Corporate Office : AESL, 3rd Floor, Incuspaze Campus-2, Plot No. 13, Sector-18,
Udyog Vihar, Gurugram, Haryana - 122015, *Ph.*+91-1244168300

MM : 180

AIATS For One Year JEE(Advanced)-2026 (XII Studying/XII Passed)_Test-8A_Paper-2_Online

Time : 180 Min.

CHEMISTRY

Section-I

1. (C)

2. (A)

3. (A)

4. (D)

Section-II

5. (A,B,D)

6. (A,C,D)

7. (A,C,D)

8. (A,B,C)

Section-III

9. (41.67)

10. (0.38)

11. (0.10,0.35)

12. (2.50,2.80)

13. (9.96)

14. (105.00)

15. (9.80)

16. (02.00)

MATHEMATICS

Section-I

17. (C)

18. (A)

19. (C)

20. (B)

Section-II

21. (A,B)

22. (A,B,C,D)

23. (A,B,C)

24. (B,C)

Section-III

25. (17.00)

26. (85.00)

27. (87.00)

28. (04.00)

29. (06.00)

30. (257.00)

31. (4017.00)

32. (04.00)

PHYSICS

Section-I

33. (C)

34. (C)

35. (D)

36. (A)

Section-II

37. (B,C)

38. (A,C,D)

39. (A,C)

40. (B,D)

Section-III

41. (02.50)

42. (00.41)

43. (10.50)

44. (05.00)

45. (00.50)

46. (03.50)

47. (00.50)

48. (02.00)

Hints and Solutions

CHEMISTRY

Section-I

(1) **Answer :** (C)
Solution:

(A) $Cu^{2+} + [Fe(CN)_6]^{4-} \rightarrow Cu_2[Fe(CN)_6] \downarrow$ reddish brown.

(B) $Cd^{2+} + [Fe(CN)_6]^{4-} \rightarrow Cd_2[Fe(CN)_6] \downarrow$ Bluish white.

(C) $Fe^{3+} + [Fe(CN)_6]^{4-} \rightarrow Fe_4[Fe(CN)_6]_3$ Prussian blue

(D) $Fe^{2+} + [Fe(CN)_6]^{3-} \rightarrow Fe_3[Fe(CN)_6]_2 \downarrow$ Turnbull's blue

(2) **Answer :** (A)
Solution:

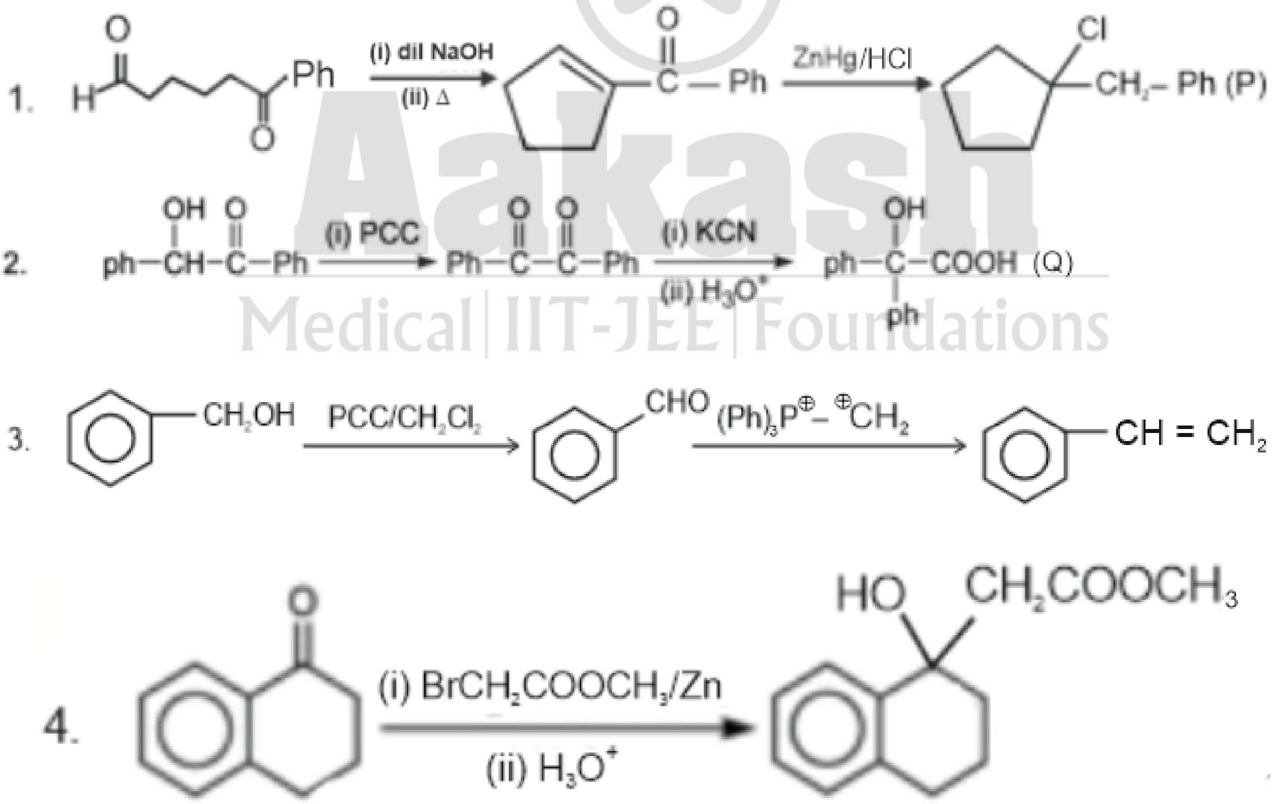
Cold & Dilute

$$2\,NaOH + Cl_2 \longrightarrow NaCl + NaOCl + H_2O$$

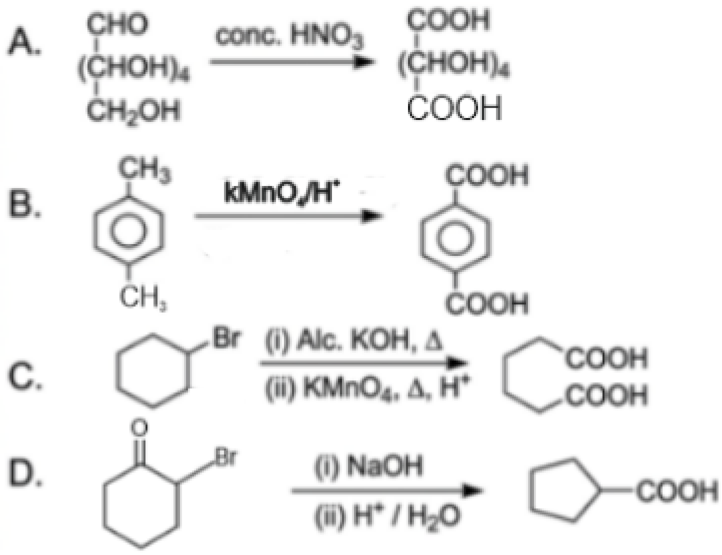
Hot & Conc.

