FIITJEE
ALL INDIA TEST SERIES
JEE (Advanced)-2025
OPEN TEST – I
PAPER –2
TEST DATE: 09-02-2025

ANSWERS, HINTS & SOLUTIONS

Physics

PART – I

SECTION – A

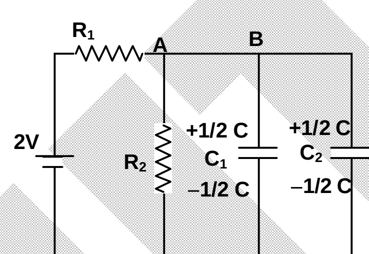
1. C

Sol. One component of velocity is along +ve y-axis

So, path will be helical. Path of particle will touch y-axis after every $\frac{2\pi m}{qB}$.

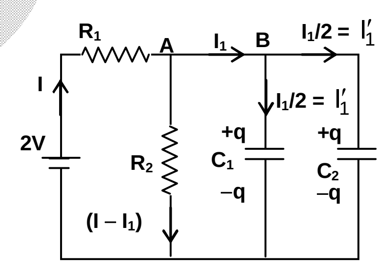
2. B

Sol.



(at t = 0)

When the switch is closed then at t = 0 the distribution of the charge is shown in the figure.



By applying Kirchhoff's Law $I_1' = \frac{(1-q)}{2}$

$$\int_{1/2}^{q}\frac{dq}{1-q} = \int_{0}^{t}\frac{dt}{2}$$

$$q = \left(1 - \frac{1}{2}e^{-t/2}\right)$$

$$I_1' = \frac{dq}{dt} = \frac{1}{4}e^{-t/2}$$

3. B

Sol. $H = -kA\frac{d\theta}{dx}$

The heat current decreases from the end P and Q through the rod hence slope of (T-x) graph also decreases.

4. A

Sol. Consider a small element in the shape ring of the radius r and thickness dr of the disc. The torque on the ring due to viscous force

$$d\tau = \eta 2\pi r dr \frac{\omega r}{d} r$$

Total torque on the disc due to viscous force

$$\tau = \int d\tau = \int_0^R \frac{2\pi\omega\eta}{d} r^3 dr = \frac{\pi\omega\eta R^4}{2d}$$

External power required to rotate the disc with uniform angular velocity ω

$$P_{ext} = \tau_{ext}\omega = \frac{\pi\omega^2\eta R^4}{2d}$$

5. C, D

Sol. Dimension of h is $\left[ML^2T^{-1}\right]$

Dimension of G is $\left[M^{-1}L^3T^{-2}\right]$

Dimension of S is $\left[MT^{-2}\right]$

Dimension of η is $\left[ML^{-1}T^{-1}\right]$

Dimension of μ_0 is $\left[MLT^{-2}A^{-2}\right]$

Dimension of ε_0 is $\left[M^{-1}L^{-3}T^4A^2\right]$

6. A, C

Sol. Number of carbon atoms in 4g carbon of living tree = $\frac{4}{12} \times 6 \times 10^{23} \times 8 \times 10^{-14} = 16 \times 10^9$

Number of carbon atoms at present = $\frac{16 \times 10^9}{2^{t/T}} = \frac{RT}{\ell n2} = \frac{1}{3} \times \frac{2.1 \times 10^9}{0.7}$

$$\frac{t}{T} = 4$$

7. A, B, C, D

Sol. $F_x = -\frac{\partial U}{\partial x} = -6N$

$F_y = -\frac{\partial U}{\partial y} = 8N$

$\Rightarrow \vec{F} = -6\hat{i} + 8\hat{j}$

$\vec{a} = \frac{\vec{F}}{m} = (-3\hat{i} + 4\hat{j}) = \text{constant}$

$\vec{v} = \vec{u} + \vec{a}t = \left(2\hat{i} - 3\hat{j}\right) + \left(-3\hat{i} + 4\hat{j}\right)t$

