CODE 2

JEE-2016 : Advanced
Paper – 2

Answers and Explanations

Physics				Chemistry				Mathematics			
1	A	**11**		**19**	A	**29**	A,B,C	**37**	C	**47**	B,D
2	C	**12**	A,C	**20**	A	**30**	B,C,D	**38**	B	**48**	A,D
3	*	**13**	D	**21**	A	**31**	A,C	**39**	B	**49**	A,B
4	C	**14**	A,B,D	**22**	D	**32**	B,D	**40**	B	**50**	A,C,D
5	A	**15**	B	**23**	D	**33**	B	**41**	C	**51**	B
6	C	**16**	A	**24**	A	**34**	C	**42**	C	**52**	C
7	A,B,D	**17**	D	**25**	B,C,D	**35**	A	**43**	B,C	**53**	A
8	A,B	**18**	D	**26**	B,C	**36**	B	**44**	B,C	**54**	C
9	A,B,C,D	* No Answer Matching		**27**	C			**45**	B,C,D		
10	A,C			**28**	A,B			**46**	A,C,D		

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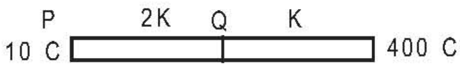
PART - I : PHYSICS

1. A



$$\frac{dQ}{dt} = \frac{390}{\left(\frac{l}{2kA} + \frac{l}{kA}\right)}$$

Temperature difference across PQ = $\frac{d\theta}{dt} \times \frac{l}{2kA}$

$$= \frac{390}{\left(\frac{1}{2} + 1\right)} \times \frac{1}{2} = 130.$$

Temprature varies linearly from 10 C to 140 C.
We can take the average temperature to be 65 C
$\therefore$ Thermal expansion = $\alpha l \Delta T$ = 0.78 mm

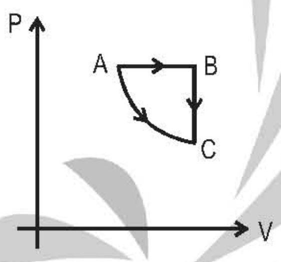
2. C Difference in Binding energy = 3.5360 MeV(ΔmC^2)

$$= \frac{3}{5} \times \frac{1.44\{8 \times 7 - 6 \times 7\}}{R}$$

Solving for R = 3.42 fm.

3. * No answer matching

4. C



$\Delta Q = nC_P\Delta T + nC_V\Delta T$

$$= C_P \frac{P\Delta V}{R} - \frac{C_V \Delta T}{R}$$

$$= \frac{5}{2} \times 10^5 \times 7 \times 10^{-3} - \frac{3}{2} \times 8 \times 10^{-3} \times \left(1 - \frac{1}{32}\right) \times 10^5$$

= 588J

5. A In first vernier 7th reading matches with main scale.
Therefore length = 2.8 + 7 0.01 = 2.87
In 2nd vernier 7th reading matches with main scale.
10mm = 11 VSD.
1VSD = 10/11 mm
Therefore length = 2.8 + 0.08 – 0.07 10/11 = 2.83

6. C $\log_e\left(\frac{A}{A_0}\right) = -\lambda t$

$$\log_e\left(\frac{1}{64}\right) = \frac{\log_e 2 \times t}{t_{1/2}}$$

$t = 18\ t_{1/2}$
= 108 days

7. A,B,D
Average value of T = 0.556
Average error in T = 0.0208

% error in T = $\frac{0.0208}{0.556} \times 100 = 3.57$

$$\frac{\Delta r}{r} \times 100 = \frac{1}{10} \times 100 = 10$$

8. A,B
8. A, B
$d\phi = B(L)vdt$
$e = BLv$

$$i = \frac{e}{R} = \frac{BLv}{R}$$

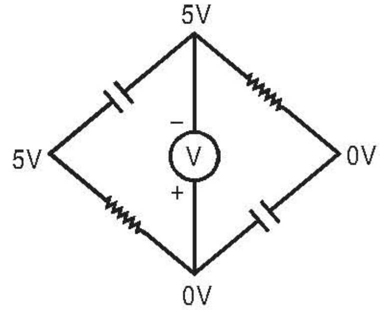
$$F = \frac{B^2L^2v}{R}$$

$$a = \frac{B^2L^2v}{mR}$$

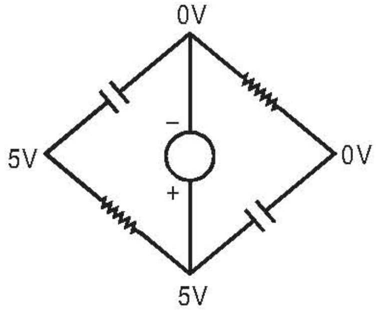
$$-v\frac{dv}{dx} = \frac{B^2L^2v}{mR}$$

