# JEE Main Online Exam 2026

## Memory Based

## Questions & Solution

### 23rd January 2026 | Evening

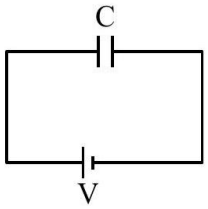
## PHYSICS

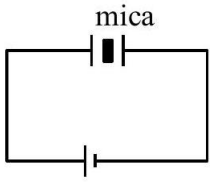
**1.** A parallel plate capacitor with plate separation 5 mm is charged by a battery. On introducing a mica sheet of 2 mm while battery is connected, it is found that it draws 25% more charge. The dielectric constant of mica is :

(1) 2 (2) 1.5 (3) 1 (4) 4

**Ans.** **[1]**

**Sol.**




$$C = \frac{\varepsilon_0 A}{5}$$

$Q_i = CV$

$Q_f = C_{eq}V = 1.25\ CV$

$$C_{eq} = \frac{\frac{\varepsilon_0 A}{3} \times \frac{K\varepsilon_0 A}{2}}{\frac{\varepsilon_0 A}{3} + \frac{K\varepsilon_0 A}{2}}$$

$$= \frac{\varepsilon_0 A 5K}{5(3K+2)}$$

$$= \frac{5CK}{3K+2}$$

$C_{eq} = 1.25\ C$

$$\frac{5K}{3K+2} = 1.25 = \frac{5}{4}$$

$4K = 3K + 2$

$K = 2$

**2.** A bomb at rest explodes into three pieces in the ratio of masses $2:2:3$. The identical masses fly off perpendicular to each other with $18\ m/s$. Find speed of the third piece.

(1) $12\sqrt{2}\ m/s$ (2) $12/\sqrt{2}\ m/s$ (3) $12\ m/s$ (4) $18\ m/s$

**Ans.** **[2]**

**Sol.** $7\ m\times 0 = 2\ m\times 18\hat{i} + 2\ m\times 18\hat{j} + 3\ m\times \vec{v}$

$\vec{v} = -12\hat{i} - 12\hat{j}$

$|\vec{v}| = 12\sqrt{2}\ m/s$

**3.** Time taken to achieve terminal velocity by a body depends on density of material (ρ), density of liquid (σ), radius of material ( r ) and viscosity of liquid ( $\eta$ ) as $t = k\rho^a r^b \eta^c \sigma^d$. Find $\frac{b+c}{a+d}$ ?

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

**Ans.** **[1]**

**Sol.** $T = \left(ML^{-3}\right)^a L^b \left(ML^{-1}\ T^{-1}\right)^c \left(ML^{-3}\right)^d$

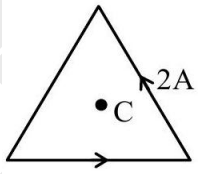
$T = M^{a+c+d} L^{-3a-c-3d+b} T^{-c}$

on comparing

$c = -1; a + c + d = 0; -3a - c - 3d + b = 0$

$b = 2; a + d = 1$

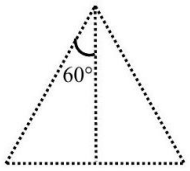
**4.** The equilateral triangular frame has current 2 A. The side of frame is $4\sqrt{3}$ cm. Magnetic field at center C is:




(1) $30\sqrt{3}\mu\ T$ (2) $10\sqrt{3}\mu\ T$ (3) $3\sqrt{10}\mu\ T$ (4) $10\sqrt{10}\mu\ T$

**Ans.** **[1]**

**Sol.**




$$B = 3\left[\frac{\mu_0 i}{4\pi\left(\frac{a}{2\sqrt{3}}\right)}\left(\sin 60 + \sin 60\right)\right]$$

$$= \frac{9\mu_0 i}{2\pi a}$$

$$= \frac{9\times 4\pi\times 10^{-7}\times 2}{2\pi\times\left(4\sqrt{3}/100\right)} = 3\sqrt{3}\times 10^{-5} = 30\sqrt{3}\mu\ T$$

**5.** Dielectric constant of a medium is 3 and its magnetic permeability $\mu = 2\mu_0$. Find ratio of velocity of light in vacuum to velocity of light in medium :

(1) $\sqrt{5}$ (2) $\sqrt{6}$ (3) 2 (4) 3

**Ans.** **[2]**

**Sol.** $\frac{c}{v} = \mu = \sqrt{\varepsilon_r \mu_r} = \sqrt{3 \times 2} = \sqrt{6}$

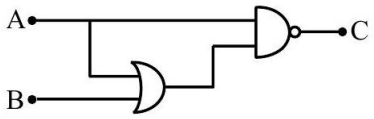
**6.** Which of the following is isobaric pairs :

(1) ${}^{3}_{1}C \& {}^{13}_{6}C$ (2) ${}^{3}_{1}H \& {}^{3}_{2}He$ (3) ${}^{14}_{7}N \& {}^{13}_{6}He$ (4) ${}^{16}_{8}O \& {}^{15}_{7}N$

**Ans.** **(2)**

**Sol.** Isobars are atoms having same number of nucleons

**7.** For given logic gate circuit choose correct truth table.




(1)

| A | B | C |
|---|---|---|
| 0 | 0 | 1 |
| 1 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 1 | 0 |

(2)

| A | B | C |
|---|---|---|
| 0 | 0 | 1 |
| 1 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 1 | 0 |

(3)

| A | B | C |
|---|---|---|
| 0 | 0 | 0 |
| 1 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 1 | 1 |

(4)

| A | B | C |
|---|---|---|
| 0 | 0 | 0 |
| 1 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 1 | 1 |

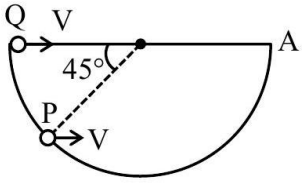
**Ans.** **[2]**

**Sol.** $C = \overline{(A + B) \cdot A}$

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

| A | B | C |
|---|---|---|
| 0 | 0 | 1 |
| 1 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 1 | 0 |

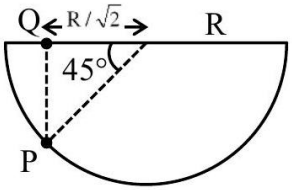
**8.** Two beads P & Q move along two wires straight and semi circle. At some instant both are shown in figure having same horizontal component of velocity V. Find relation of time taken to reach A by beads :




(1) $t_p > t_Q$ (2) $t_p < t_Q$ (3) $t_p = t_Q$ (4) None of these

**Ans.** **[2]**

**Sol.**



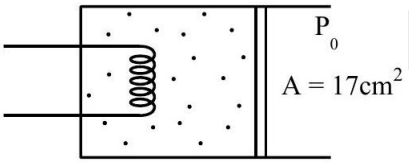

X-displacements :

$X_P < X_Q$

and average velocity in X -direction of P is $>$ average velocity in X -direction of Q hence

$t_p < t_Q$

**9.** Internal energy of gas is given as $U = 3nRT$. 1 mole He gas takes 126 J heat and its temperature rise by $4^\circ C$. Atmospheric pressure is $P_0 = 10^5$ Pa and area of piston is 17 $cm^2$. Find distance moved by piston.




(1) 18.5 cm (2) 21.3 cm (3) 12.3 cm (4) 10.2 cm

**Ans.** **[1]**

**Sol.** Piston is free to move hence

For isobaric process

$\Delta Q = \Delta U + W = 3nR\Delta T + nR\Delta T$

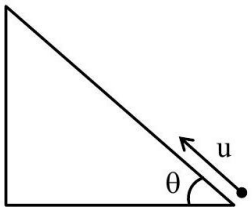
$\Delta Q = 4P\Delta V$

$126 = 4\times10^5 \times A(\Delta x)$

$$\Delta x = \frac{126}{4\times10^5 \times 17\times10^{-4}}$$

$= 0.185 \text{ m} = 18.5 \text{ cm}$

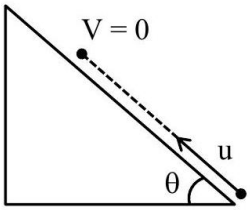
**10.** A particle is projected from bottom of inclined plane with speed u .find distance covered along plane before coming to rest :




(1) $\frac{u^2}{2g\sin\theta}$ (2) $\frac{u^2}{g\sin\theta}$ (3) $\frac{u^2}{g\cos\theta}$ (4) $\frac{u^2}{2g\cos\theta}$

**Ans.** **[1]**

**Sol.**




$a = -g\sin\theta$

$V^2 = U^2 + 2as$

$0 = u^2 - 2g\sin\theta.s$

$s = \dfrac{u^2}{2g\sin\theta}$

**11.** Speed of sound at $T_1 = 0^\circ C$ is $V_0$ and at $T_2 = \alpha^\circ C$ speed becomes $2\ V_0$. Find $\alpha$ :

(1) $819^\circ C$ (2) $918^\circ C$ (3) $546^\circ C$ (4) $1092^\circ C$

**Ans.** **[1]**

**Sol.** $V = \sqrt{\dfrac{\gamma RT}{M}}$

$\dfrac{V_1}{V_2} = \dfrac{\sqrt{T_1}}{\sqrt{T_2}}$

$\dfrac{V_0}{2\ V_0} = \sqrt{\dfrac{273}{T_2}}$

$\dfrac{1}{4} = \dfrac{273}{T_2}$

$T_2 = 4 \times 273$

$\alpha + 273$

$\alpha = 3 \times 273$

$\alpha = 819^\circ C$

**12.** A parachutist jumps from a helicopter. It falls freely for 2 sec . Then he opens parachute which produces retardation of $3\ m/s^2$. When his height from ground is 10 m his velocity is $5\ m/s$. Find his initial height from ground.

