FIITJEE

ALL INDIA TEST SERIES

JEE (Advanced)-2025

CONCEPT RECAPITULATION TEST – II

PAPER –1

TEST DATE: 24-04-2025

ANSWERS, HINTS & SOLUTIONS

Physics

PART – I

SECTION – A

1. A

Sol. From first law of thermodynamics

$$\Delta Q = \Delta U + \Delta W$$

$$\Delta Q = nC_V\left(T_2 - T_1\right) + \frac{nR\left(T_1 - T_2\right)}{x-1}$$

$$\frac{1}{n}\left(\frac{\Delta Q}{\Delta T}\right) = C_V - \frac{R}{x-1}$$

$\therefore$ $\left(C - C_V\right)\left(x-1\right) = -R$

$\therefore$ graph is a rectangular, hyperbola

$\therefore$ co–ordinate of P_1 (O, C_P)

i.e. $\left(0, \frac{5}{2}R\right)$ and that of $P_4\left(\frac{5}{3}, 0\right)$

2. D

Sol. Impulse on ball

$I = (1+0.5)\sqrt{2gh}\ m$ (vertically)

Frictional impulse on block (horizontally)

$= \mu I = 0.2 \times 1.5\ m\sqrt{2gh}$

Decrease in velocity

$$\Delta V = \frac{\mu I}{m} = 0.3\sqrt{2gh}$$

3. C

Sol. Potential of centre of sphere = $\frac{Kq}{r} + V_i = \frac{Kq}{r}$

where V_i = potential due to induced charge at centre = 0 [$\because$ Σq_i = 0 and all induced charges are equidistance from centre]

$\therefore$ potential at point $P = \frac{Kq}{r} = \frac{Kq}{r_1} + V_i$ (For conductor all points are equipotential)

$\therefore$ $V_i = K\left(\frac{q}{r} - \frac{q}{r_1}\right)$

4. A

Sol. Applying Snell's law between the points O and P, we have

$$2 \times \sin 60^0 = \left(\sin 90^0\right) \times \frac{2}{\left(1+H^2\right)}, \quad 2 \times \frac{\sqrt{3}}{2} = 1 \times \frac{2}{\left(1+H^2\right)}$$

$$\left(1+H^2\right) = \frac{2}{\sqrt{3}}, \qquad H = \sqrt{\left(\frac{2}{\sqrt{3}} - 1\right)}$$

5. ABC

Sol. $\Delta U = \frac{fR\Delta T}{2}$

$\Delta W = \frac{nR\Delta T}{1-x}$ where PV^x = constant. Here $x = -\frac{1}{2}$

6. ACD

Sol. The gravitational force due to these masses on a mass at O is equal and opposite.
So, the resultant force is zero hence, the resultant field is zero
Also, any point on y-z plane which is equidistant from two cavities will have zero field intensity hence constant potential.

7. ABCD

Sol. Due to rotation no potential difference will be across the end.

8. B

Sol. Mean value $= \frac{12.5 + 12.3 + 11.8 + 12.4 + 12.2 + 12.6}{6}$ = 12.3

Mean absolute error = $\frac{|\Delta x_1| + ... + |\Delta x_6|}{6}$

Relative error = $\frac{\text{Mean absolute error}}{\text{Mean value}}$

9. D

Sol. According to Lenz's law induced current flows in such a way that it is opposing the change in magnetic flux.

10. C

Sol. Optical path difference at any point P on the screen, $\delta(P) = S_2P - S_1P - (\mu - 1)t$ and the intensity on the screen, at point P = $4I_o \times \cos^2 \frac{\pi}{\lambda} \times \delta P$.

11. A

Sol. (P) A → B : V ↓, P constant → T↓, U↓ and ΔW is –ve, ΔQ < 0, ΔU < 0

(Q) B → C : V is same, P ↓ T ↓, U↓, ΔQ < 0, ΔU < 0

No work is done.

