JEE–MAIN EXAMINATION – APRIL 2026
MEMORY BASED QUESTIONS

(HELD ON WEDNESDAY 08th APRIL 2026) **TIME : 3:00 PM TO 6:00 PM**

PHYSICS	TEST PAPER WITH SOLUTION

1. There are two projectiles thrown at angles θ_1 & θ_2 such that their ranges are same. Their speed of projection are also same and time periods are 10 sec and 5 sec respectively. Find range.

(1) 250 m (2) 300 m

(3) 650 m (4) 100 m

Ans. (1)

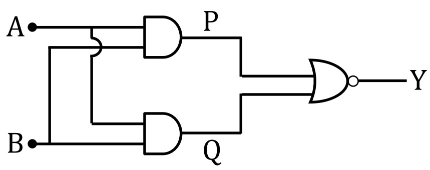
Sol. For range to be same angle of projection must be complementary angles.

$$T_1 = \frac{2u\sin\theta}{g} = 10,\ T_2 = \frac{2u\cos\theta}{g} = 5$$

$$\text{Range} = \frac{2(u\sin\theta)(u\cos\theta)}{g}$$

$$= \frac{2(50)(25)}{10}\text{m} = 250\,\text{m}$$

2. For the logic gate shown in the diagram, find the output Y for the given input A and B.



(1) $A.\overline{B}$

(2) $\overline{A}+\overline{B}$

(3) $\overline{A+B}$

(4) $\overline{A}.\overline{B}$

Ans. (2)

Sol. $\left.\begin{matrix} P = A\cdot B \\ Q = A\cdot B \end{matrix}\right)$ AND gate

$$Y = \overline{P+Q}\ \text{(NOR gate)}$$

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

$$Y = \overline{(A\cdot B)}\times\overline{(A\cdot B)}$$

$$Y = \overline{(A\cdot B)}$$

$$Y = \overline{A}+\overline{B}$$

3. A block is attached to a spring and it oscillates with natural frequency f_1. If the spring is cut in two equal half and only one of the half spring is connected to the block then the frequency becomes f_2. Find f_2/f_1.

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

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

Ans. (1)

Sol. Frequency of spring block system is $f_1 = \frac{1}{2\pi}\sqrt{\frac{K}{m}}$

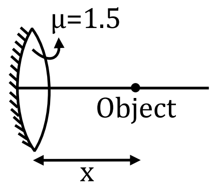
Now if spring is cut into two equal parts spring constant becomes 2K of each part.

Now frequency of spring block is $f_2 = \frac{1}{2\pi}\sqrt{\frac{2K}{m}}$

$$f_2 = \sqrt{2}f_1$$

$$\frac{f_2}{f_1} = \sqrt{2}$$

4. A biconvex lens having radius of curvature 20 cm for both surfaces and one side of lens is silvered as shown in figure. Object is at distance x cm from lens. Find x such that image is on the object itself.



Ans. (10)

Sol. Combination of lens + mirror

$$f_m = \frac{R}{2} = -10\text{cm}\ ;\ f_L = \frac{R}{2(\mu-1)} = 20\text{cm}$$

$$\frac{1}{F} = \frac{1}{f_m} - \frac{2}{f_L}$$

$$\frac{1}{F} = \frac{-1}{10} - \frac{2}{20} = -\frac{1}{5}$$

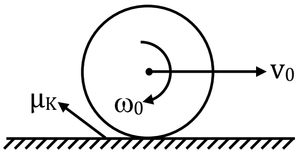
F = –5 cm

To form image at the position of object

u = 2f = 2 × 5 = 10 cm

x = 10 cm

5. A solid cylinder of mass m and radius R is projected on a rough surface having kinetic friction co-efficient μ_K with velocity v_0 and angular velocity ω_0 as shown in figure. Find out time after which rolling starts. ($\omega_0 = v_0/4R$)



(1) $\frac{3\omega_0 R}{\mu_K g}$

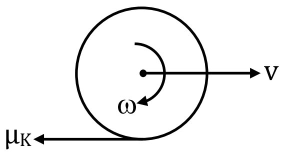
(2) $\frac{2\omega_0 R}{\mu_K g}$

(3) $\frac{\omega_0 R}{\mu_K g}$

(4) $\frac{\omega_0 R}{3\mu_K g}$

Ans. **(3)**

Sol.



$a = \frac{\mu_K mg}{m} = \mu_K g$

$\tau = \mu_K mgR = \frac{MR^2}{2} \times \alpha$

$\Rightarrow \alpha = \frac{2\mu_K g}{R}$

$\therefore\ v = v_0 - \mu_K gt$

Also, $\omega = \omega_0 + \frac{2\mu_K gt}{R}$

For rolling $v = \omega R$

$\Rightarrow v_0 - \mu_K gt = \omega_0 R + 2\mu_K gt$

$\Rightarrow 4\omega_0 R - \omega_0 R = 3\mu_K gt$

$\Rightarrow t = \frac{\omega_0 R}{\mu_K g}$

6. A new unit (α) of length is chosen such that it is equal to the distance travelled by light in vacuum in 1 second. What is distance d between Venus and Earth in terms of this new unit. If light takes 6 min 40 sec to cover the distance.

Ans. **(400)**

Sol. $n_1 v_1 = n_2 v_2$

$1 \times L_1 = 3 \times 10^8 \times 1$ m

$L_1 = 3 \times 10^8$ m

$d = v \times t = 3 \times 10^8 \times (6 \times 60 + 40)$

$= 3 \times 10^8 \times 400 = 12 \times 10^{10}$ m

$n_1 v_1 = n_2 v_2$

$n_1 L_1 = 12 \times 10^{10}$ m

$n_1 \times 3 \times 10^8$ m $= 12 \times 10^{10}$ m

$n_1 = 400$ unit

7. Find dipole moment of a system consisting of charge $q_1 = 3\ \mu C$ and $q_2 = -9\ \mu C$ with position coordinate as $\vec{r}_1 = 2\hat{i} + 3\hat{j} + 3\hat{k}$ and $\vec{r}_2 = \hat{i} + \hat{j} + \hat{k}$ respectively.

(1) $-3\hat{i}$ μC-m
(2) $-9\hat{i}$ μC-m
(3) $-6\hat{i}$ μC-m
(4) $-5\hat{i}$ μC-m

Ans. **(1)**

Sol. $\vec{P} = q_1\vec{r}_1 + q_2\vec{r}_2$

$\Rightarrow 6\hat{i} + 9\hat{j} + 9\hat{k} - 9\hat{i} - 9\hat{j} - 9\hat{k}$

$\Rightarrow -3\hat{i}$ μC-m

8. If $H = \frac{\varepsilon^r . E^p . x^q}{t^s}$ find p, q, r and s

H → Magnetic field

ε → Permittivity of medium

E → Electric field

x → distance

t → time

(1) r = 0, p = 1, q = –1, s = 1
(2) r = 1, p = –1, q = –1, s = 1
(3) r = 1, p = 1, q = +1, s = 1
(4) r = 0, p = –1, q = –1, s = 1

Ans. **(1)**

Sol. $[H] = [\varepsilon]^r [E]^p [x]^q - [t]^s$

$[M^1L^0T^{-2}A^{-1}] = [M^{-1}L^{-3}T^4A^2]^r\ [M^1L^1T^{-3}A^{-1}]^p\ [L^1]^q\ [T^1]^s$

$[M^1L^0T^{-2}A^{-1}] = [M^{-r+p}.L^{-3r+p+q}.T^{4r-3p+s}.A^{2r-p}]$

Compare power

$p - r = 1$ ...(1)

$-3r + p + q = 0$ ...(2)

$4r - 3p + s = -2$ ...(3)

$2r - p = -1$ ...(4)

on solving

$\{r = 0\}$

$\{p = 1\}$

$\{q = -p = -1\}$

$\{s = 1\}$

9. Two photons of wavelength λ and 2λ are incident on a metal surface and emits photoelectrons of maximum kinetic energies 3k and k. Find work function of metal

(1) $\frac{hc}{4\lambda}$ (2) $\frac{hc}{2\lambda}$

(3) $\frac{2hc}{3\lambda}$ (4) $\frac{hc}{\lambda}$

Ans. **(1)**

Sol. $\frac{hc}{\lambda} = W + 3K$

$\frac{hc}{2\lambda} = W + K$

$\Rightarrow \frac{hc}{\lambda} - W = 3\left[\frac{hc}{2\lambda} - W\right]$

$\Rightarrow 2W = \frac{3hc}{2\lambda} - \frac{hc}{\lambda} = \frac{hc}{2\lambda}$

