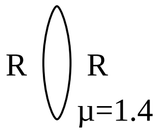
JEE–MAIN EXAMINATION – APRIL 2026
MEMORY BASED QUESTIONS

(HELD ON SATURDAY 04th APRIL 2026) **TIME : 3:00 PM TO 6:00 PM**

PHYSICS	TEST PAPER WITH SOLUTION

1. As shown figure for a biconvex lens focal length is f and both radius of curvatures are R. Find value of f/R



(1) 1.25 (2) 1.5
(3) 2 (4) 2.5

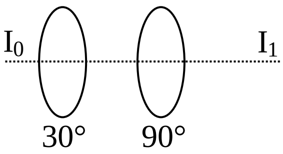
Ans. (1)

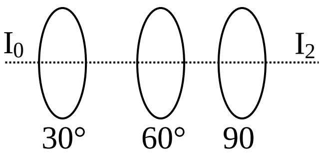
Sol. $\frac{1}{f} = (1.4-1)\left(\frac{1}{R}-\frac{1}{-R}\right)$

$\frac{1}{f} = \frac{0.8}{R}$

$\frac{f}{R} = 1.25$

2. Two setup of polarizers are used to polarize natural light as shown. Find value of ratio of intensities $\frac{I_1}{I_2}$. Angle of axes is shown in figure from a fixed axis.





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

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

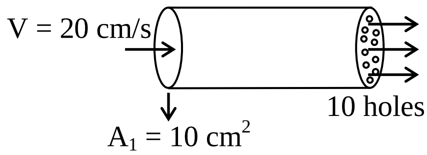
Ans. (1)

Sol. $I_1 = \frac{I_0}{2}\cos^2 60° = \frac{I_0}{8}$

$I_2 = \frac{I_0}{2}\cos^2 30° \cos^2 30° = \frac{9I_0}{32}$

$\frac{I_1}{I_2} = \frac{4}{9}$

3. Figure shows a pipe with cross-section area 10 cm^2. Water flows from one end with velocity 20 cm/s. Other end of the pipe is closed and consists of 10 holes each of area 30 mm^2. find velocity of water coming out from each hole.



(1) 66 cm/s (2) 0.66 cm/s
(3) 6.6 cm/s (4) 66 mm/s

Ans. (1)

Sol. Continuity equation

$A_1V_1 = A_2V_2$

$10 \times 10^{-4} \times 20 \times 10^{-2} = 10 \times 30 \times 10^{-6} \times V_2$

$v_2 = \frac{2}{3}$ m/s

$\Rightarrow$ 0.66 m/s $\Rightarrow$ 66 cm/s

4. **Assertion (A) :** Free charge cannot exist inside conductor.

Reason (R): If a free charge is kept between the plates of a capacitor, then it will experience force and it will drift.

(1) A & R both correct and R explain the A.
(2) A & R both correct and R does not explain A.
(3) A is true but R is false.
(4) A is false but R is true

Ans. (2)

Sol. Theoretical Questions

Both statements are correct but Reason does not explain the Assertion.

5. Material of $\mu_r = 400$ is present inside a solenoid where magnetic field is found to be 1T. If magnetic intensity here is $\alpha \times 10^5$ SI units, find α.

($\mu_0 = 4\pi \times 10^{-7}$ SI units)

(1) $\frac{1}{4\pi}$ (2) $\frac{1}{16\pi}$

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

Ans. (2)

Sol. $H = \frac{B}{\mu} = \frac{B}{\mu_0\mu_r} = \frac{1}{400\times4\pi\times10^{-7}}$

$H = \frac{1}{16\pi} \times 10^5$

6. In a YDSE experiment a sheet of thickness t and $\mu = 1.56$ introduced at a slit. The central maxima shift to position of 7th maxima. Wavelength of light is 480 nm. If t = xμm find the value of x.

Ans. (6)

Sol. $\Delta y = (\mu - 1)\, t\, \frac{D}{d} = 7\frac{\lambda D}{d}$

$(\mu - 1)t = 7\lambda$

$(1.56 - 1)t = 7 \times 480 \times 10^{-9}$

$t = 6\mu m$

7. **Statement-1 :** Two gases H_2 and O_2 are having same average kinetic energy, then they have same temperature.

Statement-2 : H_2 and O_2 will have same V_{rms} at same temperature.

(1) Statement-1 & Statement-2 both are correct and Statement-2 is correct explanation of Statement-1.

(2) Both Statement-1 & Statement-2 correct but Statement-2 is not correct explanation of Statement-1.

(3) Statement-1 true and Statement-2 is false.

(4) Both are false.

Ans. (3)

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

$KE = \frac{3}{2}nRT$

8. A solenoid of radius 2 cm and with 125 turns is kept in a uniform magnetic field of 0.4 T carries a current of 1A. The axis of solenoid makes angle 30° with the field. The torque acting on the solenoid will be :

(1) $\pi \times 10^{-6}$ N-m (2) $\pi \times 10^{-2}$ N-m

(3) $2\pi \times 10^{-6}$ N-m (4) $2\pi \times 10^{-2}$ N-m

Ans. (2)

Sol. Magnetic moment of solenoid = iAN

$= 1 \times \pi \times \left(\frac{2}{100}\right)^2 \times 125$

$\therefore \tau = |\vec{M} \times \vec{B}| = 125 \times 4\pi \times 10^{-4} \times 0.4 \times \sin 30°$

$= 100\pi \times 10^{-4}$ N-m.

9. A force $\vec{F} = (5\hat{i} + 2\hat{j})$ N is acting for 2 sec on an object of mass 0.1 kg, which is initially at rest at origin. Find final position.

(1) $50\hat{i} + 20\hat{j}$ (2) $100\hat{i} + 20\hat{j}$

(3) $50\hat{i} + 40\hat{j}$ (4) $100\hat{i} + 40\hat{j}$

Ans. (4)

Sol. $\vec{F} = 5\hat{i} + 2\hat{j}$

$\vec{a} = \frac{\vec{F}}{m} = \frac{5}{0.1}\hat{i} + \frac{2}{0.1}\hat{j} = 50\hat{i} + 20\hat{j}$

$\vec{S} = \frac{1}{2}\vec{a}t^2 = \frac{1}{2}\times(50\hat{i} + 20\hat{j})2^2$

$\vec{S} = 100\hat{i} + 40\hat{j}$

10. A Zener diode has voltage rating of 10 volts and maximum power drop across Zener diode is 0.5 watt. What resistance (in Ohm) should be connected in series with Zener diode so that it can be operated safely by a battery of 25 volts?

(1) 300 Ω (2) 200 Ω

(3) 30 Ω (4) 20 Ω

Ans. (1)

Sol. Maximum current from diode

$i = \frac{P}{V} = \frac{0.5}{10} = 0.05A$

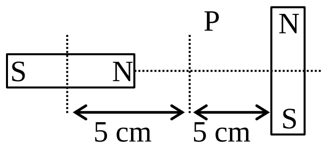
Now let resistance is R

$V_B = i\,(R + R_{diode})$

$25 = 0.05 \times R + 10$

$R = \frac{15}{0.05} = 300\ \Omega$

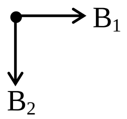
11. Point P at r = 5 cm distance from centers of two bar magnetic each of magnetic moment $3\sqrt{5}$ A-m. Magnetic field at P is ?



(1) 1.5 mT (2) 12 mT
(3) 2.5 mT (4) 4.5 mT

Ans. **(2)**

Sol. $B_{net} = \sqrt{B_1^2 + B_2^2} = \dfrac{\mu_0}{4\pi}\dfrac{M}{(r)^3}\sqrt{5}$



$= 10^{-7} \times 3\sqrt{5} \times \sqrt{5} \times \dfrac{8}{10^{-3}}$

$= 120 \times 10^{-4} = 12$ mT

12. **Assertion :** For a diode in reverse biased, current is independent of applied voltage before breakdown and it increases drastically just after breakdown.

Reason : Before breakdown only majority charge carriers flow.

(1) A & R both correct and R explain the A.
(2) A & R both correct and R does not explain A.
(3) A is true but R is false.
(4) A is false but R is true

Ans. **(3)**

Sol. Theoretical

13. Electron and proton are accelerated with same potential to achieve de-Broglie wavelength of λ_1 and λ_2 (m_p = 1849 me) then $\dfrac{\lambda_1}{\lambda_2} = ?$

(1) 37 (2) 43
(3) $\dfrac{1}{41}$ (4) $\dfrac{1}{48}$

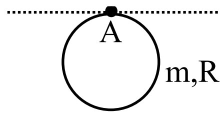
Ans. **(2)**

Sol. $\lambda = \dfrac{h}{\sqrt{2mq\Delta v}}$

$\lambda \propto \dfrac{1}{\sqrt{m}}$

$\dfrac{\lambda_e}{\lambda_p} = \sqrt{\dfrac{m_P}{m_e}} = \sqrt{1849} = 43$

14. Figure show a disc of mass 'm' & radius R hinged at point 'A' and free to oscillate about the axis. Find the time period for small oscillation of the disc



(1) $2\pi\sqrt{\dfrac{3R}{4g}}$ (2) $2\pi\sqrt{\dfrac{R}{g}}$

(3) $2\pi\sqrt{\dfrac{5R}{4g}}$ (4) $2\pi\sqrt{\dfrac{R}{4g}}$

Ans. **(3)**

Sol. $I_{disc} = \dfrac{mR^2}{4} + mR^2 = \dfrac{5mR^2}{4}$

$\therefore$ For small displacement

$\tau = -mgR\theta$

$\therefore \alpha = -\dfrac{mgR}{\dfrac{5mR^2}{4g}}\theta$

$\therefore \omega = \sqrt{\dfrac{4g}{5R}}$

$\therefore T = 2\pi\sqrt{\dfrac{5R}{4g}}$

15. A particle is projected from ground whose x, y -co-ordinates varies with time according to equations **x =** 24t, y = 43.6t – 4.9t ^{2}. Find initial angle θ made by $\vec{v}$ with x-axis.