(R) C → D : V ↑ ⇒ T↑, ΔU > 0, ΔQ > 0, ΔW > 0

(S) D → A : V decrease so ΔW < 0

∴ $T_D = T_A$ ∴ ΔU = 0

and then ΔQ < 0.

SECTION – B

12. 6

Sol. $$\frac{\Delta Q}{\Delta t} = K_A A \frac{dT}{dx}$$

$\frac{dT}{dx}$ in conductor A = slope of graph = $\sqrt{3}$

Since both conductors are connected in series, same heat current will flow in A and B.

$K_A (dT/dx)_A = K_B (dT/dx)_B$

$K_B = 6$.

13. 272

Sol. Loss in KE = $K_f - K_i$

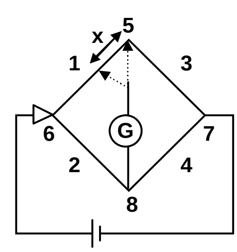
$$K_f = \frac{1}{2}mv_{cm}^2 + \frac{1}{2}I_{cm}\omega^2$$

$$K_i = \frac{1}{2}(0.08)(10)^2 + \frac{1}{2}(0.08)(6)^2$$

Apply conservation of momentum and angular momentum to get V_{cm} and ω.

14. 2

Sol. For getting null point



$$\frac{R_1}{R_3} = \frac{R_2}{R_4}$$

as R2 = R4

R1 = R3

Let the pointer at point 5 is moved to left by distance x to get nul point as shown in the figure. If resistance per unit length of wire 3 is r then that of wire 1 will be 2r.

(8 – x)2r = x × 2r + 8 × r

4x = 8

x = 2m

15. 1

Sol. $$v_0 \le \frac{gR}{3}(7\cos\alpha - 4)$$

16. 1

Sol. $a = \omega^2 A$

$f_1 = (1)\omega^2 A \le 6$ ...(1)

$f_2 = 3\omega^2 A \le 12$

$\omega^2 A \le 4$ ...(2)

$\Rightarrow \quad \omega^2 A = 4$

$$A = \frac{4}{\left(\frac{k}{m}\right)} = \frac{4 \times 6}{24} = 1$$

17. 8

Sol. $\frac{4\ell_1}{3} = \frac{2\ell_2}{4}$

Chemistry

PART – II

SECTION – A

18. C

Sol. $K_p = p_{NH_3} \times p_{HCl} = 6.25$

$\text{or}, p_{NH_3} = p_{HCl} = \sqrt{6.25} = 2.5\,\text{atm}$

$P_{equilibrium}$ = 2.5 + 2.5 = 5 atm

Mole of HCl at equilibrium = 1

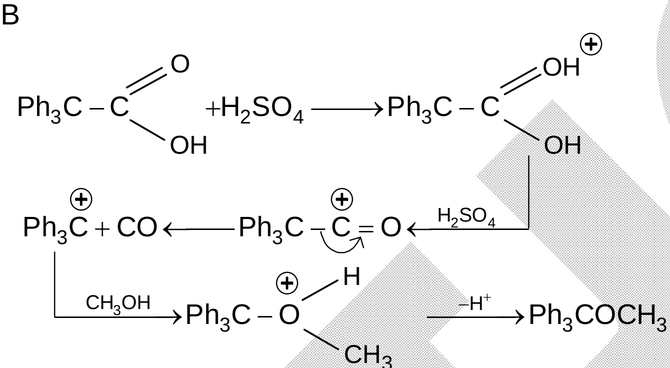
Total moles of gases at equilibrium = 1 + 1 = 2

PV = nRT

$$\text{or, } V = \frac{nRT}{P} = \frac{2 \times 0.0821 \times 304.55}{5} = 10\,\text{L}$$

19. B

Sol.



20. B

Sol. It contains three oxygen atom in the three peptide linkages and two oxygen atoms in the free COOH – group.