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

For any time t, v_x and v_y are not zero simultaneously

$$(x\hat{i} + y\hat{j}) = (2\hat{i} - 3\hat{j})t + \frac{1}{2}(-3\hat{i} + 4\hat{j})t^2 = \left(2t - \frac{3}{2}t^2\right)\hat{i} + (-3t + 2t^2)\hat{j}$$

for x = 0, $t = \frac{4}{3}$sec

for y = 0, $t = \frac{3}{2}\text{sec}$

angle between velocity and acceleration at t = 1 sec

$$\cos\theta = \frac{\vec{v}\cdot\vec{a}}{|\vec{v}||\vec{a}|} = \frac{(-\hat{i}+\hat{j})(-3\hat{i}+4\hat{j})}{\sqrt{2}\times 5} = \frac{3+4}{\sqrt{2}\times 5} = \left(\frac{7}{5\sqrt{2}}\right)$$

At, $t = \frac{3}{2}\text{sec}$, $x = 2\times\frac{3}{2} - \frac{3}{2}\left(\frac{3}{2}\right)^2 = 3 - \frac{27}{8} = -\frac{3}{8}\text{m}$

For velocity to be perpendicular to acceleration

$\vec{a}\cdot\vec{v} = 0$

$\left(-3\hat{i}+4\hat{j}\right)\cdot\left[(2-3t)\hat{i}+(-3+4t)\hat{j}\right] = 0$

$-3(2-3t)+4(-3+4t) = 0$

$-6+9t-12+16t = 0$

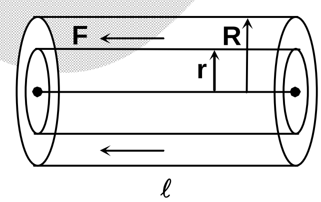
$25t = 18$

$t = \frac{18}{25}$

SECTION – B

8. 24

Sol. Let the pressure difference at the two ends of the tube is ΔP. The viscous force acting on the cylindrical volume of the liquid of radius ‘r’ is



$F = -\eta 2\pi r\ell\frac{dv}{dr}$

$F = -\eta 2\pi r\ell v_0\left(-\frac{2r}{R^2}\right)$

$F = 4\pi\eta\ell v_0\left(\frac{r^2}{R^2}\right)$ ...(i)

For the steady flow of the liquid

$\Delta P\pi r^2 = F$

$\Delta P\pi r^2 = 4\pi\eta\ell v_0\left(\frac{r^2}{R^2}\right)$

$\Delta P = \frac{4\eta\ell v_0}{R^2}$

Hence, k = 24

9. 6

Sol. $\left(\frac{D+x}{D-x}\right)^2 = \frac{9}{1}$

$\frac{D+x}{D-x} = 3$

$D+x = 3D-3x$

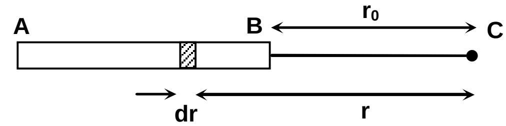
4x = 2D

$x = \frac{D}{2} = \frac{120}{2} = 60\text{ cm}$

x = 60 cm

10. 5

Sol. Potential due to rod at C



$$V = -\frac{GM}{L}\int_{r_0}^{r_0+L}\frac{dx}{x}$$

$v = -\frac{GM}{L}\ell n\left(1+\frac{L}{r_0}\right)$, where r_0 changes from L to $\frac{L}{2}$ then kinetic energy gained by m is

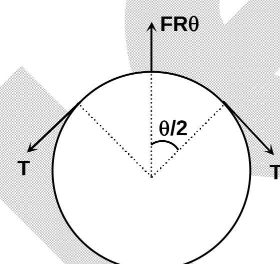
$$\frac{1}{2}mu^2 = \frac{mGM}{L}\ell n\left(\frac{3}{2}\right)$$

$$v = \sqrt{\frac{2GM}{L}\ell n\left(\frac{3}{2}\right)}$$

$\therefore$ x + y = 2 + 3 = 5

11. 6

Sol. $\text{Strain} = \frac{T/A}{Y} = \frac{d}{R}$



$$\Rightarrow T = \frac{AdY}{R}$$

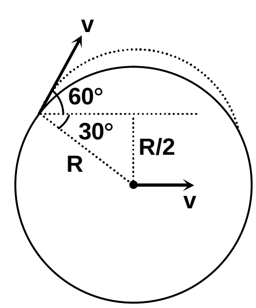
$$2T\sin\frac{\theta}{2} = FR\theta$$

$T\theta = FR\theta$

$$F = \frac{T}{R} = \frac{AdY}{R^2}$$

12. 3

Sol. Considering the motion of detached bit of mud w.r.t. centre of the wheel



$$2R\cos30° = \frac{v^2\sin120°}{g}$$

$$\Rightarrow v = \sqrt{2gR} = \sqrt{2\times10\times0.6} = 2\sqrt{3} = 3.46\text{ m/s}$$

13. 2

Sol. If $A > 2\theta_C$ then light does not emerge.