$\boxed{W = \frac{hc}{4\lambda}}$

10. A solenoid having length 30 cm. If there are 10 turns/cm and current through solenoid changes from 2A to 4A in 3.14 sec. Find emf induced. (Area is A)

(1) 0.24 A volt (2) 0.40 A volt

(3) 0.80 A volt (4) 0.20 A volt

Ans. **(1)**

Sol. $\ell = 0.3$ m

A = 1000 turns/m

total turn N = n. $\ell = 1000 \times 0.3 = 300$ turns

$\frac{di}{dt} = \frac{4-2}{3.14} = \frac{2}{3.14}$

Induced emf = $L\left|\frac{di}{dt}\right|$

& $(L)_{solenoid} = \mu_0 n^2 A\,\ell = \mu_0\, nNA$

$= (4\pi \times 10^{-7})\,(1000)^2 \times A \times 0.3$

$L = (1.2\pi \times 10^{-1})A$ H

$t = (L)\left|\frac{di}{dt}\right|$

$= (1.2\pi \times 10^{-1}) \times \frac{2}{3.14}$

$\boxed{t = 0.24A \text{ volt}}$

11. 1 mole of ideal diatomic gas is enclosed in a cylinder piston arrangement having cross-sectional area of piston $4cm^2$. If gas has only rotational modes and P_{atm} = 100 KPa, some amount of heat is added to the system as a result piston moves up slowly by 2.5 cm. If temperature changes by 1.2°C. Find heat given to gas.

(1) 19.9 J (2) 23.5 J

(3) 14.6 J (4) 10J

Ans. **(1)**

Sol. P = constant ; f = 2 (only rotational)

so $Q = nC_p\Delta T = n\left(\frac{f}{2} + 1\right)R\,\Delta T$

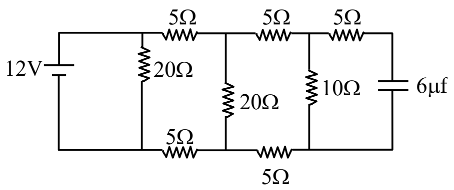
$= n(1 + 1)R\,\Delta T$

$Q = 2R\,\Delta T$

$= 2 \times 8.314 \times 1.2$ J

$= 19.95$ J

12.



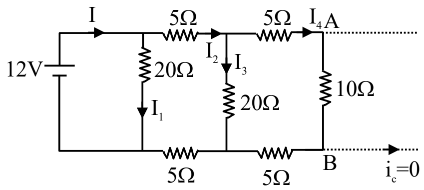
Find charge on capacitor at steady state.

(1) 18 μC (2) 16 μC

(3) 10 μC (4) 8 μC

Ans. **(1)**

Sol. at steady no current in capacitor



Req = 10Ω

so $I = \frac{12}{10} = 1.2A$

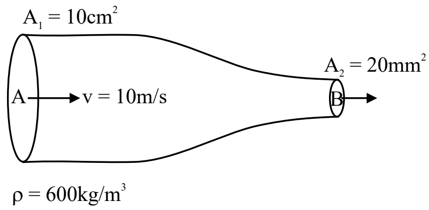
so $I_1 = I_2 = I/2 = 0.6$ A

$I_3 = I_4 = \frac{I_2}{2} = 0.3$ A

so $\Delta V_C = \Delta V_{AB} = I_4 \times 10 = 0.3 \times 10 = 3V$

so $q = C(\Delta V_C) = 6 \times 3\ \mu C = 18\ \mu C$

13.



Find pressure difference between A and B.

(1) 75 MPa (2) 85 MPa

(3) 95 MPa (4) 65 MPa

Ans. **(1)**

Sol. Using Bernoulli's theorem:-

$$P_A + \frac{1}{2}\rho V_A^2 = P_B + \frac{1}{2}\rho V_B^2 \quad \text{[same height]}$$

$(A)_A V_A = (A)_B V_B$ (continuity) equation

$10(10)^2 \times 10 = 20 \times V_B$

$V_B = 500$ m/s

$$P_A + \frac{1}{2}(600)(10)^2 = P_B + \frac{1}{2}(600)(500)^2$$

$$P_A - P_B = \frac{1}{2}(600)[(500)^2 - (10)^2]$$

$= 7497 \times 10^4$ Pa

$= 75$ MPa

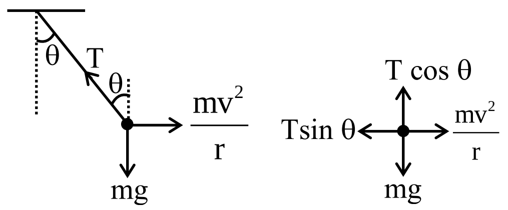
14. A car is moving in a circular path of radius 20 m with speed 54 km/hr. A pendulum is hanging from roof of car. Find angle made by pendulum with vertical. (Take $g = 10\ m/s^2$)

(1) $\tan^{-1}\left(\frac{9}{8}\right)$ (2) $\tan^{-1}\left(\frac{8}{9}\right)$

(3) $\tan^{-1}\left(\frac{4}{3}\right)$ (4) $\tan^{-1}\left(\frac{3}{4}\right)$

Ans. (1)

Sol.



$\tan\theta = \frac{v^2}{rg}$ $\left(v = 54 \times \frac{5}{18} = 15 m/s\right)$

$\tan\theta = \frac{225}{20 \times 10}$

$\tan\theta = \frac{9}{8}$

$\theta = \tan^{-1}\left(\frac{9}{8}\right)$

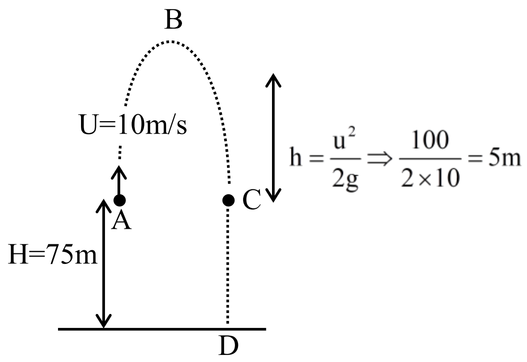
15. A balloon is moving with speed 10 m/s in upward direction. At height of 75 m a stone is released then find distance travelled by stone in air :

(1) 70 m (2) 80 m

(3) 85 m (4) 90 m

Ans. (3)

Sol.



So distance = AB + BC + CD

= 5 + 5 + 75

= 85

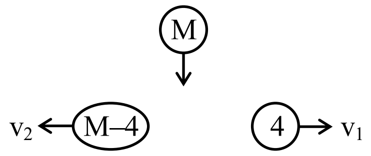
16. Two nuclei A(200 amu) & B (212 amu) undergoes α-decay and Q-value is same and equal to 1 Mev. Find ratio of KE of α-particle.

(1) $\frac{2597}{2600}$ (2) $\frac{2600}{2597}$

(3) $\frac{5200}{2597}$ (4) $\frac{2597}{5200}$

Ans. (1)

Sol.



$P_2 = P_1$

$\frac{KE_1}{KE_\alpha} \Rightarrow \frac{m_2}{m_1} = \frac{4}{m-4}$

$KE_\alpha = \frac{m-4}{m} \times Q$

$\frac{(KE_\alpha)_1}{(KE_\alpha)_2} \Rightarrow \frac{\frac{200-4}{200}}{\frac{212-4}{212}} \Rightarrow \frac{196}{200} \times \frac{212}{208} = \frac{2597}{2600}$

17. At t = 0 two particles A of mass 3.4 kg and B of mass 2.5 kg are moving along x-axis with initial velocity 5 m/s and 10 m/s respectively starting from x = 0. At t = 5s position of A is x = 104 m and of B is x = 137 m. Find the ratio of momentum at t = 10 s.

