol. 

Given, $I = 2A$ and $\frac{di}{dt} = +1A/s$

$$V_A - L\frac{di}{dt} - 5 - i \times 2 = V_B$$

$\Rightarrow$ $V_A - 1 \times 1 - 5 - 2 \times 2 = V_B$

$\Rightarrow$ $V_A - V_B = 10$ volt

10. A particle of mass m is moving around the origin with a constant force F pulling it towards the origin. If Bohr model is used to describe its motion, the radius of the nth orbit and the particle's speed v in the orbit depend on n as

(1) $r \propto n^{2/3}; v \propto n^{1/3}$
(2) $r \propto n^{4/3}; v \propto n^{-1/3}$
(3) $r \propto n^{1/3}; v \propto n^{1/3}$
(4) $r \propto n^{1/3}; v \propto n^{2/3}$

Answer (1)

Sol. Given, force is constant

$$F = \frac{mv^2}{r}$$

$\Rightarrow$ $\frac{v^2}{r}$ = constant

$\Rightarrow$ $r \propto v^2$ ...(1)

& $L = mvr = \frac{nh}{2\pi}$ ...(2)

$\Rightarrow$ on solving equation (1) and equation (2)

$v \propto n^{1/3}$ and $r \propto n^{2/3}$

11. In some appropriate units, time (t) and position (x) relation of a moving particle is given by $t = x^2 + x$. The acceleration of the particle is

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

Answer (4)

Sol. $t = x^2 + x$

$$\frac{dt}{dx} = 2x + 1$$

$$v = \frac{dx}{dt} = \frac{1}{(2x+1)}$$

$$\frac{dv}{dx} = \frac{-2}{(2x+1)^2}$$

$$a = v\frac{dv}{dx} = \frac{1}{(2x+1)}\left[\frac{-2}{(2x+1)^2}\right]$$

$$= -\frac{2}{(2x+1)^3}$$

12. A model for quantized motion of an electron in a uniform magnetic field B states that the flux passing through the orbit of the electron in $n(h/e)$ where n is an integer, h is Planck's constant and e is the magnitude of electron's charge. According to the model, the magnetic moment of an electron in its lowest energy state will be (m is the mass of the electron)

(1) $\frac{heB}{\pi m}$ (2) $\frac{heB}{2\pi m}$

(3) $\frac{he}{\pi m}$ (4) $\frac{he}{2\pi m}$

Answer (4)

Sol. Magnetic force = $\frac{mv^2}{r}$

$$evB = \frac{mv^2}{r}$$

$$v = \frac{eBr}{m}$$

$$\phi = BA$$

$$\frac{nh}{e} = B\pi r^2$$

$$Br^2 = \frac{nh}{e\pi}$$

$$\mu = IA$$

$$= \frac{e}{T}\pi r^2$$

$$= \frac{e \times v}{2\pi r}\pi r^2$$

$$\mu = \frac{evr}{2}$$

$$= \frac{1}{2}e \times \frac{eBr}{m}r$$

$$\mu = \frac{1}{2}e^2\frac{Br^2}{m}$$

$$\mu = \frac{1}{2}e^2\frac{nh}{e\pi m}$$

$$\mu = \frac{neh}{2\pi m}$$

for $n = 1$

$$\mu = \frac{eh}{2\pi m}$$

13. A microscope has an objective of focal length 2 cm, eyepiece of focal length 4 cm and the tube length of 40 cm. If the distance of distinct vision of eye is 25 cm, the magnification in the microscope is

(1) 150 (2) 250

(3) 100 (4) 125

Answer (4)

Sol. $m = \frac{L}{f_o} \times \frac{D}{f_e}$

$$= \frac{40}{2} \times \frac{25}{4}$$

$m = 125$

14. There are two inclined surfaces of equal length (L) and same angle of inclination 45° with the horizontal. One of them is rough and the other is perfectly smooth. A given body takes 2 times as much time to slide down on rough surface than on the smooth surface. The coefficient of kinetic friction (μ_k) between the object and the rough surface is close to

(1) 0.5 (2) 0.75

(3) 0.25 (4) 0.40

Answer (2)

Sol. $t_{rough} = 2t_{smooth}$

$a_{smooth} = g\sin\theta$

$$t \propto \frac{1}{\sqrt{a}} \Rightarrow t_{smooth} \propto \frac{1}{\sqrt{g\sin\theta}}$$

$a_{rough} = g\sin\theta - \mu_k g\cos\theta$

$$\frac{t_{rough}}{t_{smooth}} = \frac{\sqrt{\sin\theta}}{\sqrt{\sin\theta - \mu_k\cos\theta}} = 2$$

Squaring both sides

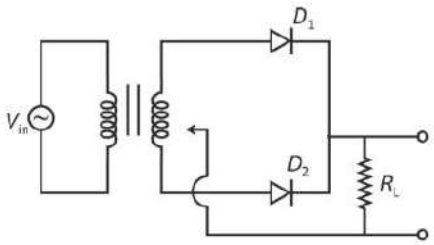
$$\frac{\sin\theta}{\sin\theta - \mu_k\cos\theta} = 4 \Rightarrow \frac{\frac{1}{\sqrt{2}}}{\frac{1}{\sqrt{2}} - \mu_k \times \frac{1}{\sqrt{2}}} = 4$$

$$\Rightarrow 1 - \mu_k = \frac{1}{4}$$

$$\mu_k = \frac{3}{4}$$

$= 0.75$

15. A full wave rectifier circuit with diodes (D_1) and (D_2) is shown in the figure. If input supply voltage $V_{in} = 220\sin(100\pi t)$ volt, then at $t = 15$ msec



(1) D_1 and D_2 both are forward biased (2) D_1 and D_2 both are reverse biased

(3) D_1 is forward biased, D_2 is reverse biased (4) D_1 is reverse biased, D_2 is forward biased.

Answer (4)

Sol. $V_{in} = 220\sin(100\pi t)$ volt

$t = 15$ ms

$t = 0.015$ s

$\omega = 100\pi$

$$\frac{2\pi}{T} = 100\pi$$

$$T = \frac{1}{50}\text{ s}$$

$T = 0.02$ s

$$\therefore\ t = \frac{3T}{4}$$

i.e. negative half cycle.

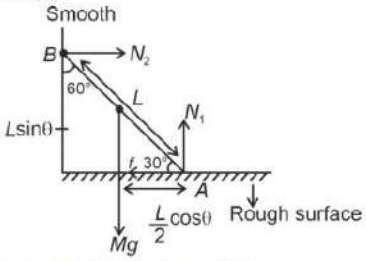
So now negative half cycle is fed to circuit making D_1 as reverse biased and D_2 as forward biased.

16. A uniform rod of mass 20 kg and length 5 m leans against a smooth vertical wall making an angle of 60° with it. The other end rests on a rough horizontal floor. The friction force that the floor exerts on the rod is (Take $g = 10\ m/s^2$)

(1) 200 N
(2) $200\sqrt{3}$ N
(3) 100 N
(4) $100\sqrt{3}$ N

Answer (4)

Sol.



For translational equilibrium

$N_1 = Mg$

$N_2 = f$

For rotational equilibrium

Torque about A, $Mg\frac{L}{2}\cos\theta = N_2 L\sin\theta$

$$\frac{Mg}{2}\cot\theta = N_2 = f$$

$$\frac{Mg}{2}\cot 30^\circ = f$$

$$\frac{Mg}{2}\sqrt{3} = N_2$$

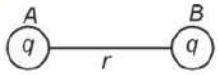
$$100\sqrt{3} = f$$

17. Two identical charged conducting spheres A and B have their centres separated by a certain distance. Charge on each sphere is q and the force of repulsion between them is F. A third identical uncharged conducting sphere is brought in contact with sphere A first and then with B and finally removed from both. New force of repulsion between spheres A and B (Radii of A and B are negligible compared to the distance of separation so that for calculating force between them they can be considered as point charges) is best given as:

(1) $\frac{F}{2}$
(2) $\frac{3F}{8}$
(3) $\frac{3F}{5}$
(4) $\frac{2F}{3}$

Answer (2)

Sol.



$$F = \frac{Kqq}{r^2}$$

$$F' = \frac{K\frac{q}{2}\frac{3q}{4}}{r^2}$$

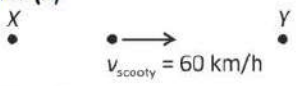
$$F' = \frac{3F}{8}$$

18. Two cities X and Y are connected by a regular bus service with a bus leaving in either direction every T min. A girl is driving scooty with a speed of 60 km/h in the direction X to Y notices that a bus goes past her every 30 minutes in the direction of her motion, and every 10 minutes in the opposite direction. Choose the correct option for the period T of the bus service and the speed (assumed constant) of the buses.

(1) 10 min, 90 km/h
(2) 15 min, 120 km/h
(3) 9 min, 40 km/h
(4) 25 min, 100 km/h

Answer (2)

Sol.



$X \to Y$

Let velocity of bus = v km/hr

Relative velocity of bus w.r.t. scooty = $(v - 60)$

Distance between 2 consecutive buses = vT

$(v - 60)30 = vT$ ...(i)

$Y \to X$

$(v + 60)10 = vT$ ...(ii)

Equating (1) and (2)

$(v - 60)30 = (v + 60)10$

$\therefore \quad v = 120$ km/hr

$T = 15$ min

19. A container has two chambers of volumes $V_1 = 2$ litres and $V_2 = 3$ litres separated by a partition made of a thermal insulator. The chambers contain $n_1 = 5$ and $n_2 = 4$ moles of ideal gas at pressures $p_1 = 1$ atm and $p_2 = 2$ atm, respectively. When the partition is removed, the mixture attains an equilibrium pressure of

(1) 1.4 atm
(2) 1.8 atm
(3) 1.3 atm
(4) 1.6 atm

Answer (4)

Sol. $P_1V_1 + P_2V_2 = P(V_1 + V_2)$

$1(2) + 2(3) = P(2 + 3)$

$\frac{8}{5} = P$

$\Rightarrow 1.6$ atm

20. De-Broglie wavelength of an electron orbiting in the $n = 2$ state of hydrogen atom is close to (Given Bohr radius = 0.052 nm)

(1) 1.67 nm
(2) 2.67 nm
(3) 0.067 nm
(4) 0.67 nm

Answer (4)

Sol. $r = 0.052\, n^2$

For $n = 2$

$r = 0.052 \times 4$

$= 0.208$ nm

$Mvr = \frac{nh}{2\pi}$

$\lambda = \frac{h}{Mv} = \pi r$

$= 3.14 \times 0.208$ nm

$= 0.65317$ nm

≈ 0.67 nm

21. To an ac power supply of 220 V at 50 Hz, a resistor of 20 Ω, a capacitor of reactance 25 Ω and an inductor of reactance 45 Ω are connected in series. The corresponding current in the circuit and the phase angle between the current and the voltage is, respectively

(1) 15.6 A and 30°

(2) 15.6 A and 45°

(3) 7.8 A and 30°

(4) 7.8 A and 45°

Answer (4)

Sol. $X_L = 45$ W , $X_C = 25$ W, $R = 20$ W

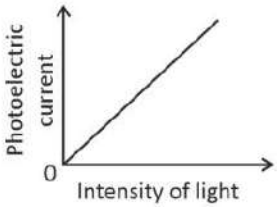
$$I = \frac{220}{\sqrt{(X_L - X_C)^2 + R^2}} = \frac{220}{\sqrt{(45-25)^2 + 20^2}}$$

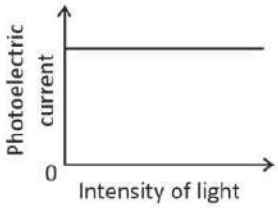
$$= \frac{220}{2\sqrt{2}} = \frac{11}{\sqrt{2}} = 7.779 \text{ A}$$

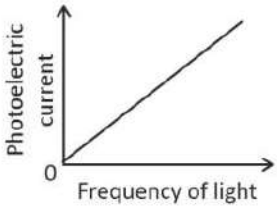
$$\tan\phi = \frac{X_L - X_C}{R} = \frac{45-25}{20} = 1$$

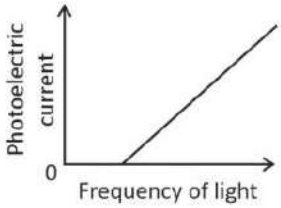
$f = 45°$

22. Which of the following options represent the variation of photoelectric current with property of light shown on the *x*-axis?

A.


B.


C.


D.


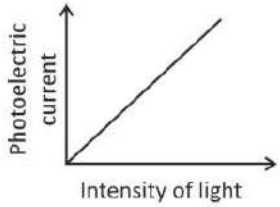
(1) A and D

(2) B and D

(3) A only

(4) A and C

Answer (3)

Sol.


Photoelectric current is directly proportional to intensity of light.

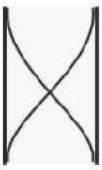
23. A pipe open at both ends has a fundamental frequency f in air. The pipe is now dipped vertically in a water drum to half of its length. The fundamental frequency of the air column is now equal to:

(1) $\frac{3f}{2}$ (2) $2f$

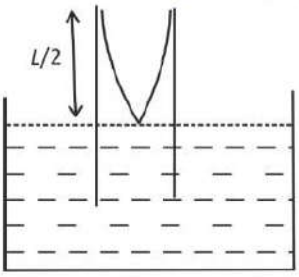
(3) $\frac{f}{2}$ (4) f

Answer (4)

Sol. Fundamental frequency of open pipe (at both ends) $f = \frac{v}{2L}$ ...(i)



Now immersed in water open pipe behaves as closed pipe.



$$f' = \frac{v}{4\left(\frac{L}{2}\right)} = \frac{v}{2L} \quad ...(ii)$$

$f = f'$

24. Two identical point masses P and Q, suspended from two separate massless springs of spring constants k_1 and k_2, respectively, oscillate vertically. If their maximum speeds are the same, the ratio (A_Q/A_P) of the amplitude A_Q of mass Q to the amplitude A_P of mass P is

(1) $\sqrt{\frac{k_2}{k_1}}$ (2) $\sqrt{\frac{k_1}{k_2}}$

(3) $\frac{k_2}{k_1}$ (4) $\frac{k_1}{k_2}$

Answer (2)

Sol. Maximum velocity $V = A\omega$

$v_P = v_Q$

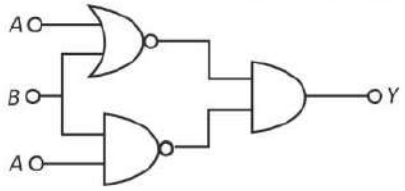
$A_P\omega_P = A_Q\omega_Q$

$$\frac{A_Q}{A_P} = \frac{\omega_P}{\omega_Q} \qquad \left(\omega = \sqrt{\frac{k}{m}}\right)$$

$$= \sqrt{\frac{k_P}{m_P}\frac{m_Q}{k_Q}}$$

$$= \sqrt{\frac{k_1}{k_2}}$$

25. The output (Y) of the given logic implementation is similar to the output of an/a _____ gate.

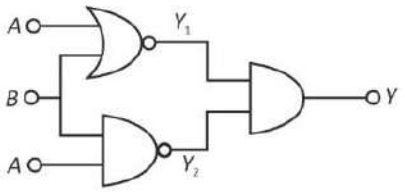


(1) OR (2) NOR

(3) AND (4) NAND

Answer (2)

Sol.



