NEET | IIT-JEE | FOUNDATION

Corporate Office: 44-A/1, Kalu Sarai, New Delhi 110016 | Web: www.meniit.com

JEE MAIN-2020

COMPUTER BASED TEST (CBT)

DATE : 05-09-2020 (SHIFT-2) | TIME : (3.00 pm to 6.00 pm)

Duration 3 Hours | Max. Marks : 300

QUESTION & SOLUTIONS

PART-A : PHYSICS

SECTION – 1 : (Maximum Marks : 80)

Single Choice Type

This section contains 20 Single choice questions. Each question has 4 choices (1), (2), (3) and (4) for its answer, out of which Only One is correct.

Full Marks : +4 If ONLY the correct option is chosen.

Negative Marks : –1 (minus one) mark will be deducted for indicating incorrect response.

1. A spaceship in space sweeps stationary interplanetary dust. As a result, its mass increases at a rate $\frac{dM(t)}{dt} = bv^2(t)$, where v(t) is its instantaneous velocity. The instantaneous acceleration of the satellite is:

(1) $-\frac{bv^3}{2M(t)}$ (2) $-bv^3(t)$ (3) $-\frac{2bv^3}{M(t)}$ (4) $-\frac{bv^3}{M(t)}$

Ans. (4)

Sol. $F = V\left(\frac{dm}{dt}\right)$

$a = \frac{F}{M} = -\frac{bv^3}{M(t)}$

2. A galvanometer is used in laboratory for detecting the null point in electrical experiments. If, on passing a current of 6 mA it produces a deflection of 2°, its figure of merit is close to :

(1) 6×10^{-3} A/div. (2) 3×10^{-3} A/div. (3) 666° A/div. (4) 333° A/div.

Ans. (2)

Sol. Current sensitivity $= \frac{I}{\theta} = -\frac{6 \times 10^{-3}}{2} = 3 \times 10^{-3}$

3. The acceleration due to gravity on the earth's surface at the poles is g and angular velocity of the earth about the axis passing through the pole is ω. An object is weighed at the equator and at a height h above the poles by using a spring balance. If the weights are found to be same, then h is : (h << R, where R is the radius of the earth)

(1) $\frac{R^2\omega^2}{4g}$ (2) $\frac{R^2\omega^2}{2g}$ (3) $\frac{R^2\omega^2}{8g}$ (4) $\frac{R^2\omega^2}{g}$

Ans. (2)

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

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

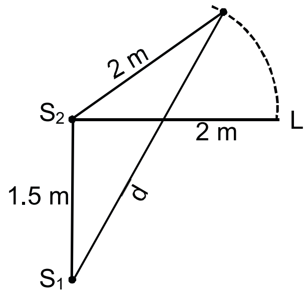
For B $g_B = g \cdot \left(1 - \frac{2h}{R}\right)$

$g_A = g_B$

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

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

4. Two coherent sources of sound, S_1 and S_2, produce sound waves of the same wavelength λ = 1m, in phase. S_1 and S_2 are placed 1.5 m apart (see fig). A listener, located at L, directly in front of S_2 finds that the intensity is at a minimum when he is 2m away from S_2. The listener moves away from S_1, keeping the distance from S_2 fixed. The adjacent maximum of intensity is observed when the listener is at a distance d from S_1. Then d is :



(1) 3m (2) 5m (3) 12 m (4) 2m

Ans. (2)

Sol. $\sqrt{2^2+(1.5)^2}=(2n+1)\frac{\lambda}{2}$ ...(1)

$\sqrt{4+2.25}=\sqrt{6.25}=(2n+1)\frac{\lambda}{2}$

$d-2=2.5+\frac{\lambda}{2}$ ...(2)

$d-2=2.5+\frac{1}{2}$

d = 2 + 2.5 + 0.5

d = 5

5. Ten charges are placed on the circumference of a circle of radius R with constant angular separation between successive charges. Alternate charges 1, 3, 5, 7, 9 have charge (+q) each, while 2, 4, 6, 8, 10 have charge (–q) each. The potential V and the electric field E at the centre of the circle are respectively: (Take V = 0 at infinity)

(1) V = 0 ; E = 0

(2) $V=\frac{10q}{4\pi\epsilon_0 R}; E=0$

(3) $V=\frac{10q}{4\pi\epsilon_0 R}; E=\frac{10q}{4\pi\epsilon_0 R^2}$

(4) $V=0, E=\frac{10q}{4\pi\epsilon_0 R^2}$

Ans. (1)

Sol. $\frac{KQ_{net}}{R}$

Q_{net} = 0

So V = 0

6. The quantities $x = \frac{1}{\sqrt{\mu_0 \in_0}}$, $y = \frac{E}{B}$ and $z = \frac{\ell}{CR}$ are defined where C–capacitance, R–Resistance, ℓ–length, E–Electric field, B–magnetic field and $\in_0$, μ_0,–free space permittivity and permeability respectively. Then :

(1) Only y and z have the same dimension. (2) Only x and y have the same dimension.

(3) Only x and z have the same dimension (4) x, y and z have the same dimension.

Ans. (4)

Sol. All are dimensions of velocity.

7. The correct match between the entries in column I and column II are :

	I Radiation		II Wavelength
(a)	Microwave	(i)	100 m
(b)	Gamma rays	(ii)	10^{-15} m
(c)	A.M. radio	(iii)	10^{-10} m
(d)	X–rays	(iv)	10^{-3} m

(1) (a)–(iv), (b) – (ii), (c) – (i), (d) – (iii) (2) (a)–(iii), (b) – (ii), (c) – (i), (d) – (iv)

(3) (a)–(i), (b) – (iii), (c) – (iv), (d) – (ii) (4) (a)–(ii), (b) – (i), (c) – (iv), (d) – (iii)

Ans. (1)

Sol. Theory based (EM Wave Spectrum)

8. An iron rod of volume 10^{-3} m^3 and relative permeability 1000 is placed as core in a solenoid with 10 turns/cm. If a current of 0.5 A is passed through the solenoid, then the magnetic moment of the rod will be :

(1) 0.5×10^2 Am^2 (2) 5×10^2 Am^2 (3) 500×10^2 Am^2 (4) 50×10^2 Am^2

Ans. (2)

Sol. Magnetic moment of an iron core solenoid

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

$= (\mu_r - 1)\cdot Ni\frac{V}{\ell}$

$= (\mu_r - 1)\cdot \frac{N}{\ell} iV$

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

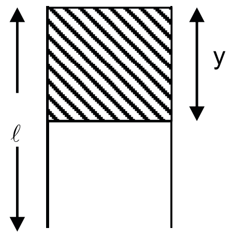
$= 499.5 \approx 500$

9. A parallel plate capacitor has plate of length 'λ' width 'w' and separation of plates is 'd'. It is connected to a battery of emf V. A dielectric slab of the same thickness 'd' and of dielectric constant k = 4 is being inserted between the plates of the capacitor. at what length of the slab inside plates, will the energy stored in the capacitor be two times the initial energy stored ?