(1) 90 m (2) 82 m (3) 92.5 m (4) 100 m

**Ans.** **[3]**

**Sol.** $S_1 = \dfrac{1}{2} \times 10 \times 2^2 = 20\ m$

$v_1 = 0 + g \times 2 = 20\ m/s$

For 2nd part of journey :

$5^2 = 20^2 + 2(-3)S_2$

$S_2 = 62.5\ m$

So, total distance $S = S_1 + S_2 + S_3$

$= 20 + 62.5 + 10 = 92.5\ m$

**13.** An experiment is performed for comparing EMF of two cells using a potentiometer. For $1^{st}$ cell, balancing length was achieved at 200 cm and for $2^{nd}$ cell it was 150 cm . If least count of measurement of length of potentiometer wire is 1 cm , the percentage error in the ratio of $\varepsilon$mf of two cells is :

(1) $\frac{8}{7}$ (2) $\frac{7}{6}$ (3) $\frac{5}{6}$ (4) $\frac{3}{2}$

**Ans.** **[2]**

**Sol.** At balancing length $\varepsilon = \lambda \ell$ [$\lambda$ is potential gradient]

$\therefore \varepsilon_1 = \lambda \times 200$

$\varepsilon_2 = \lambda \times 150$

Let $y = \frac{\varepsilon_1}{\varepsilon_2}$

$\therefore \frac{\Delta y}{y} = \frac{\Delta \varepsilon_1}{\varepsilon_1} + \frac{\Delta \varepsilon_2}{\varepsilon_2} = \frac{\Delta \ell_1}{\ell_1} + \frac{\Delta \ell_2}{\ell_2} = \frac{1}{200} + \frac{1}{150} = \frac{7}{600}$

$\therefore \%\ \text{error} = \frac{7}{6}$

**14.** A metallic sphere of diameter 2 mm and density 10.5 g / cc is dropped in glycerine having viscosity 10 poise and density 1.5 g / cc . The terminal velocity attained by sphere is ____ cm / s. $\left[\pi = \frac{22}{7},\ g = 10\ m/s^2\right]$

(1) 2.0 (2) 1.0 (3) 1.5 (4) 3.0

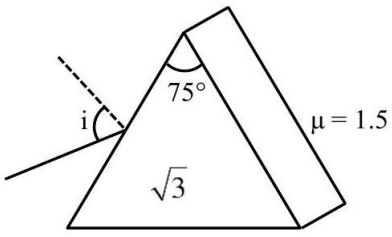
**Ans.** **[1]**

**Sol.** $V = \frac{2}{9}\frac{r^2 g}{\eta}(\rho_m - \rho_l)$

$= \frac{2}{9} \times \frac{(0.1)^2 \times 1000}{10}(10.5 - 1.5)$

$= 2\ \text{cm / s}$

**15.** A prism with angle of prism $75^\circ$ and having refractive index $\sqrt{3}$ has a slab of refractive index 1.5 kept on one side of the prism as shown. Find angle of incidence such that TIR occurs at slab prism interface. (Given $\sin 15^\circ = 0.25$ and $\sin 25^\circ = 0.43$ ) :




(1) $10^\circ < \theta < 20^\circ$ (2) $\theta < 25^\circ$ (3) $\theta < 15^\circ$ (4) $15^\circ < \theta < 25^\circ$

**Ans.** **[2]**

**Sol.** For TIR at prism-slab interface,

$r_2 = \sin^{-1}\left(\frac{1.5}{\sqrt{3}}\right) = 60^\circ$

$\therefore r_1 = 15^\circ$

$\therefore 1 \sin i = \sqrt{3}\sin 15^\circ = 0.433 \Rightarrow i = 25^\circ$

$\therefore \theta < 25^\circ$

**16.** When an object is kept at distance 8 cm and 24 cm from a convex lens, magnitude of magnification is same in both cases. Find focal length (in cm) of the lens :

(1) 18 cm (2) 16 cm (3) 20 cm (4) 8 cm

**Ans.** **[2]**

**Sol.** $m = \frac{f}{f+u}$

$m_1 = -m_2$

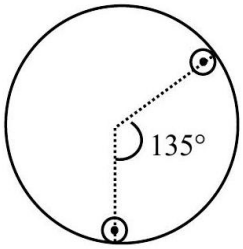
$\frac{f}{f-8} = -\frac{f}{f-24}$

$f - 8 = 24 - f$

$2f = 32$

$f = 16$ cm

**17.** A disc of mass ( M,R ) is given. Two discs of radius $\frac{R}{4}$ are cut from this, whose center are at $135^\circ$ angle. Their peripheries touch larger disc a shown. If moment of inertia of remaining disc about center is $\frac{\alpha}{256}MR^2$ find $\alpha$ :




**Ans.** **[109]**

**Sol.** $M = \sigma\pi R^2$

$\sigma\pi R^2 = 16\ m$

$m = \frac{\sigma\pi R^2}{16}$

$I_{system} = \frac{MR^2}{2} - 2\left(\frac{mR^2}{2\times16} + \frac{9mR^2}{16}\right)$

$= \frac{MR^2}{2} - 2\times\frac{19mR^2}{32}$

$= \frac{MR^2}{2} - \frac{19}{16}mR^2$

$= \frac{MR^2}{2} - \frac{19}{256}MR^2$ becoz $m = \frac{M}{16}$

$= \frac{(128-19)(MR^2)}{256}$

$= \frac{109MR^2}{256}$

**18.** An air bubble inside water at depth $h = 5$ m rises to surface. At bottom temperature is $T_1$ and volume is $V_1$ and at surface the temperature is $T_2$. Find final volume (Given that number of moles remains same and $P_0 = 10^5$ Pa ) :

(1) 6 $cm^3$ (2) 8 $cm^3$ (3) 2 $cm^3$ (4) 1 $cm^3$

**Ans.** **[3]**

**Sol.** $T_1 = 17^\circ C, V_1 = 2.9\ cm^3$

$T_2 = 27^\circ C$

$$\frac{10^5 \times 2.9}{290} = \frac{1.5 \times 10^5 \times V_2}{300}$$

$V_2 = 2\ cm^3$

**19.** Choose correct option :

(A) Number of photons required for a light beam of 2000 pm wavelength and 1 Joule energy is $1.01 \times 10^{16}$.

(B) Light with wavelength 300 nm has energy $E_1$ and for wavelength 900 nm has energy $E_2$, then $\frac{E_1}{E_2} = \frac{1}{3}$.

(C) Frequency of light is $4.5 \times 10^{16}$ then its wavelength is $6.7 \times 10^{-9}$ m.

(D) If electrons and protons are accelerated by same potential difference, then their de-Broglie wavelength are equal.

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

**Ans.** **[3]**

**20.** Two point charges $7\mu C(-9,0,0)$ and $-2\mu C(9,0,0)$ are placed in external electric field $\vec{E} = \frac{A}{r^2}\hat{r}$ where $A = 10^3$ SI unit. Find potential energy of system?

(1) $-\frac{58}{9} \times 10^{-3}$ J (2) $\frac{50}{3} \times 10^{-6}$ J (3) $40 \times 10^{-4}$ J (4) $2 \times 10^{-5}$ J

**Ans.** **[1]**

**Sol.** $U = U_{self} + U_{interaction}$

$$= q_1 V_1 + q_2 V_2 + \frac{kq_1q_2}{r}$$

Here $V = \int_\infty^r E dr = -A\left(-\frac{1}{r}\right)_\infty^r = \frac{A}{r}$

So $U = -7 \times 10^{-3} + \frac{7 \times 10^{-6}\ A}{9} - \frac{2 \times 10^{-6}\ A}{9}$

$$= \left(\frac{5}{9} - 7\right) \times 10^{-3} = -\frac{58}{9} \times 10^{-3}\ J$$

**21.** A small ring is given some velocity along the axis of a solenoid and it remains coaxial with solenoid. Current in solenoid $i = 10\sin\omega t; \omega = 1000 rad/s$. Number of turns per unit length is $500/m$. Radius of ring is 1 cm and its resistances is $10\Omega$. Find RMS value of induced current in the ring :

(1) $\sqrt{2} \times 10^{-5}$ A (2) $3 \times 10^{-4}$ A (3) $\sqrt{2} \times 10^{-4}$ A (4) $5 \times 10^{-6}$ A

**Ans.** **[3]**

**Sol.** EMF induced $\varepsilon = A\dfrac{dB}{dt} = A\mu_0 n\dfrac{di}{dt}\varepsilon = A\mu_0 ni_0\omega\cos\omega t$

current induced $i = \dfrac{\varepsilon}{R} = \dfrac{\pi r^2\mu_0 ni_0\omega}{R}\cos\omega t$

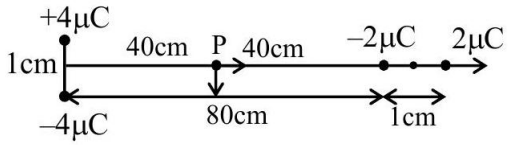
So $i = \dfrac{\pi r^2\mu_0 ni_0\omega}{\sqrt{2}R}$

$= \dfrac{\pi\times10^{-4}\times4\pi\times10^{-7}\times500\times10\times10^3}{\sqrt{2}\times10}$

$= \dfrac{20\pi^2}{\sqrt{2}}\times10^{-6}$

$= \sqrt{2}\times10^{-4}$ A

**22.** Four charges are kept as shown in the figure. Find magnitude of electric field at point P. P is mid point of line AB .