$Y_1 = \overline{A+B}$

$Y_2 = \overline{A \cdot B}$

$Y = Y_1 \cdot Y_2$

$= \overline{A+B} \cdot \overline{A \cdot B}$

$= \overline{(A+B) + A \cdot B}$

$= \overline{A + B(1+A)}$

$= \overline{A+B}$ NOR gate

26. An oxygen cylinder of volume 30 litre has 18.20 moles of oxygen. After some oxygen is withdrawn from the cylinder, its gauge pressure drops to 11 atmospheric pressures at temperature 27°C. The mass of the oxygen withdrawn from the cylinder is nearly equal to:

[Given, $R = \frac{100}{12}$ J mol^{-1} K^{-1}, and molecular mass of O_2 = 32, 1 atm pressure = 1.01×10^5 N/m]

(1) 0.116 kg (2) 0.156 kg

(3) 0.125 kg (4) 0.144 kg

Answer (1)

Sol. Number of moles left

$$n = \frac{PV}{RT} = \frac{12 \times 1.01 \times 10^5 \text{N/m}^2 \times 30 \times 10^{-3} \text{m}^3}{\frac{100}{12} \times 300}$$

$$n = \frac{12 \times 1.01 \times 12}{10} = 14.54 \text{ moles}$$

Moles removed = 18.2 – 14.54

= 3.656 moles

Mass removed = 3.656 × 32 = 116.99 g = 0.116 kg

27. In a certain camera, a combination of four similar thin convex lenses are arranged axially in contact. Then the power of the combination and the total magnification in comparison to the power (p) and magnification (m) for each lens will be, respectively

(1) $4p$ and m^4
(2) p^4 and m^4
(3) $4p$ and $4m$
(4) p^4 and $4m$

Answer (1)

Sol. For series combination of lens

$p_{eff} = p_1 + p_2 + p_3 + p_4 = 4p$

$m_{eff} = m_1 \times m_2 \times m_3 \times m_4 = m^4$

28. Two gases A and B are filled at the same pressure in separate cylinders with movable pistons of radius r_A and r_B, respectively. On supplying an equal amount of heat to both the systems reversibly under constant pressure, the pistons of gas A and B are displaced by 16 cm and 9 cm, respectively. If the change in their internal energy is the same, then the ratio $\frac{r_A}{r_B}$ is equal to

(1) $\frac{2}{\sqrt{3}}$
(2) $\frac{\sqrt{3}}{2}$
(3) $\frac{4}{3}$
(4) $\frac{3}{4}$

Answer (4)

Sol. Using first law of thermodynamics

$\Delta Q = \Delta U + P\Delta V$

ΔQ is same

ΔU is also same

$W_A = W_B$

$\therefore\ (P\Delta V)_A = (P\Delta V)_B$

P is also same

$\therefore\ A_A d_A = A_B d_B$

$\pi r_A^2 d_A = \pi r_B^2 d_B$

$$\frac{r_A}{r_B} = \left(\frac{dB}{dA}\right)^{\frac{1}{2}} = \left(\frac{9}{16}\right)^{\frac{1}{2}}$$

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

29. A balloon is made of a material of surface tension S and its inflation outlet (from where gas is filled in it) has small area A. It is filled with a gas of density ρ and takes a spherical shape of radius R. When the gas is allowed to flow freely out of it, its radius r changes from R to 0 (zero) in time T. If the speed $v(r)$ of gas coming out of the balloon depends on r as r^a and $T \propto S^\alpha A^\beta \rho^\gamma R^\delta$ then

(1) $a = -\frac{1}{2}, \alpha = -\frac{1}{2}, \beta = -1, \gamma = \frac{1}{2}, \delta = \frac{7}{2}$
(2) $a = \frac{1}{2}, \alpha = \frac{1}{2}, \beta = -\frac{1}{2}, \gamma = \frac{1}{2}, \delta = \frac{7}{2}$
(3) $a = \frac{1}{2}, \alpha = \frac{1}{2}, \beta = -1, \gamma = +1, \delta = \frac{3}{2}$
(4) $a = -\frac{1}{2}, \alpha = -\frac{1}{2}, \beta = -1, \gamma = -\frac{1}{2}, \delta = \frac{5}{2}$

Answer (1)

Sol. $T \propto S^{\alpha}A^{\beta}\rho^{\gamma}R^{\delta}$

$M^0L^0T^1 = K(MT^{-2})^{\alpha}(L^2)^{\beta}(ML^{-3})^{\gamma}L^{\delta}$

$M^0L^0T^1 = K[M^{\alpha+\gamma}L^{2\beta-3\gamma+\delta}T^{-2\alpha}]$

$-2\alpha = 1 \quad \alpha = -\frac{1}{2}$

$\alpha + \gamma = 0 \quad \gamma = \frac{1}{2}$

$2\beta - 3\gamma + \delta = 0$

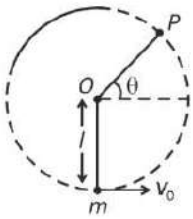
$2\beta - 3\left(\frac{1}{2}\right) + \delta = 0$

By hit and trial (using option (1))

Put $\beta = -1$

$2(-1) - \frac{3}{2} + \delta = 0 \quad \therefore \delta = \frac{7}{2}$

30. A bob of heavy mass m is suspended by a light string of length l. The bob is given a horizontal velocity v_0 as shown in figure. If the string gets slack at some point P making an angle θ from the horizontal, the ratio of the speed v of the bob at point P to its initial speed v_0 is:



(1) $\left(\frac{\cos\theta}{2+3\sin\theta}\right)^{\frac{1}{2}}$

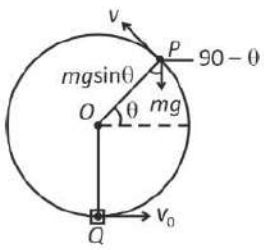
(2) $\left(\frac{\sin\theta}{2+3\sin\theta}\right)^{\frac{1}{2}}$

(3) $(\sin\theta)^{\frac{1}{2}}$

(4) $\left(\frac{1}{2+3\sin\theta}\right)^{\frac{1}{2}}$

Answer (2)

Sol.



At Point *P*, $mg\sin\theta = \frac{mv^2}{l}$ ...(1)

By conservation of mechanical energy at point $P \in Q$

$\frac{1}{2}mv_0^2 = \frac{1}{2}mv^2 + mg(l + l\sin\theta)$

$$\frac{v_0^2}{2}=\frac{v^2}{2}+gl(1+\sin\theta)$$

Put $gl = \frac{v^2}{\sin\theta}$ using (1)

$$\frac{v_0^2}{2}=\frac{v^2}{2}+\frac{v^2}{\sin\theta}(1+\sin\theta)$$

$$\frac{v_0^2}{2}=\frac{v^2}{2}+\frac{v^2}{\sin\theta}+v^2$$

$$\frac{v_0^2}{2}=\frac{3}{2}v^2+\frac{2v^2}{2\sin\theta}$$

$$v_0^2=v^2\left[3+\frac{2}{\sin\theta}\right]$$

$$\frac{v}{v_0}=\left(\frac{\sin\theta}{3\sin\theta+2}\right)^{\frac{1}{2}}$$

31. A physical quantity P is related to four observations a, b, c and d as follows:

$$P=a^3b^2/c\sqrt{d}$$

The percentage errors of measurement in a, b, c and d are 1%, 3%, 2%, and 4% respectively. The percentage error in the quantity P is

(1) 13% (2) 15%

(3) 10% (4) 2%

Answer (1)

Sol. Maximum % error in $P=\frac{\Delta P}{P}\times 100=3\left(\frac{\Delta a}{a}\times 100\right)+2\left(\frac{\Delta b}{b}\times 100\right)+\left(\frac{\Delta c}{c}\times 100\right)+\frac{1}{2}\left(\frac{\Delta d}{d}\times 100\right)$

$=3\times(1)+2\times(3)+(2)+\frac{1}{2}\times(4)$

= 13%

32. The Sun rotates around its centre once in 27 days. What will be the period of revolution if the Sun were to expand to twice its present radius without any external influence? Assume the Sun to be a sphere of uniform density.

(1) 115 days (2) 108 days

(3) 100 days (4) 105 days

Answer (2)

Sol. Assuming the Sun to be a solid sphere, $I=\frac{2}{5}mR^2$

Using conservation of angular momentum, $I'\omega' = I\omega$

$\Rightarrow \frac{2}{5}m(2R)^2\times\frac{2\pi}{T'}=\frac{2}{5}mR^2\times\frac{2\pi}{T}$

$\Rightarrow$ $T' = 4T = 4 \times 27 = 108$ days

33. The radius of Martian orbit around the Sun is about 4 times the radius of the orbit of Mercury. The Martian year is 687 Earth days. Then which of the following is the length of 1 year on Mercury?

(1) 172 earth days
(2) 124 earth days
(3) 88 earth days
(4) 225 earth days

Answer (3)

Sol. Applying Kepler's 3rd law : $T^2 \propto R^3$

Radius of Martian orbit, $R' = 4R$

$$\left(\frac{T'}{T}\right)^2 = \left(\frac{R'}{R}\right)^3 = \left(\frac{4R}{R}\right)^3 = 4^3 = 64 \Rightarrow \frac{T'}{T} = 8$$

$\therefore$ Length of 1 year on Mercury = $T = \frac{T'}{8} = \frac{687}{8} = 85.88$ days

34. A wire of resistance R is cut into 8 equal pieces. From these pieces two equivalent resistances are made by adding four of these together in parallel. Then these two sets are added in series. The net effective resistance of the combination is:

(1) $\frac{R}{16}$
(2) $\frac{R}{8}$
(3) $\frac{R}{64}$
(4) $\frac{R}{32}$

Answer (1)

Sol. After being cut into 8 equal pieces,

$\Rightarrow$ Resistance of each piece = $R' = \frac{R}{8}$

Each set has 4 pieces in parallel combination

$\Rightarrow$ Resistance of each set = $R'' = \frac{R'}{4} = \frac{R}{32}$

Both sets are connected in series

$\therefore \quad R_{eq} = R'' + R'' = 2 \times \frac{R}{32} = \frac{R}{16}$

35. A photon and an electron (mass m) have the same energy E. The ratio ($\lambda_{photon}/\lambda_{electron}$) of their de Broglie wavelengths is: (c is the speed of light)

(1) $c\sqrt{\frac{2m}{E}}$
(2) $\frac{1}{c}\sqrt{E/2m}$
(3) $\sqrt{E/2m}$
(4) $c\sqrt{2mE}$

Answer (1)

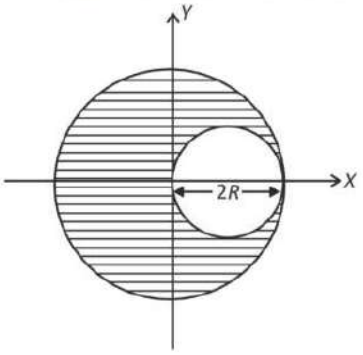
Sol. For photon, $E = \frac{hc}{\lambda_{Ph}} \Rightarrow \lambda_{Ph} = \frac{hc}{E}$

For electron, p = momentum and $E = \frac{p^2}{2m} = \left(\frac{h}{\lambda_e}\right)^2 \times \frac{1}{2m}$

$$\Rightarrow \lambda_e = \frac{h}{\sqrt{2mE}}$$

$$\therefore \frac{\lambda_{Ph}}{\lambda_e} = \frac{\frac{hc}{E}}{\frac{h}{\sqrt{2mE}}} = c\sqrt{\frac{2m}{E}}$$

36. A sphere of radius R is cut from a larger solid sphere of radius $2R$ as shown in the figure. The ratio of the moment of inertia of the smaller sphere to that of the rest part of the sphere about the Y-axis is:



(1) $\frac{7}{57}$

(2) $\frac{7}{64}$

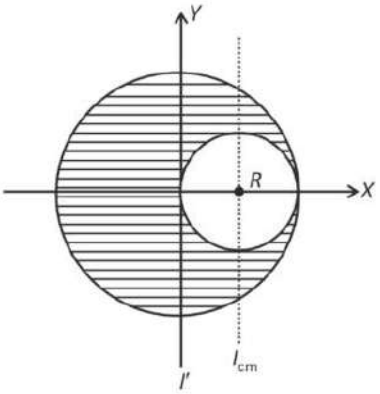
(3) $\frac{7}{8}$

(4) $\frac{7}{40}$

Answer (1)

Sol. For larger solid sphere about diameter Y-axis,

$$I_{\text{whole}} = \frac{2}{5}M(2R)^2 = \frac{8}{5}MR^2$$



Density of sphere is uniform

$$\Rightarrow \frac{M}{V_{\text{whole}}} = \frac{M_{\text{smaller}}}{V_{\text{smaller}}} \Rightarrow \frac{M}{\frac{4}{3}\pi(2R)^3} = \frac{M'}{\frac{4}{3}\pi R^3}$$

$$\Rightarrow M' = \frac{M}{8}$$

Using parallel axis theorem for smaller sphere,

$$I' = I_{cm} + M'R^2 = \frac{2}{5}\frac{MR^2}{8} + \frac{MR^2}{8} = \frac{7}{40}MR^2$$

$$\therefore \text{ Ratio} = \frac{I_{\text{smaller}}}{I_{\text{remaining}}} = \frac{I'}{I_{\text{whole}} - I'} = \frac{\frac{7}{40}MR^2}{\left(\frac{8}{5} - \frac{7}{40}\right)MR^2} = \frac{7}{64-7} = \frac{7}{57}$$

37. An electron (mass 9×10^{-31} kg and charge 1.6×10^{-19} C) moving with speed $c/100$ (c = speed of light) is injected into a magnetic field $\vec{B}$ of magnitude 9×10^{-4} T perpendicular to its direction of motion. We wish to apply an uniform electric field $\vec{E}$ together with the magnetic field so that the electron does not deflect from its path. Then (speed of light $c = 3 \times 10^8$ ms^{-1})

(1) $\vec{E}$ is parallel to $\vec{B}$ and its magnitude is 27×10^2 V m^{-1}

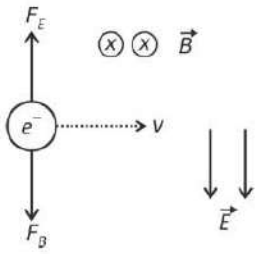
(2) $\vec{E}$ is parallel to $\vec{B}$ and its magnitude is 27×10^4 V m^{-1}

(3) $\vec{E}$ is perpendicular to $\vec{B}$ and its magnitude is 27×10^4 V m^{-1}

(4) $\vec{E}$ is perpendicular to $\vec{B}$ and its magnitude is 27×10^2 V m^{-1}

Answer (4)

Sol. For no deflection of electron, $\vec{F}_B = \vec{F}_E$



$$-e\left(\vec{v} \times \vec{B}\right) = -e\vec{E}$$

$$\Rightarrow \vec{E} = \vec{v} \times \vec{B} \quad \Rightarrow \vec{E} \perp \vec{B}$$

$$E = vB = \frac{c}{100} \times 9 \times 10^{-4}$$

$$= \frac{3 \times 10^8}{100} \times 9 \times 10^{-4}$$

$$= 27 \times 10^2 \text{ V m}^{-1}$$

38. The electric field in a plane electromagnetic wave is given by

$E_z = 60 \cos (5x + 1.5 \times 10^9 t)$ V/m.

Then expression for the corresponding magnetic field is (here subscripts denote the direction of the field) :

(1) $B_Z = 60\cos (5x + 1.5 \times 10^9 t)T$

(2) $B_y = 60 \sin (5x + 1.5 \times 10^9 t)T$

(3) $B_y = 2 \times 10^{-7} \cos (5x + 1.5 \times 10^9 t)T$

(4) $B_x = 2 \times 10^{-7} \cos (5x + 1.5 \times 10^9 t)T$

Answer (3)

Sol. In electromagnetic wave, E and B are in same phase and $B_0 = \frac{E_0}{c}$; their planes are perpendicular to each other.

$$\therefore \; B_y = \frac{60}{c}\cos(5x + 1.5 \times 10^9 t) \text{ T}$$

$$= \frac{60}{3 \times 10^8}\cos(5x + 1.5 \times 10^9 t) \text{ T}$$

$$B_y = 2 \times 10^{-7} \cos(5x + 1.5 \times 10^9 t) \text{ T}$$

39. A body weighs 48 N on the surface of the earth. The gravitational force experienced by the body due to the earth at a height equal to one-third the radius of the earth from its surface is :

(1) 32 N
(2) 36 N
(3) 16 N
(4) 27 N

Answer (4)

Sol. $W = mg$ and $g = \frac{GM}{R^2}$, $g_h = \frac{GM}{(R+h)^2}$

$$\Rightarrow \frac{W_h}{W} = \frac{mg_h}{mg} = \frac{g_h}{g} = \frac{R^2}{(R+h)^2} \quad \left(h = \frac{R}{3}\right)$$

$$\Rightarrow \frac{W_h}{W} = \frac{R^2}{\left(R+\frac{R}{3}\right)^2} = \frac{R^2}{\left(\frac{4R}{3}\right)^2} = \frac{9}{16}$$

$$\Rightarrow W_h = \frac{9}{16}W = \frac{9}{16} \times 48 \quad [W = 48\text{ N}]$$

$$= 27\text{ N}$$

40. An unpolarized light beam travelling in air is incident on a medium of refractive index 1.73 at Brewster's angle. Then

(1) Both reflected and transmitted light are perfectly polarized with angles of reflection and refraction close to 60° and 30°, respectively

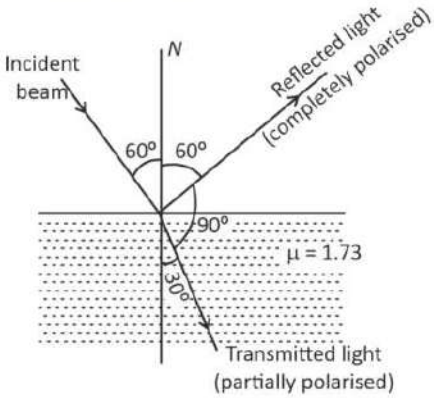
(2) Transmitted light is completely polarized with angle of refraction close to 30°

(3) Reflected light is completely polarized and the angle of reflection is close to 60°

(4) Reflected light is partially polarized and the angle of reflection is close to 30°

Answer (3)

Sol. Using Brewster law



$\mu = \tan\theta_P$

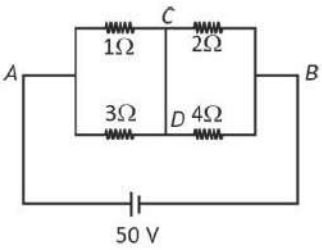
$\Rightarrow 1.73 = \tan\theta_P$

$\Rightarrow \sqrt{3} = \tan\theta_P$

$\Rightarrow \theta_P = 60°$

At this polarising angle, reflected light is perfectly polarized and transmitted light is partially polarised.