$$6\,NaOH + 3\,Cl_2 \longrightarrow 5\,NaCl + NaClO_3 + 3\,H_2O$$

(3) **Answer :** (A)
Solution:



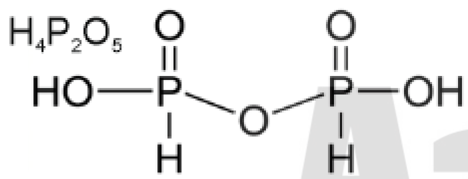
(4) **Answer :** (D)
Solution:

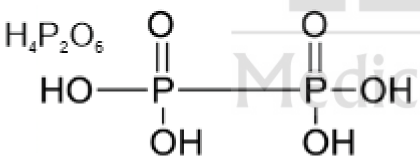


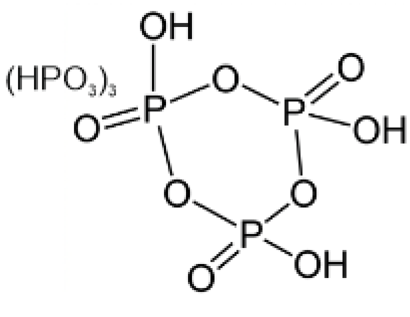
Section-II

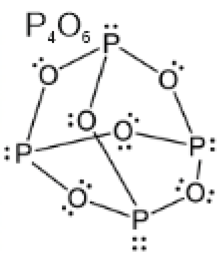
(5) **Answer :** (A,B,D)
Solution:
Statements A, B, D are correct

(6) **Answer :** (A,C,D)
Solution:



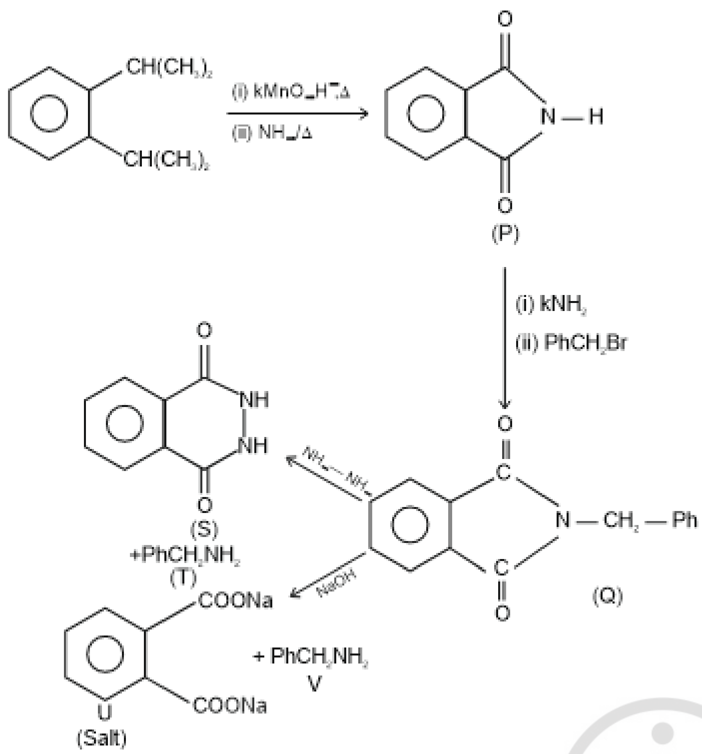




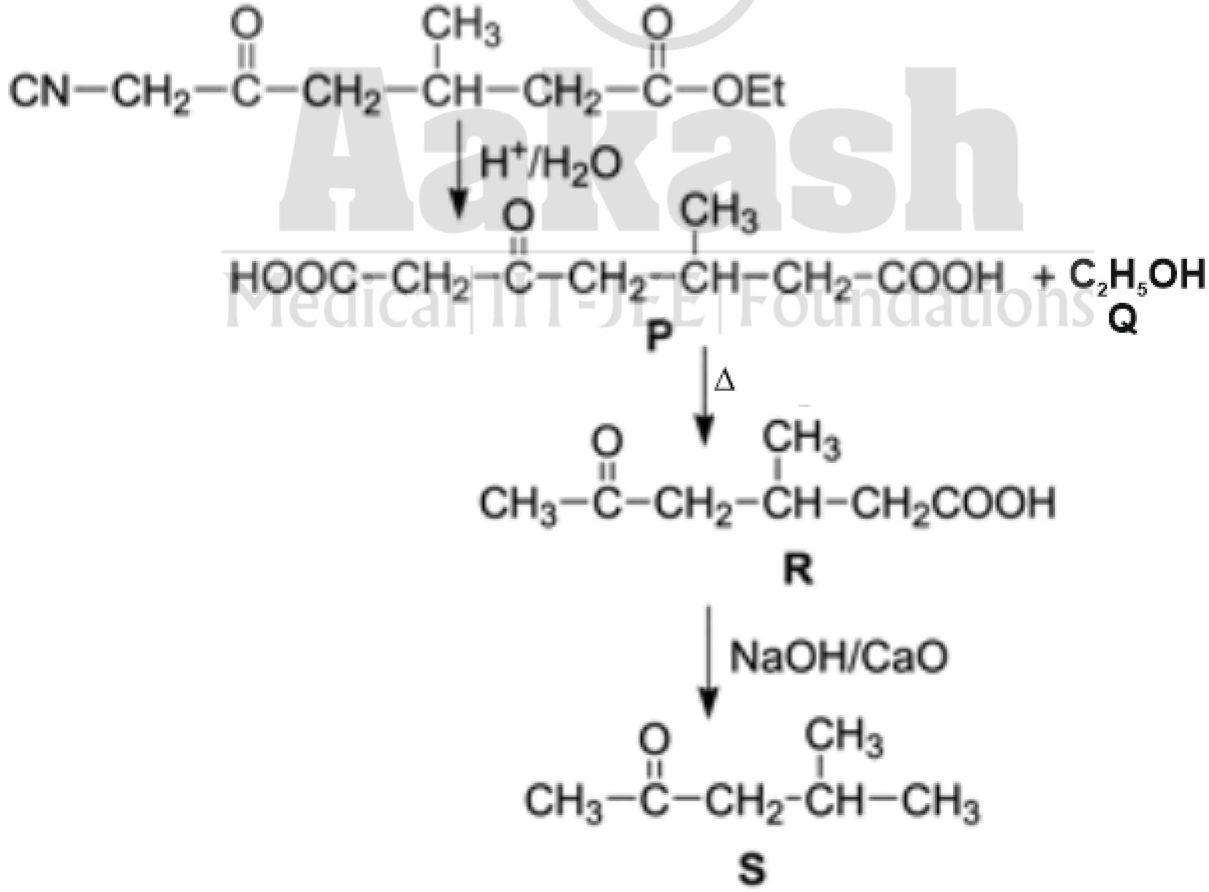


(7) **Answer :** (A,C,D)