(1) $625\sqrt{2}$ (2) $5625\sqrt{2}$ (3) $3625\sqrt{2}$ (4) $4525\sqrt{2}$

**Ans.** **[2]**

**Sol.** $E_p = -\dfrac{KP_1}{r^3}\hat{j} + \dfrac{2KP_2}{r^3}(\hat{i})$

$\left|\vec{E}_{net}\right| = \dfrac{\sqrt{2}\times2\times9\times10^9\times2\times10^{-6}\times10^{-2}}{(0.4)^3}$

$= 5625\sqrt{2}$

**23.** Energy released per fission of U-235 is 190 MeV, then total energy released by 47 g of U-235 is $x\times10^{23}$ MeV . Find the value of $x$ .

**Ans.** **[228]**

**Sol.** Total numbers of U-235 atom is

$47\text{ g} = \dfrac{47}{235}\text{ moles} = \dfrac{1}{5}\text{ moles}$

$\therefore$ Total energy released $= \dfrac{1}{5}\times6\times10^{23}\times190\text{MeV} = 228\times10^{23}\text{ MeV}$

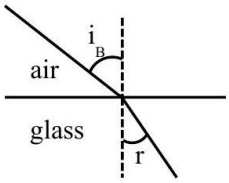
**24.** When an unpolarized light falls at a particular angle on a glass plate (placed in air). It is observed that reflected beam is completely polarized the angle of refracted beam with respect to the normal is :

(Given : $\tan^{-1}(1.52) = 57.3^\circ, \mu_{air} = 1, \mu_{glass} = 1.52$ )

(1) 57.3 (2) 36.7 (3) 28.65 (4) 61.35

**Ans.** **[2]**

**Sol.**




$$\tan i_B = \frac{n_2}{n_1} = \frac{n_g}{n_a}$$

$$\tan i_B = 1.52$$

$$i_B = 57.6^\circ$$

$$r = 90 - i_B = 36.7^\circ$$

**25.** One mole of diatomic gas is expanding isothermally from V to 2 V at $27^\circ C$. If the magnitude of work done by gas in this case is same as the work done in adiabatic process where initial temperature is $27^\circ C$ and final temperature is $T^\circ C$. Find T.

(1) $-37^\circ C$ (2) $-57^\circ C$ (3) $-35^\circ C$ (4) $-55^\circ C$

**Ans.** **[2]**

**Sol.** $W_{isothermal} = 1 \times R \times (300) \ln(2)$

$$W_{adiabatic} = \frac{nR(300 - T)}{\left(\frac{7}{5} - 1\right)} = \frac{5}{2} \times 1 \times R \times (300 - T)$$

$$W_{isothermal} = W_{adiabatic}$$

$$300 \ell n 2 = \frac{5}{2}(300 - T)$$

$$\frac{5}{2} T = 750 - 300 \ell n 2$$

$$T = 216.82 \text{ K}$$

$$T = -56.17^\circ C$$

# JEE Main Online Exam 2026

## Memory Based

## Questions & Solution

### 23rd January 2026 | Evening

## CHEMISTRY

**1.** For given reaction

$X_2(g) + Y_2(g) \rightleftharpoons 2Z\ (g)$

Moles of $X_2, Y_2$ & $Z$ are at equilibrium are 3 mole, 3 mole & 9 mole respectively. If 10 moles of Z are added at constant T then find moles of Z at restablished equilibrium.

**Ans.** **[15]**

**Sol.** $X_2(g) + Y_2(g) \rightleftharpoons 2Z\ (g)$

$$K_C = \frac{(9)^2}{3\times 3} = 9$$

Now 10 moles of $Z$ are added then reaction will move in backward direction.

$X_2(g) + Y_2(g) \rightleftharpoons 2Z\ (g)$

$3 + X \quad 3 + X \quad 19-2X$

$$K_C = \frac{(19-2X)^2}{(3+X)(3+X)} = 9$$

$$\frac{19-2X}{3+X} = 3$$

$19 - 2X = 9 + 3X$

$10 = 5X$

$X = 2$

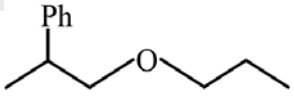
At equilibrium $\Rightarrow$ moles of $Z = 19 - 2\times 2$

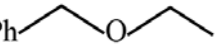
$= 15$ moles

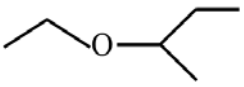
**2.** $\underset{(P)}{\text{Organic compound}} \xrightarrow[\text{(ii) A q.NaOH}]{\text{(i) excessof HI}} Q + R$

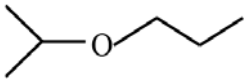
Q and R both gives Iodoform test,

Which among the following is (P) from the given organic compound?

(1) 

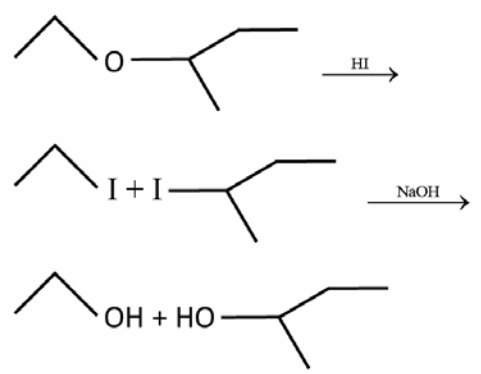

(2) 


(3) 


(4) 


**Ans.** **[3]**

**Sol.**




Both products Q & R gives idoform test.

**3.** On two metal surfaces, a monochromatic light of 6 eV was incident. They have ratio of their work function and maximum KE as

$$\frac{\phi_1}{\phi_2}=\frac{1}{2},\frac{(KE_{max})_1}{(KE_{max})_2}=\frac{2.62}{1}$$

Then $\phi_1$ and $\phi_2$ values are respectively (in eV ).

(1) 2.292, 4.584 (2) 4.584, 2.292 (3) 4.584, 9.168 (4) 1.146, 2.292

**Ans.** **[1]**

**Sol.** $KE_{max}=E-\phi$

$(KE_{max})_1=6-\phi_1$ ...(1)

$(KE_{max})_2=6-\phi_2$ ...(2)

By eq. (1) divide eq. (2)

$$\frac{(KE_{max})_1}{(KE_{max})_2}=\frac{2.62}{1}=\frac{6-\phi_1}{6-\phi_2}$$

$$\frac{2.62}{1}=\frac{6-\phi_1}{6-2\phi_1}$$

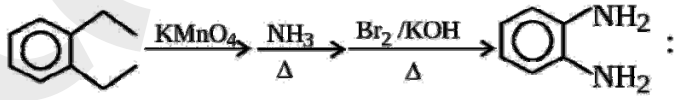
$15.72-5.24\phi_1=6-\phi_1$

$9.72=4.24\phi_1$

$$\phi_1=\frac{9.72}{4.24}$$

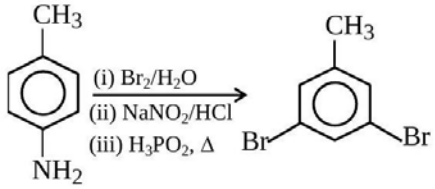
$\phi_1=2.292eV,\phi_2=4.584eV$ .

