JEE MAINS 2020 3rd SEPT SHIFT 1

Physics

Question 1. An elliptical ring of semi major and semi minor axis a and b respectively, rotates about diameter with angular speed ω in uniform magnetic field B. Resistance of elliptical ring R. Average power produced will be:

(1) $\frac{N^2\pi^2a^2b^2B^2\omega^2}{2R}$

(2) $\frac{N^2\pi^2a^2b^2B^2\omega^2}{4R}$

(3) $\frac{N^2\pi^2a^2b^2B^2\omega^2}{3R}$

(4) $\frac{N^2\pi^2a^2b^2B^2\omega^2}{R}$

Ans. (1)

Sol. $\varepsilon = NAB\omega\cos\omega t$

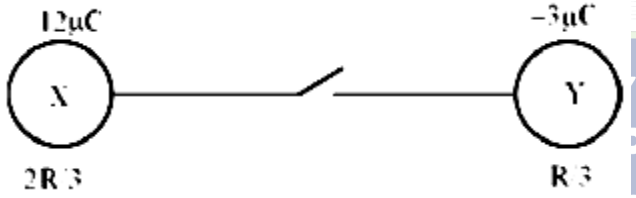
$$< P >=< \frac{\varepsilon^2}{R} >$$

$$=< \frac{N^2A^2B^2\omega^2\cos^2\omega t}{R} >$$

$$= \frac{N^2A^2B^2\omega^2}{R}\left(\frac{1}{2}\right)$$

$$= \frac{N^2\pi^2a^2b^2B^2}{2R}\left(\omega^2\right)$$

Question 2. A system consists of 2 isolated conducting spheres, kept at infinite distance. Sphere X has radius $\frac{2R}{3}$ and charge $12\mu C$ and sphere Y has radius $\frac{R}{3}$ and charge $-3\mu C$. If the switch is closed, then find charges on X & Y.



(1) $3\mu C$ and $6\mu C$ respectively

(2) $6\mu C$ on both

(3) $6\ \mu C$ and $3\mu C$

(4) None of these

Ans. (3)

Sol. Total charge = 12 - 3 = 9μC

If final charges are q1 and q2

$$\frac{q_1}{q_2} = \frac{R_1}{R_2} = \frac{2}{1}$$

$$q_1 = 6\mu C$$

$q_2 = 3\mu C$

Question 3. Pressure inside two soap bubbles is 1.01 atm and 1.02 atm. Find the ratio of their volume.

(1) 8 : 1

(2) 4 : 1

(3) 2 : 1

(4) 3 : 1

Ans. (1)

Sol. $\left(P_{excess}\right)_1 = 0.01 = \frac{4T}{R_1}$

$\left(P_{excess}\right)_2 = 0.02 = \frac{4T}{R_2}$

Dividing,

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

$R_1 = 2R_2$

$\frac{V_1}{V_2} = \frac{R_1^3}{R_2^3} = \frac{8R_2^3}{R_2^3} = \frac{8}{1}$

Question 4. A diode has potential drop of 0.5 volt in forward bias. The maximum current that can flow through diode is

10 mA. Then find the resistance connected in series with diode so that set up can be connected to a battery of 1.5 volt:

(1) 100Ω

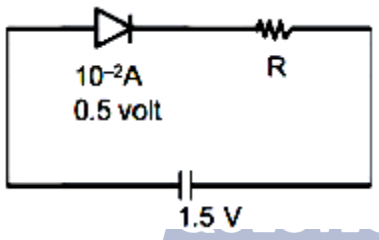
(2) 50Ω

(3) 25Ω

(4) 10Ω

Ans. (1)

Sol.



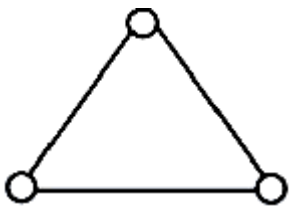
$$V_{diode} = 0.5 \text{ volt}$$

$$V_R = 1.5 - 0.5 = 1 \text{ volt}$$

$$iR = 1$$

$$R = \frac{1}{i} = \frac{1}{10^{-2}} = 100\,\Omega$$

Question 5. A triatomic molecule in the shape of a triangle can be assumed that atoms are at vertices of triangle and joined by mass less rods. Internal energy of 1 mole at temperature T is:



(1) 3RT

(2) $\frac{5}{2}$RT

(3) $\frac{9}{2}$RT

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

Ans. (1)

Sol. $U = \frac{f}{2}RT = \frac{6}{2}RT = 3RT$

Question 6. A satellite is revolving near by earth of radius = Re. If it's velocity is increased $\sqrt{\frac{3}{2}}$V where V is orbital speed of satellite then find maximum distance of satellite from the center of earth.

(1) Re

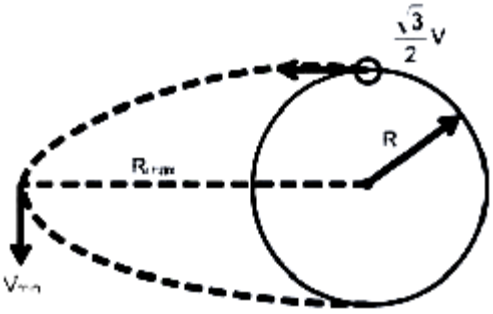
(2) 2Re

(3) 3Re

(4) 4Re

Ans. (3)

Sol.



$$V = \sqrt{\frac{GM}{R_e}}$$

From energy conversation

$$-\frac{GMm}{R_e} + \frac{1}{2}m\left(\sqrt{\frac{3}{2}}V\right)^2 = -\frac{GMm}{R_{max}} + \frac{1}{2}mV_{min}^2 \quad \text{.... (i)}$$

From angular momentum conversation

$$\sqrt{\frac{3}{2}}VR_e = V_{min}R_{max} \quad \text{.... (ii)}$$

Eliminating Vmin from equation (i) and (ii) we get

Rmax = 3Re

Question 7. When wavelength of light incident on metal surface changes from 500 nm to 200 nm, maximum possible kinetic energy of emitted photo-electrons becomes three time then find the work function of metal.

(1) 0.61 eV

(2) 0.65 eV

(3) 0.50 eV

(4) 0.25 eV

Ans. (1)

Sol. $KE_{max} = \frac{hc}{\lambda} - \phi = \frac{hc}{500} - \phi$ ..... (i)

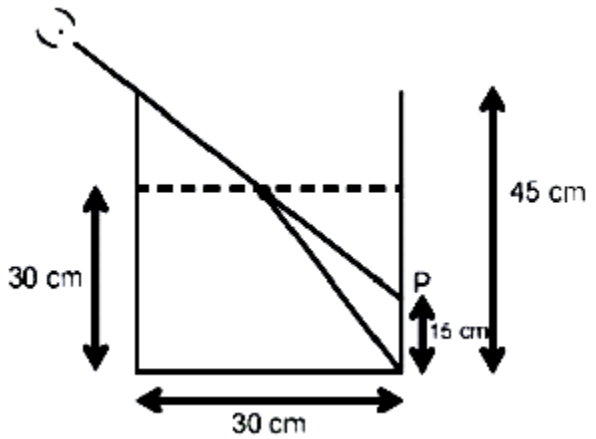
Now, $3KE_{max} = \frac{hc}{200} - \phi$ ..... (ii)

From equation (i) and (ii)

$$\frac{(ii)}{(i)} = \frac{3}{1} = \frac{\frac{hc}{200} - \phi}{\frac{hc}{500} - \phi}$$

Put the value of hc = 1237.5 and solving ϕ = 0.61 eV

Question 8. An observer's line of sight is at P, when container of diameter 30 cm and height 45 cm is empty. If this container is filled with a liquid up to 30 cm height he is able to see the edge of container. Find refractive index of liquid.



(1) $\sqrt{\frac{5}{2}}$

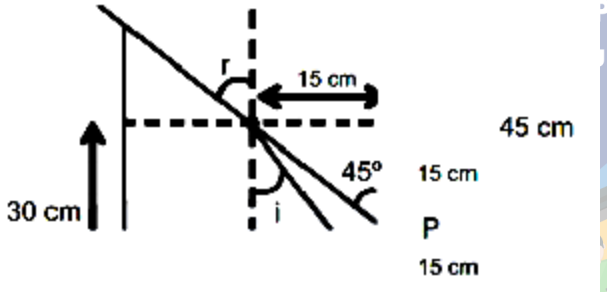
(2) $\frac{5}{\sqrt{2}}$

(3) $\frac{\sqrt{5}}{2}$

(4) $\frac{5}{2}$

Ans. (1)

Sol.