Solution:



(8) **Answer :** (A,B,C)
Solution:



Section-III

(9) **Answer :** 41.67

Solution:

$d = \frac{Z \times M}{a^3 \cdot N_A}$

$d = \frac{2 \times 100}{(200 \times 10^{-10})^3 \times 6 \times 10^{23}}$

$d = \frac{1 \times 10^2 \times 10}{4 \times 6} = 41.67\ (\text{g/cm}^3)$

(10) Answer : 0.38

Solution:

$\text{BaCl}_2 + \text{Na}_2\text{SO}_4 \rightleftharpoons \text{BaSO}_4 + 2\text{NaCl}$

2 mmol 10 mmol

Left $[\text{SO}_4^{2-}] = \left(\frac{8}{200}\right) M = 0.04\ M$

$K_{sp} = [\text{Ba}^{2+}][\text{SO}_4^{2-}]$

$[\text{Ba}^{2+}] = \frac{1.5 \times 10^{-10}}{0.04} = 37.5 \times 10^{-10}\ M$

Solubility = 0.375×10^{-8}

x = 0.375

(11) Answer : 0.10,0.35

Solution:

According to Freundlich isotherm, $\frac{x}{m} = kC^{\frac{1}{n}}$

or $\log \frac{x}{m} = \log k + \frac{1}{n} \log C$

= $\log 0.15 + \frac{1}{2.5} \log (0.45)$

$\log \frac{x}{m} = -0.96$

$\frac{x}{m} = 0.11$per gram charcoal.

the amount of ethanol adsorbed by 400g charcoal

= $0.11 \times 400 = 44$ g

Total amount of ethanol present = $4 \times 0.45 \times 46 = 82.8g$

amount of ethanol left = $82.8 - 44 = 38.8$

Molarity of ethanol left = $\frac{38.8}{46 \times 4} = 0.21$

(12) Answer : 2.50,2.80

Solution:

	$2N_2O_5(g) \longrightarrow$	$4NO_2(g) +$	$O_2(g)$
At t = 0	n	0	0
t = t	$(n-y)$;	2y	$\frac{y}{2}$
t = ∞,	0	2n	$\frac{n}{2}$

$n \propto P_0$ at t = 0

$n - y + 2y + \frac{y}{2} \propto 285$ at t=30

$n + y + \frac{y}{2} \propto 285$

$n + \frac{3y}{2} \propto 285$

$2n + \frac{n}{2} \propto 585$ at t=∞

$\frac{5n}{2} \propto 585$

$n = 234$

$k = \frac{2.303}{2t} \log \frac{n}{(n-y)}$

$k = \frac{2.303}{2 \times 30} \log \left(\frac{234}{200}\right)$

$k = 2.61 \times 10^{-3}$

(13) Answer : 9.96

Solution:

Density of solution = $1.25\ g\ \text{cm}^{-3} = 1250\ \text{kg}\ m^{-3}$

Height $h = 3\ \text{cm} = 3 \times 10^{-2}\ m$

Gravity (g) = $10\ m\ s^{-2}$

Osmotic pressure $\pi = h\rho g$
$= 3 \times 10^{-2} \times 1250 \times 10$
$= 375\ N\ m^{-2}$
$375 = \frac{1500}{M} \times 8.3 \times 300$
$M = 9.960 \times 10^3$

(14) **Answer :** 105.00
Solution:
$C_3H_8 + 5O_2 \rightarrow 3\,CO_2 + 4H_2O$
$\Delta_r G^\circ = 3 \times (-394) + 4 \times (-237) - (-30)$
$= -2100\ \text{kJ}$
$E^\circ = \frac{-1}{20F} \times \Delta_r G^\circ$
$\frac{x}{F} \times 10^3 = -\frac{1}{20F} \times \left(-2100\right) \times 10^3$
$x = \frac{2100}{20} = 105$ V

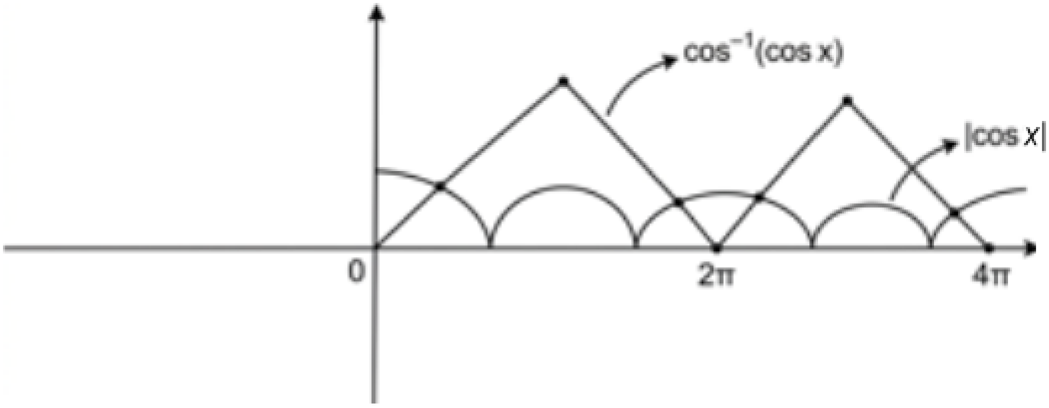
(15) **Answer :** 9.80
Solution:
$\mathrm{Cr}^{2+} = 3d^4,\ n = 4$
$\mu = \sqrt{n(n+2)} = \sqrt{4(4+2)} = \sqrt{24} = 4.9$
$\mathrm{Fe}^{2+} = 3d^6,\ n = 4$
$\mu = \sqrt{n(n+2)} = \sqrt{4(4+2)} = \sqrt{24} = 4.9$
Sum = $4.9 + 4.9 = 9.8$

(16) **Answer :** 02.00
Solution:
$\mathrm{C_{24}H_{42}O_{21}} + 3\mathrm{H_2O} \rightarrow \text{ galactose} + \text{glucose} + \text{fructose}$
Total mass of products $= 666 + 54 = 720$
Mass of galactose $= 720 \times \frac{50}{100} = 360$
Total unit $= \frac{360}{180} = 2$

