FIITJEE
ALL INDIA TEST SERIES
JEE (Advanced)-2025
FULL TEST – VIII
PAPER –2
TEST DATE: 27-04-2025

ANSWERS, HINTS & SOLUTIONS

Physics PART – I

SECTION – A

1. B

Sol. Thermal resistance of the spherical shell,

$$R = \int_a^{3a} \frac{dr}{k4\pi r^2} = \int_a^{3a} \frac{dr}{\frac{\alpha}{r^2}4\pi r^2} = \frac{2a}{4\pi\alpha} = \frac{a}{2\pi\alpha}$$

Now, $-mS\frac{d\theta}{dt} = \left(\frac{\theta-\theta_0}{R}\right)$

$$-mSR\int_{70}^{50}\frac{d\theta}{(\theta-\theta_0)} = \int_0^t dt$$

$$t = mSR\left[\ell n(\theta-\theta_0)\right]_{50}^{70}$$

$$t = mSR\ell n\left(\frac{70-30}{50-30}\right)$$

$t = mSR\ell n2$

$$t = \frac{mSa\ell n2}{2\pi\alpha}$$

2. B

Sol. Similar to gravitational force and orbital motion

$\Rightarrow v_{escape} = \sqrt{2}v_{orbital}$

3. A

Sol. Potential at 'C' = $\frac{kQ}{R} = \frac{\sigma R}{2\varepsilon_0}$

Flat surface of hemispherical shell is on equipotential surface.

4. B

Sol. $i = \dfrac{|E_1 + E_2 - E_3 - E_4|}{r_1 + r_2 + r_3 + r_4}$

5. A, B, C

Sol. $v^2 = 800 + 100\,t^2 - 200\,t$ …(i)

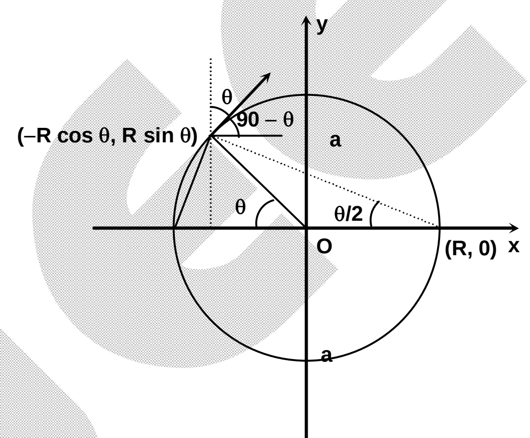
Magnitude of velocity of projectile of motion is

$v^2 = u^2 + 100\,t^2 - 2gtu\sin\theta$ …(ii)

Comparing (i) and (ii)

$u = 20\sqrt{2}$ m/s and $\theta = 45°$

6. B, D



Sol. $Id\vec{\ell} = IRd\theta\left[\sin\theta\hat{i} + \cos\theta\hat{j}\right]$

$r = R(1+\cos\theta)\hat{i} - R\sin\theta\hat{j}$

$|\vec{r}| = R\sqrt{1+\cos^2\theta + 2\cos\theta + \sin^2\theta}$

$= 2R\cos\left(\dfrac{\theta}{2}\right)$

$Id\vec{\ell}\times\vec{r} = \begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ \sin\theta & \cos\theta & 0\\ 1+\cos\theta & -\sin\theta & 0\end{vmatrix} IR^2 d\theta$