30 cm

From Shell's Law

$$\mu \times \sin i = 1 \times \sin r$$

$$\mu \times \frac{15}{\sqrt{15^2 + 30^2}} = 1 \times \sin 45°$$

$$\mu = \sqrt{\frac{5}{2}}$$

Question 9. A mass of 2kg suspended by a sting of mass 6kg. A wave of wavelength 6cm is produced at the bottom of string. The wavelength of wave at the top end of string will be.

(1) 6 cm

(2) 18 cm

(3) 12 cm

(4) 24 cm

Ans. (3)

Sol. $V = f\lambda$

$$\frac{V_1}{\lambda_1} = \frac{V_2}{\lambda_2}$$

$$\lambda_2 = \frac{V_2}{V_1}\lambda_1 = \sqrt{\frac{T_2}{T_1}}\lambda_1 \qquad T_2 = 8g(\text{Top})$$

$$\sqrt{\frac{8g}{2g}}\lambda_1 \qquad T_1 = 2g(\text{Bottom})$$

$$= 2\lambda_1 = 12\text{cm}$$

Question 10. Screw gauge of pitch 0.1 cm and 50 division on circular scale, measure thickness of an object. Which of the following measurement is possible for thickness

(1) 2.123 cm

(2) 2.124 cm

(3) 2.125 cm

(4) 2.127 cm

Ans. (2)

Sol. Thickness = M.S. Reading + Circular Scale Reading (L.C.)

$$\text{Here, LC} = \frac{0.1}{50} = 0.002 \text{ cm per division.}$$

Question 11. A bowling machine projects a ball of mass 0.15 kg in upward direction. If ball displaced along bowling machine 0.2m and released. After the released from bowling machine ball attain 20 m height then find the force exerted by bowling machine on the ball.

(1) 145.5 N

(2) 165.5 N

(3) 175.5 N

(4) 151.5 N

Ans. (4)

Sol. From work energy theorem F(0.2) - mg (20.2) = 0

$$F = mg\frac{(20.2)}{0.2}$$

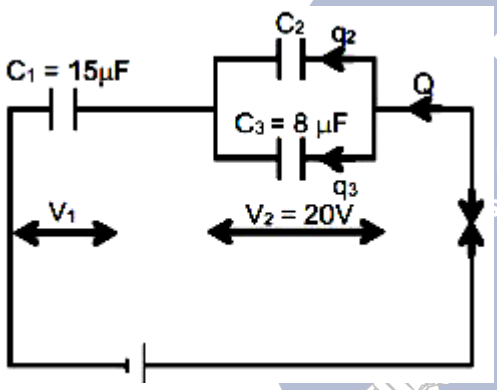
$$= mg\left(\frac{202}{2}\right)$$

$$= 0.15 \times 10 \times \frac{202}{2}$$

$$= 15 \times 10.1 \text{ N}$$

$$= 151.5 \text{ N}$$

Question 12. Total 750 μℓ C charge flows through circuit then charge flow through C2 capacitance will be.



(1) 160

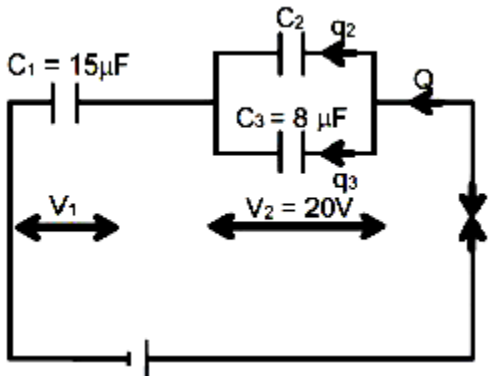
(2) 590

(3) 450

(4) 630

Ans. (2)

Sol.



$q2 + q3 = 750$

$q2 + 160 = 750$

$q2 = 590$

Question 13. A man of mass 80 kg is standing on a circumference of disk of mass 200 kg. Disk is rotating about vertical axis with angular speed 5 rev/second. Find angular speed of disk if man reaches at the centre of disk.

(1) 3 rev/sec.

(2) 6 rev/sec.

(3) 9 rev/sec.

(4) 12 rev/sec.

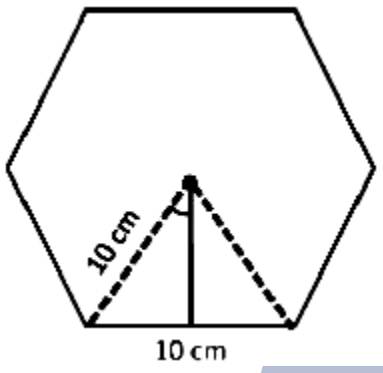
Ans. (3)

Sol. $\left(mR^2 + \frac{MR^2}{2}\right)\omega = \frac{MR^2}{2}\omega'$

$\left(80 + \frac{200}{2}\right) \times 5 = \frac{200}{2}\omega'$

$\omega' = 9 \text{ rev / sec}.$

Question 14. Magnetic field at centre of hexagonal coil having 50 turns, side 10 cm and current i in the units of $\left(\frac{\mu_0 i}{\pi}\right)$ will be:



(1) $500\sqrt{3}$

(2) $250\sqrt{3}$

(3) $300\sqrt{3}$

(4) $400\sqrt{3}$

Ans. (1)

Sol.

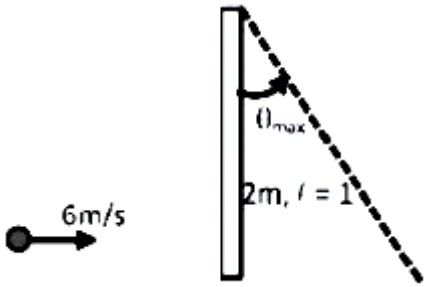
$$B = 50 \times 6 \times \frac{\mu_0 i}{4\pi\left(\frac{10}{100}\right)} \cos 30^\circ \left[\sin 30^\circ + \sin 30^\circ\right]$$

$$2 \times 75 \times 10 \frac{\mu_0 i}{\sqrt{3}\,\pi}\left(\frac{1}{2} + \frac{1}{2}\right)$$

$$\frac{1500}{\sqrt{3}}\frac{\mu_0 i}{\pi} = 500\sqrt{3}\frac{\mu_0 i}{\pi}$$

$500\sqrt{3}$Ans.

Question 15.



Find maximum angular displacement of rod. If particle sticks after collision.

(1) 63°

(2) 69°

(3) 53°

(4) 59°

Ans. (1)

Sol. Angular momentum

$$mv\ell = \left(m\ell^2 + \frac{2m\ell^2}{3}\right)\omega$$

$$mv\ell = \frac{5}{3}m\ell^2\omega$$

$$\omega = \frac{3v}{5\ell}$$

$$\frac{1}{2}I\omega^2 = 2mg\frac{\ell}{2}(1-\cos\theta) + mg\ell(1-\cos\theta)$$

$$\frac{1}{2}\left(\frac{5}{3}m\ell^2\right)\frac{9v^2}{25\ell^2} = 2mg\ell(1-\cos\theta)$$

$$\frac{3}{5\times 2}mv^2 = 2mg\ell(1-\cos\theta)$$

$$\frac{3}{10}\times\frac{36}{2\times 10} = 1-\cos\theta$$

$$1-\frac{27}{50} = \cos\theta$$

$$\cos\theta = \frac{23}{50}$$

$$\theta = 63^\circ$$

Question 16. The hollow cylinder of length ℓ and inner and outer radius R1 and R2 respectively. Find resistance of cylinder if current flows radially outward in the cylinder. Resistivity of material of cylinder is ρ.