(1) $\ell/4$ (2) $\ell/2$ (3) $\ell/3$ (4) $2\ell/3$

Ans. (3)

Sol. $\left(\frac{1}{2}CV^2\right)2 = \frac{1}{2}(C_1 + C_2)V^2$



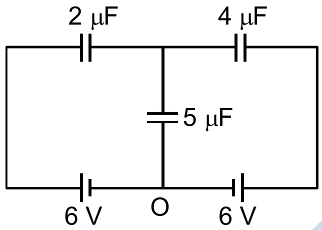
$2C = C_1 + C_2$

$2\left(\frac{\epsilon_0 W\ell}{d}\right) = \frac{\epsilon_0 KWy}{d} + \frac{\epsilon_0 W(\ell - y)}{d}$

$2\ell = ky + (\ell - y)$

$y = \frac{\ell}{3}$

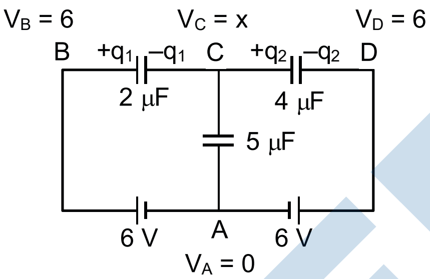
10. In the circuit shown, charge on the 5μF capacitor is :



(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. (4)

Sol.



$-q_1 + q_2 + q_3 = 0$

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

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

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

11. A driver in a car, approaching a vertical wall notices that the frequency of his car horn, has changed from 440 Hz to 480 Hz, when it gets reflected from the wall. If the speed of sound in air is 345 m/s, then the speed of the car is :

(1) 36 km/hr (2) 18 km/hr (3) 24 km/hr (4) 54 km/hr

Ans. (4)

Sol. $f_r'' = \left(\frac{v + v_c}{v - v_c}\right)f$

$480 = \left[\frac{345 + v_c}{345 - v_c}\right]400$

$\frac{12}{11} = \frac{345 + v_c}{345 - v_c}$

$V_C = 54$ Km/hr

12. In an experiment to verify Stokes law, a small spherical ball of radius r and density ρ falls under gravity through a distance h in air before entering a tank of water. If the terminal velocity of the ball inside water is same as its velocity just before entering the water surface, then the value of h is proportional to : (ignore viscosity of air)

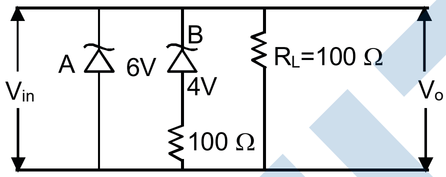
(1) r^2 (2) r (3) r^3 (4) r^4

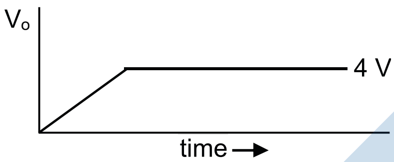
Ans. (4)

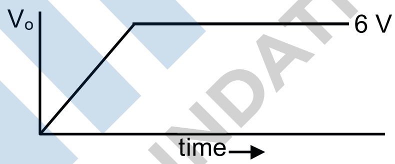
Sol. After falling through h the velocity should be equal to terminal velocity

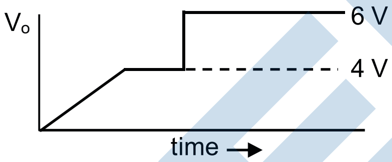
$$\sqrt{2gh} = \frac{2}{9}\frac{r^2(\rho-\sigma)g}{\eta} = \frac{2}{81}\frac{r^4 g(\rho-\sigma)^2}{\eta^2}$$

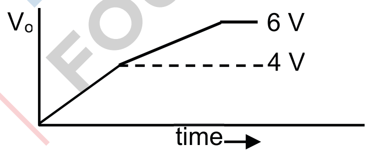
13. Two Zener diodes (A and B) having breakdown voltages of 6V and 4V respectively, are connected as shown in the circuit below. The output voltage V_0 variation with input voltage linearly increasing with time, is given by (V_{input} = 0V at t = 0)



(1)


(2)


(3)


(4)


Ans. (4)

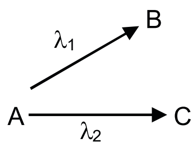
Sol. Zener diode maintain the voltage after zener breakdown

14. A radioactive nucleus decays by two different processes. The half-life for the first process is 10s and that for the second is 100s. The effective half life of the nucleus is close to :

(1) 12 sec. (2) 55 sec. (3) 6 sec. (4) 9 sec.

Ans. (4)

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



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

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

$$\frac{\ell n2}{T} = \frac{\ell n2}{T_1} + \frac{\ell n2}{T_2}$$

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

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

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

15. In an adiabatic process, the density of a diatomic gas becomes 32 times its initial value. The final pressure of the gas is found to be n times the initial pressure. The value of n is :

(1) 128 (2) 326 (3) $\frac{1}{32}$ (4) 32

Ans. (1)

Sol. In adiabatic process

Pv^{γ} = constant

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

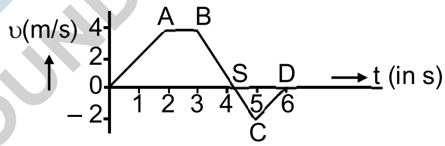
As mass in constant

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

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

$\therefore$ n = 2^7 = 128

16. The velocity (v) and time (t) graph of a body in a straight line motion is shown in the figure. The point S is at 4.333 seconds. The total distance covered by the body in 6s is :



(1) 12 m (2) $\frac{49}{4}$m

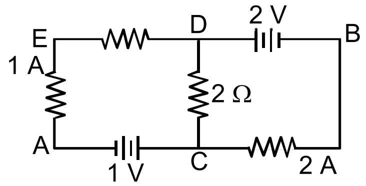
(3) 11m (4) $\frac{37}{3}$m

Ans. (4)

Sol. s = area of graph

$$=\frac{1}{2}\times 4\left(1+\frac{13}{3}\right)-\frac{1}{2}\times 2\times\frac{5}{3}=\frac{37}{3}\text{m}$$

17. In the circuit, given in the figure currents in different branches and value of one resistor are shown. Then potential at point B with respect to the point A is :



(1) +1V (2) +2V

(3) –2V (4) –1V

Ans. (1)

Sol. From KVL

$V_A + 1 + 2(1) - 2 = V_B$

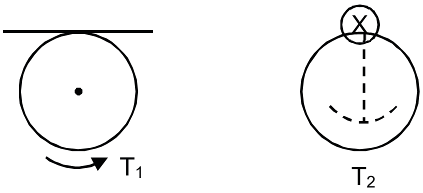
$V_B - V_A = 1$

18. A ring is hung on a nail. It can oscillate, without slipping or sliding (i) in its plane with a time period T_1 and (ii) back and forth in a direction perpendicular to its plane, with a period T_2. The ratio $\frac{T_1}{T_2}$ till be :

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

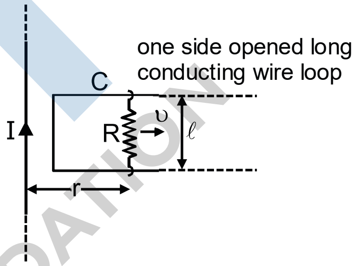
Ans. (4)

Sol.



$$\frac{T_1}{T_2}=\sqrt{\frac{T_1}{T_2}}=\sqrt{\frac{\frac{3}{2}MR^2}{2MR^2}}=\sqrt{\frac{3}{4}}$$

