MEMORY BASED QUESTIONS JEE–MAIN EXAMINATION – APRIL 2026

(HELD ON THURSDAY 02nd APRIL 2026) **TIME : 9:00 AM TO 12:00 NOON**

PHYSICS

TEST PAPER WITH SOLUTION

1. The dimension of $\frac{1}{2}\epsilon_0 E^2$ is $M^aL^bT^c$ then value of $a - 2b + c = ?$

(1) 1 (2) 2

(3) 3 (4) 4

Ans. (1)

Sol. $\frac{1}{2}\epsilon_0 E^2 = \text{Energy density} = \frac{\text{Energy}}{\text{Volume}}$

$$= \frac{ML^2T^{-2}}{L^3}$$

$$= ML^{-1}T^{-2}$$

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

$\Rightarrow a - 2b + C$

$= 1 + 2 - 2 = 1$

2. If angular position of a particle is given by $\theta = \frac{t^4}{4} + t^2$. Find angular acceleration at t = 1s :

(1) 6 rad/s^2 (2) 5 rad/s^2

(3) 10 rad/s^2 (4) 6 rad/s^2

Ans. (2)

Sol. $\theta = \frac{t^4}{4} + t^2$

$\omega = \frac{d\theta}{dt} = 4\frac{t^3}{4} + 2t$

$\omega = t^3 + 2t$

$\alpha = \frac{d\omega}{dt} = 3t^2 + 2$

at t = 1 s

$\alpha = 3(1)^2 + 2$

$= 5$ rad/s^2

3. If $\vec{r} = 10t^2\hat{i} + 5t^3\hat{j}$ and mass of object, m = 0.1 kg then at t = 1 sec :-

(A) momentum = $2\hat{i} + 1.5\hat{j}$

(B) force = $2\hat{i} + 3\hat{j}$

(C) Angular momentum = $5\hat{k}$

(D) Torque = $20\hat{k}$

(1) A, B, C are correct

(2) A, C, D are correct

(3) A, C are correct

(4) A, B, C, D are correct

Ans. (4)

Sol. $\vec{v} = 20t\hat{i} + 15t^2\hat{j}$

$\vec{a} = 20\hat{i} + 30t\hat{j}$

(Force) $\vec{F}_{t=1} = 2\hat{i} + 3\hat{j}$; $\vec{P}_{t=1} = m\vec{v}$ (momentum)

$= 2\hat{i} + 1.5\hat{j}$

Angular momentum

$\vec{L}_{t=1} = \vec{r} \times \vec{P}$

$= (10\hat{i} + 5\hat{j}) \times (2\hat{i} + 1.5\hat{j})$

$= 15\hat{k} - 10\hat{k}$

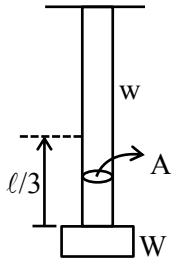
$= 5\hat{k}$

Torque $\vec{t} = \vec{r} \times \vec{F}$ -

$= (10\hat{i} + 5\hat{j}) \times (2\hat{i} + 3\hat{j})$

$= 20\hat{k}$

4. If stress at x = $\ell/3$ from bottom is $\left(\frac{W}{A}+\frac{2}{\gamma}.\frac{w}{A}\right)$ then find γ :



Ans. **($\gamma = 6$)**

Sol. stress at $\frac{\ell}{3}$

$$\frac{T}{A}=\frac{W+\frac{w}{3}}{A}=\frac{W}{A}+\frac{2w}{6A}$$

$\gamma = 6$

5. A particle is moving such that its velocity vector at co-ordinate (x,y,z) is $\vec{v}=-x\hat{i}+2y\hat{j}-z\hat{k}$. Find magnitude of acceleration at (1,1,4).

Ans. $\sqrt{33}\,m/s$

Sol. $\vec{v}=-x\hat{i}+2y\hat{j}-z\hat{k}$

$$\therefore\ V_x=\frac{dx}{dt}=-x, V_y=\frac{dy}{dt}=2y, V_z=\frac{dz}{dt}=-z$$

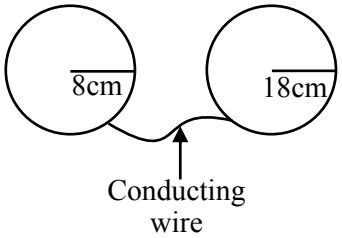
$$\vec{a}=\frac{d\vec{v}}{dt}=-\frac{dx}{dt}\hat{i}+2\frac{dy}{dt}\hat{j}-\frac{dz}{dt}\hat{k}$$

$$=+x\hat{i}+4y\hat{j}+z\hat{k}$$

$$=\hat{i}+4\hat{j}+4\hat{k}$$

$$a=\sqrt{1+16+16}=\sqrt{33}\,m/s$$

6. Two sphere are connected with a conducting wire. E_{S_1} & E_{S_2} are electric field at surface of sphere at equilibrium, find $\frac{E_{S_1}}{E_{S_2}}$.



(1) 4.5 (2) 1.125
(3) 2.25 (4) 7.5

Ans. **(3)**

Sol. $V_1 = V_2$

$$\frac{kq_1}{r_1}=\frac{kq_2}{r_2}$$

$$\frac{q_1}{q_2}=\frac{r_1}{r_2}$$

$$\frac{E_1}{E_2}=\frac{q_1}{q_2}\frac{r_2^2}{r_1^2}=\frac{r_2}{r_1}=\frac{18}{8}=\frac{9}{4}=2.25$$

7. Wavelength used in single slit diffraction is 628 nm. Width of slit is 0.2 mm. Find the angular width of central maxima in degree:

(1) 0.36° (2) 0.38°
(3) 0.45° (4) 0.40°

Ans. **(1)**

Sol. angular of width of central maxima = $\frac{2\lambda}{d}$

$$=\frac{2\times628\times10^{-9}}{0.2\times10^{-3}}$$

$$=628\times10^{-5}$$

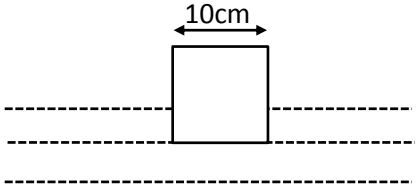
$$=628\times10^{-5}\times\frac{180}{\pi}$$

$$=35981.74\times10^{-5}=0.36°$$

8. A wooden cubical block of relative density 0.4 is floating is water. Side of cubical block is 10cm. When a coin is placed on the block, it dips by 0.3cm, weight of coin is:

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

Ans. **(3)**



Sol.

$$\frac{V_{submerged}}{V_{Total}}=\rho_{Rel}=\frac{4}{10}$$

$\therefore$ height in liquid = 4 cm

$\therefore$ Density of block = 400 kg/m^3

weight = ρvg

$$=(1000)\times\frac{0.3}{100}\times100\times10^{-4}\times10$$

$$=.3\ N$$

9. On a metal surface if light of wavelength λ falls stopping potential for emitted photoelectron is $3V_0$ and if light of wavelength 2λ falls stopping potential is V_0. Find threshold wavelength :-

Ans. (4λ)

Sol. $\frac{hC}{\lambda} - \phi = 3eV_0$ .....(i)

$\frac{hC}{2\lambda} - \phi = eV_0$ ……(ii)

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

$2\phi = \frac{hC}{2\lambda}$

$\phi = \frac{hC}{4\lambda} = \frac{hC}{\lambda_{th}}$

$\therefore \lambda_{th} = 4\lambda$

10. A container of initial volume 0.15 m^3 is expanded adiabatically from pressure 8 bar to final pressure 1 bar. If initial temperature is 140 K, then find work done by the gas :- ($C_P = 3R$, $C_V = 2R$) :-

Ans. (120 KJ)