$$v = v_0 - \frac{B^2L^2x}{mR}$$

9. A,B,C,D
$\Delta t\ t = 0$



$\Delta T\ t = \infty$



$V_{40} = 5(1 - e^{-t/\tau})$

$4_{20} = 5(1 - e^{-t/\tau})$

$\tau = RC = 1$ second

at t = ln 2 second

$V_{40} = 2.5$ V

$V_{20} = 2.5$V

$\therefore$ Voltmeter reads zero

at t = 1 second

$i = i_0 e^{-t/\tau} = \frac{i_0}{e}$

$\Delta T\ t = \infty$

i = 0

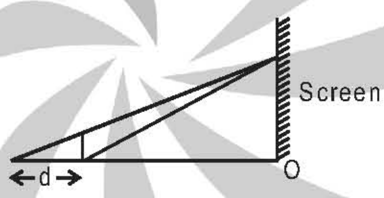
10. A,C

For maximum voltage range, the resistance of the branch containing the galvanometers must be maximum.

For maximum current range, the resistance in parallel to the galvanometers must be minimum.

11. Coming soon

12. A,C



At 'O' the path difference is d = 0.6003mm

$0.6003\text{mm} = \frac{(2n+1)}{2}\lambda$ {condition of min^n}

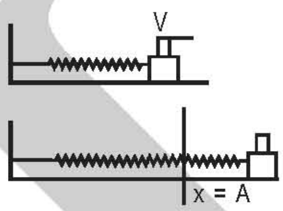
$\therefore$ Point 'O' is dark

Path difference = $d\sin\theta$ will be same for points on a circle central at 'O'.

13. D $\lambda_e = \frac{h}{P} = \frac{h}{\sqrt{2mK}} = \frac{h}{\sqrt{2m\left(eV + \frac{hc}{\lambda_{Ph}} - \phi\right)}}$

Only option 'D' is correct.

14. A, B, D



1) Amplitude A

1) $MV_0 = (M + m)V$

$MA\sqrt{\frac{K}{M}} = (M+m)V$

$V = \frac{\sqrt{MK\Delta}}{(M+m)} = A'\sqrt{\frac{M+K}{M+m}}$

$\therefore A' = A\sqrt{\frac{M}{M+m}}$

Time period = $2\pi\sqrt{\frac{M+m}{x}}$ same to both

Total energy = $\frac{1}{2}KA^2$ will decrease only for the first

$\frac{1}{2}(M+m)V^2 = \frac{1}{2}KA^2$ will decrease for both.

15. B With respect to non-inertial reference frame the force acting out ward = $m\omega^2 r$

$\therefore m\omega^2 r = m\frac{d^2r}{dt^2}$

Solving it we get $r = \frac{R}{4}(e^{\omega t} + e^{-\omega t})$ option (B).

16. A Net reaction = coiriolis force + ωt of Body

$= 2m\vec{V}_{rot} \times \vec{w} + mg\hat{k}$

where $V_{not} = \frac{dr}{dt}$

$\therefore$ Net reaction = $\frac{1}{2}m\omega^2 R(e^{\omega t} - e^{-\omega t})\hat{j} + mg\hat{k}$

17. D Once the balls get charged after coming in contact they will get repelled because of similar nature of charge.
When the balls will strike upper plate they will again be repelled from upper plate due to negative charge (option D)

18. D Current = $\frac{\text{Total Charge}}{\text{time}} = \frac{q}{t} = \frac{q}{\sqrt{\frac{2h}{a}}}$

$= \frac{q}{\sqrt{2h}} \times \sqrt{a}a = \frac{eE}{m} = \frac{eV}{md}$

$\therefore$ Current $\alpha \sqrt{V}$

PART - II : CHEMISTRY

19. A $S_2O_3^{2-} \xrightarrow{Ag^+} \underset{(x)}{[Ag(S_2O_3)_2]^{3-}}$

$\xrightarrow{Ag^+} \underset{(y)}{Ag_2S_2O_3} \longrightarrow \underset{(z)}{Ag_2S}$