21. A

Sol. Molality of benzoic acid (m) = $\frac{2}{122} \times \frac{1000}{25} = 0.655$

$$2C_6H_5COOH \rightleftharpoons (C_6H_5COOH)_2$$

Initial	1	0
	$1 - x$	$\frac{x}{2}$

$\therefore$ van't Hoff factor (i) = $\dfrac{1 - x + \frac{x}{2}}{1} = 1 - \frac{x}{2}$

$\Delta T_f = i \times K_f \times m$

or, 1.62 = $\left(1 - \frac{x}{2}\right) \times 4.9 \times 0.655$

On solving, x = 0.982

$\therefore$ % association = 98.2

22. AC

Sol. The basic nature of the oxides of iron follows the following order.
$FeO > Fe_3O_4 > Fe_2O_3$

23. AD

Sol. The reaction is first order w.r.t X. So it's half-life is $\frac{0.693}{k}$. The reaction is second order with respect to Y. So its half-life is given by $\frac{1}{ka}$.

24. AD

Sol.
$$6NaOH + 4S \longrightarrow 2Na_2S + Na_2S_2O_3 + 3H_2O$$
$$4P + 3NaOH + 3H_2O \longrightarrow 3NaH_2PO_2 + PH_3$$
$$Si + 2NaOH + H_2O \longrightarrow Na_2SiO_3 + 2H_2$$
$$3Cl_2 + 6NaOH \xrightarrow{\text{Heat}} 5NaCl + NaClO_3 + 3H_2O$$
$$Cl_2 + 2NaOH \xrightarrow{\text{Cold}} NaCl + NaOCl + H_2O$$

25. D

Sol. The orbitals which hold the electrons are:
(P) 4s
(Q) 4s and 3d
(R) 3p
(S) 4p

26. C

Sol. The compound in (P) has 16 isomers(stereo)
The compound in (Q) has 4 isomers(stereo)
The compound in (R) has 2 isomers(stereo)
The compound in (S) has 4 isomers(stereo)

27. C

Sol. $Cr^{2+}(3d^4$ or $t_{2g}^3e_g^1)$ shows Jahn Teller distortion.
$Co^{2+}(t_{2g}^6e_g^1)$ also shows Jahn Teller distortion.
$Mn^{2+}(t_{2g}^3e_g^2$ or $3d^5)$ has half filled electronic configuration.
$Ni^{2+}(t_{2g}^6e_g^2)$ has same configuration for strong field as well as weak field ligands.

28. B

Sol. Azeotropic mixtures and ideal solutions can't be separated by distillation.

SECTION – B

29. 2

Sol. Meq of HCl = 19.8 x 0.1 = 1.98
Meq of 20 ml solution of $Na_2CO_3.xH_2O$ = 1.98
Meq of 100 ml solution of $Na_2CO_3.xH_2O$ = 1.98 x 5 = 9.9