$= IR^2 d\theta = \left[-\sin^2\theta - \cos\theta - \cos^2\theta\right]\hat{k}$

$= 2IR^2\cos^2\left(\dfrac{\theta}{2}\right)(-\hat{k})d\theta$

$$d\vec{B}_1 = \frac{\mu_0}{4\pi}\frac{Id\vec{\ell}\times\vec{r}}{|\vec{r}|^3} = \frac{\mu_0}{4\pi}\frac{2IR^2\cos^2\left(\frac{\theta}{2}\right)d\theta}{8R^3\cos^{3/2}\theta}(-\hat{k}) = \frac{\mu_0 I}{16\pi R}\sec\left(\frac{\theta}{2}\right)d\theta(-\hat{k})$$

$$\vec{B}_1 = \frac{\mu_0 I}{16\pi R}\int_{-\pi/2}^{\pi/2}\sec\left(\frac{\theta}{2}\right)(-\hat{k})\,d\theta = \frac{\mu_0 I}{8\pi R}\ln\left[\sec\left(\frac{\theta}{2}\right) + \tan\left(\frac{\theta}{2}\right)\right]_{-\pi/2}^{\pi/2}(-\hat{k})$$

$$= \frac{\mu_0 I}{8\pi R}\left\{\ln\left(\sqrt{2}+1\right) - \ln\left(\sqrt{2}-1\right)\right\}\left(-\hat{k}\right) = \frac{\mu_0 I}{8\pi R}\ln\left(\frac{\sqrt{2}+1}{\sqrt{2}-1}\right)(-\hat{k}) = \frac{\mu_0 I}{4\pi R}\ln\left(\sqrt{2}+1\right)(-\hat{k})$$

$$\vec{B} = 4\vec{B}_1 = \frac{\mu_0 I}{\pi R}\ln\left(\sqrt{2}+1\right)(-\hat{k})$$

Second Method

$$dB = \frac{\mu_0 Id\ell\sin\left(90 - \frac{\theta}{2}\right)}{4\pi\left[2R\cos\left(\frac{\theta}{2}\right)\right]^2} = \frac{\mu_0 I}{16\pi R}\sec\left(\frac{\theta}{2}\right)d\theta$$

$$\vec{M} = \left(4R^2 + 2\pi R^2\right)I(+\hat{k}) = 2R^2 I(2+\pi)(+\hat{k})$$

7. A, B, C, D

Sol. From the frame of ring

$V_P \cos 37° = 20$ ....(i)

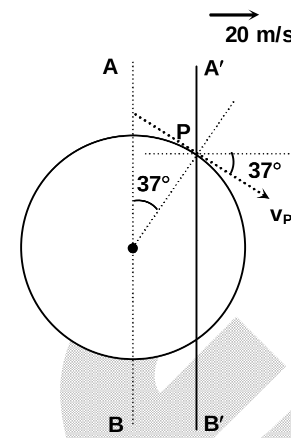
$V_P = 25$ m/s

$a_P \cos 37° = a_R$ ....(ii)

$a_P \sin 37° = a_t$ ....(iii)

$$a_P = \frac{a_R}{\cos 30°} = \frac{(20)^2/2}{4/5} = \frac{3125}{8} \text{ m/s}^2$$

$a_P \sin 37° = a_t$



SECTION – B

8. 25

Sol. COM

$4 \times 2.5 = 4\,V_C + 4\,V_1$

$\Rightarrow V_c + V_1 = 2.5$

COAM

$4 \times 2.5 \times \frac{1}{2} = 4 \times V_1 \times \frac{1}{2} + [2 \times 2\,(\frac{1}{2})^2]\omega$

$\Rightarrow 2.5 = V_1 + \frac{\omega}{2}$

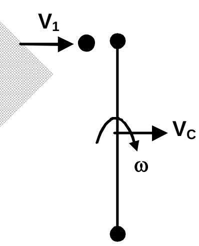
$V_{sep} = e\,V_{app}$

$V_C + \omega\frac{1}{2} - V_1 = \frac{1}{2} \times 2.5$

$\Rightarrow V_C + \frac{\omega}{2} = V_1 + \frac{2.5}{2}$

By solving equation, $\omega = 2.5$ rad/s, $V_C = \frac{2.5}{2}$ m/s, $V_1 = \frac{2.5}{2}$ m/s