20. A Correct acidic order is I > II > III > IV due to ortho effect.

21. A

22. D Anode
$H_2 \rightarrow 2H^+ + 2e^-$
Cathode
$2e^- + M^{+4} \rightarrow M^{+2}$
Net reaction is
$H_2 + M^{+4} \rightarrow 2H^+ + M^{+2}$

$0.092 = (0.151 - 0) - \frac{0.059}{2}\log\frac{[M^{+2}](1)^2}{[M^{+4}](1)}$

$\log 10^x = 2$
$10^x = 10^2$
$x = 2$

23. D

24. A

25. B, C, D
All will form tertiary carbocation.

26. B, C

27. C

28. A, B

29. A, B, C

30. B, C, D
(A) Co-ordination no. for top most layer is 9.
(B) Efficiency of atom packing is 74%.
(C) z = 4 for CCP
No. of octahedral voids = 4
No. of tetrahedral voids = 8
No. of octahedral voids per atom = 1
No. of tetrahedral voids per atom = 2
(D) $r + 2r + r = a\sqrt{2}$
$a = 2\sqrt{2}\,r$.

31. A, C
C_2^{-2} total number of e^- = 14

$\sigma 1s^2 < \sigma^* 1s^2 < \sigma 2s^2 < \sigma^* 2s^2 < \pi_{2p^2_x} = \pi_{2p^2_y} < \sigma_{2p^2_z}$

diamagnetic in nature

N_2^+ total number of $e^- = 13$

$B.O = = \frac{1}{2}[9-4] = \frac{5}{2} = 2.5$

N_2^- total number of $e^- = 15$

$B.O = \frac{1}{2}[10-5] = \frac{5}{2} = 2.5$

So N_2^+ and N_2^- have same bond order

32. B, D
$P_4O_{10} + HNO_3 \rightarrow N_2O_5 + HPO_3$
N_2O_5 is diamagnetic and on reaction with sodium metal produces NO_2 which is brown coloured.