Sol. $P_1V_1^{\gamma} = P_2V_L^{\gamma}$

$\gamma = \frac{C_P}{C_V} = \frac{3}{2}$

$V_2 = \left(\frac{P_1}{P_2}\right)^{1/\gamma} .V_1$

$V_2 = (8)^{2/3} \times 0.15 = 4 \times 0.15 = 0.6$

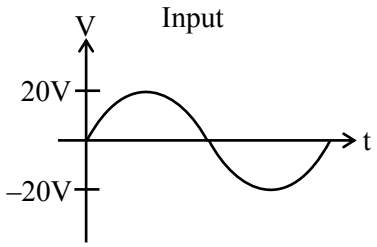
$\omega = \frac{P_2V_2 - P_1V_1}{1-\gamma} \Rightarrow \left\{\frac{1\times0.6 - 8\times0.15}{1-\frac{3}{2}}\right\} \times 10^5$

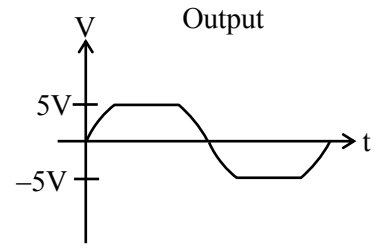
$= \left\{\frac{0.6-1.2}{-0.5}\right\} \times 10^5 = \frac{0.6}{0.5} \times 10^5$

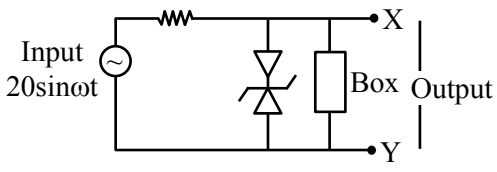
$\Rightarrow 1.2 \times 10^5$

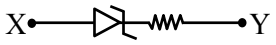
$\Rightarrow 120$ KJ

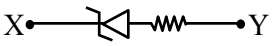
11. Diagram shows a circuit consisting of some elements. The input and output of the circuit is shown. Choose the correct option that shows the component in box. (Zener diode has a breakdown potential of 5V)

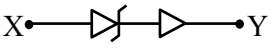


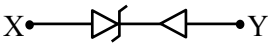




(1) 

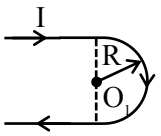
(2) 

(3) 

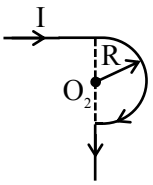
(4) 

Ans. (4)

12. Consider two arrangement of wires. Find out ratio of magnetic field at center of semi-circular part :



(a)



(1) $\frac{2+\pi}{1+\pi}$ (2) $\frac{1+\pi}{2+\pi}$

(3) $\frac{2+\pi}{2+\pi}$ (4) $\frac{2+\pi}{3+\pi}$

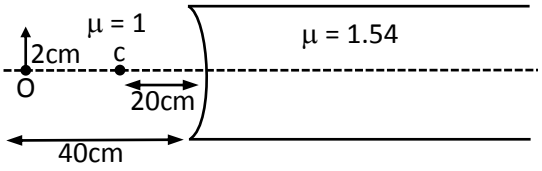
Ans. (1)

Sol. $B_1 = \frac{\mu_0 I}{2\pi R} + \frac{\mu_0 I}{4R}$

$B_2 = \frac{\mu_0 I}{4\pi R} + \frac{\mu_0 I}{4R}$

$\frac{B_1}{B_2} = \left(\frac{2+\pi}{1+\pi}\right)$

13. Object is placed at 40 cm from spherical surface whose radius of curvature is 20 cm. Find height of image formed.



(1) 2 cm

(2) 4 cm

(3) 0.96 cm

(4) 1.96 cm

Ans. (3)

Sol. $\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$

$\frac{1.54}{v} - \frac{1}{(-40)} = \frac{1.54-1}{-20}$

$\frac{1.54}{v} = -\frac{1.54}{20} - \frac{1}{40}$

$\frac{1.54}{v} = -\frac{2.08}{40}$

$v = -29.61$ cm

$\frac{hi}{h_0} = \frac{\mu_1 v}{\mu_2 u}$

$= \frac{1\times(-29.61)}{1.54\times(-40)}$

$\frac{hi}{h_0} = 0.48$

$hi = 0.48 \times 2 = 0.96$ cm

14. A satellite is revolving around planet of mass 2M in orbit of radius R with time period is T_1. Another satellite is revolving around planet of mass 4M in orbit of radius 2R, with time period T_2. Find $\frac{T_1}{T_2}$.

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

Ans. (3)

Sol. $T = \frac{2\pi}{\sqrt{GMs}} r^{3/2}$

$\frac{T_1}{T_2} = \sqrt{\frac{M_{s_2}}{M_{s_1}}}\left(\frac{r_1}{r_2}\right)^{3/2}$

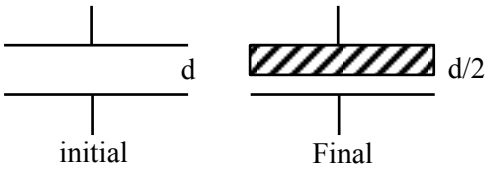
$= \sqrt{\frac{4M}{2M}}\left(\frac{R}{2R}\right)^{3/2}$

$= \sqrt{2}\left(\frac{1}{2}\right)^{3/2} = \sqrt{2}\frac{1}{\sqrt{8}}$

$= \frac{1}{2}$

$\frac{T_1}{T_2} = \frac{1}{2}$

15. There is a parallel plate capacitor of capacitance C. If half of the space is filled with dielectric of dielectric constant k = 5 as in the figure. Find percentage increase in capacitance.



Ans. (66.67%)

Sol. $C_i = \frac{A\epsilon_0}{d}$

$\frac{1}{C_f} = \frac{d/2}{A\epsilon_0} + \frac{d/2}{A\epsilon_0 5} = \frac{d}{2A\epsilon_0} + \frac{d}{10A\epsilon_0}$

$= \frac{6d}{10A\epsilon_0} = \frac{3d}{5A\epsilon_0}$

$C_f = \frac{5A\epsilon_0}{3d}$

$\Delta C = C_f - C_i = \frac{2}{3}\frac{A\epsilon_0}{d}$

% increase $= \frac{\Delta C}{C}\times 100 = \frac{2}{3}\times 100 = 66.67\%$

16. In Searl's experiment diameter of wire is measured with screw gauge of least count 0.001 cm and its value is 0.08 cm. Length of wire is 150 cm with least count 0.1 cm and elongation 0.5 cm with least count 0.001 cm. Weight suspended is 100 N then absolute error in Young's modulus is $N \times 10^9$ N/m^2. Then N is :

(1) 1.64 (2) 1.65

(3) 1.63 (4) 1.66

Ans. (2)

Sol. $Y = \dfrac{4WL}{\pi d^2 \ell} = 5.97 \times 10^{10}\ N/m^2$

$$\frac{\Delta Y}{Y} = \frac{\Delta L}{L} + \frac{2\Delta d}{d} + \frac{\Delta \ell}{\ell}$$

$$\frac{\Delta Y}{5.97 \times 10^{10}} = \frac{0.1}{150} + \frac{2(0.001)}{0.08} + \frac{0.001}{0.5}$$

$\Rightarrow \Delta Y = 1.65 \times 10^9\ N/m^2$

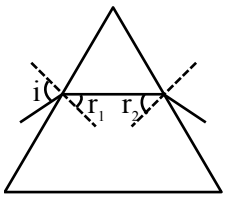
17. Thin symmetric prism of $\mu = 1.5$. Find ratio of incident angle and minimum deviation.:

Ans. (3/2)

Sol. For small angle

$10\ \mu_1 \sin(i) = \mu_2 \sin(r)$

$(1)i = (\mu)\ (r)$



and $r_1 = r_2 = \dfrac{A}{2}$

$$i = (\mu)\left(\frac{A}{2}\right)$$

$\delta_{min} = (\mu - 1)A$

$$\frac{i}{\delta_{min}} = \frac{(\mu)(A/2)}{(\mu-1)A} = \frac{\mu}{2(\mu-1)} = \frac{1.5}{2(0.5)}$$