A = 60º

θ_C should be less than 30º

$$\sin30° = \frac{1}{\mu}$$

$\Rightarrow \quad \mu = 2$

minimum value of μ is 2.

SECTION – C

14. 60.00

15. 10.00

Sol. (Q.14-15). x-coordinate of first order maxima = $\pm\frac{\lambda D'}{d}$

Where $D' = D + \frac{Mg}{k}(1-\cos\omega t)$, $\left(\omega = \sqrt{\frac{k}{M}}\right)$

$= \frac{5Mg}{k} + \frac{Mg}{k}(1-\cos t) = 60 - 10\cos t$

So, $x = \pm\frac{1}{100}(60-10\cos t)m = \pm(60-10\cos t)$ cm

16. 6.00

17. 4.00

Sol. (Q.16-17).

The maximum acceleration with which the blocks can move together without slipping

$a_{max} = \frac{\mu mg}{3M} = \frac{0.3\times1\times10}{3\times2} = 0.5\ m/s^2$

$F_{max} = 2(M+m)a_{max} = 6\times0.5 = 3$ N

The friction force between the front blocks,

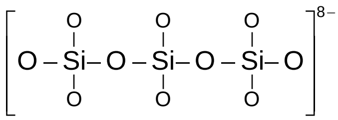
$F_S = (M + 2m)\ a_{max} = 4 \times 0.5 = 2$ N

Chemistry

PART – II

SECTION – A

18. D

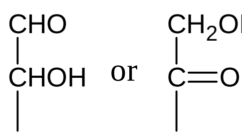
Sol. (A) 

(B) HF reacts with glass, so it is used to make marking on the glass (etching).

(C) Since Fe^{3+} reacts with KCNS to produce red colour. So, it can be used as an indicator in the titration of Fe^{3+} with Sn^{2+}.

(D) $Pb_3O_4 + HCl \longrightarrow PbCl_2 + H_2O + \underset{\text{(Greenish yellow)}}{Cl_2} \uparrow$

19. B

Sol.  unit required for osazone formation.

20. C

Sol. $\dfrac{0.1}{\left(\dfrac{51}{f_1}\right)} = \dfrac{43.9}{11200}$ $\quad f_1 = 2$

i.e. $M \longrightarrow M^{+2}$

Now, $M^{+2} \xrightarrow{\text{Permanganate}} M^{+n}$

$\dfrac{58.8 \times 0.1}{1000} = \dfrac{0.1}{\dfrac{51}{f_2}}$ $\quad f_2 = 3$

$\therefore$ Higher oxidation state = 2 + 3 = +5

21. B

Sol. $2HSO_4^- \longrightarrow 2e^- + H_2S_2O_8$

To produce 1 mole/hr of $H_2S_2O_8$, 2 mole/hr of electrons need to be released (i.e. 2F).

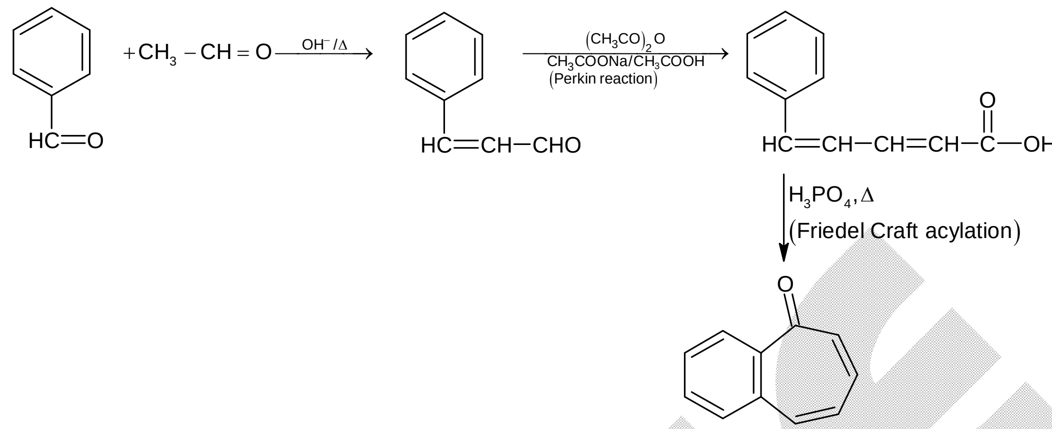
Because efficiency is 75% $\therefore \dfrac{8}{3}F$