(1) $\frac{\rho}{\pi\ell}\ell n\frac{R_2}{R_1}$

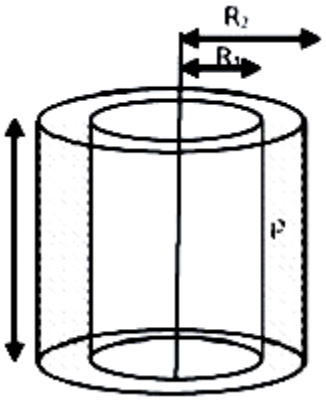
(2) $\frac{\rho}{4\pi\ell}\ell n\frac{R_2}{R_1}$

(3) $\frac{\rho}{3\pi\ell}\ell n\frac{R_2}{R_1}$

(4) $\frac{\rho}{2\pi\ell}\ell n\frac{R_2}{R_1}$

Ans. (4)

Sol.



The resistance of small element

$$dR = \frac{\rho dr}{2\pi r\ell}$$

$$R = \frac{\rho}{2\pi\ell}\int_{R_1}^{R_2}\frac{dr}{r}$$

$$R = \frac{\rho}{2\pi\ell}\ell n\frac{R_2}{R_1}$$

Question 17. 1μC charge moves with the velocity $\vec{v} = 4\hat{i} + 6\hat{j} + 3\hat{k}$ in uniform magnetic field. $\vec{B} = \left(3\hat{i} + 4\hat{j} - 3\hat{k}\right)10^{-3}$. Force experience by charged particle in units of 10-9 N will be:

(1) $-0.3\hat{i}+2.1\hat{j}+0.4\hat{k}$

(2) $-30\hat{i}+21\hat{j}-2\hat{k}$

(3) $-0.03\hat{i}+0.21\hat{j}+0.04\hat{k}$

(4) $-3\hat{i}+0.21\hat{j}+0.4\hat{k}$

Ans. (2)

Sol. $\vec{F}=10^{-6}\times10^{-3}\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 4 & 6 & 3\\ 3 & 4 & -3\end{vmatrix}$

$=10^{-9}\left[\hat{i}(-30)-\hat{j}(-12-9)+\hat{k}(16-18)\right]$

$=10^{-9}\left[-30\hat{i}+21\hat{j}-2\hat{k}\right]$

Question 18. In YDSE wavelength of light used is 500 nm and slit width is 0.05 mm. then the angular fringe width will be

(1) 1.8°

(2) 3.2°

(3) 0.57°

(4) 0.48°

Ans. (3)

Sol. $\beta_0 = \frac{\lambda}{d} = \frac{500\times10^{-9}}{5\times10^{-5}} = 10^{-2}$ Radian $= 0.57°$

Question 19. If in a radioactive sample $\frac{9}{16}$ part remains undecayed after time t, then how much part had remained undecayed after $\frac{t}{2}$?

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

(2) $\frac{9}{16}$

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

(4) $\frac{16}{9}$

Ans. (1)

Sol. $N = N_0 e^{-\lambda t}$ .... (1)

$N' = N_0 e^{\frac{\lambda t}{2}}$ .... (2)

from (1) & (2)

$$\left(\frac{N'}{N_0}\right) = \left(\frac{N}{N_0}\right)^{\frac{1}{2}} = \left(\frac{9}{16}\right)^{\frac{1}{2}} = \frac{3}{4}$$

Question 20. Electromagnetic wave is given by B = 3 × 10-8 $\sin(ky+\omega t)(\hat{i})$ find E =?

(1) $9\sin(ky+\omega t)(-\hat{k})\,v/m$

(2) $9\sin(ky+\omega t)(\hat{k})\,v/m$

(3) $6\sin(ky+\omega t)(-\hat{k})\,v/m$

(4) $4\sin(ky+\omega t)(-\hat{k})\,v/m$

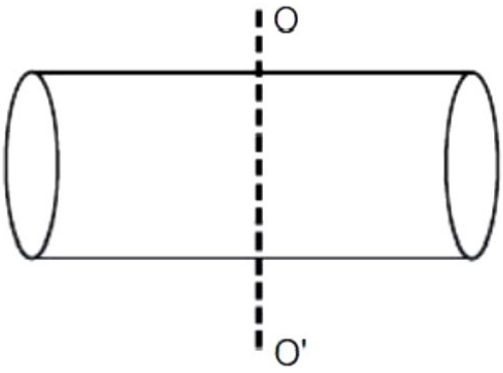
Ans. (1)

Sol. E0 = cB0

$$\vec{E} = 3\times10^{8}\times3\times10^{-8}\sin(ky+\omega t)(-\hat{k}) = 9\sin(ky+\omega t)(-\hat{k})$$

(Direction of propagation of em waves is the direction of E x B, and here wave is traveling towards -y axis so direction of E is -k)

Question 21. For a given volume of solid cylinder, find the ratio $\frac{L}{R}$ such that moment of inertia of cylinder about axis OO' will be maximum.



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

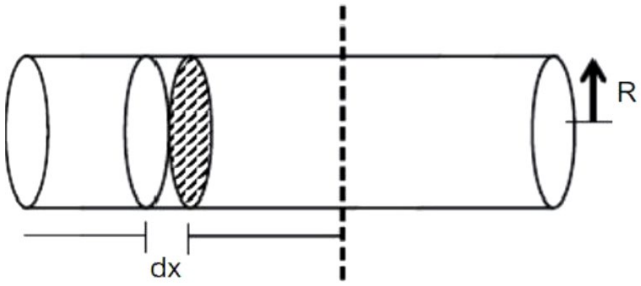
(2) $\sqrt{2}$

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

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

Ans. (1)

Sol. Let a cylinder of mass m1 length L and radius R then Let take elementary disc of radius R and thickness dx at a distance of x from axis OO' then moment of inertia about OO' as this element



$$dI = \frac{dmR^2}{4} + dmx^2$$

$$I = \int dl = \int \frac{dmR^2}{4} + \int_{n=L/2}^{n=-L/2} \frac{M}{L} dx \times x^2$$

$$I = \frac{MR^2}{4} + \frac{ML^2}{12}$$

$$I = \frac{M}{4} + \frac{V}{\pi L} + \frac{ML^2}{12}$$

$$I = \frac{MV}{4\pi L} + \frac{ML^2}{12}$$

$$\frac{dI}{dL} = -\frac{MV}{4\pi L^2} + \frac{M \times 2L}{12} = 0$$

$$\Rightarrow V = \frac{2}{3}\pi L^3$$

$$\Rightarrow \pi R^2 L = \frac{2}{3}\pi L^3$$

$$\Rightarrow \frac{L}{R} = \sqrt{\frac{3}{2}}$$

Question 22. Energy of electron in its nth orbit is given as $\left(E_n = -\frac{13.6}{n^2} \times z\right)$ eV. Consider a hydrogen atom, find the amount of energy needed to transfer electron from 1st orbit to 3rd orbit:

(1) 13.6 eV

(2) 1.51 eV

(3) 3.4 eV

(4) 12.09 eV

Ans. (4)

Sol. For hydrogen, Z = 1

Energy of 1st orbit = $E_1 = -\frac{13.6}{1^2}eV = -13.6eV$

Energy of 3rd orbit = $E_3 = -\frac{13.6}{3^2}eV = -1.51eV$

Energy difference $DE = E_3 - E_1 = 12.08eV$

Question 23. An external pressure P is applied on a cube at 273 K hence it compresses equally from all sides, α is the coefficient of linear expansion & K is the bulk modulus of material. To bring the cube to its original size by heating, the temperature rise must be

(1) $\frac{P}{3\alpha k}$

(2) $\frac{P}{\alpha k}$

(3) $\frac{P}{2\alpha k}$

(4) $\frac{P}{4\alpha k}$

Ans. (1)

Sol. $K = -\frac{P}{\Delta v / v} \Rightarrow \left(\frac{\Delta v}{v}\right)_1 = -\frac{P}{k}$

& due to thermal expansion

$\left(\frac{\Delta v}{v}\right)_2 = \gamma \Delta\theta$ [where $\Delta\theta$ is increase in temp]

Also, $(\gamma = 3\alpha)$

$\Rightarrow \left(\frac{\Delta v}{v}\right)_1 + \left(\frac{\Delta v}{v}\right)_2 = 0$ [for restoring shape]

$\Rightarrow \frac{-P}{K} + 3\alpha\Delta\theta$

$\Delta\theta = \frac{P}{3\alpha K}$

Question 24. In the series LCR circuit as shown in figure, due to the heat developed in t seconds temperature of resistance increases by 100C. If heat capacity of resistance material is 100J/0C. Then calculate the value of t.