$= 3/2$

$$\frac{i}{\delta_{min}} = \frac{3}{2}$$

18. For diatomic gas, find the ratio Q : ΔU : W for isobaric process :-

(1) 2 : 5 : 7 (2) 2 : 3 : 5

(3) 2 : 7 : 3 (4) 7 : 5 : 2

Ans. (4)

Sol. $W = P\Delta V = nR\Delta T$

$\Delta U = nC_V\Delta T = n\frac{f}{2}R\Delta T = n\frac{5}{2}R\Delta T$

$Q = \Delta U + W = nR\Delta T + \frac{5}{2}nR\Delta T$

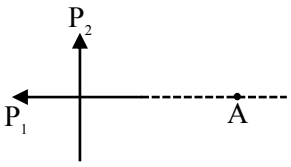
$Q = \frac{7}{2}nR\Delta T$

$\frac{Q}{W} = \frac{7}{2}$

$\frac{\Delta U}{W} = \frac{5}{2}$

$Q : \Delta U : W$ is 7 : 5 : 2

19. Net electric field at point A as shown in figure is at an angle of 60° with x-axis then, find $\frac{P_2}{P_1} = ?$

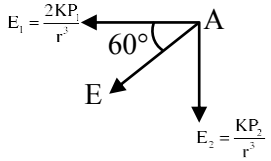


(1) $\frac{1}{\sqrt{3}}$ (2) $2\sqrt{3}$

(3) $\sqrt{3}$ (4) $\sqrt{3}/2$

Ans. (2)

Sol.



$\tan 60^\circ = \frac{E_2}{E_1} = \frac{P_2}{2P_1}$

$\sqrt{3} = \frac{P_2}{2P_1}$

$\frac{P_2}{P_1} = 2\sqrt{3}$

20. Angular momentum of the electron in a hydrogen atom is $\frac{3h}{2\pi}$, then find the energy of the electron in the orbit :-

(1) –13.6 eV (2) –3.4 eV

(3) –1.51 eV (4) –0.85 eV

Ans. (3)

Sol. According to Bohar's model, $L = \frac{nh}{2\pi}$

$\therefore$ Electron is present in 3rd orbit.

$E = \frac{-13.6}{n^2} = \frac{-13.6}{9}eV = -1.51eV$

21. The equation of a plane progressive wave is given by $y = 5\cos\pi\left(200t - \frac{x}{150}\right)$ where x and y are in cm and t is in seconds. Find the wave velocity :

Ans. (300 m/s)

Sol. $\omega = 200\pi$

$k = \frac{\pi}{150}$

$v = \frac{\omega}{k} = \frac{200}{\left(\frac{1}{150}\right)} = 200 \times 150$

$= 3 \times 10^4$ cm/s

$= 300$ m/s

22. $Li^{+2} \longrightarrow Li^{+3} + e^-$:

Energy required for this process.

Given ionisation energy for ground state of hydrogen atom is 2.17×10^{-18} J.

(1) 19.53×10^{-18} J (2) 19.54×10^{-18} J

(3) 19.56×10^{-18} J (4) 19.55×10^{-18} J

Ans. (1)

Sol. $E \propto \frac{Z^2}{n^2}$

$\frac{E_1}{E_2} = \left(\frac{Z_1}{Z_2}\right)^2 \times \left(\frac{n_2}{n_1}\right)^2$

$\frac{2.17 \times 10^{-18}}{E_2} = \left(\frac{1}{3}\right)^2 \times \left(\frac{1}{1}\right)^2$

$E_2 = 9 \times 2.17 \times 10^{-18}$

$= 19.53 \times 10^{-18}$

23. Electric field of electromagnetic wave is $E = 800\sin\pi\left(10^8 t + \frac{x}{150}\right)V/m$. Where x in cm and 't' in sec. A charged particle is moving with speed of 1.5×10^6 m/s. Find the ratio of magnetic force to electric force on charge particle.

(1) 10^{+2} (2) 10^{-2}

(3) 2×10^2 (4) 2×10^{-2}

Ans. (2)

Sol. $E = 800\sin\left(\pi\left(10^8 t + \frac{x}{150}\right)\right)$

$$V_{wave} = \frac{w}{k} = \frac{10^8\pi}{\pi/150}\,cm/s = 1.5\times10^8\,m/s$$

$$\frac{F_{Magnetic}}{F_{Electric}} = \frac{qVB}{qE} = \frac{VB}{BV_{wave}} = \frac{V}{V_{wave}}$$

$$= \frac{1.5\times10^6}{1.5\times10^8} = \frac{1}{100} = 10^{-2}$$

24. A liquid drop having diameter 2mm and surface tension 0.08 N/m. This drop splits into 512 identical small drops. Find change in surface energy ?

(1) 4.034 (2) 5

(3) 7.034×10^{-6} (4) 9.03

Ans. (3)

Sol. Vol^m constant

$V_1 = V_2$

$R = n^{1/3}.r$

$1 = (512)^{1/3}.r$

$r = \frac{1}{8}mm$

$\Rightarrow \Delta SE = SE_2 - SE_1$

$= T \times 4\pi r^2 \times n - T \times 4\pi R^2$

$= T\times4\pi\left\{nr^2 - R^2\right\}$

$$= 0.08\times4\pi\left\{512\times\left(\frac{1}{8}\right)^2 - 1^2\right\}\times10^{-6}$$

$= 0.08\times4\pi\{7\}\times10^{-6} = 7.034 \times 10^{-6}$

25. If power dissipated in a coil having total number of turns 'N', cross-section area 'A' and radius of coil 'R' when kept in a time varying magnetic field is P. Now if another coil having total number of turns '2N', cross-section area '2A' and radius of coil '3R' is placed is same time varying magnetic field power dissipated is α P, then value of α is :

(1) 108

(2) 324

(3) 216

(4) 432

Ans. (1)

Sol. $$P = \frac{\varepsilon^2}{R} = \frac{\left[N\pi R^2\frac{dB}{dt}\right]^2}{\rho\frac{2\pi RN}{A}}$$

$$\alpha P = \frac{\varepsilon'^2}{R'} = \frac{\left[2N\pi(3R)^2\frac{dB}{dt}\right]^2}{\rho\frac{2\pi(3R)}{2A}.2N} = 108P$$

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CHEMISTRY

TEST PAPER WITH SOLUTION

1. For first order reaction, rate constant at 27°C and t°C are 1.5×10^3 and 4.5×10^3 respectively. If activation energy of the reaction is 60 $KJmol^{-1}$, then ($R = 8.3\ Jmol^{-1}K^{-1}$) $\ell n3 = 1.1$

Find temperature 't'(in °C).

Ans. (41)

Sol. $$\ell n\left(\frac{K_2}{K_1}\right) = \frac{E_a}{R}\left[\frac{T_2 - T_1}{T_1T_2}\right]$$

$$\ell n\left(\frac{4.5\times10^3}{1.5\times10^3}\right) = \frac{60\times10^3}{8.3}\left[\frac{T_2 - 300}{300.T_2}\right]$$

$$\ell n3 = \frac{60\times10^3}{8.3}\left[\frac{T_2 - 300}{300.T_2}\right]$$

$\Rightarrow T_2 = 314.35\ K$

$\Rightarrow t = 41.2°C$

2. One mole of an alkane on complete combustion required 8 mole of O_2, find out sum of carbon and hydrogen atoms in one molecule of the alkane.