(1) $\cot^{-1}$ (1.82) (2) $\tan^{-1}$ (1.82)
(3) $\tan^{-1}$ (2.82) (4) $\tan^{-1}$ (3.4)

Ans. **(2)**

Sol. $v_x \Rightarrow \dfrac{dx}{dt} = 24$

$v_y = \dfrac{dy}{dt} = 43.6 - 9.8t$

$\tan\theta = \dfrac{v_y}{v_x} = \dfrac{43.6 - 9.8t}{24}$

at t = 0 {Initially}

$\tan\theta \Rightarrow \dfrac{43.6}{24} = 1.82$

or $\theta = \tan^{-1}$ (1.82)

16. At what height does gravitational acceleration becomes $\frac{1}{9}$th of gravity at the surface of a planet, if radius of the planet is R?

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

(2) 2R

(3) $2\sqrt{2}R$

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

Ans. (2)

Sol. $g_h = \frac{g_s}{\left(1+\frac{h}{R}\right)^2}$

$$\frac{g_s}{9} = \frac{g_s}{\left(1+\frac{h}{R}\right)^2}$$

$$1+\frac{h}{R} = 3$$

$$h = 2R$$

17. Two cars A & B are moving on a road with speed 100 km/hr and 80 km/hr. A stone is thrown from car B with speed V km/hr relative to it. Stone hit the car A with speed 5 m/s with respect to car A (ignore gravity). The value of V is :- [all the given velocities are in same direction]

(1) 40 km/hr

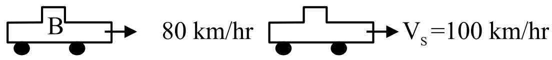
(2) 38 km/hr

(3) 38 m/s

(4) 40 m/s

Ans. (2)

Sol.



$$V = \vec{V}_{SB}$$

$$V = \vec{V}_S - \vec{V}_B$$

$$V_B + V = \vec{V}_S$$

$$\boxed{\vec{V}_S = V + 80}$$

$$\vec{V}_{SA} = 5m/s = 18km/hr$$

$$\vec{V}_S - \vec{V}_A = \vec{V}_{SA}$$

V + 80 – 100 = 18 km/hr

V – 20 = 18

V = 38 km/hr

18. A toy gun fires bullets in every possible direction. It is found that bullet lands at a maximum horizontal distance of 6.4m from gun. Find speed of projection ($g = 10m/s^2$)

Ans. (8)

Sol. $R_{max} = \frac{v^2}{g} = 6.4$

v = $\sqrt{64} = 8$ m/s

19. A rod of length L is heated from temp T_1 to T_2 Let $T_2 - T_1 = \Delta T$ and expansion of rod = ΔL_1

The rod is further heated from T_2 to T_3 such that $T_1 + T_3 = 2T_2$. Find expansion of rod ΔL_2

(1) $\Delta L_2 = \Delta L_1 (1 + \alpha\Delta T)$

(2) $\Delta L_2 = \Delta L_1 (1 + 2\alpha\Delta T)$

(3) $\Delta L_2 = \Delta L_1 (1 + \alpha^2\Delta T^2)$

(4) $\Delta L_2 = \Delta L_1 (1 + 2\alpha^2\Delta T^2)$

Ans. (1)

Sol. $T_3 - T_2 = (2T_2 - T_1) - T_2 = T_2 - T_1$

at temp T_2

$L_1 = L (1 + \alpha(T_2 - T_1) = L + L\alpha\Delta T$ ....(1)

$L_1 - L = \alpha\Delta T \Rightarrow \Delta L_1 = \alpha\Delta T$

at temp T_3

$L_2 = L_1 (1 + \alpha (T_3 - T_2)) = L_1 + L_1 \alpha\Delta T$ ...(2)

(2) – (1)

$L_2 - L_1 = (L_1 - L) + (L_1 - L) \alpha\Delta T$

$\Delta L_2 = \Delta L_1 + \Delta L_1 \alpha\Delta T$

$= \Delta L_1 (1 + \alpha\Delta T)$

20. $\vec{B} = B_0 \sin(\omega t - kx)\hat{j}$ is magnetic field of EM wave then its electic field is:

(1) $-E_0 \sin(\omega t - kx)\ \hat{k}$

(2) $+E_0 \sin(\omega t - kx)\ \hat{i}$

(3) $-E_0 \sin(\omega t - kx)\ \hat{i}$

(4) $+E_0 \sin(\omega t - kx)\ \hat{k}$

Ans. (1)

Sol. $\hat{E} = \hat{B} \times \hat{C}$

$= \hat{j} \times \hat{i} = -\hat{k}$

$\Rightarrow E = -E_0 \sin(\omega t - kx)\hat{k}$

21. Why does only few α-particles rebound from gold nucleus in Rutherford experiment

S1→Size of gold nucleus is very less than gold atom

S2→Impact parameter of α particles is very less.

S3→Nuclear charge of He^{+2} particles is very less as compared to gold

S4→Very few α particles undergo head on collision.

Then correct statement are

(1) S1 and S2

(2) S1, S2 and S3

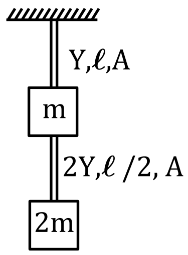
(3) S1, S2 and S4

(4) S1 and S3

Ans. (3)

Sol. Theoritical

22. Two rods and two blocks are connected as shown in figure. Find out ratio of extension in the rods :-



(1) 6 : 1 (2) 2 : 1

(3) 3 : 1 (4) 4 : 1

Ans. (1)

Sol. $\Delta\ell = \frac{T\ell}{YA}$

$\Delta\ell_1 = \frac{3mg\ell}{YA}$

$\Delta\ell_2 = \frac{2mg(\ell/2)}{2YA} = \frac{mg\ell}{2YA}$

$\frac{\Delta\ell_1}{\Delta\ell_2} = 6$

23. Match the given quantities according to their dimension :-

(A) ϕ (Work function)	(P) T^{-1}
(B) h (Planck's constant)	(Q) $ML^2T^{-3}A^{-1}$
(C) V_S (Stopping potential)	(R) ML^2T^{-1}
(D) f (frequency)	(S) ML^2T^{-2}

(1) A-R, B-S, C-Q, D-P
(2) A-S, B-R, C-P, D-Q
(3) A-S, B-R, C-Q, D-P
(4) A-P, B-Q, C-R, D-S

Ans. **(3)**

Sol. $[\phi] = ML^2T^{-2}$

$$[h] = \left[\frac{E}{f}\right] = ML^2T^{-2}T = ML^2T^{-1}$$

$$[V_S] = \left[\frac{E}{q}\right] = \frac{ML^2T^{-2}}{AT} = ML^2T^{-3}A^{-1}$$

$[f] = T^{-1}$

24. A dipole is kept in an electric field $\vec{E}_1 = E_0\hat{i}$. It oscillates with some frequency. New electric field $\vec{E}_2 = 2E_0\hat{j} + 2E_0\hat{k}$ is superimposed over existing electric field. Now dipole is kept in direction of E_{net} and is displaced slightly, it oscillates with some other frequency. Find percentage change in frequency.

(1) 100% (2) 200%
(3) 50% (4) 73%

Ans. **(4)**

Sol. Initially for small oscillation

$$\vec{\tau} = PE\sin\theta \approx PE\theta$$

$$\alpha = \frac{PE}{I}\theta$$

$$\omega^2 = \frac{PE}{I}$$

$$\omega = \sqrt{\frac{PE}{I}}$$

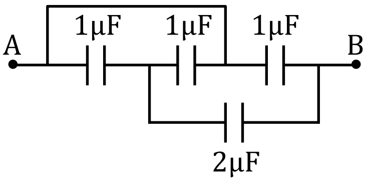
Finally, $\vec{E}_{net} = \vec{E}_1 + \vec{E}_2 = E_0\hat{i} + 2E_0\hat{j} + 2E_0\hat{k}$

$$E_{net} = \sqrt{E_0^2 + 4E_0^2 + 4E_0^2} = 3E_0$$

$$\omega' = \sqrt{\frac{P3E_0}{I}} = 1.73\sqrt{\frac{PE_0}{I}}$$

% change in ω = 73%

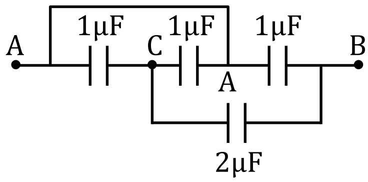
25. For given capacitor circuit, find out equivalent capacitance between A and B.