(1) 10 second

(2) 20 second

(3) 30 second

(4) 40 second

Ans. (2)

Sol. Heat = (irms)2. Rt

$$i_{rms} = \frac{25}{Z\sqrt{2}}$$

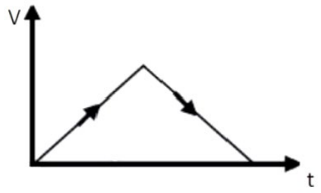
$$Z = \sqrt{R^2 + (x_L - x_c)^2} = \sqrt{4^2 + (7-4)^2} = 5\Omega$$

$$\Rightarrow \text{Heat} = \left(\frac{25}{5\sqrt{2}}\right)^2 \times 4 \times t = c\ \Delta\theta = 100 \times 10$$ and Amplitude of wattles current $= i_0 \sin\phi$

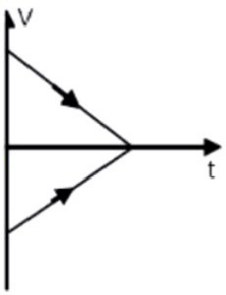
T = 20 second

Question 25. A body is shown vertically upwards. Which graph represents the variation of velocity wrt time?

(1)



(2)



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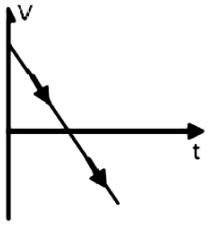
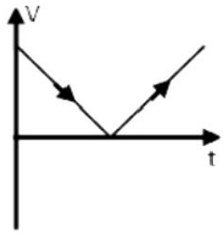


(4)



Ans. (3)

Sol. Using 1st equation of motion

Initial velocity = u

Acceleration = -g

$V = u + at \Rightarrow v = u - gt$ ...(1)

Equation (1) represents a straight line curve with (-ve) slope. Hence answer is (3)

Chemistry

Question 26. Novestrol will give which of the following reactions:

(1) Br_2/H_2O, HCl + $ZnCl_2$, neutral $FeCl_3$

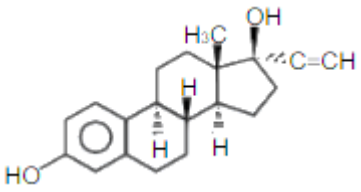
(2) Br_2/H_2O, HCl + $ZnCl_2$, I_2/OH^-

(3) alc. HCN, I_2/OH^-, $HCl + ZnCl_2$

(4) alc. HCN, I_2/OH^-, NaOCl

Answer: (1)

Solution:



Novestrol (Anti Fertility Drugs)

Novestrol has phenolic functional group, alcoholic functional group and Terminal alkyne.

Question 27. $R-X \rightarrow [R^+][X^-] \xrightarrow{Nu^-} R-Nu$

Which statement is/are correct for this reaction?

(I) Polarity of solvent decrease then rate of reaction increases.

(II) Strong nucleophile is more suitable for this reaction.

(III) If R is bulky then carbocation become more stable.

(IV) Racemisation take place in this reaction.

(1) Only I and II

(2) Only II and IV

(3) I, II and IV

(4) Only III and IV

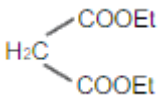
Answer: (4)

Solution:

Above reaction is SN_1 reaction as it proceed via formation of carbocation. Polar protic solvent is more suitable for SN_1 and racemisation takes place

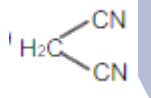
Question 28. Which of the following compound has strongest acidic Hydrogen?

(1)

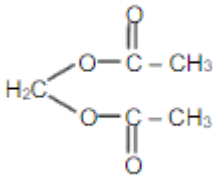


(2) $CH_3 - C \equiv CH$

(3)



(4)

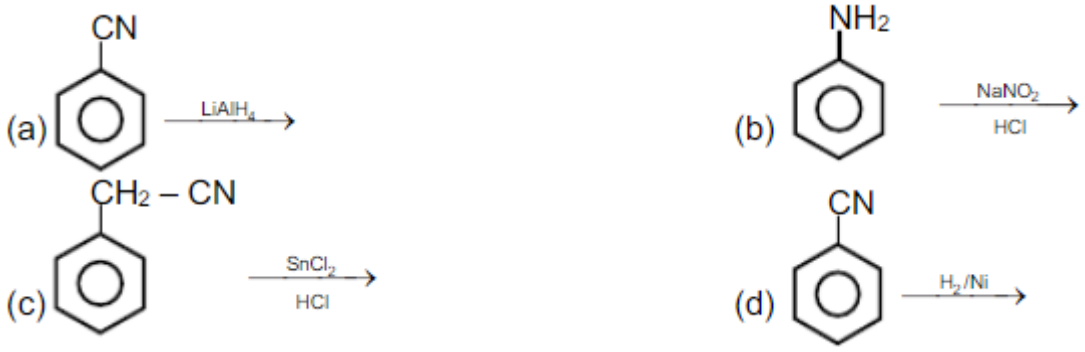


Answer: (3)

Solution:

Acidic strength ∝-1, -M effect due to strong -I, -M effect of -CN in $CH_2(CN)_2$, it has most acidic Hydrogen.

Question 29. Which of the following product will not show Kjeldhal Test in the given reactions?



(1) Only (a)

(2) Both (b) & (c)

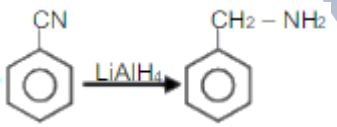
(3) (a), (b) & (c)

(4) (a), (c) & (d)

Answer: (b)

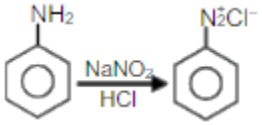
Solution:

(a)



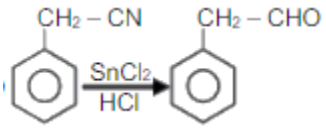
(N – present in product so will show Kjeldhal Test)

(b)



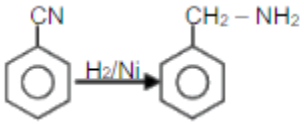
(-N2+ Never show Kjeldhal Test)

(c)



(N – abscent, wo will not show Kjeldhal Test)

(d)



(will give positive Kjeldhal test due to presence of -NH2 group)

Question 30. Effect of thermal power plant is

(1) Acid rain

(2) Ozone depletion

(3) Eutrophication

(4) None of these

Answer: (1)

Solution:

Burning of fossil fuels (which contain Sulphur and nitrogenous matter) such as coal and oil in power stations and furnaces produce sulphur dioxide and nitrogen oxides which causes acid rain.

Question 31. Which method is used for separating Glycerol from spent-lye in soap industry?

(1) Fractional Distillation

(2) Steam Distillation

(3) Destructive Distillation

(4) Reduce pressure Distillation

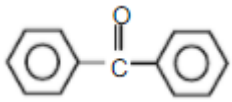
Answer: (4)

Solution:

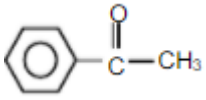
Glycerol can be separated from spent-lye in soap industry by using Reduce pressure Distillation technique.

Question 32. Which of the following is most reactive towards nucleophilic addition reaction.

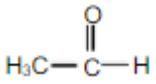
(1)



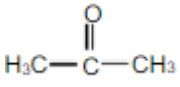
(2)



(3)



(4)



Answer: (3)

Solution:

Aldehydes are more reactive than ketones in nucleophilic reactions.

Factors influence the reactivity of ketone and aldehyde are:

(i) + l effect of alkyl group decrease the amount of charge on C+(C+ - O-)

(ii) Steric effect also causes the less reactivity of carbonyl group.

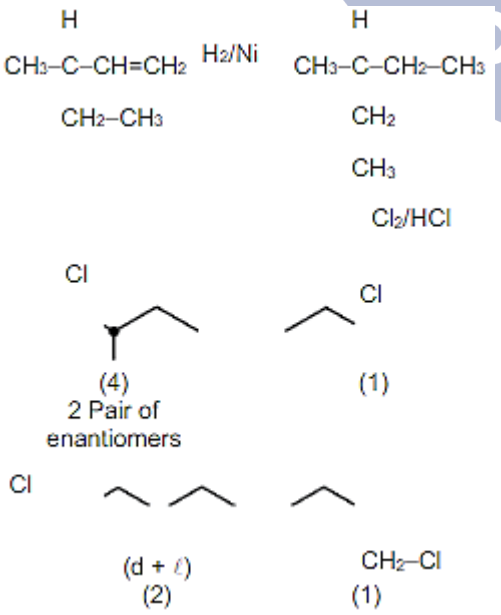
Question 33. Smallest optically active alkene

$\xrightarrow{\text{Hydrongenation}}$ $\xrightarrow{Cl_2/hv}$

How many monochloro products [including stereoisomer] are formed?

