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JEE (MAIN) 2025

MEMORY BASED QUESTIONS & TEXT SOLUTION

SHIFT-2

DATE & DAY: 03nd April 2025 & Thursday

PAPER-1

Duration: 3 Hrs.
Time: 03:00 PM – 06:00 PM

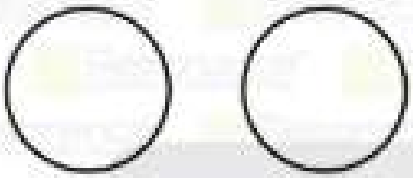
SUBJECT: PHYSICS

PART : PHYSICS

1. Excess pressure inside bubble A is half of that of bubble B. find ratio of volume of bubble A to bubble B.
(1) 8 (2) 4 (3) 27 (4) 16

Ans. (1)

Sol.



Bubble A B

we know that $\Delta P = \frac{4S}{r}$ $\therefore \Delta P_A = \frac{\Delta P_B}{2}$

$r_A = 2r_B$

$\frac{V_A}{V_B} = 8$

2. The ratio of intensities of two coherent is 1 : 9. The ratio of the maximum to the minimum intensities is
(1) 9 : 1 (2) 16 : 1 (3) 8 : 1 (4) 4 : 1

Ans. (4)

Sol. $\frac{I_{max}}{I_{min}} = \frac{\left(\sqrt{I_1}+\sqrt{I_2}\right)^2}{\left(\sqrt{I_1}-\sqrt{I_2}\right)^2} = \frac{(1+3)^2}{(1-3)^2} = \frac{16}{4}$

$\frac{I_{max}}{I_{min}} = \frac{4}{1}$

3. A magnetic dipole experience a torque of $80\sqrt{3}$ Nm when placed in uniform magnetic field in such a way that dipole moment makes an angle of 60° with magnetic field. The potential energy of the dipole is ?
(1) 80 J (2) 40 (3) –70 (4) – 80 J

Ans. (4)

Sol. Given

$\vec{\tau} = \vec{M} \times \vec{B}$

$\tau = MB\sin\theta = 80\sqrt{3}$ ...(1)

$U = -\vec{M}\vec{B}$

$U = -MB\cos\theta$

$U = -\frac{MB\sin\theta}{\sin\theta}\cos\theta$

$U = -\frac{80\sqrt{3}}{\sin\theta}\cos\theta$

$U = -\frac{80\sqrt{3}}{\tan\theta}$

$U = -\frac{80\sqrt{3}}{\tan 60^\circ}$, $U = -\frac{80\sqrt{3}}{\sqrt{3}}$

$U = -80$ J

4. Math the coloum

A	B
(a) Boltzmann's constant	(i) $ML^2T^{-2}K^{-1}$
(b) coeticient of viscosity	(ii) $ML^{-1}T^{-1}$
(c) plank constant	(iii) ML^2T^{-1}
(d) Thermal Conductivity	(iv) $MLT^{-3}K^{-1}$

(1) a(i), b(ii), c(iii), d(iv) (2) a(ii), b(i), c(iii) d(iv) (3) a(iii), b(ii), c(ii) d(iv) (4) a(i), b(iii), c(ii), d(iv)

Ans. (1)

Sol. (a) $PV = NKJ$

$$K = \frac{ML^2T^{-2}}{K} = ML^2T^{-2}K^{-1}$$

(b) $F = 6\pi\eta rv$

$$\eta = \frac{MLT^{-2}}{LLT^{-1}} = ML^{-1}T^{-1}$$

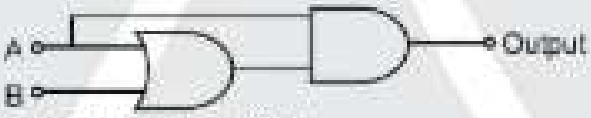
(c) $E = h\nu$

$$h = \frac{ML^2T^{-2}}{T^{-1}} = ML^2T^{-1}$$

(d) $H = KA\frac{\Delta\theta}{\ell}$

$K = MLT^{-3}K^{-1}$

5. Semiconductor



The correct truth table for the given circuit will be :-

(1)

A	B	output
0	0	0
0	1	1
1	0	0
1	1	0

(2)

A	B	output
0	0	0
0	1	0
1	0	1
1	1	1

(3)

A	B	output
0	0	1
0	1	1
1	0	0
1	1	0

(4)

A	B	output
0	0	0
0	1	0
1	0	0
1	1	1

Ans. (2)

Sol.

Output = A.(A + B)
= A.A + A.B
= A + A.B
= A(1 + B) = A.1
= A

The correct truth table will be :

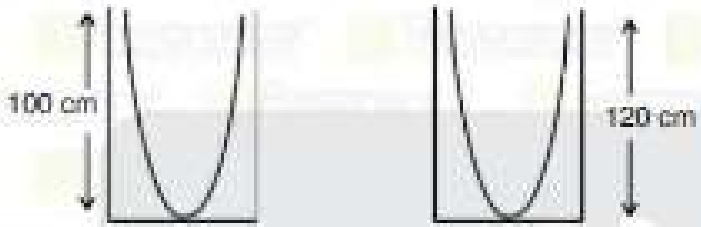
A	B	output
0	0	0
0	1	0
1	0	1
1	1	1

6. In the resonance experiment, two air column's closed at one end of 100 cm and 120 cm along, given 15 beats per second when each one is sounding in the respective fundamental nodes. The velocity of sound in the air column is