41. A constant voltage of 50 V is maintained between the points A and B of the circuit shown in the figure. The current through the branch CD of the circuit is:

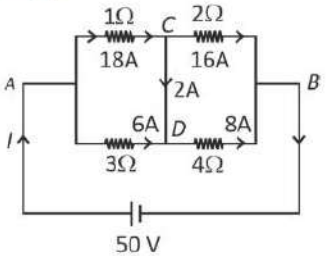


(1) 2.5 A (2) 3.0 A

(3) 1.5 A (4) 2.0 A

Answer (4)

Sol.



R_{AB} = (1Ω/3Ω) in series with (2Ω/4Ω)

$$=\frac{3\times1}{3+1}+\frac{2\times4}{2+4}$$

$$=\frac{3}{4}+\frac{8}{6}=\frac{9+16}{12}=\frac{25}{12}\Omega$$

Now total current through cell

$$I=\frac{50}{25/12}=24\text{A}$$

$$I_{1\Omega}=\frac{3}{4}\times24=18\text{A},\ I_{3\Omega}=\frac{1}{4}\times24=6\text{A}$$

$$I_{2\Omega}=\frac{4}{6}\times24=16\text{A},\ I_{4\Omega}=\frac{2}{6}\times24=8\text{A}$$

Using junction rule at C, I_{CD} = 18 – 16 = 2A (From C to D)

42. The plates of a parallel plate capacitor are separated by d. Two slabs of different dielectric constant K_1 and K_2 with thickness $\frac{3}{8}d$ and $\frac{d}{2}$, respectively are inserted in the capacitor. Due to this, the capacitance becomes two times larger than when there is nothing between the plates.

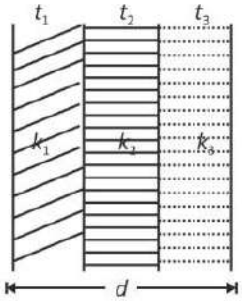
If $K_1 = 1.25\ K_2$, the value of K_1 is:

(1) 1.60 (2) 1.33

(3) 2.66 (4) 2.33

Answer (3)

Sol.



Using $C_{eq} = \dfrac{\varepsilon_0 A}{\dfrac{t_1}{K_1} + \dfrac{t_2}{K_2} + \dfrac{t_3}{K_3}}$

here $C_0 = \dfrac{\varepsilon_0 A}{d}, t_1 = \dfrac{3d}{8}, t_2 = \dfrac{d}{2}, t_3 = \dfrac{d}{8}$

$K_1 = K_1,\ \ K_2 = \dfrac{K_1}{1.25}$ and $K_3 = 1$

Given $C_{eq} = 2C_0$

$$\Rightarrow 2C_0 = \frac{\varepsilon_0 A}{\dfrac{3d}{8k_1} + \dfrac{d \times 1.25}{2k_1} + \dfrac{d}{8}}$$

$$\Rightarrow \frac{2\varepsilon_0 A}{d} = \frac{\varepsilon_0 A}{\dfrac{3d}{8k_1} + \dfrac{d}{2k_1} \times \dfrac{5}{4} + \dfrac{d}{8}}$$

$$\Rightarrow 2 = \frac{1}{\dfrac{3}{8k_1} + \dfrac{5}{8k_1} + \dfrac{1}{8}} \Rightarrow k_1 = \frac{8}{3} = 2.66$$

43. Consider the diameter of a spherical object being measured with the help of a Vernier callipers. Suppose its 10 Vernier Scale Divisions (V.S.D.) are equal to its 9 Main Scale Divisions (M.S.D.). The least division in the M.S. is 0.1 cm and the zero of V.S. is at $x = 0.1$ cm when the jaws of Vernier callipers are closed.

If the main scale reading for the diameter is $M = 5$ cm and the number of coinciding vernier division is 8, the measured diameter after zero error correction, is

(1) 4.98 cm (2) 5.00 cm

(3) 5.18 cm (4) 5.08 cm

Answer (1)

Sol. Least count = 1MSD – 1VSD

$= 1\,\text{MSD} - \dfrac{9}{10}\text{MSD}$

$= \dfrac{1}{10}\text{MSD}$

$= \dfrac{1}{10} \times 0.1\text{ cm} = 0.01\text{ cm}$

Zero error = +0.1 cm

Main scale reading = 5 cm

Vernier scale reading = 8 × 0.01 = 0.08 cm

Final measurement of diameter

= 5 + 0.08 – 0.1 = 4.98 cm

44. A 2 amp current is flowing through two different small circular copper coils having radii ratio 1 : 2. The ratio of their respective magnetic moments will be

(1) 2 : 1 (2) 4 : 1

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

Answer (3)

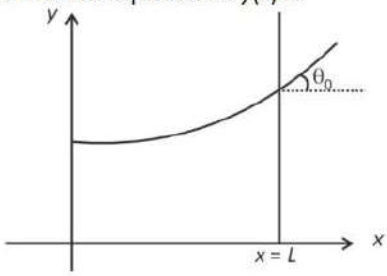
Sol. Magnetic moment of current carrying circular loop = IA

$M = IA$

$M \propto A$ [I–Same]

$$\frac{M_1}{M_2} = \frac{A_1}{A_2} = \frac{\pi r_1^2}{\pi r_2^2} = \left(\frac{1}{2}\right)^2 = \frac{1}{4}$$

45. Consider a water tank shown in the figure. It has one wall at $x = L$ and can be taken to be very wide in the z direction. When filled with a liquid of surface tension S and density ρ, the liquid surface makes angle θ_0 ($\theta_0 << 1$) with the x-axis at $x = L$. If $y(x)$ is the height of the surface then the equation for $y(x)$ is:



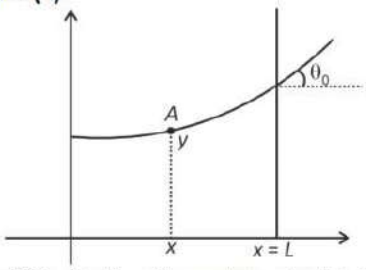
(take $\theta(x) = \sin\theta(x) = \tan\theta(x) = \frac{dy}{dx}$, g is the acceleration due to gravity)

(1) $\frac{d^2y}{dx^2} = \sqrt{\frac{\rho g}{S}}$ (2) $\frac{dy}{dx} = \sqrt{\frac{\rho g}{S}}x$

(3) $\frac{d^2y}{dx^2} = \frac{\rho g}{S}x$ (4) $\frac{d^2y}{dx^2} = \frac{\rho g}{S}y$

Answer (4)

Sol.



ROC = Radius of curvature at point A

$$\text{Curvature} = \frac{1}{ROC} = \frac{\left|\frac{d^2y}{dx^2}\right|}{\left(1+\left(\frac{dy}{dx}\right)^2\right)^{\frac{3}{2}}} = \frac{\left|\frac{d^2y}{dx^2}\right|}{(1+0)^{\frac{3}{2}}} = \frac{d^2y}{dx^2} \qquad \left[\because \frac{dy}{dx} = \tan\theta \simeq 0\right]$$

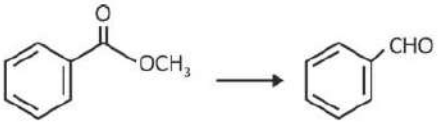
$\Delta P = S \times$ curvature

$$\Rightarrow \rho g y = S\frac{d^2y}{dx^2}$$

$$\therefore \frac{d^2y}{dx^2} = \frac{\rho g y}{S}$$

CHEMISTRY

46. Identify the suitable reagent for the following conversion.



(1) (i) $NaBH_4$, (ii) H^+/H_2O

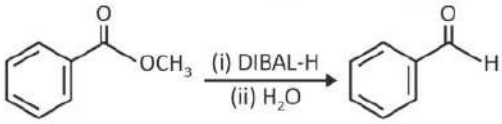
(2) $H_2/Pd\text{-}BaSO_4$

(3) (i) $LiAlH_4$, (ii) H^+/H_2O

(4) (I) $AlH(iBu)_2$, (II) H_2O

Answer (4)

Sol. Esters are reduced to aldehydes with DIBAL-H



47. The correct order of decreasing acidity of the following aliphatic acids is

(1) $HCOOH > CH_3COOH > (CH_3)_2CHCOOH > (CH_3)_3CCOOH$

(2) $HCOOH > (CH_3)_3CCOOH > (CH_3)_2CHCOOH > CH_3COOH$

(3) $(CH_3)_3CCOOH > (CH_3)_2CHCOOH > CH_3COOH > HCOOH$

(4) $CH_3COOH > (CH_3)_2CHCOOH > (CH_3)_3CCOOH > HCOOH$

Answer (1)

Sol. Electron donating group decreases the acidity of carboxylic acids.

So correct order is

$HCOOH > CH_3COOH > (CH_3)_2CHCOOH > (CH_3)_3CCOOH$

48. Which one of the following reactions does **NOT** belong to "Lassaigne's test"?

(1) $Na + X \xrightarrow[\Delta]{} + NaX$

(2) $2CuO + C \xrightarrow[\Delta]{} 2Cu + CO_2$

(3) $Na + C + N \xrightarrow[\Delta]{} NaCN$

(4) $2Na + S \xrightarrow[\Delta]{} Na_2S$

Answer (2)

Sol. Nitrogen, sulphur, halogens and phosphorus present in an organic compound are detected by "Lassaigne's test".

$$Na + C + N \xrightarrow{\Delta} NaCN$$

$$2Na + S \xrightarrow{\Delta} Na_2S$$

$$Na + X \xrightarrow{\Delta} \underset{(X=Cl, Br, I)}{NaX}$$

49. If the rate constant of a reaction is 0.03 s^{-1}, how much time does it take for 7.2 mol L^{-1} concentration of the reactant to get reduced to 0.9 mol L^{-1}?

(Given: log 2 = 0.301)

(1) 210 s

(2) 21.0 s

(3) 69.3 s

(4) 23.1 s

Answer (3)

Sol. $k = 0.03\ s^{-1}$

$$t = \frac{2.303}{k}\log\frac{a}{a-x}$$

$$= \frac{2.303}{0.03}\log\frac{7.2}{0.9}$$

$$= \frac{2.303}{0.03}\log 8$$

$$= \frac{2.303}{0.03}\times 3\times \log 2$$

$$= \frac{2.303}{0.03}\times 3\times 0.301$$

$$= 69.3\ s$$

50. Given below are two statements :

Statement I : A hypothetical diatomic molecule with bond order zero is quite stable.

Statement II : As bond order increases, the bond length increases.

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

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

(2) Statement I is false but Statement II is true

(3) Both Statement I and Statement II are true

(4) Both Statement I and Statement II are false

Answer (4)

Sol.
- A positive bond order means a stable molecule while a negative or zero bond order means an unstable molecule.
- When bond order increases, the bond length decreases.

51. Out of the following complex compounds, which of the compound will be having the minimum conductance in solution?

(1) $[Co(NH_3)_6]Cl_3$

(2) $[Co(NH_3)_5Cl]Cl$

(3) $[Co(NH_3)_3Cl_3]$

(4) $[Co(NH_3)_4Cl_2]$

Answer (3, 4)

Conductance of any complex depends on the following factor.

(1) Number of ions produced by complex.

(2) If number of ions are same then we will check charge on complex unit.

(1) $[Co(NH_3)_6]Cl_3 \rightarrow [Co(NH_3)_6]^{+3} + 3Cl^-$

(2) $[Co(NH_3)_5Cl]Cl \rightarrow [Co(NH_3)_5Cl]^+ + Cl^-$

(3) $\left[Co^{+3}(NH_3)_3Cl_3\right]$
(4) $\left[Co^{+2}(NH_3)_4Cl_2\right]$
} Both complex units have no charge. Therefore both complex units have same conductance.

52. Which of the following aqueous solution will exhibit highest boiling point?

(1) 0.01M Na_2SO_4

(2) 0.015M $C_6H_{12}O_6$

(3) 0.01M Urea

(4) 0.01M KNO_3

Answer (1)

$\Delta T_b = iK_b \times m$

$\Delta T_b \propto i \times m$

By considering molarity same as molality

(1) 0.01M Na_2SO_4 $i \times m = 3 \times 0.01 = 0.03$

(2) 0.015M $C_6H_{12}O_6$ $i \times m = 1 \times 0.015 = 0.015$

(3) 0.01M Urea $i \times m = 1 \times 0.01 = 0.01$

(4) 0.01 M KNO_3 $i \times m = 2 \times 0.01 = 0.02$

$T_b' = T_b^* + \Delta T_b$

Higher the value of $(i \times m)$ more will be the boiling point.

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

Assertion (A) : undergoes S_N2 reaction faster than Cl.

Reason (R) : Iodine is a better leaving group because of its large size.

In the light of the above statements, choose the **correct** answer from the options given below:

(1) **A** is true but **R** is false

(2) **A** is false but **R** is true

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

(4) Both **A** and **R** are true but **R** is **not** the correct explanation of **A**

Answer (3)

Rate of S_N2 reaction of I is faster than Cl.

Because iodine is a good leaving group due to large size of iodine. Which stabilises the I^- ion.

54. Consider the following compounds :

$\underline{K}O_2$, $H_2\underline{O}_2$ and $H_2\underline{S}O_4$

The oxidation state of the underlined elements in them are, respectively,

(1) +1, –2, and +4

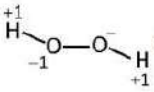
(2) +4, –4, and +6

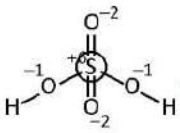
(3) +1, –1, and +6

(4) +2, –2, and +6

Answer (3)

KO_2 → Alkali metal always shows +1 oxidation state. Therefore oxidation state of K is +1.

H_2O_2 →  Oxidation state of oxygen in H_2O_2 is –1.

H_2SO_4 →  Oxidation state of sulphur in H_2SO_4 is +6.

55. Match **List-I** with **List-II**.

	List-I		List-II
A.	Haber process	I.	Fe catalyst
B.	Wacker oxidation	II.	$PdCl_2$
C.	Wilkinson catalyst	III.	$[(PPh_3)_3RhCl]$
D	Ziegler catalyst	IV.	$TiCl_4$ with $Al(CH_3)_3$

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

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

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

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

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

Answer (1)

	Process		Catalyst used
A.	Haber process	I.	Fe catalyst
B.	Wacker oxidation	II.	$PdCl_2$
C.	Wilkinson catalyst	III.	$[(PPh_3)_3RhCl]$
D	Ziegler catalyst	IV.	$TiCl_4$ with $Al(CH_3)_3$

56. Given below are two statements :

Statement I : Like nitrogen that can form ammonia, arsenic can form arsine.

Statement II : Antimony cannot form antimony pentoxide.

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

(1) Statement I is correct but Statement II is incorrect

(2) Statement I is incorrect but Statement II is correct

(3) Both Statement I and Statement II are correct

(4) Both Statement I and Statement II are incorrect

Answer (1)

Sol. All the elements of group 15 form hydrides of EH_3 type. Nitrogen forms ammonia (NH_3) while Arsenic forms Arsine (AsH_3)

All the elements of group 15 form two types of oxides : E_2O_3 and E_2O_5

Antimony forms antimony pentoxide Sb_2O_5

Hence, statement I is correct and statement II is incorrect

57. Given below are two statements :

Statement I : Ferromagnetism is considered as an extreme form of paramagnetism.

Statement II : The number of unpaired electrons in a Cr^{2+} ion (Z = 24) is the same as that of a Nd^{3+} ion (Z = 60).

In the light of the above statements, choose the **correct** answer from the options given below :

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

(2) Statement I is false but Statement II is true

(3) Both Statement I and Statement II are true

(4) Both Statement I and Statement II are false

Answer (1)

Sol. Substances which are attracted very strongly in applied magnetic field are termed as ferromagnetic. Infact, ferromagnetism is an extreme form of paramagnetism.

Hence statement I is correct.

$Cr^{2+} = 3d^4 4s^0$

Unpaired electrons = 4

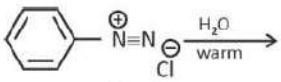
$Nd^{3+} = 4f^3\ 6s^0$

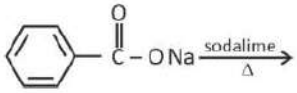
Unpaired electrons = 3

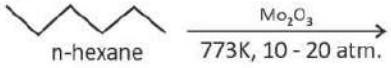
Hence, Statement II is incorrect

58. Which one of the following reactions does **NOT** give benzene as the product?

(1) $H-C\equiv C-H \xrightarrow[\text{at 873 K}]{\text{red hot Iron Tube}}$

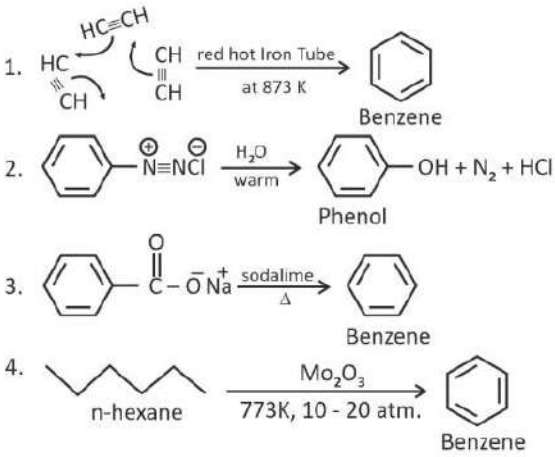
(2) 

(3) 

(4) 

Answer (2)

Sol.