MATHEMATICS

Section-I

(17) **Answer :** (C)
Solution:
$$\sqrt{\frac{\left(1-\tan^2\frac{x}{2}\right)^2 - 4\tan^2\frac{x}{2}}{\left(1+\tan^2\frac{x}{2}\right)^2} + 1} = \sqrt{2}\ \cos^{-1}\left(\cos\ x\right)$$
$$\Rightarrow \sqrt{\left(\frac{1-\tan^2\frac{x}{2}}{1+\tan^2\frac{x}{2}}\right)^2 - \left(\frac{2\tan\frac{x}{2}}{1+\tan^2\frac{x}{2}}\right)^2 + 1} = \sqrt{2}\ \cos^{-1}\left(\cos\ x\right)$$
$= \sqrt{\left(\cos^2 x\right) - \left(\sin^2 x\right) + 1} = \sqrt{2}\ \cos^{-1}\left(\cos\ x\right)$
$= \sqrt{\cos 2x + 1} = \sqrt{2}\ \cos^{-1}\left(\cos\ x\right)$
$= \sqrt{2}\left|\cos\ x\right| = \sqrt{2}\ \cos^{-1}\left(\cos\ x\right)$
$\Rightarrow \left|\cos\ x\right| = \cos^{-1}\left(\cos\ x\right)$



$\therefore$Number of solutions = 4

(18) **Answer :** (A)
Solution:
for any $x \neq t$, we have

$\frac{|g(x)-g(t)|}{|x-t|} < \left|x-t\right|^{\alpha}$

Since $\lim_{x \to t} \left|x-t\right|^{\alpha} = 0$

$\therefore \lim_{x \to t} \left|\frac{g(x)-g(t)}{x-t}\right| = \lim_{x \to t} \frac{|g(x)-g(t)|}{|x-t|} = 0$

Hence $\lim_{x \to t} \frac{g(x)-g(t)}{x-t} = 0$

$\therefore g'(t)$ exists for any $t \in R$ since

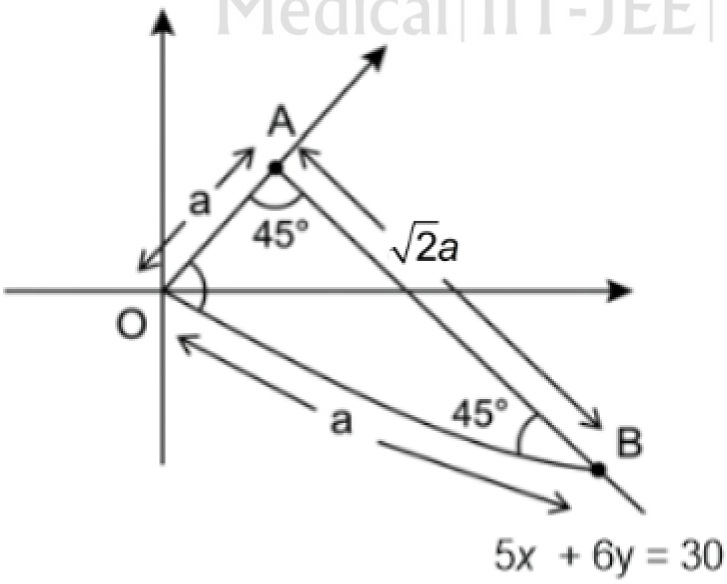
$g'\left(t\right) = \lim_{x \to t} \frac{g(x)-g(t)}{x-t} = 0$

$\Rightarrow g(x)$ is Constant

Given $g(5) = 10$

$\therefore \sum_{r=1}^{50} \frac{g(r)}{10} \Rightarrow \frac{(10)\times 50}{10} \Rightarrow 50$

(19) **Answer :** (C)
Solution:
Sol: $\mathrm{OA} = OB$($\Delta\,\mathrm{AOB}$ is isosceles triangle).



Let slope of line $\mathrm{OA} \rightarrow m_1$
So, equation $\rightarrow y = m_1 x$.

$\therefore \tan\ 45^{\circ} = \left|\frac{m_1 - m_2}{1+m_1 m_2}\right|$

$1=\left|\frac{m_1+\frac{5}{6}}{1-\frac{5}{6}m_1}\right|$

$\Rightarrow 1-\frac{5}{6}m_1=m_1+\frac{5}{6}$

$\Rightarrow \frac{1}{6}=\frac{11m_1}{6}$

$\Rightarrow m_1=\frac{1}{11}$

$\Rightarrow y=\frac{x}{11}$ — (1)

Point of intersection of OA& line $5x+6y=30$ is $A\left(\frac{330}{61},\frac{30}{61}\right)$

$\therefore \mathrm{OA}^2=a^2=\left(\frac{330}{61}\right)^2+\left(\frac{30}{61}\right)^2$

$a^2=\left(30\right)^2\left(\left(\frac{11}{61}\right)^2+\left(\frac{1}{61}\right)^2\right)$

$a^2=\left(30\right)^2\left(\frac{122}{(61)^2}\right)$

$a^2=\frac{1800}{61}$

$\therefore \alpha=\mathrm{OA}^2+\mathrm{AB}^2+\mathrm{BO}^2$

$\alpha=a^2+a^2+2a^2$

$\alpha=4a^2=4\left(\frac{1800}{61}\right)$

$\alpha=\frac{7200}{61}$

$\left[\frac{\alpha}{10}\right]=11$

(20) **Answer :** (B)
Solution:
Answer (2)

$\lim_{x\to\infty}\left(1-\frac{1}{x}+\frac{5}{x^2}\right)^{-3x}$

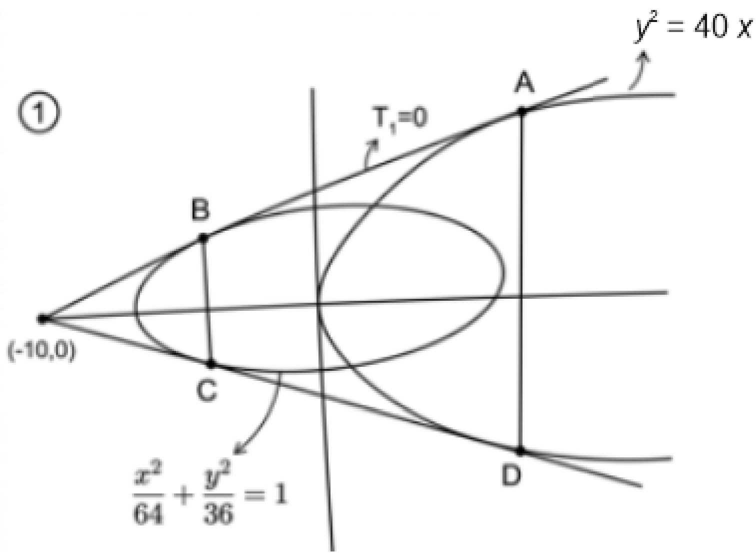
$=\lim_{x\to\infty}\left(\left(1+\left(\frac{5-x}{x^2}\right)\right)^{\frac{x^2}{5-x}}\right)^{\frac{(x-5)3x}{x^2}}$

$\Rightarrow \lim_{e^{x\to\infty}}\frac{3x^2-15x}{x^2}$

$= e^3$

Section-II

(21) **Answer :** (A,B)
Solution:



Sol: $E: \frac{x^2}{64}+\frac{y^2}{36}=1$ — (1)

Tangent: $y=m_1x\pm\sqrt{64m_1^2+36}$

$P: y^2=40x$,

$y=m_2x+\frac{10}{m_2}$

For common tangent

$m=m_1=m_2$

$\sqrt{64m_1^2+36}=\frac{10}{m_2}$

$\Rightarrow 64m^2+36=\frac{100}{m^2}$

$\Rightarrow m=\pm1$

$\therefore y=x+10^2,\ y=-x-10^3$ are tangents.