(1) 320 m/s (2) 340 m/s (3) 360 m/s (4) 380 m/s

Ans. (3)

Sol.



$$f_1 = \frac{V}{4L_1} \qquad f_2 = \frac{V}{4L_2}$$

$$f_1 - f_2 = 15$$

$$\frac{V}{4L_1} - \frac{V}{4L_2} = 15$$

$$\frac{V}{4}\left[\frac{1}{L_1} - \frac{1}{L_2}\right] = 15$$

$$V\left[\frac{1}{1} - \frac{1}{1.2}\right] = 60$$

$$V = \frac{0.2}{1.2} = 60$$

$V = 360$ m/sec

7. In a medium of refractive index 2 the frequency of light is 5×10^{14} Hz, the wavelength of the light is:

(1) 200 nm (2) 300 nm (3) 500 nm (4) 600 nm

Ans. (2)

Sol. $V = u\lambda$

$$\lambda = \frac{V}{u}$$

$$\lambda = \frac{c}{\mu u} = \frac{3\times10^8}{2\times5\times10^{14}}$$

$$\lambda = \frac{3}{10} \times \frac{10^8}{10^{14}}$$

$\lambda = 3 \times 10^{-7}$

$\lambda = 300$ nm.

8. If range is three times of maximum height than range will be $R = \frac{u^2}{25g} \times K$, value of K will be

(1) 12 (2) 24 (3) 36 (4) 40

Ans. (2)

Sol. $R = 3H$

$$\frac{H}{R} = \frac{\tan\theta}{4} = \frac{1}{3} \Rightarrow \tan\theta = \frac{4}{3}$$

$$R = \frac{u^2 \times 2\sin\theta\cos\theta}{g} = \frac{2}{g}u^2 \times \frac{4}{5} \times \frac{3}{5}$$

$K = 24$

9.

$K = 3000$, find maximum compression in spring.

(1) 0.4 cm (2) 0.2 cm (3) 0.1 cm (4) 0.6 cm

Ans. **(3)**

Sol. $\frac{1}{2}Kx^2 = \frac{1}{2}\mu u_{rel}^2$

$$3000x^2 = \frac{10 \times 5}{15} \times 3$$

$$x = \frac{1}{10}m = 0.1\ cm$$

10. $z = \frac{pq^2}{r^3\sqrt{s}}$ If percentage error are respectively p,q,r and s are 1,2,3 and 2. Find percentage error in z.

(1) 10% (2) 15% (3) 9% (4) 4%

Ans. **(2)**

Sol. $\%s = \%p + 2(\%q) + 3(\%\ r) + \frac{1}{2}(\%s)$

$$= 1 + 2 \times 2 + 3 \times 3 + \frac{1}{2} \times 2$$

$= 15\%.$

11. Displacement $(x) = \alpha(t^2 - 2) + c(t-2)^2$ initial velocity and acceleration will be :

(1) $V = +ve$ (2) $a = 2\alpha + 2c$ (3) $a = 2\alpha$ (4) $V = c$

Ans. **(2)**

Sol. $V = \alpha \times 2t + c \times 2(t-2)$

$t = 0$

$V = -4c$

$a = 2\alpha + 2c$

12. The ratio of width of the slits is 4 : 1 in YDSE, then the ratio of $\frac{(I_{max})_{max}}{(I_{min})_{min}}$ will be :-

(1) $\frac{3}{1}$ (2) $\frac{9}{1}$ (3) $\frac{6}{1}$ (4) $\frac{16}{1}$ b

Ans. **(2)**

Sol. $I_1 = 4I \Rightarrow A_1 = 2A$

$I_2 = I \Rightarrow A_2 = A$

$$\frac{(A_{eq})_{max}}{(A_{eq})_{min}} = \frac{2A + A}{2A - A} = \frac{3}{1}$$

$$\frac{(I_{eq})_{max}}{(I_{eq})_{min}} = \left(\frac{3}{1}\right)^2 = \frac{9}{1}$$

13. A bulb rated 100 W, 220 V connected to an ac supply of 220 V. Find peak current in the bulb

(1) 8 A (2) 0.64 A (3) 3.2 A (4) 2 A

Ans. (2)

Sol. $P = V_{rms} I_{rms}$

$100 = 220\, I$

$$I = \frac{10}{22} = \frac{5}{11} A$$

$$I_{rms} = \frac{I_0}{\sqrt{2}}$$

$I_0 = \sqrt{2}\, I_{rms}$

$$I_0 = \sqrt{2} \cdot \frac{5}{11}$$

$I_0 = 0.64$ A

14. A block of mass 1 kg, moving along x-axis with speed $v_i = 10$ m/s enters a rough region ranging from $x = 0.1$ m to $x = 1.9$ m. The retarding force acting on the block in this range is $F_r = -kx$ N, with $K = 10$ N/m. Then the final speed of the block as it crosses rough region is

(1) 8 m/s (2) 6 m/s (3) 10 m/s (4) 4 m/s

Ans. (1)