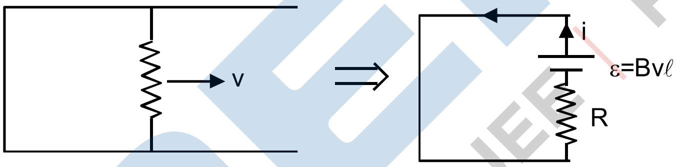
19. An infinitely long straight wire carrying current I, one side opened rectangular loop and a conductor C with a sliding connector are located in the same plane, as shown in the figure. The connector has length ℓ. and resistance R. It slides to the right with a velocity v. The resistance of the conductor and the self inductance of the loop are negligible. The induced current in the loop, as a function of separation r, between the connector and the straight wire is :



(1) $\frac{\mu_0}{\pi}\frac{I v\ell}{Rr}$ (2) $\frac{2\mu_0}{\pi}\frac{I v\ell}{Rr}$ (3) $\frac{\mu_0}{4\pi}\frac{I v\ell}{Rr}$ (4) $\frac{\mu_0}{2\pi}\frac{I v\ell}{Rr}$

Ans. (4)

Sol.



$$i=\frac{Bv\ell}{R}=\left(\frac{\mu_0 I}{2\pi r}\right)\left(\frac{v\ell}{R}\right)$$

20. Two different wires having lengths L_1 and L_2 and respective temperature coefficient of linear expansion α_1 and α_2, are joined end–to–end. then the effective temperature coefficient of linear expansion is :

(1) $\frac{\alpha_1 L_1+\alpha_2 L_2}{L_1+L_2}$ (2) $4\frac{\alpha_1\alpha_2}{\alpha_1+\alpha_2}\frac{L_1L_2}{(L_2+L_1)^2}$ (3) $2\sqrt{\alpha_1\alpha_2}$ (4) $\frac{\alpha_1+\alpha_2}{2}$

Ans. (1)

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

At t + Δt°C; $\ell_{eq}'=\ell_1'+\ell_2'$

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

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

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

SECTION – 2 : (Maximum Marks : 20)

This section contains FIVE (05) questions. The answer to each question is **NUMERICAL VALUE** with two digit integer and decimal upto one digit.

If the numerical value has more than two decimal places truncate/round-off the value upto TWO decimal places.

Full Marks : +4 If ONLY the correct option is chosen.

Zero Marks : 0 In all other cases

21. Nitrogen gas is at 300°C temperature. The temperature (in K) at which the rms speed of a H_2 molecule would be equal to the rms speed of a nitrogen molecule, is ……….(Molar mass of N_2 gas 28g).

Ans. 41

Sol. $V_{rms} = \sqrt{\frac{3RT}{M}}$

$\frac{T_2}{T_1} = \frac{M_2}{M_1}$

Putting the value T_2 = 41 K

22. A prism of angle A = 1° has a refractive index μ = 1.5. A good estimate for the minimum angle of deviation (in degrees) is close to N/10. Value of N is ……..

Ans. 5

Sol. For this prism gives minimum angle of deviation

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

$\delta = (1.5 - 1) \times 1° = \frac{1}{2} = \frac{5}{10}$

N = 5

23. The surface of a metal is illuminated alternately with photons of energies E_1 = 4eV and E_2 = 2.5 eV respectively. the ratio of maximum speeds of the photoelectrons emitted in the two cases is 2. The work function of the metal in (eV) is……….

Ans. 2

Sol. $\frac{1}{2}mv_1^2 = 4 - w \quad ...(1)$

$\frac{1}{2}mv_2^2 = 2.5 - w \quad ...(2)$

dividing and putting the value $v_1/v_2 = 2$

24. A body of mass 2kg is driven by an engine delivering a constant power of 1J/s. the body starts from rest and moves in a straight line. After 9 seconds, the body has moved a distance (in m)….

Ans. 18

Sol. P = 1 J/sec

Pt = W = ΔK

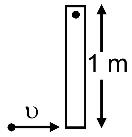
t = 1/2 m. $v^2 = v^2$

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

$\int_0^s ds = \int_0^9 \sqrt{t}\, dt$

s = 18

25. A thin rod of mass 0.9 kg and length 1m is suspended, at rest, from one end so that it can freely oscillate in the vertical plane. A particle of move 0.1 kg moving in a straight line with velocity 80 m/s hits the rod at its bottom most point and sticks to it (see figure). The angular speed (in rad/s) of the rod immediately after the collision will be ....



Ans. 20

Sol. $L_i = L_f$

$0.1 \times 80 \times 1 = \frac{0.9 \times (1)^2}{3} \times \omega$

ω = 20

PART-B : CHEMISTRY

SECTION – 1 : (Maximum Marks : 80)

Single Choice Type

This section contains 20 Single choice questions. Each question has 4 choices (1), (2), (3) and (4) for its answer, out of which Only One is correct.

Full Marks : +4 If ONLY the correct option is chosen.

Negative Marks : –1 (minus one) mark will be deducted for indicating incorrect response.

---

26. Consider the complex ions, trans–$[Co(en)_2Cl_2]^+$ (A) and cis –$[Co(en)_2Cl_2]^+$ (B). The correct statement regarding them is :

(1) can be optically active, but (B) cannot be optically active.

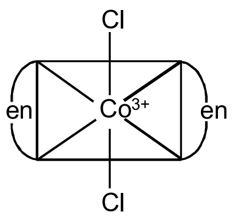
(2) Both (A) and (B) cannot be optically active.

(3) (A) cannot be optically active.

(4) both (A) and (B) can be optically active.

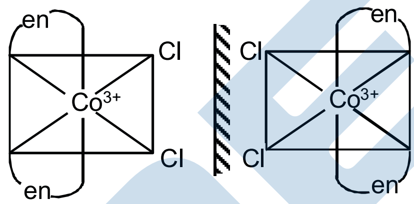
Ans. (3)

Sol.



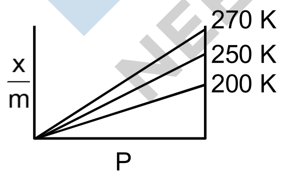
Have Plane of symmetry so will be optically inactive.

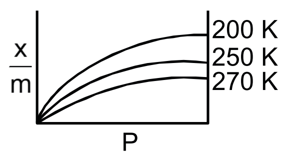
Trans-$[Co(en)_2Cl_2]^+$

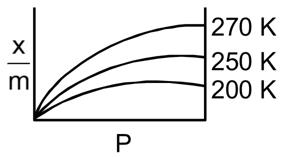


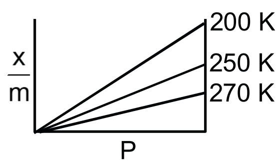
cis-$[Co(en)_2Cl_2]^+$ $\rightarrow$ is optically active without plane of symmetry.

27. Adsorption of a gas follows freudlich adsorption isotherm. If x is the mass of the gas adsorbed on mass m of the adsorbent, the correct plot of $\frac{x}{m}$ versus p is :

(1)


(2)


(3)


(4)


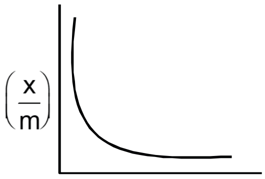
Ans. (2)

Sol. From Freundlich adsorption isotherm

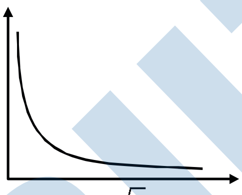
$\frac{x}{m} \propto P$ (At low pressure)

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

$\rightarrow$ On increasing temperature physical adsorption decreases.