Loss of energy = $K_{e(i)} - K_{e(f)} = 3.12$ J



9. 5

Sol. $e_{av} = \frac{\Delta\phi}{\Delta t} = \frac{2BA}{\Delta t}$

$\Rightarrow B = \frac{e_{av}\Delta t}{2A}$

$= \frac{20 \times 10^{-3} \times 0.2}{2 \times 4 \times 10^{-4}} = 5$

10. 5

Sol. For leaving the surface, $\cos\theta = 2/3$

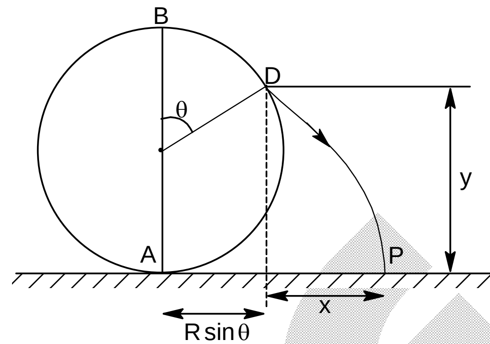
$y = (v \sin \theta)t + \frac{1}{2} gt^2 = R(1 + \cos\theta)$ … (1)

and $x = (v \cos \theta)t$ … (2)

and $v^2 = \frac{2}{3}gR$ … (3)

On solving;

$AP = R \sin \theta + x = \frac{5}{27}(\sqrt{5} + 4\sqrt{2})R$



11. 250

Sol. Let the rms current through the capacitance C is I_1

Now, $Z_2 = R + \omega Li$

$Z_2 = 20 + 20i$

The rms current through the inductor is

$$I_2 = \frac{80}{20\sqrt{2}} = 2\sqrt{2}\text{ A}$$

Now,

$$I^2 = I_1^2 + I_2^2 + 2I_1I_2 \cos\left(\frac{3\pi}{4}\right)$$

$$4 = I_1^2 + 8 + 2I_1 \times 2\sqrt{2}\left(-\frac{1}{\sqrt{2}}\right)$$

$$I_1^2 - 4I_1 + 4 = 0$$

$$\Rightarrow (I_1 - 2)^2 = 0 \Rightarrow I_1 = 2\text{A}$$

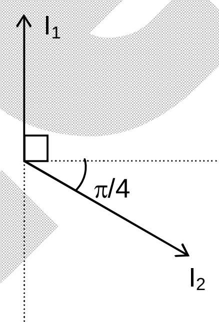
$$X_C = \frac{80}{I_1} = \frac{80}{2} = 40\Omega$$

$X_C = 40\ \Omega$

$$\frac{1}{\omega C} = 40$$

$$C = \frac{1}{100 \times 40} = 250 \times 10^{-6}\text{ F}$$

$C = 250\ \mu F$



12. 7

Sol. $$\frac{4}{3}\pi R^3\rho_1,\frac{dv}{dt} + v\frac{d}{dt}\left(\frac{4}{3}\pi R^3\rho_1\right) = \frac{4}{3}\pi R^3\rho_1 g.$$

$$R\frac{dv}{dt} + 3v\frac{dR}{dt} = Rg \quad \text{…(i)}$$

Also, $\pi R^2 v\rho_2 = \frac{dm}{dt}$

$$v = \frac{4\rho_1}{\rho_2}.\frac{dR}{dt} \quad \text{…(ii)}$$

After a long time when acceleration becomes constant v = at will satisfy our differential equation.