Sol. $m = 1$ kg

$F = -kx$

$F = -10x$

$ma = -10x$

$a = -10x$

$a = -10x$

$$\frac{vdv}{dx} = -10x$$

$$\int_{10}^{v} vdv = \int_{0.1}^{1.9} -10x dx$$

$$\left[\frac{v^2}{2}\right]_{10}^{v} = -10\left[\frac{x^2}{2}\right]_{0.1}^{1.9}$$

$v^2 - 100 = -10[1.9^2 - 0.1^2]$

$v^2 = 64$

$v = 8$ m/s

15. A capacitor of capacitance 100 PF is charged with a battery of voltage 60 volt. It is disconnected to the battery and it is connected with a second capacitor which is initially uncharged. If the final potential on the second capacitor is 20 volt, then the capacitance of the second capacitor will be :-

(1) 100 PF (2) 200 PF (3) 300 PF (4) 50 PF

Ans. **(2)**

Sol. $V_c = \frac{C_1V_1 + C_2V_2}{C_1 + C_2}$

$20 = \frac{(100P)(60) + (C_2)(0)}{(100P) + C_2} \Rightarrow 20 \times 100 + 20 \quad C_2 = 6000 \Rightarrow C_2 = 200$

16. The pressure of an ideal gas is increased by 0.4% keeping the volume constant. Find the initial temperature of the gas if there is a 1°C rise in temperature:

(1) 250 k (2) 25°C (3) 2500 k (4) 2500°C

Ans. **(1)**

Sol. $Pv = nRT$

$P = \frac{nR}{V}T$

$P = kT$

$\frac{\Delta P}{P} = \frac{\Delta T}{T}$

$\Delta P = \frac{\Delta T}{T} \times 100$

$\frac{0.4}{100} = \frac{1}{T}k$

$T = \frac{100}{0.4}$

$T = 250$ k.

17. **Statement-1:** ion O^{-2} and H^+, projected perpendicular to uniform magnetic field with same momentum than radius of curvature of path O^{-2} is less than H^+.

Statement-2: Proton and electron projected perpendicular to uniform magnetic field with same momentum than radius of curvature of path proton is less than electron.

(1) Statement-1 is True, Statement-2 is True

(2) Statement-1 is True, Statement-2 is False

(3) Statement-1 is False, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True

Ans. **(2)**

Sol. $r = \frac{mv}{qB} \Rightarrow r \propto \frac{1}{q}$

$q_1 > q_2 \Rightarrow R_1 < R_2$

Statement-1 is true. **Ans.**

Statement-2 is false $q_1 = q_2 \Rightarrow R_1 = R_2$.

18. Two battery ($r_1 = 2\Omega$, V_1 1V) and ($r_2 = 1\Omega$, $V_2 = 2V$) are connected with external resistance (K = 6), first in series combination (i_1), second in parallel combination (i_2), if $\frac{i_1}{i_2} = \frac{x}{3}$ $\Rightarrow$ value of x will be.

Ans. **04.00**

Sol. (a) series $E_{eq} = 3$

$r_{eq} = 3$

$$i_1 = \frac{e_q}{r_{eq}+R} = \frac{3}{3+6} = \frac{1}{3}A$$

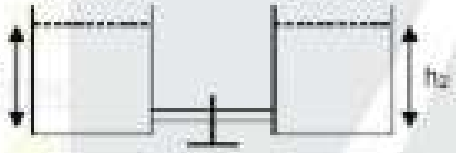
(b) parallel $e_{eq} = \frac{1\times1+2\times2}{3} = \frac{5}{3}$

$r_{eq} = \frac{2}{3}$

$$i_2 = \frac{5/3}{\frac{2}{3}+6} = \frac{5\times3}{3\times(2+18)} = \frac{1}{4}$$

$$\frac{i_1}{i_2} = \frac{1\times4}{3\times1} = \frac{x}{3} \Rightarrow x = 4$$

19.



$A_1 = A_2 = 2$

$h_1 = 6$

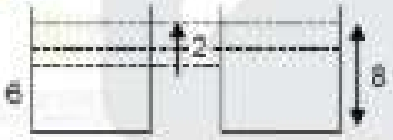
$h_2 = 8$

work done by gravity when level of water become same.

(1) 10^4 J (2) 3×10^4 J (3) 2×10^4 J (4) 5×10^4 J

Ans. **(3)**

Sol.



$W = mgh$

$m = \rho \times v$

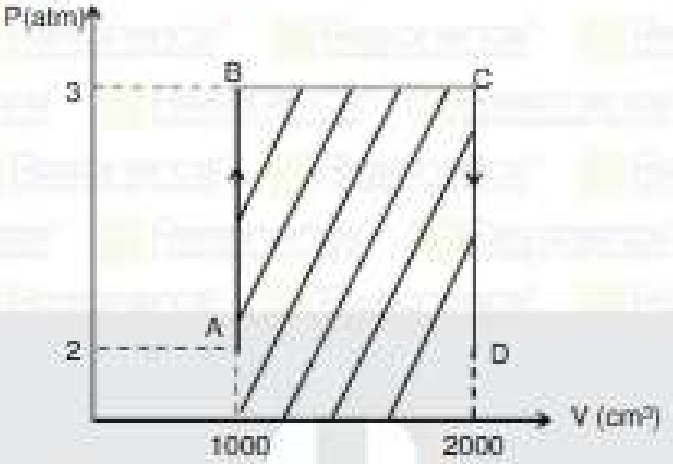
$= 10^3 \times 2 \times 1$

$h = 1$

$W = 2 \times 10^3 \times 1 \times 10$

$W = 2 \times 10^4$ J **Ans.**

20. Find out magnitude of work done in the process ABCD (in KJ) (1 atm. Lit = 101.3 J)



(1) 0.1 (2) 0.2 (3) 0.3 (4) 0.4

Ans. **(3)**

Sol. Work done = Area under the curve = $W_{AB} + W_{BC} + W_{CD}$

$W_{AB} = 0 = W_{CD}$, $W_{BC} = 3 \times 1000 \times 10^{-6} \times 10^5 = 0.3 \times 10^3$ J = 0.3 KJ