(1) 2.17 (2) 0.17

(3) 3.17 (4) 1.17

Ans. (4)

Sol. For particle A

$S = ut + \frac{1}{2}at^2$

$104 = 5 \times 5 + \frac{1}{2} \times a \times 25$

$\Rightarrow a = \frac{79 \times 2}{25}$

Velocity of A at t = 10s

$v_A = u_i + at$

$= 5 + \frac{79\times 2}{25}\times 10 = \frac{341}{5}$

For particle B

$S = ut + \frac{1}{2}at^2$

$137 = 10 \times 5 + \frac{1}{2} \times a \times 25$

$a = \frac{87\times 2}{25}$

Velocity of B at t = 10s

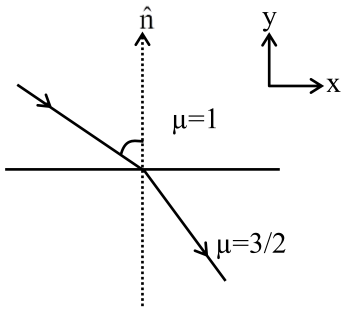
$v_B = u_i + at$

$= 10 + \frac{87\times 2}{25}\times 10 = \frac{398}{5}$

Ratio of momentum $\frac{P_A}{P_B} = \frac{m_A v_A}{m_B v_B} = \frac{3.4\times\frac{341}{5}}{2.5\times\frac{398}{5}}$

$= 1.165 \approx 1.17$

18. Incident ray is along $3\hat{i} - 2\hat{j}$ and refracted ray is along $c\hat{i} - 4\hat{j}$. Find c.



(1) 1.6 (2) 0.6

(3) 2.6 (4) 4

Ans. **(3)**

Sol. Normal is along y-axis

$\hat{e}(\text{unit vector along incident ray}) = \frac{3\hat{i}-2\hat{j}}{\sqrt{13}}$

$\hat{r}(\text{unit vector along refracted ray}) = \frac{c\hat{i}-4\hat{j}}{\sqrt{c^2+4^2}}$

$\hat{r}\times\hat{j} = c\hat{k}$

$\hat{e}\times\hat{j} = 3\hat{k}$

Using Snell's law

$\mu_1 \sin i = \mu_2 \sin r.$

$(\mu_1)\left|\frac{(\hat{e}\times\hat{n})}{|\hat{e}||\hat{n}|}\right| = (\mu_2)\left|\left(\frac{\hat{r}\times\hat{n}}{|\hat{r}||\hat{n}|}\right)\right|$

$(1)\ \frac{3}{\sqrt{3^2+2^2}} = \frac{3}{2}\frac{c}{\sqrt{c^2+16}}$

$13c^2 = 4c^2 + 64$

$9c^2 = 64$

$c = \frac{8}{3}$

19. A water droplet falls in air and attains terminal velocity v_1. If it splits into 64 identical droplets each having terminal velocity of v_2. Find $\frac{v_2}{v_1}$

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

(3) $\frac{1}{16}$ (4) $\frac{1}{32}$

Ans. **(3)**

Sol. $v_T = \frac{2}{9}\frac{r^2 g}{\eta}(\rho_s - \rho_\ell)$

$\therefore v_T \propto r^2$

$\therefore v_1 \propto r_1^2$

$v_2 \propto r_2^2$

$\therefore \frac{v_2}{v_1} = \left(\frac{r_2}{r_1}\right)^2$

By mass conservation

$\rho\ \frac{4}{3}\pi r_1^3 = 64\rho\ \frac{4}{3}\pi r_2^3$

$\therefore r_1 = 4r_2$

$\Rightarrow \frac{r_2}{r_1} = \frac{1}{4}$

$\therefore \frac{v_2}{v_1} = \frac{1}{16}$

20. Initial pressure and volume of monoatomic gas is P and V. It is expanded adiabatically to 27 times of initial volume. Find magnitude of change in internal energy.

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

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

Ans. (3)

Sol. $P_1V_1^{\gamma} = P_2V_2^{\gamma}$

$\gamma = \frac{5}{3}$

$PV^{5/3} = P_2 \times (27V)^{5/3}$

$P_2 = \frac{P}{(27)^{5/3}} = \frac{P}{3^5}$

$\Delta U \Rightarrow nC_v\Delta T = \frac{nR\Delta T}{(\gamma - 1)}$

$= \frac{P_2V_2 - P_1V_1}{(r-1)}$

$\Rightarrow \frac{\frac{P}{3^5} \times 3^3.V - PV}{\frac{5}{3} - 1} \Rightarrow \frac{-PV\left\{1 - \frac{1}{9}\right\}}{\frac{2}{3}}$

$= -PV \times \frac{8}{9} \times \frac{3}{2} \Rightarrow -\frac{4}{3}PV$

JEE–MAIN EXAMINATION – APRIL 2026
MEMORY BASED QUESTIONS

(HELD ON WEDNESDAY 08th APRIL 2026) **TIME : 3:00 PM TO 6:00 PM**

CHEMISTRY	TEST PAPER WITH SOLUTION

1. Calculate $|\Delta_r H°|$ for the following reaction (in kJ/mol) :

$2H_2S(g) + 3O_2(g) \rightarrow 2SO_2(g) + 2H_2O(\ell)$

$\Delta_f H°(H_2S,g) = -20.6$ kJ/mol

$\Delta_f H°(SO_2,g) = -296.8$ kJ/mol

$\Delta_f H°(H_2O,\ell) = -285.8$ kJ/mol.

Ans. (1124)

Sol. $\Delta_r H° = \Sigma\Delta H_f°(\text{product}) - \Sigma\Delta H_f°(\text{Reactant})$

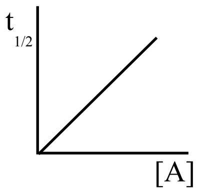
$\Delta_r H° = 2 \times \Delta H_f°(SO_2,g) + 2 \times \Delta H_f°(H_2O,\ell) - 2 \times \Delta H_f°(H_2S,s)$

$\Delta_r H° = 2 \times (-296.8) + 2 \times (-285.8) - 2(-20.6)$

$\Delta_r H° = -1124$ kJ/mol.

2. Statement-I : When temperature is increased from 298 K to 308 K, having $E_a = 12.72$ Kcal mol^{-1}, Rate constant (K) is doubled.

Statement-II : For a first (1st) order reaction A→B the following graph is valid.



(1) Both Statement I and Statement II are correct.
(2) Statement I is correct but Statement II is incorrect.
(3) Statement I is incorrect but Statement II is correct.
(4) Both Statement I and Statement II are incorrect.

Ans. (2)

Sol. S-I : $\ell n\left(\dfrac{K_2}{K_1}\right) = \dfrac{12.72 \times 10^3}{2}\left[\dfrac{10}{298 \times 308}\right]$

$\Rightarrow \ell n\left(\dfrac{K_2}{K_1}\right) = 0.693$

$\Rightarrow \dfrac{K_2}{K_1} = 2$

S-II : For 1st order

$\mathbf{t_{1/2}} = \dfrac{\ell n 2}{K}$; $t_{1/2} \propto [A]^0$ constant.

3. $E°_{Fe^{+2}/Fe} = x$ volts, $E°_{Fe^{+3}/Fe} = y$ volts.

Calculate $E°_{Fe^{+2}/Fe^{+3}}$ in volts.

(1) 3x – 2y (2) 3y – 2x
(3) 2x – 3y (4) 2y – 3x

Ans. (3)

Sol. (i) $Fe^{+2}(aq) + 2e^- \rightarrow Fe(s)$ ……. $\Delta G_1°$

(ii) $Fe^{+3}(aq) + 3e^- \rightarrow Fe(s)$ ……. $\Delta G_2°$

(iii) $Fe^{+2}(aq) \rightarrow Fe^{+3}(aq) + e^-$ ……. $\Delta G_3°$

iii = i – ii

$-E°_3 = -2E°_1 - (-3E°_2)$

$E°_3 = 2x - 3y$

4. $2XY \rightleftharpoons X_2 + Y_2$; $K_1 = 2.5 \times 10^{-5}$

$\frac{1}{2}Z_2 + XY \rightleftharpoons XYZ$; $K_2 = 5 \times 10^{-3}$

Calculate equilibrium constant for the following equilibrium.