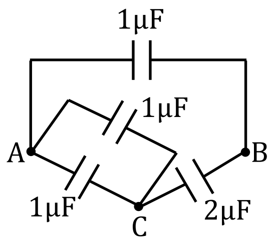


(1) 4 μF (2) 2 μF
(3) 1 μF (4) 0.5 μF

Ans. **(2)**

Sol.





$C_{AB} = 2\mu F$

JEE–MAIN EXAMINATION – APRIL 2026
MEMORY BASED QUESTIONS

(HELD ON SATURDAY 04th APRIL 2026) **TIME : 3:00 PM TO 6:00 PM**

CHEMISTRY	TEST PAPER WITH SOLUTION

1. Given that :

$$E^{o}_{Fe^{3+}/Fe} = -0.036V \ \& \ E^{o}_{M^{x+}/M} = 0.15V$$

A Galvanic cell is formed by using above electrodes, whose E_{cell} is 0.2047 V when reaction quotient of cell reaction is 10^{-2}. Find the value of x. [Nearest integer]

Ans. (2)

Sol. Anode : $Fe(s) \rightarrow Fe^{+3}(aq) + 3e^{-}$

Cathode : $M^{+x}(aq) + xe^{-} \rightarrow M(s)$

$3M^{+x} + xFe(s) \rightarrow 3M(s) + xFe^{+3}$

$E^{\circ}_{cell} = 0.15 + 0.036 = 0.186$ V

$$E_{cell} = E^{\circ}_{cell} - \frac{0.059}{3x} \log 10^{-2}$$

$$0.2047 = 0.186 - \frac{0.059}{3x}(-2)$$

$$0.0187 = +\frac{0.118}{3x}$$

X = 2.1

2. 20 ml of CH_3COOH solution is neutralised by 28.08 ml of NaOH. In the 20 ml of same solution 14.04 ml of same NaOH solution is poured, then pH of resultant solution will be :

(pKa of CH_3COOH = 4.75)

(1) 4.75 (2) 7

(3) 3.5 (4) 4.5

Ans. (1)

Sol. $CH_3COOH + NaOH \rightarrow CH_3COO^{-}Na^{+} + H_2O$

In the experiment 1, 28.08 ml is required for complete neutralization therefore for 14.04 ml half equivalence point will be achieved to form acidic buffer.

pH = pKa of CH_3COOH + log [Salt/acid]

pH = pKa = 4.75

3. For a given reversible reaction at 300 K :

$$2N_2O_5(g) \rightleftharpoons 4NO_2(g) + O_2(g)$$

If N_2O_5 is 50% dissociated at 5 bar and 300 K at equilibrium then find |ΔG°| for the reaction ?

[Given : log 2 = 0.3, log 7 = 0.84]

Ans. (8)

Sol.

$$2N_2O_5(g) \rightleftharpoons 4NO_2(g) + O_2(g)$$

Let 1 mole

$1-\alpha$ 2α $\alpha/2$

$\because \alpha = 0.5$

0.5 1 0.25

$$K_P = \frac{\left(n_{NO_2}\right)^4 \left(n_{O_2}\right)^1}{\left(n_{N_2O_5}\right)^2}\left[\frac{P_T}{n_T}\right]^{\Delta n_g}$$

$$K_P = \frac{(1)^4 \times 0.25}{(0.5)^2}\left[\frac{5}{1.75}\right]^3$$

$$K_P = \left(\frac{20}{7}\right)^3$$

$\Delta G^{\circ} = -RT \ln K_P$

$$= -8.314 \times 300 \ln\left(\frac{20}{7}\right)^3$$

$= -7.926$ kJ

4. Which of the following have same radius according to Bohr's theory :

(A) Radius of Ist orbit of H-atom.

(B) Radius of Ist orbit of He^{+}.

(C) Radius of IInd orbit of He^{+}.

(D) Radius of IInd orbit of Li^{2+}.

(E) Radius of IInd orbit of Be^{3+}.

(1) A and B (2) A and E

(3) B, C and E (4) A and D

Ans. (2)

Sol. Radius of n^{th} orbit = 0.529 Å $\frac{n^2}{Z} = a_0 \frac{n^2}{Z}$

(A) $r = a_0\left[\frac{1^2}{1}\right] = a_0$

(B) $r = a_0\left[\frac{1^2}{2}\right] = \frac{a_0}{2}$

(C) $r = a_0\left[\frac{2^2}{2}\right] = 2a_0$

(D) $r = a_0\left[\frac{2^2}{3}\right] = \frac{4a_0}{3}$

(E) $r = a_0\left[\frac{2^2}{4}\right] = a_0$

5. For the Ist order reaction

$$A \rightarrow P$$

Based on given data, find the time x (in min)

Time (minutes)	0	X	20
Concentration	0.625M	0.0625M	0.00625M

Ans. (10)

Sol. In I^{st} order kinetics, in equal time interval, the left amount of reactant forms G.P.

$\therefore$ x = 10 min

6. When 3.395 gm $C_2H_5OH_{(\ell)}$ is burnt completely, it liberate 101.11 kJ of heat, then find the enthalpy of formation of $C_2H_5OH_{(\ell)}$

Given ΔH_f^0 of $H_2O_{(\ell)}$ = –285.8 kJ/mol

ΔH_c^0 of graphite = –393.5 KJ/mol

(1) –274.43 KJ/mol

(2) –548.86 KJ/mol

(3) –683.5 KJ/mol

(4) –872.1 KJ/mol

Ans. (1)

Sol. $\underset{3.395}{C_2H_5OH(\ell)} + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(\ell)$

Moles of $C_2H_5OH(\ell)$ = $\frac{3.395}{46}$ = 0.0738 mole

Heat liberated by combustion of 1 mole $C_2H_5OH(\ell)$

= $\frac{101.11}{0.0738}$

= 1369.97 KJ/mol

$\Delta_r H^o$ = –1369.97 KJ/mol

ΔH_c^o of graphite = ΔH_f of CO_2

$\Delta_r H^o = 2\times\Delta H_f^o(CO_2)+3\times\Delta H_f^o(H_2O)-\Delta H_f^o(C_2H_5OH)$

$-1369.97 = 2\times(-393.5)+3\times(-285.8)-\Delta H_f^o(C_2H_5OH)$

$\Delta H_f^o(C_2H_5OH)$ = –274.43 KJ/mol

7. From given data

(I) 90.8 lit of $H_2(g)$ at STP

(II) 684 gm of sucrose

(III) 2 moles of cyclohexane

Correct order of total number of atoms will be

(1) (I) > (II) > (III)

(2) (III) > (II) > (I)

(3) (II) > (III) > (I)

(4) (I) > (III) > (II)

Ans. (3)

Sol. (I) moles of H_2 = $\frac{90.8}{22.7}$ = 4 moles

Moles of atom of H = 8 moles

(II) $C_{12}H_{22}O_{11}$

$n_{sucrose} = \frac{684}{342} = 2$

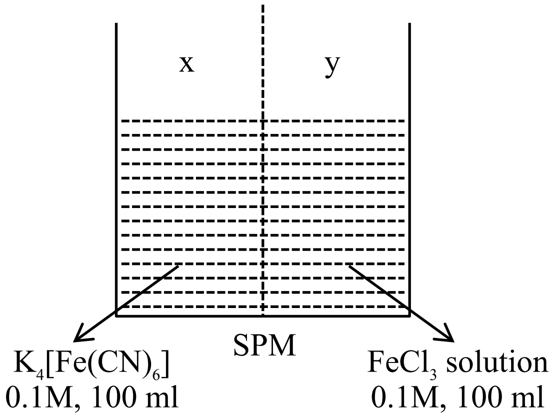
moles of atoms = 45 × 2 = 90 moles

(III) moles of atoms in C_6H_{12}

= 2 × 18

= 36 moles

8.



Which of the following is correct for above figure

(1) y is hypotonic solution

(2) Both compartment will have blue colour

(3) To perform reverse osmosis, any pressure can be applied on x-side

(4) Solute can pass through semi-permeable membrane.

Ans. **(1)**

Sol. On x-side   On y-side

i = 5   **i = 4**

So $\pi_x > \pi_y$

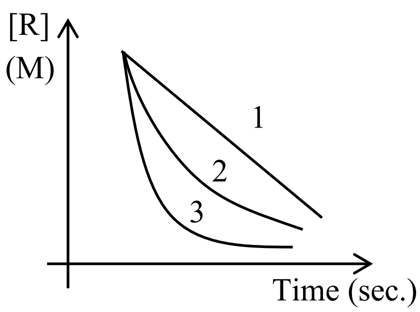
(A) x $\rightarrow$ hypertonic, y-hypotonic

(B) only solvent molecule passes, so no blue colour

(C) pressure applied should be more than $\Delta(\pi)$ but not any pressure

(D) only solvent molecule passes through SPM.

9. For the reaction : R $\rightarrow$ P



I. Curve 1 will be observed when order of reaction is 1.

II. If curve 2 & curve 3 are observed for 1st order then rate constant for 3rd curve will be greater than rate constant for 2nd curve.