Answer: 8.00

Solution:



Question 34. An element have IUPAC name un-nil-ennium, the atomic number of element is

(1) 109

(2) 102

(3) 119

(4) 108

Answer: (1)

Solution:

un = 1

nil = 0

enn = 9

So atomic number = 109

Question 35. Which of the complex show optical isomerism

(1) cis-$[CrCl_2(OX)_2]^{3-}$

(2) trans-$[CrCl2(OX)_2]^{3-}$

(3) cis-$[CoCl_2(NH_3)_4]^{+}$

(4) trans-$[CoCl_2(NH_3)_4]^{+}$

Answer: (1)

Solution:

Only cis-$[CrCl_2(OX)_2]^{3-}$ show optical isomerism while its trans form do not show optical isomerism due to presence of plane of symmetry.

Question 36. Boiling point of water is 373 K, then boiling point H_2S is.

(1) Less than 300K

(2) More than 300K but less than 373K

(3) More than 300K

(4) More than 373K

Answer: (1)

Solution:

At room temperature water is liquid and has boiling 373 K due to hydrogen bonding where as H_2S is gas and it has no hydrogen bonding. Hence boiling point of H_2S is less than 300K [Boiling point of H_2S is -60°C]

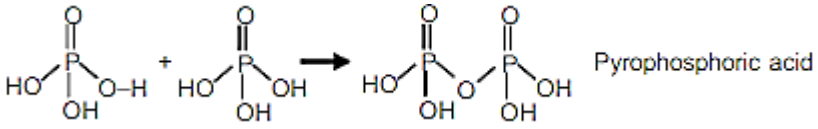
Question 37. Pyrophosphoric acid contains.

	No. of P = O bond	No. of P – OH bond	No. of P – O – P bond
1	2	4	1
2	4	2	1
3	2	3	2

4	2	2	1

Answer: 1

Solution:



No. of P = O bond = 2

P – OH bond = 4

P – O – P bond = 1

Question 38. Which of the following can form buffer solution.

(1) 0.1M, 100 ml CH_3COOH + 0.1 M, 200 ml NaOH

(2) 0.1M, 100 ml CH_3COOH + 0.1 M, 100 ml NaOH

(3) 0.1M, 100 ml HCl + 0.1 M, 100 ml NaCl

(4) 0.1M, 100 ml CH_3COOH + 0.1 M, 200 ml CH_3COONa

Answer: (4)

Solution:

Mixture of weak acid and its salt with strong base acts as buffer solution

Question 39. Select true statement among following

(1) 2nd order reaction is always multi step reaction.

(2) 1st order reaction is always single step reaction.

(3) zero order reaction is always single step reaction.

(4) zero order reaction is always multi step reaction.

Answer: (4)

Solution:

Zero order reaction is always multi step reaction

Question 40. Which of the following gas is released when noble metal Au & Pt are treated with aqua regia?

(1) N_2O_5

(2) NO

(3) N_2O_3

(4) N_2

Answer: (2)

Solution:

Aqua regia is HNO_3 : HCl

1 : 3

$HNO_3 + 3HCl \rightarrow 2H_2O + NO + 3[Cl]$

(1) $Au + 3[Cl] \rightarrow AuCl_3 \xrightarrow{HCl} HAuCl_4$

(2) $Pt + 4[Cl] \rightarrow PtCl_4 \xrightarrow{HCl} H_2PtCl_6$

Question 41. Which of the following has weakest bond?

(1) NO^{+}

(2) NO^{2+}

(3) NO^{-}

(4) NO

Answer: (3)

Solution:

	Species	Bond order
(1)	NO^{+}	3
(2)	NO^{2+}	2.5
(3)	NO^{-}	2
(4)	NO	2.5

Bond strength α bond order

Question 42. Four gases α, β, γ & δ have kH values 50 kbar, 20 kbar, 2×10^{-3} kbar and 2 kbar respectively. Then?

(1) α is more soluble in water

(2) Pressure of γ in 55.5 molal solution is 1 bar

(3) Pressure of δ in 55.5 molal solution is 250 bar

(4) Pressure of β in 55.5 molal solution is 50 bar

Answer: (2)

Solution:

(1) From Henery's law

$P = kH(X)$

Higher the value of kH smaller will be solubility so δ is more soluble.

(2) For γ

$(P)\gamma = (pH)\gamma \,.\, (X)\gamma$

$$= 2 \times \left[\frac{55.5}{55.5 + \frac{1000}{18}} \right] = 1 \text{bar}$$

(3) For δ ⇒ $P\delta = (kH)\delta \,.\, (X)\delta$

$$= 2 \times 103 \times \frac{1}{2} = 1000 \text{ bar.}$$

(4) For β

$(P)\beta = (pH)\beta \,.\, (X)\beta$

Question 43. When Helium gas balloon explode, this process is:

(1) isothermal reversible

(2) isothermal irreversible

(3) adiabatic reversible

(4) adiabatic irreversible

Answer: (4)

Solution:

Process is adiabatic irreversible.

Question 44. Conductance of NaCl and $BaSO_4$ is C_1 and C_2 at temperature T_1, then which of the following statement is correct.

(1) $C_1 >> C_2$

(2) $C_1 (T_1) > C_1 (T_2)$ [where $T_2 > T_1$]

(3) $C_2 >> C_1$

(4) $C_1 > C_2$

Answer: (1)

Solution:

(1) NaCl is completely soluble salt while $BaSO_4$ is sparingly soluble salt so $C_1 >> C_2$

(2) On increase in temperature conductance increase.

Question 45. The Tyndall effect is observed only when following conditions are satisfied:

(a) The diameter of the dispersed particles is much smaller than the wavelength of the light used.

(b) The diameter of the dispersed particles is not much smaller than the wavelength of the light used

(c) The refractive indices of the dispersed phase and dispersion medium are almost similar in magnitude

(d) The refractive indices of the dispersed phase and dispersion medium differ greatly in magnitude

(1) (b) and (d)

(2) (a) and (c)

(3) (b) and (c)

(4) (a) and (d)

Answer: (1)

Solution:

*The diameter of the dispersed particles is much smaller than the wavelength of the light used

*The intensity of scattered light depends on the difference between the refractive indice of the D.P and D.M., In lyophobic colloids, this difference is appreciable and therefore the tyndal is quite well defined buyt in lyophollic sols the difference is very small and the tyndal effect is very weak.

So, to show Tyndall effect the refractive indices of the dispersed phase and dispersion medium differ greatly in magnitude.

Question 46. For $[Ti(H_2O)_6]^{3+}$, the absorption maximum due to d-d transition is found to be 20,300 cm^{-1}, therefore the crystal filed stabilization energy in kJ/mole is

[Given: 1 kJ/mole = 33.7 cm-1]

Answer: -97

Solution:

$[Ti(H_2O)_6]^{3+} \Rightarrow Ti^{3+} = 3d14s0$

$\Rightarrow$ tg1,0,0 , eg0,0

CFSE =[-0.4nt2g + 0.6neg] $\Delta 0$ +n(p)

= [-0.4 × 1] 20300

= -8120 cm-1

$= \frac{-8120}{83.7} kJ/mole$

= -97 kJ/mole

Question 47. In 0.1 mole fraction glucose solution, find % (w/w) of water in the sample [in nearest integer].