28. The variation of molar conductively with concentration of an electrolyte (X) in aqueous solution is shown in the given figure.



The electrolyte X is :

(1) CH_3COOH (2) KNO_3 (3) HCl (4) NaCl

Ans. (1)

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

29. The compound that has the largest H–M–H bond angle (M = N, O, S, C), is :

(1) NH_3 (2) CH_4 (3) H_2S (4) H_2O

Ans. (2)

Sol.

sp^3, ℓ.p = 2, B. A. = 104°30'

$H_2S \rightarrow$ No hybridisation [Drago's rule], bond angle = 92°

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

CH_4 sp^3 ℓ.p = 0. B.A. = 109°28'

30. The correct statement about probability density (except at infinite distance from nucleus) is :

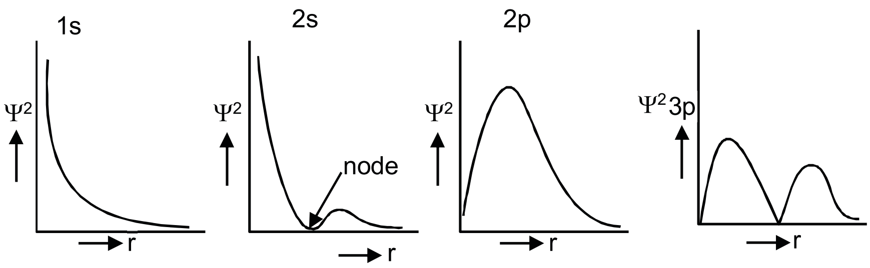
(1) It can be zero for 1s orbital (2) It can never be zero for 2s orbital

(3) It can be negative for 2p orbital (4) It can be zero for 3p orbital

Ans. (4)

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

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



31. The major product formed in the following reaction is :

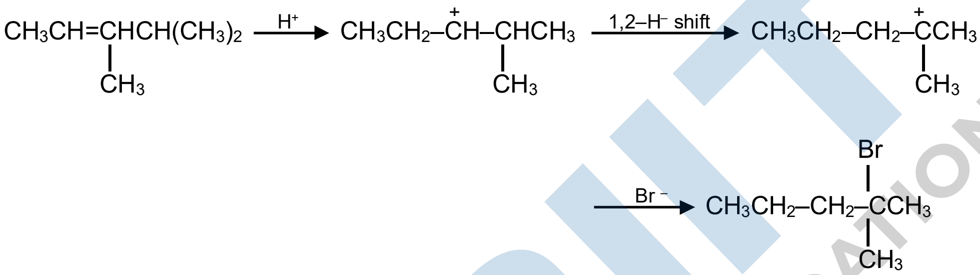
$CH_3CH = CHCH(CH_3)_2 \xrightarrow{HBr}$

(1) $CH_3CH(Br)CH_2CH(CH_3)_2$ (2) $Br(CH_2)_3CH(CH_3)_2$

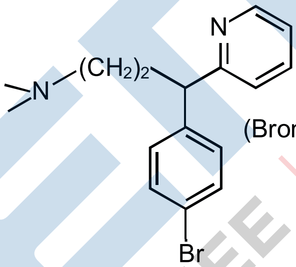
(3) $CH_3CH_2CH_2C(Br)(CH_3)_2$ (4) $CH_3CH_2CH(Br)CH(CH_3)_2$

Ans. (3)

Sol.



32. The following molecule acts as an :



(Brompheniramine)

(1) Anti–depressant (2) Antiseptic (3) Anti–histamine (4) Anti–bacterial

Ans. (3)

Sol. Synthetic drugs, brompheniramine (Dimetapp) act as antihistamines.

33. Lattice enthalpy and enthalpy of solution of NaCl are 788 kJ mol^{-1} and 4kJ mol^{-1}, respectively. The hydration enthalpy of NaCl is :

(1) –784 kJ mol^{-1} (2) –780 kJ mol^{-1} (3) 780 kJ mol^{-1} (4) 784 kJ mol^{-1}

Ans. (4)

Sol. Incorrect terminology is used in the question.

34. The correct order of the ionic radii of O^{2-}, N^{3-}, F^-, Mg^{2+}, Na^+ and Al^{3+} is :

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

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

Ans. (2)

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

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

35. Boron and silicon of very high purity can be obtained through :

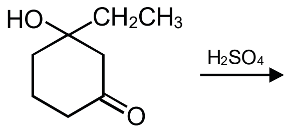
(1) liquation (2) electrolytic refining

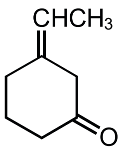
(3) zone refining (4) vapour phase refining

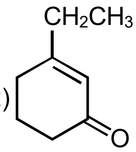
Ans. (3)

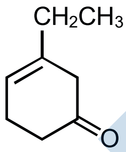
Sol. Germanium, Silicon, Boron, Gallium and Indium can be obtained in pure state by zone refining process.

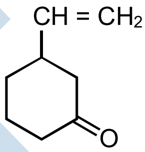
36. The major product of the following reaction is :



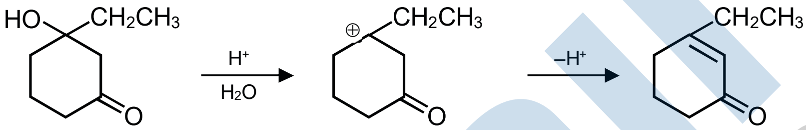
(1) 

(2) 

(3) 

(4) 

Ans. (2)

Sol. 

Conjugated enone

37. Which of the following polymers is not obtained by condensation polymerisation ?

(1) Nylon 6, 6 (2) Buna – N (3) Bakelite (4) Nylon 6

Ans. (2)

Sol. (1) $H_2N\text{–}(CH_2)_5\text{–}COOH \xrightarrow{\Delta} \text{–}NH\text{–}(CH_2)_5\text{–}\overset{\overset{O}{\|}}{C}[NH\text{–}(CH_2)_5\text{–}\overset{\overset{O}{\|}}{C}\text{–}]\text{–}$