59. Match **List-I** with **List-II**

	List-I		List-II
A.	XeO_3	(I)	sp^3d; linear
B.	XeF_2	(II)	sp^3; pyramidal
C.	$XeOF_4$	(III)	sp^3d^3; distorted octahedral
D.	XeF_6	(IV)	sp^3d^2; square pyramidal

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

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

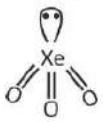
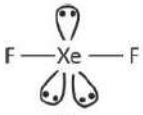
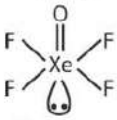
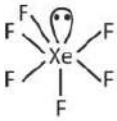
(2) A-IV, B-II, C-I, D-III

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

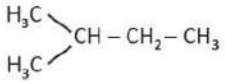
(4) A-II, B-I, C-III, D-IV

Answer (3)

Sol.

Molecule	Hybridisation	Shape
	sp^3	Pyramidal
	sp^3d	Linear
	sp^3d^2	Square Pyramidal
	sp^3d^3	Distorted Octahedral

60. How many products (including stereoisomers) are expected from monochlorination of the following compound?



(1) 5

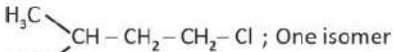
(2) 6

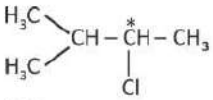
(3) 2

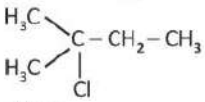
(4) 3

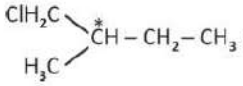
Answer (2)

Sol. Possible monochlorination products :


; One isomer


; Two isomers due to presence of chiral carbon


; One isomer


; Two isomers due to chiral carbon

Total 6 isomers

61. Which of the following statements are true?

A. Unlike Ga that has a very high melting point, Cs has a very low melting point.

B. On Pauling scale, the electronegativity values of N and Cl are not the same.

C. Ar, K^+, Cl^-, Ca^{2+}, and S^{2-} are all isoelectronic species.

D. The correct order of the first ionization enthalpies of Na, Mg, Al, and Si is Si >Al > Mg > Na.

E. The atomic radius of Cs is greater than that of Li and Rb.

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

(1) C and D only

(2) A, C, and E only

(3) A, B, and E only

(4) C and E only

Answer (4)

Sol. Both Ga and Cs have low melting points.

Element	Melting point/K
Ga	303
Cs	302

- On Pauling scale, the electronegativity value of N and Cl have same (3.0).
- Ar, K^+, Cl^-, Ca^{2+} and S^{2-} have 18 electrons. So these are isoelectronic species.
- The correct order of first ionization enthalpy is Si > Mg > Al > Na

  First ionisation enthalpy of Mg is higher than Al because the penetration of a 3s-electron to the nucleus is more than that of a 2p-electron.

- Generally down the group atomic radii increases

Atom	Atomic radius/pm
Li	152
Rb	244
CS	262

62. The standard heat of formation, in kcal/mol of Ba^{2+} is :

[Given : standard heat of formation of SO_4^{2-} ion (aq) = –216 kcal/mol, standard heat of crystallisation of $BaSO_4(s)$ = –4.5 kcal/mol, standard heat of formation of $BaSO_4(s)$ = – 349 kcal/mol]

(1) + 133.0

(2) + 220.5

(3) – 128.5

(4) – 133.0

Answer (3)

Sol. $S + 2O_2 + 2e^- \longrightarrow SO_4^{2-}$ $\Delta H_f = -216$ kcal/mol ...(1)

$Ba^{2+}(g) + SO_4^{2-}(g) \longrightarrow BaSO_4(s)$ $\Delta H_{crystallisation} = -4.5$ kcal/mol ...(2)

$Ba + S + 2O_2 \longrightarrow BaSO_4(s)$ $\Delta H_{f(BaSO_4)} = -349$ kcal/mol ...(3)

$Ba(s) \longrightarrow Ba^{2+}(g) + 2e^-$ ...(4)

From equation (1),(2) and (3) we get equation (4). Applying equation (3) – (1) – (2)

So, –349 – (–4.5) – (–216)

So – 349 + 4.5 + 216

= –349 + 220.5

= – 128.5 kcal/mol

63. Match List-I with List-II

	List-I (Example)		**List-II (Type of Solution)**
A.	Humidity	I.	Solid in solid
B.	Alloys	II.	Liquid in gas
C.	Amalgams	III.	Solid in gas
D.	Smoke	IV.	Liquid in solid

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

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

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

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

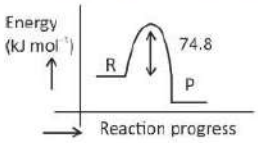
(4) A-II, B-I, C-IV, D-III

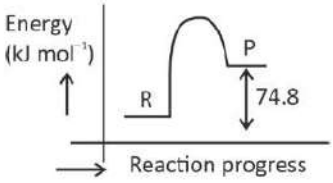
Answer (4)

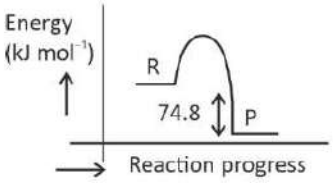
Sol.

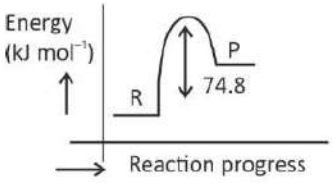
- Humidity is a solution of liquid in gas
- Alloy is a solution of solid in solid
- Amalgam is a solution of liquid in solid
- Smoke is a solution of solid in gas

64. $C(s) + 2H_2(g) \rightarrow CH_4(g)$; $\Delta H = -74.8$ kJ mol^{-1}. Which of the following diagrams gives an accurate representation of the above reaction? [R → reactants; P → products]

(1)


(2)


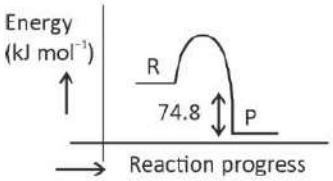
(3)


(4)


Answer (3)

Sol. $\Delta H = -74.8$ k J mol^{-1}, it is an exothermic reaction.

So, accurate representation is



65. Sugar 'X'

A. is found in honey

B. is a keto sugar

C. exists in α and β – anomeric forms.

D. Is laevorotatory.

'X' is :

(1) Maltose

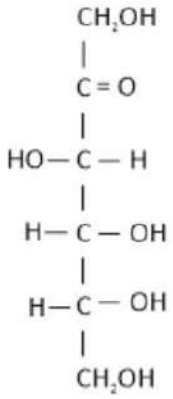
(2) Sucrose

(3) D-Glucose

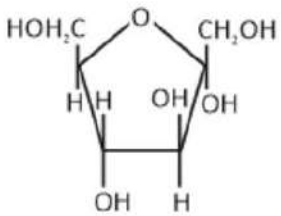
(4) D-Fructose

Answer (4)

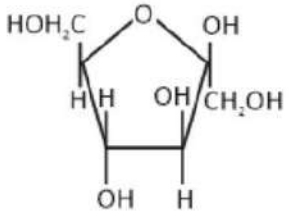
Sol. D-Fructose is found in honey and is a keto sugar.



D—(—) — Fructose



α–D–(–)–Fructofuranose



β–D–(–)–Fructofuranose

66. Total number of possible isomers (both structural as well as stereoisomers) of cyclic ethers of molecular formula C_4H_8O is :

(1) 10

(2) 11

(3) 6

(4) 8

Answer (1)

Sol. For cyclic ethers O should be in ring * carbon here is chiral

(1)

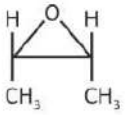
2(d, l pair)

(2)

1

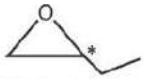
(3)

1

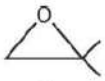
(4) 

(1)

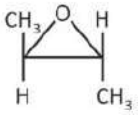
Meso compound

(5) 

2(d, l pair)

(6) 

1

(7) 

2(d, l pair)

Total number of isomers = 2 + 1 + 1 + 1 + 2 + 1 + 2 = 10

67. For the reaction $A(g) \rightleftharpoons 2B(g)$, the backward reaction rate constant is higher than the forward reaction rate constant by a factor of 2500, at 1000 K.

[Given : R = 0.0831 L atm mol^{-1} K^{-1}]

K_P for the reaction at 1000 K is

(1) 0.033

(2) 0.021

(3) 83.1

(4) 2.077×10^5

Answer (1)

Sol. $K_C = \frac{k_f}{k_b} = \frac{1}{2500}$

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

$= \frac{1}{2500} \times 0.0831 \times 1000$

= 0.033

68. The ratio of the wavelengths of the light absorbed by a Hydrogen atom when it undergoes n = 2 → n = 3 and n = 4 → n = 6 transitions, respectively, is

(1) $\frac{1}{9}$

(2) $\frac{1}{4}$

(3) $\frac{1}{36}$

(4) $\frac{1}{16}$

Answer (2)

Sol. $\Delta E = \frac{hc}{\lambda} = E_{final} - E_{initial} \quad \left(E_n = \frac{-R_H}{n^2}\right)$

$$\Delta E_{2\to3} = \frac{hc}{\lambda_{2\to3}} = E_3 - E_2 = \frac{-R_H}{3^2} - \left(\frac{-R_H}{2^2}\right)$$

$$= R_H\left(\frac{1}{4} - \frac{1}{9}\right)$$

$$= R_H \times \frac{5}{36}$$

$$\therefore \lambda_{2\to3} = \frac{hc \cdot 36}{R_H \cdot 5}$$

$$\Delta E_{4\to6} = E_6 - E_4 = \frac{-R_H}{36} + \frac{R_H}{16} = \frac{R_H \times 20}{36 \times 16}$$

$$\frac{hc}{\lambda_{4\to6}} = \frac{R_H \times 20}{36 \times 16}$$

$$\lambda_{4\to6} = \frac{hc \times 36 \times 16}{R_H \cdot 20}$$

$$\frac{\lambda_{2\to3}}{\lambda_{4\to6}} = \frac{\frac{hc \cdot 36}{R_H \cdot 5}}{\frac{hc \times 36 \times 16}{R_H \cdot 20}}$$

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

69. If the molar conductivity (Λ_m) of a 0.050 mol L^{-1} solution of a monobasic weak acid is 90 S cm^2 mol^{-1}, its extent (degree) of dissociation will be

[Assume Λ_+° = 349.6 S cm^2 mol^{-1} and Λ_-° = 50.4 S cm^2 mol^{-1}.]

(1) 0.225

(2) 0.215

(3) 0.115

(4) 0.125

Answer (1)

Sol. Degree of dissociation (α) is given as

$$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ}$$

$$\Lambda_m^\circ = \Lambda_+^\circ + \Lambda_-^\circ$$

= 349.6 + 50.4

= 400 S cm^2 mol^{-1}

$$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ} = \frac{90}{400} = 0.225$$

70. 5 moles of liquid X and 10 moles of liquid Y make a solution having a vapour pressure of 70 torr. The vapour pressures of pure X and Y are 63 torr and 78 torr respectively. Which of the following is true regarding the described solution?

(1) The solution is ideal.

(2) The solution has volume greater than the sum of individual volumes.

(3) The solution shows positive deviation.

(4) The solution shows negative deviation.

Answer (4)

Sol. $P_{total} = X_x P_x^{\circ} + X_y P_y^{\circ}$

$= \frac{5}{15} \times 63 + \frac{10}{15} \times 78$

= 21 + 52

= 73 torr

Observed total pressure of solution is 70 torr.

It is less than calculated total pressure.

Hence, it shows negative deviation.

71. Among the following, choose the ones with equal number of atoms.

A. 212 g of $Na_2CO_3(s)$ [molar mass = 106 g]

B. 248 g of $Na_2O(s)$ [molar mass = 62 g]

C. 240 g of NaOH(s) [molar mass = 40 g]

D. 12 g of $H_2(g)$ [molar mass = 2 g]

E. 220 g of $CO_2(g)$ [molar mass = 44 g]

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

(1) B, C, and D only

(2) B, D, and E only

(3) A, B, and C only

(4) A, B, and D only

Answer (4)

Sol. Number of atoms = $\frac{\text{given mass}}{\text{molar mass}} \times \text{atomicity} \times N_A$

A. $\frac{212}{106} \times 6 \times N_A = 12\ N_A$

B. $\frac{248}{62} \times 3 \times N_A = 12\ N_A$

C. $\frac{240}{40} \times 3 \times N_A = 18\ N_A$

D. $\frac{12}{2} \times N_A \times 2 = 12\ N_A$

E. $\frac{220}{44} \times N_A \times 3 = 15\ N_A$

A, B and D have same number of atoms

72. Which of the following are paramagnetic?

A. $[NiCl_4]^{2-}$

B. $Ni(CO)_4$

C. $[Ni(CN)_4]^{2-}$

D. $[Ni(H_2O)_6]^{2+}$

E. $Ni(PPh_3)_4$

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

(1) A and D only

(2) A, D and E only

(3) A and C only

(4) B and E only

Answer (1)

Sol.

A. $[NiCl_4]^{2-}$; Ni^{+2}; $3d^8$; sp^3 hybridisation; 2 unpaired electrons; paramagnetic

B. $Ni(CO)_4$; Ni; $3d^8\ 4s^2$; sp^3 hybridisation; Zero unpaired electron; diamagnetic

C. $[Ni(CN)_4]^{2-}$; Ni^{+2}; $3d^8$; dsp^2 hybridisation; Zero unpaired electron; diamagnetic

D. $[Ni(H_2O)_6]^{2+}$; Ni^{2+}, $3d^8$; sp^3d^2 hybridisation; Two unpaired electron; paramagnetic

E. $Ni(PPh_3)_4$; Ni; $3d^8\ 4s^2$, sp^3 hybridisation; zero unpaired electron; Diamagnetic

73. If the half-life ($t_{1/2}$) for a first order reaction is 1 minute, then the time required for 99.9% completion of the reaction is closest to :

(1) 5 minutes

(2) 10 minutes

(3) 2 minutes

(4) 4 minutes

Answer (2)

Sol. For 1st order reaction

$kt = 2.303 \log \frac{A_0}{A_t}$ A_0 = initial concentration

A_t = Final concentration

$t_{99.9\%} = 10\ t_{1/2}$

$t_{99.9\%} = 10 \times 1$ minute = 10 minutes

74. Energy and radius of first Bohr orbit of He^+ and Li^{2+} are

[Given $R_H = 2.18 \times 10^{-18}$ J, $a_0 = 52.9$ pm]

(1) $E_n(Li^{2+}) = -19.62 \times 10^{-16}$ J;

$r_n(Li^{2+}) = 17.6$ pm

$E_n(He^+) = -8.72 \times 10^{-16}$ J;

$r_n(He^+) = 26.4$ pm

(2) $E_n(Li^{2+}) = -8.72 \times 10^{-16}$ J;

$r_n(Li^{2+}) = 17.6$ pm

$E_n(He^+) = -19.62 \times 10^{-16}$ J;

$r_n(He^+) = 17.6$ pm

(3) $E_n(Li^{2+}) = -19.62 \times 10^{-18}$ J;

$r_n(Li^{2+}) = 17.6$ pm

$E_n(He^+) = -8.72 \times 10^{-18}$ J;

$r_n(He^+) = 26.4$ pm

(4) $E_n(Li^{2+}) = -8.72 \times 10^{-18}$ J;

$r_n(Li^{2+}) = 26.4$ pm

$E_n(He^+) = -19.62 \times 10^{-18}$ J;

$r_n(He^+) = 17.6$ pm

Answer (3)

Sol. $E_n = \frac{-2.18 \times 10^{-18} \times z^2}{n^2}$ J; $r_n = \frac{52.9 \times n^2}{z}$ pm

For He^+

$E_{He^+} = -2.18 \times 10^{-18} \times 4 = -8.72 \times 10^{-18}$ J

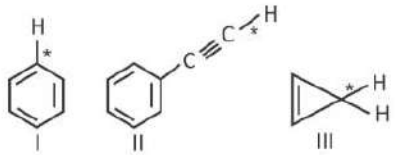
$r_{He^+} = \frac{52.9 \times 1}{2} = 26.45$ pm

For Li^{2+}

$E_{Li^{2+}} = -2.18 \times 10^{-18} \times 9 = 19.62 \times 10^{-18}$ J

$r_{Li^{2+}} = \frac{52.9 \times 1}{3} = 17.63$ pm

75. Among the given compounds I-III, the correct order of bond dissociation energy of C–H bond marked with * is :



(1) III > II > I

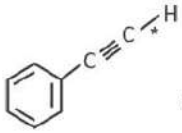
(2) II > III > I

(3) II > I > III

(4) I > II > III

Answer (3)

Sol. I. carbon of this bond is sp^2 hybridised

II.  carbon of this bond is sp hybridised

III. carbon of this bond is sp^3 hybridised

Higher the percentage s character, stronger is C–H bond. Correct order of bond dissociation energy of C–H bond:

II > I > III

76. Dalton's Atomic theory could not explain which of the following?

(1) Law of multiple proportion
(2) Law of gaseous volume
(3) Law of conservation of mass
(4) Law of constant proportion

Answer (2)

Sol. Dalton's theory could explain the laws of chemical combination. However, it could not explain the laws of gaseous volumes.