21. **Bohr modal**

Statement-1 : Bohr's modal applicable only for H-like species

Statement-2 : It is due to electron-repulsion effect

(1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(2) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(3) Statement-1 is True, Statement-2 is False
(4) Statement-1 is False, Statement-2 is True

Ans. **(1)**

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PAPER-1

Duration: 3 Hrs.
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SUBJ ECT: CHEMISTRY

REGISTERED & CORPORATE OFFICE (CIN: U80302RJ2007PLC024029):
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PART : CHEMISTRY

1. Amongs the following select the compounds which acts as primary standard:

(I) $FeSO_4.7H_2O$

(II) $K_2Cr_2O_7$

(III) $Na_2B_4O_7.10H_2O$

(IV) NaOH

(V) $KMnO_4$

(1) II, III (2) I, IV, V (3) II, IV (4) I, II, III

Ans. **(1)**

Sol. Theory based

2. Match the following family with corresponding element:

Column-I	**Column-II**
(A) Chalcogen family	(i) Ts
(B) Noble gas	(ii) Lv
(C) Halogen family	(iii) Mc
(D) Pinctogen family	(iv) Og

Correct answer is :

(1) A → (ii), B → (iv), C → (i), D → (iii) (2) A → (i), B → (ii), C → (iii), D → (iv)

(3) A → (ii), B → (iv), C → (iii), D → (i) (4) A → (iii), B → (i), C → (iv), D → (ii)

Ans. **(1)**

Sol. Theory based

3. Amongs Sc, Mn, Co & Cu element showing highest enthalpy of atomisation have in +2 oxidation state spin only magnetic moment value :

(1) $\sqrt{3}$ BM (2) $\sqrt{8}$ BM (3) $\sqrt{15}$ BM (4) $\sqrt{24}$ BM

Ans. **(3)**

Sol. $_{27}Co^{+2}$: $[Ar]3d^7$ {n = 3}

$\sqrt{15}$ BM

4. $Mg + HCl \longrightarrow$

In this reaction to obtain 220 mL of H_2 at NTP, determine mass of Mg used (Mg =24) :

(1) 0.235 g (2) 235 g (3) 0.112 g (4) 112 g

Ans. **(1)**

Sol. $Mg + 2HCl \longrightarrow MgCl_2 + H_2$

$\frac{220}{22400}$ mol $\frac{220}{22400}$ mol

Mass of Mg $\frac{220}{22400} \times 24 = 0.235$ g

5. For Arrhenious equation $K = Ae^{\frac{-Ea}{RT}}$ which of the following statement is correct for a particular temperature range.

(a) Both E_a and A are temperature dependent

(b) At certain temperature if E_a is reduced reaction become fast

(c) E_a depends on temperature and A independent of temperature

(d) Both E_a and A are independent of temperature

(1) a, b only (2) b, c only (3) b, d only (4) a only

Ans. **(3)**

Sol. For a particular temperature range both E_a and A remain constant.

6. Select correct option for B family elements:

(I) r : B < Al < Ga < In < Tl

(II) IE : B > Tl > Ga > Al > In

(III) d : B < Al < Ga < In < Tl

(IV) EN : B > Al > Ga > In > Tl

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

Ans. **(1)**

Sol. Theory Based

7. 0.4 gram of organic compound is heated with CuO in a CO_2 atmosphere at 300 K, the volume of N_2 gas collected over H_2O, is 60 ml. If aqueous tension is 15 mm of Hg at 300 K and pressure recorded is 715 mm of Hg then percentage of nitrogen in organic compound is _____ [nearest integer]

Ans. **(16)**

Sol. Pressure of $N_2(g)$ =(715 –15) =700 mg of Hg

$$n_{N_2} = \frac{PV}{RT} = \frac{700}{760} \times \frac{60 \times 10^{-3}}{0.0821 \times 300}$$

$$= 2.24 \times 10^{-3} \text{ mole}$$

Mass of N_2 =$(2.24 \times 10^{-3} \times 28)$ gram

$$\% \text{ of } N_2 = \left(\frac{0.06272}{0.4}\right) \times 100 = 15.68$$

8. Cotton takes more times to dry than nylon because of

(1) H-bonding in cotton

(2) absence of H-bonding in cotton

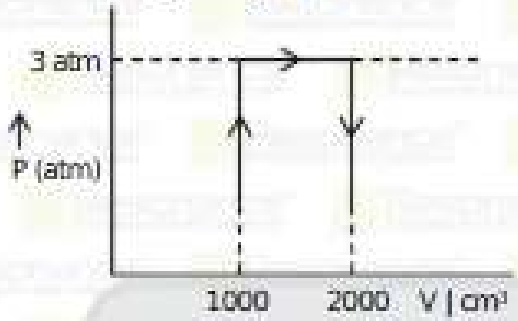
(3) absence of H-bonding in cotton and it's hydrophobic nature

