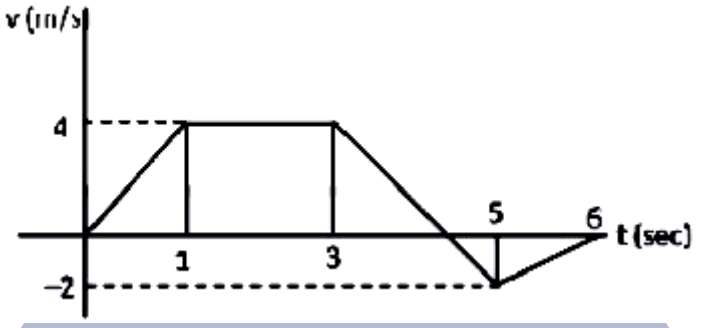
JEE MAIN 2020 5th SEPT SHIFT 2

Physics

Question 1. Velocity time graph of a particle is shown in figure. Find displacement of the particle.



(1) 7

(2) 11

(3) 5

(4) 15

Ans. (2)

Sol. s = area of graph

$$= \frac{1}{2} \times 4\left(2 + \frac{13}{3}\right) - \frac{1}{2} \times 2 \times \frac{5}{3} = \frac{38}{3} - \frac{5}{3} = 11\text{m}$$

Question 2. A light of 4 eV incident on metal surface of work function ϕ_1 eV. Another light of 2.5 eV incident on

another metal surface of work function ϕ_2 eV. Find the ratio of maximum velocity of photo electrons $\left(\frac{v_1}{v_2}\right)$.

(1) $\sqrt{\frac{4+\phi_1}{2.5-\phi_2}}$

(2) $\sqrt{\frac{4-\phi_1}{2.5-\phi_2}}$

(3) $\sqrt{\frac{3-\phi_1}{2.5-\phi_2}}$

(4) $\sqrt{\frac{6+\phi_1}{2.5-\phi_2}}$

Ans. (2)

Sol. $\frac{1}{2}mv^2 = E - \phi$

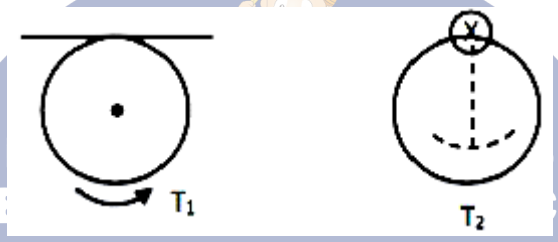
For 1st metal $\frac{1}{2}mv_1^2 = 4 - \phi_1$ .... (1)

For IInd metal $\frac{1}{2}mv_2^2 = 2.5 - \phi_2$ .... (2)

$\left(\frac{v_1}{v_2}\right)^2 = \frac{4-\phi_1}{2.5-\phi_2}$

$$\frac{v_1}{v_2} = \sqrt{\frac{4-\phi_1}{2.5-\phi_2}}$$

Question 3. A ring-1 oscillate with period T_1 about tangential axis in the plane of ring and an another ring-2 oscillate with period T_2 about tangential axis perpendicular to plane of ring. $\frac{T_1}{T_2} = ?$



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

(2) $\sqrt{\frac{5}{8}}$

(3) $\sqrt{\frac{8}{5}}$

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

Ans. (1)

Sol. $\frac{T_1}{T_2} = \sqrt{\frac{I_1}{I_2}} = \sqrt{\frac{\frac{3}{2}MR^2}{2MR^2}} = \sqrt{\frac{3}{4}}$

Question 4. A car is moving towards a fixed wall. It blows horn of frequency of 440 Hz. The frequency of reflected sound observed by the driver is 480 Hz then find the speed of car in km/hr. (Speed of sound is 350 m/sec):

(1) 64.78 km/hr

(2) 26.78 km/hr

(3) 54.78 km/hr

(4) 47.78 km/hr

Ans. (3)

Sol. $f_f'' = \left(\frac{V + V_c}{V - V_c}\right) f$

$$480 = \left[\frac{350 - V_c}{350 - V_c}\right] 400$$

$$\frac{12}{11} = \frac{350 + V_c}{350 - V_c}$$

$350 \times 12 - 12VC = 350 \times 11 + 11\ VC$

$350\ (12 - 11) = 23\ VC$

$350 = 23\ VC$

$$V_c = \frac{350}{23} m/s$$

$$V_c = \frac{350}{23} \times \frac{18}{5}$$

VC = 54.78 km/hr

Question 5. Given that $x = \frac{1}{\sqrt{\varepsilon_0 \mu_0}}$, $y = \frac{E}{B}$ & $z = \frac{1}{RC}$. Which of the following in correct.

(1) dimension of x and z will be same

(2) dimension of y and z will be same

(3) dimension of x and y will be same

(4) dimension of x, y and z is different

Ans. (3)

Question 6. There are two rods of length ℓ_1 and ℓ_2 and coefficient of linear expansions are α_1 and α_2 respectively. Find equivalent coefficient of thermal expansion for their combination in series.

(1) $\frac{\alpha_1 + \alpha_2}{2}$

(2) $\frac{\alpha_1 \ell_1 + \alpha_2 \ell_2}{\alpha_1 + \alpha_2}$

(3) $\frac{\alpha_1 \ell_1 + \alpha_2 \ell_2}{\ell_1 + \ell_2}$

(4) $\sqrt{\alpha_1 \alpha_2}$

Ans. (3)

Sol. At t°C; $\ell_{eq} = \ell_1 + \ell_2$

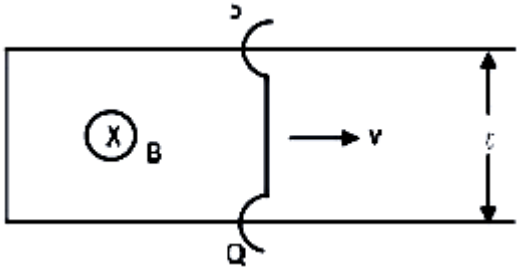
At $t + \Delta t°C$; $\ell'_{eq} = \ell'_1 + \ell'_2$

$$\ell_{eq}\left(1 + \alpha_{eq}\Delta t\right) = \ell_1\left(1 + \alpha_1 \Delta t\right) + \ell_2\left(1 + \alpha_2 \Delta t\right)$$

$$\left(\ell_1 + \ell_2\right)\left(1 + \alpha_{eq}\Delta t\right) = \ell_1 + \ell_2 + \ell_1\alpha_1\Delta t + \ell_2\alpha_2\Delta t$$

$$\therefore \alpha_{eq} = \frac{\alpha_1\ell_1 + \alpha_2\ell_2}{\ell_1 + \ell_2}$$

Question 7. A rod having length l and resistance R is moving with velocity v on a π shape conductor. Find the current in the rod.