∴point of intersection of ① and ② and ③

$B\equiv\left(\frac{-32}{5},\ \frac{18}{5}\right)$, $C\equiv\left(\frac{-32}{5},-\frac{18}{5}\right)$

Similary point of intersection of $y^2=40x$and ② and ③

$A\equiv(10,\ 20)$, $D\equiv(10,-20)$

Intersection of $T_1=0$and $T_2=0$is $(-10,\ 0)$

Area of quadrilateral $\mathrm{ABCD}=\frac{1}{2}\left(40+\frac{36}{5}\right)\left(10+\frac{32}{5}\right)$

$\Rightarrow \frac{9676}{25}$

(22) **Answer :** (A,B,C,D)

Solution:

$z^4+z^3+z^2+z^2+z+1=0$

$z^2(z^2+z+1)+(z^2+z+1)=0$

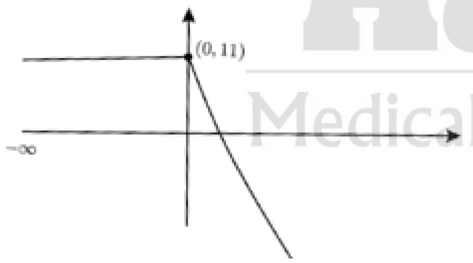
$(z^2+1)(z^2+z+1)=0$

$z=\pm i,\ z=\omega,\ \omega^2$

(23) **Answer :** (A,B,C)

Solution:

We have $g\left(x\right)=\begin{cases}11 & ,\ x\le 0\\ (2025)^{-x}-(2025)^{x}+11 & ,\ x>0\end{cases}$



As $g(x)$ is constant for $x\le 0$and for $x>0$ graph is decreasing

∴ function is into and many-one. Thus, A, B, C are wrong statements.

(24) **Answer :** (B,C)

Solution:

$g'(x)=0$

$\Rightarrow g(x)=\mathrm{Constant}$

$\therefore g(3)=168$

$\Rightarrow g(x)=168$

$$Q^2=Q.Q=\begin{bmatrix}\cos\left(\frac{2\pi}{24}\right) & \sin\left(\frac{2\pi}{24}\right)\\ -\sin\left(\frac{2\pi}{24}\right) & \cos\left(\frac{2\pi}{24}\right)\end{bmatrix}$$

$$Q^n=\begin{bmatrix}\cos\left(\frac{n\pi}{24}\right) & \sin\left(\frac{n\pi}{24}\right)\\ -\sin\left(\frac{n\pi}{24}\right) & \cos\left(\frac{n\pi}{24}\right)\end{bmatrix}$$

$$\therefore Q^{12}=\begin{bmatrix}0 & 1\\ -1 & 0\end{bmatrix}$$

$$Q^{24}=Q^{12}\cdot Q^{12}=\begin{bmatrix}-1 & 0\\ 0 & -1\end{bmatrix}$$

$\therefore Q^{24} \neq Q^{12}$

$\therefore Q^{12}$ is not Idempotent matrix.

Now $\alpha Q^{16} + \beta Q^{8} + I = 0$

$\Rightarrow \alpha \begin{bmatrix} -\frac{1}{2} & \frac{\sqrt{3}}{2} \\ -\frac{\sqrt{3}}{2} & -\frac{1}{2} \end{bmatrix} + \beta \begin{bmatrix} \frac{1}{2} & \frac{\sqrt{3}}{2} \\ -\frac{\sqrt{3}}{2} & \frac{1}{2} \end{bmatrix} + \gamma \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = 0$

$\Rightarrow -\frac{\alpha}{2} + \frac{\beta}{2} + \gamma = 0$ ---- (1)

$\frac{\sqrt{3}}{2}(\beta + \alpha) = 0$ ---- (2)

from (1) & (2)

$\gamma = \alpha$ and $\beta = -\gamma$

$\therefore \frac{\gamma + \beta + 2026\gamma}{\alpha} \Rightarrow 2026$

$\therefore g(2026) = 168 \Rightarrow 2^3 \cdot 3 \cdot 7$

Sum of even divisors = $(2 + 2^2 + 2^3)(1+3)(1+7) = 448$

$(Q^{24})^2 = Q^{24}$ $\therefore$ Q^{24} is involutary matrix.

Section-III

(25) Answer : 17.00

Solution:

$\alpha = \frac{5}{25} = \frac{1}{5}$

$\beta = \frac{{}^5C_1 \times {}^4C_1 \times \frac{3!}{2!}}{(5)^3}$

$\beta = \frac{(5)(4)\cdot(3)}{5\cdot5\cdot5}$

$\beta = \frac{12}{25}$

$\therefore \frac{\alpha}{\beta} = \frac{1/5}{12/25}$

$\frac{p}{q} = \frac{5}{12}$

$\Rightarrow a + b = 5 + 12 = 17$

(26) Answer : 85.00

Solution:

$5\,a_n = (n+5)(n+6) \Rightarrow a_n = \frac{(n+5)(n+6)}{5}$

$\Rightarrow S_n = \sum_{k=1}^{n} \frac{1}{a_k}$

$= 5\sum_{k=1}^{n} \frac{1}{k^2+11k+30}$

$= 5\sum_{k=1}^{n} \frac{1}{(k+5)(k+6)}$

$= 5\sum_{k=1}^{n} \left(\frac{1}{k+5} - \frac{1}{k+6}\right)$

$= 5\left[\left(\frac{1}{6} - \frac{1}{7}\right) + \left(\frac{1}{7} - \frac{1}{8}\right) + \ldots + \left(\frac{1}{n+5} - \frac{1}{n+6}\right)\right]$

$\Rightarrow 5\left(\frac{1}{6} - \frac{1}{n+6}\right)$

$S_n = 5\left(\frac{n}{6(n+6)}\right)$

$S_{102} = \frac{5}{6}\left(\frac{102}{108}\right)$

$108\,S_{102} = (5)17 \Rightarrow 85$

(27) Answer : 87.00

Solution:

Given $x^4(1+x)^{112} + x^5(1+x)^{111} + \cdots + x^{65}(1+x)^{48}$

It is a G.P with first term = $x^4(1+x)^{112}$.