III. Decomposition of HI on gold surface represent curve (1).

Select the option representing correct set of statements :-

(1) I, II, III   (2) I, II

(3) II, III   (4) I, III

Ans. **(3)**

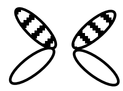
Sol. (I) curve (1) will be for zero order reaction

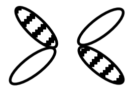
(II) $K_3 > K_2$

(III) Zero order

10. Assume internuclear axis to be z-axis, the correct molecular orbital representation of π^* antibonding molecular orbital of overlapping between two 'p' orbitals will be :

(1) 

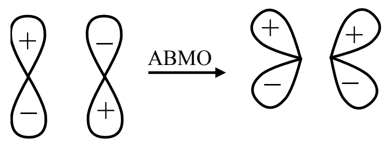
(2) 

(3) 

(4) 

Ans. **(3)**

Sol. For internuclear axis 'z'



11. If first ionization enthalpy of Mg is 738 kJ/mol then second ionization enthalpy of Mg in kJ/mol will be :

(1) –640 kJ/mol   (2) –527 kJ/mol

(3) 658 kJ/mol   (4) 1450 kJ/mol

Ans. **(4)**

Sol. Since successive ionization energy increases thus $IE_2 > IE_1$

12. Element 'M' of group 13 has same electronegativity as Ge.

Consider the statements

(A) M^{+3} is good oxidizing agent

(B) M^{+3} is good reducing agent

(C) $E^0_{M^{3+}/M} > 0$

(D) M^{+3} is more stable than $M^{\oplus}$

Which of the following is correct?

(1) A & D

(2) A & C

(3) B & D

(4) A & D

Ans. **(2)**

Sol. EN based on Pauling scale of Ge = 1.8 in group 13 ; EN of $T\ell$ = 1.8

Element 'M' is $T\ell$

$\Rightarrow T\ell^{3+}$ is a good oxidizing agent

$\Rightarrow E°(T\ell^{3+}/T\ell) = +1.26$ V

$\Rightarrow T\ell^{+1}$ is more stable than $T\ell^{3+}$

13. Consider the following elements.

Hf [z = 72] ; Yb [z = 70] ; Lu [z = 71]

Gd [z = 64] ; Eu [z = 63] ; Tm [z = 69]

Dy [z = 66] ; Er [z = 68]

A : [Hf, Yb]

B : [Gd, Eu]

C : [Lu, Tm]

D : [Er, Dy]

The pair which contains same number of 'f' electrons.

(1) A and B (2) B and C

(3) C and D (4) A and D

Ans. **(1)**

Sol. Hf – $[Xe]4f^{14}\,6s^2\,5d^2$

Yb – $[Xe]4f^{14}\,6s^2$

Lu – $[Xe]4f^{14}\,5d^1\,6s^2$

Gd – $[Xe]4f^7\,5d^1\,6s^2$

Eu – $[Xe]4f^7\,6s^2$

Tm – $[Xe]4f^{13}\,6s^2$

Dy – $[Xe]4f^{10}\,6s^2$

Er – $[Xe]4f^{12}\,6s^2$

14. Which of the following ion forms a precipitate on addition of NH_4OH and H_2S.

(1) Pb^{2+}

(2) Mn^{2+}

(3) Cu^{2+}

(4) Fe^{3+}

Ans. (2)

Sol. All should give ppt. but according to group reagent answer should be (2)

NH_4OH and H_2S are used for analysis of group IV cations [Ni^{2+}, Co^{2+} , Mn^{2+} , Zn^{2+}]

15. Consider the following complex compounds

(A) $[Ni(NH_3)_6]^{2+}$

(B) $[NiCl_4]^{2-}$

(C) $[Ni(en)_3]^{2+}$

The number of unpaired electrons in A, B and C respectively and order of frequency of absorbed radiation among A, B and C is :

(1) 2, 2, 2 and C > A > B

(2) 0, 2, 2 and A > B > C

(3) 2, 2, 0 and A > C > B

(4) 2, 2, 2 and C > B > A

Ans. (1)

Sol. (A) Ni^{2+} $3d^8$ SFL $t_{2g}^{2,2,2}$ $e_g^{1,1}$ n = 2

(B) Ni^{2+} $3d^8$ tetrahedral $e^{2,2}$ $t_2^{2,1,1}$ n = 2

(C) Ni^{2+} $3d^8$ SFL $t_{2g}^{2,2,2}$ $e_g^{1,1}$ n = 2

Ligand strength : en > NH_3 > Cl.

16. If |x| represents the difference in maximum oxidation state possible for Mn in its oxide and in its fluoride.

Among the following ions, which ions contain unpaired electrons equal to |x|.

(A) Zn^{+2}

(B) Fe^{+2}

(C) Co^{+2}

(D) V^{+2}

(E) Sc^{+3}

(1) A and E

(2) C and D

(3) B and C

(4) B and D

Ans. (2)

Sol. Oxide of Mn in highest O.S. = Mn_2O_7 [Mn^{+7}]

Fluoride of Mn in highest O.S. = MnF_4 [Mn^{+4}]

$\Rightarrow$ Difference in O.S. = |x| = 3

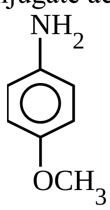
Zn^{2+} & Sc^{+3} $\Rightarrow$ 0 unpaired e^-

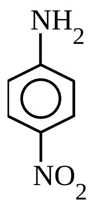
Fe^{+2} $\Rightarrow$ 4 unpaired e^-

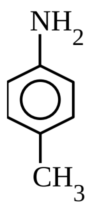
Co^{+2} $\Rightarrow$ 3 unpaired e^-

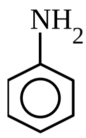
V^{+2} $\Rightarrow$ 3 unpaired e^-

17. Which of the following compound has most stable conjugate acid?

(1) 

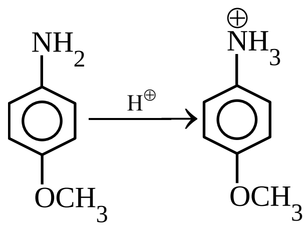
(2) 

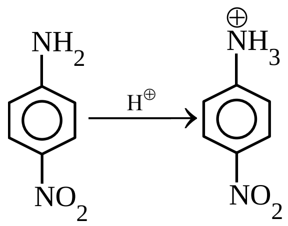
(3) 

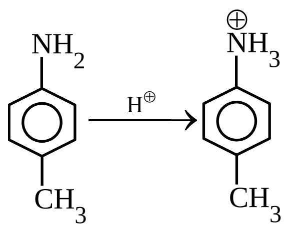
(4) 

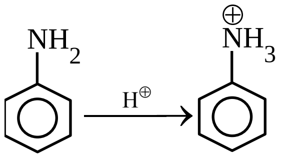
Ans. (A)

Sol.

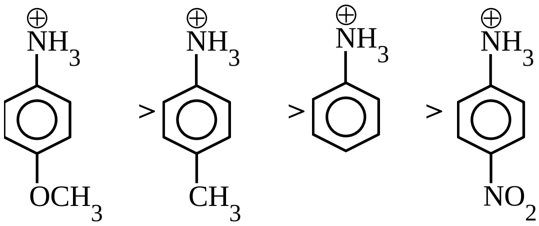








Stability order of conjugated acid :

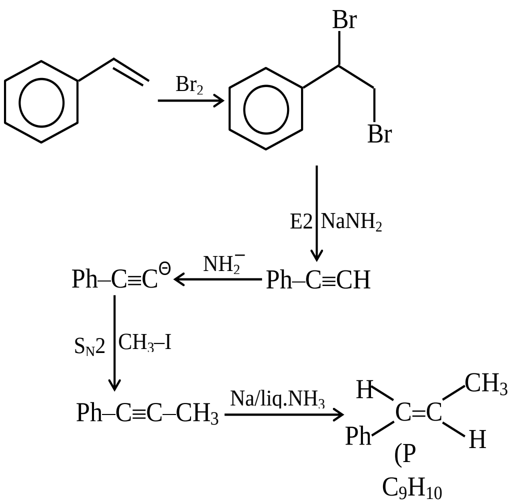


18. $\text{Styrene} \xrightarrow[\text{(iii)}CH_3-I \quad \text{(iv)}H_2/Na/liq.NH_3]{\text{(i)}Br_2/CHCl_3 \quad \text{(ii)}NaNH_2\text{(Excess)}} \text{(P)}$

Molar mass of product (P) is gives

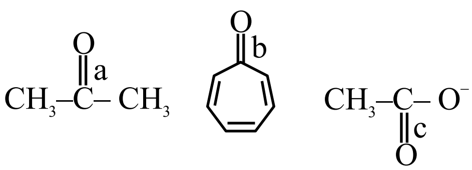
Ans. (118)

Sol.



Molar mass of P = 118 gm

19.



Compare C–O bond length?

(1) b > a > c

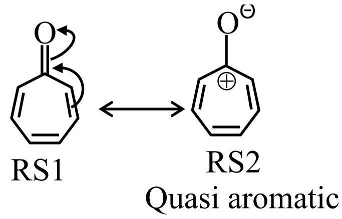
(2) b > c > a

(3) a > b > c

(4) c > a > b

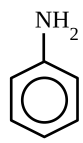
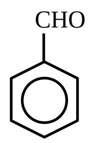
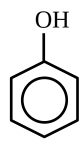
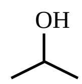
Ans. (2)

Sol.