$\frac{1}{2}X_2 + \frac{1}{2}Y_2 + \frac{1}{2}Z_2 \rightleftharpoons XYZ$

Ans. (1)

Sol. $X_2 + Y_2 \rightleftharpoons 2XY$, $K' = \dfrac{1}{2.5 \times 10^{-5}} = \dfrac{1}{25 \times 10^{-6}}$

$\frac{1}{2}X_2 + \frac{1}{2}Y_2 \rightleftharpoons XY$,

$$K'' = \left(\frac{1}{25 \times 10^{-6}}\right)^{1/2} \quad ……(1)$$

$\frac{1}{2}Z_2 + XY \rightleftharpoons XYZ$, $K_2 = 5 \times 10^{-3}$ ……. (2)

On adding equation (1) & (2)

$\frac{1}{2}X_2 + \frac{1}{2}Y_2 + \frac{1}{2}Z_2 \rightleftharpoons XYZ$,

$$K_{eq} = 5 \times 10^{-3} \times \left(\frac{1}{25 \times 10^{-6}}\right)^{1/2} = 1$$

5. Wavelengths of two photons are given as $\lambda_1 = 3000$ Å & $\lambda_2 = 6000$ Å respectively. Calculate the ratio of their energies $\left(\frac{E_1}{E_2}\right)$

Ans. (2)

Sol. $E_{photon} = \frac{hc}{\lambda}$

$\Rightarrow \frac{E_1}{E_2} = \frac{\lambda_2}{\lambda_1}$

$\Rightarrow \frac{E_1}{E_2} = \frac{6000}{3000}$

$\Rightarrow \frac{E_1}{E_2} = 2$

6. **Statement-I :** 30% (w/w) methanol in CCl_4 have mole fraction of solvent equal to 0.33.

Statement-II : CCl_4 & methanol mixture show positive deviation from Raoult's law.

(1) Both Statement I and Statement II are correct.

(2) Statement I is correct but Statement II is incorrect.

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

(4) Both Statement I and Statement II are incorrect.

Ans. (1)

Sol. (i) Let wt of solution = 100 g

wt of methanol = 30 g

wt of CCl_4 = 100 – 30 = 70 g

mole fraction of $CCl_4 = \frac{n_{CCl_4}}{n_{CCl_4} + n_{CH_3OH}} = \frac{\frac{70}{154}}{\frac{70}{154} + \frac{30}{32}}$

$= 0.3267 \approx 0.33$

(ii) CCl_4 & methanol is mixture of positive deviation from Raoult's law.

So, statement (I) & statement (II) are correct.

7. **Statement-I :** K_b is more than K_f for water.

Statement-II : When we add a non-volatile solute in water, elevation in boiling point is more than depression in freezing point.

(1) Both Statement I and Statement II are correct.

(2) Statement I is correct but Statement II is incorrect.

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

(4) Both Statement I and Statement II are incorrect.

Ans. (4)

Sol. (i) K_b for water = $0.512 \frac{°C - Kg}{mol}$

K_f for water = $1.86 \frac{°C - Kg}{mol}$

So, $K_b < K_f$ for water

(ii) Since, $K_b < K_f$ so $\Delta T_b < \Delta T_f$ [same equimolal solution]

Both Statement I and Statement II are incorrect.

8. $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g),\ K_{P_1} = 8 \times 10^{-2}$

$C(s) + CO_2(g) \rightleftharpoons 2CO(g)\ ;\ K_{P_2} = 2$

If partial pressure of CO at equilibrium is x × 10^{-1} atm, then find the value of x?

Ans. (4)

Sol. $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g),\ K_{P_1} = 8 \times 10^{-2}$

$K_{P_1} = P_{CO_2} = 8 \times 10^{-2}$

$C(s) + CO_2(g) \rightleftharpoons 2CO(g),\ K_{P_2} = 2$

$K_{P_2} = \frac{P_{CO}^2}{P_{CO_2}} = 2$

$\frac{P_{CO}^2}{8 \times 10^{-2}} = 2$

$P_{CO}^2 = 16 \times 10^{-2}$

$P_{CO} = 4 \times 10^{-1}$

So, value of x = 4

9. Match the following :

List-I (Mass of molecule)		List-II (Number of molecule)	
(P)	3.6 mg of H_2O	(I)	0.5×10^{-4} N_A
(Q)	1.8 mg of Carbon	(II)	2×10^{-4} N_A
(R)	4.9 mg of H_2SO_4	(III)	1×10^{-4} N_A
(S)	5.85 mg of NaCl	(IV)	1.5×10^{-4} N_A

Select the correct match :

(1) P-III, Q-I, R-II, S-IV

(2) P-II, Q-IV, R-I, S-III

(3) P-II, Q-IV, R-III, S-I

(4) P-II, Q-I, R-IV, S-III

Ans. (2)

Sol.

(P) Number of H_2O molecule

$= \frac{3.6\times10^{-3}}{18}\times N_A = 2 \times 10^{-4}\ N_A$

(Q) Number of C-atom $= \frac{1.8\times10^{-3}}{12}\times N_A$

$= 1.5 \times 10^{-4}\ N_A$

(R) Number of H_2SO_4 molecule

$= \frac{4.9\times10^{-3}}{98}\times N_A = 0.5 \times 10^{-4}\ N_A$

(S) Number of NaCl molecule

$= \frac{5.85\times10^{-3}}{58.5}\times N_A = 1 \times 10^{-4}\ N_A$

10. **Statement I :** Among the following set of ionic species, [Cr^{+3} , Mn^{+2}] ; [Ti^{+4} , V^{+2}] ; [Sc^{+3}, V^{+4}] and [Co^{+3}, Cu^{+2}] ; three sets have both ions are coloured.

Statement II : Among the following set of ionic species [Lu^{+3} , La^{+3}] ; [Lr^{+3} Ce^{+4}] ; [Yb^{+2}, Eu^{+2}] and [Nd^{+3} , Sm^{+3}] ; three sets have both ions diamagnetic in nature.

(1) Both Statement I and Statement II are correct.

(2) Statement I is correct but Statement II is incorrect.

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

(4) Both Statement I and Statement II are incorrect.

Ans. **(4)**

Sol. Ti^{+4}, Sc^{+3} are colourless species.

Paramagnetic species : Eu^{+2}, Nd^{+3} , Sm^{+3}

Diamagnetic species : Lu^{+3} , La^{+3} , Ce^{+4} , Lr^{+3} , Yb^{+2}

11. For the given coordination compounds.

1) $[Co(ox)_3]^{3-}$ 2) $[Fe(CN)_6]^{3-}$

3) $[Ni(CN)_4]^{2-}$ 4) $[NiCl_4]^{2-}$

5) $[Ni(CO)_4]$ 6) $[MnBr_4]^{2-}$

7) $[CoF_6]^{3-}$ 8) $[Cr(H_2O)_3F_3]$

The number of paramagnetic species are

Ans. **(5)**

Sol. Paramagnetic species are : $[Fe(CN)_6]^{3-}$; $[NiCl_4]^{2-}$; $[MnBr_4]^{2-}$; $[CoF_6]^{3-}$; $[Cr(H_2O)_3F_3]$

12. **Statement I :** d-Block elements utilize their only 3d electrons for bonding on the surface of catalyst.

Statement II : This leads to strengthening of bonds in the reacting molecules.

(1) Both Statement I and Statement II are correct.

(2) Statement I is correct but Statement II is incorrect.

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

(4) Both Statement I and Statement II are incorrect.

Ans. **(4)**

Sol. First row transition metals utilize 3d and 4s electrons for bonding on the catalyst surface. This has the effect of strengthening of bonds in the reacting molecules.

13. Consider the statements related to group 15 hydrides.

(A) Stability of hydrides decreases down the group.

(B) Reducing nature of hydrides increases down the group.

(C) Lone pair donating tendency increases down the group.

(D) $H-E-H$ bond angle decreases down the group.

(1) A, B and C are correct.

(2) A, B and D are correct.

(3) B and C are correct.

(4) A, C and D are correct.