Answer: 47.37

Solution:

Let total mole of solution = 1

So mole of glucose = 0.1

Mole of H_2O = 0.9

$$\%(w/w) \text{ of } H_2O = \left[\frac{0.9\times18}{0.9\times18+0.1\times180}\right]\times100$$

= 47.368

= 47.37

Question 48. In a solid substance edge length of unit cell is 405 pm, density of solid is 10.9 gram/cm^3 and molar mass of substance is 109 gram, then. Find radius of atom which form this unit cell in pm

Answer: 143.17

Solution:

$$d = \frac{Z \times M}{Na \times Volume}$$

$$10.9 = \frac{Z \times 109}{6.02 \times 10^{23} \times [4.05 \times 10^{-3}]^3}$$

$Z = 4 \Rightarrow$ fcc unit cell

For fcc unit cell $4r = \sqrt{2}\,a$

$$r = \frac{1.414 \times 405}{4}$$

$= 143.1675$ pm

$= 143.17$ pm

Question 49. Find volume strength of 8.9 M H_2O_2 solution kept at 273 K and 1 atm pressure

$$[R = 0.0821 \frac{atm \times Lit.}{Mole \times K}]$$

Answer: 99.68

Solution:

$$\text{Molarity of } H_2O_2 \text{ solution} = \left\{\frac{\text{Volume strength}}{11.2}\right\}$$

Volume strength = 8.9 × 11.2

= 99.68V

Question 50. A beam of light is fall on sodium metal (work function = 2.5ev), to stop photoelectric current following cell is used.

$$Pt(s)\left|H_2(g)\right|_{1\ Bar}\left\|H^+(aq)\right|_{1\ M}\left\|Cl^-(aq)\right|_{1\ M}\left|AgCl(s)\right|Ag(s)$$

If same light is fall on potassium metal (work function = 2.3 ev) and to stop photoelectric current same cell is used, then pH of HCl solution (if other condition remains same) is-

[Given: $E^0_{Cl^-|AgCl|Ag} = 0.22V$ & $\frac{2.303RT}{F} = 0.06$]

Answer: 3.33

Solution:

Sodium metal:

E = E0 + (KE)max ; E0cell = 0.22V

(KE)max = E0cell = 0.22 eV

So E = 2.5 + 0.22 = 2.72 eV

For potassium metal:

$E = E0 + (KE)max$

$2.72 = 2.3 + (KE)max$

$(KE)max = 0.42 = Ecell$

Cell reaction

Cathode: $AgCl(s) + e^- \rightarrow Ag(s) + Cl^-(aq)$

Anode : $\frac{1}{2}H_2(g) \rightarrow H^+(aq) + e^-$

Overall : $AgCl(s) + \frac{1}{2}H_2(g) \rightarrow Ag(s) + H^+(aq) + Cl^-(aq)$

$Ecell = E0cell - \log[H^+][Cl^-]$

$0.42 = 0.22 - 0.66 \log[H^+]$

$0.2 = 0.06 \times pH$

$pH = 3.33$

Mathematics

Question 51. Area enclosed by

$0 \le y \le x^2 + 1, 0 \le y \le x + 1, \frac{1}{2} \le x \le 2$ is:

(1) $\frac{1}{12}$

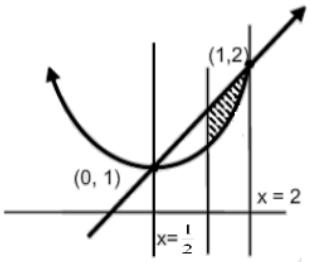
(2) $\frac{1}{6}$

(3) 1

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

Ans. (1)

Sol.



$$A = \int_{1/2}^{1}\left[\left(x+1\right)-\left(x^2+1\right)\right]dx = \int_{1/2}^{1}\left(x-x^2\right)dx$$

$$=\left[\frac{x^2}{2}-\frac{x^3}{3}\right]_{1/2}^{1}=\left(\frac{1}{2}-\frac{1}{3}\right)-\left(\frac{1}{8}-\frac{1}{24}\right)=\frac{1}{6}-\frac{1}{12}=\frac{1}{12}$$

Question 52. If T_1, T_2, T_3..... are in A.P. such that $T_1 + T_2 + ... + T_{25} = T_{26} + T_{27} +..... T_{40}$ and first term is 3 then value of common difference of A.P. is

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

(2) $\frac{1}{6}$

(3) 2

(4) 3

Ans. (2)

Sol.

$S_{25} = S_{40} - S_{25}$

$\Rightarrow 2.S_{25} = S_{40}$

$\Rightarrow 2.\frac{25}{2}[2a + 24d] = \frac{40}{2}[2a + 39d]$

$\Rightarrow 25(6 + 24d) = 20(6 + 39d)$

$\Rightarrow 25 \times 6[1 + 4d] = 20 \times 3[2 + 13d]$

$\Rightarrow 5 + 20d = 4 + 26d$

$\Rightarrow d = \frac{1}{6}$

Question 53. If $\left(\frac{1+i}{1-i}\right)^{\frac{m}{2}} = \left(\frac{1+i}{1-i}\right)^{\frac{n}{3}} = 1, m, n \in N$, then HCF of (m, n) for least m & n is

(1) 4

(2) 3

(3) 6

(4) 9

Ans. (1)

Sol. $\left(\frac{(1+i)^2}{2}\right)^{\frac{m}{2}} = \left(\frac{(1+i)^2}{2}\right)^{\frac{n}{3}} = 1$

$\Rightarrow \left(\frac{2i}{2}\right)^{m/2} = \left(\frac{2i}{2}\right)^{n/3} = 1$

$\Rightarrow i^{m/2} = i^{n/3} = 1$

mleast = 8, nleast = 12

HCF (8.12) = 4

Question 54. A pair of dice is thrown and sum of dice come up multiple of 4, then find the probability that at least one dice shows 4.

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

(2) $\frac{4}{9}$

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

(4) $\frac{5}{8}$

Ans. (3)

Sol. A $\rightarrow$ multiple of 4, B $\rightarrow$ at least one dice shows 4

(1, 3), (2, 2), (3, 1)

(6, 2) (2, 6), (5, 3), (3, 5), (4, 4) $\rightarrow$ favourable

(6, 6)

$$P\left(\frac{B}{A}\right)=\frac{1}{9}$$

Question 55. Let $A=\begin{bmatrix} x & 1 \\ 1 & 0 \end{bmatrix}$ be a 2×2 matrix such that $A^4=\left[a_{ij}\right]_{2\times 2}$ $a_{11}=109$, then find a22.

(1) 12

(2) 4

(3) -8

(4) 10

Ans. (4)

Sol. $A^2=\begin{bmatrix} x & 1 \\ 1 & 0 \end{bmatrix}\begin{bmatrix} x & 1 \\ 1 & 0 \end{bmatrix}=\begin{bmatrix} x^2+1 & x \\ x & 1 \end{bmatrix}$

$$A^4=\begin{bmatrix} x^2+1 & x \\ x & 1 \end{bmatrix}\begin{bmatrix} x^2+1 & x \\ x & 1 \end{bmatrix}=\begin{bmatrix} \left(x^2+1\right)^2+x^2 & \left(x^2+1\right)x+x \\ \left(x^2+1\right)x+x & x^2+1 \end{bmatrix}$$

Now, a11 = 109

$$\Rightarrow \left(x^2+1\right)^2+x^2=109$$

$$\Rightarrow x^4+3x^2-108=0 \Rightarrow \left(x^2+12\right)\left(x^2-9\right)=0$$

$$\Rightarrow x^2=9$$

Hence, $a_{22}=x^2+1=9+1=10$

Question 56. The equation of curve satisfying differential equation $\left(1+y^2\right)\left(e^x+1\right)dy=e^x y^2 dx$ and also passes through the point (0, 1) is

(1) $y^2+1=y\ell n\left(\frac{1+e^x}{2}\right)$

(2) $y^2-1=y\ell n\left(\frac{1+e^x}{2}\right)$

(3) $y+1=y\ell n\left(\frac{1+e^x}{2}\right)$

(4) $2y^2+1=y\ell n\left(\frac{1+e^x}{2}\right)$

Ans. (2)

Sol. Given equation is

$$\frac{1+y^2}{y^2}dy=\frac{e^x}{1+e^x}dx \Rightarrow \left(\frac{1}{y^2}+1\right)dy=\frac{e^x dx}{1+e^x} \Rightarrow -\frac{1}{y}+y=\ell\ln\left(1+e^x\right)+$$

$\because$ It passes through (0, 1)

$\therefore -1+1=\ell n\,2+C \Rightarrow C=-\ell n2$

equation of curve $y-\frac{1}{y}=\ell n\left(1+e^{x}\right)-\ell n2$

$\Rightarrow \left(y^{2}-1\right)=y\ell n\left(\frac{1+e^{x}}{2}\right)$

Question 57. Let $\frac{x^{2}}{4}+\frac{y^{2}}{3}=1$ is an ellipse and a hyperbola which is confocal with ellipse such that its transverse axis is $\sqrt{2}$, then which of following point does not lie on hyperbola