77. Identify the correct orders against the property mentioned

A. $H_2O > NH_3 > CHCl_3$ – dipole moment

B. $XeF_4 > XeO_3 > XeF_2$ – number of lone pairs on central atom

C. O–H > C–H > N–O – bond length

D. $N_2 > O_2 > H_2$ – bond enthalpy

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

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

Answer (3)

Sol.

		μ(D)
A.	H_2O	1.85
	NH_3	1.47
	$CHCl_3$	1.04

B. XeF_4 : 2 lone pairs of electron

XeO_3 : 1 lone pair of electron

XeF_2 : 3 lone pairs of electron

C. Order of Bond length :- N–O > C–H > O–H

D. N_2 Bond order is 3

H_2 Bond order is 1

O_2 Bond order is 2

78. Match **List-I** with **List-II.**

	List-I (Name of Vitamin)		List-II (Deficiency disease)
A.	Vitamin B_{12}	I.	Cheilosis
B.	Vitamin D	II.	Convulsions
C.	Vitamin B_2	III.	Rickets
D.	Vitamin B_6	IV.	Pernicious anaemia

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

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

Answer (4)

Sol.

	List-I (Name of Vitamin)	List-II (Deficiency disease)
A.	Vitamin B_{12}	Pernicious anaemia
B.	Vitamin D	Rickets
C.	Vitamin B_2	Cheilosis
D.	Vitamin B_6	Convulsions

79. The correct order of decreasing basic strength of the given amines is:

(1) N-ethylethanamine > ethanamine > N-methylaniline > benzenamine
(2) benzenamine > ethanamine > N-methylaniline > N-ethylethanamine
(3) N-methylaniline > benzenamine > ethanamine > N-ethylethanamine
(4) N-ethylethanamine > ethanamine > benzenamine > N-methylaniline

Answer (1)

Sol. Lower is the value of pK_b, higher is the basicity

Also aliphatic amines are stronger bases than aromatic amines.

pK_b : Benzenamine > N-Methylaniline > Ethanamine > N-Ethylethanamine

Basic strength : N-Ethylethanamine > Ethanamine > N-Methylaniline > Benzenamine

80. The correct order of the wavelength of light absorbed by the following complexes is,

A. $[Co(NH_3)_6]^{3+}$
B. $[Co(CN)_6]^{3-}$
C. $[Cu(H_2O)_4]^{2+}$
D. $[Ti(H_2O)_6]^{3+}$

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

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

Answer (4)

Sol. $\lambda \propto \dfrac{1}{\text{strength of ligand}}$

$\lambda \propto \dfrac{1}{\text{splitting}}$

A. $[Co(NH_3)_6]^{3+}$; 475 nm

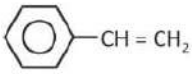
B. $[Co(CN)_6]^{3-}$; 310 nm

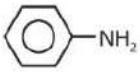
C. $[Cu(H_2O)_4]^{2+}$; 600 nm

D. $[Ti(H_2O)_6]^{3+}$; 498 nm

Order of λ = C > D > A > B

81. Which one of the following compounds **does not** decolourize bromine water?

(1) 

(2) 

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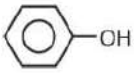
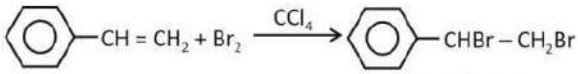
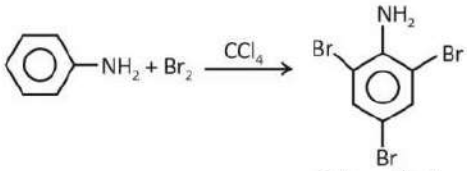
(4) 

Answer (3)

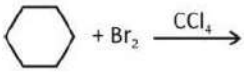
Sol. Test for unsaturation i.e. Bromine water Reddish orange colour of bromine solution in CCl_4 will discharge when bromine adds to an unsaturation site.



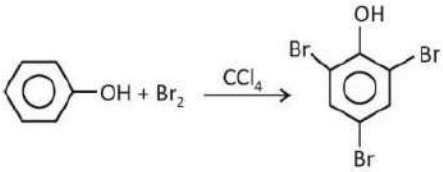
Colour discharge



Colour discharge

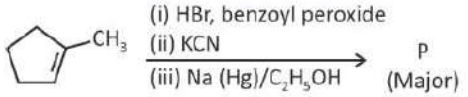


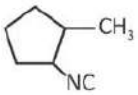
No reaction
No discharge of orange colour

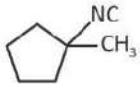


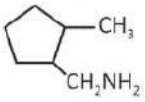
Colour discharge

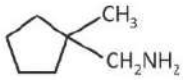
82. Predict the major product 'P' in the following sequence of reactions-



(1) 

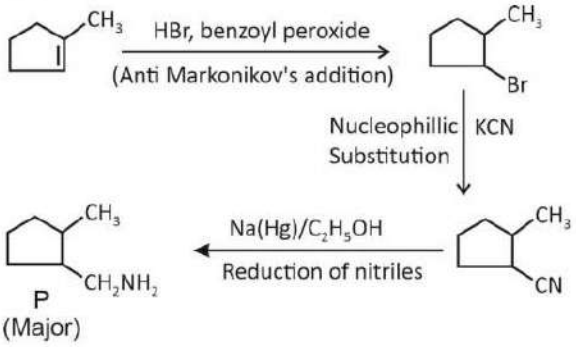
(2) 

(3) 

(4) 

Answer (3)

Sol.



83. Match **List I** with **List II**

	List-I (Mixture)		**List-II (Method of separation)**
A.	$CHCl_3 + C_6H_5NH_2$	(I)	Distillation under reduced pressure
B.	Crude oil in petroleum industry	(II)	Steam distillation
C.	Glycerol from spent-lye	(III)	Fractional distillation
D.	Aniline - water	(IV)	Simple distillation

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

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

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

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

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

Answer (3)

Sol.

		(Method of separation)
(A)	$CHCl_3 + C_6H_5NH_2$	Simple distillation
(B)	Crude oil in petroleum industry	Fractional distillation
(C)	Glycerol from spent-lye	Distillation under reduced pressure
(D)	Aniline - water	Steam Distillation

84. Which among the following electronic configurations belong to main group elements?

A. $[Ne]3s^1$

B. $[Ar]3d^3 4s^2$

C. $[Kr]4d^{10} 5s^2 5p^5$

D. $[Ar]3d^{10} 4s^1$

E. $[Rn]5f^0 6d^2 7s^2$

Choose the correct answer from the option given below :

(1) D and E only

(2) A, C and D only

(3) B and E only

(4) A and C only

Answer (4)

Sol. (A) $[Ne]3s^1$; Na (s-block)

(B) $[Ar]3d^3 4s^2$; V (d-block)

(C) $[Kr]4d^{10} 5s^2 5p^5$; I (p-block)

(D) $[Ar]3d^{10} 4s^1$; Cu (d-block)

(E) $[Rn]5f^0 6d^2 7s^2$; Th (f-block)

Main group elements (A and C only)

85. Which one of the following compounds can exist as cis-trans isomers?

(1) 1, 1-Dimethylcyclopropane

(2) 1, 2-Dimethylcyclohexane

(3) Pent-1-ene

(4) 2-Methylhex-2-ene

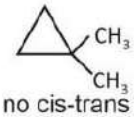
Answer (2)

Sol. Cis-trans isomers shown by :

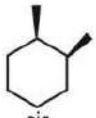
Condition: Restricted rotation around double bond

Or

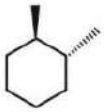
Different group around double bond



no cis-trans



cis



trans

$CH_3 - CH_2 - CH_2 - CH = CH_2$

no cis-trans

$$CH_3 - CH_2 - CH_2 - CH = \overset{\overset{CH_3}{|}}{C} - CH_3$$

no cis-trans

86. Phosphoric acid ionizes in three steps with their ionization constant values K_{a_1}, K_{a_2} and K_{a_3}, respectively, while K is the overall ionization constant. Which of the following statements are true?

A. $\log K = \log K_{a_1} + \log K_{a_2} + \log K_{a_3}$

B. H_3PO_4 is a stronger acid than $H_2PO_4^-$ and HPO_4^{2-}

C. $K_{a_1} > K_{a_2} > K_{a_3}$

D. $K_{a_1} = \frac{K_{a_3} + K_{a_2}}{2}$

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

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

Answer (2)

Sol. H_3PO_4 is a stronger acid than $H_2PO_4^-$ and HPO_4^{2-}

$H_3PO_4(aq) \rightleftharpoons H^+(aq) + H_2PO_4^-(aq)$ $\quad K_{a_1} = 7.5\times10^{-3}$

$H_2PO_4^-(aq) \rightleftharpoons H^+(aq) + HPO_4^{2-}(aq)$ $\quad K_{a_2} = 6.2\times10^{-8}$

$HPO_4^{2-}(aq) \rightleftharpoons H^+(aq) + PO_4^{3-}(aq)$ $\quad K_{a_3} = 1.7\times10^{-12}$

$K_{a_1} > K_{a_2} > K_{a_3}$

$\log K = \log K_{a_1} + \log K_{a_2} + \log K_{a_3}$

Ans. (A), (B) and (C) only

87. Match **List I** with **List II**

	List-I (Ion)		List-II (Group Number in Cation Analysis)
A.	Co^{2+}	I.	Group-I
B.	Mg^{2+}	II.	Group-III
C.	Pb^{2+}	III.	Group-IV
D.	Al^{3+}	IV.	Group-VI

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

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

Answer (4)

Sol.

	Ion	Group number in Cation Analysis
A.	Co^{2+}	Group-IV
B.	Mg^{2+}	Group-VI
C.	Pb^{2+}	Group-I
D.	Al^{3+}	Group-III

88. Higher yield of NO in $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ can be obtained at

[ΔH of the reaction = +180.7 kJ mol^{-1}]

A. Higher temperature

B. Lower temperature

C. Higher concentration of N_2

D. Higher concentration of O_2

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

(1) B, C, D only

(2) A, C, D only

(3) A, D only

(4) B, C only

Answer (2)

Sol. Yield of the product generally depends on

- Temperature
- Concentration of reactant(s) and product(s)
- Pressure

As this is an endothermic reaction (ΔH = +180.7 kJ mol^{-1}), so, increase in temperature will shift equilibrium in forward direction to increase yield of NO.

Increase in concentration of reactants (N_2 and O_2) also shifts the equilibrium in forward direction and increase the yield of NO.

Hence, (A), (C) and (D) only will increase yield of NO.

89. Given below are two statements :

Statement-I : Benzenediazonium salt is prepared by the reaction of aniline with nitrous acid at 273 – 278 K. It decomposes easily in the dry state.

Statement-II : Insertion of iodine into the benzene ring is difficult and hence iodobenzene is prepared through the reaction of benzenediazonium salt with KI.

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

(1) Statement I is correct but Statement II is incorrect

(2) Statement I is incorrect but Statement II is correct

(3) Both Statement I and Statement II are correct

(4) Both Statement I and Statement II are incorrect

Answer (3)

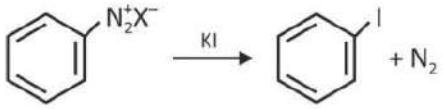
Sol. Benzene diazonium chloride is prepared by the reaction of aniline with nitrous acid at 273-278 K.

Nitrous acid is produced in the reaction mixture by reaction of $NaNO_2$ with HCl.

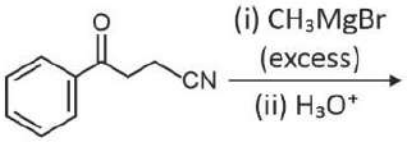
$$C_6H_5NH_2 + NaNO_2 + 2HCl \xrightarrow{273-278\,K} C_6H_5\overset{+}{N_2}\overset{-}{Cl} + NaCl + 2H_2O$$

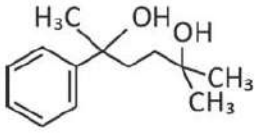
Benzene diazonium chloride decomposes easily in the dry state

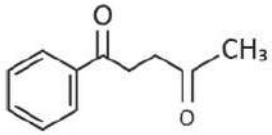
Iodobenzene is prepared by shaking benzene diazonium salt with KI because direct insertion of iodine into benzene ring is difficult

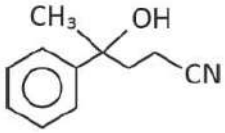


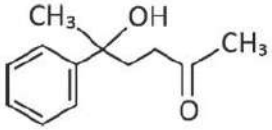
90. The major product of the following reaction is



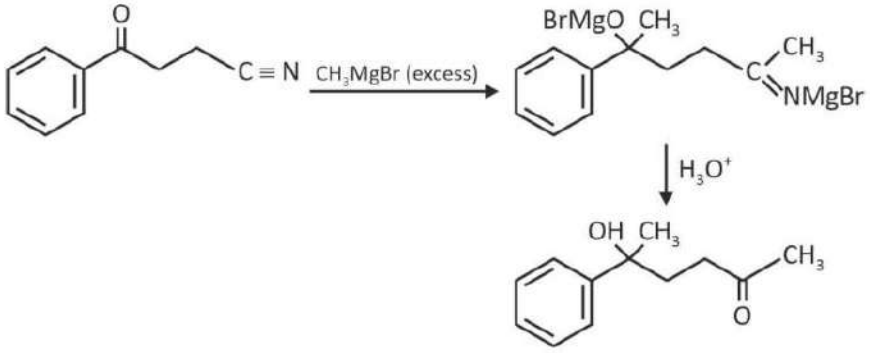
(1) 

(2) 

(3) 

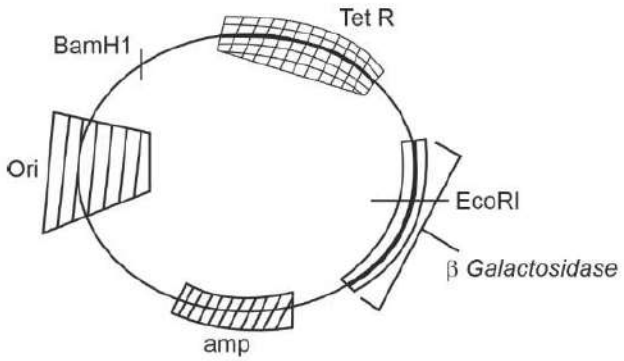
(4) 

Answer (4)

Sol. 

BIOLOGY

91.



In the above represented plasmid, an alien piece of DNA is inserted at EcoRI site. Which of the following strategies will be chosen to select the recombinant colonies?

(1) White color colonies will be selected.

(2) Blue color colonies grown on ampicillin plates can be selected.

(3) Using ampicillin & tetracycline containing medium plate.

(4) Blue color colonies will be selected.

Answer (1)

Sol. The correct answer is that white-colored colonies will be selected.

Since an alien piece of DNA is being inserted at EcoRI site, the gene β-galactosidase present here will undergo insertional inactivation.

This gene is responsible for producing blue-colored colonies, but since it has been insertionally inactivated, white colored colonies will be produced.

Ampicillin and tetracycline resistance genes present in the given DNA will remain intact. Thus, the given DNA will show amp^R and tet^R.

92. The protein portion of an enzyme is called:

(1) Apoenzyme

(2) Prosthetic group

(3) Cofactor

(4) Coenzyme

Answer (1)

Sol. There are number of cases in which non-protein constituents called co-factors are bound to the enzyme to make the enzyme catalytically active.

In these instances, the protein portion of the enzymes is called the apoenzyme.

Three kinds of co-factors are identified prosthetic groups, co-enzymes and metal ions. Prosthetic groups are organic compounds and they are tightly bound with apoenzyme. Co-enzymes are also organic compounds but their association with apoenzyme is only transient.

93. Given below are two statements:

Statement I : The primary source of energy in an ecosystem is solar energy.

Statement II : The rate of production of organic matter during photosynthesis in an ecosystem is called net primary productivity (NPP).

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

(1) Statement I is correct but statement II is incorrect

(2) Statement I is incorrect but statement II is correct

(3) Both statement I and statement II are correct

(4) Both statement I and statement II are incorrect

Answer (1)

Sol. Primary source of energy in the ecosystem is solar energy.

Gross primary productivity of an ecosystem is the rate of production of organic matter during photosynthesis.

Hence, statement I is correct but statement II is incorrect.

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

Assertion (A) : A typical unfertilised, angiosperm embryo sac at maturity is 8 nucleate and 7-celled.

Reason (R) : The egg apparatus has 2 polar nuclei.

In the light of the above statements, choose the **correct** answer from the options given below :

(1) **A** is true but **R** is false

(2) **A** is false but **R** is true

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

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

Answer (1)

Sol. A typical Angiosperm embryo sac, at maturity is 7-celled and 8 nucleate.