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

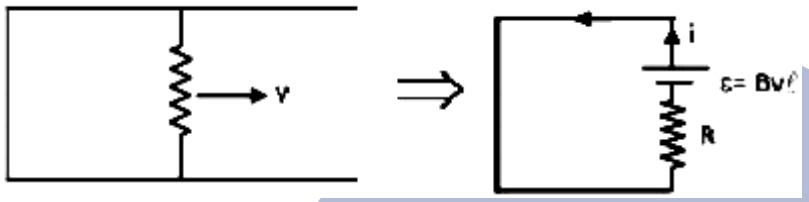
(2) $\frac{2Bvl}{R}$

(3) $\frac{3Bvl}{R}$

(4) $\frac{Bvl}{R}$

Ans. (4)

Sol.



$$i = \frac{Bvl}{R}$$

Question 8. There are two bodies A and B of same mass. A is placed near equator of earth and B is placed at a height 'h' above the pole of earth. If both the bodies weighs equally. Find 'h' in terms of radius 'R' of earth, angular speed 'ω' of earth and 'g' acceleration due to gravity close to earth.

(1) $\frac{R\omega^2}{2g}$

(2) $\frac{R^2\omega^2}{2g}$

(3) $\frac{gR}{\omega^2}$

(4) $\frac{g}{\omega^2}$

Ans. (2)

Sol. Both weight equally, if means effective 'g' is same for both

For A $g_A = g. - R\omega^2$

For B $g_B = g.\left(1 - \frac{2h}{R}\right)$

$gA = gB$

$R\omega^2 = \frac{2g}{R}$

$\therefore h = \frac{R^2\omega^2}{2g}$

Question 9. Radioactive nucleus A decays into B with half-life 10 sec. A also convert into C with half-life 100 sec. Find half-life of A for both emission.

(1) 6 sec

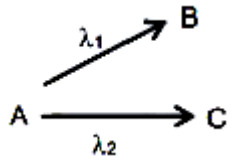
(2) 9 sec

(3) 3 sec

(4) 2 sec

Ans. (2)

Sol.



$$-\frac{dN}{dt} = \lambda_1 N + \lambda_2 N$$

$$-\frac{dN}{dt} = (\lambda_1 + \lambda_2) N$$

$$\lambda_{eq} = (\lambda_1 + \lambda_2)$$

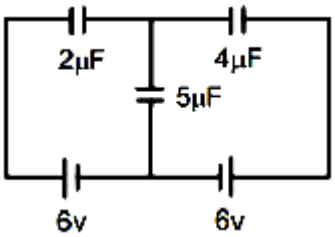
$$\frac{\ell n 2}{T} = \frac{\ell n 2}{T_1} + \frac{\ell n 2}{T_2}$$

$$\frac{1}{T} = \frac{1}{T_1} + \frac{1}{T_2}$$

$$\frac{1}{T} = \frac{1}{10} + \frac{1}{100} = \frac{11}{100}$$

$$T = \frac{100}{11} \approx 9 \sec$$

Question 10. Find charge on 5μF .



(1) $\frac{120}{11}\mu C$

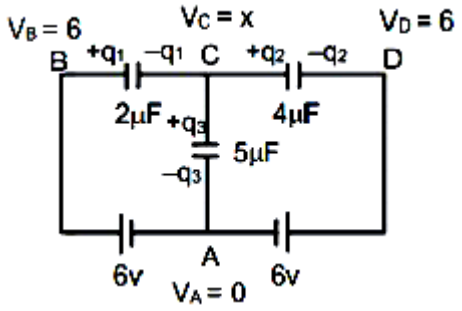
(2) $\frac{150}{11}\mu C$

(3) $\frac{180}{11}\mu C$

(4) $\frac{90}{11}\mu C$

Ans. (3)

Sol.



$$-q_1 + q_2 + q_3 = 0$$

$$-2(6 - x) + 4(x - 6) + 5(x - 0) = 0$$

$$-12 + 2x + 4x - 24 + 5x = 0$$

$$11x = 36 \Rightarrow x = \frac{36}{11}$$

$$q_3 = 5 \times \frac{36}{11} = \frac{180}{11}\mu C$$

Question 11. An ideal diatomic gas is taken through an adiabatic process in which density increases to 32 times. If pressure increases to 'n' times. Find n.

(1) 4

(2) 8

(3) 64

(4) 128

Ans. (4)

Sol. In adiabatic process

$$Pv^{\gamma} = \text{constant}$$

$$\therefore P\left(\frac{m}{\rho}\right)^{\gamma} = \text{constant}$$

As mass in constant

$$\therefore p \propto \rho^{\gamma}$$

$$\frac{P_f}{P_i} = \left(\frac{\rho_f}{\rho_i}\right)^{\gamma} = (32)^{7/5}$$

$$\therefore n = 2^{7} = 128$$

Question 12. A body of mass 2 kg at rest is supplied constant power 1 J/sec., the distance travelled by the body after 6 sec. is:

(1) $2\sqrt{6}$m

(2) $4\sqrt{6}$m

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

(4) $6\sqrt{3}$m

Ans. (2)

Sol. P = 1 J/sec

$$Pt = W = \Delta K$$

$$t = 1/2 \text{ m. } v^2 = v^2$$

$$\therefore v = \sqrt{t} = \frac{ds}{dt}$$

$$\int_0^5 ds = \int_0^6 \sqrt{t}\,dt$$

$$S = \frac{2}{3}\left[t^{3/2}\right]_0^6$$

$$= \frac{2}{3} \times 6\sqrt{6} = 4\sqrt{6}\text{m}$$

Question 13. A dielectric having dielectric constant K = 4 is filled in a capacitor having plate length l and width b. Now length of capacitor is increased by l_1 for which energy stored becomes half of initial value. l_1 should be:

(1) 2l

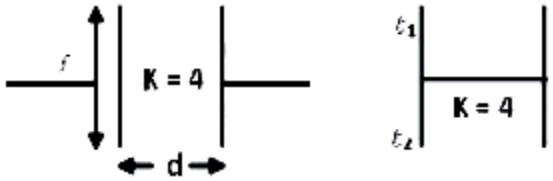
(2) 6l

(3) 8l

(4) 4l

Ans. (4)

Sol. Capacitance



$$\frac{Q^2}{2C_i} = 2\frac{Q^2}{2C_f}$$

$$\frac{1}{C_i} = \frac{2}{C_f}$$

$$C_f = 2C_i$$

$$\frac{\varepsilon_0}{d}(bl_1 + bl4) = \frac{\varepsilon_0}{d} bl4 \times 2$$

$$l_1 + 41 = 81$$

$$l_1 = 41$$

Question 14. There is prism of refractive index 1.5 and prism angle 2°. Find minimum deviation caused by this prism.

(1) 1°

(2) 2°

(3) 1/3°

(4) 1/2°

Ans. (1)

Sol. For this prism gives minimum angle of deviation

$$\delta = (\mu - 1)A$$

$$\delta = (1.5 - 1) \times 2^\circ$$

$$= 1^\circ$$

Question 15. There is an iron core solenoid of turn density 10 turns/cm and volume 10-3m^3. It carries a current of 0.5 A and relative permeability of iron core is $\mu_r = 1000$. The magnetic moment of this solenoid is approximately (in A-m^2)

(1) 5×10^2

(2) 5×10^3

(3) 5×10^4

(4) 5×10^5

Ans. (1)

Sol. Magnetic moment of an iron core solenoid

$$M = (\mu_r - 1).NiA$$

$$= (\mu_r - 1).Ni\frac{v}{l}$$

$$= (\mu - 1)\frac{N}{l}iV$$

$$= 999 \times \frac{10}{10^2} \times 0.5 \times 10^{-3}$$

$= 499.5$

Question 16. A ball is dropped from a height h. If falls on the liquid surface. Its velocity does not change when it enters in the liquid, find height h in terms of r = radius of ball, σ =density of liquid, ρ =density of ball, η= coefficient of viscosity and g = acceleration due to gravity:

(1) $\frac{2}{81}\frac{r^4 g(\rho-\sigma)^2}{\eta^2}$

(2) $\frac{2}{50}\frac{r^4 g(\rho-\sigma)^2}{\eta^2}$

(3) $\frac{2}{25}\frac{r^4 g(\rho-\sigma)^2}{\eta^2}$

(4) $\frac{2}{90}\frac{r^4 g(\rho-\sigma)^2}{\eta^2}$ s

Ans. (1)

Sol. After falling through h the velocity should be equal to terminal velocity

$$\sqrt{2gh} = \frac{2}{9}\frac{r^2(\rho-\sigma)g}{\eta}$$

$$= \frac{2}{81}\frac{r^4 g(\rho-g)^2}{\eta^2}$$

Question 17. A rocket moving in free space has varying mass due to fuel exhausted

$$\frac{dm(t)}{dt} = -bv^2(t)$$

where m(t) = instantaneous mass

b = constant

v(t) = instantaneous velocity

If gases are ejected with velocity u, with respect to rocket, instantaneous acceleration of rocket should be

(1) $\frac{ubv^2(t)}{m(t)}$

(2) $\frac{ubv^2(t)}{2m(t)}$

(3) $\frac{ubv(t)}{m(t)}$

(4) $\frac{ub}{m(t)}$

Ans. (1)

Sol. $F_{th} = u\frac{dm}{dt}$

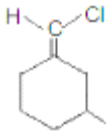
$ma = u.bv^2$

$$a = \frac{ubv^2}{m}$$

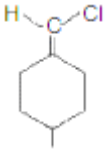
Chemistry

Question 18. Which of the following compound will show geometrical isomerism?

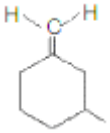
(1)



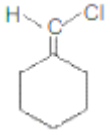
(2)



(3)



(4)



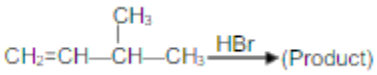
Answer: (1)

Solution:

Geometrical isomerism arises due to

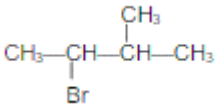
(1) The presence of a restricted rotation (double bond or a ring structure).
(2) Two different groups should be attached to any two carbon atoms of restricted rotation.

Question 19.

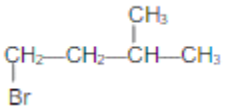


The product will be

(1)



(2)



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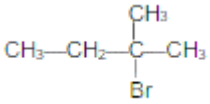
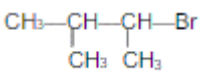
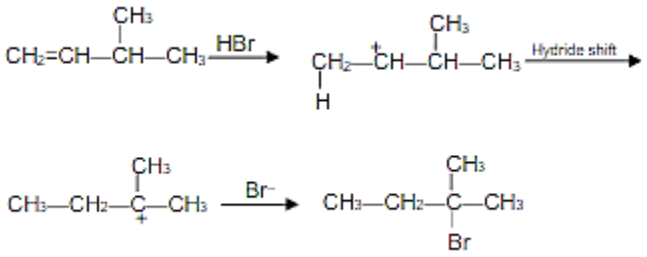


(4)



Answer: (3)

Solution:



Question 20. Which is not a condensation polymer?

(1) Nylon-6

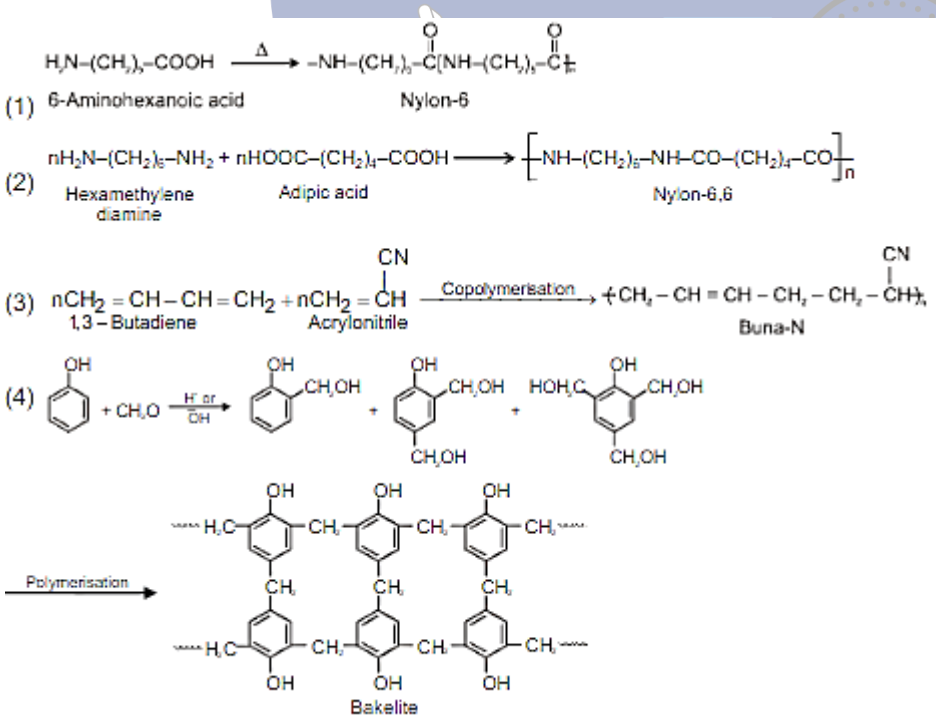
(2) Nylon-6, 6

(3) Buna-N

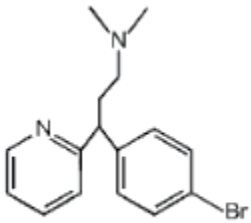
(4) Bakelite

Answer: (3)

Solution:



Question 21. What is the use of Brompheniramine?



Brompheniramine

(1) Antidepressant

(2) Antihistamines

(3) Antiseptic

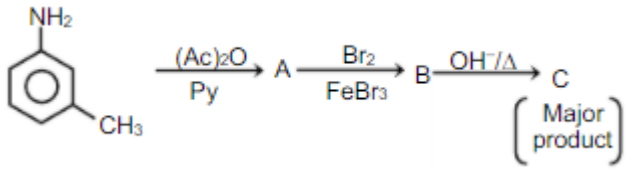
(4) Analgesic

Answer: (2)

Solution:

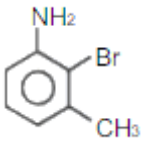
Synthetic drugs, brompheniramine (Dimetapp) act as antihistamines.

Question 22.