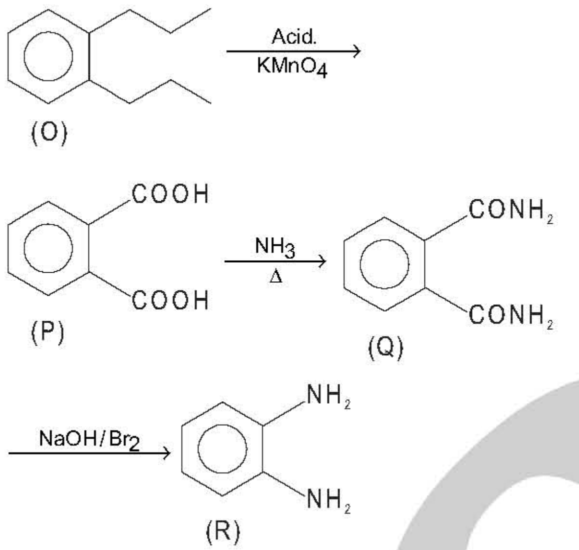
33. B $X_2(g) \rightleftharpoons 2X(g)$

1	0
$\left(1-\frac{\beta}{2}\right)$	β

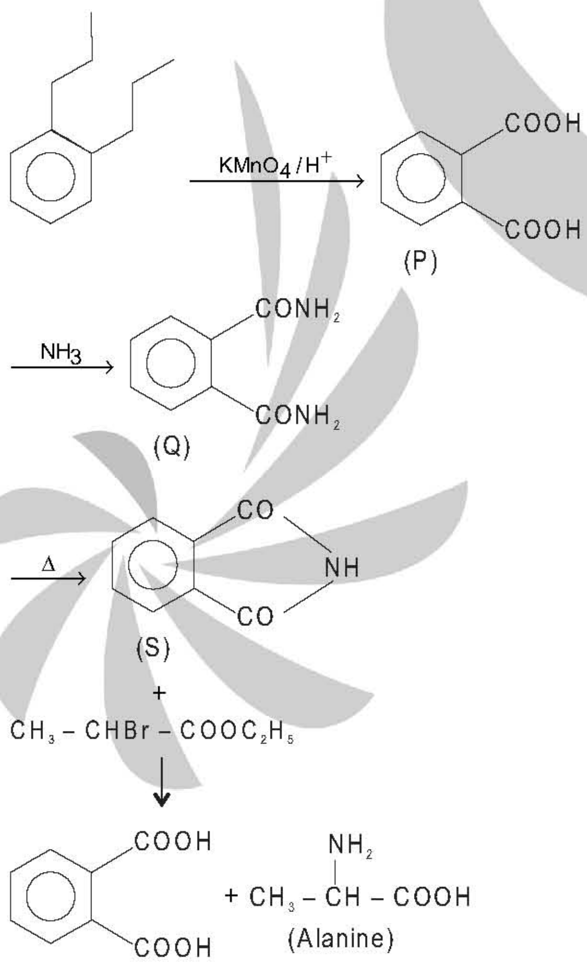
$$k_p = \frac{\left(\frac{\frac{\beta}{1+\frac{\beta}{2}}}{}\times 2\right)^2}{\left(\frac{1-\frac{\beta}{2}}{1+\frac{\beta}{2}}\times 2\right)} = \frac{8\beta^2}{(4-\beta^2)}$$

34. C

35. A



36. B



PART - III : MATHEMATICS

37. C

Image of P is $P'(x_1, y_1, z_1)$

$$\frac{x_1-3}{1}=\frac{y_1-1}{-1}=\frac{z_1-7}{1}$$

$$=\frac{-2(3-1+7-3)}{1+1+1}$$

$x_1 = -1$, $y = 5$, $z = 3$

$$\begin{vmatrix} x & y & z \\ 1 & 2 & 1 \\ -1 & 5 & 3 \end{vmatrix} = 0$$

$x - 4y + 7z = 0$

38. B

39. B $\log_e b_1, \log_e b_2, \ldots\ldots\ldots\ldots \log_e b_{101}$ A.P.

$b_1, b_2, \ldots\ldots\ldots\ldots b_{101}$ G.P

$r = 2$

$a_1, a_2, \ldots\ldots\ldots\ldots a_{101}$ A.P

$a_{51} = b_{51}, a_1, 2^{50} = a_1 + 50d$

$$d=\left(\frac{2^{50}-1}{50}\right)a_1$$

$t = b_1 + b_2 + \ldots\ldots\ldots\ldots + b_{51} = a_1 (2^{51} - 1)$

$s = a_1 + a_2 + \ldots\ldots\ldots\ldots a_{51} = \frac{51}{2}\left(a_1 + a_1 2^{50}\right)$

$=\frac{51}{2}\left(2^{50}+1\right)a_1$

$s > t$

$a_{101} = a_1 + 100d = a_1\left[1+100\frac{2^{50}-1}{50}\right]$

$= a_1 [2^{51} - 1]$

$b_{101} = a, 2^{100}$

$\therefore b_{101} > a_{101}$

40. B

$$I=\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}}\frac{x^2\cos x}{1+e^{x}}dx \qquad =\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}}\frac{x^2\cos x}{1+e^{-x}}dx$$

$$2I=\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}}x^2\cos x\,dx \qquad I=\int_{0}^{\frac{\pi}{2}}x^2\cos x\,dx$$

$$=\left[x^2\sin x+2x\cos x+2\sin x\right]_0^{\pi/2}$$

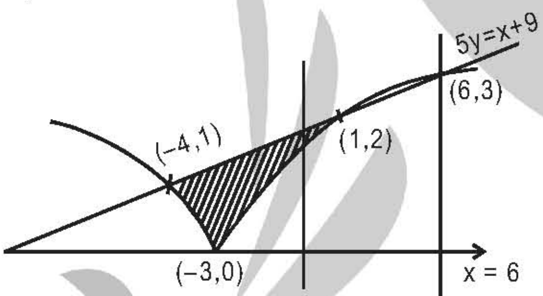
$$=\frac{\pi^2}{4}+2$$

41. C $y\ge\sqrt{|x+3|}$

$y\ge\sqrt{x+3}, x\ge -3$

$y>\sqrt{-x-3}, x<-3$

$5y \le x+9 \le 15$



$$\int_{-4}^{-3}\left(\frac{x+9}{5}-\sqrt{-x-3}\right)dx+\int_{-3}^{1}\left(\frac{x+9}{5}-\sqrt{x+3}\right)dx$$