$v = at \qquad v = \frac{4\rho_1}{\rho_2}\frac{dR}{dt}$

$R = \dfrac{at^2\rho_2}{8\rho_1}$

From equation (i) and (ii)

$\dfrac{at^2\rho_2 a}{8\rho_1} + \dfrac{3\rho_2}{4\rho_1}(at)^2 = \dfrac{at^2\rho_2 g}{8\rho_1}$

$\dfrac{a}{8} + \dfrac{3a}{4} = \dfrac{g}{8}$

$a = \dfrac{g}{7}$

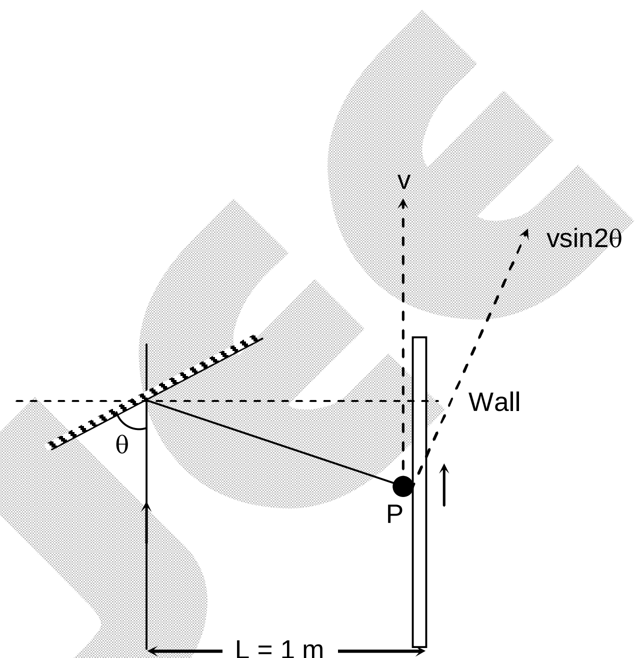
13. 8

Sol. $\tan(2\theta - 90) = \dfrac{Y}{L}$

$y = -L\cot 2\theta$

$\dfrac{dy}{dt} = -L \times \left(-\text{cosec}^2 2\theta\right) \times 2\dfrac{d\theta}{dt}$

$= 2L\left(\text{cosec}^2 2\theta\right)\dfrac{d\theta}{dt}$



SECTION – C

14. 0.50

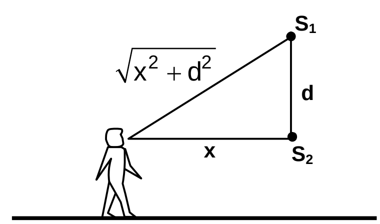
15. 2.50

Sol. **(for Q. 14-15).**

In steady state photo current = $\dfrac{IAe}{hf} = \dfrac{V}{R}$

16. 17.88

Sol. Path difference = $\dfrac{\lambda}{2}$



Here $\lambda = \dfrac{1}{2}$m

$\sqrt{x^2 + d^2} - x = \dfrac{\lambda}{2}$

$(x^2 + d^2) = \left(x + \dfrac{\lambda}{2}\right)^2 = x^2 + \dfrac{\lambda^2}{4} + x\lambda$

$\therefore\ x = \dfrac{d^2}{\lambda} - \dfrac{\lambda}{4} = \dfrac{3^2}{1/2} - \dfrac{1/2}{4} = 17.875$ m

17. 6.00

Sol. Total number of minima heard will be 6.

Chemistry

PART – II

SECTION – A

18. D

Sol. $Na-Hg+H_2O \longrightarrow NaOH+Hg+\frac{1}{2}H_2$

19. C

Sol. $Au+4HNO_3+4Cl^- \longrightarrow \left[AuCl_4^-\right]+NO+2H_2O$

$3Pt+16H^+ +4HNO_3^- +18Cl^- \longrightarrow 3\left[PtCl_6\right]^{2-} +4NO+8H_2O$

20. A

Sol. Concentration of $|H^+|$ at anode = 10^{-8} M

$\therefore$ concentration of $|H^+|$ at cathode = 10^{-7} M

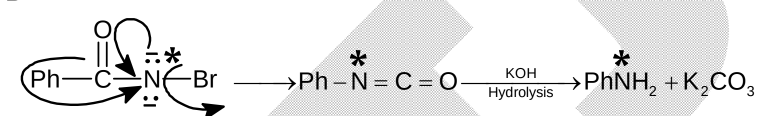
because pH = $\frac{1}{2}\left[pkw+pka-pkb\right]=\frac{1}{2}[14+4.74-4.74]$ = 7.