$\dfrac{8}{3} \times 96500 = i \times 60 \times 60$

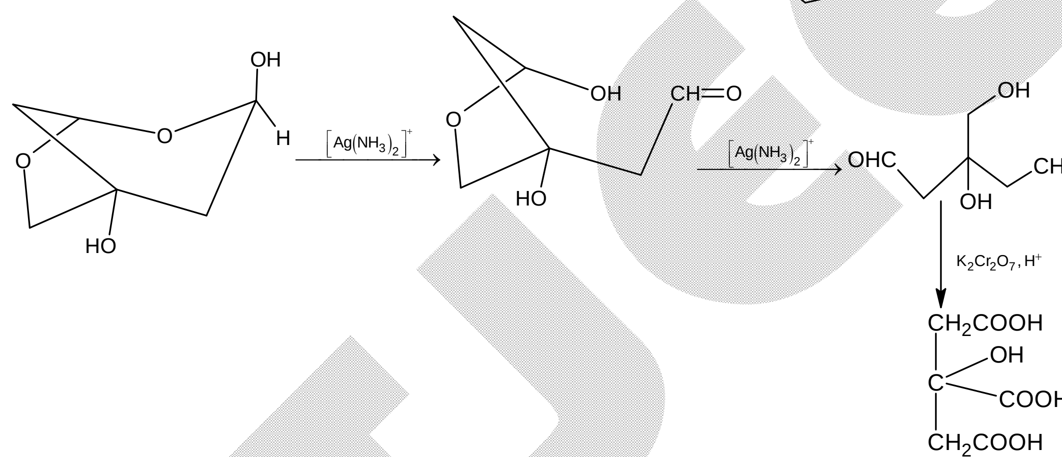
$i \approx 71$ amp.

22. A, B, C, D

Sol. (A)

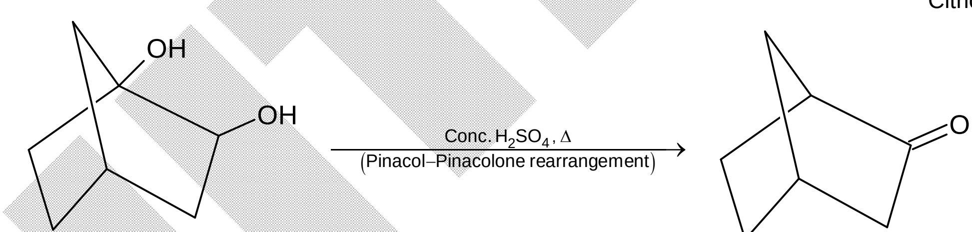


(B)

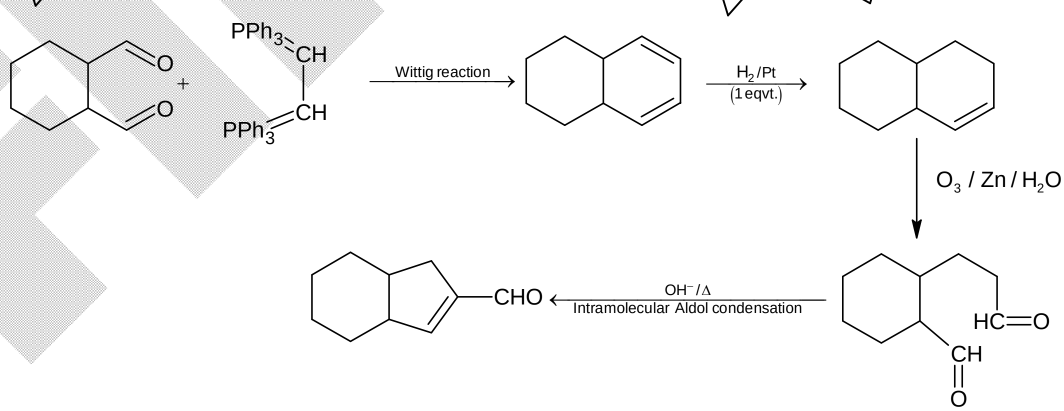


Citric acid

(C)



(D)



23. A, B, D

Sol.