(4) hydrophobic nature of cotton

Ans. **(1)**

Sol. Theory based

9. Form following P – V graph



Total magnitude of work done is _____ J (Nearest integer]
(Take 1 atm x lit =100 J)

Ans. 300

Sol. $W = -P\Delta V$
$= -3 \times 1000 \times 10^{-3}$
$= -3$ atom $\times$ lit
$= -300$ J

10. Amongs the following select the spece which is diamagnetic and octahedral.
(1) $[Co(NH_3)_6]^{3+}$ (2) $[Mn(CN)_6]^{4-}$ (3) $[FeF_6]^{3-}$ (4) $[Ni(H_2O)_6]^{2+}$

Ans. **(1)**

Sol. $Co^{+3}(d^6)$ with strong field ligand (CN =6) is diamagnetic and octahedral.

11. In bomb calorimeter 1.14 gram of n-octane on complete combustion show 5°C increment in temperature then enthalpy of combustion is _____ kJ /mol.
(Given: C_v =5 kJ /mol ×K)

Ans. **(13)**

Sol. $C_8H_{18}(\ell) + \frac{27}{2}O_2(g) \longrightarrow 8CO_2(g) + 9H_2O(\ell)$

$$\text{Combustion} = \left[\frac{m}{M}\right] C_v \Delta t = \frac{1.14}{114} \times 5 \times 5 = 0.25 \text{ KJ}$$

$$\Delta H = \Delta U + \Delta n_g RT = 0.25 - 5.5 \times 8.314 \times 10^{-3} \times 298 = 0.25 - 13.626 = -13.376 \text{ kJ}$$

12. Which set of quantum number is not possible?

	n	ℓ	m	s		n	ℓ	m	s
(1)	3	0	0	$+\frac{1}{2}$	(2)	2	1	–1	$-\frac{1}{2}$
(3)	3	2	–3	$+\frac{1}{2}$	(4)	1	0	0	$+\frac{1}{2}$

Ans. **(3)**

Sol. Value of m is from $-\ell$ to $+\ell$

13. The orbital angular momentum for 2s and $2p_x$ orbitals is respectively.

(1) 0, $\sqrt{2}\frac{h}{2\pi}$ (2) $\sqrt{2}\frac{h}{2\pi}$, 0 (3) 0, 0 (4) $\sqrt{2}\frac{h}{2\pi}$, $\sqrt{2}\frac{h}{2\pi}$

Ans. **(1)**

Sol. $\sqrt{l(l+1)}\frac{h}{2\pi}$

For 2s $\rightarrow$ 0

For $2p_x$ $\rightarrow$ $\sqrt{2}\frac{h}{2\pi}$

14. 20 mL, 1 M NaOH is mixed with 10 mL, 2 M HCl which is further diluted to 100 mL. Final the concentration of final NaCl solution

(1) 2×10^{-3} M (2) 2×10^{-2} M (3) 0.1 M (4) 0.2 M

Ans. **(4)**

Sol. $[NaCl]=\frac{20\text{ mm}}{100\text{ mL}}=0.2\text{ M}$

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SUBJECT: MATHEMATICS

REGISTERED & CORPORATE OFFICE (CIN: U80302RJ2007PLC024029):
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PART : MATHEMATICS

1. If $\lim_{x\to 0}\left(\frac{\tan x}{x}\right)^{1/x^2}=P$, then 96 ℓnp is

(1) 12 (2) 18 (3) 32 (4) 48

Ans. **(3)**

Sol. $e^{\lim_{x\to 0}\left(\frac{\tan x}{x}-1\right)\frac{1}{x^2}}=e^{1/3}$

$96\ \ell n e^{1/3}=96\times\frac{1}{3}=32$

2. Let $A=\{-3,-2,-1,0,1,2,3\}$. A relation R is defined such that x R y iff $y=\max.\{x,1\}$. Number of elements required to make it reflexive is ℓ, number of elements required to make it symmetric is m and number of elements in the relation R is n. The value of $\ell+m+n$ is

Ans. **(15)**

Sol. $R=\{(-3,1),(-2,1),(-1,1),(0,1),(1,1),(2,2),(3,3)\}$

$n=7$

Ref. Add $\rightarrow\{(-3,-3),(-2,2),(-1,1),(0,0)\}\quad\rightarrow 4=\ell$

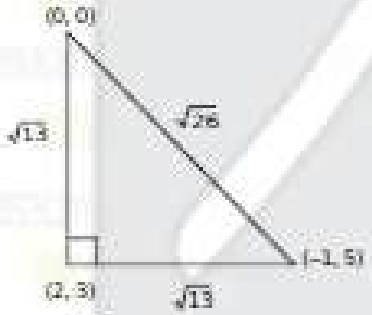
Symmetry Add. $\{(1,-3),(1,-2),(1,0),(1,-1)\}\rightarrow m=4$

$\ell+m+n=4+4+7=15$

3. Let a circle with radius r passes through four distinct point (0, 0), (k, 3k), (2, 3) & (−1, 5) such that $k\neq 0$ then $10k+2r^2$ is equal to

Ans. **(27)**

Sol.