**4.** **Statement-I :**




:

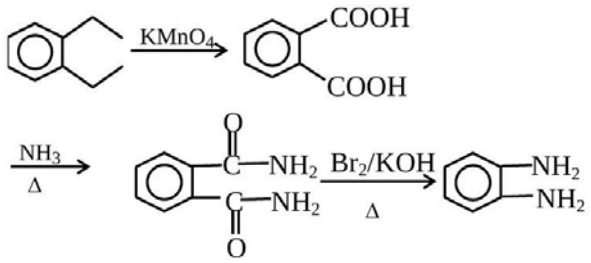
**Statement-II :**



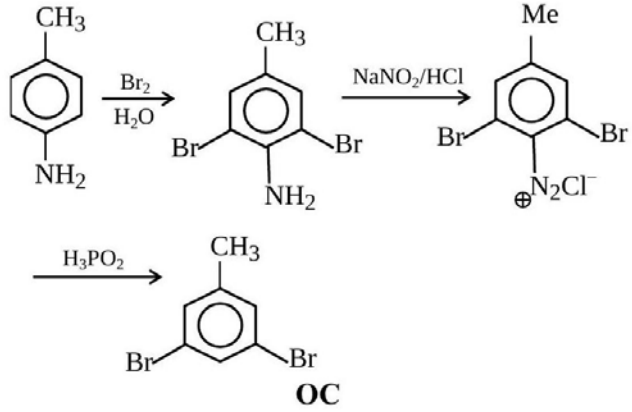
(1) Statement-I and Statement-II both are correct
(2) Statement-I is incorrect Statement-II is correct
(3) Statement-I is correct Statement-II is incorrect
(4) Statement-I and Statement-II both incorrect

**Ans.** **[1]**

**Sol.** **Statement-I**




**Statement-II**




**OC**

**5.** The oxidation state of ' Cr ' in the final product formed by reaction between KI and acidified $K_2Cr_2O_7$ is :

(1) +2 (2) +6 (3) +4 (4) +3

**Ans.** **[4]**

**Sol.** $K_2Cr_2O_7 + KI \xrightarrow{H^+} I_2 + Cr^{3+}$

**6.** Correct statement is :

(A) NaOCl when reacted with KI gives KOI
(B) KOI is best reducing agent
(C) Methanoic acid gives iodoform test
(D) Isopropyl alcohol gives iodoform test

(E) $H_3C-CH=CH-\overset{\overset{O}{\|}}{C}-CH_3$ gives iodoform test

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

**Ans.** **[3]**

**Sol.** Isopropyl alcohol and $H_3C-CH=CH-\overset{\overset{O}{\|}}{C}-CH_3$ gives positive Iodoform test.

**7.** Consider the following changes :

$SnO_2 \rightarrow SnO \quad \Delta G_1^0$

$PbO_2 \rightarrow PbO \quad \Delta G_2^0$

Select the correct option

(1) $\Delta G_1^0 > 0, \Delta G_2^0 > 0$ (2) $\Delta G_1^0 > 0, \Delta G_2^0 < 0$ (3) $\Delta G_1^0 < 0, \Delta G_2^0 < 0$ (4) $\Delta G_1^0 < 0,\ \Delta G_2^0 > 0$

**Ans.** **[2]**

**Sol.** $\rightarrow$ $Pb^{2+}$ is more stable than $Pb^{4+}$ (inert pair effect)

$\Rightarrow \Delta G_2^0 < 0$

$\Rightarrow \Delta G_1^0 > 0$ . As $Sn^{4+}$ is more stable than $Sn^{2+}$

**8.** 3 moles of liquid A and 1 mole of liquid B are mixed to form an ideal solution. The vapour pressure of solution becomes 500 mm Hg. If 1 mole of A is further added then vapour pressure of solution increases by 20 mm Hg. Find vapour pressure of pure $B\left(P^\circ_B\right)$ in mm Hg ?

**Ans.** **[200]**

**Sol.** $X_A = \frac{3}{4}, X_B = \frac{1}{4}$

$P_S = P_A^o X_A + P_B^o X_B$

$500 = P_A^o \times \frac{3}{4} + P_B^o \times \frac{1}{4}$

$3P_A^o + P_B^o = 2000 \quad ...(1)$

Now 1 moles of A is further added so $n_A = 4$ mole, $n_B = 1$ mole

$X'_A = \frac{4}{5}, X'_B = \frac{1}{5}$

$P_S = 520 = P_A^o \times \frac{4}{5} + P_B^o \times \frac{1}{5}$

$4P_A^o + P_B^o = 2600 \quad ...(2)$

By equation (2) – equation (1)

$P_A^o = 600$ mmHg

$P_B^o = 200$ mmHg

**9.** 0.245 gm of an unknown organic compound gave 0.5453 gm of AgCl through Carious method. Calculate % of Cl in unknown compound.

**Ans.** **[55.06]**

**Sol.** $\%\ Cl = \frac{\left(\frac{.5453}{143.5}\right) \times 35.5}{.245} \times 100$

% of Cl = 55.06

**10.** How many of the following complexes have unpaired electrons $[Ni(CO)_4], [NiCl_4]^{2-}, [PtCl_4]^{2-}$, $[Pt(CN)_4]^{2-}, \left[Pt\left(NH_3\right)_2 Cl_2\right]$

**Ans.** **[1]**

**Sol.** In $[Ni(CO)_4], Ni^0 : 3\,d^{10}\,4\,s^0\,4p^0$

Hybridisation state : $sp^3, n = 0$

In $[NiCl_4]^{2-}, Ni^{2+} : 3\,d^8 e^{2,2} t_2^{2,1,1}$

Hybridisation state: $sp^3, n = 2$

In $[PtCl_4]^{2-}, Pt^{2+} : 5\,d^8$ square planar

Hybridisation state: $dsp^2, n = 0$

In $[Pt(CN)_4]^{2-}\,5\,d^8$ square planar

Hybridisation state: $dsp^2, n = 0$

In $\left[Pt\left(NH_3\right)_2 Cl_2\right] Pt^{2+} : 5\,d^8$ square planar

Hybridisation state: $dsp^2, n = 0$

**11.** A cell is given as

$M(s)\left|M^{n+}(aq)\right\| M^{+n}(aq)\left|M(s)\right.$

For which of the following condition, $E_{cell}$ is positive:

(1) $C_1 < C_2$ (If $C_1$ is concentration at cathode)

(2) $C_2 < C_1$ (If $C_1$ is concentration at anode)

(3) $C_1 < C_2$ (If $C_2$ is concentration at anode)

(4) $C_1 > C_2$ (If $C_1$ is concentration at cathode)

**Ans.** **[4]**

**Sol.** $M(s) + M^{n+}(aq) \rightarrow M(s) + M^{n+}(aq.)$

(cathode) (anode)

$$E_{cell} = E^\circ_{cell} - \frac{0.059}{n} \log \frac{\left[M^{n+}\right]_{anode}}{\left[M^{n+}\right]_{cathode}}$$

For concentration cell : $E^\circ_{cell} = 0$

$$E_{cell} = -\frac{0.059}{n} \log \frac{\left[M^{n+}\right]_{anode}}{\left[M^{n+}\right]_{cathode}}$$

For $E_{cell} = +ve$

$\left[M^{n+}\right]_{anode} < \left[M^{n+}\right]_{cathode}$

**12.** Iodoform test can differentiate :

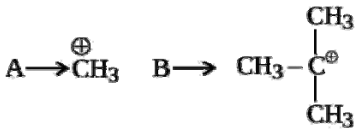
(1) Anisole and Acetone (2) Acetic acid and Aniline

(3) Ethanol and Acetone (4) Methanol and benzoic acid

**Ans.** **[1]**

**Sol.** Acetone $Me - CO - Me$ will show Iodoform due to methylketo group $Me - CO - Me$

**13.** Consider the following



**Statement-I :** B is more stable due to $9\alpha H$

**Statement-II :** A is less stable due to $3\alpha H$

(1) Statement-I and Statement-II both are correct

(2) Statement-I is incorrect Statement-II is correct

(3) Statement-I is correct Statement-II is incorrect

(4) Statement-I and Statement-II both incorrect

**Ans.** **[3]**

**Sol.** Tertiary butyl carbocation has $9\alpha H$

Methylcarbocation has zero $\alpha H$

**14.** Given at 10 AM , reaction is started

(i) $A \xrightarrow{k}$ Product ($1^{st}$ order reaction)

(ii) $BrO_3^- + 5Br^- \rightarrow 3Br_2$

At 10:10 AM, rate of disappearance of $Br^-$ was $2\times10^{-3}$ M / min . and concentration of A was 0.1 M , if both reactions were proceed with same rate at this time then value of k will be ?

(1) $10^{-3}$ $min^{-1}$ (2) $2\times10^{-3}$ $min^{-1}$ (3) $4\times10^{-3}$ $min^{-1}$ (4) $8\times10^{-3}$ $min^{-1}$

**Ans.** **[3]**

**Sol.** Rate of reaction $= \dfrac{2\times10^{-3}}{5} = k[0.1]$

$k = 4\times10^{-3}$ $min^{-1}$

**15.** **Statement-I :** Size of $O^{2-}$ is smaller than $F^-$.

**Statement-II :** Second ionization energy of Na is greater than second ionization energy of Mg.

(1) Both statements are correct.

(2) Both statements are incorrect.

(3) Statement I is correct while Statement II is incorrect.

(4) Statement I is incorrect while statement II is correct.

**Ans.** **[4]**

**Sol.** Size of $O^{2-} > F^-$

$IE_2$ of Na > $IE_2$ of Mg

**16.** If $K_2Cr_2O_7\left(200\ cm^3, x\times10^{-3}\ M\right)$ reacts with 0.6 M , $750\ cm^3$ Mohr's salt then find value of x ?