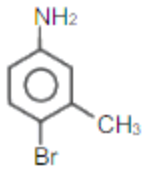


Product ‘C’ will bet

(1)



(2)



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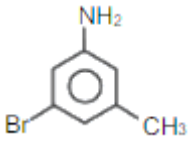
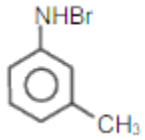
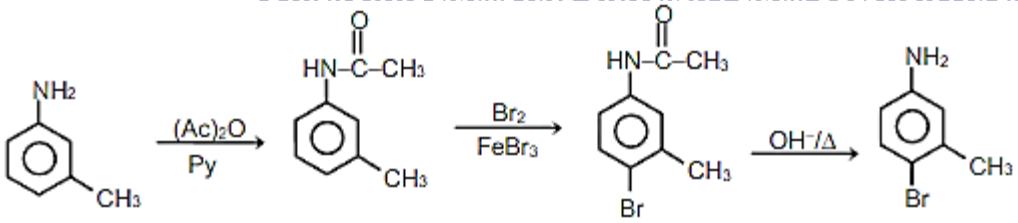


(4)

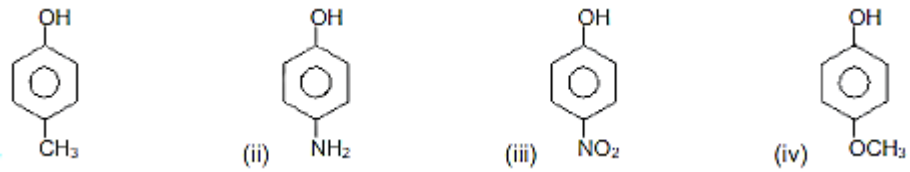


Answer: (2)

Solution:



Question 23. Which is the correct order of Boiling point of given compounds?



(1) (ii) > (iii) > (iv) > (i)

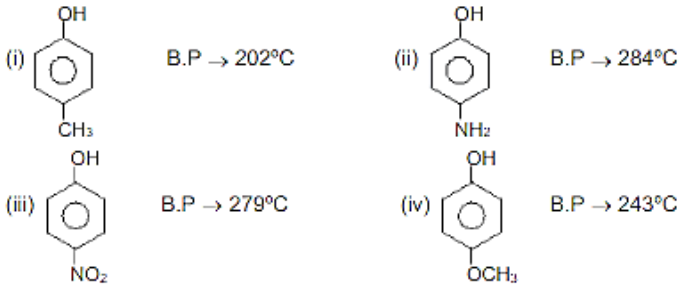
(2) (ii) > (i) > (iv) > (iii)

(3) (i) > (iii) > (iv) > (ii)

(4) (i) > (iii) > (ii) > (iv)

Answer: (1)

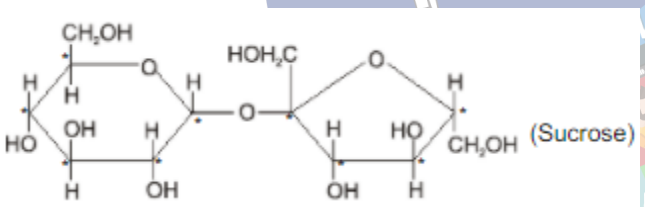
Solution:



Question 24. Total number of chiral carbon atoms present in sucrose is

Answer: 9

Solution:



Question 25. The minimum distance between the center of two octahedral voids in FCC lattice in terms of edge length is:

(1) a

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

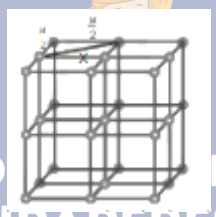
(3) $\frac{a}{\sqrt{2}}$

(4) $\sqrt{2}a$

Answer: (3)

Solution:

In FCC octahedral voids are present at the edge centers and body center.



Minimum distance between centers of two octahedral voids

$$= x = \sqrt{\left(\frac{a}{2}\right)^2 + \left(\frac{a}{2}\right)^2} = \sqrt{\frac{a^2}{4} + \frac{a^2}{4}} = \frac{a}{\sqrt{2}}$$

Question 26. Which of the following statement is correct regarding probability density (except infinity)

(1) For 2p cannot be zero

(2) For 3p can be zero

(3) For 1s can be zero

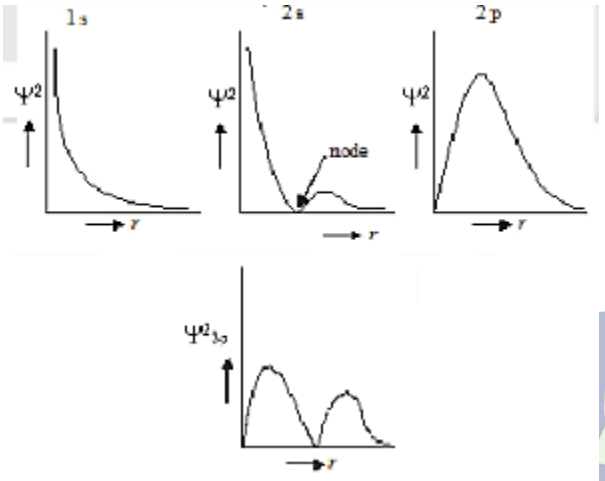
(4) For 2s never be zero

Answer: (2)

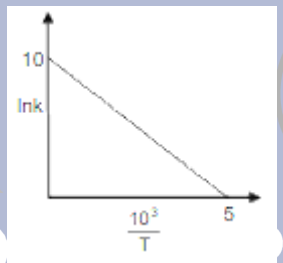
Solution:

From the following Ψ^2 function graph (Ψ^2 = probability density)

Ψ^2 can be zero for 3p orbital other than infinity.



Question 27. Using following graph find activation energy (in kJ)



(1) R

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

(3) 2R

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

Answer: (3)

Solution:

$k = Ae^{-Ea/RT}$

$$\ln k = \ln A - \left(\frac{E_a}{R}\right)\frac{1}{T}$$

$$\ln k = \ln A - \left(\frac{E_a}{R \times 10^3}\right) \times \frac{10^3}{T}$$

Slope of graph

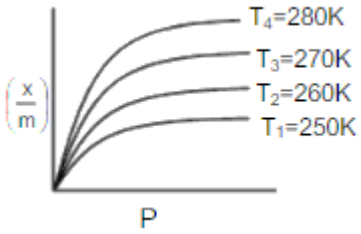
$$= \frac{-E_a}{R \times 10^3} = \frac{-10}{5}$$

$$-E_a = 2R \times 10^3 \text{ J}$$

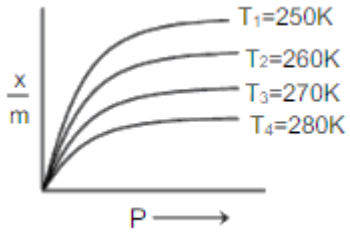
$$E_a = 2R \text{ kJ}$$

Question 28. Which of the following graph between $\left(\frac{x}{m}\right)$ Vs P is correct?