	$2ACl_3 \longrightarrow$	A_2O_5
at $t = 0$	1M	0
After time $= 10$ min	$(1-x)$	$\frac{x}{2}$

So, $(1-x)\times 2 = \frac{1}{4}\times 0.8\times 5$

$\therefore x = 0.5$ mole

So, $t_{1/2} = 10\text{min}$

Now, $k = \frac{1}{2\times t_{1/2}\times [A]_o} = \frac{1}{2\times 10\times 1} = 0.05\ \ell\text{mol}^{-1}\text{min}^{-1}$

Also, after t = 20 min,

$$20 = \frac{1}{2\times 0.05}\left[\frac{1}{[A]_t} - \frac{1}{[A]_o}\right]$$

$$2 = \frac{1}{[A]_t} - 1$$

$$\therefore [A]_t = \frac{1}{3}$$

So, % of ACl_3 left unreacted after 20 min $= \frac{1}{3}\times 100 = 33.33\%$

24. A, D

Sol. The order of volatility is IV < III < II < I

So, I = CH_3F, II = CH_2O, III = CH_3OH, IV = CH_3COOH

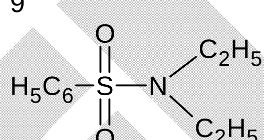
SECTION – B

25. 6

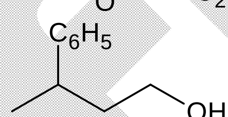
Sol. Only KNO_3, Ag_2O, $KClO_3$, HgO, $NaNO_3$ and H_2O_2 will decompose on heating to give O_2 as the only gaseous product.

26. 9

Sol.



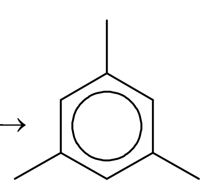
; $C_6H_5NH_2$; $C_6H_5-CH_3$; $C_6H_5-\underset{}{CH}(CH_3)-C\equiv C-H$;



; $C_6H_5-NO_2$ are insoluble in aq. NaOH and rest are soluble.

27. 7

Sol. $CH_2=C=CH_2 \xrightarrow{H_3O^+} \underset{(X)}{CH-\overset{\overset{O}{||}}{C}-CH_3} \xrightarrow[\Delta]{\text{conc. } H_2SO_4}$



(Y)

28. 27

Sol. Wt. of pay load $= 80 \times 10^3$ g

$$80 \times 10^3 + 0 + 100 \times x = \frac{nRT}{P} \times 1.25 \times x$$

$\therefore x = 26.8 \approx 27$

So, minimum number of balloon required is 27.

29. 21

Sol. I, II, V and VII will exist as anion at pH = 7, So, y = 4 and rest III, IV and VI will exist as cation at pH = 7. So, x = 3.

30. 11

Sol. x = 4 (I, II, III, VII)
y = 5 (I, II, III, IV, VII)
z = 2 (V, VI)

SECTION – C

31. 0.80

Sol. $\Delta S_1 + \Delta S_2 + \Delta S_3 + \Delta S_4 + \Delta S_5 + \Delta S_6 = 0$ (because the process is cyclic).

Also, $\Delta S_2 = \Delta S_4 = \Delta S_6 = 0$ (reversible adiabatic process).

So, $\Delta S_1 + \Delta S_3 + \Delta S_5 = 0 = x$

So, $\frac{x+4}{5} = \frac{0+4}{5} = 0.80$

32. 2.50

Sol. $q_{total} + w_{total} = \Delta U = 0$ (cyclic process)