**Ans.** **[375]**

**Sol.** $K_2Cr_2O_7 + Fe^{2+} \longrightarrow Cr^{3+} + Fe^{3+}$

$n_f = 6$ $n_f = 1$

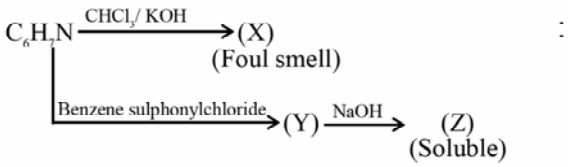
V=200 $cm^3$ V=750 $cm^3$

x × $10^{-3}$ M 0.6 M

milli eq. of $K_2Cr_2O_7$ = milli eq. of $FeSO_4$

$6\times x\times10^{-3}\times200 = 1\times0.6\times750$

$x = 375$

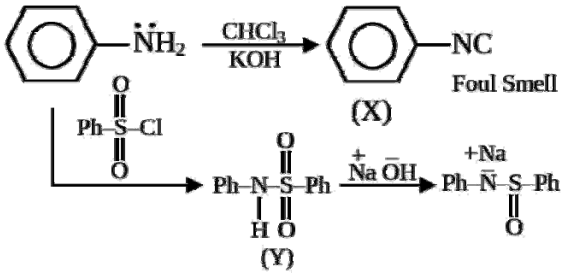
**17.** 

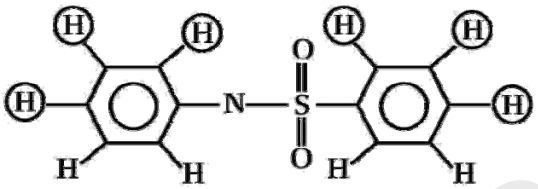

Number of different H -atoms in (Y)

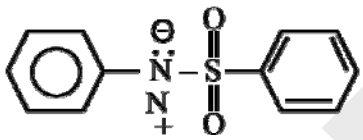
(1) 4 (2) 7 (3) 12 (4) 13

**Ans.** **[2]**

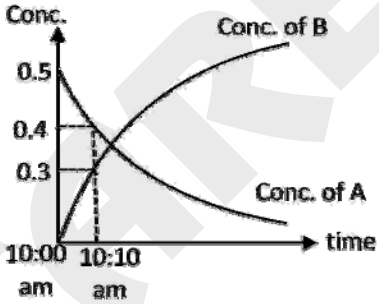
**Sol.**




**18.** For a given reaction $A \rightarrow nB$ , a graph is given between concentration and time. Find value of $n$ for above reaction, based on the information given in graph for 10 min .




**Ans.** **[3]**

**Sol.**

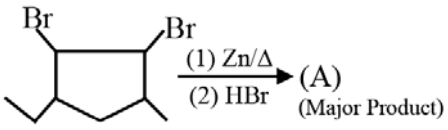
| | A | $\rightarrow$ | nB |
|---|---|---|---|
| at 10:00 am | 0.5 | | – |
| at 10:10 am | 0.5–x | | nx |
| | = 0.4 | | |

$x = 0.1$

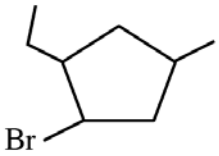
$nx = 0.3$

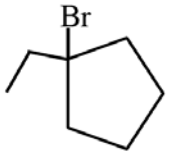
$n = \frac{0.3}{x} = 3$

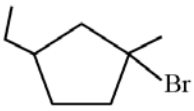
**19.**

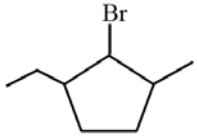



Identify (A) ?

(1) 

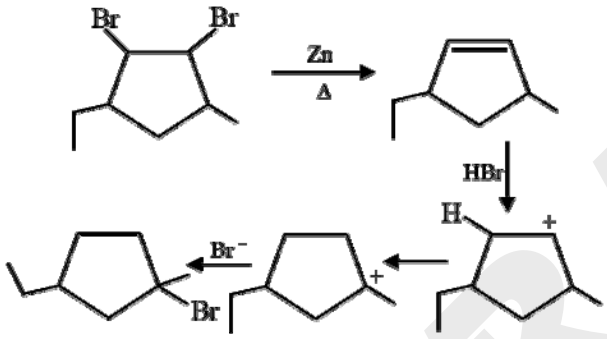

(2) 


(3) 


(4) 


**Ans.** **[3]**

**Sol.**




**20.** For $XeO_2F_2$, select the correct statements :

(A) It has see-saw shape

(B) $\angle FXeF \approx 180^\circ$

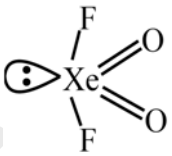
(C) $\angle OXeO \approx 180^\circ$

(D) Number of valence electron on $Xe = 5$

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

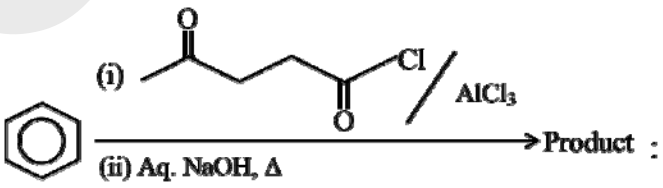
**Ans.** **[2]**

**Sol.**




See-saw

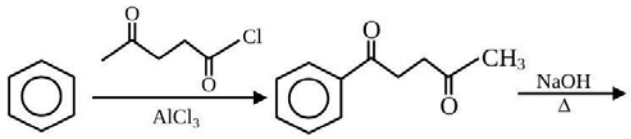
**21.**

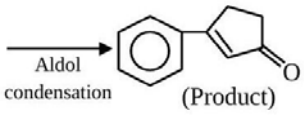



Calculate total number of mass percentage of oxygen in the product

**Ans.** **[10.13]**

**Sol.**




Molecular mass of product = 158

Mass % of oxygen $= \frac{16}{158} \times 100 = 10.13\%$

**22.** From the following :

(A) $\left[Co(NH_3)_6\right]^{3+}$ : Inner orbital complex , $d^2sp^3$ hybridization

(B) $\left[MnCl_6\right]^{3-}$ : Outer orbital complex , $sp^3\ d^2$ hybridization

(C) $\left[CoF_6\right]^{3-}$ : Outer orbital complex, $d^2sp^3$ hybridization

(D) $\left[FeF_6\right]^{3-}$ : Outer orbital complex, $sp^3\ d^2$ hybridization

(E) $\left[Ni(CN)_4\right]^{2-}$ : Inner orbital complex , $sp^3$ hybridization

Choose the correct answer from the given options.

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

**Ans.** **[3]**

**Sol.** (A) $Co^{3+}$ 3 $d^6 t_{2g}^{2,2,2} e_g^{0,0}$ $d^2sp^3$ Inner orbital complex

(B) $Mn^{3+}$ 3 $d^4 t_{2g}^{1,1,1} e_g^{1,0} sp^3\ d^2$ Outer orbital complex

(C) $Co^{3+}$ 3 $d^6 t_{2g}^{2,1,1} e_g^{1,1} sp^3\ d^2$ Outer orbital complex

(D) $Fe^{3+}$ 3 $d^5, t_{2g}^{1,1,1} e_g^{1,1}\ sp^3\ d^2$ Outer orbital complex

(E) $Ni^{2+}$ 3 $d^8$ Square planar $dsp^2$ Inner orbital complex

**23.** Electronegativity difference between a group 15 element and P is less than electronegativity difference between another group 15 element and P. Those group 15 elements respectively are :

(1) Bi, N (2) Sb, As (3) Sb, Bi (4) N, As

**Ans.** **[1]**

**Sol.**

| | EN |
|---|---|
| N | 3.0 |
| P | 2.1 |
| As | 2.0 |
| Sb | 1.9 |
| Bi | 1.9 |

**24.** Which of the following are isobars?

(1) $^{232}_{92}U$ and $^{238}_{92}U$ (2) $^{3}_{1}H$ and $^{2}_{1}H$ (3) $^{3}_{1}H$ and $^{3}_{2}He$ (4) $^{14}_{7}N$ and $^{15}_{7}N$

**Ans.** **[3]**

**Sol.** Isobars have same mass number.

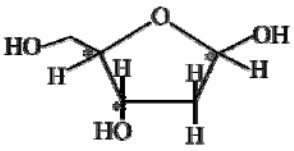
**25.** Both DNA and RNA are chiral molecules. The chirality in DNA and RNA arises due to the presence of :

(1) D-sugar component (2) Phosphodiester linkage

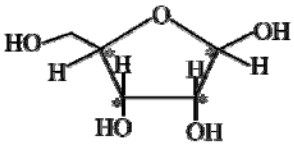
(3) L-sugar component (4) Nitrogenous bases

**Ans.** **[1]**

**Sol.**




2-Deoxyribose




D-ribose

CAREER POINT

# JEE Main Online Exam 2026

## Memory Based

## Questions & Solution

### 23rd January 2026 | Evening

## MATHEMATICS

**1.** If $\vec{a},\vec{b},\vec{c}$ are three vectors such that $\vec{a}\times\vec{b}=2(\vec{a}\times\vec{c})$, $|\vec{a}|=1,|\vec{b}|=4,|\vec{c}|=2$ and angle between $\vec{b}$ & $\vec{c}$ is $60^\circ$, then find $|\vec{a}\cdot\vec{c}|$ :