(1) $\left(1,-\frac{1}{\sqrt{2}}\right)$

(2) $\left(-\sqrt{\frac{3}{2}},1\right)$

(3) $\left(\sqrt{\frac{3}{2}},\frac{1}{\sqrt{2}}\right)$

(4) None of these

Ans. (3)

Sol. ellipse $\frac{x^{2}}{4}+\frac{y}{3}=1$ $a_{1}=2$; $b_{1}=\sqrt{3}$

$e_{1}=\sqrt{1-\frac{3}{4}}=\frac{1}{2}$

Focus = $(\pm 1, 0)$

for hyperbola, $a_2 = \frac{1}{\sqrt{2}}$ and $a_2 e_2 = 1$

$\Rightarrow e_2 = \sqrt{2} \Rightarrow b_2 = a_2 = \frac{1}{\sqrt{2}}$

hyperbola $\frac{x^2}{a_2^2} - \frac{y^2}{b_2^2} = 1$

$\Rightarrow x^2 - y^2 = \frac{1}{2}$

Question 58. $2\pi - \left[\sin^{-1}\frac{4}{5} + \sin^{-1}\frac{5}{13} + \sin^{-1}\frac{16}{65}\right] =$

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

(2) π

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

(4) $-\frac{\pi}{2}$

Ans. (3)

Sol. $2\pi - \left[\tan^{-1}\frac{4}{3} + \tan^{-1}\frac{5}{12} + \tan^{-1}\frac{16}{63}\right]$

$$\Rightarrow 2\pi-\left[\tan^{-1}\left(\frac{\frac{4}{3}+\frac{5}{12}}{1-\frac{4}{3}.\frac{5}{12}}\right)+\tan^{-1}\frac{16}{63}\right]$$

$$\Rightarrow 2\pi-\left[\tan^{-1}\frac{63}{16}+\cot^{-1}\frac{63}{16}\right]=2\pi-\frac{\pi}{2}=\frac{3\pi}{2}$$

Question 59. If $y^2+\ell n\cos^2 x=y$ then

(1) $|y''(0)|=2$

(2) $|y'(0)|+|y''(0)|=1$

(3) $|y'(0)|+|y''(0)|=3$

(4) None of these

Ans. (1)

Sol. $2yy'-2\tan x=y'$ ..... (1)

$2yy''+2(y')^2-2\sec^2 x=y''$ ..... (2)

when $x=0\Rightarrow y=0,1$

if $x=0$ and $y=0\Rightarrow y'(0)=0$

if $x=0$ and $y=1\Rightarrow y'(0)=0$

equation (2) $2yy''+2(y')^2-2\sec^2 x=y''$

at $x=0\Rightarrow 2yy''-2=y''\Rightarrow y''(2y-1)=2$

$$\Rightarrow y''(0)=\frac{2}{2y-1}=\begin{cases}-2 & ;y=0\\ 2 & y=1\end{cases}\Rightarrow |y''(0)|=2$$

60. $\left|\lim\limits_{x\to 0}\left(\frac{1-x+|x|}{1+[x]-\lambda}\right)\right|=L(\text{finite})$ where [.] denotes the greatest integer function then find L.

(1) 0

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

(3) 1

(4) 2

Ans. (4)

Sol. LHL = RHL

$$\Rightarrow\left|\lim_{h\to 0^-}\left(\frac{1+h+h}{1-1-\lambda}\right)\right|=\left|\lim_{h\to 0^+}\left(\frac{1-h+h}{1+0-\lambda}\right)\right|$$

$$\Rightarrow\left|-\frac{1}{\lambda}\right|=\left|\frac{1}{1-\lambda}\right|$$

$$\Rightarrow\frac{1}{\lambda}=\frac{1}{1-\lambda}\quad\text{or}\quad\frac{1}{\lambda}=\frac{1}{\lambda-1}$$

$$\Rightarrow 1-\lambda=\lambda\quad\text{or}\quad\lambda-1=\lambda\,(\text{not possible})$$

$$\Rightarrow\lambda=\frac{1}{2}$$

$$\Rightarrow L = \left| \lim_{x \to 0} \left(\frac{1 - x + |x|}{\frac{1}{2} + [x]} \right) \right| = \left| \frac{1}{\frac{1}{2}} \right| = 2$$

Question 61. Let α, β are roots of $x^2 + px + 2 = 0$ and $\frac{1}{\alpha}, \frac{1}{\beta}$ are the roots of $2x2 - 2qx + 1 = 0$. Then find the value of $\left(\alpha + \frac{1}{\beta}\right)\left(\beta + \frac{1}{\alpha}\right)\left(\alpha - \frac{1}{\alpha}\right)\left(\beta - \frac{1}{\beta}\right)$.

(1) $\frac{9}{4}(9 - p^2)$

(2) $\frac{9}{4}(9 + p^2)$

(3) $\frac{4}{9}(9 - q^2)$

(4) $\frac{9}{4}(9 - q^2)$

Ans. (1)

Sol. $\alpha + \beta = -p, \ \alpha\beta = 2$

$\frac{1}{\alpha} + \frac{1}{\beta} = q, \ \frac{1}{\alpha\beta} = \frac{1}{2}$

$$= \left(\alpha + \frac{1}{\beta}\right)\left(\beta + \frac{1}{\alpha}\right)\left(\alpha - \frac{1}{\alpha}\right)\left(\beta - \frac{1}{\beta}\right)$$

$$= \left(\alpha\beta + 2 + \frac{1}{\alpha\beta}\right)\left(\alpha\beta - \frac{\alpha}{\beta} - \frac{\beta}{\alpha} + \frac{1}{\alpha\beta}\right)$$

$$= \left(2 + 2 + \frac{1}{2}\right)\left(2 - \frac{\alpha^2 + \beta^2}{\alpha\beta} + \frac{1}{2}\right) = \frac{9}{2}\left(\frac{5}{2} - \frac{(\alpha+\beta)^2 - 2\alpha\beta}{\alpha\beta}\right)$$

$$= \frac{9}{2}\left(\frac{5}{2} - \frac{p^2 - 4}{2}\right) = \frac{9}{2}\left(\frac{5 - p^2 + 4}{2}\right) = \frac{9}{4}(9 - p^2).$$

Question 62. Evaluate $\int_{-\pi}^{\pi} |\pi - |x|| dx$.

(1) π^2

(2) $\frac{\pi^2}{2}$

(3) $\frac{\pi^2}{3}$

(4) $\frac{\pi^2}{4}$

Ans. (1)

Sol.

$$\int_{-\pi}^{\pi}\left|\pi-|x|\right|dx=2\int_{0}^{\pi}|\pi-x|dx=2\int_{0}^{\pi}(\pi-x)\,dx=2\left[\pi x-\frac{x^2}{2}\right]_0^{\pi}$$

$$=2\left(\pi^2-\frac{\pi^2}{2}\right)=2.\frac{\pi^2}{2}=\pi^2$$

Question 63. $\lim\limits_{x\to 0}\dfrac{\left(1-\cos\dfrac{x^2}{2}\right)\left(1-\cos\dfrac{x^2}{4}\right)}{x^8}=2^{-K}$, find K

Ans. (08.00)

Sol. $\lim\limits_{x\to 0}\left(\dfrac{1-\cos\dfrac{x^2}{2}}{x^4}\right)\left(\dfrac{1-\cos\dfrac{x^2}{4}}{x^4}\right)=2^{-K}$

$$\Rightarrow \lim_{x\to 0}\left(\frac{1-\cos\frac{x^2}{2}}{\left(\frac{x^2}{2}\right)^2}\right)\frac{1}{4}\left(\frac{1-\cos\frac{x^2}{4}}{\left(\frac{x^2}{4}\right)^2}\right)\frac{1}{16}=2^{-k}$$

$$\Rightarrow \frac{1}{2}.\frac{1}{4}.\frac{1}{2}.\frac{1}{16}=2^{-k}$$

$$\Rightarrow \frac{1}{2^8}=2^{-k}\Rightarrow 2^{-8}=2^{-k}$$

$$\Rightarrow k=8$$

Question 64. The value of $0.16^{\log_{2.5}\left(\frac{1}{3}+\frac{1}{3^2}+\frac{1}{3^3}+\ldots\infty\right)}$ is

Ans. (04.00)

Sol. Given $= 0.16^{\log_{2.5}\left(\frac{1}{3}+\frac{1}{3^2}+\frac{1}{3^3}+\ldots\ldots\infty\right)}$

$= 0.16^{\log_{2.5}\left(\frac{1}{2}\right)} = 0.16^{\log_{\frac{5}{2}}\left(\frac{1}{2}\right)} = \left(\frac{5}{2}\right)^{2\log_{5/2}2} = 2^2 = 4.$

Question 65. $S = \left(2.{}^1P_0 - 3.{}^2P_1 + 4.{}^3P_2 + \ldots\ldots + 51 \text{ terms}\right)$
$+\left(1! - 2! + 3! - 4! + \ldots\ldots 51 \text{ terms}\right)$, find S

(1) $1 + 51!$

(2) $1 + 52!$

(3) $1 + 50(51!)$

(4) $1 + 51(51!)$

Ans. (2)

Sol.