so $|H^+|$ = 10^{-7} M

E = 0 - $\frac{0.059}{1}\log\frac{10^{-8}}{10^{-7}}$ = E = 0.059 V

21. B

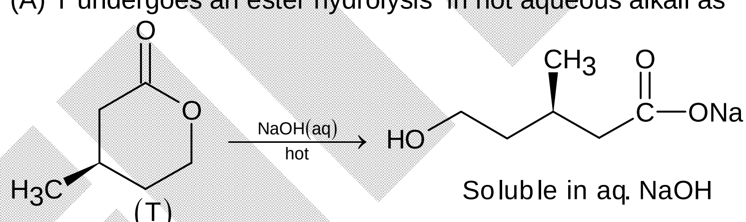
Sol.



Intramolecular rearrangement takes place.

22. A, C, D

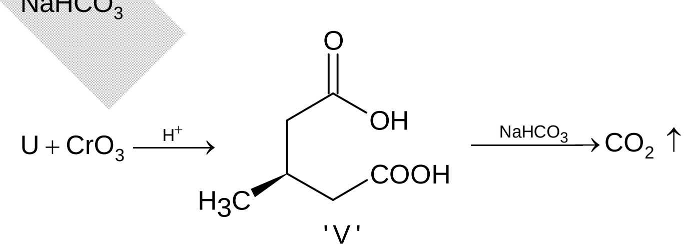
Sol. (A) T undergoes an ester hydrolysis in hot aqueous alkali as



(B) $LiAlH_4$ reduces ester to alcohol as 'U' no chiral carbo, optically inactive

(C) U on treatment with excess of acetic anhydride form a diester

(D) U on treatment with CrO_3 / H^+ undergo oxidation to diacid which gives effervescence with $NaHCO_3$



23. A, B, C

Sol. Compounds containing $C, S \& N$ gives blood red colour in Lassaigne's test

24. A, C, D

Sol. For NaA, $K_h = \frac{K_W}{K_a} = \frac{10^{-14}}{10^{-8}} = 10^{-6}$

For NaB, $K_h = \frac{K_W}{K_a} = \frac{10^{-14}}{10^{-6}} = 10^{-8}$

For NaC, $K_h = \frac{K_W}{K_a} = \frac{10^{-14}}{2\times10^{-8}} = \frac{10^{-6}}{2}$

For NaD, $K_h = \frac{K_W}{K_a} = \frac{10^{-14}}{10^{-10}} = 10^{-4}$

For NaE, $K_h = \frac{K_W}{K_a} = \frac{10^{-14}}{10^{-7}} = 10^{-7}$

Since, K_h of NaD is the highest, therefore, NaD is most extensively hydrolysed.

For NaB, $pH = \frac{1}{2}(pK_W + pK_a + \log C)$

or $pH = \frac{1}{2}\left(14 + 6 + \log\frac{1}{10}\right) = \frac{1}{2}(20-1) = \frac{1}{2}\times 19$

or pH = 9.5

For isohydric solution, $K_{a_1}C_1 = K_{a_2}C_2$

$\because 10^{-7}\times 0.1 = 10^{-6}\times 0.01 = 10^{-8}$

Hence, 0.1 (M) HE is isohydric to 0.01 (M) HB solution.

SECTION – B

25. 2

Sol. $LiAlH_4$ and $Zn + NaOH / MeOH$ reduces nitrobenzene into azobenzene.