Ans. (17)

Sol. $$C_nH_{2n+2} + \left(\frac{3n+1}{2}\right)O_2 \rightarrow nCO_2 + (n+1)\,H_2O$$

$$1 \qquad \left(\frac{3n+1}{2}\right)$$

$$\frac{3n+1}{2} = 8 \Rightarrow 3n + 1 = 16$$

$$\Rightarrow 3n = 15$$

$$n = 5$$

So alkane is $C_5H_{12} \Rightarrow 17$

3. Relation between $t_{1/2}$ & $t_{100\%}$ for zero order & Ist order reaction respectively is:

(1) $t_{100\%} = 2 \times t_{1/2} : t_{100\%} = 2 \times t_{1/2}$

(2) $t_{100\%} = 2 \times t_{1/2} : t_{100\%} = t_{1/2}$

(3) $t_{100\%} = 2 \times t_{1/2} : t_{100\%} = \infty$

(4) $t_{100\%} = \infty : t_{100\%} = 2 \times t_{1/2}$

Ans. (3)

Sol. Zero –order

$$t_{100\%} = \frac{a}{k};\ t_{1/2} = \frac{a}{2k}$$

Ist order

$$t_{100\%} = \infty$$

$$t_{1/2} = \frac{\ell n2}{k}$$

4. 18 g of steam reacted with iron to from Fe_3O_4, how much iron will be consumed.

(1) 21 gm (2) 42 gm

(3) 84 gm (4) 10.5 gm

Ans. (2)

Sol. $3Fe + 4\,H_2O \rightarrow Fe_3O_4 + 4H_2O$

$$n_{steam} = \frac{18}{18} = 1$$

$$n_{Fe}\ \text{required} = \frac{3}{4}$$

$$\text{mass of Fe required} = \frac{3}{4}\times 56$$

$= 42$ gm

5. Angular momentum of the electron in a hydrogen atom is $\frac{3h}{2\pi}$ then find total energy of electron (in eV/atom)

(1) –1.51 (2) –122.4

(3) –40.8 (4) –4.53

Ans. (1)

Sol. $$\text{Angular Momentum} = \frac{nh}{2\pi} = \frac{3h}{2\pi}$$

$n = 3$

$$\text{Energy of electron} = -13.6\frac{Z^2}{n^2}\ eV/atom$$

$$= \frac{-13.6\times1}{3^2}\ eV$$

$= -1.51$ eV

6. For a reversible adiabatic process involving ideal gas if initial pressure and volume are 8 bar and 0.15 m^3 respectively and final pressure is 1 bar.

Calculate |work done| (in Kilo Joule)

$[C_V = 2R, C_P = 3R]$

Ans. (120)

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

$8 \times (0.15)^{3/2} = 1 \times (V_2)^{3/2}$

$(2^3)^{2/3} \times (0.15) = V_2$

$V_2 = 0.6\ m^3$

$$w = \frac{P_2V_2 - P_1V_1}{\gamma - 1}$$

$$= \frac{1 \times 0.6 - 8 \times 0.15}{\left(\frac{3}{2} - 1\right)} = \frac{0.6 - 1.2}{1/2}$$

$w = -1.2$ bar-m^3

$= -1.2 \times 10^5$ J

$= -120$ KJ

7. For reaction $A \rightleftharpoons B$

$\Delta G° = 105 - 35 \log T$

Find the transition temperature (in °C) of the above reaction at 1 bar

Ans. (727)

Sol. $\Delta G° = 0$

$105 - 35 \log T = 0$

$\log T = 3$

$T = 1000$ K

$T = 727°C$

8. Given $K_{SP}(Ag_2C_2O_4) = 32X$

$K_{SP}(AgBr) = 4Y$

Find ratio of solubility of the given salts in pure water

(1) $\frac{X^{1/3}}{\sqrt{2Y}}$ (2) $\frac{2X^{1/3}}{\sqrt{2Y}}$

(3) $\frac{2X^{1/3}}{\sqrt{Y}}$ (4) $\frac{X^{1/3}}{\sqrt{Y}}$

Ans. (4)

Sol. For $Ag_2C_2O_4$

$4S_1^3 = 32\ X$

$\Rightarrow S_1 = 2\ X^{1/3}$

For AgBr

$S_2^2 = 4\ Y$

$\Rightarrow S_2 = 2\ Y^{1/2}$

$$\text{Ratio}\left(\frac{S_1}{S_2}\right) = \frac{X^{1/3}}{\sqrt{Y}}$$

9. 19.5 gm FCH_2COOH is dissolved in 500 gm water due to which depression in freezing point is found to be 1°C. Calculate K_a of FCH_2COOH.

{K_f of water = 1.86 K-kg/mole, m = M}

(1) 2.8×10^{-3} (2) 2.8×10^{-2}

(3) 1.4×10^{-3} (4) 5.6×10^{-3}

Ans. (1)

Sol. $\Delta T_f = iK_fm$

$$\text{no. of moles} = \frac{19.5}{78} = \frac{1}{4}\text{mole}$$

$$1 = i \times 1.86 \times \frac{1/4}{1/2}$$

$$i = \frac{2}{1.86}$$

$i = 1 + (n-1)\alpha$

$i = 1 + \alpha$

$$\alpha = \frac{2}{1.86} - 1 = 0.075$$

$K_a = C\alpha^2$

$$= \frac{1}{2} \times (0.075)^2$$

$= 0.00281 = 2.8 \times 10^{-3}$

10. Consider following reaction :

$Fe(OH)_2 + 2e^- \longrightarrow Fe(s) + 2OH^-$ $E^O = -0.88$ V

$AgBr(s) + e^- \longrightarrow Ag(s) + Br^-(aq)$ $E^O = 0.07$ V

Select the correct statement.

(1) $E^o_{cell} = -0.95V$

(2) E^o_{cell} is an extensive property

(3) Fe is getting reduced

(4) Net cell reaction

$Fe(s) + 2OH^-(aq) + 2AgBr(s) \longrightarrow Fe(OH)_2 + 2Ag(s) + 2Br^-(aq)$

Ans. (4)

Sol. $E^o_{cell} = E^o_{R(cathode)} - E^o_{R(anode)}$

$= 0.07 - (-0.88) = 0.95$ V

11. Match the column and select correct option:-

(i) Vit. B_1	(P) Ascorbic acid
(ii) Vit. B_2	(Q) Riboflavin
(iii) Vit. B_6	(R) Thiamine
(iv) Vit. C	(S) Pyridoxine

(1) (i) $\rightarrow$ R, (ii) $\rightarrow$ Q, (iii) $\rightarrow$ S, (iv) $\rightarrow$ P

(2) (i) $\rightarrow$ Q, (ii) $\rightarrow$ R, (iii) $\rightarrow$ S, (iv) $\rightarrow$ P

(3) (i) $\rightarrow$ R, (ii) $\rightarrow$ Q, (iii) $\rightarrow$ P, (iv) $\rightarrow$ S

(4) (i) $\rightarrow$ S, (ii) $\rightarrow$ Q, (iii) $\rightarrow$ R, (iv) $\rightarrow$ P

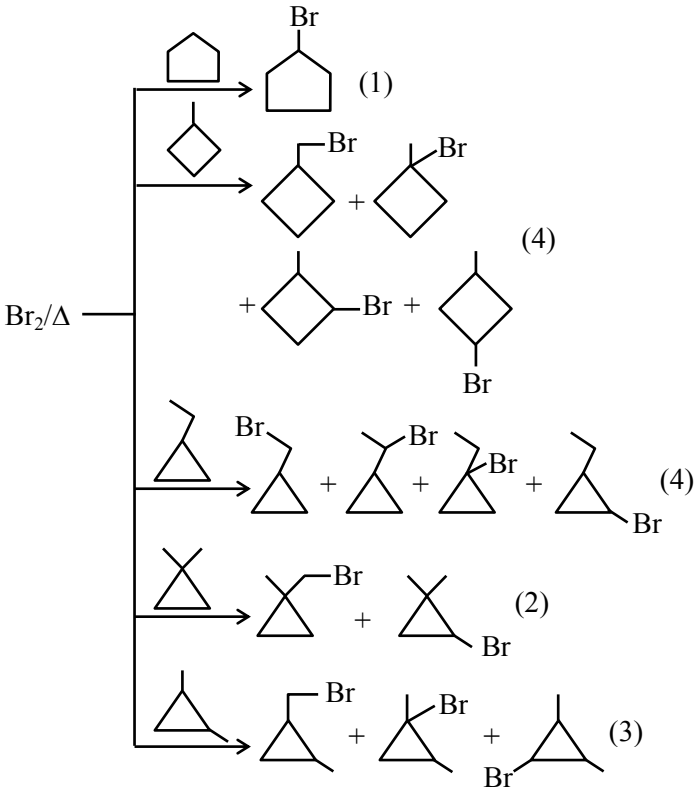
Ans. (1)

Sol. Theory based

12. Organic compound C_5H_{10} does not give Baeyer's reagent test. Calculate total number of structural monobromo isomers when react with $Br_2/h\nu$.