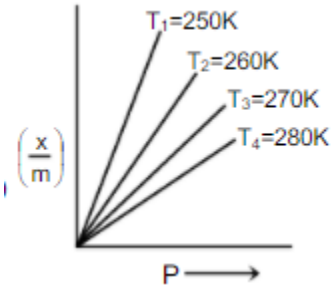
(1)



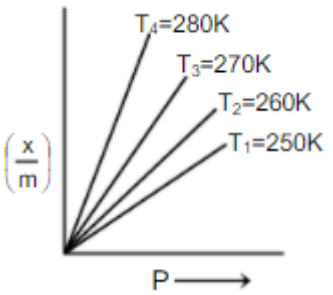
(2)



(3)



(4)



Answer: (2)

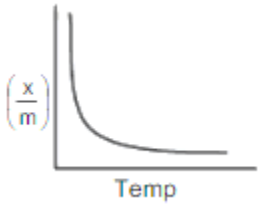
Solution:

From Freundlich adsorption isotherm

$\frac{x}{m} \propto P$ (At low pressure)

$\frac{x}{m} \propto P^{\circ}$ (At high pressure)

→On increasing temperature physical adsorption decreases



Question 29. A diatomic gas expands adiabatically so that final density is 32 times the initial density. Final pressure becomes N times of initial pressure. The value of N is

(1) 128

(2) $\frac{1}{32}$

(3) 32

(4) $\frac{1}{128}$

Answer: (1)

Solution:

1. Since the data of temperature is not given. It should be reversible adiabatic process

2. Since it is diatomic gas, we can take degree of freedom = 5

$$\gamma = \frac{f+2}{f} = \frac{7}{5}$$

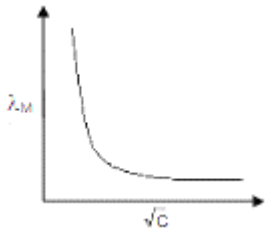
3. Use $PV^{\gamma} = K$

$$P_1V_1^{\gamma} = P_2V_2^{\gamma} \Rightarrow \frac{P_2}{P_1} = \left(\frac{V_1}{V_2}\right)^{\gamma}$$

$$\text{Given: } \frac{d_2}{d_1} = 32 = \frac{\frac{m}{v_2}}{\frac{m}{v_1}} = 32 \Rightarrow \frac{v_1}{v_2} - 32$$

$$\frac{P_2}{P_1} = (32)^{\frac{1}{5}} = \left[2^5\right]^{\frac{1}{5}} = 2^7 \Rightarrow \frac{P_2}{P_1} = 128 \Rightarrow P_2 = 128P_1$$

Question 30. Following graph is observed for which of the electrolytic solution



(1) CH_3COOH

(2) HCl

(3) KNO_3

(4) NaCl

Answer: (1)

Solution:

Graph represent variation of λ_M^c with respect to $\sqrt{C}$ for weak electrolyte.

Question 31. The products formed by reaction of ammonia with excess of Chlorine are:

(1) $NH_4Cl + HCl$

(2) $NCl_3 + N_2$

(3) $NCl_3 + HCl$

(4) $NH_4Cl + N_2$

Answer: (3)

Solution:

$NH_3 + 3Cl_2 \rightarrow NCl_3 + 3HCl$

Limiting excess

$8NH_3 + 3Cl_2 \rightarrow 6NH_4Cl + N_2$

excess limiting

Question 32. (A) = cis$[Co(en)2Cl_2]\oplus$ & (B) = trans$[Co(en)2Cl_2]\oplus$

Which of the above complexes is optically active?

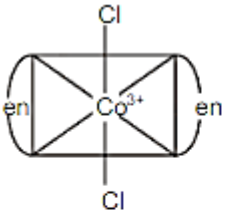
(1) Only A

(2) Only B

(3) Both

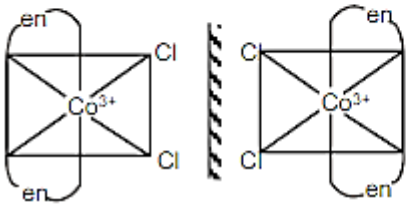
(4) None

Solution:



Have Plane of symmetry so will be optically inactive.

Trans-$[Co(en)_2Cl_2]^+$



cis-$[Co(en)2Cl_2]^+ \rightarrow$ is optically active without plane of symmetry.

Question 33. Correct arrangement of the following species in the increasing order of their size is: N^{3-}, O^{2-}, F^- ,Na^+,Mg^{2+},Al^{3+}

(1) Al^{3+}, Mg^{2+}, Na^+, F^-, O^{2-}, N^{3-}

(2) N^{3-}, O^{2-}, F^-, Na^+, Mg^{2+}, Al^{3+}

(3) Al^{3+}, Mg^{2+}, Na^+, N^{3-}, O^{2-}, F^-

(4) Na^+, Mg^{2+}, Al^{3+}, F^-, O^{2-}, N^{3-}

Answer: (1)

Solution:

$Al^{3+} < Mg^{2+} < Na^+ < F^- < O^{2-} < N^{3-}$

All are isoelectronic species so more is the zeff less will be the ionic size.

Question 34. Which of the following has maximum bond angle [consider C, N, O, S as central atom]

(1) H_2O

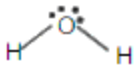
(2) H_2S

(3) NH_2

(4) CH_4

Answer: (4)

Solution:



$sp^3, \ell.p = 2,\ B.A. = 104^0 30'$

$H_2S \rightarrow$ No hybridization [Drago's rule], bond angle = 900

$\ddot{N}H_3\ \ sp^3, \ell.p = 1,\ B.A. = 107^0$

$CH_4\ \ sp^3, \ell.p = 0,\ B.A. = 109^0 28'$

Question 35. In pure form H_2O_2 is found as:

(1) Linear, Blue colour

(2) Linear, Colourless

(3) Planar, Blue colour

(4) Non planar, Blue colour

Answer: (4)

Solution:

Structure of H_2O_2 is of open book shape. It is a colour less viscous liquid but in large quantity appears blue in colour.

Question 36. Pure boron and silicon can be obtained by

(1) Electrolytic refining

(2) Vapour phase refining

(3) Zone refining

(4) Mond's process

Answer: (3)

Solution:

Germanium, Silicon, Boron, Gallium and Indium can be obtained in pure state by zone refining process.

Question 37. 0.02 M $K_2Cr_2O_7$ is treated with 0.288 gram of Ferrous oxalate. How much volume (in mL) of $K_2Cr_2O_7$ is required?

Answer: 100

Solution:

Milliequivalent of $K_2Cr_2O_7$ = Milliequivalent of FeC_2O_4

$$V_{ml} \times 0.02 \times 6 = \frac{0.288}{144} \times 3 \times 1000$$

$$V_{ml} \times 0.02 \times 6 = 2 \times 6$$

$$V_{ml} = 100 \text{ ml}$$

Question 38. For the reaction, $2A(g) \rightarrow A2(g)$ following data is obtained at 298 K. $\Delta U = -20$ kJ, $\Delta S = -30$J then find ΔG (in kJ)

Answer: -13.5

Solution:

From $\Delta H = \Delta U + \Delta ngRT$

$\Delta H = -20 \times 1000 - 1 \times 8.314$ J/mol. K $\times$ 298 K

$= -22477.572$ J

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

$= -13537.572$ J

$= -13.5$ kJ

Question 39. For the reaction, $x + y \rightleftharpoons 2z$ initially 1 mol of x, 1.5 mole of y and 0.5 mole z are taken, then at equilibrium 1 mole of z is obtained, If $k_{eq} = \frac{X}{15}$ then, find the value of 'X'.