26. 4

Sol. $r_n \propto n^2$

But $r_n + 1 - r_n = r_n - 1$

$(n+1)^2 - n^2 = (n-1)^2$

n = 4

27. 6

Sol. $\Delta E = \Delta H = \Delta T = q = P_{ext} = \Delta S_{surr} = 0$

$\Delta S_{sys} = \Delta S_{total} = +ve$

$\Delta G_{sys} = -Ve$

28. 72

Sol. $P_4 + 20HNO_3 \longrightarrow 4H_3PO_4 + 20NO_2 + 4H_2O$

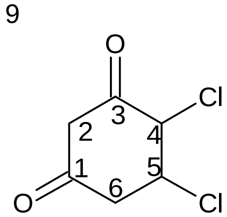
29. 6

Sol. i = 1.25

original mole fraction = $\frac{1}{n} = \frac{1}{1+(n-1)}$

Now $\frac{1.25}{1.25+(n-1)} = \frac{1}{5}$

6.25 = 1.25 + (n – 1)
n = 6

30. 9
Sol.


SECTION – C

31. 0.60

32. 1.40
Sol. **(for Q. 31 to 32).**

$\frac{P_A^0}{2} + \frac{P_B^0}{2} = 1 \;\; \Rightarrow P_A^0 + P_B^0 = 2$

$\frac{P_A^0}{4} + \frac{3P_B^0}{4} > 1\,\text{atm} \quad P_A^0 + 3P_B^0 > 4\,\text{atm}$

and $\frac{P_A^0}{8} + \frac{3P_B^0}{8} + \frac{4P_C^0}{8} = 1 \quad \Rightarrow P_A^0 + 3P_B^0 + 4P_C^0$ = 8 atm.

$\Rightarrow \quad P_A^0 + 3P_B^0$ = (8 – 4 × 0.8) atm = 4.8 atm.

33. 4.50

34. 5.20
Sol. **(for Q. 33 to 34)**

Distance between nearest neighbour $= \frac{\sqrt{3}a}{2}$

Distance between next nearest neighbour = a.

Mathematics

PART – III

SECTION – A

35. D
Sol. Number of ways = Coefficient of x^{30} in $[(x^{\circ} + x^2 + x^3) + x^4(x + 1)]^7 = 420$

36. D
Sol. Let $S = \sum_{m=1}^{\infty}\sum_{n=1}^{\infty}\left[\frac{mn}{3^n} \times \frac{n \cdot 3^m + m \cdot 3^n - n \cdot 3^m}{3^m\left(n \cdot 3^m + m \cdot 3^n\right)}\right]$

$= \sum_{m=1}^{\infty}\sum_{n=1}^{\infty}\left[\frac{m^2 n \cdot 3^n}{3^n \cdot 3^m\left(n \cdot 3^m + m \cdot 3^n\right)}\right] = \sum_{m=1}^{\infty}\sum_{n=1}^{\infty}\left[\frac{m^2 n}{3^m\left(n \cdot 3^m + m \cdot 3^n\right)}\right]$

Interchanging m and n

$S = \sum_{n=1}^{\infty}\sum_{m=1}^{\infty}\frac{n^2 m}{3^n\left(m \cdot 3^n + n \cdot 3^m\right)}$

$\Rightarrow 2S = \sum_{m=1}^{\infty}\sum_{n=1}^{\infty}\frac{mn}{3^m \cdot 3^n} = \left(\sum_{m=1}^{\infty}\frac{m}{3^m}\right)^2 = \frac{9}{16}$