Ans. **(2)**

Sol. Stability of hydrides : $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$

Reducing nature : $NH_3 < PH_3 < AsH_3 < SbH_3 < BiH_3$

Lone pair donating tendency : $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$

Bond angle : $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$

14. Column-I Column-II

Configuration (n = 2)	IE values (kJ/mol)
(A) ns^2np^1	(P) 2080
(B) ns^2np^6	(Q) 801
(C) ns^2	(R) 1402
(D) ns^2np^3	(S) 899

(1) $A \rightarrow P$; $B \rightarrow S$; $C \rightarrow Q$; $D \rightarrow R$

(2) $A \rightarrow Q$; $B \rightarrow R$; $C \rightarrow P$; $D \rightarrow S$

(3) $A \rightarrow Q$; $B \rightarrow P$; $C \rightarrow S$; $D \rightarrow R$

(4) $A \rightarrow R$; $B \rightarrow P$; $C \rightarrow S$; $D \rightarrow Q$

Ans. (3)

Sol. (A) = $2s^2\ 2p^1$ B

(B) = $2s^2\ 2p^6$ Ne

(C) = $2s^2$ Be

(D) = $2s^2\ 2p^3$ N

Be B N Ne

IE order B < Be < N < Ne

15. Bromine trifluoride auto ionizes into $BrF_2^{\oplus}$ and $BrF_4^{\ominus}$. The geometry of these ions respectively are :

(1) Linear , square planar

(2) Bent, square planar

(3) Bent, see-saw

(4) Linear , tetrahedral

Ans. (2)

Sol. $BrF_2^{\oplus} \Rightarrow sp^3$

[Bond pair = 2 , lone pair = 2]

$\Rightarrow$ bent

$BrF_4^{\ominus} \Rightarrow sp^3d^2$

[Bond pair = 4 , lone pair = 2]

$\Rightarrow$ square planar

16. Benzene reacts with $CO/HCl/AlCl_3$ and give 'P' benzene react with $CH_3-\overset{O}{\overset{\|}{C}}-Cl$ / $AlCl_3$ to give 'Q'.

P and Q react with each other in presence of NaOH / H_2O give product Z. Find number of π e^- in product Z.

(1) 12

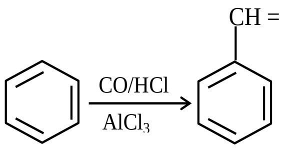
(2) 14

(3) 16

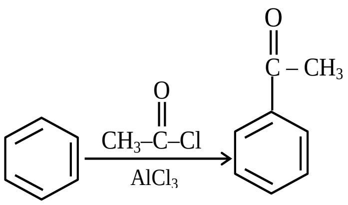
(4) 18

Ans. (3)

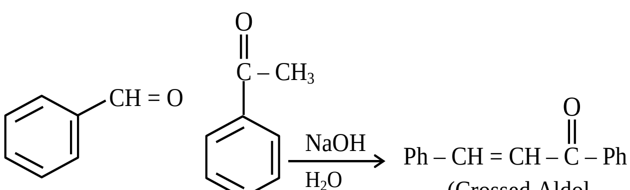
Sol.



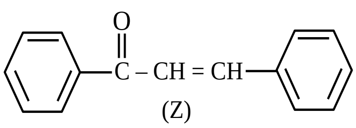
(Gatterman Koch)



(Friedal Craft asylation)

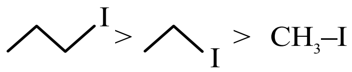


(P) (Q) (Crossed Aldol condensation)

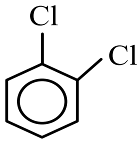
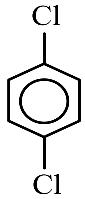


(Z)

Number of π e^- in Z = $16\pi e^-$.

17. Statement 1: 

Boiling point order is in decreasing order due to decreasing Vanderwall's forces.

Statement 2:  and 

P-dichlorobenzene has more melting point value due to its symmetric structure than O-dichlorobenzene while it has less boiling point than O-dichlorobenzene.

(1) Both Statement I and Statement II are correct.

(2) Statement I is correct but Statement II is incorrect.

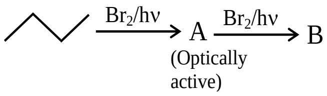
(3) Statement I is incorrect but Statement II is correct.

(4) Both Statement I and Statement II are incorrect.

Ans. (1)

Sol. Theory based NCERT

18. How many dibromo products are possible for 'B' (Including stereoisomer)

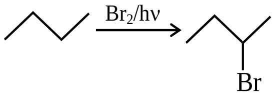


(1) 3 (2) 5

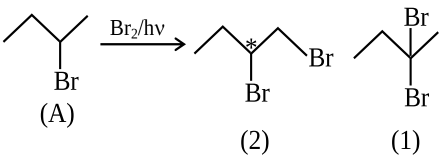
(3) 6 (4) 8

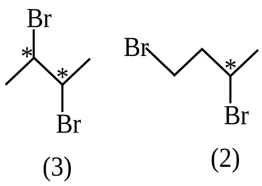
Ans. (8)

Sol.



(A) Optically active (2)





Total dibromo products = 8

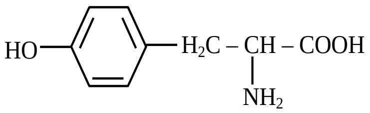
19. Which of the following compounds give a positive neutral $FeCl_3$ test?

(1) Threonine (2) Cysteine

(3) Tyrosine (4) Serine

Ans. **(3)**

Sol. Neutral $FeCl_3$ test is given by phenolic group



(Tyrosine)

20. **Statement-1 :** During fractional distillation higher boiling point will condensed first.

Statement-2 : In fractionating column one which has higher boiling point value will be more in concentration above the fractionating column.

(1) Both Statement I and Statement II are correct

(2) Statement I is correct but Statement II is incorrect.

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

(4) Both Statement I and Statement II are incorrect

Ans. **(2)**

Sol. Theory based

21. Which of the following statement(s) are incorrect

(1) All oligosaccharides give same monosaccharide an acidic hydrolysis.

(2) All monosaccharides are reducing sugar.

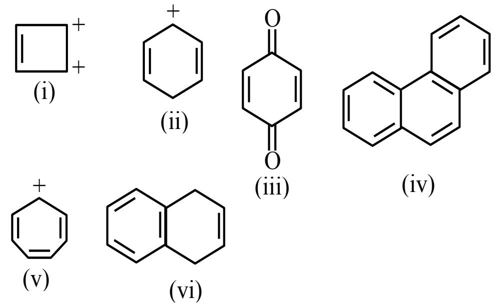
(3) Starch and cellulose are long chain polymer high molecuar mass.

(4) Open chain glucose and cyclic α and β–D-glucose are in equilibrium in aq. solution.

Ans. **(A)**

Sol. Theory based

22. Find total number of aromatic compounds from the given organic molecules.



(1) 3

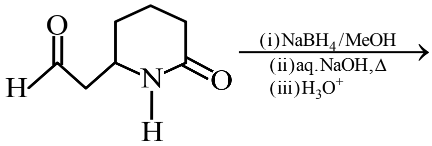
(2) 4

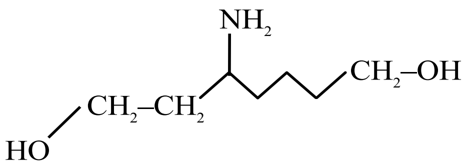
(3) 5

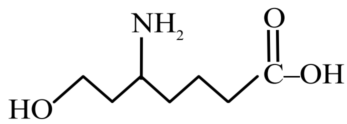
(4) 6

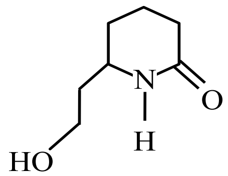
Ans. **(2)**

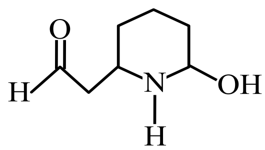
Sol. Compound (i), (iv), (v), (vi)

23.  Product is

(1) 

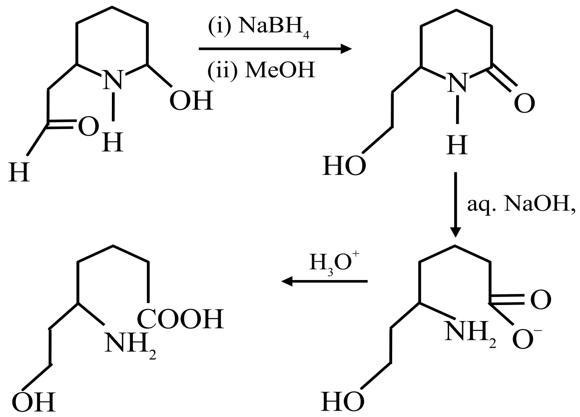
(2) 

(3) 

(4) 

Ans. **(2)**

Sol.



24. Which of the following statement is correct about Hoffmann's bromamide degradation reaction?

(a) Alkyl amide do not react.

(b) Secondary amide do not form secondary amide.