$2r=\sqrt{26}$

$4r^2=26$

$2r^2=13$

equation of ⊙ is $x(x+1)+(y)(y-5)=0$

$k(k+1)+3k(3k-5)=0$

$k+1+9k-15=0$

$10k=14$

$10k+2r^2=14+13=27$

4. $S=1+\frac{1+3}{1!}+\frac{1+3+5}{2!}+\ldots\infty$. The value of S is equal to

Ans. **(5)**

Sol. $S=1+\frac{2^2}{1!}+\frac{3^2}{2!}+\frac{4^2}{3!}+\ldots$

$\sum_{r=0}^{\infty}\frac{r^2}{(r-1)!}$

$r-1=n$

$r=n+1$

$\sum_{n=0}^{\infty}\frac{(n+1)^2}{n!}$

$\sum_{n=0}^{\infty}\frac{n^2+2n+1}{n!}$

$\sum_{n=0}^{\infty}\frac{n}{(n-1)!}+\frac{2}{(n-1)!}+\frac{1}{n!}$

$\sum_{n=0}^{\infty}\left(\frac{1}{(n-2)!}+\frac{3}{(n-1)!}+\frac{1}{n!}\right)$

$e+3e+e=5e$

5. Let $I=\int_0^{\pi}\frac{8x}{4\cos^2 x+\sin^2 x}dx$ is equal to

(1) π^2 (2) $2\pi^2$ (3) $4\pi^2$ (4) $3\pi^2$

Ans. **(2)**

Sol. $\because$ $I=\int_0^{\pi}\frac{8x}{4\cos^2 x+\sin^2 x}dx$ ..... (1)

$I=\int_0^{\pi}\frac{8(\pi-x)}{4\cos^2 x+\sin^2 x}dx$ ..... (2)

(1) + (2)

$2I=\int_0^{\pi}\frac{8\pi}{4\cos^2 x+\sin^2 x}dx$

$I=4\pi\int_0^{\pi}\frac{1}{1+3\cos^2 x}dx$

$I=8\pi\int_0^{\pi/2}\frac{1}{1+3\cos^2 x}dx$

$I=8\pi\int_0^{\pi/2}\frac{\sec^2 x}{\sec^2 x+3}dx$

$I=8\pi\int_0^{\pi/2}\frac{\sec^2 x}{4+\tan^2 x}dx$ Put $\tan x=t$

$\sec^2 x\,dx=dt$

$$I = 8\pi \int_0^{\infty} \frac{dt}{t^2 + 2^2}$$

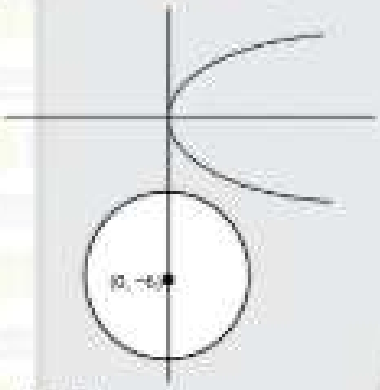
$$I = 4\pi \left(\tan^{-1}\left(\frac{t}{2}\right) \right)_0^{\infty} \quad \Rightarrow \quad U = 4\pi \times \frac{\pi}{2} = 2\pi^2$$

6. Minimum distance between $y^2 = 8x$ & $x^2 = y^2 + 12y + 35 = 0$ is

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

Ans. **(2)**

Sol. Let point P $(2t^2, 4t)$ lies on parabola



normal at P is

$$y - 4t = -\frac{4t}{4}\left(x - 2t^2\right)$$

It passes through centre of circle (0, –6)

$-6 - 4t = -t(-2t^2)$

$2t^3 + 4t + 6 = 0$

$t = -1$ is one of root

$(t + 1)(2t^2 - 2t + 6) = 0$

$t = -1$

Point P (2, –4) hence

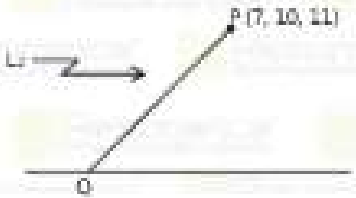
min. distance $= \sqrt{4 + 4} - 1 = 2\sqrt{2} - 1$

7. The distance of the point (7, 10, 11) from the line $\frac{x-4}{1} = \frac{y-4}{0} = \frac{z-2}{3}$ along the line $\frac{x-9}{2} = \frac{y-13}{3} = \frac{z-17}{6}$ is –

(1) 14 (2) 12 (3) 13 (4) 11

Ans. **(14)**

Sol.



$$L_1 : \frac{x-4}{1} = \frac{y-4}{0} = \frac{z-2}{3}$$

L_2 : $\frac{x-9}{2}=\frac{y-13}{3}=\frac{z-17}{6}$

$\because$ (7, 10, 11) is lying L_2

$\therefore$ required distance = PQ

$\because$ Q $(4+\lambda, 4, 3\lambda+2)$ $\because$ Q line on L_2

$\therefore$ $\frac{4+\lambda-9}{2}=\frac{4-13}{3}=\frac{3\lambda+2-17}{6}$

$\frac{\lambda-5}{2}=-3=\frac{3\lambda-15}{6}$

$\Rightarrow$ $\lambda=-1$

$\therefore$ Q (3, 4, –1)