C–O bond length is maximum in compound (b) because RS2 of this compound has aromatic character.

20. Match the column-I with column-II

Column-I		Column-II	
(A)		(P)	Hinsberg reagent
(B)		(Q)	Tollen's reagent
(C)		(R)	Lucas reagent
(D)		(S)	Phthalein dye test

(1) A-P, B-Q, C-S, D-R

(2) A-R, B-S, C-Q, D-P

(3) A-S, B-R, C-P, D-Q

(4) A-P, B-R, C-Q, D-S

Ans. (A)

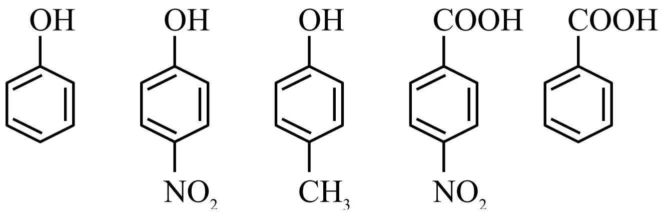
Sol. Aniline gives +ve test with Hinsberg reagents.

Benzaldehyde gives +ve test with Tollen's reagent

Phenol gives +ve Phthalein dye test

Isopropanol gives +ve Lucas test.

21. Compare acidic strength of following :



I II III IV V

(1) II > IV > V > III > I

(2) IV > V > III > I > II

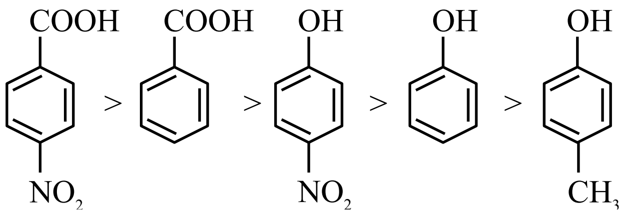
(3) IV > V > II > I > III

(4) IV > II > I > V > III

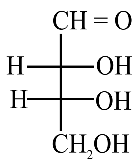
Ans. **(3)**

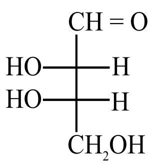
Sol.

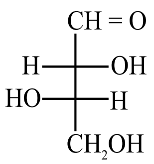
Order of acidic strength

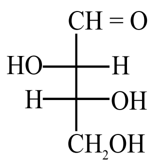


22. Product of D-aldotetroses with conc. HNO_3 gives optically inactive dicarboxylic acid. Which among the following will be D-Aldotetrose in the given structures?

(1) 

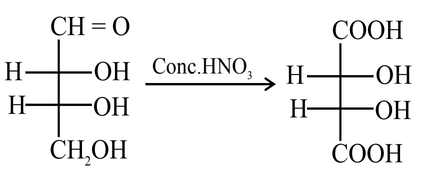
(2) 

(3) 

(4) 

Ans. **(1)**

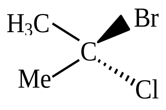
Sol.



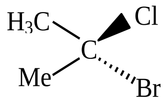
D-Aldotetrose

Optically inactive Dicarboxylic acid

23. Relationship between following pair of compounds?



(I)



(II)

(1) Enantiomer (2) Identical

(3) Diastereomer (4) Constitutional isomer

Ans. **(2)**

Sol. Theory based

24. Match the column-I with column-II

Column-I		**Column-II**	
(i)	Friedel craft reaction	(P)	Electrophilic substitution
(ii)	Williamson's ether synthesis	(Q)	Nucleophilic substitution
(iii)	Chlorination of alkane in presence of sunlight	(R)	Free radical substitution
(iv)	$Br_2/CHCl_3$	(S)	Electrophilic addition

(1) i→ R, ii→ S, iii→ Q, iv→ P

(2) i→ Q, ii→ P, iii→ R, iv→ S

(3) i→ P, ii→ Q, iii→ S, iv→ R

(4) i→ P, ii→ Q, iii→ R, iv→ S

Ans. **(4)**

Sol. Theory based

25. Compound (X) has mole mass 76, 2×10^{-3} mole of x gives 0.4813 gm $BaSO_4$ as ppt. What is the % of S in compound (X). Mention answer in 10^{-1} form.

Ans. **(435)**

Sol. $\% \text{ of } S = \dfrac{\text{Mass of S}}{\text{Mass of } BaSO_4} \times \dfrac{m}{w} \times 100$

m = gm of $BaSO_4$ ppt

w = gm of Organic compound

$w = 2 \times 10^{-3} \times 76 = 0.152$ gm

$\% \text{ of } S = \dfrac{32}{233} \times \dfrac{0.4813}{0.152} \times 100 = 43.487$

In form of 10^{-1}

$= 43.487 \times 10^{-1} = 434.87 \approx 435$

JEE–MAIN EXAMINATION – APRIL 2026
MEMORY BASED QUESTIONS

(HELD ON SATURDAY 04th APRIL 2026) **TIME : 3:00 PM TO 6:00 PM**

MATHEMATICS	TEST PAPER WITH SOLUTION

1. If $\sum_{i=1}^{10}(x_i+2)^2=180$ and $\sum_{i=1}^{10}(x_i-1)^2=90$, then the Standard Deviation is equal to

(1) 3 (2) 2

(3) 4 (4) 5

Ans. **(1)**

Sol. $\sum_{i=1}^{10}(x_i+2)^2=180$

$\sum_{i=1}^{10}x_i^2+4\sum_{i=1}^{10}x_i+\sum_{i=1}^{10}4=180$

$\sum_{i=1}^{10}x_i^2+4\sum_{i=1}^{10}x_i=180-40$ …(1)

Also $\sum_{i=1}^{10}(x_i-1)^2=90$

$\sum_{i=1}^{10}x_i^2-2\sum_{i=1}^{10}x_i+\sum_{i=1}^{10}1=90$

$\sum_{i=1}^{10}x_i^2-2\sum_{i=1}^{10}x_i=90-10$ …(2)

$\sum_{i=1}^{10}x_i^2+4\sum_{i=1}^{10}x_i=140$

$\sum_{i=1}^{10}x_i^2-2\sum_{i=1}^{10}x_i=80$

$\sum_{i=1}^{10}x_i^2=100$ and $\sum_{i=1}^{10}x_i=10$

$$\sigma^2=\frac{\sum_{i=1}^{10}x_i^2}{N}-\left(\frac{\sum_{i=1}^{10}x_i}{N}\right)^2$$

$$=\frac{100}{10}-\left(\frac{10}{10}\right)^2$$

$\sigma^2 = 10 - 1 = 9$

$\Rightarrow \sigma = 3$

2. If the system of equations

$x + y + z = 5$

$x + 2y + 3z = 9$

$x + 3y + \lambda z = \mu$

has infinitely many solutions, then value of $\lambda + \mu$ is

(1) 13 (2) 20

(3) 18 (4) 26

Ans. **(3)**

Sol. $D = \lambda - 5$

$D_1 = \lambda + \mu - 18$

$D_2 = 4\lambda - 2\mu + 6$

$D_3 = \mu - 13$

Here $x=\frac{D_1}{D}$; $y=\frac{D_2}{D}$; $z=\frac{D_3}{D}$

For infinitely many solutions

$D = D_1 = D_2 = D_3 = 0$

$\Rightarrow \lambda = 5$; $\mu = 13$

$\therefore \lambda + \mu = 18$

3. Let $f(x)=\begin{cases} e^{x-1} & x<0 \\ x^2-5x+6 & x\geq 0\end{cases}$

and $g(x) = f(|x|) + |f(x)|$.

If α = number of points of discontinuity of g(x) and

β = number of points of non-differentiability of g(x),

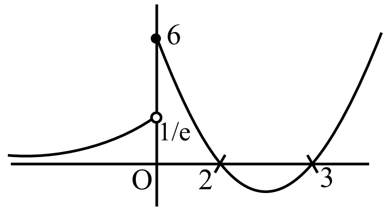
then $\alpha + \beta =$

(1) 2 (2) 4

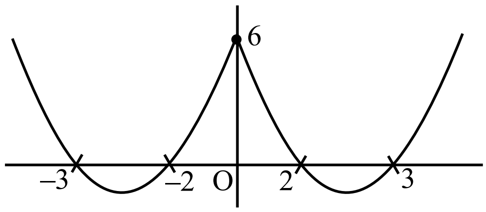
(3) 3 (4) 5

Ans. **(2)**

Sol. Graph of f(x)

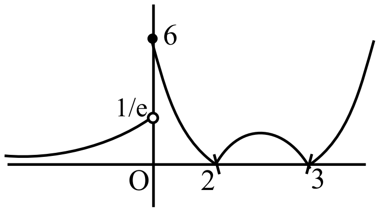


Now graph of f(|x|)