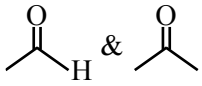
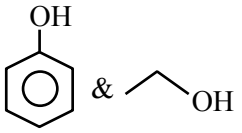
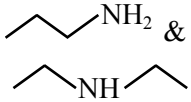
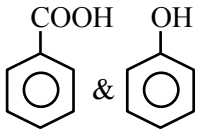
Ans. (14)

Sol.



$1 + 4 + 4 + 2 + 3 = 14$

13. Match correctly with the reagents given in column-I with organic compounds given in column-II.

	Column-I (Name of test)		**Column-II (Pair of compounds)**
(i)	Neutral $FeCl_3$ test	(P)	
(ii)	Isocyanide test $CHCl_3$ + KOH/Δ	(Q)	
(iii)	Ammonical silver nitrate test	(R)	
(iv)	$NaHCO_3$ test	(S)	

(1) (i)-Q, (ii)-R, (iii)-P, (iv)-S

(2) (i)-P, (ii)-Q, (iii)-R, (iv)-S

(3) (i)-R, (ii)-S, (iii)-Q, (iv)-P

(4) (i)-S, (ii)-R, (iii)-Q, (iv)-P

Ans. (1)

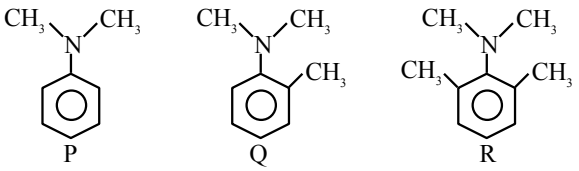
Sol. (i) Phenol gives violet colour with neutral $FeCl_3$ not ethanol.

(ii) 1° amine gives positive test with $CHCl_3$/KOH not 2° amine.

(iii) Aldehyde gives positive test with ammonical silver nitrate not ketone.

(iv) Benzoic acid release CO_2 with $NaHCO_3$ not phenol.

14. Write the correct order of rate of reaction of following compounds with PhN_2Cl



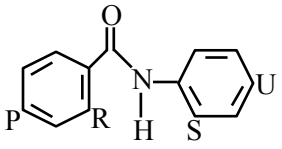
(1) P > Q > R (2) P > R > Q

(3) Q > P > R (4) R > P > Q

Ans. (1)

Sol. Rate of ESR ∝ nucleophilicity of benzene ring

Order of nucleophilicity P > Q > R.

15. 

Most preferred site for electrophilic substitution in above example?

(1) Predominantly at U

(2) S and R

(3) Predominantly at R

(4) R and S

Ans. (1)

Sol. U is predominant site towards attack of electrophile because of +M nature of nitrogen.

16. Which of the following order is correct for priority of functional group in IUPAC nomenclature ?

(1) –CHO > –COOR > –CO– > –CN > ≡ > $–NH_2$

(2) $–CONH_2$ > –CN > –CHO > –CO– > $–NH_2$ > ≡

(3) $–CONH_2$ > –COOR– > –CN > –CHO > –CO– > ≡

(4) –COOR > –CN > $–CONH_2$ > –CHO > –CO– > ≡

Ans. (2)

Sol. Theory based

17. **Statement-1 :** Benzyl chloride reacts faster than ethyl chloride towards SN^1.

Statement-2 : Positive charge on ethyl will be unstable.

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

(2) Statement-I and statement-II both are incorrect.

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

(4) Statement-I incorrect but statement-II is correct.

Ans. (1)

Sol. Rate of SN^1 ∝ Stability of carbocation

Order of stability of carbocation :

$Ph–\overset{\oplus}{C}H_2 > CH_3–\overset{\oplus}{C}H_2$

18. **Statement-I :** 1, 2, 3-trihydroxy propane can be separated from water by using simple distillation.

Statement-II : Azeotropic mixture cannot be separated by using fractional distillation.

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

Ans. **(4)**

Sol. Glycerol is separated by distillation under reduced pressure.

19. Statement-I : The correct increasing order of bond length among the following is $O_2^{\oplus} < O_2 < O_2^{-} < O_2^{2-}$

Statement-II : The correct order of number of unpaired electrons is $O_2^{2-} < O_2 < O_2^{-} < O_2^{+}$

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

Ans. **(2)**

Sol.

Species	**Bond order**	**unpaired electrons**
$O_2^{\oplus}$	2.5	1
O_2	2	2
O_2^{-}	1.5	1
O_2^{2-}	1	0

20. **Statement-I :** The correct order of Ionization energy is Na > Mg > Al > Ar

Statement-II : Among the following elements Sc, Ca and Mg, Ca has highest 3rd Ionisation Energy

(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

Correct order are

Ans. **(4)**

Sol. Statement I IE : Ar > Mg > Al > Na

Statement II IE : Mg > Ca > Sc

21. Cation of salt A when treated in flame gives apple green colour. When salt A is heated with Chromate solution gives yellow precipitate & when salt is heated with conc HNO_3 & Ammionium molybdate it gives canary yellow ppt. Salt A contains :

(1) Ba^{+2} and PO_4^{3-} (2) Ca^{+2} and SO_4^{2-}

(3) Ba^{+2} and SO_4^{2-} (4) Sr^{+2} and PO_4^{3-}

Ans. **(1)**

Sol. (i) Ba^{+2} gives apple green colour while Ca^{+2} and Sr^{+2} gives brick red and crimson red in flame test.

(ii) $Ba^{+2} + CrO_4^{2-} \rightarrow \underset{\text{Yellow ppt}}{BaCrO_4}$

(iii) $PO_4^{3-} + \text{Conc } HNO_3 + (NH_4)_2MoO_4 \longrightarrow \underset{\text{Canery yellow ppt}}{(NH_4)_3[P(Mo_3O_{10})_4]}$

22. 5.33 gram of $CrCl_3.6H_2O$(1:3 electrolyte) is passed through cation exchanger. The resulting solution is then treated with an excess of $AgNO_3$, leading to formation of 8.61 gran of precipitate. Calculate :

$$\frac{\text{number of moles of complex reacted}}{\text{number of moles of AgCl precipitated}} \times 100$$

Ans. **(33)**

Sol. $[Cr(H_2O)_6]Cl_3 + \underset{\text{excess}}{AgNO_3} \rightarrow \underset{\text{ppt}}{3AgCl(s)}$

$$\frac{\text{no. of moles of complex reacted}}{\text{no. of moles of AgCl precipitated}} \times 100 = \frac{1}{3} \times 100 = 33.3$$

23. Find the correct match.

	Column-I (Complex compound)	**Column-II (Δ_0 (CFSE) cm^{-1})**
(i)	$[Cr(CN)_6]^{3-}$	(P) 17000
(ii)	$[Cr(H_2O)_6]^{3+}$	(Q) 15000
(iii)	$[Cr(en)_3]^{3+}$	(R) 12000
(iv)	$[CrF_6]^{3-}$	(S) 20,000