Polar nuclei are situated below the egg apparatus in the large central cell.

Three cells are grouped together at micropylar end and constitute the egg apparatus.

Hence, A is true but R is false.

95. Neoplastic characteristics of cells refer to :

A. A mass of proliferating cell

B. Rapid growth of cells

C. Invasion and damage to the surrounding tissue

D. Those confined to original location

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

(1) A, B, D only

(2) B, C, D only

(3) A, B only

(4) A, B, C only

Answer (4)

Sol. The correct answer will include : A, B and C only.

A neoplasm is a general term for any abnormal growth of tissue.

Neoplastic characteristics of cells refer to

(1) A mass of proliferating cell.

(2) Rapid growth of cells.

(3) Invasion and damage to the surrounding tissue.

Cancer specifically refers to malignant neoplasms, which are cancerous and invasive.

Benign tumours remain confined to their original location. Thus, D is not included in the answer.

The malignant tumours, on the other hand are a mass of proliferating cells called neoplastic or tumour cells. These cells grow very rapidly, invading and damaging the surrounding normal tissues.

96. Which one of the following is the characteristic feature of gymnosperms?

(1) Seeds are absent

(2) Gymnosperms have flowers for reproduction

(3) Seeds are enclosed in fruits

(4) Seeds are naked

Answer (4)

Sol. The gymnosperms (*Gymnos* : naked, *sperma* seed) are plants in which the ovules are not enclosed by an ovary wall and remains exposed, both before and after fertilization. The seeds that develop post-fertilization, are not covered, *i.e.*, naked.

97. Match **List-I** with **List-II**.

	List-I		**List-II**
A.	Progesterone	I.	Pars intermedia
B.	Relaxin	II.	Ovary
C.	Melanocyte stimulating hormone	III.	Adrenal Medulla
D.	Catecholamines	IV.	Corpus luteum

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

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

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

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

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

Answer (3)

Sol. The correct answer is [A-IV, B-II, C-I, D-III]

- Progesterone – A steroidal hormone which is secreted by the corpus luteum
- Relaxin – A proteinaceous hormone which is secreted by the ovaries in the later stage of pregnancy
- Melanocyte stimulating hormone – A proteinaceous hormone released by the pars intermedia
- Catecholamines – An amino-acid derived hormone released from the adrenal medulla during emergency conditions

98. Which chromosome in the human genome has the highest number of genes?

(1) Chromosome 1

(2) Chromosome 10

(3) Chromosome X

(4) Chromosome Y

Answer (1)

Sol. In human genome, Chromosome 1 has the highest number of genes, *i.e.*, 2968.

99. Which of the following statements about RuBisCO is true?

(1) It is an enzyme involved in the photolysis of water

(2) It catalyzes the carboxylation of RuBP

(3) It is active only in the dark

(4) It has higher affinity for oxygen than carbon dioxide

Answer (2)

Sol. Carboxylation is the most crucial step of the Calvin cycle where CO_2 is utilised for the carboxylation of RuBP. This reaction is catalysed by enzyme RuBP carboxylase. Since this enzyme also has an oxygenase activity, RuBisCO has higher affinity for carbon dioxide than oxygen.

100. The first menstruation is called :

(1) Diapause

(2) Ovulation

(3) Menopause

(4) Menarche

Answer (4)

Sol. The first menstruation begins at puberty and is called menarche.

- Ovulation is the process that deals with the release of secondary oocyte from the mature Graafian follicle.
- In human beings, menstrual cycles ceases around 50 years of age; that is termed as menopause.
- Diapause is a state of dormancy or developmental arrest in an organism.

101. Which of the following genetically engineered organisms was used by Eli Lilly to prepare human insulin?

(1) Virus

(2) Phage

(3) Bacterium

(4) Yeast

Answer (3)

Sol. The correct answer is bacterium.

In 1983, Eli Lilly, an American company, prepared two DNA sequences corresponding to 'A' and 'B' chains of human insulin and introduced them in plasmids of *E.coli* (a gram negative bacterium) to produce insulin chains.

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

Assertion (A) : All vertebrates are chordates but all chordates are not vertebrate.

Reason (R) : The members of subphylum vertebrata possess notochord during the embryonic period, the notochord is replaced by cartilaginous or bony vertebral column in adults.

In the light of the above statements, choose the **correct** answer from the options given below:

(1) **(A)** is true but **(R)** is false

(2) **(A)** is false but **(R)** is true

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

(4) Both **(A)** and **(R)** are true but **(R)** is **not** the correct explanation of **(A)**

Answer (3)

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

The members of subphylum vertebrata possess notochord during the embryonic period. The notochord is replaced by a cartilaginous or bony vertebral column in the adult.

Thus, all vertebrates are chordates but all chordates are not vertebrates.

103. What is the main function of the spindle fibers during mitosis?

(1) To repair damaged DNA

(2) To regulate cell growth

(3) To separate the chromosomes

(4) To synthesize new DNA

Answer (3)

Sol. During mitosis, spindle fibre get attach to the kinetochores of the chromosome and help in the separation of the chromosome.

104. Match **List I** with **List II**:

	List-I		**List-II**
A.	Alfred Hershey and Martha Chase	I.	Streptococcus pneumoniae
B.	Euchromatin	II.	Densely packed and dark-stained
C.	Frederick Griffith	III.	Loosely packed and light-stained
D.	Heterochromatin	IV.	DNA as genetic material confirmation

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

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

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

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

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

Answer (1)

Sol. The unequivocal proof that DNA is the genetic material came from the experiment of Alfred Hershey and Martha Chase.

Euchromatin are lightly stained region with loosely packed chromatin fibre.

Frederick Griffith performed series of experiments by selecting the different strains of *Streptococcus pneumoniae*.

Heterochromatin are darkly stained region with tightly packed chromatin fibre.

105. Match **List I** with **List II**:

	List-I		**List-II**
A.	Adenosine	I.	Nitrogen base
B.	Adenylic acid	II.	Nucleotide
C.	Adenine	III.	Nucleoside
D.	Alanine	IV.	Amino acid

Choose the option with all **correct** matches.

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

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

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

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

Answer (1)

Sol. The correct answer is A-III, B-II, C-I, D-IV

- Adenosine – It is a nucleoside which is composed of nitrogen base and sugar only.
- Adenylic acid – It is a nucleotide which is composed of nitrogen base, sugar and a phosphate group is esterified to the sugar.
- Adenine – Nitrogen base (Purine)

Alanine – An amino acid that contains a methyl group as the 'R' group.

106. In frog, the Renal portal system is a special venous connection that acts to link :

(1) Kidney and intestine

(2) Kidney and lower part of body

(3) Liver and intestine

(4) Liver and kidney

Answer (2)

Sol. In frogs, special venous connection between liver and intestine as well as the kidney and lower parts of the body are present in frogs. The former is called hepatic portal system and the latter is called renal portal system.

107. Which of the following are the post-transcriptional events in an eukaryotic cell?

A. Transport of pre-mRNA to cytoplasm prior to splicing.

B. Removal of introns and joining of exons.

C. Addition of methyl group at 5' end of hnRNA.

D. Addition of adenine residues at 3' end of hnRNA.

E. Base pairing of two complementary RNAs.

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

(1) B, C, E only

(2) C, D, E only

(3) A, B, C only

(4) B, C, D only

Answer (4)

Sol. The process of copying genetic information from one strand of the DNA into RNA is known as transcription. It occurs in the cytoplasm with the help of transcripting enzyme.

Transport of pre-mRNA to cytoplasm prior to splicing is a part of transcription.

The primary transcript is converted into functional mRNA after post transcriptional processing involves 3 steps as follows-

- Modification of 5' end by capping,
- Tailing,
- Splicing.

Base pairing of two complementary RNA is not on event of post-transcription. Hence, statements B, C, D are post-transcriptional modification events in eukaryotic cell.

108. Polymerase chain reaction (PCR) amplifies DNA following the equation.

(1) $2n + 1$

(2) $2N^2$

(3) N^2

(4) 2^n

Answer (4)

Sol. PCR *i.e.*, polymerase chain reaction amplifies DNA as per the equation 2^n, where '*n*' refers to number of cycles. Thus, say, if 3 PCR cycles will run, then 2^3 *i.e.*, $2 \times 2 \times 2 \Rightarrow 8$ DNA fragments will be formed.

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

Assertion (A) : Both wind and water pollinated flowers are not very colourful and do not produce nectar.

Reason (R) : The flowers produce enormous amount of pollen grains in wind and water pollinated flowers.

In the light of the above statements, choose the **correct** answer from the options given below:

(1) **A** is true but **R** is false

(2) **A** is false but **R** is true

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

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

Answer (4)

Sol. Both wind and water pollinated flowers are not very colourful and do not produce nectar, this is because they rely on wind and water to carry their pollen. Wind and water pollinated flower do not need to attract insect, so they did not evolve to produce bright coloured flower.

110. Epiphytes that are growing on a mango branch is an example of which of the following?

(1) Predation

(2) Amensalism

(3) Commensalism

(4) Mutualism

Answer (3)

Sol. Commensalism is the type of interaction in which one-species benefits and another is neither harmed nor benefited. An orchid growing as an epiphyte on a mango branch is an example of commensalism.

111. Find the correct statement :

(A) In human pregnancy, the major organ systems are formed at the end of 12 weeks.

(B) In human pregnancy the major organ systems are formed at the end of 8 weeks.

(C) In human pregnancy heart is formed after one month of gestation.

(D) In human pregnancy, limbs and digits develop by the end of second month.

(E) In human pregnancy the appearance of hair is usually observed in the fifth month.

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

(1) B, C, D and E only

(2) A, C, D and E only

(3) A and E only

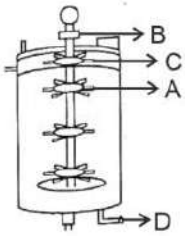
(4) B and C only

Answer (2)

Sol. In a human female's pregnancy.

- By the end of 12 weeks (1st trimester), most of major organ systems are formed (not by end of 8 weeks).
- After one month of pregnancy, the embryo's heart is formed.
- By the end of second month of pregnancy, the foetus develops limbs and digits.
- The first movements of foetus and appearance of hair on head are usually observed during the fifth month.

112. Identify the part of a bio-reactor which is used as a foam braker from the given figure.



(1) D

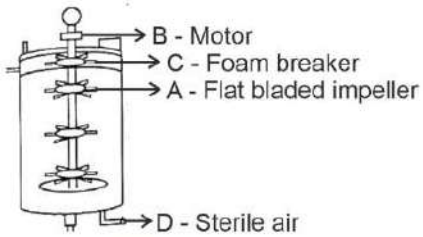
(2) C

(3) A

(4) B

Answer (2)

Sol.



$\therefore$ Part labelled as C is foam breaker.

113. Frogs respire in water by skin and buccal cavity and on land by skin, buccal cavity and lungs.

Choose the **correct** answer from the following :

(1) The statement is false for water but true for land

(2) The statement is false for both the environment

(3) The statement is true for water but false for land

(4) The statement is true for both the environment

Answer (1)

Sol.
- In water, frogs respire through skin and not through buccal cavity *i.e.,* undergo cutaneous respiration only.
- On land, the buccal cavity, skin and lungs act as respiratory organs *i.e.,* undergo buccopharyngeal, cutaneous and pulmonary respiration.

114. Consider the following statements regarding function of adrenal medullary hormones :

(A) It causes pupilary constriction.

(B) It is a hyperglycemic hormone.

(C) It causes piloerection.

(D) It increases strength of heart contraction.

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

(1) A, C and D only

(2) D only

(3) C and D only

(4) B, C and D only

Answer (4)

Sol. Adrenal medulla secretes two hormones called adrenaline or epinephrine and noradrenaline or norepinephrine (also called emergency hormones).

Both the hormones -

- Cause pupillary dilation (not constriction)
- Stimulate breakdown of glycogen resulting in increased concentration of glucose in blood i.e., cause hyperglycemia.
- Cause piloerection (raising of hair).
- Increase strength of heart contraction *i.e.* heartbeat.

115. Read the following statements on plant growth and development.

(A) Parthenocarpy can be induced by auxins.

(B) Plant growth regulators can be involved in promotion as well as inhibition of growth.

(C) Dedifferentiation is a pre-requisite for re-differentiation.

(D) Abscisic acid is a plant growth promoter.

(E) Apical dominance promotes the growth of lateral buds.

Choose the option with all correct statements.

(1) A, D, E only

(2) B, D, E only

(3) A, B, C only

(4) A, C, E only

Answer (3)

Sol. ABA is a plant growth inhibitor and an inhibitor of plant metabolism.

Apical dominance promotes growth of apical bud.

Statements A, B and C are correct.

116. Which of the following hormones released from the pituitary is actually synthesized in the hypothalamus?

(1) Follicle-stimulating hormone (FSH)

(2) Adrenocorticotropic hormone (ACTH)

(3) Luteinizing hormone (LH)

(4) Anti-diuretic hormone (ADH)

Answer (4)

Sol. Neurohypophysis *i.e.*, posterior pituitary (Pars nervosa) stores and releases two hormones called oxytocin and vasopressin (Also called ADH *i.e.*, antidiuretic hormone) which are actually synthesised by hypothalamus and are transported axonally to neurohypophysis. The pars distalis (anterior pituitary) produces follicle stimulating hormone (FSH), adrenocorticotropic hormone (ACTH) and luteinizing hormone (LH).

117. Which of the following is an example of non-distilled alcoholic beverage produced by yeast?

(1) Beer

(2) Rum

(3) Whisky

(4) Brandy

Answer (1)

Sol. Wine and beer are produced without distillation whereas whisky, brandy and rum are produced by distillation of fermented broth.

118. What is the pattern of inheritance for polygenic trait?

(1) Autosomal dominant pattern

(2) X-linked recessive inheritance pattern

(3) Mendelian inheritance pattern

(4) Non-mendelian inheritance pattern

Answer (4)

Sol. Polygenic inheritance refers to the inheritance of a trait controlled by two or more genes. When human disorders are determined by mutation in the single gene then they are transmitted to the offspring as per Mendelian principle. Polygenic trait shows non-Mendelian inheritance pattern.

119. Match **List - I** with **List - II**.

	List - I		List - II
A.	Head	(i)	Enzymes
B.	Middle piece	(ii)	Sperm motility
C.	Acrosome	(iii)	Energy
D.	Tail	(iv)	Genetic material

Choose the correct answer from the options given below :

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

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

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

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

Answer (3)

Sol.
- The sperm head contains elongated nucleus which possesses the genetic material.
- The middle piece possesses numerous mitochondria, which produce energy for movement.
- Acrosome is a cap-like structure filled with enzymes that help in fertilization of ovum.
- The tail of sperm facilitates sperm motility essential for fertilisation.

120. Which of the following is an example of a zygomorphic flower?

(1) Pea

(2) Chilli

(3) Petunia

(4) Datura

Answer (1)

Sol. Zygomorphic flowers can be divided into two equal halves by only a single vertical plane and shows bilateral symmetry.

Pea possess zygomorphic flowers.

Chilli, Petunia and Datura possess actinomorphic flowers.

121. Which of following organisms **cannot** fix nitrogen?

A. *Azotobacter*

B. *Oscillatoria*

C. *Anabaena*

D. *Volvox*

E. *Nostoc*

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

(1) B only

(2) E only

(3) A only

(4) D only

Answer (4)

Sol. *Azotobacter, Oscillatoria, Anabaena* and *Nostoc* can fix nitrogen but *Volvox* cannot fix nitrogen.

122. Which one of the following is an example of ex-situ conservation?

(1) Zoos and botanical gardens

(2) Protected areas

(3) National Park

(4) Wildlife Sanctuary

Answer (1)

Sol. Zoological parks (Zoos), botanical gardens and wildlife safari parks are examples of ex-situ conservation. Sacred groves, biosphere reserves, national parks and wildlife sanctuaries are examples of in-situ conservation.

123. Who is known as the father of Ecology in India?

(1) Ram Udar

(2) Birbal Sahni

(3) S.R. Kashyap

(4) Ramdeo Misra

Answer (4)

Sol. Ramdeo Misra is known as the father of Ecology in India.

124. Given below are two statements :

Statement I : In the RNA world, RNA is considered the first genetic material evolved to carry out essential life processes. RNA acts as a genetic material and also as a catalyst for some important biochemical reactions in living systems. Being reactive, RNA is unstable.

Statement II : DNA evolved from RNA and is a more stable genetic material. Its double helical strands being complementary, resist changes by evolving repairing mechanism.

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

(1) Statement I is correct but statement II is incorrect

(2) Statement I is incorrect but statement II is correct

(3) Both statement I and statement II are correct

(4) Both statement I and statement II are incorrect

Answer (3)

Sol. In RNA world, RNA was the first genetic material as there are enough evidences to suggest that essential life processes (such as metabolism, translation, splicing, etc) evolved around RNA. RNA used to act as a genetic material as well as catalyst (there are some important biochemical reaction in living systems that are catalysed by RNA catalysts not by protein enzymes) so, statement I is correct statement II is also correct as DNA being double stranded and having complementary strands further resists changes by evolving a process of repair.