$\therefore$ $PQ=\sqrt{16+36+144}=\sqrt{196}=14$

8. If $(1+x+x^2)^{10}=1+a_1x+a_2x^2+\ldots\ldots\ldots\ldots$

Then $a_1+a_3+a_5+\ldots\ldots a_{19}-11a_2$ is equal to

Ans. **(28919)**

Sol. $x=1$ $3^{10}=1+a_1+a_2+a_3+\ldots\ldots+a_{19}+a_{20}$

$X=-1$ $1-a_1+a_2-a_3+\ldots\ldots\ldots-a_{19}+a_{20}$

Substrate

$3^{10}-1$ $2(a_1+a_3+a_5+\ldots\ldots a_{19})$

$a_1+a_3+a_5+\ldots\ldots a_{19}=\frac{3^{10}-1}{2}$

$(1+x+x^2)^{10}={}^{10}C_0+{}^{10}C_1(x+x^2)+{}^{10}C_2(x+x^2)+\ldots\ldots$

Coefficient of $x^2={}^{10}C_1+{}^{10}C_2=a_2$

$a_2=55$

So, $a_1+a_3+\ldots\ldots a_{19}-11a_2=\frac{3^{10}-1}{2}-11\times55$

$=29524-605$

$=28919$

9. Let $y=f(x)$ be the solution of the differential equation $\frac{dy}{dx}+3y\tan^2x+3y=\sec^2x$.

Such that $f(0)=e^3+\frac{1}{3}$. Then $f\left(\frac{\pi}{4}\right)$ is equal to

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

Ans. **(3)**

Sol. $\frac{dy}{dx}+(3\sec^2x)\,y=\sec^2x$

$IF=e^{\int 3\sec^2x\,dx}=e^{3\tan x}$

Sol. $y \cdot e^{3\tan x} = \int e^{3\tan x} \sec^2 x dx + c$

$Y\, e^{3\tan x} = \frac{e^{3\tan x}}{3} + c$

$x = 0$ and $y = e^3 + \frac{1}{3}$

$e^3 + \frac{1}{3} = \frac{1}{3} + C$

$C = e^3$

$y\, e^{3\tan x} = \frac{e^{3\tan x}}{3} + e^3$

$x = \frac{\pi}{4}$

$y\, e^3 = \frac{e^3}{3} + e^3$

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

10. If $f(x) + 3f\left(\frac{24}{x}\right) = 4x,\ x \neq 0$, then the value of $f(3) + f(8)$ is equal to

Ans. **(11)**

Sol. Put $x = 3$

$f(3) + 3f(8) = 12$ ____(1)

Put $x = 8$

$f(8) + 3f(3) = 32$ ____(2)

$(1) + (2)$

$4(f(3) + f(8)) = 44$

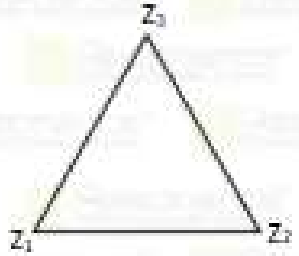
$f(3) + f(8) = 11$

11. If Z_0 is the centroid of equilateral triangle ABC having vertices Z_1, Z_2 & Z_3. The value of $\sum_{k=1}^{3} (Z_k - Z_0)^2$ is