$\therefore$ Meq of 0.7g $Na_2CO_3.xH_2O$ = 9.9

$$\therefore \frac{0.7}{\frac{106+18x}{2}} \times 1000 = 9.9$$

On solving, x = 1.98 $\approx$ 2

30. 3

Sol. $Mg(OH)_2 \rightleftharpoons \underset{s}{Mg^{2+}} + \underset{2s}{2OH^-}$

$K_{sp} = 4s^3 = 5 \times 10^{-10}$

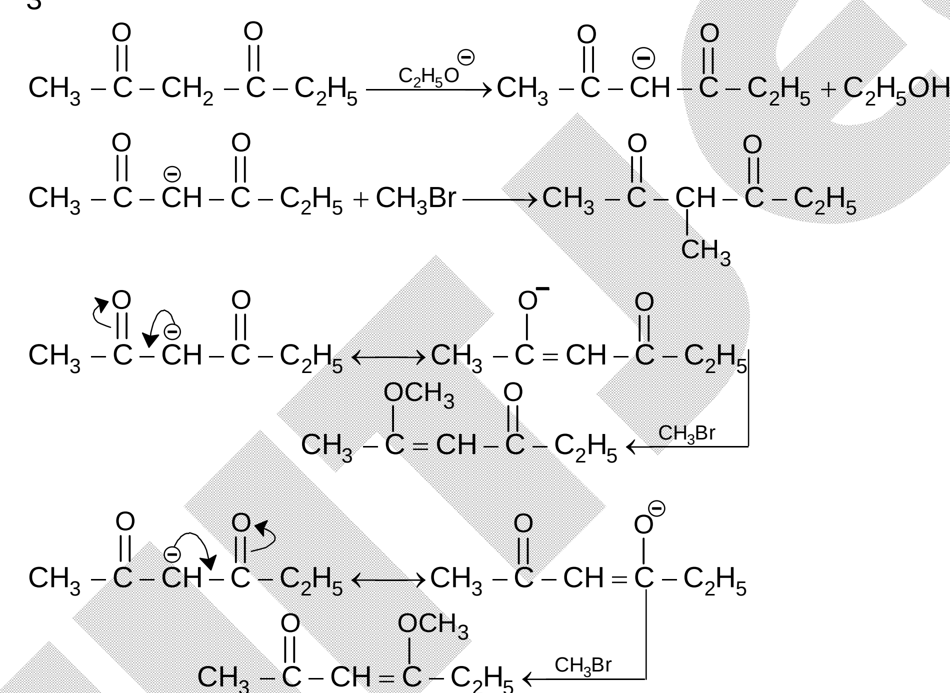
or, s = 5×10^{-4}

$[OH^-] = 2s = 2 \times 5 \times 10^{-4} = 10^{-3}$

$\therefore p^{OH} = -\log[OH^-] = 3$

31. 3

Sol.

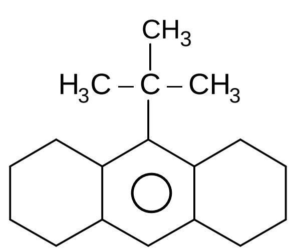


32. 7

Sol. The isomers are

$[Co(H_2O)_4BrCl]NO_2$, $[Co(H_2O)_4(NO_2)Br]Cl$, $[Co(H_2O)_4(ONO)Br]Cl$, $[Co(H_2O)_4(NO_2)Cl]Br$, $[Co(H_2O)_4(ONO)Cl]Br$, $[Co(H_2O)_3(ONO)BrCl].H_2O$, $[Co(H_2O)_3(NO_2)BrCl].H_2O$

33. 5

Sol. The major product is  It forms five monochloro products.

34. 4

Sol. $N_2 + 3F_2 \rightleftharpoons 2NF_3$

Initial a $3a$ 0

At Equi $\left(a - \frac{a}{4}\right)\left(3a - \frac{3a}{4}\right)\left(\frac{2a}{4}\right)$

Total moles at equilibrium = $\frac{7a}{2}$

$\therefore\ p_{NF_3} = \frac{2a/4}{7a/2} \times 28 = 4\,\text{atm}$

Mathematics

PART – III

SECTION – A

35. C

Sol. We have, $(\cos\theta + i\sin\theta)(\cos 2\theta + i\sin 2\theta).....\times(\cos n\theta + i\sin n\theta) = 1$

$\Rightarrow \cos(\theta + 2\theta + 3\theta + ... + n\theta) + i\sin(\theta + 2\theta + ... + n\theta) = 1$

$\Rightarrow \cos\left(\frac{n(n+1)}{2}\theta\right) + i\sin\left(\frac{n(n+1)}{2}\theta\right) = 1$

$\Rightarrow \cos\left(\frac{n(n+1)}{2}\theta\right) = 1$ and $\sin\left(\frac{n(n+1)}{2}\theta\right) = 0$

$\Rightarrow \frac{n(n+1)}{2}\theta = 2m\pi$

$\Rightarrow \theta = \frac{4m\pi}{n(n+1)}$, where $m \in Z$.