$f(|x|)$ is continuous function and it is non diff. at $x = 0$

Graph of $|f(x)|$



$|f(x)|$ is discontinuous at $x = 0$

$|f(x)|$ is non-diff. at $x = 0, 2, 3$

$g(x) = f(|x|) + |f(x)|$

$g(x)$ will be discontinuous at $x = 0$

$g(x)$ will be non diff at $x = 0, 2, 3$

$\alpha = 1, \beta = 3$

$\alpha + \beta = 1 + 3 = 4$

4. Area bounded between the curves $x = -2y^2$ and $x = 1 - 4y^2$ is

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

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

Ans. **(2)**

Sol. Solving both the curves

$-2y^2 = 1 - 4y^2$

$y = \frac{1}{\sqrt{2}}, \frac{-1}{\sqrt{2}}$

Required area $= \left|\int_{-1/\sqrt{2}}^{1/\sqrt{2}} (x_2 - x_1)dx\right|$

$= \left|\int_{-1/\sqrt{2}}^{1/\sqrt{2}} (1 - 4y^2 + 2y^2)dy\right|$

$= \left|2\int_{0}^{1/\sqrt{2}} (1 - 2y^2)dy\right|$

$= \left|2\left[\left(y - \frac{2y^3}{3}\right)\right]_0^{\frac{1}{\sqrt{2}}}\right|$

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

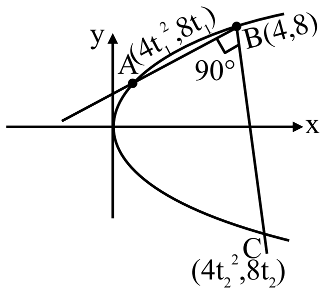
5. From point B(4,8) on the parabola $y^2 = 16x$, two perpendicular chords BA and BC are drawn. Given that the locus of centroid of triangle BAC is another parabola with length of the latus rectum equal to ℓ, then 3ℓ is equal to

(1) 14 (2) 15

(3) 12 (4) 16

Ans. **(4)**

Sol.



Variable point A & C are shown in the figure

$\because\ m_{AB}.m_{BC} = -1$

$\Rightarrow t_1 + t_2 + t_1t_2 = -5$ …(1)

Suppose locus of centroid of ΔABC is (h,k)

$\therefore\ 3h = 4 + 4t_1^2 + 4t_2^2\ \&\ 3k = 8 + 8t_1 + 8t_2$

by eliminating t_1 & t_2 using equation (1) also

we get $h = \frac{9}{48}k^2 + \frac{40}{3}$

$\therefore$ locus of centroid of parabola is

$x = \frac{9}{48}y^2 + \frac{40}{3}$

$\therefore\ \ell(\text{L.R.}) = \frac{48}{9}$

$\therefore\ 3\ell(\text{L.R.}) = \frac{48}{3}$

6. If the quadratic equation $(\lambda + 2)x^2 - 3\lambda x + 4\lambda = 0$ (where $\lambda \neq -2$) has two positive roots then the numbers of possible integral values of λ is

(1) 2 (2) 4

(3) 1 (4) 3

Ans. **(1)**

Sol. $f(x) = (\lambda + 2)x^2 - 3\lambda x + 4\lambda$

C-1 $af(0) > 0$

$(\lambda + 2)4\lambda > 0$

$\Rightarrow \lambda < -2$ or $\lambda > 0$

C-2 $-\dfrac{b}{2a} > 0$

$\dfrac{3\lambda}{2(\lambda+2)} > 0$

$\Rightarrow \lambda < -2$ or $\lambda > 0$

C-3 $D \geq 0$

$(-3\lambda)^2 - 4(\lambda + 2) \times 4\lambda \geq 0$

$\lambda(7\lambda + 32) \leq 0$

$\Rightarrow \lambda \in \left[\dfrac{-32}{7}, 0\right]$

C-1 and C-2 and C-3

$\Rightarrow \lambda \in \left[\dfrac{-32}{7}, -2\right)$

$\lambda \in [-4.57, -2)$

$\Rightarrow \lambda = -4, -3$

$\therefore$ Number of values of $\lambda = 2$

7. If function y(x) satisfies the differential equation $\dfrac{dy}{dx} + \left[\dfrac{6x^2 + e^{-2x}(3x^2 + 2x^3 + 4)}{(x^3+2)(2+e^{-2x})}\right]y = e^{-2x} + 2$ such that $y(0) = \dfrac{3}{2}$ & $y(1) = \alpha(e^{-2} + 2)$, then α is equal to

(1) $\dfrac{13}{12}$ (2) $\dfrac{12}{13}$

(3) $\dfrac{4}{13}$ (4) $\dfrac{17}{12}$

Ans. **(1)**

Sol. I.F. $= e^{\int \frac{6x^2+e^{-2x}(3x^2+2x^3+4)}{(x^3+2)(2+e^{-2x})}dx}$

$= e^{\int \frac{6x^2+e^{-2x}(3x^2-2x^3-4)+(4x^3+8)e^{-2x}}{(x^3+2)(2+e^{-2x})}dx}$

Let $(x^3 + 2)(2 + e^{-2x}) = t$

$(6x^2 + e^{-2x}(3x^2 - 2x^3 - 4))dx = dt$

I.F. $= e^{\ell n|(x^3+2)(2+e^{-2x})| - \int \frac{4e^{-2x}dx}{2+e^{-2x}}}$

$= e^{\ell n|(x^3+2)(2+e^{-2x})| - 2\,\ell n|2+e^{-2x}|}$

$= e^{\ell n\left|\frac{x^3+2}{2+e^{-2x}}\right|} = \dfrac{x^3+2}{2+e^{-2x}}$

$\Rightarrow y.\left(\dfrac{x^3+2}{2+e^{-2x}}\right) = \int\left(\dfrac{x^3+2}{2+e^{-2x}}\right)(e^{-2x}+2)dx + C$

$y.\left(\dfrac{x^3+2}{2+e^{-2x}}\right) = \dfrac{x^4}{4} + 2x + C$ at $y(0) = \dfrac{3}{2} \Rightarrow C = 1$

So $y.\left(\dfrac{x^3+2}{2+e^{-2x}}\right) = \dfrac{x^4}{4} + 2x + 1$

at x = 1

$y.\left(\dfrac{3}{2+e^{-2}}\right) = \dfrac{1}{4} + 2 + 1$

$\Rightarrow y = \dfrac{13}{12}(e^{-2} + 2)$

So $\alpha = \dfrac{13}{12}$

8. 3 numbers are selected randomly from numbers 1, 2, 3...., 31. The probability that they are in A.P. is

(1) $\dfrac{15}{31}$ (2) $\dfrac{7}{31}$

(3) $\dfrac{8}{17}$ (4) $\dfrac{45}{899}$

Ans. **(4)**

Sol. Total numbers of ways of selecting

3 numbers = ${}^{31}C_3 = \dfrac{31 \times 30 \times 29}{3 \times 2 \times 1} = 4495$

a, b, c are in A.P.

$\Rightarrow$ either a & c both odd numbers

or both even numbers

$= {}^{16}C_2 + {}^{15}C_2$

= 120 + 105

= 225

Probability $= \dfrac{225}{4495} = \dfrac{45}{899}$

9. The maximum value of $E = 16\sin\dfrac{x}{2}\cos^3\dfrac{x}{2}$ where $x \in [0, \pi]$, is

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

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

Ans. **(2)**

Sol. $E = 16\sin\frac{x}{2}\cos^3\frac{x}{2}$

$E = 4\sin x\,[1 + \cos x]$

$\frac{dE}{dx} = 4\,[\cos x + \cos 2x]$

$= 8\cos\frac{3x}{2}\cos\frac{x}{2} = 0$

$\Rightarrow \cos\frac{3x}{2} = 0$ or $\cos\frac{x}{2} = 0$

$\Rightarrow x = \left\{\frac{\pi}{3}, \pi\right\}$ are critical points of the function

$E(0) = 0$

$E(\pi) = 0$

$E\left(\frac{\pi}{3}\right) = 3\sqrt{3}$

$\therefore$ maximum value of $E = 3\sqrt{3}$

10. $\int_0^1 \cot^{-1}(1+x+x^2)dx$ is equal to

(1) $2\tan^{-1}2 - \frac{1}{2}\log_e\left(\frac{5}{4}\right) - \frac{\pi}{2}$

(2) $2\tan^{-1}2 - \frac{1}{2}\log_e\left(\frac{5}{4}\right) + \frac{\pi}{2}$

(3) $2\tan^{-1}2 + \frac{1}{2}\log_e\left(\frac{5}{4}\right) - \frac{\pi}{2}$

(4) $2\tan^{-1}2 + \frac{1}{2}\log_e\left(\frac{5}{4}\right) + \frac{\pi}{2}$

Ans. **(1)**

Sol. $= \int_0^1 \tan^{-1}\left(\frac{1}{1+x+x^2}\right)dx$

$= \int_0^1 \tan^{-1}\left(\frac{(x+1)-x}{1+x(x+1)}\right)dx$

$= \int_0^1 (\tan^{-1}(x+1) - \tan^{-1}x)dx$

$= \left(x\tan^{-1}(x+1) - \frac{1}{2}\ell n|1+(1+x)^2| + \tan^{-1}(x+1)\right)_0^1$

$- \left(x\tan^{-1}x - \frac{1}{2}\ell n|1+x^2|\right)_0^1$

$= \left(2\tan^{-1}2 - \frac{\pi}{4} - \frac{1}{2}\ell n\frac{5}{2}\right) - \left(\frac{\pi}{4} - \frac{1}{2}\ell n 2\right)$