(c) Ratio of NaOH and Br_2 is 4 : 2

(d) Na_2CO_3, NaBr and H_2O also formed along with amine.

(1) b, c and d only (2) a, b and c only

(3) b and d only (4) a, b, c and d

Ans. (3)

Sol. Hoffmann bromamide degradation

$$R-\overset{\overset{\displaystyle O}{\|}}{C}-NH_2 + \underset{4\text{ mole}}{NaOH} + \underset{1\text{ mole}}{Br_2} \xrightarrow{\Delta} R-NH_2 + Na_2CO_3 + 2NaBr + 2H_2O$$

JEE–MAIN EXAMINATION – APRIL 2026
MEMORY BASED QUESTIONS

(HELD ON WEDNESDAY 08th APRIL 2026) **TIME : 3:00 PM TO 6:00 PM**

MATHEMATICS	TEST PAPER WITH SOLUTION

1. If $\alpha = 3\sin^{-1}\left(\frac{6}{11}\right)$ and $\beta = 3\cos^{-1}\left(\frac{4}{9}\right)$, consider statements :

Statement 1 : $\cos(\alpha + \beta) > 0$

Statement 2 : $\cos\alpha < 0$

Then which of the following is true?

(1) Statement 1 and 2 are correct

(2) Only statement 1 is correct

(3) Only statement 2 is correct

(4) None of these statements are correct

Ans. (1)

Sol. $\frac{1}{2} < \frac{6}{11} < \frac{1}{\sqrt{2}}$

$\sin^{-1}\left(\frac{1}{2}\right) < \sin^{-1}\left(\frac{6}{11}\right) < \sin^{-1}\left(\frac{1}{\sqrt{2}}\right)$

$\frac{\pi}{6} < 3\sin^{-1}\left(\frac{6}{11}\right) < \frac{\pi}{4}$

$\frac{\pi}{2} < \alpha < \frac{3\pi}{4} \quad \therefore \cos\alpha < 0$

$0 < \frac{4}{9} < \frac{1}{2}$

$\frac{\pi}{3} < \cos^{-1}\left(\frac{4}{9}\right) < \frac{\pi}{2}$

$\pi < 3\cos^{-1}\left(\frac{4}{9}\right) < \frac{3\pi}{2}$

$\pi < \beta < \frac{3\pi}{2}$

Now $\frac{3\pi}{2} < \alpha + \beta < \frac{9\pi}{4}$

$\therefore \cos(\alpha + \beta) > 0$

2. If $\left(x\sqrt{1-x^2}\right)dy - \left(y\sqrt{1-x^2} - x^2\cos^{-1}x\right)dx = 0$ and $\lim_{x\to 1^-} y(x) = 1$, then $y\left(\frac{1}{2}\right)$ is

(1) $\frac{\pi^2}{36}$ (2) $\frac{\pi^2 + 18}{36}$

(3) $\frac{\pi^2 - 18}{36}$ (4) $\frac{\pi^2}{18}$

Ans. (2)

Sol. $\frac{dy}{dx} - \frac{y}{x} = \frac{-x\cos^{-1}x}{\sqrt{1-x^2}}$

I.F. $= e^{-\int \frac{1}{x}dx} = \frac{1}{x}$

$\frac{y}{x} = -\int \frac{\cos^{-1}x}{\sqrt{1-x^2}}dx$

$\frac{y}{x} = \frac{(\cos^{-1}x)^2}{2} + C$

$1 = 0 + C \Rightarrow C = 1$

$y = \frac{x}{2}(\cos^{-1}x)^2 + x$

$y\left(\frac{1}{2}\right) = \frac{1}{4}\left(\cos^{-1}\frac{1}{2}\right)^2 + \frac{1}{2}$

$= \frac{1}{4}\left(\frac{\pi^2}{9}\right) + \frac{1}{2}$

3. Statement 1 : $f(x) = e^{|\sin x|} - |x|$ is differentiable for all $x \in R$.

Statement 2 : f(x) is increasing in $x \in \left(-\pi, \frac{-\pi}{2}\right)$

(1) Statement 1 and 2 are false

(2) Statement 1 is true and statement 2 is false

(3) Statement 1 is false and statement 2 is true

(4) Statement 1 and 2 are true

Ans. (3)

Sol. $f(x) = e^{|\sin x|} - |x|$ is

non-differentiable at $x = \pi$

and for $x \in \left(-\pi, \frac{-\pi}{2}\right)$

$f(x) = e^{-\sin x} + x$

$f'(x) = -e^{-\sin x}\cos x + 1$

for $x \in \left(-\pi, \frac{-\pi}{2}\right)$ $\quad\quad$ $\cos x < 0$

$\therefore f'(x) > 0$

$\therefore f(x)$ is increasing

4. A person goes to college either by bus, scooter or car. The probability that he goes by bus is $\frac{2}{5}$, by scooter is $\frac{1}{5}$ and by car is $\frac{3}{5}$. The probability that he entered late in college if he goes by bus is $\frac{1}{7}$, by scooter is $\frac{3}{7}$ and by car is $\frac{1}{7}$. If it is given that he entered late in college, then the probability that he goes to college by car is

(1) $\frac{3}{7}$ $\quad$ (2) $\frac{3}{8}$

(3) $\frac{4}{7}$ $\quad$ (4) $\frac{5}{8}$

Ans. **(2)**

Sol. $P(B) = \frac{2}{5}$ $\quad\quad$ $P(\text{late}/B) = \frac{1}{7}$

$P(S) = \frac{1}{5}$ $\quad\quad$ $P(\text{late}/S) = \frac{3}{7}$

$P(C) = \frac{3}{5}$ $\quad\quad$ $P(\text{late}/C) = \frac{1}{7}$

$$P(\text{car}/\text{late}) = \frac{\frac{3}{5}\times\frac{1}{7}}{\frac{3}{5}\times\frac{1}{7}+\frac{1}{5}\times\frac{3}{7}+\frac{2}{5}\times\frac{1}{7}}$$

$$= \frac{3}{3+3+2} = \frac{3}{8}$$

5. Let $\vec{a} = 4\hat{i} - \hat{j} + 3\hat{k}$, $\vec{b} = 10\hat{i} + 2\hat{j} - \hat{k}$ and a vector $\vec{c}$ be such that $2(\vec{a}\times\vec{b}) + 3(\vec{b}\times\vec{c}) = 0$. If $\vec{a}.\vec{c} = 15$, then the value of $\vec{c}.(\hat{i}+\hat{j}-3\hat{k})$ is

(1) 5 $\quad$ (2) –5

(3) 3 $\quad$ (4) –3

Ans. **(2)**

Sol. $2(\vec{a}\times\vec{b}) - 3(\vec{c}\times\vec{b}) = 0$

$(2\vec{a} - 3\vec{c})\times\vec{b} = 0$

$\vec{b} \,||\, (2\vec{a} - 3\vec{c})$

$2\vec{a} - 3\vec{c} = \lambda\vec{b}$

$\vec{c} = \frac{2\vec{a} - \lambda\vec{b}}{3}$ $\quad\quad\quad$ …(1)

$\vec{a}.\vec{c} = 15$

$\left(\frac{2\vec{a} - \lambda\vec{b}}{3}\right).\vec{a} = 15$

$\frac{2|a|^2 - \lambda\vec{b}.\vec{a}}{3} = 15$

$2(26) - \lambda(40 - 2 - 3) = 45$

$\lambda = \frac{1}{5}$

$\Rightarrow \vec{c}.(\hat{i}+\hat{j}-3\hat{k}) = \frac{\left(2(4\hat{i}-\hat{j}+3k) - \frac{1}{5}(10\hat{i}+2\hat{j}-k).(\hat{i}+\hat{j}-3\hat{k})\right)}{3}$

$$= \frac{2(4-1-9) - \frac{1}{5}(10+2+3)}{3} = -5$$

6. The line passing through point of intersection of $3x + 4y = 1$ and $4x + 3y = 1$ intersects axes at P and Q, then locus of midpoint of PQ is

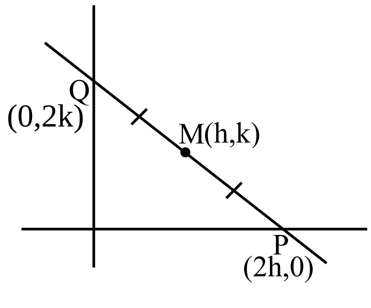
(1) $\frac{1}{x} + \frac{1}{y} = 14$ $\quad$ (2) $\frac{3}{x} + \frac{4}{y} = 14$