36. A

Sol. We have $f'(x) = f(x) \Rightarrow \frac{f'(x)}{f(x)} = 1 \Rightarrow \ln(f(x)) = x + c$

As $x = 0$, $f(0) = 1 \Rightarrow c = 0$

Now, $g(x) = e^x(x+1)^2 - e^x = e^x(x^2 + 2x)$

So, $\int_0^1 f(x)g(x)dx = \int_0^1 e^{2x}(x^2 + 2x)dx$,

Put $2x = t, dx = \frac{1}{2}dt$

$= \frac{1}{2}\int_0^2 e^t\left(\frac{t^2}{4} + t\right)dt$

$= \left(\frac{3}{4}\right)e^2 + \frac{1}{4} = ae^2 + b$

$\therefore (a+b) = \frac{3}{4} + \frac{1}{4} = 1$

37. B

Sol. Here, $\begin{vmatrix} -1 & a & a \\ b & -1 & b \\ c & c & -1 \end{vmatrix} = 0$

Applying, $C_2 \to C_2 - C_1$; $C_3 \to C_3 - C_1$, we get $\begin{vmatrix} -1 & a+1 & a+1 \\ b & -(b+1) & 0 \\ c & 0 & -(1+c) \end{vmatrix} = 0$

Applying $R_1 \to \frac{R_1}{a+1}, R_2 \to \frac{R_2}{b+1}, R_3 \to \frac{R_3}{c+1}$

$$\begin{vmatrix} -\frac{1}{a+1} & 1 & 1 \\ \frac{b}{b+1} & -1 & 0 \\ \frac{c}{c+1} & 0 & -1 \end{vmatrix} = 0$$

$$\Rightarrow -\frac{1}{a+1} + \frac{b}{b+1} + \frac{c}{c+1} = 0$$

$$\therefore -\frac{1}{a+1} + 1 - \frac{1}{b+1} + 1 - \frac{1}{c+1} = 0$$

$$\Rightarrow \frac{1}{a+1} + \frac{1}{b+1} + \frac{1}{c+1} = 2$$

38. B

Sol. $|\vec{u} \times \vec{v}| = 2|\vec{a} \times \vec{b}|$

$\therefore |\vec{u} \times \vec{v}|^2 = 4|\vec{a} \times \vec{b}|^2 = 4\left[\vec{a}^2 \vec{b}^2 - (\vec{a}.\vec{b})^2\right]$

$= 4\left[16 - (\vec{a}.\vec{b})^2\right]$

$\Rightarrow$ Result

39. AC

Sol. Exactly two distinct digits

${}^9C_2$, number of ways of selecting two non – zero digits

1222, 1122, 1112

↓ ↓ ↓

4 6 4

${}^9C_2 \times (4 + 6 + 4) = 36 \times 14$

$= 504$

1000, 1100, 1110

↓ ↓ ↓

1 3 3

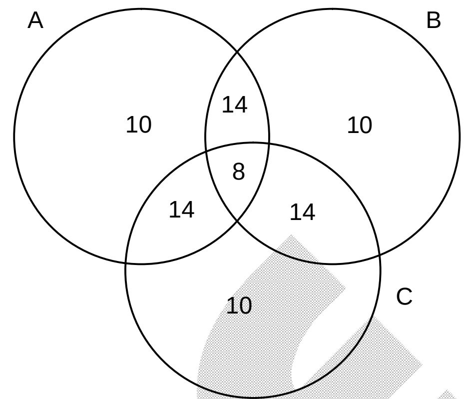
$9 \times 7 = 63$

40. AC

Sol. $P\left(\dfrac{A\cap B\cap C}{A\cap B}\right)=\dfrac{P(A\cap B\cap C)}{P(A\cap B)}=\dfrac{x}{x+14}$

$\dfrac{x}{x+14}=\dfrac{1}{3}\Rightarrow x=7$

$P(A\cup B\cup C)=79$



41. BC

Sol. (A) Let $\sin\dfrac{1}{x}=0\Rightarrow \underset{x\to 0}{\text{Lim}}\, g(f(x))=0$