$= 2\tan^{-1}2 - \frac{1}{2}\ell n\left(\frac{5}{4}\right) - \frac{\pi}{2}$

11. Let $S = \{z : z^2 + 4z + 16 = 0,\ z \in C\}$, then value of $\sum_{z\in S}|z + \sqrt{3}i|^2$ is equal to

(1) 34 (2) 35

(3) 38 (4) 41

Ans. **(3)**

Sol. $z^2 + 4z + 16 = 0$

$\Rightarrow (z+2)^2 = -12$

$\Rightarrow z = -2 \pm 2\sqrt{3}i$

$\Rightarrow S = \{-2+2\sqrt{3}i, -2-2\sqrt{3}i\}$

$\therefore \sum_{z\in S}\left|z+\sqrt{3}i\right|^2$

$= \left|-2+2\sqrt{3}i+\sqrt{3}i\right|^2 + \left|-2-2\sqrt{3}i+\sqrt{3}i\right|^2$

$= \left|-2+3\sqrt{3}i\right|^2 + \left|-2-\sqrt{3}i\right|^2$

$= 38$

12. If f(x) satisfies the functional equation $f(x + y) = f(x) + 2y^2 + y + \alpha xy$ (where x, y are whole numbers), such that f(0) = – 1 & f(1) = 2, then the value of $\sum_{i=1}^{5}\left(f(i)+\alpha\right)$ is

(1) 130 (2) 145

(3) 120 (4) 140

Ans. (4)

Sol. Given $f(x + y) = f(x) + 2y^2 + y + \alpha x y$ ......(1)

put x = 1, y = 1 $\Rightarrow f(2) = 5 + \alpha$

put x = 2, y = 1 $\Rightarrow f(3) = 8 + 3\alpha$ ......(2)

put x = 1, y = 2 $\Rightarrow f(3) = 12 + 2\alpha$ .....(3)

from (2) & (3) $\Rightarrow \alpha = 4$

put x = 3, y = 1 $\Rightarrow f(4) = 35$

put x = 4, y = 1 $\Rightarrow f(5) = 54$

$\therefore \Rightarrow$ value of $\sum_{i=1}^{5}\left(f(i)+\alpha\right) = \sum_{i=1}^{5} f(i)+5\alpha$

$= f(1) + f(2) + f(3) + f(4) + f(5) + 5\alpha$

= 140

13. If $f(x) = \int_0^x \tan(t-x)dt + \int_0^x f(t)\tan t\, dt$, then the value of $f''\left(\frac{\pi}{6}\right)-12f'\left(-\frac{\pi}{6}\right)+f\left(\frac{\pi}{6}\right)$ is equal to

(1) $-7-\frac{16}{3\sqrt{3}}$ (2) $7+\frac{5}{3\sqrt{3}}$

(3) $7-\frac{16}{3\sqrt{3}}$ (4) $\frac{1}{3\sqrt{3}}$

Ans. (1)

Sol. $f(x) = \int_0^x \tan\left(x-t-x\right)dt + \int_0^x f(t)\tan t\, dt$

$f(x) = -\int_0^x \tan t dt + \int_0^x f(t)\tan t\, dt$

$f'(x) = -\tan x + f(x)\tan x$

$\frac{dy}{y-1} = \tan x\, dx$

$y - 1 = \sec x . c$

$y = 1 + c \sec x$

$f(0) = 0$

$0 = 1 + c \sec 0$

$c = -1$

$y = 1 - \sec x$

$f(x) = 1 - \sec x$

$f\left(\frac{\pi}{6}\right) = 1-\frac{2}{\sqrt{3}}$

$f'(x) = -\sec x \tan x$

$f'\left(\frac{-\pi}{6}\right) = +\frac{2}{\sqrt{3}}\times\frac{1}{\sqrt{3}} = \frac{2}{3}$

$f''(x) = -\left(\sec x \tan^2 x + \sec^3 x\right)$

$f''\left(\frac{\pi}{6}\right) = -\left(\frac{2}{\sqrt{3}}\times\frac{1}{3}+\frac{8}{3\sqrt{3}}\right) = \frac{-10}{3\sqrt{3}}$

$f''\left(\frac{\pi}{6}\right)-12f'\left(\frac{-\pi}{6}\right)+f\left(\frac{\pi}{6}\right)$

$= \frac{-10}{3\sqrt{3}}-12\times\left(\frac{2}{3}\right)+1-\frac{2}{\sqrt{3}}$

$= -7-\frac{16}{3\sqrt{3}}$

14. Number of non-negative integral solutions of the equation a + b + 2c = 22 is

(1) 144 (2) 121 (3) 168 (4) 99

Ans. (1)

Sol. $c = 0 \Rightarrow a + b = 22 \rightarrow {}^{22+2-1}C_{2-1} = {}^{23}C_1$

$c = 1 \Rightarrow a + b = 20 \rightarrow {}^{20+2-1}C_{2-1} = {}^{21}C_1$

$\vdots \qquad \vdots \qquad \vdots$

$c = 10 \Rightarrow a + b = 2 \rightarrow {}^{2+2-1}C_{2-1} = {}^{3}C_1$

$c = 11 \Rightarrow a + b = 0 \rightarrow {}^{0+2-1}C_{2-1} = {}^{1}C_1$

Number of non-negative integral solutions

${}^{1}C_1 + {}^{3}C_1 + {}^{5}C_1 + \ldots + {}^{23}C_1$

1 + 3 + 5…...+23

= 144

15. If $\alpha = \frac{1}{4}+\frac{1}{8}+\frac{1}{16}+.....$ up to infinity

$\beta = \frac{1}{3}+\frac{1}{9}+\frac{1}{27}+.....$ up to infinity

Then value of $(0.2)^{\log_{\sqrt{5}}\alpha}+(0.04)^{\log_5\beta}$ is

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

Ans. **(2)**

Sol. $\alpha = \frac{1/4}{1-\frac{1}{2}} = \frac{1}{2}$

$\beta = \frac{1/3}{1-\frac{1}{3}} = \frac{1}{2}$

$(0.2)^{\log_{\sqrt{5}}\alpha} = \alpha^{\log_{\sqrt{5}}\frac{1}{5}} = \left(\frac{1}{2}\right)^{-2} = 4$

$(0.04)^{\log_5\beta} = 5^{-2\log_5\beta} = \left(\frac{1}{2}\right)^{-2} = 4$

$\Rightarrow 4 + 4 = 8$

16. If z_1, z_2 and z_3 are roots of $x^3 + ax^2 + bx + c = 0$. Let $z_1 = 1$, $z_2 = 1+i\sqrt{2}$ and a, b, c $\in$R then the value of $\int_{-1}^{1}(x^3+ax^2+bx+c)\,dx$ is

(1) –8 (2) 8 (3) 6 (4) –4

Ans. **(1)**

Sol. $\int_{-1}^{1}(x^3+ax^2+bx+c)\,dx$

$\Rightarrow \int_{-1}^{1}(ax^2+c)\,dx = 2\int_{0}^{1}(ax^2+c)\,dx \quad \ldots(1)$

Roots are $1, 1+i\sqrt{2}$ and $1-i\sqrt{2}$ because a, b, c $\in$R

$1+1+i\sqrt{2}+1-i\sqrt{2} = -a$

$a = -3$

$1(1+i\sqrt{3})(1-i\sqrt{3}) = -c$

$c = -4$

$2\int_{0}^{1}(-3x^2-3)\,dx \Rightarrow -2[x^3+3x]_0^1$

$= -2[4]$

$= -8$

17. The shortest distance between the lines is :

$\vec{r} = \frac{1}{3}\hat{i}+2\hat{j}+\frac{8}{3}\hat{k}+\lambda(2\hat{i}-5\hat{j}+6\hat{k})$ and

$\vec{r} = \left(-\frac{2}{3}\hat{i}-\frac{1}{3}\hat{k}\right)+\mu(\hat{j}-\hat{k})$, $\lambda, \mu \in R$

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

(3) $\sqrt{15}$ (4) $\sqrt{5}$

Ans. **(2)**

Sol. $\vec{a} = \frac{1}{3}\hat{i}+2\hat{j}+\frac{8}{3}\hat{k}$

$\vec{a}_2 = \frac{-2}{3}\hat{i}-\frac{1}{3}\hat{k}$

$\vec{b}_1 = 2\hat{i}-5\hat{j}+6\hat{k}, \quad \vec{b}_2 = \hat{j}-\hat{k}$

$\vec{b}_1\times\vec{b}_2 = \begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 2 & -5 & 6\\ 0 & 1 & -1\end{vmatrix} = -\hat{i}+2\hat{j}+2\hat{k}$

$\vec{a}_1-\vec{b}_2 = \hat{i}+2\hat{j}+3\hat{k}$

$S.D = \left|\frac{(\vec{a}_1-\vec{a}_2)\cdot(\vec{b}_1\times\vec{b}_2)}{|\vec{b}_1\times\vec{b}_2|}\right|$

$S.D = \left|\frac{(\hat{i}+2\hat{j}+3\hat{k})\cdot(-\hat{i}+2\hat{j}+2\hat{k})}{3}\right|$