$q_{total} + (-700) = 0$

$\therefore q_{total} = 700$ J

Now, $Q_1 + Q_3 + Q_5 + Q_2 + Q_4 + Q_6 = 700$

$500 + 800 + Q_5 + 0 + 0 + 0 = 700$

$Q_5 = -600$ J

Also, $\Delta S_1 + \Delta S_3 + \Delta S_5 + \Delta S_2 + \Delta S_4 + \Delta S_6 = 0$ (cyclic process)

$$\frac{500}{250} + \frac{800}{200} + \frac{(-600)}{T_5} + 0 + 0 + 0 = 0$$

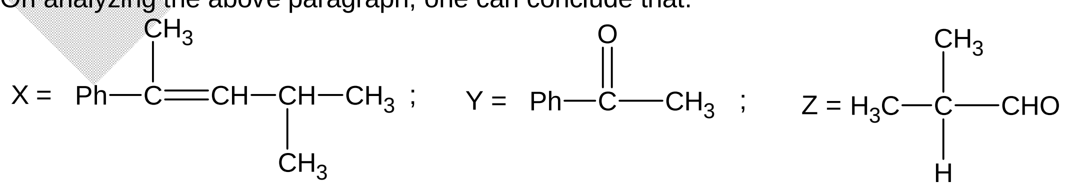
$T_5 = 100$K

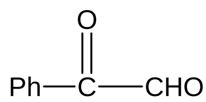
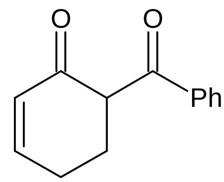
$T_1 = 250$ K (given)

So, $\frac{T_1}{T_5} = 2.50$

33. 16.00

Sol. On analyzing the above paragraph, one can conclude that:



A = HCOONa ; B =  ; C =  ;

Also, ‘X’ can form a total of 10 ozonides including cross-ozonides.

34. 5.25

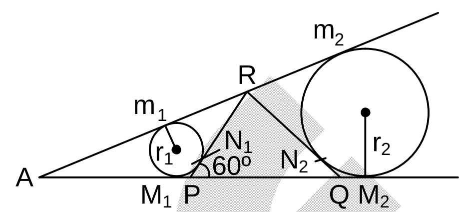
Sol. m = 21; n = 8

Mathematics PART – III

SECTION – A

35. A

Sol. As $M_1M_2 = m_1m_2$



$M_1M_2 = M_1P + PQ + QM_2 = \frac{r_1}{\sqrt{3}} + a + \frac{r_2}{\sqrt{3}}$

$m_1m_2 = m_1R + Rm_2$ ..... (1)

$= N_1R + N_2R$

$= a - \frac{r_1}{\sqrt{3}} + a - \frac{r_2}{\sqrt{3}}$ ..... (2)

From equation (1) and (2), we get $a + \frac{r_1 + r_2}{\sqrt{3}} = 2a - \left(\frac{r_1 + r_2}{\sqrt{3}}\right)$

$2\left(\frac{r_1 + r_2}{\sqrt{3}}\right) = a$

36. A

Sol. $P_n = \frac{1}{6}\left\{\frac{5}{6}\cdot\frac{1}{6}\cdot P_{n-3} + \frac{5}{6}\cdot P_{n-2}\right\} + P_{n-1}\cdot\frac{5}{6}$

$216P_n - 5P_{n-3} - 30P_{n-2} - 180P_{n-1} = 0$

37. B

Sol. $B^n = PA^nP$ $(P^2 = I)$

$\Rightarrow PB^nP = P(PA^nP)P = A^n$

38. B

Sol. $f'(x) = -\frac{1}{\left(\sin^2 x - (x-a)^2\right)^2}\{\sin 2x - 2(x-a)\} < 0\ \forall\ x \in (0, 1)$

39. A, B, C, D

Sol. N = 13725 if n is odd, then $\prod_{b=1}^{n}\left(1 + e^{\frac{2\pi iab}{n}}\right) = 2^{\gcd(a,n)}$

40. A, B, C, D

Sol. $f'(x) > 0\ \forall\ x \in (1, \infty)$ so f(x) is strictly increasing

So, $f(x) \ge f(1)\ \forall\ x \in (1, \infty) \Rightarrow f'(x) \le \frac{1}{x^2 + 1}$

So, $f(x) = 1 + \int_1^x f'(t)dt \le 1 + \int_1^x \frac{1}{t^2 + 1}dt \le 1 + \left|\tan^{-1} t\right|_1^x \le 1 + \tan^{-1} x - \frac{\pi}{4}$