Common ratio = $\frac{x}{1+x}$.

Sum of these terms = $x^4\left(1+x\right)^{112} \cdot \left(\frac{\left(\frac{x}{1+x}\right)^{65} - 1}{\frac{x}{1+x} - 1}\right)$

$\Rightarrow x^4\left(1+x\right)^{113}-x^{69}(1+x)^{48}$

To find coefficient of x^{80}:

In $x^4(1+x)^{113}$, we need coeff. of x^{76}

In $x^{69}(1+x)^{48}$, we need coeff. of x^{11}

$\Rightarrow {}^{113}C_{76}-{}^{48}C_{11}$

Comparing with ${}^{113}C_{\alpha}-{}^{48}C_{\beta}$:

$\alpha=76$ and $\beta=11$

$\therefore \alpha+\beta=76+11=87$

(28) **Answer :** 04.00

Solution:

$\int \frac{\operatorname{cosec}^2 x \cdot \sin^3 x}{\sin^3 x+\cos^3 x}\mathrm{dx}=\int \frac{\sin x}{\sin^3 x+\cos^3 x}\mathrm{dx}$

Put $\tan x=t \Rightarrow \sec^2 x\mathrm{dx}=\mathrm{dt}$

$\Rightarrow \int \frac{t}{(t+1)(t^2-t+1)}\mathrm{dt}$

$\Rightarrow \int\left(\frac{A}{t+1}+\frac{B(2t-1)}{t^2-t+1}+\frac{C}{t^2-t+1}\right)\mathrm{dt}$

$\Rightarrow A\left(t^2-t+1\right)+B\left(2t-1\right)\left(t+1\right)+C\left(t+1\right)=t$

$\Rightarrow t^2\left(A+2B\right)+t\left(-A+B+C\right)+A-B+C=t$

$\therefore A+2B=0$ --- (1)

$-A+B+C=1$ --- (2)

$A-B+C=0$ --- (3)

$\Rightarrow C=\frac{1}{2}\Rightarrow A-B=-\frac{1}{2}$ --- (4)

Solving the above equation we get $A=-\frac{1}{3},\ B=\frac{1}{6}$

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

$I=-\frac{1}{3}\ln\left|\left(1+\tan x\right)\right|+\frac{1}{6}\ln\left|\tan^2 x-\tan x+1\right|+\frac{1}{2}\cdot\frac{2}{\sqrt{3}}\tan^{-1}\left(\frac{\tan x-1/2}{\sqrt{3}/2}\right)$

$\therefore\ a=\frac{-1}{3},\ b=\frac{1}{6},\ c=\frac{1}{\sqrt{3}}$

$\therefore\ 24\left(a+b+c^2\right)=24\left(-\frac{1}{3}+\frac{1}{6}+\frac{1}{3}\right)$ = 4

(29) **Answer :** 06.00

Solution:

$\cos\theta=\frac{\left(\beta\hat{i}-\hat{j}+\hat{k}\right)\cdot\left(\beta\hat{i}+6\beta\hat{j}+\hat{k}\right)}{\sqrt{\beta^2+2}\sqrt{\beta^2+36\beta^2+1}}$

$\cos\theta=\frac{\beta^2-6\beta+1}{\sqrt{\beta^2+2}\sqrt{37\beta^2+1}}$

$\Rightarrow \beta^2-6\beta+1>0$

$\Rightarrow (\beta-3)^2-9+1>0$

$\Rightarrow (\beta-3)^2>8$

$\Rightarrow |\beta-3|>2\sqrt{2}$

$\Rightarrow \beta-3>2\sqrt{2}$ or $\beta-3<-2\sqrt{2}$

$\Rightarrow \beta>3+2\sqrt{2}$ or $\beta<3-2\sqrt{2}$

$\Rightarrow \beta\in\left(-\infty,3-2\sqrt{2}\right)\cup\left(3+2\sqrt{2},\infty\right)$

As $3-2\sqrt{2}\approx 3-2.828=0.172$

Least positive integral value of β in the interval is 6 (since β must be positive integral).

(30) **Answer :** 257.00

Solution:

$x=\frac{8}{\sqrt{30}}=\frac{a}{e}$

Focus: $\left(\sqrt{30},0\right)\equiv\left(\mathrm{ae},0\right)$

$\Rightarrow \mathrm{ae}=\sqrt{30},\ \frac{a}{e}=\frac{8}{\sqrt{30}}$

$\therefore a^2=8$

$\therefore e=\sqrt{\frac{15}{4}}$

$e^2=1+\frac{b^2}{a^2}$

$\frac{15}{4} = 1 + \frac{b^2}{8}$

$\Rightarrow \frac{11}{4} = \frac{b^2}{8}$

$\Rightarrow 22 = b^2$

$\therefore l = \frac{2b^2}{a} = \frac{2(22)}{2\sqrt{2}}$

$l = 11\sqrt{2}$

$\therefore 4e^2 + l^2 = 15 + 242 = 257$

(31) **Answer :** 4017.00

Solution:

$n(P) = 3,\ n(Q) = 4$

$\Rightarrow n(P \times Q) = 12$.

$\therefore$Total number of subsets of set $(P \times Q) = 2^{12}$

Number of subsets of set $P \times Q$ having no element $= 1$

Number of subsets of set $P \times Q$ having one element $= {}^{12}C_1$

Number of subsets of set $P \times Q$ having two elements $= {}^{12}C_2$

$\therefore$Number of subsets having atleast three elements

$= 2^{12} - \left({}^{12}C_0 + {}^{12}C_1 + {}^{12}C_2\right)$

$= 2^{12} - (1 + 12 + 66)$

$= 4017$

(32) **Answer :** 04.00

Solution:

$x^4 + 3x^2 + 3x = 3x - 2$

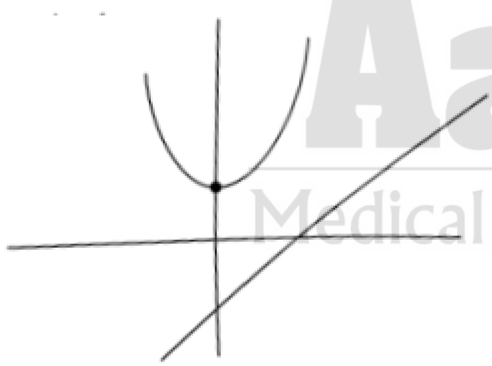
$\Rightarrow x^4 + 3x^2 + 2 = 0$

$x^2 = \frac{-3 \pm \sqrt{9-8}}{2}$

$x^2 = \frac{-3 \pm 1}{2} < 0 \Rightarrow$ no real root.