(3) $\frac{4}{x} + \frac{3}{y} = 14$ $\quad$ (4) $x + y = 14$

Ans. **(1)**

Sol. Point of intersection of the lines

$3x + 4y = 1$ and $4x + 3y = 1$ is $\left(\frac{1}{7}, \frac{1}{7}\right)$



Let the line be $\frac{x}{2h} + \frac{y}{2k} = 1$

Satisfy $\left(\frac{1}{7},\frac{1}{7}\right)$

$$\frac{1}{14h}+\frac{1}{14k}=1$$

$$\frac{1}{x}+\frac{1}{y}=14$$

7. If α = 3 + 4 + 8 + 9 + 13 + … upto 40 terms and $(\tan\beta)^{\frac{\alpha}{1020}}$ is the root of the equation $x^2 - x - 2 = 0$, then the value of $\sin^2\beta + 3\cos^2\beta$ is

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

Ans. (3)

Sol. a = (3 + 8 + 13…. upto 20 terms) + (4 + 9 + 14+… upto 20 terms)

$$=\frac{20}{2}[6+19\times5]+\frac{20}{2}(8+19\times5)$$

= 2040

$$(\tan\beta)^{\frac{2040}{1020}}=\tan^2\beta$$

Now roots of the equation $x^2 - x - 2 = 0$ are 2, –1

$\Rightarrow \tan^2\beta = 2 \Rightarrow \cos^2\beta = 1/3$

$$\Rightarrow 1+2\cos^2\beta=\frac{5}{3}$$

8. A person has 3 different bags & 4 different books. The number of ways in which he can put these books in the bags so that no bag is empty, is

(1) 36 (2) 24 (3) 32 (4) 30

Ans. (1)

Sol. B_1 B_2 B_3

1 1 2

No. of ways = $\frac{4!}{2!2!}\times3!=6\times6=36$

9. Let $\frac{x^2}{f(a^2+2a+7)}+\frac{y^2}{f(3a+14)}=1$ represents an ellipse. The major axis of given ellipse is y-axis and f is a decreasing function, If the range of a is $R-[\alpha,\beta]$ then $\alpha+\beta$ is

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

Ans. (1)

Sol. Given $f(3a + 14) > f(a^2 + 24 + 7)$

$\Rightarrow a^2 + 2a + 7 > 3a + 14$

$a^2 - a - 7 > 0$

$$a\in R-\left[\frac{1-\sqrt{29}}{2},\frac{1+\sqrt{29}}{2}\right]$$

$$\Rightarrow \alpha+\beta=\frac{1-\sqrt{29}}{2}+\frac{1+\sqrt{29}}{2}=1$$

10. Locus of the mid-point of chord of circle $x^2 + y^2 - 6x - 8y - 11 = 0$, subtending a right angle at the center is

(1) $x^2 + y^2 - 6x - 8y + 7 = 0$

(2) $x^2 + y^2 - 6x - 8y - 7 = 0$

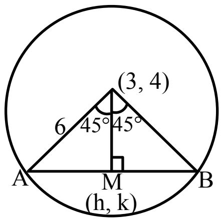
(3) $x^2 + y^2 + 6x + 8y - 7 = 0$

(4) $x^2 + y^2 - 6x + 8y + 7 = 0$

Ans. (1)

Sol. OM = 6 cos 45°

$$\sqrt{(h-3)^2+(k-4)^2}=6\cdot\frac{1}{\sqrt{2}}=3\sqrt{2}$$



$\Rightarrow h^2 + k^2 - 6h - 8k + 25 = 18$

$\Rightarrow h^2 + k^2 - 6h - 8k + 7 = 0$

$\Rightarrow x^2 + y^2 - 6x - 8y + 7 = 0$

11. The number of values of $z \in C$ satisfying $|z-4-8i|=\sqrt{10}$ and

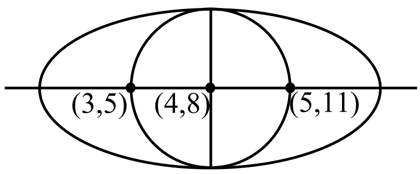
$|z-3-5i|+|z-5-11i|=4\sqrt{5}$ is

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

Ans. (3)

Sol. $(x-4)^2 + (y-8)^2 = 10 \rightarrow$ circle

$\sqrt{(x-3)^2+(y-5)^2}=\sqrt{(x-5)^2+(y-11)^2}=4\sqrt{5} \rightarrow$ ellipse



$$2a=4\sqrt{5}, 2ae=\sqrt{4+36}=2\sqrt{10}$$

$$e=\frac{1}{\sqrt{2}}$$

$$b^2=a^2(1-e^2)=20\left(1-\frac{1}{2}\right)=10$$

b = r $\Rightarrow$ circle touches the ellipse internally at end of minor axis.

12. Let A = {–2, – 1, 0, 1, 2}

A relation R is defined on set A such that aRb $\Rightarrow$ 1 + ab > 0.

Statement-1 : It is an equivalence relation.

Statement-2 : Number of elements in R is 17.

(1) Statement 1 and 2 are false

(2) Statement 1 is true and statement 2 is false

(3) Statement 1 is false and statement 2 is true

(4) Statement 1 and 2 are true

Ans. (3)

Sol. (a, a) $\in$R because $1 + a^2 > 0$

$\therefore$ Reflexive

If 1 + ab > 0 $\Rightarrow$ 1 + ba > 0

$\therefore$ (a, b) $\in$R and (b, a) $\in$R

(–2,0)$\in$R (0,1)$\in$R

But (–2,1) $\notin$R

Hence it is not transitive

$\therefore$ It is not equivalence

Total number of elements in the relation R is 17

Because Total elements = 25

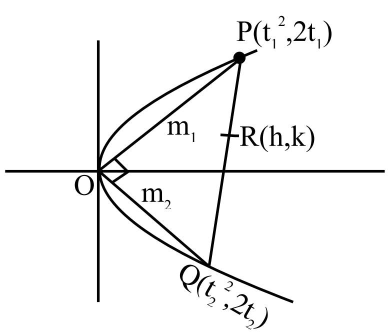
But (–2, 1) (–2, 2) (–1, 2) (1, –2) (2, –2) (2, –1) (–1, 1) and (1, –1) are not in relation.

13. Let O be the vertex of the parabola $y^2 = 4x$. Let P and Q be two points on parabola such that chords OP and OQ are perpendicular to each other. If the locus of mid-point of segment PQ is a conic C, then latus rectum of C is

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

Ans. (2)

Sol.



$t_1t_2 = -4$

$2h = t_1^2 + t_2^2$ $\qquad$ $2k = 2(t_1 + t_2)$

$2h = k^2 - 2t_1t_2$

$2h = k^2 + 8$

$k^2 = 2h - 8$

$= 2((h - 4)$

L.R. = 2

14. The mean & variance of x_1, x_2 x_3, x_4 be 1 and 13 respectively and the mean and variance of y_1, y_2, …y_6 be 2 and 1 respectively, the variance of x_1, x_2,…, x_4, y_1, y_2,…y_6 will be

(1) 6.04 (2) 6.00 (3) 5.85 (4) 5.99

Ans. **(1)**

Sol. Given $\bar{x} = 1, \sigma_1^2 = 13$

$\bar{y} = 2, \sigma_2^2 = 1$

Combined variance = $\frac{n_1\sigma_1^2 + n_2\sigma_2^2}{n_1 + n_2} + \frac{n_1n_2}{(n_1+n_2)^2}(\bar{x}-\bar{y})^2$

$= \frac{4\times13+6\times1}{10} + \frac{4\times6}{10^2}(2-1)^2$

$\frac{58}{10} + \frac{24}{100} = \frac{580+24}{100} = \frac{604}{100} = 6.04$

15. The value of $\int_0^2 \sqrt{\frac{x(x^2+x+1)}{(x+1)(x^4+x^2+1)}}dx$ is

(1) $\frac{1}{3}\ell n\left(2^{3/2}+3\right)$ (2) $\ell n\left(2^{3/2}+3\right)$

(3) $\frac{2}{3}\ell n\left(2^{2/3}+3\right)$ (4) $\frac{2}{3}\ell n\left(2^{3/2}+3\right)$