Answer: 16.00

Solution:

	x	+	y	$\rightleftharpoons$	2z
t = 0	1 mol		1.5 mol		0.5 mol

Since moles of Z are increased at equilibrium therefore reaction goes in forward direction to attain the equilibrium.

$$x \quad + \quad y \quad \rightleftharpoons \quad 2z$$

t = teq $1-a$ $1.5-a$ $0.5+2a = 1$ mole

$\Rightarrow a = 0.25$

$$x \quad + \quad y \quad \rightarrow \quad 2z$$

0.75 mol 1.25 mol 1 mol

$$k_{eq} = \frac{[z]^2}{[x][y]} = \frac{1}{0.75 \times [1.25]} = \frac{X}{15}$$

$$X = \frac{15}{(0.75 \times 1.25)} = 16$$

Mathematic

Question 40. If α, β are roots of equation $7x^2 - 3x + 2 = 0$ then find the value of $\frac{\alpha}{1-\alpha^2} + \frac{\beta}{1-\beta^2}$

(1) $\frac{7}{24}$

(2) $\frac{5}{24}$

(3) $\frac{24}{5}$

(4) $\frac{24}{7}$

Ans. (2)

Sol. $\alpha+\beta=\frac{3}{7},\ \alpha\beta=\frac{2}{7}$

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

$$=\frac{(\alpha+\beta)-\alpha\beta(\alpha+\beta)}{1+(\alpha\beta)^2-(\alpha+\beta)^2+2\alpha\beta}\Rightarrow\frac{\left(\frac{3}{7}-\frac{2}{7}\left(\frac{3}{7}\right)\right)}{1+\left(\frac{2}{7}\right)^2-\left(\frac{3}{7}\right)^2+2\left(\frac{2}{7}\right)}\Rightarrow\frac{\left(\frac{15}{49}\right)}{\left(\frac{72}{49}\right)}=\frac{15}{72}$$

Question 41. If $\vec{a},\vec{b},\vec{c}$ are three vectors such that $|\vec{a}|=2,|\vec{b}|=4,|\vec{c}|=4,\vec{b}.\hat{a}=\vec{c}.\hat{a}$ then find the value of $\left|\vec{a}+\vec{b}-\vec{c}\right|$

(1) 6

(2) $\sqrt{6}$

(3) 7

(4) $2\sqrt{6}$

Ans. (1)

Sol. Given, $\vec{b}.\hat{a} = \vec{c}.\hat{a}$

$$\Rightarrow \frac{\vec{b}.\vec{a}}{|\vec{a}|} = \frac{\vec{c}.\vec{a}}{|\vec{a}|} \Rightarrow \vec{b}.\vec{a} = \vec{c}.\vec{a}$$

$$\left|\vec{a}+\vec{b}-\vec{c}\right|^2 = |\vec{a}|^2 + |\vec{b}|^2 + |\vec{c}|^2 + 2\left(\vec{a}.\vec{b} - \vec{b}.\vec{c} - \vec{a}.\vec{c}\right)$$

$$= 4+16+16+2\left(\vec{a}.\vec{b} - 0 - \vec{a}.\vec{c}\right) = 36$$

$$\Rightarrow \left|\vec{a}+\vec{b}-\vec{c}\right| = 6$$

Question 42. If the line $x + 2y = 3$ cuts a chord of length r unit with the circle $x^2 + y^2 = r^2$ then find r^2.

(1) $\frac{12}{5}$

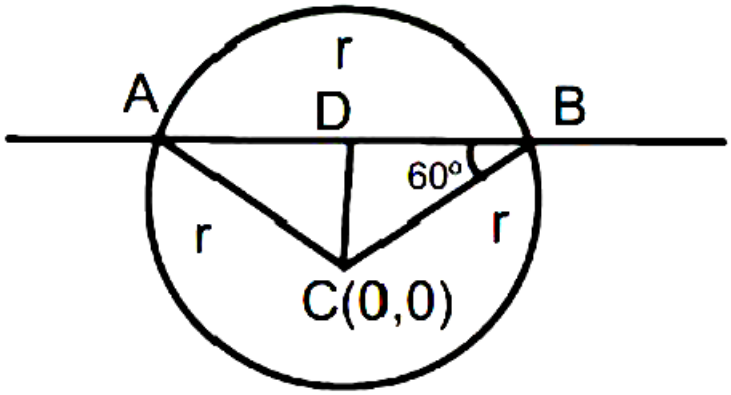
(2) $\sqrt{12}$

(3) $\frac{5}{12}$

(4) $\sqrt{\frac{12}{5}}$

Ans. (1)

Sol. $AB = r$, $AD = \frac{r}{2}$



$$CD = r\sin 60° = \frac{\sqrt{3}r}{2}$$

$$\Rightarrow \frac{|0+0-3|}{\sqrt{1^2+2^2}} = \frac{\sqrt{3}r}{2} \Rightarrow r = 2\sqrt{\frac{3}{5}} \Rightarrow r^2 = \frac{12}{5}$$

Question 43. Find the coefficient of x4 in the expansion of $(1 + x + x^2 + x^3)6$

(1) 100

(2) 110

(3) 120

(4) 125

Ans. (3)

Sol. $(1 + x + x^2 + x^3)6 = (1 + x)6.\ (1 + x^2)6$

$$= \left(\sum_{r=0}^{6} {}^6C_r.x^r\right).\left(\sum_{r=0}^{6} {}^6C_r.x^{2r}\right)$$

Coefficient of $x^4 = {}^6C_0.\ {}^6C_2 + {}^6C_2.\ {}^6C_1 + {}^6C_4.\ {}^6C_0$

Coefficient of $x^4 = 15 + 90 + 15 = 120$

Question 44. If the mean and standard deviation of 5, 3, 7, a, b are 5 and 2 respectively, then a and b are roots of equation.

(1) $x^2 - 10x + 18 = 0$

(2) $x^2 - 20x + 18 = 0$

(3) $x^2 - 20x + 19 = 0$

(4) $x^2 - 10x + 19 = 0$

Ans. (4)

Sol. $\bar{x} = \dfrac{5+3+7+a+b}{5}$

$5 + 3 + 7 + a + b = 25 \Rightarrow a + b = 10$

$$\text{S.D.} = \sqrt{\frac{5^2+3^2+7^2+a^2+b^2}{5} - 5^2} = 2$$

$$\Rightarrow \frac{a^2+b^2+83}{5} - 25 = 4 \Rightarrow a^2 + b^2 = 62$$

$$\Rightarrow (a+b)^2 - 2ab = 62 \Rightarrow ab = 19$$

So, equation whose roots are a and b is $x^2 - 10x + 19 = 0$

Question 45. There are three section A, B, C in a paper each section having 5 questions. In how many ways a student can solve exactly 5 questions taken at least one question from each section.

(1) 2200

(2) 2225

(3) 2250

(4) 2275

Ans. (3)

Sol. $A \rightarrow 5Q$ $B \rightarrow 5Q$ $C \rightarrow 5Q$

A_1, A_2, A_3, A_4, A_5 B_1, B_2, B_3, B_4, B_5 C_1, C_2, C_3, C_4, C_5

No. of ways when 3 questions are selected from one section and one each from other sections $= {}^3C_1 \times {}^5C_3 \times {}^5C_1 \times {}^5C_1 = 750$

No. of ways when 2 questions are selected from two sections and from other section $= {}^3C_2 \times {}^5C_2 \times {}^5C_2 \times {}^5C_1 = 1500$

$\therefore$ total $= 2250$

Question 46. $\left(\frac{-1+\sqrt{3}i}{1-i}\right)^{30}$ simplifies to

(1) -215i

(2) 215i

(3) 215

(4) -215

Ans. (1)