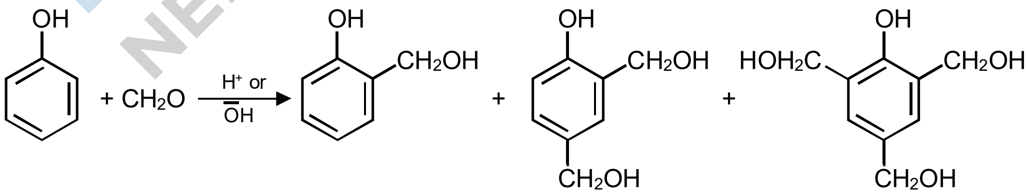
6-Aminohexanoic acid Nylon-6

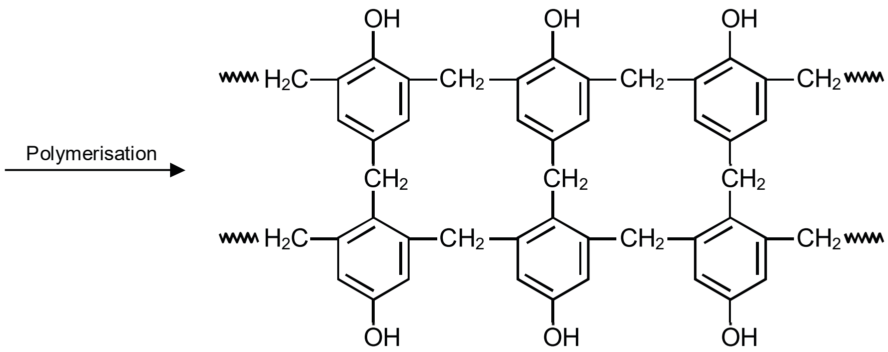
(2) $nH_2N\text{–}(CH_2)_6\text{–}NH_2 + nHOOC\text{–}(CH_2)_4\text{–}COOH \longrightarrow \text{–}[NH\text{–}(CH_2)_6\text{–}NH\text{–}CO\text{–}(CH_2)_4\text{–}CO]\text{–}$

Hexamethylene diamine Adipic acid Nylon-6, 6

(3) $nCH_2 = CH - CH = CH_2 + nCH_2 = \underset{}{\overset{\overset{CN}{|}}{CH}} \xrightarrow{\text{Copoly merisation}} \text{–}(CH_2 - CH = CH - CH_2 - CH_2 - \overset{\overset{CN}{|}}{CH})\text{–}$

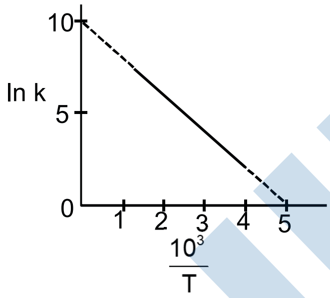
1,3 – Butadiene Acrylonitrile Buna-N

(4) 



Bakelite

38. The rate constant (k) of a reaction is measured at different temperature (T), and the data are plotted in the given figure. the activation energy of the reaction in kJ mol^{-1} is : (R is gas constant)



(1) R (2) 2R (3) 2/R (4) 1/R

Ans. (2)

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

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

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

$$\text{Slope of graph} = \frac{-E_a}{R \times 10^3} = \frac{-10}{5}$$

$E_a = 2R \times 10^3$ J

$E_a = 2R$ kJ

39. The one that is not suitable for the removal of permanent hardness of water is :

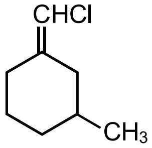
(1) Treatment with sodium carbonate (2) Ion–exchange method

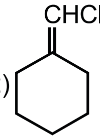
(3) Calgon's method (4) Clark's method

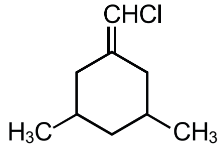
Ans. (4)

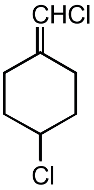
Sol. Clark's Method is used to remove temporary hardness by using lime water (or) $Ca(OH)_2$.

40. Among the following compounds, geometrical isomerism is exhibited by :

(1) 

(2) 

(3) 

(4) 

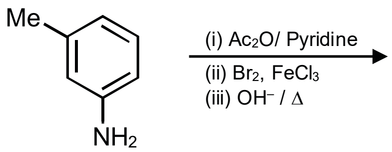
Ans. (1) {Answer should be 1 and 3 both}

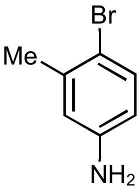
Sol. Geometrical isomerism arises due to

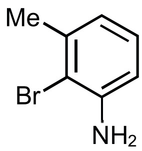
(1) The presence of a restricted rotation (double bond or a ring structure).

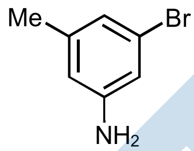
(2) Two different groups should be attached to any two carbon atoms of restricted rotation.

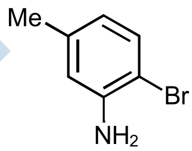
41. The final major product of the following reaction is :



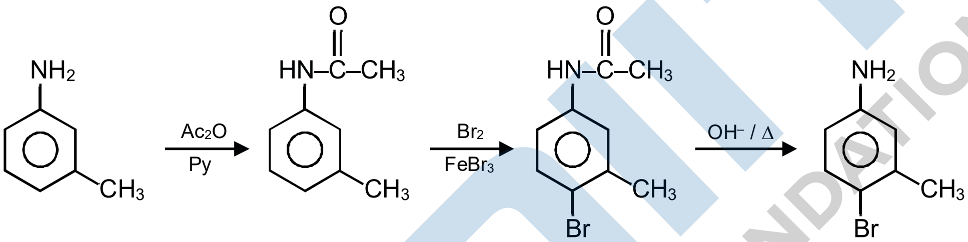
(1) 

(2) 

(3) 

(4) 

Ans. (1)

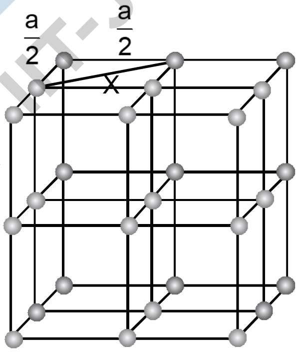
Sol. 

42. An element crystallises in a face–centred cubic (fcc) unit cell with cell edge a. The distance between the centres of two nearest octahedral voids in the crystal lattice is :

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

Ans. (1)

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



Minimum distance between centers of two octahedral voids

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

$$= \sqrt{\frac{a^2}{4} + \frac{a^2}{4}} = \frac{a}{\sqrt{2}}$$

43. Reaction of ammonia with excess Cl_2 gives :

(1) NCl_3 and NH_4Cl (2) NCl_3 and HCl (3) NH_4Cl and HCl (4) NH_4Cl and N_2

Ans. (2)

Sol. $\underset{\text{limiting}}{NH_3} + \underset{\text{excess}}{3Cl_2} \longrightarrow NCl_3 + 3HCl$

$\underset{\text{excess}}{8NH_3} + \underset{\text{limiting}}{3Cl_2} \longrightarrow 6NH_4Cl + N_2$

44. Hydrogen peroxide, in the pure state, is :

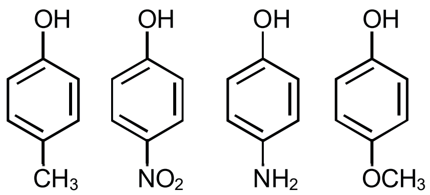
(1) Linear and almost colorless (2) Linear and blue in color

(3) non–planar and almost colorless (4) planar and blue in color

Ans. (3)

Sol. 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.

45. The increasing order of boiling points of the following compounds is :

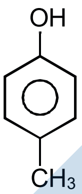


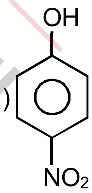
I II III IV

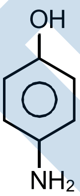
(1) I < IV < III < II (2) IV < I < II < III (3) I < III < IV < II (4) III < I < II < IV

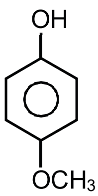
Ans. (1)

Sol. (II) and (III) compound almost have same boiling point. In the given options, (I) option will be answer.