Ans. **(4)**

Sol. $I = \int_0^2 \sqrt{\frac{x(x^2+x+1)}{(x+1)(x^2-x+1)(x^2+x+1)}}dx$

$= \int_0^2 \sqrt{\frac{x}{x^3+1}}dx$

$(x^{3/2} = t \Rightarrow \frac{3}{2}x^{1/2}dx = dt)$

$= \frac{2}{3}\int_0^{2^{3/2}} \frac{dt}{\sqrt{t^2+1}}$

$= \frac{2}{3}\left(\ell n(t+\sqrt{t^2+1})\right)_0^{2^{3/2}}$

$= \frac{2}{3}\ell n\left(2^{3/2}+3\right)$

16. If $\int_{\pi/6}^{\pi/4}\left((\cot(x-\frac{\pi}{3})\cot(x+\frac{\pi}{3})+1\right)dx$

$= \alpha \log_e(\sqrt{3}-1)$ then $9\alpha^2$ is

(1) 12 (2) 14

(3) 9 (4) 17

Ans. **(1)**

Sol. $\int_{\pi/6}^{\pi/4}\left((\cot+(x-\frac{\pi}{3})\cot(x+\frac{\pi}{3})+1\right)dx$

using $\cot(A-B) = \frac{\cot B\ \cot A + 1}{\cot B - \cot A}$

$\Rightarrow \int_{\pi/6}^{\pi/4} -\frac{1}{\sqrt{3}}\left[\cot(x-\frac{\pi}{3}) - \cot(x+\frac{\pi}{3})\right]dx$

$\Rightarrow \frac{-1}{\sqrt{3}}\left[\ell n\left|\frac{\sin(x-\frac{\pi}{3})}{\sin(x+\frac{\pi}{3})}\right|\right]_{\frac{\pi}{6}}^{\frac{\pi}{4}}$

$= \frac{-1}{\sqrt{3}}\left[\ell n\left|\left(\frac{\sin 15°}{\sin 75°}\right)\right| - \ell n\left|\frac{\sin 30°}{\sin 90°}\right|\right]$

$= \frac{-1}{\sqrt{3}}\left[\ell n(\tan 15°) - \ell n\left(\frac{1}{2}\right)\right]$

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

$\Rightarrow \frac{-1}{\sqrt{3}}\ell n\left(4-2\sqrt{3}\right) = \frac{-2}{\sqrt{3}}\ell n\left(\sqrt{3}-1\right)$

$\therefore \alpha = \frac{-2}{\sqrt{3}} \therefore 9\alpha^2 = 12$

17. If $\lim_{x\to\frac{\pi}{2}} \frac{b(1-\sin x)}{(\pi-2x)^2} = \frac{1}{3}$, then $\int_0^{3b-6} |x^2+2x-3|\, dx$ is equal to

(1) 3 (2) 4

(3) 7/4 (4) 2

Ans. **(2)**

Sol. $\lim_{x\to\frac{\pi}{2}} \frac{b(1-\cos(\frac{\pi}{2}-x))}{4\left(\frac{\pi}{2}-x\right)^2} = \frac{1}{3} \Rightarrow b = \frac{8}{3}$

$\int_0^2 |x^2+2x-3| dx = \int_0^2 |(x+3)(x-1)| dx$

put x –1 = t

$\int_{-1}^1 |(t+4)t| dt = \int_{-1}^0 (-t^2-4t)dt + \int_0^1 (t^2+4t)dt$

$\left(\frac{-t^3}{3}-2t^2\right)_{-1}^0 + \left(\frac{t^3}{3}+2t^2\right)_0^1 = 4$

18. Let $f(x) = \frac{x-1}{x+1}$, $f^{i+1} = f(f^i(x))$ and $g(x) + f^{26}(x) = 0$

The area of the region enclosed by the curves $y = g(x)$, $y = 0$, $x = 4$ and $2y = 2x - 3$ is

(1) $\frac{1}{4}+\ell n2$ (2) $\frac{1}{8}+2\ell n2$

(3) $\frac{1}{4}+2\ell n2$ (4) $\frac{1}{8}+\ell n2$

Ans. **(4)**

Sol. $f^2(x) = f(f(x)) = \frac{\frac{x-1}{x+1}-1}{\frac{x-1}{x+1}+1} = \frac{-1}{x}$

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

$f^4(x) = f(f^3(x)) = f\left(f\left(\frac{-1}{x}\right)\right) = x$

$f^5(x) = f(f^4(x)) = f(x)$

$f^6(x) = f(f^5(x)) = f(f(x)) = \frac{-1}{x}$

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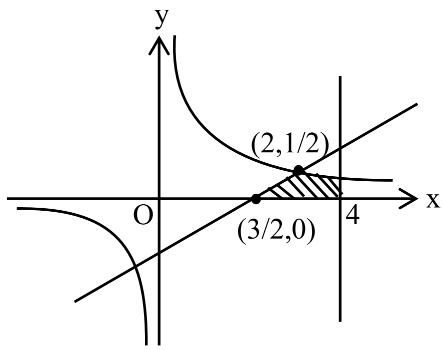
$f^{26}(x) = \frac{-1}{x}$

$g(x) = \frac{1}{x}$



$x - 3/2 = 1/x \Rightarrow 2x^2 - 3x - 2 = 0$

$\Rightarrow x = -1/2, 2$

Req. area $= \int_2^4 \frac{1}{x} dx + \frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}$

$= \frac{1}{8} + (\ell n x)_2^4 = \frac{1}{8} + \ell n2$

SECTION-B

1. Consider the system of equations

$x + y + z = 6$

$x + 2y + 5z = 18$

$2x + 2y + \lambda z = \mu$

If the system of equations has infinitely many solutions, then the value of $(\lambda + \mu)$ is equal to

Ans. **(14)**

Sol. $2x + 2y + \lambda z - \mu$

$= A(x + y + z - 6) + B(x + 2y + 5z - 18)$

Comparing the coefficients

$x : 2 = A + B$

$y : 2 = A + 2B$

$\Rightarrow B = 0, A = 2$

$z : \lambda = A + 5B$

$\Rightarrow \lambda = 2$

Const. $-\mu = -6A - 18B$

$-\mu = -12 \Rightarrow \mu = 12$

$\lambda + \mu = 14$ Ans.

2. If $26\left(\frac{2^3.\ {}^{12}C_2}{3} + \frac{2^5.\ {}^{12}C_4}{5} ..... + \frac{2^{13}.\ {}^{12}C_{12}}{13}\right)$

$= 3^{13} - \alpha$, then find the value of α.

Ans. **(51)**

Sol. $(1 + x)^{12} = {}^{12}C_0 + {}^{12}C_1 x + {}^{12}C_2 x^2 + ... + {}^{12}C_{12} x^{12}$

integrating both sides

$$\left(\frac{(1+x)^{13}}{13}\right)_{-2}^{2} = \left({}^{12}C_0 x + {}^{12}C_1 \frac{x^2}{2} + {}^{12}C_2 \frac{x^3}{3} + ... + {}^{12}C_{12} \frac{x^{13}}{13}\right)$$

$$\frac{3^{13}}{13} + \frac{1}{13} = \left({}^{12}C_0 2 + {}^{12}C_1 \frac{2^2}{2} + {}^{12}C_2 \frac{2^3}{3} + ... + {}^{12}C_{12} \frac{2^{13}}{13}\right.$$

$$-\left(-{}^{12}C_0.2 + {}^{12}C_1 \frac{2^2}{2} - {}^{12}C_2.\frac{2^3}{3} + ... + {}^{12}C_{12}.\frac{2^{13}}{13}\right.$$

$$= 2\left(2.{}^{12}C_0 + {}^{12}C_2.\frac{2^3}{3} + {}^{12}C_4.\frac{2^5}{5} + ... + {}^{12}C_{12}.\frac{2^{13}}{13}\right.$$

$$3^{13} + 1 = 26\left(2 + {}^{12}C_{12}.\frac{2^3}{3} + {}^{12}C_4.\frac{2^5}{5} + ... + {}^{12}C_{12}.\frac{2^{13}}{13}\right.$$

$$3^{13} - 51 = 26\left({}^{12}C_2.\frac{2^3}{3} + {}^{12}C_4.\frac{2^5}{5} + ... + {}^{12}C_{12}.\frac{2^{13}}{13}\right.$$

$\therefore \alpha = 51$