Sol. $\left(\frac{-1+\sqrt{3}i}{1-i}\right)^{30} = \left(\frac{2\cos\left(\frac{2\pi}{3}\right)+i\sin\left(\frac{2\pi}{3}\right)}{\sqrt{2}\left(\cos\frac{\pi}{4}-i\sin\frac{\pi}{4}\right)}\right)$

$$= \frac{2^{30}\left(\cos 20\pi + i\sin 20\pi\right)}{2^{15}\left(\cos\frac{15\pi}{2} - i\sin\frac{15\pi}{2}\right)}$$

$$= \frac{2^{15}\left(1+0i\right)}{\left(0+i\right)} = -2^{15}i$$

Question 47. If the lines $x - y = a$ and $x + y = b$ are tangents for $y = x^2 - 3x + 2$ then $\frac{a}{b} =$

Ans. (2)

Sol. $y = x^2 - 3x + 2$, $x + y = a1$, $x - y = b$

$2x1 - 3 = 1$ $\quad$ $2x2 - 3 = -1$

$x1 = 2$ $\quad$ $x2 = 1$

$y1 = 4 - 6 + 2 = 0$ $\quad$ $y2 = 0$

$(2, 0)$ $\quad$ $(1, 0)$

$a = 2$ $\quad$ $b = 1$

$$\therefore \frac{a}{b} = \frac{2}{1} = 2$$

Question 48. Let

$y_1 = \tan^{-1}\left(\frac{\sqrt{1+x^2}-1}{x}\right)$ and $y_2 = \tan^{-1}\left(\frac{2x\sqrt{1-x^2}}{1-2x^2}\right)$ then $\frac{dy_1}{dy_2} =$

(1) $\frac{\sqrt{1-x^2}}{2\left(1+x^2\right)}$

(2) $\frac{\sqrt{1-x_2}}{4\left(1+x^2\right)}$

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

(4) $\frac{1}{4\left(1+x^2\right)\sqrt{1-x^2}}$

Ans. (2)

Sol. Let $x = \tan\theta$

$$y_1 = \tan^{-1}\left(\frac{\sec\theta-1}{\tan\theta}\right) = \tan^{-1}\left(\tan\frac{\theta}{2}\right) = \frac{\theta}{2} = \frac{1}{2}\tan^{-1}x$$

Let, $x = \sin\phi$

$$y_2 = \tan^{-1}\left(\frac{2\sin\phi\cos\phi}{\cos 2\phi}\right) = \tan^{-1}\left(\tan 2\phi\right) = 2\phi = 2\sin^{-1}x$$

$$\frac{dy_1}{dy_2} = \frac{dy_1/dx}{dy_2/dx} = \frac{\frac{1}{(1+x^2)}\cdot\frac{1}{2}}{2.\frac{1}{\sqrt{1-x^2}}}$$

$$= \frac{\sqrt{1-x^2}}{4(1+x^2)}$$

Question 49. In a G.P sum of 2nd, 3rd and 4th term is 3 and that of 6th, 7th and 8th term is 243 then S50 =

(1) $\frac{3^{50}+1}{26}$

(2) $\frac{3^{50}-1}{13}$

(3) $\frac{3^{50}-1}{26}$

(4) $\frac{3^{49}-1}{26}$

Ans. (3)

Sol. Let a, ar, ar2, ……. G.P.

T2 + T3 + T4 = 3 $\Rightarrow$ ar (1 + r + r2) = 3 …. (i)

T6 + T7 + T8 = 243 $\Rightarrow$ ar5 (1 + r + r2) = 243 …. (ii)

By (i) and (ii)

$$r4 = 81 \quad \Rightarrow \quad r = 3$$

$$\therefore a = \frac{1}{13}$$

$$S_{50} = \frac{a\left(r^{50}-1\right)}{r-1} = \frac{3^{50}-1}{26}$$

Question 50. $\int \frac{\cos\theta}{7+\sin\theta-2\cos^2\theta}d\theta$ is equal to

(1) $\frac{2}{\sqrt{39}}\tan^{-1}\left(\frac{2\sin\theta+1}{\sqrt{39}}\right)+C$

(2) $\frac{2}{\sqrt{39}}\tan^{-1}\left(\frac{4\sin\theta+1}{\sqrt{39}}\right)+C$

(3) $\frac{4}{\sqrt{39}}\tan^{-1}\left(\frac{4\sin\theta+1}{\sqrt{39}}\right)+C$

(4) $\frac{4}{\sqrt{39}}\tan^{-1}\left(\frac{2\sin\theta+1}{\sqrt{39}}\right)+C$

Ans. (2)

Sol. $I = \int \frac{\cos\theta}{7+\sin\theta-2\left(1-\sin^2\theta\right)}d\theta$

$$= \int \frac{\cos\theta}{2\sin^2\theta+\sin\theta+5}d\theta$$

$$\sin\theta = t \Rightarrow \cos\theta.d\theta = dt$$

$$I = \int \frac{dt}{2t^2 + t + 5} = \frac{1}{2}\int \frac{dt}{\left(t + \frac{1}{4}\right)^2 + \frac{39}{16}}$$

$$\Rightarrow I = \frac{1}{2}.\frac{1}{\frac{\sqrt{39}}{4}} \tan^{-1}\left(\frac{t + \frac{1}{4}}{\frac{\sqrt{39}}{4}}\right) + C$$

$$= \frac{2}{\sqrt{39}} \tan^{-1}\left(\frac{4\sin\theta + 1}{\sqrt{39}}\right) + C$$

Question 51. The area enclosed by $[x].(x-1) \le y \le 2\sqrt{x}$ for x = 0 to 2 where [x] is greatest integer less than or equal to x., is equal to

(1) $\frac{8\sqrt{2}}{3} + \frac{1}{2}$

(2) $\frac{8\sqrt{2}}{3}$

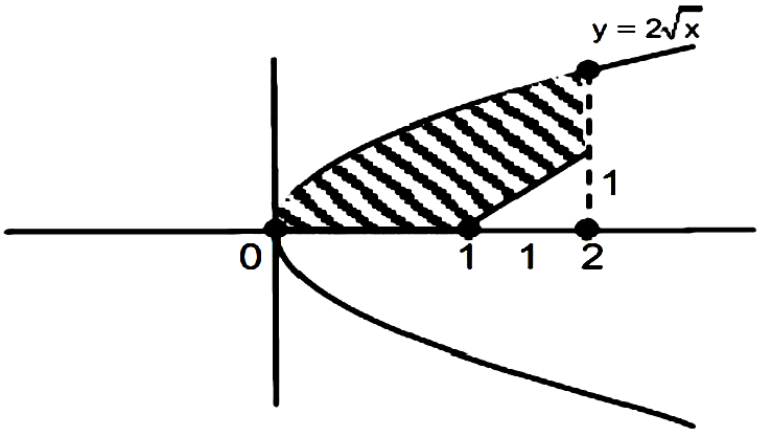
(3) $\frac{8\sqrt{2}}{3} - \frac{1}{2}$

(4) $\frac{8}{3} - \frac{1}{\sqrt{2}}$

Ans. (3)

Sol. $y = [x](x-1)$

$$= \begin{cases} 0 & 0 \le x < 1 \\ x-1 & 1 \le x < 2 \end{cases}$$



Required Area $= \int_0^2 2\sqrt{x}\,dx - \frac{1}{2}(1)(1) = \left(\frac{4x^{3/2}}{3}\right)_0^2 - \frac{1}{2} = \frac{8\sqrt{2}}{3} - \frac{1}{2}$