(i)  B.P. $\rightarrow$ 202°C

(ii)  B.P. $\rightarrow$ 279°C

(iii)  B.P. $\rightarrow$ 284°C

(iv)  B.P. $\rightarrow$ 243°C

SECTION – 2 : (Maximum Marks : 20)

This section contains FIVE (05) questions. The answer to each question is **NUMERICAL VALUE** with two digit integer and decimal upto one digit.

If the numerical value has more than two decimal places truncate/round-off the value upto TWO decimal places.

Full Marks : +4 If ONLY the correct option is chosen.

Zero Marks : 0 In all other cases

---

46. The volume, in mL, of 0.02 M $K_2Cr_2O_7$ solution required to react with 0.288 g of ferrous oxalate in acidic medium is ………... (Molar mass of Fe = 56 g mol^{-1})

Ans. 100 {NTA answer is 50}

Sol. milliequivalent of $K_2Cr_2O_7$ = milliequivalent of FeC_2O_4

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

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

$V_{mL} = 100$ mL

47. For a reaction X + Y = 2Z, 1.0 mol of X, 1.5 mol of Y and 0.5 mol of Z were taken in a 1L vessel and allowed to react. At equilibrium, the concentration of Z was 1.0 mol L^{-1}. the equilibrium constant of the reaction is ……….. $\frac{x}{15}$. The value of x is …….

Ans. 16

Sol.

	x	+	y	⇌	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	+	y	⇌	2z
$t=t_{eq}$	1-a		1.5 – a		0.5 + 2a = 1 mol
					$\Rightarrow$ a = 0.25

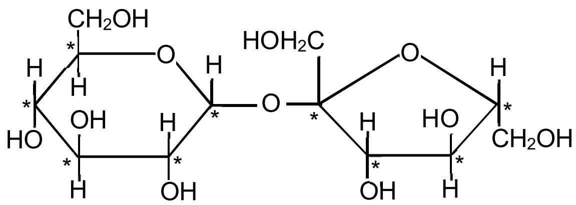
x	+	y	$\longrightarrow$	2z
0.75 mol		1.25 mol		1 mol

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

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

48. The number of chiral carbons present in sucrose is ……….

Ans. 9

Sol. 

(Sucrose)

49. Considering that $\Delta_0 > P$, the magnetic moment (in BM) of $[Ru(H_2O)_6]^{2+}$ would be ……

Ans. 0

Sol. $Ru^{2+} = 4d^6 = t_{2g}^{2,2,2}$, $eg^{0,0}$ since $\Delta_0 > P$

No. of unpaired electrons = zero

Magnetic Moment = 0

50. For a dimerization reaction,

$2\ A(g) \rightarrow A_2(g)$,

at 298 K, $\Delta U^{-} = -20 kJ\ mol^{-1}$, $\Delta S^{-} = -30\ JK^{-1}\ mol^{-1}$, then the ΔG^{-} will be …..J.

Ans. –13538

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

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

$= -22477.572\ J$

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

$= -13537.572\ J$

$= -13538\ J$

PART-C : MATHEMATICS

SECTION – 1 : (Maximum Marks : 80)

Single Choice Type

This section contains 20 Single choice questions. Each question has 4 choices (1), (2), (3) and (4) for its answer, out of which Only One is correct.

Full Marks : +4 If ONLY the correct option is chosen.

Negative Marks : –1 (minus one) mark will be deducted for indicating incorrect response.

51. If α and β are the roots of the equation, $7x^2 - 3x - 2 = 0$, then the value of $\frac{\alpha}{1-\alpha^2}+\frac{\beta}{1-\beta^2}$ is equal to :

(1) $\frac{1}{24}$ (2) $\frac{27}{32}$ (3) $\frac{27}{16}$ (4) $\frac{3}{8}$

Ans. (3)

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

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

$$\Rightarrow \frac{(\alpha+\beta)-\alpha\beta(\alpha+\beta)}{1+(\alpha\beta)^2-(\alpha+\beta)^2+2\alpha\beta}=\frac{\frac{3}{7}+\frac{2}{7}\left(\frac{3}{7}\right)}{1+\left(\frac{2}{7}\right)^2-\left(\frac{3}{7}\right)^2-2\left(\frac{2}{7}\right)}=\frac{27}{16}$$

52. The statement

$(p \to (q \to p)) \to (p \to (p \vee q))$ is :

(1) equivalent to $(p \vee q) \wedge (\sim p)$ (2) a contradiction

(3) a tautology (4) equivalent to $(p \wedge q) \vee (\sim q)$

Ans. (3)

Sol.

p	q	$q \to p$	$p \vee q$	$r : p \to (q \to p)$	$s : p \to (p \vee q)$	$r \to s$
T	T	T	T	T	T	T
T	F	T	T	T	T	T
F	T	F	T	T	T	T
F	F	T	F	T	T	T

53. If the line $y = mx + c$ is a common tangent to the hyperbola $\frac{x^2}{100}-\frac{y^2}{64}=1$ and the circle $x^2 + y^2 = 36$, then which one of the following is true ?

(1) $4c^2 = 369$ (2) $5m = 4$ (3) $c^2 = 369$ (4) $8m + 5 = 0$

Ans. (1)

Sol. $c^2 = 36(1 + m^2)$ …(1)

$c^2 = 100m^2 - 64$ …(2)

$100m^2 - 64 = 36 + 36m^2$

$64m^2 = 100$

$m^2 = \frac{100}{64}$

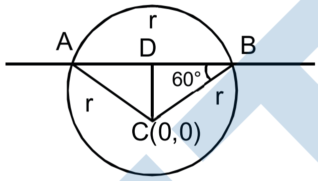
$\Rightarrow \quad c^2 = 36\left(1 + \frac{100}{64}\right) = \frac{369}{4}$

54. If the length of the chord of the circle, $x^2 + y^2 = r^2$ $(r > 0)$ along the line, $y-2x = 3$ is r, then r^2 is equal to:

(1) $\frac{9}{5}$ (2) 12 (3) $\frac{12}{5}$ (4) $\frac{24}{5}$

Ans. (3)

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



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

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

55. If x = 1 is a critical point of the function f(x) = $(3x^2 + ax - 2 - a)$ ex, then :

(1) x = 1 and $x = -\frac{2}{3}$ are local minima of f.

(2) x = 1 is a local maxima and $x = -\frac{2}{3}$ is a local minima of f.

(3) x = 1 is a local minima and $x = -\frac{2}{3}$ is a local maxima of f.

(4) x = 1 and $x = -\frac{2}{3}$ are local maxima of f.