$\Rightarrow S = \frac{9}{32} = \frac{p}{q} \Rightarrow q - 3p = 32 - 27 = 5$

37. A
Sol. Sum of elements = $\sum_{r=0}^{3}\left(\frac{4\pi}{3} + 2r\pi\right) = \frac{52\pi}{3}$

38. C
Sol. Put $e^{\frac{y^2}{x}} = t \Rightarrow y(y - x) = x \log_e(ce^y - 1)$

39. B, D
Sol. Here, $\Delta'(x) = Ax + B$
$\Delta''(x) = A$
$\Delta'''(x) = 0$

40. A, D
Sol. $p'(x) = \lambda[(x - \beta)^2 + \gamma^2 + 2(x - \alpha)(x - \beta)]$

41. A, D
Sol. $A^4 - 7A^3 + 15A^2 - 9A = 0$ (Null matrix)
$\Rightarrow B + C = 4A$

SECTION – B

42. 7
Sol. 111111, 888888 and numbers formed by (8, 8, 8, 1, 1, 1) are only the 6 digit numbers which are divisible by 21
$\Rightarrow n_3 = 20, n_2 = 11, n_1 = 2$

43. 5

Sol. $\int \frac{(e^x-1)\sin x-(e^x-1-x)\cos x}{1+(e^x-1-x-\cos x)(e^x-1-x+\cos x)}dx$

$= \int \frac{(e^x-1)\sin x-(e^x-1-x)\cos x}{\sin^2 x+(e^x-1-x)^2}dx$

$= \int \frac{(e^x-1)\sin x-(e^x-1-x)\cos x}{\sin^2 x\left[1+\left(\frac{e^x-1-x}{\sin x}\right)^2\right]}dx$

Let $\frac{e^x-1-x}{\sin x}=t$

$I=\tan^{-1}\left(\frac{e^x-1-x}{\sin x}\right)+c$

44. 8

Sol. Image of B in the crease always lies on line AD. Thus the parabola formed has the focus at B and directrix AD

45. 4

Sol. Number of favourable cases = 7788

46. 5

Sol. $I=\int_0^1 \frac{x^{15}-x^{11}+x^7}{(3x^{16}-4x^{12}+6x^8)^{\frac{3}{4}}}dx \Rightarrow I=\frac{1}{48}\int_0^5 \frac{dt}{t^{\frac{3}{4}}}=\frac{5^{\frac{1}{4}}}{12}$

47. 2

Sol. Let $\cot^{-1}(2x-1)=\theta$; $0<\theta<\pi$

$\Rightarrow \sin 2\theta=\frac{1+\cot\theta}{2} \Rightarrow \frac{2t}{1+t^2}=\frac{t+1}{2t} \Rightarrow t^3-3t^2+t+1=0$

$\Rightarrow t = 1, 1 \pm \sqrt{2}$; $t=1-\sqrt{2}$ does not satisfy

$\therefore\ x=1, \frac{1}{\sqrt{2}}$

SECTION – C

48. 12.00

49. 2.00

Sol. **(for Q. 48 to 49)**

$x + 2y + a = 0$, $12x - 6y - 41 = 0$ and radical axis of the given circles will be concurrent

$\Rightarrow a = 2$

Now for required circle S = 0

$x^2 + y^2 - 4 + \lambda(x + 2y + 2) = 0$

(Equation of family of circles passing through the intersection points of $x + 2y + a = 0$ and $x^2 + y^2 = 4$)

Now, common chord with C_2 is $(\lambda + 4)x + 2(\lambda + 1)y + 2\lambda - 5 = 0$

Which is same as $12x - 6y - 41 = 0 \Rightarrow \lambda=-\frac{8}{5}$

50. 1.00

51. 3.00

Sol. $f(x + y + z) = f(x)\, f(y)\, f(z)$

Putting $y = z = -1$

$f(x - 2) = f(x)\, f(-1)\, f(-1)$

Putting $x = 2$

$f(0) = 4(f(-1))^2 \Rightarrow f(0)$ is positive

Now, putting $x = 0 = y = z$

$f(0) = f(0)^3 \Rightarrow f(0) = 1$

Again, putting $y = 2$ and $z = 0$

$f(x + 2) = f(x)\, f(2)\, f(0)$

$\Rightarrow f(x + 2) = 4f(x)$

$\Rightarrow f'(x + 2) = 4f'(x)$

$\Rightarrow f'(2) = 12$