Ans. **(0)**

Sol. $(Z_1 - Z_0)^2 + (Z_2 - Z_0)^2 + (Z_3 - Z_0)^2$

$\sum Z_1^2 - 2Z_0 \sum Z_1 + 3Z_0^2$



$Z_1 + Z_2 + Z_3 = 3Z_0$ & $\sum Z_1^2 - Z_1 Z_2 = 0$

$\sum Z_1^2 + 2\sum Z_1 Z_2 = 9Z_0^2$

$\sum Z_1^2 = 3Z_0^2$

now $(Z_1 - Z_0)^2 + (Z_2 - Z_0)^2 + (Z_3 - Z_0)^2$

$= 3Z_0^2 - 2Z_0(3Z_0) + 3Z_0^2 = 0$

12. Let $f(x) = |\,|x+2| - 2|x|\,|$. If m denotes number of minima and n denotes number of maxima, then value of $(m+n)$

Ans. **(3)**

Sol. $f(x) = |\,|x+2| - 2|x|\,|$

$|x+2| - 2|x| \geq 0 \quad \Rightarrow \quad |x+2| \geq 2|x|$

$(x+2)^2 \leq 4x^2$

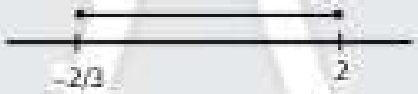
$x^2 + 4x + 4 \leq 4x^2$

$3x^2 - 4x - 4 \geq 0$

$3x^2 - 6x + 2x - 4 \geq 0$

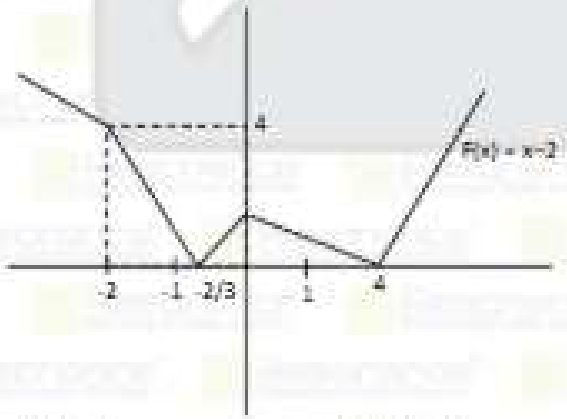
$3x(x-2) + 2(x-2) \geq 0$

$(x-2)(3x+2) \geq 0$



$\therefore \quad f(x) = \begin{cases} |x+2| - 2|x|; & x \in \left[-\frac{2}{3}, 2\right] \\ |x+2| + 2|x|; & x \in \left(-\infty, -\frac{2}{3}\right) \cup (2, \infty) \end{cases}$

$= \begin{cases} -x+2; & 0 \leq x \leq 2 \\ 3x+2; & -\frac{2}{3} \leq x < 0 \\ -3x-2; & -2 \leq x < -\frac{2}{3} \\ -x+2; & x < -2 \\ x-2; & x \geq 2 \end{cases}$



$\therefore \; m = 2$

$n = 1$

$\therefore \; m + n = 3$

13. If the equation $x(x+2)(12-k)=2$ has equal roots then shortest distance between $P\left(K,\frac{K}{2}\right)$ from $3x+4y+5=0$

Ans. **(15)**

Sol. $x^2+2x-\frac{2}{12-K}=0$

Roots one equal

$D=0$

$4+\frac{8}{12-K}=0$

$48-4K+8=0$

$K=14$

Now S.D. P(14,7) from line

$=\left|\frac{42+28+5}{5}\right|$

$=15$

14. Area bounded by region $|x-y|\le y\le 4\sqrt{x}$

(1) $\frac{1024}{3}$ (2) $\frac{1042}{3}$ (3) $\frac{512}{3}$ (4) $\frac{256}{3}$

Ans. **(64)**

Sol. **Case – I** When $x\ge y$

Then $x-y\le y \;\&\; y\le 4\sqrt{x}$

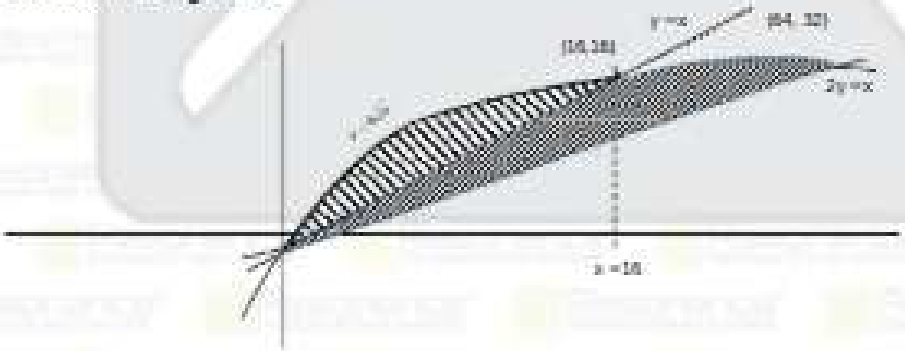
$x\le 2y$

Case – II When $x\le y$

$-x+y\le y$

$x\ge 0$

So common region is



Required area

$\int_0^{64} 4\sqrt{x}\,dx-\frac{1}{2}(64)(32)$

$=\left(\frac{2\times 4}{3}x^{3/2}\right)_0^{64}-1024$

$=\frac{1024}{3}$

15. Let $\vec{a}=\hat{i}-2\hat{j}+\hat{k}$, $\vec{b}=3\hat{i}+3\hat{j}+3\hat{k}$, $\vec{c}=2\hat{i}-\hat{j}+2\hat{k}$ and $\vec{b}\times\vec{d}=\vec{c}\times\vec{d}$ and $\vec{a}\cdot\vec{d}=4$ then $|\vec{a}\times\vec{d}|^2$ is

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

Ans. **(2)**

Sol. $(\vec{b}-\vec{c})\times\vec{d}=0$

$\vec{b}-\vec{c}=\lambda\vec{d}$

$\vec{b}-\vec{c}+\lambda\vec{d}$

Now taking dot with $\vec{a}$

$\vec{a}\cdot\vec{b}=\vec{a}\cdot\vec{c}+\lambda\vec{a}\cdot\vec{d}$

$(3-6+3)=(2+2+2)+\lambda(4)$

$\lambda=\frac{-3}{2}$

Hence $\vec{d}=\frac{2}{3}(\vec{b}-\vec{c})$

$=\frac{-2}{3}(\hat{i}+4\hat{j}+\hat{k})$

$=\frac{-2}{3}(\hat{i}+4\hat{j}+\hat{k})$

$\vec{a}\times\vec{d}=\frac{-2}{3}\begin{vmatrix}\hat{i}&\hat{j}&\hat{k}\\1&-2&1\\1&4&1\end{vmatrix}$

$=\frac{-2}{3}\quad(-6\hat{i}+6\hat{k})$

Now $|\vec{a}\times\vec{d}|^2=\frac{2}{3}\sqrt{36+36}=4\sqrt{2}$