Ans. (3)

Sol. $f(x) = (3x^2 + ax - 2 - a)e^x$

$f'(x) = (3x^2 + ax - 2 - a)e^x + e^x(6x + a) = e^x(3x^2 + (a + 6)x - 2)$

$\because$ x = 1 is a critical point $\therefore$ f'(1) = 0

$\therefore 3 + a + 6 - 2 = 0$

$a = -7$

$\therefore f'(x) = e^x(3x^2 - x - 2) = e^x(3x^2 - 3x + 2x - 2) = e^x(3x + 2)(x - 1)$

$\therefore$ maxima at x = –2/3 $\therefore$ minima at x = 1

56. The derivative of $\tan^{-1}\left(\frac{\sqrt{1+x^2}-1}{x}\right)$ with respect to $\tan^{-1}\left(\frac{2x\sqrt{1-x^2}}{1-2x^2}\right)$ at $x = \frac{1}{2}$ is:

(1) $\frac{\sqrt{3}}{10}$ (2) $\frac{\sqrt{3}}{12}$ (3) $\frac{2\sqrt{3}}{5}$ (4) $\frac{2\sqrt{3}}{3}$

Ans. (1)

Sol. Let x = tanθ

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

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

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

$$= \frac{\sqrt{1-x^2}}{4(1+x^2)} = \frac{\sqrt{1-\frac{1}{4}}}{4\left(1+\frac{1}{4}\right)} = \frac{\sqrt{3}}{10}$$

57. If the sum of the second, third and fourth terms of a positive term G.P. is 3 and the sum of its sixth, seventh and eighth terms is 243, then the sum of the first 50 terms of this G.P. is :

(1) $\frac{2}{13}(3^{50}-1)$ (2) $\frac{1}{26}(3^{49}-1)$ (3) $\frac{1}{13}(3^{50}-1)$ (4) $\frac{1}{26}(3^{50}-1)$

Ans. (4)

Sol. Let a, ar, ar^2,…….G.P.

$T_2 + T_3 + T_4 = 3 \quad \Rightarrow \quad ar(1 + r + r^2) = 3 \quad$ …..(i)

$T_6 + T_7 + T_8 = 243 \quad \Rightarrow \quad ar^5(1 + r + r^2) = 243 \quad$ …..(ii)

by (i) and (ii)

$r^4 = 81 \Rightarrow r = 3$

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

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

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

(1) $x^2 - 20x + 18 = 0$ (2) $2x^2 - 20x + 19 = 0$

(3) $x^2 - 10x + 19 = 0$ (4) $x^2 - 10x + 18 = 0$

Ans. (3)

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

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

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

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

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

59. If $\int \frac{\cos\theta}{5+7\sin\theta-2\cos^2\theta}d\theta = A\log_e|B(\theta)|+C$, where C is a constant of integration, then $\frac{B(\theta)}{A}$ can be:

(1) $\frac{2\sin\theta+1}{5(\sin\theta+3)}$ (2) $\frac{5(2\sin\theta+1)}{\sin\theta+3}$ (3) $\frac{2\sin\theta+1}{\sin\theta+3}$ (4) $\frac{5(\sin\theta+3)}{2\sin\theta+1}$

Ans. (2)

Sol. $I = \int \frac{\cos\theta}{2\sin^2\theta+7\sin\theta+3}d\theta$

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

$$= \frac{1}{2}\int \frac{1}{t^2+\frac{7}{2}t+\frac{3}{2}}dt = \frac{1}{2}\int \frac{1}{\left(t+\frac{7}{4}\right)^2-\left(\frac{5}{4}\right)^2}dt = \frac{1}{5}\ln\left|\frac{2t+1}{t+3}\right|+c = \frac{1}{5}\ln\left|\frac{2\sin\theta+1}{\sin\theta+3}\right|+c$$

so $A = \frac{1}{5}$

$B(\theta) = \frac{5(2\sin\theta+1)}{\sin\theta+3}$

60. The value of $\left(\frac{-1+i\sqrt{3}}{1-i}\right)^{30}$ is :

(1) 6^5 (2) $2^{15}\,i$ (3) -2^{15} (4) $-2^{15}\,i$

Ans. (4)

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

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

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

61. $\lim\limits_{x\to 0}\frac{\left(e^{(\sqrt{1+x^2+x^4}-1)/x}-1\right)}{\sqrt{1+x^2+x^4}-1}$

(1) does not exist (2) is equal to 1 (3) is equal to e (4) is equal to 0

Ans. (2)

Sol. $$\lim_{x\to 0}\frac{\left(e^{\frac{\sqrt{1+x^2+x^4}-1}{x}}-1\right)}{\left(\frac{\sqrt{1+x^2+x^4}-1}{x}\right)}$$

put $\frac{\sqrt{1+x^2+x^4}-1}{x} = t$

clearly $x\to 0 \Rightarrow t\to 0$

$\therefore$ given limit $= \lim\limits_{t\to 0}\dfrac{e^t - 1}{t} = 1$

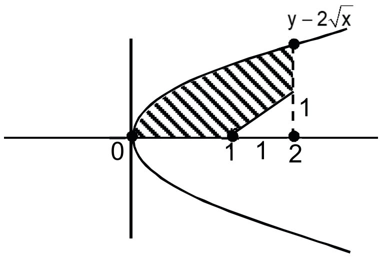
62. The area (in sq. units) of the region A = {x, y) : (x – 1) [x] ≤ y ≤ 2 x , 0 ≤ x ≤ 2}, where [t] denotes the greatest integer function, is :

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

Ans. (4)

Sol. y = [x] (x – 1)

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



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

63. If the system of linear equations

x + y + 3z = 0

x + 3y + k²z = 0

3x + y + 3z = 0

has a non–zero solution (x, y, z) for some

$k \in R$, then $x + \left(\frac{y}{z}\right)$ is equal to :

(1) –9 (2) –3 (3) 9 (4) 3

Ans. (2)

Sol. So $D = 0 \rightarrow \begin{vmatrix} 1 & 1 & 3 \\ 1 & 3 & k^2 \\ 3 & 1 & 3 \end{vmatrix} = 0 \quad \Rightarrow \quad k^2 = 9$

x + y + 3z = 0 .....(1)

x + 3y + 9z = 0 .....(2)

3x + y + 3z = 0 .....(3)

(1) – (3)

x = 0 $\Rightarrow$ y + 3z = 0

$\frac{y}{z} = -3$

so $x + \left(\frac{y}{z}\right) = -3$

64. If $L = \sin^2\left(\frac{\pi}{16}\right) - \sin^2\left(\frac{\pi}{8}\right)$ and

$M = \cos^2\left(\frac{\pi}{16}\right) - \sin^2\left(\frac{\pi}{8}\right)$

(1) $M = \frac{1}{4\sqrt{2}} + \frac{1}{4}\cos\frac{\pi}{8}$

(2) $M = \frac{1}{2\sqrt{2}} + \frac{1}{2}\cos\frac{\pi}{8}$

(3) $L = \frac{1}{2\sqrt{2}} + \frac{1}{2}\cos\frac{\pi}{8}$

(4) $L = \frac{1}{4\sqrt{2}} - \frac{1}{4}\cos\frac{\pi}{8}$

Ans. (2)

Sol. $L = \sin\left(\frac{\pi}{16} + \frac{\pi}{8}\right)\sin\left(\frac{\pi}{16} - \frac{\pi}{8}\right)$

$\sin\frac{3\pi}{16}.\sin\left(-\frac{\pi}{16}\right)$

$= \frac{1}{2}\left(\cos\left(\frac{3\pi}{16} + \frac{\pi}{16}\right) - \cos\left(\frac{3\pi}{16} - \frac{\pi}{16}\right)\right) = \frac{1}{2}\left(\frac{1}{\sqrt{2}} - \cos\frac{\pi}{8}\right)$