$x \to \infty$, $f(x) \to 1 + \frac{\pi}{4}$

41. A, C, D

Sol. Let α_i for i = 1, 2, 3, 4, 5, 6, 7, 8 are positive real roots

$\sum \alpha_i = 4$, $\prod \alpha_i = \frac{1}{2^8}$ using AM $\geq$ GM

$\frac{\sum \alpha_i}{8} \geq \left(\frac{1}{2^8}\right)^{\frac{1}{8}}$ as AM = GM $\Rightarrow$ all roots are equal to $\frac{1}{2}$

$$\frac{b_2 b_6}{b_4} = \frac{{}^8C_6\left(\frac{1}{2}\right)^6 \cdot {}^8C_2\left(\frac{1}{2}\right)^2}{{}^8C_6\left(\frac{1}{2}\right)^4}$$

SECTION – B

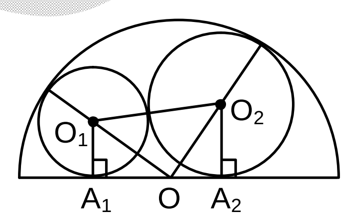
42. 3

Sol. Required area = $\frac{1}{2} + \int_{-1}^{0}\left(2\sqrt{1+x}\right)dx + \int_{0}^{1}\left(-x + 2\sqrt{1+x}\right)dx + \int_{0}^{1}\left(-2\sqrt{1+x} + 2 + x\right)dx$

$= \frac{1}{2} + \frac{4}{3} + 2 = \frac{23}{6}$

43. 6

Sol. $A_1A_2 = \sqrt{(r_1+r_2)^2 - (r_1-r_2)^2} = 2\sqrt{r_1r_2}$



and $A_1A_2 = A_1O + OA_2 = \sqrt{(1-r_1)^2 - r_1^2} + \sqrt{(1-r_2)^2 - r_2^2}$

$= \sqrt{1-2r_1} + \sqrt{1-2r_2}$

$\Rightarrow \sqrt{1-2r_1} + \sqrt{1-2r_2} = 2\sqrt{r_1r_2}$

$\Rightarrow r_1 + r_2 = 2\sqrt{r_1r_2}\left(\sqrt{2} - \sqrt{r_1r_2}\right) \leq (r_1+r_2)\left(\sqrt{2} - \sqrt{r_1r_2}\right)$

$\sqrt{r_1r_2} \leq \sqrt{2} - 1 \Rightarrow r_1 + r_2 \leq 2\left(\sqrt{2}-1\right)$

44. 4

Sol. Let g(x) = P(x)·Q(x) + $x^4 - 5x^2$ + y, the g(–2) = 0, g(2) = 0, g(–1) = 0, g(1) = 0

45. 1

Sol. Let $\sin\left(\frac{1}{n^2}\right) + \sin\left(\frac{2}{n^2}\right) + ... + \sin\left(\frac{n}{n^2}\right)$ be S_n

So, $\sum \frac{1}{n^2} - \frac{1}{6}\sum \frac{n^3}{n^6} < S_n < \frac{1}{n^2} + \frac{2}{n^2} + ... + \frac{n}{n^2}$

46. 1

Sol. Let $A = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$, a + d = 3 = ad – bc

47. 1

Sol. n = 1 ; 1 + 2 + 3 + ….. + 9 = 45

n = 2 ; $\begin{vmatrix} 1 & 0 \\ 0 & 0 \end{vmatrix} + \begin{vmatrix} 1 & 0 \\ 0 & 1 \end{vmatrix} + ... + \begin{vmatrix} 9 & 9 \\ 9 & 9 \end{vmatrix}$

$$= \sum_{\substack{1 \le i \le 9 \\ 0 \le j, k, \ell \le 9}} \begin{vmatrix} i & j \\ k & \ell \end{vmatrix} = \sum (i\ell - jk) = 100 \sum_{\substack{1 \le i \le 9 \\ 0 \le \ell \le 9}} i\ell - 90 \sum_{1 \le j, k \le 9} jk$$

$= 100.45^2 - 90.45^2$

SECTION – C

48. 0.50

49. 2.75

Sol. (Q.48.-49)

Image of one focus about tangent, point of contact of tangent and other focus are collinear

50. 0.00

51. 0.00

Sol. (Q. 50.-51)

Lines L_1 and L_2 are coplanar and lies on plane $x + y = 1$