Curves do not intersect

$\rightarrow$ at $x = 0$



$\therefore y = x^4 + 3x^2 + 3x$

$\frac{dy}{dx} = 4x^3 + 6x + 3 = 3$

$\Rightarrow 4x^3 + 6x = 0$

$\Rightarrow x\left(4x^2 + 6\right) = 0$

$\Rightarrow x = 0$

$\therefore d = \frac{-2}{\sqrt{10}} \Rightarrow d^2 = \frac{4}{10}$

$\Rightarrow \boxed{10d^2 = 4}$

PHYSICS

Section-I

(33) **Answer :** (C)

Hint:

Intensity = $\frac{1}{2} \in_2 E^2 C$

Solution:

$\frac{1}{c\mu_0}\left(\frac{j}{\sigma}\right)^2 = \left[\frac{E^2}{c\mu_0}\right] = \left[\frac{E}{c} \cdot \frac{E}{\mu}\right] = \frac{B \cdot E}{\mu} =$ Poynting vector.

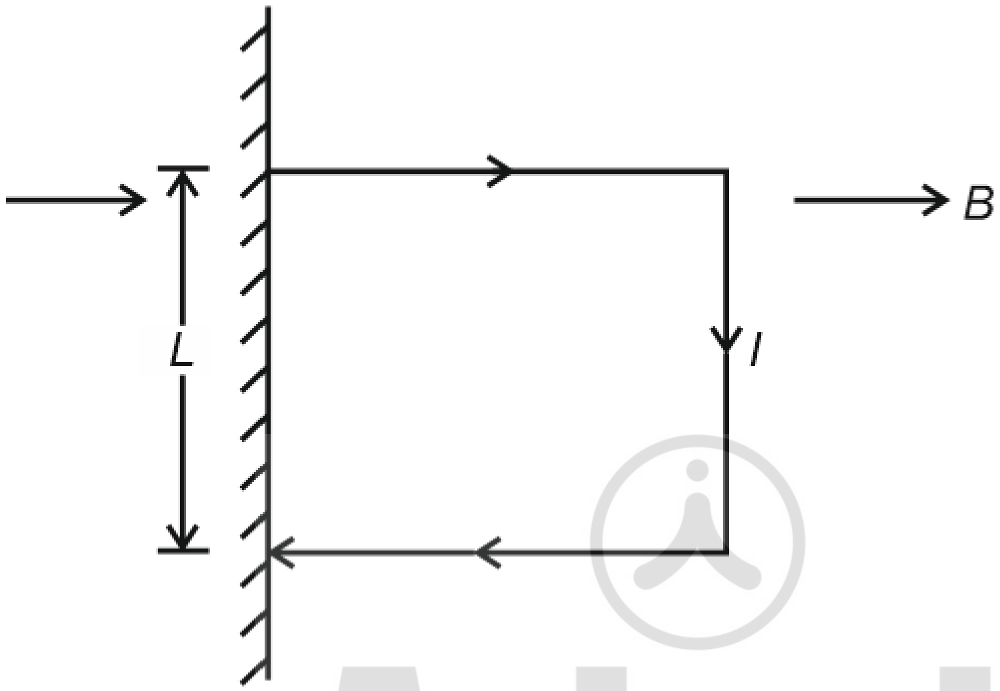
dimension = $ML^0T^{-3}I^0$

(34) Answer : (C)

Hint:

$\tau = \overrightarrow{M} \times \overrightarrow{B}$

Solution:



$\tau = \overrightarrow{r} \times \overrightarrow{F}$

$\tau = 2iB\int_0^L x\mathrm{dx} = 2\left(\frac{BiL^2}{2}\right) = BiL^2$

$I\alpha = \frac{BiL^2}{2}$

$I = \frac{M}{4} \times \frac{L^2}{3} + \frac{M}{4} \times \frac{L^2}{3} + \frac{M}{4} \times L^2$

$= \frac{ML^2}{4}\left[\frac{2}{3} + 1\right] = \frac{5}{12}ML^2$

$\frac{5}{12}ML^2\alpha = \frac{BIL^2}{2}$

$\alpha = \frac{12}{5}\frac{BI}{M}$

(35) Answer : (D)

Hint:

$\frac{Q_1^2}{2C_1} + \frac{Q_2^2}{2C_2} - \frac{(Q_1 + Q_2)^2}{2(C_1 + C_2)}$

Solution:

$\Delta u = \frac{k}{2}\left(\frac{Q_1^2}{R_1} + \frac{Q_2^2}{R_2} - \frac{(Q_1 + Q_2)^2}{R_1 + R_2}\right)$

(36) Answer : (A)

Hint:

$d\sum = Bwrdr$

Solution:

Rotation emf $\propto w \& B(r)$,

$v = wr$

$E(r) = vB = wB_0r^2$

$F = q\left(\overrightarrow{v} \times \overrightarrow{B}\right)$ radially outward.

$\varepsilon = \int E \cdot \mathrm{dl} = \frac{wB_0}{3}\left({r_2}^3 - {r_1}^3\right)$

Section-II

(37) Answer : (B,C)

Hint:

$d(TS) = TdS + SdT$

Solution:

Clearly $T_0S_1 = T_2S_2 = 2$

$\Rightarrow d(TS) = TdS + SdT = 0$

$\Rightarrow SdT = -dQ = CdT$

$\Rightarrow \frac{dQ}{dT} = -S = \frac{-2}{T}$

For $(ca) \rightarrow dQ_1 = 0$

For (ab) $dQ_2 = \int_{T_1}^{T_2} -\frac{2}{T}.\, dT$

$\Rightarrow \int dQ_2 = 2\ln(e) = 2$

$\Rightarrow \int dQ_3 = T_2(S_2 - S_1) = -\frac{2(e-1)}{e}$

$\Rightarrow n = \frac{Q_2 - Q_3}{Q_2} = \frac{1}{e}$

(38) Answer : (A,C,D)

Hint:

$y = \frac{\lambda D}{d}$

Solution:

$\lambda \rightarrow$vary hence central maxima shift. spectral dependence broaden maxima. specific μ can nullify phase shift.