$M = \cos\left(\frac{\pi}{16} + \frac{\pi}{8}\right)\cos\left(\frac{\pi}{16} - \frac{\pi}{8}\right)$

$\cos\frac{3\pi}{16}.\cos\left(-\frac{\pi}{16}\right)$

$= \frac{1}{2}\left(\cos\left(\frac{3\pi}{16} + \frac{\pi}{16}\right) + \cos\left(\frac{3\pi}{16} - \frac{\pi}{16}\right)\right) = \frac{1}{2}\left(\frac{1}{\sqrt{2}} + \cos\frac{\pi}{8}\right)$

65. If for some $\alpha \in R$, the lines

$L_1 : \frac{x+1}{2} = \frac{y-2}{-1} = \frac{z-1}{1}$ and

$L_2 : \frac{x+2}{\alpha} = \frac{y+1}{5-\alpha} = \frac{z+1}{1}$ are coplanar, then the line L_2 passes through the point :

(1) (2, –10, –2)
(2) (10, 2, 2)
(3) (–2, 10, 2)
(4) (10, –2, –2)

Ans. (1)

Sol. Lines are coplanar

so $\begin{vmatrix} \alpha & 5-\alpha & 1 \\ 2 & -1 & 1 \\ +1 & +3 & 2 \end{vmatrix} =$

$-5\alpha + (\alpha - 5)3 + 7 = 0$

$-2\alpha = 8 \Rightarrow \alpha = -4$

$\Rightarrow L_2 : \frac{x+2}{-4} = \frac{y+1}{9} = \frac{z+1}{1}$

Now by cross checking option (1) is correct.

66. If a + x = b + y = c + z + 1, where a, b, c, x, y, z are non–zero distinct real numbers,

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

(1) y (a – b) (2) 0 (3) y(b – a) (4) y(a – c)

Ans. (1)

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

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

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

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

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

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

67. Let y = y(x) be the solution of the differential equation

$\cos x\frac{dy}{dx} + 2y\sin x = \sin 2x, x \in \left(0, \frac{\pi}{2}\right)$

If y(π/3) =0, then y(π/4) is equal to :

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

Ans. (3)

Sol. $\frac{dy}{dx} + 2\tan x.y = 2\sin x$

$I.F. = e^{\int 2\tan x dx} = \sec^2 x$

solution is

$y.\sec^2 x = \int 2\sin x.\sec^2 x dx + c$

$y \sec^2 x = 2\sec x + C$

$0 = 2.2 + c \Rightarrow c = -4$

$y\sec^2 x = 2\sec x - 4$

$y\left(\frac{\pi}{4}\right) = \sqrt{2} - 2$

68. There are 3 sections in a question paper and each section contains 5 questions. A candidate has to answer a total of 5 questions, choosing at least one question from each section. Then the number of ways, in which the candidate can choose the questions, is :

(1) 3000 (2) 2250 (3) 2255 (4) 1500

Ans. (2)

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

$A_1A_2A_3\ B_1C_1 \Rightarrow 3C_1 \times 5C_3 \times 5C_1 \times 5C_1 = 750$

$A_1A_2B_1B_2C_1 \Rightarrow 3C_2 \times 5C_2 \times 5C_2 \times 5C_1 = 1500$

$\therefore$ total = 2250

69. If the sum of the first 20 terms of the series log $\log_{(7^{1/2})} x + \log_{(7^{1/3})} x + \log_{(7^{1/4})} x + ...$ is 460, then x is equal to :

(1) e^2 (2) $7^{46/21}$ (3) 7^2 (4) $7^{1/2}$

Ans. (3)

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

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

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

$\Rightarrow$ $\log_7 x = 2$

$\Rightarrow$ $x = 49$

70. Which of the following points lies on the tangent to the curve $x^4e^y + 2\sqrt{y+1} = 3$ at the point (1, 0) ?

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

Ans. (3)

Sol. $e^y y^1 x^4 + 4x^3 e^y + 2y' \frac{1}{2\sqrt{y+1}} = 0$

at (1, 0)

$y' + 4 + y' = 0 \quad \Rightarrow \quad y' = -2$

equation of tangent at (1, 0) is $2x + y - 2 = 0$

so option (3) is correct

SECTION – 2 : (Maximum Marks : 20)

This section contains FIVE (05) questions. The answer to each question is **NUMERICAL VALUE** with two digit integer and decimal upto one digit.

If the numerical value has more than two decimal places truncate/round-off the value upto TWO decimal places.

Full Marks : +4 If ONLY the correct option is chosen.

Zero Marks : 0 In all other cases

---

71. In a bombing attack, there is 50% chance that a bomb will hit the target. At least two independent hits are required to destroy the target completely. then the minimum number of bombs, that must be dropped to ensure that there is at least 99% chance of completely destroying the target, is …..

Ans. 11

Sol. let probability of hitting the target = p $\Rightarrow$ $p = \frac{1}{2}$

Let n be the minimum number of bombs

According to given condition

$$1-({}^nC_0P^0(1-P)^n + {}^nC_1P^1(1-P)^{n-1}) \geq \frac{99}{100}$$

$\Rightarrow$ $2^n \geq (n + 1)100$

n = 10 $\Rightarrow$ $2^{10} \geq 1100$ Reject

n = 11 $\Rightarrow$ $2^{11} \geq 1200$ Select

72. Let the vectors $\vec{a}, \vec{b}, \vec{c}$ be such that $|\vec{a}| = 2, |\vec{b}| = 4$ and $|\vec{c}| = 4$. If the projection of $\vec{b}$ on $\vec{a}$ is equal to the projection of $\vec{c}$ on $\vec{a}$ and $\vec{b}$ is perpendicular to $\vec{c}$, then the value of $|\vec{a}+\vec{b}-\vec{c}|$ is …….

Ans. 6

Sol. $\vec{b}.\vec{a} = \vec{c}.\vec{a}$

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

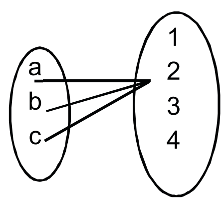
$$= 4 + 16 + 16 + 2(\vec{a}.\vec{b} - 0 - \vec{a}.\vec{c}) = 36$$

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

73. Let A = {a, b, c} and B = {1, 2, 3, 4}. Then the number of elements in the set C = {f : A $\rightarrow$ B | 2 $\in$ f(A) and f is not one–one } is ….

Ans. 19

Sol. only '2' in range $\rightarrow$ 1 function



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

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

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

Total function = 1 + 18 = 19

74. If the lines x + y = a and x – y = b touch the curve $y = x^2 - 3x + 2$ at the points where the curve intersects the x–axis, then $\frac{a}{b}$ is equal to ....

Ans. 0.5

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

$2x_1 - 0 = 3\ 1$ $2x_2 - 3 = -1$

$x_1 = 2$ $x_2 = 1$

$x_1 = 4 - 6 + 2 = 0$ $x_2 = 0$

(2,0) (1,0)

b = 2 a = 1

$\therefore \frac{a}{b} = \frac{1}{2} = 0.5$

75. The coefficient of x^4 in the expansion of $(1 + x + x^2 + x^3)^6$ in powers of x, is .....

Ans. 49

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

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

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

$\Rightarrow$ $\log_7 x = 2$

$\Rightarrow$ $x = 49$