(A) (i) → P ; (ii) → Q ; (iii) → S ; (iv) → R
(B) (i) → S ; (ii) → Q ; (iii) → P ; (iv) → R
(C) (i) → R ; (ii) → P ; (iii) → Q ; (iv) → S
(D) (i) → P ; (ii) → R ; (iii) → Q ; (iv) → S

Ans. **(B)**

Sol. CFSE is proportional to strength of ligand followed by chelation.
CN^- is stronger than en
$CN^- > en > H_2O > F^-$

MEMORY BASED QUESTIONS JEE–MAIN EXAMINATION – APRIL 2026

(HELD ON THURSDAY 02nd APRIL 2026) **TIME : 9:00 AM TO 12:00 NOON**

MATHEMATICS

TEST PAPER WITH SOLUTION

1. If y = f(x) is the solution of the differential equation $(1 + \sin x)\dfrac{dy}{dx} + \cos x = 0$, such that $f(0) = 0$, then $f\left(\dfrac{\pi}{2}\right)$ is

(1) ln 2 (2) $-l$n 2

(3) ln 3 (4) ln 4

Ans. (2)

Sol. $dy + \dfrac{\cos x}{(1+\sin x)}dx = 0$

$y + l\text{n}(1 + \sin x) = C$

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

$y = -l\text{n}(1 + \sin x)$

$f\left(\dfrac{\pi}{2}\right) = -l\text{n}\,2$

2. The value of $\displaystyle\int_0^3 \frac{e^x + e^{-x}}{([x])!}dx$ is equal to

(where [·] denotes greatest integer function)

(1) $\dfrac{e^3 + e^2 - e^{-2} - e^{-3}}{2}$ (2) $\dfrac{e^3 - e^2 - e^{-2} + e^{-3}}{2}$

(3) $e^3 + e^2 - e^{-2} - e^{-3}$ (4) $e^3 - e^2 - e^{-2} + e^{-3}$

Ans. (1)

Sol. $\displaystyle\int_0^1 \frac{e^x + e^{-x}}{1}dx + \int_1^2 \frac{e^x + e^{-x}}{1}dx + \int_2^3 \frac{e^x + e^{-x}}{2}dx$

$\displaystyle\int_0^2 e^x dx + \int_0^2 e^{-x}dx + \frac{1}{2}\int_2^3 (e^x + e^{-x})dx$

$(e^2 - 1) + \dfrac{(e^{-2} - 1)}{-1} + \dfrac{1}{2}\left((e^3 - e^2) - (e^{-3} - e^{-2})\right)$

$\dfrac{e^3 + e^2}{2} + 1 - 1 - \dfrac{e^{-2}}{2} - \dfrac{e^{-3}}{2}$

$\dfrac{e^3 + e^2 - e^{-2} - e^{-3}}{2}$

3. Number of seven digits numbers which can be formed by using all the digits 1, 2, 3, 4, 5 with at least one digit repeated is _____.

(1) 16200 (2) 15600

(3) 16800 (4) 14800

Ans. (3)

Sol. Exactly one digit repeated $\rightarrow {}^5C_1 \times \dfrac{7!}{3!} = 4200$

Exactly two digits repeated $\rightarrow {}^5C_2 \times \dfrac{7!}{2!2!} = 12600$

Total numbers = 16800

4. The Range of $f(x) = \sin^{-1}\left(\dfrac{1}{x^2 - 2x + 2}\right)$ is

(1) $\left(0, \dfrac{\pi}{2}\right)$ (2) $\left[0, \dfrac{\pi}{2}\right]$

(3) $\left(0, \dfrac{\pi}{2}\right]$ (4) $\left[0, \dfrac{\pi}{2}\right)$

Ans. (3)

Sol. $f(x) = \sin^{-1}\left(\dfrac{1}{(x-1)^2 + 1}\right)$

$(x-1)^2 + 1 \geq 1$

$0 < \sin^{-1}\left(\dfrac{1}{(x-1)^2 + 1}\right) \leq \dfrac{\pi}{2}$

So range is $\left(0, \dfrac{\pi}{2}\right]$

5. Let $x \in [-\pi, \pi]$ &

$S = \{x : \sin x(\sin x + \cos x) = a, a \in I\}$, then number of elements in set S is equal to :

(1) 5 (2) 10

(3) 9 (4) 4

Ans. (3)

Sol. $\sin x(\sin x + \cos x) \in \left[\frac{1-\sqrt{2}}{2}, \frac{1+\sqrt{2}}{2}\right]$

2 integer will be there $\Rightarrow a = 0, 1$

If $a = 0$ $\quad \sin x(\sin x + \cos x) = 0$

$\Rightarrow \sin x = 0$ or $\sin x + \cos x = 0$

$\boxed{x = -\pi, 0, \pi}$ $\quad = \tan x = -1$

3 solutions $\quad \boxed{x = -\frac{\pi}{4}, \frac{3\pi}{4}}$ 2 solutions

If $a = 1$ $\quad \sin x(\sin x + \cos x) = 1$

$\sin^2 x + \sin x \cos x = 1$

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

$1 - \cos 2x + \sin 2x = 2$

$\text{Sin}2x - \cos 2x = 1 \rightarrow$ square

$\text{Sin } 4x = 0$

$4x = -4\pi, -3\pi, \ldots\ldots\ldots, 3\pi, 4\pi$

$x = -\pi, -\frac{3\pi}{4}, -\frac{\pi}{2}, -\frac{\pi}{4}, 0, \frac{\pi}{4}, \frac{\pi}{2}, \frac{3\pi}{4}, \pi$

$\Rightarrow x = -\frac{3\pi}{4}, -\frac{\pi}{2}, \frac{\pi}{4}, \frac{\pi}{2}$ $\quad$ 4 solutions

Total 9 solution

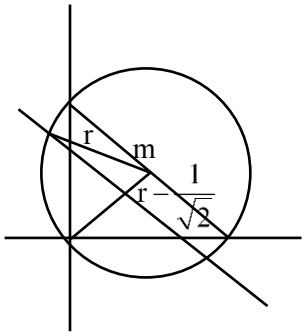
6. A circle meets coordinate axes at 3 points and cuts equal intercepts. If it cuts a chord of length $\sqrt{14}$ unit on $x + y = 1$, then square of its radius is (centre lies in first quadrant)

(1) 2 (2) 4

(3) 8 (4) 16

Ans. (3)

Sol.



$$r^2 = \left(\frac{\sqrt{14}}{2}\right)^2 + \left(r - \frac{1}{\sqrt{2}}\right)^2$$

$$r^2 = \frac{7}{2} + r^2 - \sqrt{2}r + \frac{1}{2}$$

$$\sqrt{2}r = 4$$

$$r = 2\sqrt{2}$$

$$r^2 = 8$$

7. Let $|\vec{a}| = 2, |\vec{b}| = 3$, then maximum value of $3|3\vec{a} + 2\vec{b}| + 4|3\vec{a} - 2\vec{b}|$ is

(1) 50 (2) 60

(3) 70 (4) 80

Ans. (2)

Sol. $E = 3\sqrt{9a^2 + 4b^2 + 12\vec{a}.\vec{b}} + 4\sqrt{9a^2 + 4b^2 - 12\vec{a}.\vec{b}}$

$= 3\sqrt{36 + 36 + 12 \times 6\cos\theta} + 4\sqrt{36 + 36 - 72\cos\theta}$

$= 3\sqrt{72 + 72\cos\theta} + 4\sqrt{72 - 72\cos\theta}$

$= 18\sqrt{2}\sqrt{1 + \cos\theta} + 24\sqrt{2}\sqrt{1 - \cos\theta}$

$= 18\sqrt{2}\sqrt{2}\cos\frac{\theta}{2} + 24\sqrt{2}\left(\sqrt{2}\sin\frac{\theta}{2}\right)$