Let $\sin\dfrac{1}{x}\neq 0\Rightarrow \underset{x\to 0}{\text{Lim}}(f(x))=\underset{x\to 0}{\text{Lim}}\cos\left(x^2\sin\dfrac{1}{x}\right)=1.$

$\Rightarrow$ LIMIT DNE

(B) Let $h(x)=[x]\to$ GIF

$g(x)=\cos x;\ f(x)=x$

f is constant at $x=\pi$, g is continuous at $x=f(\pi)=\pi$

h is discontinuous at $x=g(f(\pi))=-1$

but $\phi=h(g(f(x)))=[\cos x]\to 41F$

$\phi(\pi)=-1;\ \lim\limits_{x\to\pi}[\cos x]=-1=\lim\limits_{x\to\pi^+}[\cos x]$

(C) Check left LHL + RHL

(D) $f(x)=x,\ g(x)=\begin{cases}\dfrac{1}{x^2}: & x\neq 0\\ 0: & x=0\end{cases}$

$f(x).g(x)=\begin{cases}\dfrac{1}{x}: & x\neq 0\\ 0: & x=0\end{cases}$ Not Continuous

42. B

Sol. $L:3x-2y-4+\lambda(x-2y+4)=0$

$P(a,b)\equiv(4,\ 4)$

$S:x^2+y^2=8$

(P) $a+b=8$

(Q) $L_T=\sqrt{S_1}=\sqrt{16+18-8}=2\sqrt{6}$

(R) Least distance $=OP-r=4\sqrt{2}-2\sqrt{2}=2\sqrt{2}$

(S) Least distance of the circle containing the given circle is $=OP+r=4\sqrt{2}+2\sqrt{2}=6\sqrt{2}$

43. A

Sol. $3x + y - z = 0$ ......(1)

$x - \frac{py}{4} + z = 0$ .....(2)

$2x - y + 2z = q$ .....(3)

Equation $(2)\times(2)-$ equation (3)

$\Rightarrow \quad \left(1-\frac{p}{2}\right)y = 4-q$

For unique solution, $p \neq 2,\ q \in N \Rightarrow$ Number of ordered pairs (p, q) in [1, 10] are 90.

For infinite solution, $p = 2$ and $q = 4 \Rightarrow$ exactly one ordered pair.

For no solution, $p = 2$ and $q \neq 4 \Rightarrow$ Number of ordered pairs (p, q) in [1, 10] are 9.

44. C

Sol. (P) L.H.S. = (cos30° + 3cos10°) + (3sin20° – sin60°)

$= \frac{\sqrt{3}}{2} + 3\cos 10° + 3\sin 20° - \frac{\sqrt{3}}{2} = 3(\cos 10° + \sin 20°)$

(Q) L.H.S. = $\frac{\cos\theta\cos 3\theta}{\sin 4\theta} - \frac{\sin 3\theta \sin\theta}{\sin 4\theta} = \frac{\cos 4\theta}{\sin 4\theta} = \cot 4\theta$

(R) $\frac{1-\cos 2\theta + \sin 2\theta}{1+\cos 2\theta + \sin 2\theta} = \frac{2\sin^2\theta + 2\sin\theta\cos\theta}{2\cos^2\theta + 2\sin\theta\cos\theta} = \tan\theta$

(S) $\frac{\cot\theta - 1}{\cot\theta + 1} = \frac{1-\sin 2\theta}{\cos 2\theta}$

45. B

Sol. (P) Let $z = (a + b\omega + c\omega^2)$, then $\bar{z} = (a + b\omega^2 + c\omega)$