(39) Answer : (A,C)

Hint:

$\frac{\Delta F}{F} = \frac{1}{2}\frac{\Delta T}{T}$

Solution:

$v = \sqrt{\frac{T}{\mu}} = 100 \text{ m/s}$

$\frac{\lambda}{4} = 0.1 \Rightarrow \frac{\lambda}{2} = 0.2 \Rightarrow \lambda = 0.4 \text{ m}$

$f = \frac{100}{0.4} = 250 \text{ Hz}$

$\frac{\Delta f}{f} = \frac{1}{2}.\frac{4}{100}$

$\Rightarrow \Delta f = \frac{4 \times 50}{2 \times 100} = 1 \text{ Hz}$

(40) Answer : (B,D)

Hint:

$\int_A^C pdv > \int_A^B pdv$

Solution:

Work done = area under graph.

$W_{AB} = \left(\frac{P_B + P_A}{2}\right)(V_B - V_A)$

$W_{AC} = \left(\frac{P_C + P_A}{2}\right)(V_C - V_A)$

also $P_BV_B = P_CV_C$

$\Rightarrow W_{AB} > W_{AC}$

$P^\alpha T^\beta \equiv P^{\alpha+\beta}V^\beta = \text{constant}$

Section-III

(41) Answer : 02.50

Hint:

$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

Solution:

M = $1 + \frac{D}{f}$

(42) Answer : 00.41

Solution:

$F_{net} = mg - 6\pi\eta r v_T$

$= 0.5 - 6 \times \pi \times 1.5 \times 10^{-3} \times 5 \times 10^{-1} \times \frac{20}{\pi}$

$= 0.5 - 0.09$

$F_{net} = 0.41\ N$

(43) Answer : 10.50

Hint:

$\frac{1}{2}\,m\left(\text{red}\right)\,V_0^2\ =\ \Delta\,E_0$

Solution:

$\frac{1}{2}\ \frac{25\times10}{35}v_0^2\ =3$

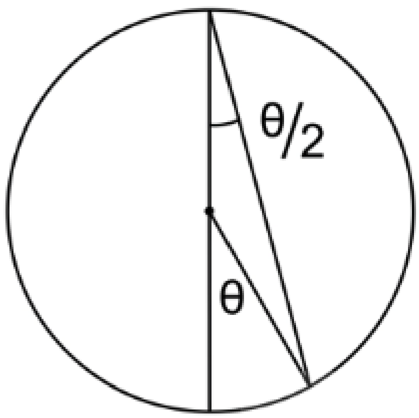
$So\ \frac{1}{2}\ \times\ 25V_0^2\ \ =\ \frac{3\times35}{10}\ =\ 10.5\ \text{MeV}$

(44) Answer : 05.00

Hint:

mg = kR; Δx = $\left(2R\ \cos\frac{\theta}{2}-\ R\right)$

Solution:



$\theta = \left(\frac{x}{R}\right)$

mg = *kR*

for small displacent ‘ θ’

$F_{(\text{restoring})}$ = Mg sin θ – R_2K cos $\frac{\theta}{2}$. $\sin\frac{\theta}{2}+\ KR\sin\frac{\theta}{2}$

$\Rightarrow F_{(r)} =\ \frac{kR}{2}.\ \frac{x}{R}$

$\Rightarrow\ \lambda =\ -\frac{F(r)}{m}\ =\ \frac{-kx}{2m}\ \Rightarrow w^2\ =\ \sqrt{\frac{k}{2m}}$

$T =\ \ 2\pi\sqrt{\frac{2m}{k}}\ =\ 2\pi\sqrt{\frac{2R}{g}}$

(45) Answer : 00.50

Hint:

$E =\ \frac{\beta WR^2}{2}$

Solution:

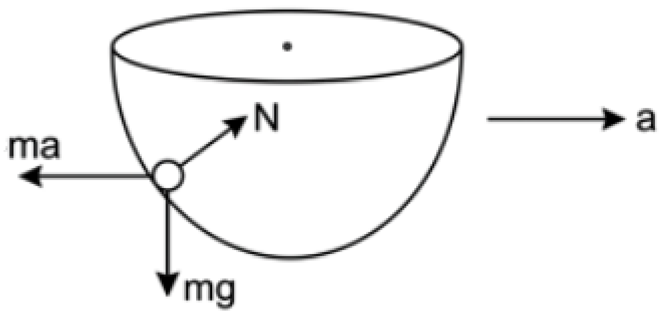
$\varepsilon=\int_0^R\overrightarrow{E}\cdot d\,\overrightarrow{l}=\int\left(\overrightarrow{v}\times\overrightarrow{B}\right)d\,\overrightarrow{t}=\int\omega RBdr=\frac{\omega BR^2}{2}$

(46) Answer : 03.50

Hint:

$T =\ 2\pi\sqrt{\frac{R}{g_{\text{eff}}}}$

Solution:



$\omega=\sqrt{\frac{g_{eff}}{R}}$

$g_{eff} = \sqrt{g^2 + a^2} = \sqrt{g^2 + \frac{3g^2}{4}} = \sqrt{\frac{7g^2}{4}} = \frac{g}{2}\sqrt{7}$

$\omega = \sqrt{\frac{g\sqrt{7}}{2R}}$

$T = 2\pi\sqrt{\frac{2R}{g\sqrt{7}}}$

So, $\frac{n}{m} = 3.50$

(47) Answer : 00.50

Hint:

$\oint E.dl = -\frac{d}{dt}\left(B\pi R^2\right)$

Solution:

$\pi R^2 K = E\, 2\pi R$

$E = \frac{KR}{2} \quad T = qER = I\alpha$

$\alpha = \frac{qER}{mR^2}$

$\alpha = \frac{qKR^2/2}{mR^2} = \frac{qK}{2m}$

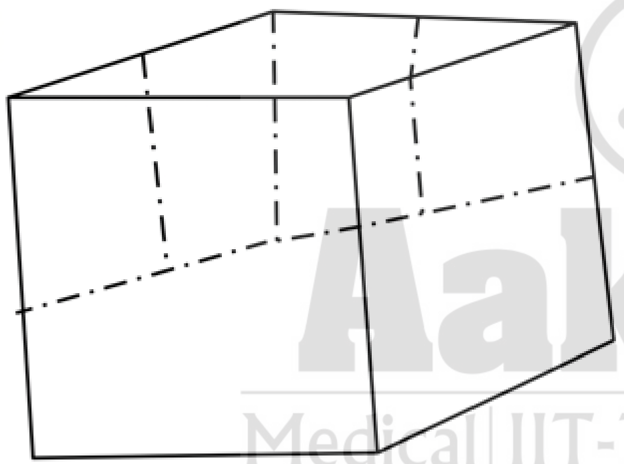
$n = 1/2$

(48) Answer : 02.00

Hint:

$V_{(\text{corner})} \propto \rho a^2$

Solution:



→Let potential at one corner be $v \propto \rho a^2$

At centre (Corner of 8 cubes)

$8\left[K\rho\frac{a^2}{4}\right] = 8\frac{v}{4} = 2v$

$\frac{2v}{v} = 2$