$= 36\left(\cos\frac{\theta}{2}\right) + 48\sin\left(\frac{\theta}{2}\right)$

$E_{max} = \sqrt{(36)^2 + (48)^2} = \sqrt{6^4 + 6^2 \times 8^2} = 60$

8. If probability that $ax^2 + 2\sqrt{2}bx + c > 0 \ \forall \ x \in R$ where a,b,c, $\in \{1,2,3,4\}$ is $\frac{m}{n}$ where m & n are coprime than (m+n) is

(1) 81 (2) 18

(3) 78 (4) 17

Ans. (1)

Sol. $8b^2 - 4ac < 0 \Rightarrow 2b^2 < ac$

b	a	c		
1	1	3,4	$\rightarrow$	2
1	2	2,3,4	$\rightarrow$	3
1	3	1,2,3,4	$\rightarrow$	4
1	4	1,2,3,4	$\rightarrow$	4
2	3	3,4	$\rightarrow$	2
2	4	3,4	$\rightarrow$	2
				17

Required probability $= \frac{17}{64} \equiv \frac{m}{n}$

$\therefore \ m + n = 17 + 64 = 81$

9. Consider $f(x)=\begin{cases}\left|\dfrac{\sin x}{x}\right|, & x\neq 0\\ 1, & x=0\end{cases}$

Number of critical points of f(x) in the interval $(-2\pi, 2\pi)$ is

(1) 3 (2) 5

(3) 7 (4) 1

Ans. (1)

Sol. We find points where f'(x) = 0 or f'(x) is not defined.

$\therefore\ x=-\pi,0,\pi$

$\therefore$ 3 points

10. If eccentricity of an ellipse $\dfrac{x^2}{a^2}+\dfrac{y^2}{b^2}=1$, which passes through the point (3, 4) is $\dfrac{\sqrt{5}}{3}$, then length of latus rectum of ellipse, is :

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

(3) $\dfrac{4\sqrt{7}}{3}$ (4) $\dfrac{8\sqrt{7}}{3}$

Ans. (2)

Sol. $e^2=1-\dfrac{b^2}{a^2} \Rightarrow \dfrac{b^2}{a^2}=1-e^2=1-\dfrac{5}{9}=\dfrac{4}{9}$

$\Rightarrow \dfrac{b^2}{a^2}=\dfrac{4}{9}$ .... (1)

Passes through (3, 4) $\Rightarrow \dfrac{9}{a^2}+\dfrac{16}{b^2}=1$ .... (2)

From (1) and (2) $a^2 = 45, b^2 = 20$

LR = $\dfrac{2b^2}{a}=\dfrac{8\sqrt{5}}{3}$

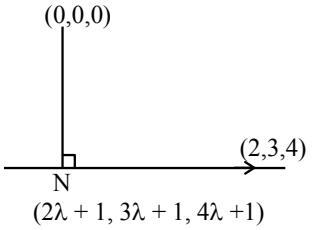
11. Foot of perpendicular from origin on a line passing through (1, 1, 1) having direction ratios <2, 3, 4>, is:

(1) $\left(\dfrac{11}{29},\dfrac{2}{29},\dfrac{7}{29}\right)$ (2) $\left(\dfrac{11}{29},\dfrac{-2}{29},\dfrac{-7}{29}\right)$

(3) $\left(\dfrac{11}{29},\dfrac{2}{29},\dfrac{-7}{29}\right)$ (4) $\left(\dfrac{-11}{29},\dfrac{2}{29},\dfrac{-7}{29}\right)$

Ans. (3)

Sol. Line : $\vec{r}=(\hat{i}+\hat{j}+\hat{k})+\alpha(2\hat{i}+3\hat{j}+4\hat{k})$



$\overrightarrow{ON}.(2\hat{i}+3\hat{j}+4\hat{k})=0$

$2(2\lambda + 1) + 3(3\lambda + 1) + 4(4\lambda + 1) = 0$

$29\lambda + 9 = 0$

$\lambda=\dfrac{-9}{29}$

Foot $\left(\dfrac{11}{29},\dfrac{2}{29},\dfrac{-7}{29}\right)$

12. $\underline{\alpha}$, $\alpha + 2 \in Z$ and $n \in N$, where α, $\alpha+2$ are roots of equation $x(x + 2) + (x + 1)(x + 3) + \ldots + (x+n-1)(x + n+1) = 4n$ then $\alpha + n =$

(1) 0 (2) 1

(3) 2 (4) 3

Ans. (2)

Sol. $nx^2 + x(2 + 4 + 6 + ... + 2n) + (1.3 + ... + (n-1)(n+1)) = 4n$

$$nx^2 + n(n+1)x + \frac{n(n+1)(2n+1)}{6} - 5n = 0$$

$$x^2 + (n+1)x + \frac{(n+1)(2n+1)}{6} - 5 = 0$$

D must be a perfect square

$$D = \frac{122 - 2n^2}{6} = 20 - \left(\frac{n^2-1}{3}\right)$$

If make perfect square $\Rightarrow \frac{n^2-1}{3} = 16 \Rightarrow n = 7$

So Equation is

$$\Rightarrow x^2 + 8x + \frac{8\times 15}{6} - 5 = 0$$

$x^2 + 8x + 15 = 0$

$x = -3, -5$

$\alpha = -5,\ \alpha + 2 = -3$

$\alpha + n = 7 - 5 = 2$

13. Let $K = \sin\frac{\pi}{18}\sin\frac{5\pi}{18}\sin\frac{7\pi}{18}$ then the value of $\sin\left(10K\frac{\pi}{3}\right)$ is :

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

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

Ans. (2)

Sol. $K = \sin10°\ \sin50°\ \sin70°$

$$= \frac{1}{4}\sin30° = \frac{1}{8}$$

$$\sin10K\frac{\pi}{3} = \sin\left(10\times\frac{1}{8}.\frac{\pi}{3}\right) = \sin\frac{5\pi}{12} = \frac{\sqrt{3}+1}{2\sqrt{2}}$$

14. Value of definite integral

$$I = \int_0^{2\sqrt{3}} \log_2(x^2+4)dx + \int_2^4 \sqrt{2^x - 4}\ dx$$

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

(3) $6\sqrt{3}$ (4) $8\sqrt{3}$

Ans. (4)

Sol. Direct $I = 4.(2\sqrt{3}) - 2(0) = 8\sqrt{3}$

15. If $\sum_{k=1}^{n} a_k = 6n^3$ then evaluate $\sum_{k=1}^{6}\left(\frac{a_{k+1} - a_k}{36}\right)^2$ _____.

Ans. (91)

Sol. $a_1 + a_2 + ... + a_n = 6n^3$.

$a_1 + a_2 + ... + a_n + a_{n+1} = 6(n+1)^3$

$a_{n+1} = 6(n+1)^3 - 6n^3$

$= 6\left((n+1) - n\right) = \left((n+1)^2 + n^2 + n(n+1)\right)$

$a_{n+1} = 6(1)\left(3n^2 + 3n + 1\right)$

$a_n = 6\left(3(n-1)^2 + 3(n-1) + 1\right)$

$= 6\left(3(n^2 - 2n + 1 + n - 1) + 1\right)$

$= 6\left(3(n^2 - n) + 1\right)$

$a_n = 6\ (3n^2 - 3n + 1)$

$$\sum_{k=1}^{6}\left(\frac{6(3k^2 + 3k + 1 - 6(3k^2 - 3k + 1)}{36}\right)^2$$

$$\sum_{k=1}^{6}\left(\frac{36k}{36}\right)^2 = \sum_{k=1}^{6} k^2 = \frac{6\times7\times13}{6} = 91$$

16. If $\lim\limits_{x\to 2}\dfrac{\sin(x^3-5x^2+ax+b)}{\left(\sqrt{x-1}-1\right).\log_e(x-1)}=m$ (exists finitely) then find the value of a + b + m.