Clearly $z\bar{z} = (a + b\omega + c\omega^2)(a + b\omega^2 + c\omega)$

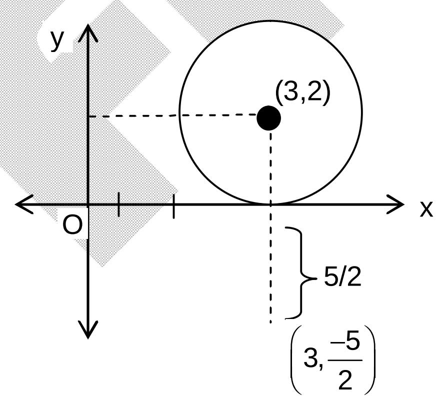
$= (a^2+b^2+c^2-ab-bc-ca)$

now $|a + b\omega + c\omega^2| + |(a + b\omega^2 + c\omega| = |z| + |\bar{z}| = 2|z| = 2\cdot\frac{1}{\sqrt{2}}\sqrt{(a-b)^2 + (b-c)^2 + (c-a)^2}$

$\geq \sqrt{2}\sqrt{1^2+1^2+2^2} = \sqrt{12} = 144^{1/4}$

$\therefore$ minimum value $144^{1/4} \Rightarrow n = 144$.

(Q) $|z - 3 - 2i| \leq 2$



Represents interior of a circle with centre (3, 2) and radius 2.

$\therefore |2z - 6 + 5i| = 2\left|z - 3 + \frac{5i}{2}\right|$

= 2 × distance of z from $\left(3, \frac{-5}{2}\right)$

$\Rightarrow$ Minimum value is $2 \times \left(\frac{5}{2}\right) = 5$.

SECTION – B

46. 3

Sol. $3\sin x + 4\cos x = 5$ and $\cos y = 1 \Rightarrow 2$ ordered (or)
$3\sin x + 4\cos x = -5$ and $\cos y = -1 \Rightarrow 1$ ordered

47. 0

Sol. $z_1 + z_2 = 1, |z_1 - z_2| = 1$

$\left|(z_1 + z_2)^2 - 2z_1z_2\right| = 1$

$|1 - 2ai| = 1$

$1^2 + 4a^2 = 1$

48. 0

Sol. Focal segment subtends 90^o at point on y – axis but we get angle is acute from circle

49. 12

Sol. $I_n = 2\int_0^{\pi} \frac{\cos n\theta}{\cos\theta} d\theta$

$I_n + I_{n-2} = 2\int_0^{\pi} \frac{\cos\theta + \cos(n-2)\theta}{\cos\theta} d\theta$

$= 2\int 2\cos(n-1)\theta\cos\theta\, d\theta$

$= 4\left[\frac{\sin(n-1)\theta}{n-1}\right]_0^{\pi} = 0$

$I_1 = 2\int_0^{\pi} d\theta = 2\pi,\ I_{\backslash 2} = 2\int_0^{\pi} \frac{2\cos^2\theta - 1}{\cos\theta} d\theta = 0$

$\Rightarrow I_1 = 2\pi,\ I_3 = -2\pi$

50. 34

Sol. $a_1 + a_2 + \ldots\ldots + a_n + 1 + 3 + 5\ldots\ldots 2n - 1$
= 835
$714 + n^2 = 835$
$n^2 = 121 \Rightarrow n = 11$

$11a + 55d$
$= 715a + 5d$
$= 34$

51. 4

Sol. $\vec{d}.\vec{c} = \lambda\left(\vec{a}\times\vec{b}\right).\vec{c} + \mu\left(\vec{b}+\vec{c}\right).\vec{c} + \nu\left(\vec{c}\times\vec{a}\right).\vec{c}$

$= \lambda\left[\vec{a}\ \ \vec{b}\ \ \vec{c}\right] + 0 + 0 = \lambda\left[\vec{a}\ \ \vec{b}\ \ \vec{c}\right] = \frac{\lambda}{8}$

Hence, $\lambda = 8\left(\vec{d}.\vec{c}\right)$ Similarly, $\mu = 8\left(\vec{d}.\vec{a}\right)$ and $\nu = 8\left(\vec{d}.\vec{b}\right)$

$\therefore \quad \lambda + \mu + \nu = 8\vec{d}.\vec{c} + 8\vec{d}.\vec{a} + 8\vec{d}.\vec{b}$

$= 8\vec{d}.\left(\vec{a}+\vec{b}+\vec{c}\right) = 64$