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

**Ans.** **[2]**

**Sol.** $\vec{a}\times\vec{b}-2(\vec{a}\times\vec{c})=0$

$\vec{a}\times(\vec{b}-2\vec{c})=0\Rightarrow\vec{b}-2\vec{c}=\lambda\vec{a}$

$|\lambda a|^2=|\vec{b}-2\vec{c}|^2\Rightarrow\lambda^2|\vec{a}|^2=b^2+4c^2-4\vec{b}\cdot\vec{c}$

$\lambda^2=16+16-4.4.2\cdot\frac{1}{2}$

$\lambda^2=16$

$\lambda=\pm4$

$\because\vec{b}-2\vec{c}=\pm4\vec{a}$

Dot with $\vec{c}\Rightarrow\vec{b}\cdot\vec{c}-2|\vec{c}|^2=\pm4(\vec{a}\cdot\vec{c})$

$4.2.\frac{1}{2}-2.4=\pm4(\vec{a}.\vec{c})$

$|\vec{a}.\vec{c}|=1$

**2.** If $z=\frac{\sqrt{3}}{2}+\frac{i}{2}$, then $\left(z^{201}-i\right)^8$ is -

(1) 0 (2) 256 (3) 1 (4) –1

**Ans.** **[2]**

**Sol.** $z=\cos\frac{\pi}{6}+i\sin\frac{\pi}{6}$

$z^{201}=\cos\left(201\frac{\pi}{6}\right)+i\sin\left(201\frac{\pi}{6}\right)=-i$

$\left(z^{201}-i\right)^8=(-2i)^8=256$

**3.** If matrices A & B are such that $A=\begin{bmatrix}0 & -2 & 3\\ -2 & 0 & 1\\ -1 & 1 & 0\end{bmatrix}$, $B(I-A)=(I+A)$, then find B .

(1) $B=\begin{bmatrix}-1 & 2/3 & 2/3\\ -2 & 5/3 & -10/3\\ -2 & 2 & -3\end{bmatrix}$ (2) $B=\begin{bmatrix}-1 & 1/3 & 1/3\\ -2 & 5/3 & -10/3\\ -2 & 2 & -3\end{bmatrix}$

(3) $B=\begin{bmatrix}-1 & 0 & 2/3\\ 0 & 5/3 & -10/3\\ 2 & 2 & -3\end{bmatrix}$ (4) $B=\begin{bmatrix}-1 & 2/3 & 2/3\\ -2/3 & 1 & 5/3\\ -2 & 2 & -3\end{bmatrix}$

**Ans.** **[1]**

**Sol.** $I-A=\begin{bmatrix}1 & 2 & -3\\ 2 & 1 & -1\\ 1 & -1 & 1\end{bmatrix}, I+A=\begin{bmatrix}1 & -2 & 3\\ -2 & 1 & 1\\ -1 & 1 & 1\end{bmatrix}$

$|(I-A)|=1(0)-2(3)-3(-3)$

$=-6+9=3$

$(I-A)^{-1}=\frac{1}{3}\begin{bmatrix}0 & 1 & 1\\ -3 & 4 & -5\\ -3 & 3 & -3\end{bmatrix}$

$B=(I+A)(I-A)^{-1}$

$B=\frac{1}{3}\begin{bmatrix}1 & -2 & 3\\ -2 & 1 & 1\\ -1 & 1 & 1\end{bmatrix}\begin{bmatrix}0 & 1 & 1\\ -3 & 4 & -5\\ -3 & 3 & -3\end{bmatrix}$

$B=\frac{1}{3}\begin{bmatrix}-3 & 2 & 2\\ -6 & 5 & -10\\ -6 & 6 & -9\end{bmatrix}$

$B=\begin{bmatrix}-1 & 2/3 & 2/3\\ -2 & 5/3 & -10/3\\ -2 & 2 & -3\end{bmatrix}$

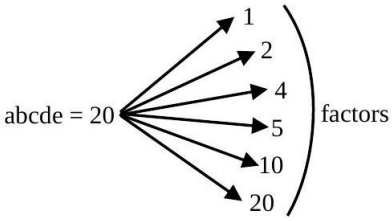
**4.** Let S = number of 4 digit numbers abcd, where

a > b > c > d & P = number of 5 digit numbers abcde, where product of digits is 20 , then S + P =

**Ans.** **[260]**

**Sol.** $S={}^{10}C_4=210$

For P ∴



$\therefore$ **Case -(1)** $54111 \Rightarrow \frac{5!}{3!} = 20$

**Case -(2)** $52211 \Rightarrow \frac{5!}{2!2!} = 30$

$\therefore P = 20 + 30 = 50$

$\therefore S + P = 260$

**5.** If $y = f(x)$ satisfies the differential equation

$(x^2 - 4)y' - 2xy + 2x(4 - x^2)^2 = 0$ and $f(3) = 15$, then find local maximum value of $f(x)$

(1) 16 (2) 20 (3) 25 (4) 30

**Ans.** **[1]**

**Sol.** $\frac{(x^2 - 4)\frac{dy}{dx} - 2xy}{(4 - x^2)^2} = -2x$

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

$\therefore \frac{y}{x^2 - 4} = -x^2 + C$

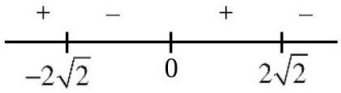
$\{(3,15) \Rightarrow \frac{15}{5} = -9 + C \Rightarrow C = 12\}$

$\Rightarrow \frac{y}{x^2 - 4} = 12 - x^2$

$\Rightarrow y = (x^2 - 4)(12 - x^2)$

$y' = (x^2 - 4)(-2x) + (12 - x^2) \cdot 2x$

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




Local maximum value of

$f(x) = f(\pm 2\sqrt{2})$

$= (8 - 4)(12 - 8) = 16$

**6.** Let sets $A : \{x : ||x - 3| - 3| \le 1\}, x \in z$.

set $B$ : $\left\{x : x \in R(x \ne 1,2) \frac{(x-2)(x-4)}{(x-1)} \log_e |x - 2| = 0\right\}$ then number of onto functions from $A \to B$.

(1) 61 (2) 62 (3) 63 (4) 64

**Ans.** **[2]**

**Sol.** $A : ||x - 3| - 3| \le 1$

$\Rightarrow -1 \le |x - 3| - 3 \le 1$

$2 \le |x-3| \le 4$

$2 \le (x-3) \le 4$ or $-4 \le (x-3) \le -2$

$5 \le x \le 7$ or $-1 \le x \le 1$

$A = \{-1,0,1,5,6,7\}$

$B \Rightarrow x = 4, |x-2| = 1 \Rightarrow x = 3$ or 1 (reject) +

$B = \{4,3\}$

Number of onto functions from A to $B = 2^6 - 2 = 62$

**7.** If $\sum_{k=1}^{n} a_k = \alpha n^2 + \beta n$ & $a_{10} = 59, a_6 = 7a_1$, then find $\alpha + \beta$ :

(1) 5 (2) 10 (3) 8 (4) 3

**Ans.** **[1]**

**Sol.** $\because S_n = \alpha n^2 + \beta n$

$\therefore a_n = S_n - S_{n-1} = \alpha\left(n^2 - (n-1)^2\right) + \beta(1)$

$= (2n-1)\alpha + \beta$

$\because a_{10} = 59 \Rightarrow 19\alpha + \beta = 59$ .....(1)

$a_1 = \alpha + \beta$

$a_6 = 11\alpha + \beta$

$\because a_6 = 7a_1$

$11\alpha + \beta = 7\alpha + 7\beta$

$4\alpha = 6\beta$

$2\alpha = 3\beta$ .....(2)

From (1) & (2)

$19\alpha + \frac{2\alpha}{3} = 59$

$\alpha = 3 \Rightarrow \beta = 2$

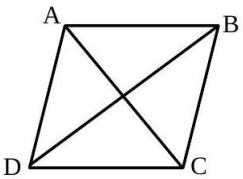
$\therefore \alpha + \beta = 5$

**8.** Rhombus ABCD is given with vertices $A(1,2)$, $C(-3,-6)$ and sides AD & BC are parallel to the line $7x - y = 14$. If coordinates of $B$ & $C$ are $(\alpha,\beta)$ & $(\gamma,\delta)$ respectively, then find $\alpha + \beta + \gamma + \delta =$ ?