$S = \left(2.{}^1P_0 - 3.{}^2P_1 + 4.{}^3P_2 + \ldots\ldots + 51 \text{ terms}\right)$
$+\left(1! - 2! + 3! - 4! + \ldots\ldots 51 \text{ terms}\right)$

$= 2! - 3! + 4! - 5! + \ldots\ldots\ldots + 52! + (1! - 2! + 3! - 4! + \ldots\ldots\ldots 51!) = 1 + 52!$

Question 66. The preposition on $p \Rightarrow \left(\sim\left(p \wedge \sim q\right)\right)$ is equivalent to

(1) q

(2) $\sim p \vee q$

(3) $p \vee \sim q$

(4) $\sim p \vee \sim q$

Ans. (2)

Sol. Given $\equiv p \Rightarrow (\sim (p \wedge \sim q))$

$\equiv \sim p \vee (\sim (p \wedge \sim q))$

$\equiv \sim p \vee (\sim p \vee q)$

$\equiv \sim p \vee q$

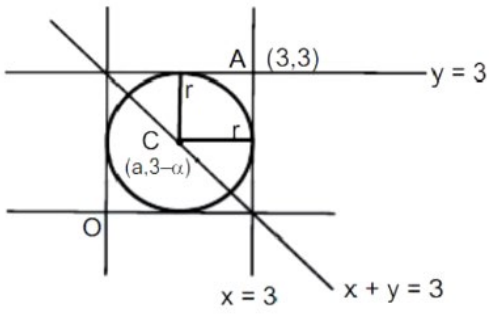
Question 67. The centre of a circle lies on $x + y = 3$ and touching the lines $x = 3$, $y = 3$ then find diameter of circle.

Ans. (03.00)

Sol. Let centre is $C(\alpha, 3-\alpha)$

Now $r = 3 - \alpha$

Or $r = 3 - (3 - \alpha) = \alpha$



$\therefore 3 - \alpha = \alpha$

$\alpha = \frac{3}{2} \quad \therefore \; r = \frac{3}{2}$

$2r = 3$

Question 68. $\left(2^{\frac{1}{2}} + 5^{\frac{1}{8}}\right)^n$ has 33 integral terms, then least value of n is:

(1) 256

(2) 257

(3) 258

(4) 259

Ans. (1)

Sol. $T_{r+1} = {}^nC_r . 2^{\frac{n-r}{2}} . 5^{\frac{r}{8}}$

For integral terms

$\frac{r}{8}, \frac{n-r}{2} \in I^+ \cup \{0\}$

Then r = 8, 16, 24, ...

$n = t_{33} = 0 + 32 \times 8 = 256$

$= 256$

Question 69. The area (in sq. unit) of the region $\left\{(x, y); \frac{1}{2} \le y \le \sin x, 0 \le x \le \pi\right\}$ is equal

(1) $3-2\pi$

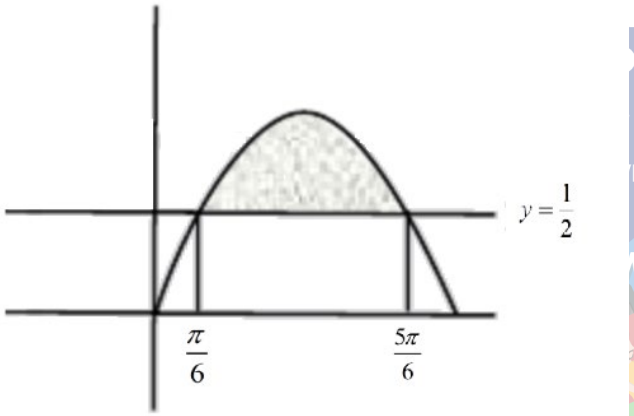
(2) $\sqrt{3}-\frac{\pi}{6}$

(3) $3-\frac{\pi}{3}$

(4) $\sqrt{3}-\frac{\pi}{3}$

Ans. (4)

Sol.



Required area

$$=\int_{\pi/6}^{5\pi/6}\sin x\,dx-\left(\frac{5\pi}{6}-\frac{\pi}{6}\right)\frac{1}{2}=-\left(\cos x\right)_{\pi/6}^{5\pi/6}-\frac{\pi}{3}=\left[\frac{2\sqrt{3}}{2}\right]-\frac{\pi}{3}$$

Question 70. Let the data 4, 10, x, y, 27 be in increasing order. If the median of data is 18 and its mean deviation about mean is 7.6 then the mean of this data is:

(1) 17

(2) 16

(3) 16.5

(4) 15.5

Ans. (1)

Sol. Median $= \left(\frac{n+1}{2}\right)^{th}$ term $= x = 18$

$$\text{mean} = \frac{59+y}{5} = \bar{x}$$

$$\text{Now } \frac{\Sigma|x_i - \bar{x}|}{5} = 7.6$$

$$\Sigma|x_i - \bar{x}| = 38$$

$$(3\bar{x} - 32) + (y + 27 + 2\bar{x}) = 38$$

$$\bar{x} - 5 + y = 38$$

$$\bar{x} = 43 - y$$

Than $5(43 - y) = 59 + y$

$6y = -59 + 215$

$6y = 156$

$y = 26$

$$\bar{x} = \frac{59+26}{5} = \frac{85}{5} = 17$$

Question 71. A bag contains 6 red and 10 green balls, 3 balls are drawn from it one by one without replacement. If the third ball drawn is red, then the probability, that first two balls are green is

(1) $\frac{3}{7}$

(2) $\frac{9}{149}$

(3) $\frac{9}{56}$

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

Ans. (1)

Sol. Probability = $\frac{P(g_1 g_1 R_3)}{P(R_1 R_2 R_3)+P(R_1 g_2 g_3)+P(g_1 R_2 R_3)+P(g_1 g_2 R_3)}$

$= \frac{10.9.6}{6.5.4+6.10.5+10.6.5+10.9.6}$

$= \frac{90}{20+50+50+90} = \frac{9}{21} = \frac{3}{7}$.

Question 72. If

$$\begin{vmatrix} x-2 & 2x-3 & 3x-4 \\ 2x-3 & 3x-4 & 4x-5 \\ 3x-5 & 5x-8 & 10x-17 \end{vmatrix} = Ax^3 + Bx^2 + Cx + D$$ then find

the absolute value of B + C?

Ans. (03.00)

Sol. $R2 \to R2 - 2R1, R3 \to R3 - 3R1$

$$\begin{vmatrix} x-2 & 2x-3 & 3x-4 \\ 1 & -x+2 & -2x+3 \\ 1 & -x+1 & x-5 \end{vmatrix} = Ax^3 + Bx^2 + Cx + D$$

$R3 \to R3 - R2$

$$\begin{vmatrix} x-2 & 2x-3 & 3x-4 \\ 1 & 2-x & 3+2x \\ 0 & -1 & 3x-8 \end{vmatrix} = Ax^3 + Bx^2 + Cx + D$$

$1[(3 - 2x)(x - 2) - (3x - 4)] + (3x - 8)[-x2 - 4 + 4x - 2x + 3]$
$= Ax^3 + Bx^2 + Cx + D$

So A = -3

B = -2 + 8 + 6 = 12

C = 7 – 3 – 3 – 16 = -15

D = 6

B + C = - 3