125. Given below are two statements :

Statement I : Transfer RNAs and ribosomal RNA do not interact with mRNA.

Statement II : RNA interference (RNAi) takes place in all eukaryotic organisms as a method of cellular defence.

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

(1) Statement I is correct but statement II is incorrect

(2) Statement I is incorrect but statement II is correct

(3) Both statement I and statement II are correct

(4) Both statement I and statement II are incorrect

Answer (2)

Sol. Both transfer RNAs and ribosomal RNA interact with mRNA.

RNA interference (RNAi) takes place in all eukaryotic organisms as a method of cellular defence.

126. Match **List-I** with **List-II.**

	List-I		List-II
A.	Heart	(i)	Erythropoietin
B.	Kidney	(ii)	Aldosterone
C.	Gastro-intestinal tract	(iii)	Atrial natriuretic factor
D.	Adrenal Cortex	(iv)	Secretin

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

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

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

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

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

Answer (2)

Sol.

Organ Name	-	**Hormone Secreted**
Heart	-	Atrial natriuretic factor
Kidney	-	Erythropoietin
Gastro-intestinal tract	-	Secretin
Adrenal cortex	-	Aldosterone

127. All living members of the class Cyclostomata are :

(1) Symbiotic

(2) Ectoparasite

(3) Free living

(4) Endoparasite

Answer (2)

Sol. All living members of class Cyclostomata are ectoparasites.

128. Streptokinase produced by *bacterium Streptococcus* is used for

(1) Liver disease treatment

(2) Removing clots from blood vessels

(3) Curd production

(4) Ethanol production

Answer (2)

Sol. Streptokinase produced by the bacterium *Streptococcus* and modified by genetic engineering is used as a 'clot buster' for removing clots from blood vessels of patients who have undergone myocardial infarction leading to heart attack. Curd production is done by *Lactobacillus* and ethanol production is done by *Saccharomyces.*

129. Role of the water vascular system in Echinoderms is :

A. Respiration and Locomotion

B. Excretion and Locomotion

C. Capture and transport of food

D. Digestion and Respiration

E. Digestion and Excretion

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

(1) B and C Only

(2) B, D and E Only

(3) A and B Only

(4) A and C Only

Answer (4)

Sol. Water vascular system in Echinoderms helps in locomotion, capture and transport of food and respiration.

Excretory system is absent in echinoderms. Excretion takes place through general body surface.

130. Match **List-I** with **List-II**.

	List-I		List-II
A.	Pteridophyte	(i)	*Salvia*
B.	Bryophyte	(ii)	*Ginkgo*
C.	Angiosperm	(iii)	*Polytrichum*
D.	Gymnosperm	(iv)	*Salvinia*

Choose the option with all **correct** matches.

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

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

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

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

Answer (4)

Sol. Pteridophyte - *Salvinia*

Bryophyte - *Polytrichum*

Angiosperm - *Salvia*

Gymnosperm - *Ginkgo*

131. Which are correct:

A. Computed tomography and magnetic resonance imaging detect cancers of internal organs.

B. Chemotherapeutics drugs are used to kill non-cancerous cells.

C. α -interferon activate the cancer patients' immune system and helps in destroying the tumour.

D. Chemotherapeutic drugs are biological response modifiers.

E. In the case of leukaemia blood cell counts are decreased.

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

(1) C and D only

(2) A and C only

(3) B and D only

(4) D and E only

Answer (2)

Sol. Statements A and C are correct while statements B, D and E are incorrect.

Chemotherapeutic drugs are used to kill cancerous cells.

In case of leukaemia, blood cell counts are increased.

α-interferons are biological response modifiers.

132. What are the potential drawbacks in adoption of the IVF method?

A. High fatality risk to mother

B. Expensive instruments and reagents

C. Husband/wife necessary for being donors

D. Less adoption of orphans

E. Not available in India

F. Possibility that the early embryo does not survive

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

(1) A, B, C, D only

(2) A, B, C, E, F only

(3) B, D, F only

(4) A, C, D, F only

Answer (3)

Sol. Statements B, D and F are correct while statements A, C and E are incorrect.

Husband/wife is not necessary for being donors. IVF is available in India.

133. Consider the following :

A. The reductive division for the human female gametogenesis starts earlier than that of the male gametogenesis.

B. The gap between the first meiotic division and the second meiotic division is much shorter for males compared to females.

C. The first polar body is associated with the formation of the primary oocyte.

D. Luteinizing Hormone (LH) surge leads to disintegration of the endometrium and onset of menstrual bleeding.

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

(1) B and D are true

(2) B and C are true

(3) A and B are true

(4) A and C are true

Answer (3)

Sol. Statements A and B are true while statements C and D are false.

The first polar body is associated with the formation of the secondary oocyte LH surge leads to ovulation. Decreased levels of progesterone during late luteal phase leads to degeneration of the endometrium and onset of menstrual bleeding.

134. In bryophytes, the gemmae help in which one of the following?

(1) Nutrient absorption

(2) Gaseous exchange

(3) Sexual reproduction

(4) Asexual reproduction

Answer (4)

Sol. Gemmae are green, multicellular, asexual buds which develop in small receptacles called gemma cups and help in asexual reproduction in bryophytes.

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

Assertion (A) : The primary function of the Golgi apparatus is to package the materials made by the endoplasmic reticulum and deliver it to intracellular targets and outside the cell.

Reason (R) : Vesicles containing materials made by the endoplasmic reticulum fuse with the cis face of the Golgi apparatus, and they are modified and released from the trans face of the Golgi apparatus.

In the light of the above statements, choose the **correct** answer from the options given below :

(1) **A** is true but **R** is false

(2) **A** is false but **R** is true

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

(4) Both **A** and **R** are true but **R** is not the correct explanation of **A**

Answer (4)

Sol. The primary function of Golgi apparatus is to package the materials made by endoplasmic reticulum and deliver it to intracellular targets and outside the cell, this statement is correct and the reason statement is also correct. Golgi apparatus remains in close association with endoplasmic reticulum. Here, assertion and reason statements both are correct but reason is not correctly explaining assertion.

136. Which one of the following statements refers to Reductionist Biology?

(1) Chemical approach to study and understand living organisms

(2) Behavioural approach to study and understand living organisms

(3) Physico-chemical approach to study and understand living organisms

(4) Physiological approach to study and understand living organisms

Answer (3)

Sol. The physico-chemical approach to study and understand living organisms is called 'Reductionist Biology'.

137. After maturation, in primary lymphoid organs, the lymphocytes migrate for interaction with antigens to secondary lymphoid organ(s) / tissue(s) like

A. thymus

B. bone marrow

C. spleen

D. lymph nodes

E. Peyer's patches

Choose the *correct* answer from the options given below

(1) E, A, B only

(2) C, D, E only

(3) B, C, D only

(4) A, B, C only

Answer (2)

Sol. The primary lymphoid organs are bone marrow and thymus where immature lymphocytes differentiate into antigen-sensitive lymphocytes.

After maturation, the lymphocytes migrate into secondary lymphoid organs like spleen, lymph nodes, Peyer's patches of small intestine and appendix.

These secondary lymphoid organ provide the sites for interaction of lymphocytes with the antigen.

138. Match **List I** with **List II**:

	List I		**List II**
A.	The Evil Quartet	I.	Cryopreservation
B.	Ex situ conservation	II.	Alien species invasion
C.	*Lantana camara*	III.	Causes of biodiversity losses
D.	Dodo	IV.	Extinction

Choose the option with all correct matches.

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

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

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

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

Answer (4)

Sol. The Evil Quartet – Causes of biodiversity losses

Ex situ conservation – Cryopreservation

Lantana camara – Alien species invasion

Dodo – Extinction

139. How many meiotic and mitotic divisions need to occur for the development of a mature female gametophyte from the megaspore mother cell in an angiosperm plant?

(1) 1 Meiosis and 3 Mitosis

(2) No Meiosis and 2 Mitosis

(3) 2 Meiosis and 3 Mitosis

(4) 1 Meiosis and 2 Mitosis

Answer (1)

Sol. Development of a mature female gametophyte, i.e., embryo sac from a megaspore mother cell in an angiosperm plant requires 1 meiotic and 3 mitotic divisions.

140. Which of the following type of immunity is present at the time of birth and is a non-specific type of defence in the human body?

(1) Cell-mediated Immunity

(2) Humoral Immunity

(3) Acquired Immunity

(4) Innate Immunity

Answer (4)

Sol. Innate immunity is non-specific type of defence, that is present at the time of birth. This is accomplished by providing different types of barriers to the entry of the foreign agents into our body. Acquired immunity is pathogen specific, characterised by memory cells.

Immune response mediated by B-lymphocytes is humoral immunity and other immune response mediated by T-lymphocytes is called cell-mediated immunity.

141. Given below are two statements :

Statement I : Fig fruit is a non-vegetarian fruit as it has enclosed fig wasps in it.

Statement II : Fig wasp and fig tree exhibit mutual relationship as fig wasp completes its life cycle in fig fruit and fig fruit gets pollinated by fig wasp.

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

(1) Statement I is correct but statement II is incorrect

(2) Statement I is incorrect but statement II is correct

(3) Both statement I and statement II are correct

(4) Both statement I and statement II are incorrect

Answer (4)

Sol. Fig fruit is a vegetarian fruit as it only gets pollinated by wasp. Fig tree and fig wasps shows mutualism in which both species are benefitted. So, statement I is incorrect. Statement II is also not correct as fig inflorescence/flower gets pollinated by fig wasp.

142. Given below are two statements : One is labelled as **Assertion (A)** and other is labelled as **Reason (R)**.

Assertion (A) : Cells of the tapetum possess dense cytoplasm and generally have more than one nucleus.

Reason (R) : Presence of more than one nucleus in the tapetum increases the efficiency of nourishing the developing microspore mother cells.

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

(1) **A** is true but **R** is false

(2) **A** is false but **R** is true

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

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

Answer (1)

Sol. Cell of the tapetum possess dense cytoplasm and generally have more than one nucleus because the presence of more than one nucleus in the tapetal cells increases the efficiency of nourishing the develpoing pollen grains.

143. From the statements given below choose the **correct** option :

A. The eukaryotic ribosomes are 80S and prokaryotic ribosomes are 70S.

B. Each ribosome has two sub-units.

C. The two sub-units of 80S ribosome are 60S and 40S while that of 70S are 50S and 30S.

D. The two sub-units of 80S ribosome are 60S and 20S and that of 70S are 50S and 20S.

E. The two sub-units of 80S are 60S and 30S and that of 70S are 50S and 30S.

(1) A, B, E are true

(2) B, D, E are true

(3) A, B, C are true

(4) A, B, D are true

Answer (3)

Sol. The eukaryotic ribosomes are 80S and prokaryotic ribosomes are 70S type.

Each ribosome has two sub-units.

The two sub-units of 80S ribosome are 60S and 40S while that of 70S are 50S and 30S.

144. Which one of the following enzymes contains 'Haem' as the prosthetic group?

(1) Succinate dehydrogenase

(2) Catalase

(3) RuBisCo

(4) Carbonic anhydrase

Answer (2)

Sol. In peroxidase and catalase, which catalyze the breakdown of hydrogen peroxide to water and oxygen, haem is the prosthetic group and it is part of the active site of the enzymes.

Zinc is the cofactor in enzyme carbonic anhydrase.

RuBisCo is the most abundant protein in whole of the biosphere.

Succinate is the substrate of enzyme succinic dehydrogenase.

145. What is the name of the blood vessel that carries deoxygenated blood from the body to the heart in a frog?

(1) Pulmonary vein

(2) Vena cava

(3) Aorta

(4) Pulmonary artery

Answer (2)

Sol. Frog's heart is a muscular structure with three chambers. It receives deoxygenated blood from body parts through the major veins called vena cava. Vena cava carries deoxygenated blood. Aorta and pulmonary vein carries oxygenated blood. Whereas, pulmonary artery will carry deoxygenated blood towards the lungs.

146. Given below are the stages in the life cycle of pteridophytes. Arrange the following stages in the correct sequence.

A. Prothallus stage

B. Meiosis in spore mother cells

C. Fertilisation

D. Formation of archegonia and antheridia in gametophyte.

E. Transfer of antherozoids to the archegonia in presence of water.

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

(1) D, E, C, A, B

(2) E, D, C, B, A

(3) B, A, D, E, C

(4) B, A, E, C, D

Answer (3)

Sol. In a pteridophytes life cycle, the correct sequence of stages will be given as follows:

B $\rightarrow$ Meiosis in spore mother cells

A $\rightarrow$ Prothallus stage

D $\rightarrow$ Formation of archegonia and antheridia in gametophyte

E $\rightarrow$ Transfer of antherozoids to the archegonia in presence of water

C $\rightarrow$ Fertilisation will occur

So, the correct sequence is B $\rightarrow$ A $\rightarrow$ D $\rightarrow$ E $\rightarrow$ C

147. The blue and white selectable markers have been developed which differentiate recombinant colonies from non-recombinant colonies on the basis of their ability to produce colour in the presence of a chromogenic substrate.

Given below are two statements about this method:

Statement I : The blue coloured colonies have DNA insert in the plasmid and they are identified as recombinant colonies.

Statement II : The colonies without blue colour have DNA insert in the plasmid and are identified as recombinant colonies.

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

(1) **Statement I** is correct but **Statement II** is incorrect

(2) **Statement I** is incorrect but **Statement II** is correct

(3) Both **Statement I** and **Statement II** are correct

(4) Both **Statement I** and **Statement II** are incorrect

Answer (2)

Sol. Statement I is incorrect but statement II is correct as a recombinant DNA is inserted within the coding sequence of an enzyme, β-galactosidase. This results into inactivation of the gene for synthesis of this enzyme. Thus, presence of insert results into insertional inactivation of the β-galactosidase gene and the colonies do not produce any colour and identified as recombinant colonies. Whereas non-recombinant transformants will produce blue colour in presence of chromogenic substrate.

148. Which of the following microbes is **NOT** involved in the preparation of household products?

A. *Aspergillus niger*

B. *Lactobacillus*

C. *Trichoderma polysporum*

D. *Saccharomyces cerevisiae*

E. *Propionibacterium sharmanii*

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

(1) C and D only

(2) C and E only

(3) A and B only

(4) A and C only

Answer (4)

Sol. *Lactobacillus* is used for production of curd.

Saccharomyces cerevisiae is used for the fermentation of palm sap to obtain toddy drink.

Propionibacterium sharmanii is used for production of swiss cheese.

Aspergillus niger is used for the commercial production of citric acid.

Trichoderma polysporum is used for the production of cyclosporin A and also act as a biocontrol agent.

A, C are used in industrial production of citric acid and cyclosporin-A.

149. Silencing of specific mRNA is possible via RNAi because of

(1) Complementary tRNA

(2) Non-complementary ssRNA

(3) Complementary dsRNA

(4) Inhibitory ssRNA

Answer (3)

Sol. RNAi (RNA interference) takes place in all eukaryotic organisms as a method of cellular defense. This method involves silencing of a specific mRNA due to a complementary dsRNA molecule that binds to and prevents translation of the mRNA.

150. The complex II of mitochondrial electron transport chain is also known as

(1) Cytochrome c oxidase

(2) NADH dehydrogenase

(3) Cytochrome bc_1

(4) Succinate dehydrogenase

Answer (4)

Sol. Complex II of mitochondrial electron transport chain is also known as succinate dehydrogenase. Cytochrome c oxidase (complex IV), NADH dehydrogenase (complex I), cytochrome bc_1 (complex III).

151. While trying to find out the characteristic of a newly found animal, a researcher did the histology of adult animal and observed a cavity with presence of mesodermal tissue towards the body wall but no mesodermal tissue was observed towards the alimentary canal. What could be the possible coelome of that animal?

(1) Schizocoelomate

(2) Spongocoelomate

(3) Acoelomate

(4) Pseudocoelomate

Answer (4)

Sol. In pseudocoelomates, the body cavity is not entirely lined with mesoderm, instead, mesodermal tissue is present along the body wall but not towards the gut.

- Schizocoelomates are animals whose coelom or body cavity develops middle from a split in the mesoderm, the middle germ layer of the embryo.
- In acoelomates, coelom is absent.

Spongocoel is a central cavity found in Sponges.

152. Given below are two statements:

Statement I: In a floral formula ⊕ stands for zygomorphic nature of the flower, and $\underline{G}$ stands for inferior ovary.

Statement II: In a floral formula ⊕ stands for actinomorphic nature of the flower and $\underline{G}$ stands for superior ovary.

In the light of the above statements, choose the **correct** answer from the options given below:

(1) Statement I is correct but Statement II is incorrect

(2) Statement I is incorrect but Statement II is correct

(3) Both Statement I and Statement II are correct

(4) Both Statement I and Statement II are incorrect

Answer (2)

Sol. The floral formula symbol ⊕ is used for actinomorphic flower, while % is used for zygomorphic flower.

The symbol G represents gynoecium and $\underline{G}$ symbol represent superior ovary, while inferior ovary is represented by $\bar{G}$.

Thus, statement I is incorrect and Statement II is correct.

153. Given below are two statements:

Statement I: In ecosystem, there is unidirectional flow of energy of sun from producers to consumers.