(1) –4 (2) 5 (3) –6 (4) –7

**Ans.** **[3]**

**Sol.** Mid points of BD & AC are same




As $\frac{\alpha+\gamma}{2} = \frac{1+(-3)}{2}, \frac{\beta+\delta}{2} = \frac{2+(-6)}{2}$

$\alpha + \gamma = -2,\ \beta + \delta = -4$

$\alpha + \beta + \gamma + \delta = -6$

**9.** Number of ways of distributing 16 identical oranges among 4 persons such that each one gets atleast one oranges is

(1) 435 (2) 455 (3) 470 (4) 489

**Ans.** **[2]**

**Sol.** $x_1 + x_2 + x_3 + x_4 = 16$

Number of positive integral solution

$= {}^{15}C_3 = 455$

**10.** If $\cot\theta = -\frac{1}{2\sqrt{2}}$ where $\theta \in \left(\frac{3\pi}{2}, 2\pi\right)$ then value of $\sin\left(\frac{15\theta}{2}\right)(\sin 8\theta + \cos 8\theta) + \cos\left(\frac{15\theta}{2}\right)(\cos 8\theta - \sin 8\theta)$ is :

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

**Ans.** **[2]**

**Sol.** $\cos\left(8\theta - \frac{15\theta}{2}\right) + \sin\left(\frac{15\theta}{2} - 8\theta\right)$

$\cos\frac{\theta}{2} - \sin\frac{\theta}{2} = -\sqrt{1-\sin\theta}$

$= -\sqrt{1+\frac{2\sqrt{2}}{3}}$

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

**11.** If the point of intersection of ellipses $x^2 + 2y^2 - 6x - 12y + 23 = 0$ and $4x^2 + 2y^2 - 20x - 12y + 35 = 0$ lie on a circle of radius $r$ and centre $(a,b)$, then the value of $ab + 18r^2$ is

(1) 90 (2) 95 (3) 85 (4) 100

**Ans.** **[2]**

**Sol.** $4x^2 + 2y^2 - 20x - 12y + 35 = 0$

$\frac{2\left(x^2 + 2y^2 - 6x - 12y + 23\right) = 0}{6x^2 + 6y^2 - 32x - 36y + 81 = 0}$

$x^2 + y^2 - \frac{16}{3}x - 6y + \frac{27}{2} = 0$

$(a,b) \equiv \left(\frac{8}{3}, 3\right)$

$r = \sqrt{\frac{64}{9} + 9 - \frac{27}{2}} = \sqrt{\frac{87}{18}}$

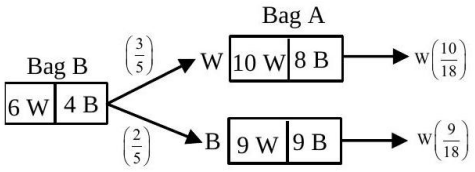
$r^2 = \frac{87}{18} \Rightarrow 18r^2 = 87$

Now, $ab + 18r^2 = 8 + 87 = 95$

**12.** Bag A contains 9 White & 8 Black balls and bag B contains 6 White & 4 Black balls. A ball is randomly transferred from bag B to bag A then a ball is drawn from bag A. If probability that drawn ball is White, is $\frac{p}{q}$ (Where $p \& q$ are coprime), then $(p+q)$ is

**Ans.** **[23]**

**Sol.**




$$\therefore P(\text{ Drawn ball is white }) = \frac{3}{5}\times\frac{10}{18}+\frac{2}{5}\times\frac{9}{18}=\frac{48}{90}=\frac{8}{15}=\frac{p}{q}$$

$$\therefore p+q=23$$

**13.** If PQ is a chord perpendicular to the transverse axis of $\frac{x^2}{4}-\frac{y^2}{b^2}=1$ of eccentricity $\sqrt{3}$ such that $\Delta OPQ$ is equilateral $\Delta$ (where O is the origin), then area of $\Delta OPQ$ is :

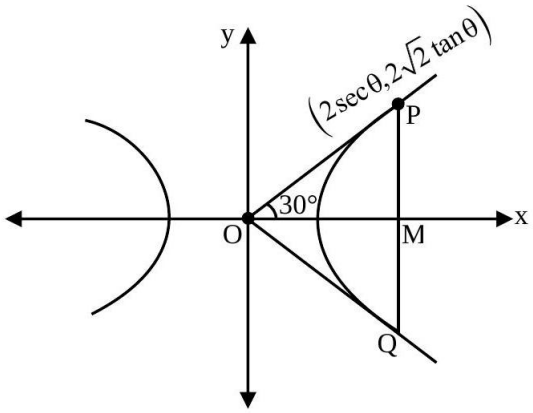
(1) $\frac{4}{5}\sqrt{3}$ (2) $\frac{2}{5}\sqrt{3}$ (3) $\frac{8}{5}\sqrt{3}$ (4) $\frac{16\sqrt{3}}{5}$

**Ans.** **[3]**

**Sol.** $e=\sqrt{1+\frac{b}{4}}=\sqrt{3}$

$$\Rightarrow b=8$$

$\therefore$ Hyperbola $\frac{x^2}{4}-\frac{y^2}{8}=1$




$$\frac{PM}{OM}=\tan 30^\circ$$

$$\Rightarrow \frac{2\sqrt{2}\tan\theta}{2\sec\theta} = \frac{1}{\sqrt{3}} \Rightarrow \sin\theta = \frac{1}{\sqrt{6}}$$

$$\text{Area} = 2 \times \frac{1}{2} \times OM \times MP$$

$$= 2\sec\theta \times 2\sqrt{2}\tan\theta$$

$$= 4\sqrt{2}\frac{\sin\theta}{\cos^2\theta} = 4\sqrt{2} \times \frac{1}{\sqrt{6} \times \left(1 - \frac{1}{6}\right)} = \frac{8\sqrt{3}}{5}$$

**14.** Let $A = \{1,2,3,\ldots,9\} : xRy$, if

$|(x-y)|$ is multiple of 3.

$S_1$ : Number of elements in R is 36

$S_2 : R$ is equivalence relation.

(1) $S_1$ & $S_2$ both correct

(2) $S_1$ & $S_2$ is correct, but $S_2$ not correct

(3) $S_2$ is correct, but $S_1$ is not correct

(4) $S_1$ & $S_2$ both incorrect

**Ans.** **[3]**

**Sol.** Number of numbers of form $3n \Rightarrow 3$

Number of numbers of form $3n+1 \Rightarrow 3$

Number of numbers of form $3n+2 \Rightarrow 3$

Number of ordered pairs $(x,y) = 3(3\times 3) = 27$

$S_1$ false

$\Rightarrow xRy \Leftrightarrow yRx$

$\Rightarrow (x-y) = 3\lambda, (y-z) = 3\mu$

$\Rightarrow (x-z) = 3(\lambda+\mu)$

R is reflexive, symmetric & transitive

$S_2$ is true

Ans. $S_1$ is false but $S_2$ is true

**15.** The minimum value of $\cos^2\theta + 6\sin\theta\cos\theta + 3\sin^2\theta + 3$ is :

(1) $-1$ (2) 1 (3) $5+\sqrt{10}$ (4) $5-\sqrt{10}$

**Ans.** **[4]**

**Sol.** $3(2\sin\theta\cos\theta) + 2\sin^2\theta + (\cos^2\theta + \sin^2\theta) + 3$

$= 3\sin 2\theta + (1 - \cos 2\theta) + 4$

$= 5 + (3\sin 2\theta - \cos 2\theta)$

So, minimum value $= 5 - \sqrt{9+1}$

$= 5 - \sqrt{10}$

**16.**

| **Class** | 4 – 8 | 8 – 12 | 12 – 16 | 16 – 20 |
|---|---|---|---|---|
| **Freq.** $(f_i)$ | 3 | $\lambda$ | 4 | 7 |

The mean and variance of following data is $\mu$ & 19 respectively & $\mu$ is an integer. The value of $(\lambda+\mu)$ is

(1) 19 (2) 20 (3) 13 (4) 17

**Ans.** **[1]**

**Sol.** $\mu=\dfrac{\sum f_i x_i}{\sum f_i}=\dfrac{18+10\lambda+56+126}{14+\lambda}$

$=\dfrac{200+10\lambda}{\lambda+14}=10+\left(\dfrac{60}{\lambda+14}\right)$

$\lambda+14$ is multiply of $60 \Rightarrow \lambda=1$ or 6 or 16 .