Ans. (6)

Sol. $\because$ Denominator = 0 at x = 2

$\Rightarrow$ Numerator = 0 at x = 2

$\Rightarrow 2^3-5(2)^2+a(2)+b=0$

$\Rightarrow 2a+b=12 \quad ...(1)$

$$\therefore m=\lim_{x\to 2}\frac{\dfrac{\sin(x^3-5x^2+ax+b)}{(x^3-5x^2+ax+b)}.(x^3-5x^2+ax+b)}{\left(\dfrac{x-1-1}{\sqrt{x-1}+1}\right).\dfrac{\log_e(1+(x-2))}{(x-2)}.(x-2)}$$

$$\Rightarrow m=\lim_{x\to 2}2\left(\frac{x^3-5x^2+ax+b}{(x-2)^2}\right)$$

$$\Rightarrow m=\lim_{x\to 2}2\left(\frac{3x^2-10x+a}{2(x-2)}\right)$$

$\because$ Denominator = 0 at x = 2

$\Rightarrow$ Numerator = 0 at x = 2

$\Rightarrow 3(2)^2-10(2)+a=0 \Rightarrow a=8$

put a = 8 in (1), we get b = – 4

$$\therefore \ m=\lim_{x\to 2}2\left(\frac{6x-10}{2}\right)\Rightarrow m=2$$

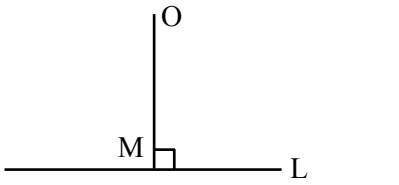
$\therefore$ a + b + m = 6

17. A line through (1, 1, 1) and perpendicular to both $\hat{i}+2\hat{j}+2\hat{k}$, $2\hat{i}+2\hat{j}+\hat{k}$, let (a, b, c) be foot of perpendicular from origin then 34 (a + b + c) is

Ans. (100)

Sol. Direction vector of line is

$$=\begin{vmatrix}\hat{i}&\hat{j}&\hat{k}\\1&2&2\\2&2&1\end{vmatrix}=-2\hat{i}+3\hat{j}-2\hat{k}$$



$(2\lambda+1, -3\lambda+1, 2\lambda+1)$

$$\frac{x-1}{2}=\frac{y-1}{-3}=\frac{z-1}{2}$$

So equation of line is

$$\frac{x-1}{2}=\frac{y-1}{-3}=\frac{z-1}{2}=\lambda \text{ let}$$

let $(2\lambda+1, -3\lambda+1, 2\lambda+1)$ be the foot of perpendicular from (0, 0, 0) upon given line

$\Rightarrow \overrightarrow{OM}.\left(2\hat{i}-3j+2\hat{k}\right)=0$

$\Rightarrow 2(2\lambda+1)-3(-3\lambda+1)+2(2\lambda+1)=0$

$$\Rightarrow \lambda=-\frac{1}{17}$$

$$\text{So (a, b, c)} \equiv \left(\frac{-2}{17}+1,\frac{3}{17}+1,\frac{-2}{17}+1\right)$$

$\Rightarrow 34(a+b+c)=100$

18. If $^{36}C_{r+1}=6\ .\ \dfrac{^{35}C_r}{k^2-3}$, then number of ordered pairs (r, k), where r, k $\in$ Z is _____.

Ans. (4)

Sol. $$\frac{36}{r+1}.{}^{35}C_r=6.\frac{^{35}C_r}{k^2-3}$$

$$k^2-3=\frac{r+1}{6}$$

$$k^2=\frac{r+19}{6}$$

$0 \le r \le 35$

$19 \le r+19 \le 54$

$$3.1 \le \frac{r+19}{6} \le 9$$

$\therefore k^2=4, 9$

$k=\pm 2, \pm 3$

$\therefore$ (r, k) $\Rightarrow$ (5, $\pm$ 2) $\Rightarrow$ (35, $\pm$ 3)

$\therefore$ 4

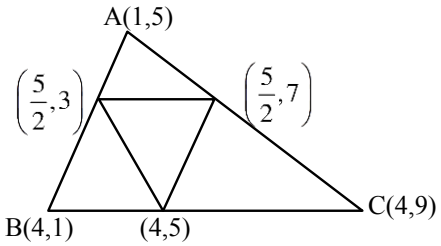
19. let mid – point of sides of Δ are

$$\left(\frac{5}{2},3\right),\left(\frac{5}{2},7\right)\&(4,5)$$

If incentre is (h, k) then value of 3h + k is

Ans. (13)

Sol.



$I = \left(\frac{24}{9},5\right)$

$\therefore$ 3h + k = 8 + 5 = 13

20. If domain of $f(x) = \sqrt{\log_{0.6}\left|\frac{2x-5}{x^2-4}\right|}$ is $(-\infty, a] \cup \{b\} \cup [c,d) \cup (e,\infty)$ then the value of (a + b + c + d + e) is :

Ans. (4)

Sol. For domain $\log_{0.6}\left|\frac{2x-5}{x^2-4}\right| \geq 0$

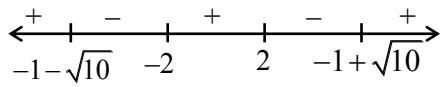
$\left|\frac{2x-5}{x^2-4}\right| \leq 1$ & $x \neq \frac{5}{2}$ ..... (1)

$-1 \leq \frac{2x-5}{x^2-4} \leq 1$

$\frac{2x-5}{x^2-4}+1 \geq 0$

$\frac{x^2+2x-9}{x^2-4} \geq 0$

$\frac{(x+1)^2-10}{(x-2)(x+2)} \geq 0$



$x \in \left(-\infty,-1-\sqrt{10}\right] \cup (-2,2) \cup \left[-1+\sqrt{10},\infty\right)$ .....(2)

$\frac{2x-5}{x^2-4}-1 \leq 0$

$\frac{2x-5-x^2+4}{x^2-4} \leq 0$

$\frac{x^2-2x+1}{x^2-4} \geq 0$

$\frac{(x-1)^2}{(x-2)(x+2)} \geq 0$

$x \in (-\infty,-2) \cup (2,\infty) \cup \{1\}$ ....(3)

(1) $\cap$ (2) $\cap$ (3)

$x \in \left(-\infty,-1-\sqrt{10}\right] \cup \{1\} \cup \left[-1+\sqrt{10},\frac{5}{2}\right) \cup \left(\frac{5}{2},\infty\right)$

a + b + c + d + e = –2 + 1 + 5 = 4

21. Consider two AP's S_1 & S_2 such that

S_1 : {First term = 1, Common difference = 5, no. of terms = 101}

S_2 : {First term = 9, Common difference = 7, no. of terms = 71}

Find the number of common terms in both AP's

Ans. (14)

Sol. AP_1 : 1, 6, 11, ... 101 terms

AP_2 : 9, 16 ..... 71 terms

D = L.C.M $\{d_1, d_2\}$ = 35

1st Common term is 16

16 + (n – 1) 35 $\leq$ 499

n $\leq$ 14.8

$\Rightarrow$ n = 14

22. If $50\left(\frac{2x}{1+3i}+\frac{y}{1-2i}\right) = 31+17i$ where x, y $\in \mathbb{R}$ & $i = \sqrt{-1}$ then value of 10(x + 3y) is _____

Ans. (75)

Sol. $50\left(\frac{2x(1-3i)}{10}+\frac{y(1+2i)}{5}\right) = 31+17i$

10x – (30x)i + 10y + 20y i= 31 + 17i

$\left.\begin{aligned} 10(x+y) &= 31 \\ -30x+20y &= 17 \end{aligned}\right\}$

$30x+30y = 93$

$\underline{-30x+20y = 17}$

$50y = 110$

$y = \frac{11}{5}$

10x = 31 – 10y

10x = 31 – 22 = 9

10(x + 3y) = 10x + 30y = 9 + 66 = 75