Question 52. If $x + a = y + b + 1 = z + c$ then the value of

$$\begin{vmatrix} x & a+y & a+x \\ y & b+y & b+y \\ z & c+y & c+z \end{vmatrix}$$ is

(1) $y(a-b)$

(2) $y(b-c)$

(3) $y(c-a)$

(4) 0

Ans. (3)

Sol. Given $x + a = y + b + 1 = z + c$

$$\text{Now } \begin{vmatrix} x & a+y & a+x \\ y & b+y & b+y \\ z & c+y & c+z \end{vmatrix} = \begin{vmatrix} x & a+y & a \\ y & b+y & b \\ z & c+y & c \end{vmatrix} \left(C_3 \to C_3 - C_1\right)$$

$$= \begin{vmatrix} x & y & a \\ y & y & b \\ z & y & c \end{vmatrix} \left(C_2 \to C_2 - C_3\right)$$

$$= y \begin{vmatrix} x & 1 & a \\ y & 1 & b \\ z & 1 & c \end{vmatrix}$$

$R_2 \to R_2 - R_1$ and $R_3 \to R_3 - R_1$

$$y. \begin{vmatrix} x & 1 & a \\ y-x & 0 & b-a \\ z-x & 0 & c-a \end{vmatrix}$$

$$= -y\,(c-a) \begin{vmatrix} x & 1 & a \\ y-x & 0 & b-a \\ -1 & 0 & 1 \end{vmatrix}$$

$= -y.(c - a)(y - x + b - a) = y\,(c - a)$

Question 53. If $\log_{7^{\frac{1}{2}}} x + \log_{7^{\frac{1}{3}}} x + \log_{7^{\frac{1}{4}}} x + \ldots\ldots\ldots$ 20 times $= 460$ then $x = ?$

Ans. (49)

Sol. Given $\log_{7^{\frac{1}{2}}} x + \log_{7^{\frac{1}{3}}} x + \log_{7^{\frac{1}{4}}} x + \ldots\ldots$ 20 times $= 460$

$$\Rightarrow (2+3+4+.....+21)\log_7 x = 460$$

$$\Rightarrow \frac{20}{2}(2+21)\log_7 x = 460$$

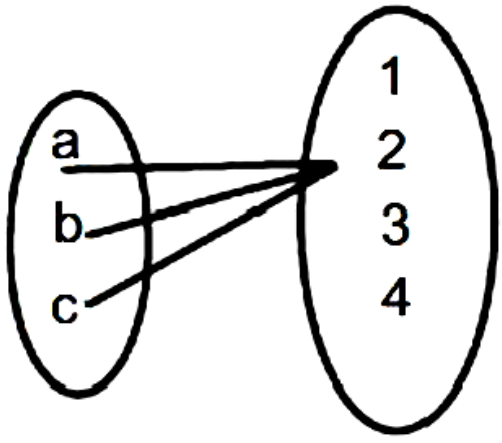
$$\Rightarrow \log_7 x = 2$$

$$\Rightarrow x = 49$$

Question 54. A function $f : A \to B$ where A = {a, b, c}, B = {1, 2, 3, 4}. How many function can be defined from A to B which are not one-one such that $2 \in f(A)$

Ans. (19)

Sol. only '2' is range $\to$ 1 function



one element out of 1, 3, 4, is in range with '2'

Number of ways = $^3C_1 . \frac{3!}{2!.1!} . 2! = 18$

(Select one from 1, 3, 4 and distribute among a, b, c)

Total function = 1 + 18 = 19

Question 55. If the system of equations $x + y + z = 0$, $x + 3y + k2z = 0$ and $x + 2y + z = 0$ have a non-zero solution then the value of $y + \frac{x}{z}$ is

(1) 1

(2) 0

(3) -1

(4) 2

Ans. (3)

Sol.

$$\left.\begin{aligned} x+y+z&=0\\ x+3y+k^2z&=0\\ x+2y+z&=0 \end{aligned}\right\} \text{ has a non-zero solution.}$$

$$\therefore \begin{vmatrix} 1 & 1 & 1 \\ 1 & 3 & k^2 \\ 1 & 2 & 1 \end{vmatrix} = 0$$

$$\Rightarrow 3-2k^2-1+k^2+2-3 \Rightarrow k^2=1$$

$\therefore$ system is

$x + y + z = 0$

$x + 2y + z = 0$

$x + 3y + z = 0$

$\therefore y = 0, x + z = 0 \Rightarrow \frac{x}{z} = -1$

$\therefore y + \frac{x}{z} = -1$

Question 56. If $y = mx + C$ is a common tangent of circle $x^2 + y^2 = 3$ and hyperbola $\frac{x^2}{64} - \frac{y^2}{100} = 1$ then which of the following statement is true:

(1) $8m = 4$

(2) $61C^2 = 492$

(3) $4C^2 = 369$

(4) $8m + 5 = 0$

Ans. (2)

Sol. Tangent of circle $\Rightarrow C^2 = 3(1 + m^2)$

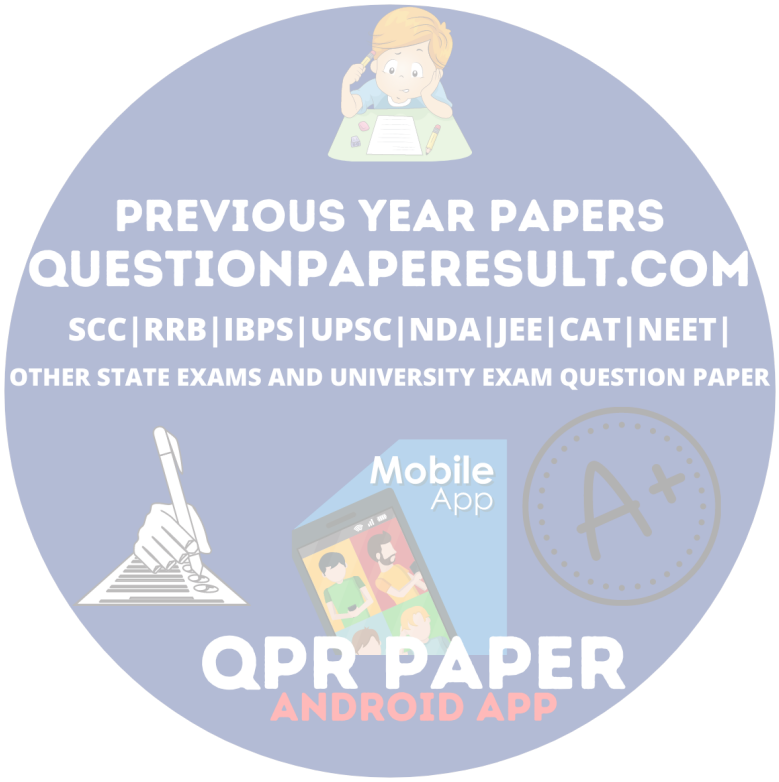
and tangent of hyperbola $\Rightarrow C^2 = 64m^2 - 100$

$\Rightarrow 3(1 + m^2) = 64m^2 - 100$

$\Rightarrow 61m^2 = 103$

$\Rightarrow m^2 = \frac{103}{61}$

$\Rightarrow C^2 = 3\left(1 + \frac{103}{61}\right) = \frac{492}{61}$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