$\sigma^2=\dfrac{\sum x_1^2}{\lambda+14}-(\mu)^2$

$\sigma^2=\dfrac{6^2(3)+10^2(\lambda)+14^2(4)+(18)^2(7)}{\pi+14}-\mu^2$

for $\lambda=6, \mu=10+3=13$

$\lambda+\mu=19$

**17.** Sum of solutions of the equation $\log_{x+3}\left(6x^2+28x+30\right)=5-2\log_{6x+10}\left(x^2+6x+9\right)$, are :

(1) 0 (2) 1 (3) 2 (4) 3

**Ans.** **[1]**

**Sol.** $\log_{x+3}\left[(x+3)(6x+10)\right]=5-2\log_{6x+10}(x+3)^2$

$1+\log_{x+3}(6x+10)=5-4\log_{6x+10}(x+3)$

Let $\log_{6x+10}(x+3)=t$

$$1+\frac{1}{t}=5-4t$$

$$t+1=5t-4t^2 \Rightarrow 4t^2-4t+1=0$$

$$\Rightarrow (2t-1)^2=0 \Rightarrow t=\frac{1}{2}$$

$\therefore \log_{6x+10}(x+3)=\dfrac{1}{2} \Rightarrow x+3=(6x+10)^{1/2}$

$\Rightarrow x^2+6x+9=6x+10$

$\Rightarrow x=1,-1$

So, sum of solution $=0$

**18.** If $I(x)=3\int \dfrac{dx}{(4x+6)\sqrt{4x^2+8x+3}}, I(0)=\dfrac{\sqrt{3}}{4}$, then $I(1)=$

(1) $\dfrac{3\sqrt{15}}{20}$ (2) $\dfrac{3\sqrt{15}}{10}$ (3) $\dfrac{\sqrt{15}}{10}$ (4) $\dfrac{\sqrt{15}}{20}$

**Ans.** **[1]**

**Sol.** Let $4x+6=\frac{1}{t}$

$$dx=\frac{-dt}{4t^2}$$

$$I=\frac{-3}{4}\int\frac{dt}{t^2\times\frac{1}{t}\times\sqrt{\left(\frac{\frac{1}{t}-6}{4}\right)^2+2\left(\frac{1}{t}-6\right)+3}}$$

$$=\frac{-3}{4}\int\frac{dt}{t\sqrt{\frac{1}{4}\left(\frac{1-6t}{t}\right)^2+\frac{2}{t}-9}}$$

$$=\frac{-3}{2}\int\frac{dt}{\sqrt{1-4t}}$$

$$=\frac{-3}{2}\times\frac{-1}{4}\times\frac{(1-4t)^{\frac{1}{2}}}{\frac{1}{2}}+C$$

$$=\frac{3}{4}\sqrt{1-4t}+C=\frac{3}{4}\sqrt{1-\frac{4}{4x+6}}+C$$

$$I(0)=\frac{3}{4}\sqrt{1-\frac{2}{3}}+C=\frac{\sqrt{3}}{4}\Rightarrow C=0$$

$$I(x)=\frac{3}{4}\sqrt{1-\frac{4}{4x+6}}$$

$$\therefore I(1)=\frac{3}{4}\times\sqrt{\frac{6}{10}}=\frac{3\sqrt{6}}{4\sqrt{10}}=\frac{3\sqrt{60}}{40}=\frac{3\sqrt{15}}{20}$$

**19.** The system of linear equations

$x+y+z=6$

$2x+5y+az=36$

$x+2y+3z=b$

(1) Infinitely many solutions for $a=8$ & $b=16$

(2) Unique solution for $a=8$ & $b=16$

(3) Unique solution for $a=8$ & $b=14$

(4) Infinitely many solutions for $a=8$ & $b=14$

**Ans.** **[4]**

**Sol.** If $D=\begin{vmatrix}1&1&1\\2&5&a\\1&2&3\end{vmatrix}=0\Rightarrow a=8$

If $D_1 = \begin{vmatrix} 6 & 1 & 1 \\ 36 & 5 & a \\ b & 2 & 3 \end{vmatrix} = 0 \Rightarrow ab - 5b - 12a + 54 = 0$

If $D_2 = \begin{vmatrix} 1 & 6 & 1 \\ 2 & 36 & a \\ 1 & b & 3 \end{vmatrix} = 0 \Rightarrow ab - 6a - 2b - 36 = 0$

If $D_3 = \begin{vmatrix} 1 & 1 & 6 \\ 2 & 5 & 36 \\ 1 & 2 & b \end{vmatrix} = 0 \Rightarrow b = 14$

For $a = 8$ & $b = 14 \Rightarrow D_1$ & $D_2$ are also zero

For $a = 8$ & $b = 14 \Rightarrow D = D_1 = D_2 = D_3 = 0$

$\Rightarrow$ infinitely many solutions.

**20.** $\int_0^x t^2 \sin(x-t)\,dt = x^2$, then sum of values of $x$ where $x \in [0,100]$

(1) $300\pi$ (2) $272\pi$ (3) $200\pi$ (4) $240\pi$

**Ans.** **[4]**

**Sol.** $\int_0^x (x-t)^2 \sin t\,dt = x^2$

$\int_0^x \left(x^2 - 2xt + t^2\right)\sin t\,dt = x^2$

$x^2(-\cos t)_0^x - 2x\int_0^x t\sin t\,dt + \int_0^x t^2 \sin t\,dt = x^2$

$-x^2(\cos x - 1) - 2x(-t\cos t + \sin t)_0^x + \left(t^2(-\cos t)\right)_0^x + \int_0^x 2t\cos t\,dt = x^2$

$-x^2\cos x + x^2 - 2x(-x\cos x + \sin x) - x^2\cos x + 2(t\sin t + \cos t)_0{}^x = x^2$

$-x^2\cos x + x^2 + 2x^2\cos x - 2x\sin x - x^2\cos x + 2(x\sin x + \cos x - 1) = x^2$

$x^2 + 2\cos x - 2 = x^2$

$\cos x = 1$

$x = 2m\pi,\ m \in I$

$0 + 2\pi + 4\pi + \ldots + 30\pi$

$= 2\pi(1 + 2 + \ldots + 15)$

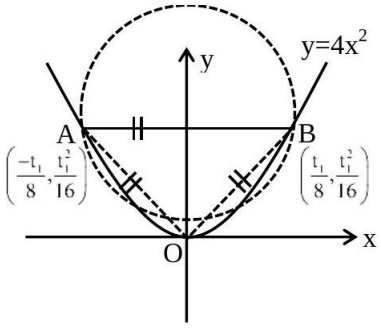
$= 2\pi \cdot \frac{15 \cdot 16}{2} = 240\pi$

**21.** An equilateral triangle OAB is inscribed in the parabola $y = 4x^2$ whose vertex is O . Find the least distance of the circle described on AB as diameter from the origin.

(1) $\frac{6-\sqrt{3}}{2}$ (2) $\frac{3-\sqrt{3}}{4}$ (3) $\frac{6+\sqrt{3}}{2}$ (4) $\frac{3+\sqrt{3}}{2}$

**Ans.** **[2]**

**Sol.**




$OB^2 = AB^2$

$\Rightarrow \frac{t_1^2}{64} + \frac{t_1^4}{256} = \frac{t_1^2}{16}$

$\Rightarrow 4t_1^2 + t_1^4 = 16t_1^2$

$\Rightarrow t_1 = 2\sqrt{3}$

$\therefore A\left(\frac{-\sqrt{3}}{4}, \frac{3}{4}\right)$ & $B\left(\frac{\sqrt{3}}{4}, \frac{3}{4}\right)$

Midpoint of AB i.e. centre of circle is $\left(0, \frac{3}{4}\right)$ and radius $= \frac{\sqrt{3}}{4}$

$\therefore OP = OM - r = \frac{3}{4} - \frac{\sqrt{3}}{4} = \frac{3-\sqrt{3}}{4}$

**22.** $f(x) = \begin{cases} \frac{a|x| + 2x^2 - 2\sin|x|\cos|x|}{x} & ; x \neq 0 \\ b & ; x = 0 \end{cases}$

If $f(x)$ is continuous then value of $a + b$ is equal to

(1) 2 (2) 3 (3) 4 (4) 5

**Ans.** **[1]**

**Sol.** $\lim_{x\to 0}\left(\frac{a|x| + 2x^2 - 2\sin|x|\cos|x|}{x}\right)$

$f(0^+) = a - 2$

$f(0^-) = -a + 2$

for continuity

$a - 2 = -a + 2 = b \Rightarrow a = 2$ & $b = 0$

so $a + b = 2$

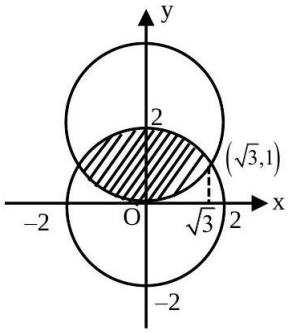
**23.** Find the area bounded by the curves $x^2 + y^2 = 4$ & $x^2 + (y-2)^2 = 4$

(1) $\frac{8\pi}{3} - 2\sqrt{3}$ Sq. units (2) $\frac{8\pi}{3} + \sqrt{3}$ Sq. units

(3) $\frac{4\pi}{3} - 2\sqrt{3}$ Sq. units (4) $\frac{4\pi}{3} + 2\sqrt{3}$ Sq. units

**Ans.** **[1]**

**Sol.**




$$A = 2\int_0^{\sqrt{3}} \left[\sqrt{4-x^2} - \left(2 - \sqrt{4-x^2}\right)\right] dx$$

$$= 2\int_0^{\sqrt{3}} \left(2\sqrt{4-x^2} - 2\right) dx$$

$$= 4\int_0^{\sqrt{3}} \left(\sqrt{4-x^2} - 1\right) dx$$

$$= \left[4\left[\frac{1}{2}\left(x\sqrt{4-x^2} + 4\sin^{-1}\frac{x}{2}\right) - x\right]\right]_0^{\sqrt{3}}$$

$$= 4\left[\frac{1}{2}\left(\sqrt{3} + 4\times\frac{\pi}{3}\right) - \sqrt{3}\right] = 4\left[\frac{2\pi}{3} - \frac{\sqrt{3}}{2}\right]$$

$$= \frac{8\pi}{3} - 2\sqrt{3} \text{ (Sq. units)}$$