Statement II: Ecosystems are exempted from 2nd law of thermodynamics.

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

(1) Statement I is correct but statement II is incorrect

(2) Statement I is incorrect but statement II is correct

(3) Both statement I and statement II are correct

(4) Both statement I and statement II are incorrect

Answer (1)

Sol. Sun is the only source of energy for all ecosystems on Earth, except for deep sea-hydro-thermal ecosystem.

The energy flow is unidirectional from the sun to producers and then to consumers.

Ecosystems are not exempted from the second law of thermodynamics. They need a constant supply of energy to synthesise the molecules they require to counteract the universal tendency towards increasing disorderliness.

154. Which of the following is the unit of productivity of an Ecosystem?

(1) KCal m^{-3}

(2) (KCal m^{-2})yr^{-1}

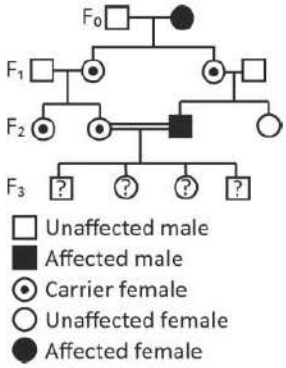
(3) gm^{-2}

(4) KCal m^{-2}

Answer (2)

Sol. The rate of biomass production is called productivity. It is expressed in terms of $gm^{-2}yr^{-1}$ or (KCal m^{-2})yr^{-1} to compare the productivity of different ecosystems.

155. With the help of given pedigree, find out the probability for the birth of a child having no disease and being a carrier (has the disease mutation in one allele of the gene) in F_3 generation.



(1) 1/8

(2) Zero

(3) 1/4

(4) 1/2

Answer (3)

Sol. As in the F_1 generation the carrier female and non-affected (normal, not carrier) had affected male child that means the genetic disorder is sex-linked recessive.

The consanguineous mating between female (X^cX) and male (X^cY)

♀ \ ♂	X^c	Y
X^c	X^cX^c	X^cY
X	X^cX	XY

Out of 4 child only one is carrier i.e. $\frac{1}{4}$.

156. In the seeds of cereals, the outer covering of endosperm separates the embryo by a protein-rich layer called :

(1) Integument

(2) Aleurone layer

(3) Coleoptile

(4) Coleorhiza

Answer (2)

Sol. In monocot seeds, the outer covering of endosperm separates the embryo by a proteinous layer called aleurone layer.

157. Match **List I** with **List II**:

	List-I		List-II
A.	Chlorophyll a	(I)	Yellow-green
B.	Chlorophyll b	(II)	Yellow
C.	Xanthophylls	(III)	Blue-green
D.	Carotenoids	(IV)	Yellow to Yellow-orange

Choose the option with all **correct** matches.

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

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

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

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

Answer (4)

Sol. A chromatographic separation of the leaf pigments shows that the colour that we see in leaves is not due to single pigment but due to four pigments.

Chlorophyll a	–	Bright or blue-green in the chromatogram
Chlorophyll b	–	Yellow-green
Xanthophylls	–	Yellow
Carotenoids	–	Yellow to Yellow-orange

158. Who proposed that the genetic code for amino acids should be made up of three nucleotides?

(1) Jacque Monod

(2) Franklin Stahl

(3) George Gamow

(4) Francis Crick

Answer (3)

Sol. George Gamow, a physicist proposed that genetic code for amino acids should be made up of three nucleotides.

159. Histones are enriched with -

(1) Phenylalanine & Leucine

(2) Phenylalanine & Arginine

(3) Lysine & Arginine

(4) Leucine & Lysine

Answer (3)

Sol. In eukaryotes, packaging of DNA is much more complex. There is a set of positively charged, basic proteins called histones.

Histones are organised to form a unit of light molecules called histone octamer.

They are rich in the basic amino acid residues lysine and arginine.

160. Which of the following enzyme(s) are **NOT** essential for gene cloning?

A. Restriction enzymes

B. DNA ligase

C. DNA mutase

D. DNA recombinase

E. DNA polymerase

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

(1) D and E only

(2) B and C only

(3) C and D only

(4) A and B only

Answer (3)

Sol. Gene cloning is a process where a specific gene or DNA sequence is isolated and replicated, creating multiple identical copies.

In gene cloning, restriction enzymes, DNA ligase and DNA polymerase are primarily used.

161. A specialised membranous structure in a prokaryotic cell which helps in cell well wall formation, DNA replication and respiration is

(1) Cristae

(2) Endoplasmic Reticulum

(3) Mesosome

(4) Chromatophores

Answer (3)

Sol. Mesosome is membranous extension in bacterial cell that helps in cell wall formation, DNA replication and contains enzymes for respiration.

162. Which factor is important for termination of transcription?

(1) ρ (rho)

(2) γ (gamma)

(3) α (alpha)

(4) σ (sigma)

Answer (1)

Sol. In prokaryotes the RNA polymerase is only capable of catalysing the process of elongation. It associates transiently with initiation factor (σ) and termination factor (ρ) to initiate and terminate the transcription respectively.

163. Which of the following statement is **correct** about location of the male frog copulatory pad?

(1) Second digit of fore limb

(2) First digit of the fore limb

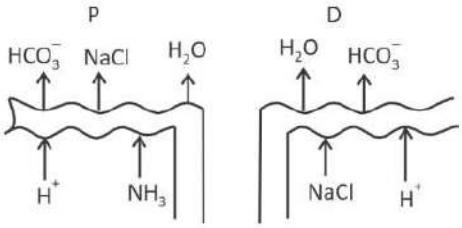
(3) First and Second digit of fore limb

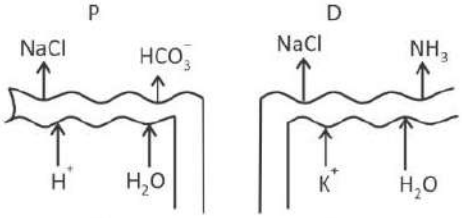
(4) First digit of hind limb

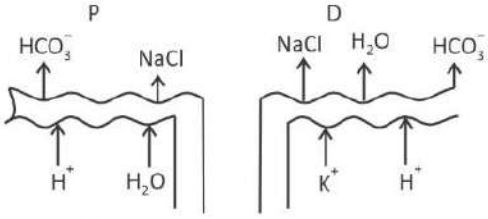
Answer (2)

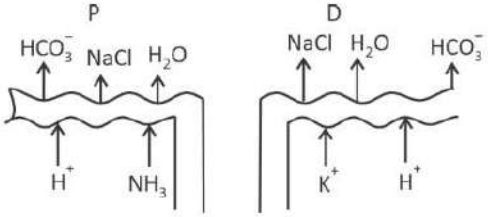
Sol. In male frogs, copulatory pad is present on the first digit of the forelimbs which are absent in female frogs.

164. Which of the following diagrams is correct with regard to the proximal (P) and distal (D) tubule of the Nephron.

(1)


(2)


(3)


(4)


Answer (4)

Sol. During urine formation, the tubular cells secrete substances like H^+, K^+ and ammonia into the filtrate. Tubular secretion is also an important step in urine formation as it helps in the maintenance of ionic and acid base balance of body fluids.

PCT $\rightarrow$ Selective secretion of H^+, ammonia and K^+ into the filtrate.

DCT $\rightarrow$ Capable of reabsorption of HCO_3^- and selective secretion of H^+, K^+ and NH_3.

165. Identify the statement that is **NOT** correct.

(1) Antigen binding site is located at C-terminal region of antibody molecules.

(2) Constant region of heavy and light chains are located at C-terminus of antibody molecules

(3) Each antibody has two light and two heavy chains.

(4) The heavy and light chains are held together by disulfide bonds.

Answer (1)

Sol. Each antibody molecule has four peptide chains, two small called light chains and two longer called heavy chains. Hence, an antibody is represented as H_2L_2.

In an antibody molecule, antigen binding site is located at N-terminal region.

166. Match **List I** with **List II** :

	List I		List II
A.	Scutellum	I.	Persistent nucellus
B.	Non-albuminous seed	II.	Cotyledon of Monocot seed
C.	Epiblast	III.	Groundnut
D.	Perisperm	IV.	Rudimentary cotyledon

Choose the option with all **correct** matches.

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

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

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

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

Answer (3)

Sol. Scutellum is cotyledon of monocot seed.

Groundnut seed is non-albuminous seed.

Epiblast is rudimentary cotyledon in monocot seed.

Perisperm is persistent nucellus.

167. Find the statement that is **NOT** correct with regard to the structure of monocot stem.

(1) Vascular bundles are conjoint and closed.

(2) Phloem parenchyma is absent.

(3) Hypodermis is parenchymatous.

(4) Vascular bundles are scattered.

Answer (3)

Sol. In monocot stem, hypodermis is sclerenchymatous.

168. Twins are born to a family that lives next door to you. The twins are a boy and a girl. Which of the following must be true?

(1) They were conceived through in vitro fertilization.

(2) They have 75% identical genetic content.

(3) They are monozygotic twins.

(4) They are fraternal twins.

Answer (4)

Sol. Fraternal twins or dizygotic twins are 2 separate fertilized eggs, they usually develop 2 separate amniotic sacs, placentas and supporting structures.

If twins are a boy and a girl, this indicates they are fraternal twins.

169. Sweet potato and potato represent a certain type of evolution. Select the correct combination of terms to explain the evolution.

(1) Homology, convergent

(2) Analogy, divergent

(3) Analogy, convergent

(4) Homology, divergent

Answer (3)

Sol. Sweet potato is a root modification while potato is a stem modification but both of them have same function. Analogous structures are not anatomically similar structures though they perform similar functions.

Analogous structures are the result of convergent evolution.

- Homologous organs are anatomically similar but they do not perform similar function. Homologous organs are the result of divergent evolution.

170. Which one of the following phytohormones promotes nutrient mobilization which helps in the delay of leaf senescence in plants?

(1) Gibberellin

(2) Cytokinin

(3) Ethylene

(4) Abscisic acid

Answer (2)

Sol. Cytokinins help to overcome apical dominance. They promote nutrient mobilisation which helps in the delay of leaf senescence.

171. Why can't insulin be given orally to diabetic patients?

(1) Because of structural variation

(2) Its bioavailability will be increased

(3) Human body will elicit strong immune response

(4) It will be digested in Gastro-Intestinal (GI) tract

Answer (4)

Sol. Insulin can't be administered orally to diabetic patients as being the proteinaceous molecule, it will be digested in gastro-intestinal tract.

172. Name the class of enzyme that usually catalyze the following reaction :

$S - G + S^{\#} \rightarrow S + S^{\#} - G$

Where, $G \rightarrow$ a group other than hydrogen

$S \rightarrow$ a substrate

$S^{\#} \rightarrow$ another substrate

(1) Transferase

(2) Ligase

(3) Hydrolase

(4) Lyase

Answer (1)

Sol. Enzymes catalysing a transfer of G group, (other than hydrogen) between a pair of substrates, S and S' are known as transferases.

$S - G + S^{\#} \rightarrow S + S^{\#} - G$

- Ligases catalyse the linking together of 2 compounds such as C – O, C – S, C – N bonds *etc*
- Lyases catalyse removal of groups from substrates by mechanisms other than hydrolysis leaving double bonds

Hydrolases are enzymes that catalyse hydrolysis of ester, ether, peptide , glycosidic, C – C, C – halide or P – N bonds.

173. Given below are two statements :

Statement I : The DNA fragments extracted from gel electrophoresis can be used in construction of recombinant DNA.

Statement II : Smaller size DNA fragments are observed near anode while larger fragments are found near the wells in an agarose gel.

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

(1) Statement I is correct but statement II is incorrect

(2) Statement I is incorrect but statement II is correct

(3) Both statement I and statement II are correct

(4) Both statement I and statement II are incorrect

Answer (3)

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

The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece. This step is known as elution. The DNA fragments purified in this way are used in constructing rDNA by joining them with cloning vectors.

- In gel electrophoresis, the DNA fragments separate (resolve) according to their size through sieving effect provided by the agarose gel. Hence, the smaller the fragment size, the farther it moves from cathode towards anode.

174. The correct sequence of events in the life cycle of bryophytes is

A. Fusion of antherozoid with egg.

B. Attachment of gametophyte to substratum.

C. Reduction division to produce haploid spores.

D. Formation of sporophyte.

E. Release of antherozoids into water.

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

(1) B, E, A, D, C

(2) D, E, A, B, C

(3) D, E, A, C, B

(4) B, E, A, C, D

Answer (1)

Sol. The correct sequence of events in the life cycle of bryophytes is

- Attachment of gametophyte to substratum.
- Release of antherozoids into water.
- Fusion of antherozoid with egg.
- Formation of sporophyte.
- Reduction division to produce haploid spores.

175. Genes R and Y follow independent assortment. If RRYY produce round yellow seeds and rryy produce wrinkled green seeds, what will be the phenotypic ratio of the F2 generation?

(1) Phenotypic ratio - 9 : 3 : 3 : 1

(2) Phenotypic ratio - 9 : 7

(3) Phenotypic ratio - 1 : 2 : 1

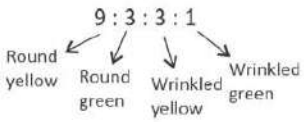
(4) Phenotypic ratio - 3 : 1

Answer (1)

Sol. A classical dihybrid cross performed by Mendel involves.

A cross which was made between a pure round yellow seeded pea plant (RRYY) with wrinkled green seeded plant (rryy). Yellow colour is dominant over green and round seed shape over wrinkled seed shape.

Phenotypic ratio in F2 generation



176. Each of the following characteristics represent a Kingdom proposed by Whittaker. Arrange the following in increasing order of complexity of body organization.

A. Multicellular heterotrophs with cell wall made of chitin.

B. Heterotrophs with tissue/organ/organ system level of body organization.

C. Prokaryotes with cell wall made of polysaccharides and amino acids.

D. Eukaryotic autotrophs with tissue/organ level of body organization.

E. Eukaryotes with cellular body organization.

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

(1) A, C, E, D, B

(2) C, E, A, B, D

(3) A, C, E, B, D

(4) C, E, A, D, B

Answer (4)

Sol. Increasing order of complexity of body organisation in the kingdom given by R.H. Whittaker is as follows-

C. Monera-Prokaryotes with cell wall made up of polysaccharide.

↓

E. Protista - Unicellular eukaryotes.

↓

A. Fungi -Multicellular heterotrophic with cell wall made up of chitin.

↓

D. Plantae - Eukaryotes autotrophs with tissue body organisation.

↓

B. Animalia - Heterotrophs with tissue organ/system of body organisation

Correct sequence is C, E, A, D, B.

177. Match **List-I** with **List- II**.

	List-I		**List-II**
A.	Centromere	I.	Mitochondrion
B.	Cilium	II.	Cell division
C.	Cristae	III.	Cell movement
D.	Cell membrane	IV.	Phospholipid Bilayer

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

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

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

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

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

Answer (2)

Sol. Centromere - Helps in cell division

Cilium - Helps in cell movement

Cristae - Finger like structures of mitochondria

Cell membrane - Is a phospholipid bilayer

178. Which one of the following equations represents the Verhulst-Pearl Logistic Growth of population?

(1) $\frac{dN}{dt} = rN\left(\frac{N-K}{N}\right)$

(2) $\frac{dN}{dt} = N\left(\frac{r-K}{K}\right)$

(3) $\frac{dN}{dt} = r\left(\frac{K-N}{K}\right)$

(4) $\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$

Answer (4)

Sol. Logistic growth is described by Verhulst-Pearl logistic growth equation $\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$.

179. Match **List-I** with **List-II**.

	List-I		List-II
A.	Emphysema	I.	Rapid spasms in muscle due to low Ca^{++} in body fluid
B.	Angina Pectoris	II.	Damaged alveolar walls and decreased respiratory surface
C.	Glomerulonephritis	III.	Acute chest pain when not enough oxygen is reaching to heart muscle
D.	Tetany	IV.	Inflammation of glomeruli of kidney

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

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

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

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

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

Answer (2)

Sol. Emphysema - Damaged alveolar walls and decreased respiratory surface

Angina pectoris - Acute chest pain when not enough oxygen is reaching to heart muscle

Glomerulonephritis - Inflammation of glomeruli of kidney

Tetany - Rapid spasms in muscle due to low Ca^{++} in body fluid

180. Cardiac activities of the heart are regulated by:

A. Nodal tissue

B. A special neural centre in the medulla oblongata

C. Adrenal medullary hormones

D. Adrenal cortical hormones

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

(1) A, C and D Only

(2) A, B and D Only

(3) A, B and C Only

(4) A, B, C and D

Answer (3)

Sol. Normal cardiac activities of the heart are regulated intrinsically, i.e., auto regulated by specialised muscles (nodal tissue), hence the heart is called myogenic. A special neural centre in the medulla oblongata can moderate the cardiac function through autonomic nervous system.

Sympathetic nervous system can increase the rate of heartbeat, ventricular contraction and thereby cardiac output.

Parasympathetic neural signals decrease the rate of heartbeat, speed of conduction of action potential and thereby the cardiac output. Adrenal medullary hormones can also increase the cardiac output.