$= \frac{9}{3} = 3$

18. If $\hat{u}, \hat{v}$ are unit vectors and $|\hat{u}\times\hat{v}| = \frac{\sqrt{3}}{2}$ and $\hat{A} = \lambda\hat{u}+\hat{v}+\hat{u}\times\hat{v}$ then find λ [angle between $\hat{u}$ & $\hat{v}$ is acute]

(1) $\lambda = \frac{1}{3}\hat{A}.\hat{u}-\frac{1}{3}\hat{A}.\hat{v}$

(2) $\lambda = \frac{4}{3}\hat{A}.\hat{u}-\frac{2}{3}\hat{A}.\hat{v}$

(3) $\lambda = \frac{8}{3}\hat{A}.\hat{u}-\frac{2}{3}\hat{A}.\hat{v}$

(4) $\lambda = \frac{2}{3}\hat{A}.\hat{u}-\frac{4}{3}\hat{A}.\hat{v}$

Ans. **(2)**

Sol. $|\hat{u}\times\hat{v}| = \frac{\sqrt{3}}{2}$

$|\hat{u}||\hat{v}|\sin\theta = \frac{\sqrt{3}}{2} \quad \therefore \theta = \frac{\pi}{3}$

and $\hat{u}\cdot\hat{v} = |\hat{u}||\hat{v}|\cos\frac{A}{3} = \frac{1}{2}$

$\hat{A} = \lambda\hat{u}+\hat{v}+\hat{u}\times\hat{v} \quad \ldots(A)$

Dot with $\hat{u}$

$\hat{A}\cdot\hat{u} = \lambda(1)+\hat{u}.\hat{v}+\hat{u}\cdot(\hat{u}\times\hat{v})$

$$\hat{A}\cdot\hat{u}=\lambda+\frac{1}{2}$$

Or $2\hat{A}\cdot\hat{u}=2\lambda+1$ …(1)

Dot equation (A) with $\hat{v}$

$$\hat{A}\cdot\hat{v}=\lambda(\hat{u}\cdot\hat{v})+\hat{v}\cdot\hat{v}+\hat{v}\cdot(\hat{u}\times\hat{v})$$

$$\hat{A}\cdot\hat{v}=\frac{\lambda}{2}+1$$

$$\hat{A}\cdot\hat{v}-\frac{\lambda}{2}=1 \quad \dots(2)$$

From (1) and (2)

$$2\hat{A}\cdot\hat{u}-2\lambda=\hat{A}.\hat{v}-\frac{\lambda}{2}$$

$$\therefore\ \lambda=\frac{4}{3}\hat{A}\cdot\hat{u}-\frac{2}{3}\hat{A}.\hat{v}$$

19. In the expansion of $\left(9x-\frac{1}{3\sqrt{x}}\right)^{18}$, if coefficient of term independent of x is 221k, then value of k is

Ans. **(84)**

Sol. General term in above expression is

$$T_{r+1}={}^{18}C_r(9x)^{18-r}\left(-\frac{1}{3\sqrt{x}}\right)^r$$

$$=\left(-\frac{1}{3}\right)^r {}^{18}C_r 9^{18-r}\cdot x^{18-\frac{3r}{2}}$$

For term independent of x, $18-\frac{3r}{2}=0\Rightarrow r=12$

$\therefore$ Coefficient of term independent of x

$$=\left(-\frac{1}{3}\right)^{12} {}^{18}C_{12} 9^{18-12}$$

= 18564

= 221 k (given)

$\Rightarrow$ k = 84

20. If $f(x) = (x-1)^4 + 1\ \forall x\in[1,\infty)$.

Statement-1 : $f(x) = f^{-1}(x)$ has only two solutions.

Statement-2 : $f^{-1}(x+1) = f(x)$ has no solution.

(1) Statement 1 and Statement 2 both are true

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

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

(4) Statement 1 and Statement 2 both are false

Ans. **(3)**

Sol. $f(x) = (x-1)^4 + 1$

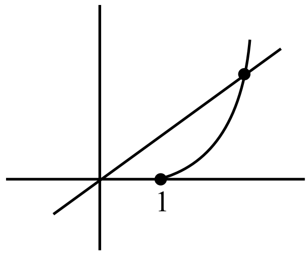
$f'(x) = 4(x-1)^3$; $f'(x) \geq 0$

$\therefore$ f(x) is increasing

$\therefore (x-1)^4 + 1 = x$

$(x-1)\,[(x-1)^3 - 1] = 0$

x = 1, x = 2 are two solution



Now

$f^{-1}(x) = (x-1)^{1/4} + 1$

$f^{-1}(x+1) = x^{1/4} + 1$

$f^{-1}(x+1) = f(x)$

$x^{1/4} + 1 = (x-1)^4 + 1$

$x = (x-1)^{16}$

Above equation has one solution using graph.

Hence option (3) is correct.

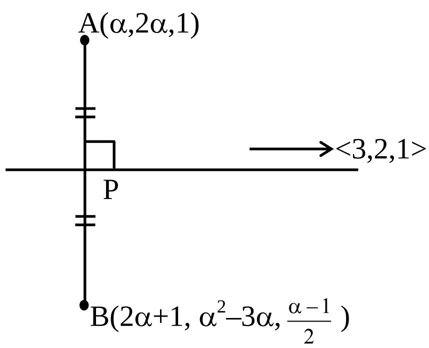
SECTION-B

1. If $(2\alpha + 1, \alpha^2 - 3\alpha, \frac{\alpha-1}{2})$ is image of $(\alpha, 2\alpha, 1)$ in the line $\frac{x-2}{3}=\frac{y-1}{2}=\frac{z}{1}$, then the value of α is

Ans. **(3)**

Sol. $\therefore$ P is mid point of AB and lies on the given line

$$\Rightarrow P\left(\frac{3\alpha+1}{2},\frac{\alpha^2-\alpha}{2},\frac{\alpha+1}{4}\right)$$



Now put coordinates of P in the line

$$\Rightarrow \frac{\frac{3\alpha+1}{2}-2}{3} = \frac{\frac{\alpha^2-\alpha}{2}-1}{2} = \frac{\alpha+1}{4}$$

$$\Rightarrow \frac{\alpha-1}{2} = \frac{\alpha+1}{4} = \frac{\alpha^2-\alpha-2}{4}$$

$\Rightarrow \alpha = 3$

Now for $\alpha = 3$, clearly AB is perpendicular to $3\hat{i}+2\hat{j}+k$

for $\alpha = 3$ point B is image of point A

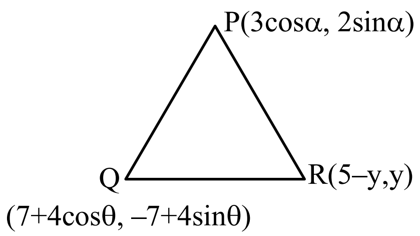
2. P is a point on $\frac{x^2}{9}+\frac{y^2}{4}=1$ as $(3\cos\alpha, 2\sin\alpha)$ Q is a point on $x^2 + y^2 - 14x + 14y + 82 = 0$ R is a point on line $x + y = 5$ their centroid is on $\left(\cos\alpha+2, \frac{2\sin\alpha}{3}+3\right)$. Find the sum of possible ordinates of R.

Ans. (22)

Sol. Centroid :

$$\left(\frac{3\cos\alpha+7+4\cos\theta+5-y}{3}, \frac{2\sin\alpha-7+4\sin\theta+y}{3}\right)$$

$$=\left(\cos\alpha+2, \frac{2}{3}\sin\alpha+3\right)$$



On comparison

$$\cos\theta = \frac{y-6}{4} \ \& \ \sin\theta = \frac{16-y}{4}$$

$\sin^2\theta + \cos^2\theta = 1 \Rightarrow (y-6)^2 + (y-16)^2 = 16$

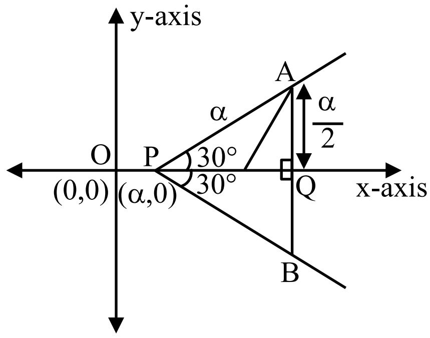
$y^2 - 22y + 138 = 0$

Sum of possible values of y = 22

3. P is point of intersection of these two set of half lines $x-\sqrt{3}y=\alpha, \alpha>0$. A and B are two points on these lines at distance 'α' from 'P'. If length of perpendicular from P on AB is $\frac{9}{2}$ and radius of circumcircle of ΔPAB is R, then $\frac{\alpha^2}{R}$ is

Ans. (9.00)

Sol. ΔPAB is equilateral



$$PQ = \frac{\sqrt{3}\alpha}{2} = \frac{9}{2} \qquad \therefore \quad \alpha = \frac{9}{\sqrt{3}}$$

$$\alpha = 3\sqrt{3}$$

$$\frac{\alpha}{2r} = \cos 30°$$

$$\alpha = \frac{\sqrt{3}}{2}\cdot 2R$$

$$\alpha = \sqrt{3}\,R$$

$$\boxed{R=3}$$

$$\frac{\alpha^2}{R} = \frac{(3\sqrt{3})^2}{3} = 9$$