$$\int_{-4}^{-3}\frac{x+9}{5}dx-\int_{-4}^{-3}\sqrt{-x-3}\,dx-\int_{-3}^{1}\sqrt{x+3}\,dx$$

$$\frac{1}{5}\left[\frac{x^2}{2}+9x\right]_{-4}^{1}-\int_{-4}^{-3}\sqrt{4+x}\,dx-\int_{-3}^{1}\sqrt{x+3}\,dx$$

$$\frac{1}{5}\left(\frac{1}{2}+9-8+36\right)-\left[\frac{(x+4)^{3/2}}{3/2}\right]_{-4}^{-3}-\left[\frac{(x+3)^{3/2}}{3/2}\right]_{-3}^{1}$$

$$=\frac{15}{2}-\frac{2}{3}-\frac{16}{3}=\frac{15}{2}-6=\frac{3}{2}$$

42. C $\displaystyle\sum_{k=1}^{13}\frac{1}{\sin\left(\frac{\pi}{4}+\frac{(k-1\pi)}{6}\right)\sin\left(\frac{\pi}{4}+\frac{k\pi}{6}\right)}$

$$\frac{1}{\sin\frac{\pi}{6}}\sum_{k=1}^{13}\cot\left(\frac{\pi}{4}+\frac{(k-1)\pi}{6}\right)-\cot\left(\frac{\pi}{4}+\frac{k\pi}{6}\right)$$

$$=2\left[\cot\frac{\pi}{4}-\cot\left(\frac{\pi}{4}+\frac{\pi}{6}\right)\right.$$

$$+\cot\left(\frac{\pi}{4}+\frac{\pi}{6}\right)-\cot\left(\frac{\pi}{4}+\frac{2\pi}{6}\right)$$

$$+$$

$$\vdots$$

$$\left.\cot\left(\frac{\pi}{4}+\frac{12\pi}{6}\right)-\cot\left(\frac{\pi}{4}+\frac{13\pi}{6}\right)\right]$$

$$=2\left[\cot\frac{\pi}{4}-\cot\left(\frac{\pi}{4}+\frac{13\pi}{6}\right)\right]$$

$$=2\left[1-\cot\left(\frac{\pi}{4}+\frac{\pi}{6}\right)\right]$$

$$=2\left[1-\frac{1-\frac{1}{\sqrt{3}}}{1+\frac{1}{\sqrt{3}}}\right]=\frac{4}{\sqrt{3}+1}=2(\sqrt{3}-1)$$

43. B, C

44. B, C

45. B, C, D

$ax + 2y = \lambda$

$3x - 2y = \mu$

if $\alpha = -3$

$3x - 2y = -\lambda$

$3x - 2y = \mu$

$\lambda+\mu=0$ Infinite solution

$\lambda+\mu\ne 0$, No solution

$a\ne -3$, unique solution

46. A,C,D

$y^2 = 4x$

let $p(t^2, 2t)$

s (2, 8)

s will be on normal of parabola at P

$y = -tx + 2t + t^3$

$8 = -2t + 2t + t^3$

$t = 2$

P (4, 4)

$\therefore$ Equation of normal $y = -2x + 12$

$SP = \sqrt{(2)^2 + 4^2} = 2\sqrt{5}$

$SQ = 2, \quad QP = 2\sqrt{5} - 2$

$\frac{SQ}{QP} = \frac{2}{2(\sqrt{5}-1)} = \frac{\sqrt{5}+1}{4}$

x intercept of normal = 6

slope of tangent to circle $= \frac{1}{2}$

47. B,D

$f : \left[-\frac{1}{2}, 2\right] \to R$

$g : \left[-\frac{1}{2}, 2\right] \to R$

$g(x) = f(x)\,(|4x - 7| + |x|)$

$= [x^3 - 3]\,(|4x - 7| + |x|)$

$= ([x^2] - 3)\,(|4x - 7| + |x|)$

$$= \begin{cases} (-3) \quad (-4x + 7 - x) \cdots\cdots & -\frac{1}{2} \le x < 0 \\ (-3) \quad (-4x + 7 + x) \cdots\cdots & 0 \le x < \frac{7}{4} \\ (-3) \quad (4x - 7 + x) \cdots\cdots & \frac{7}{4} \le x < 1 \\ (1-3) \quad (4x - 7 + x) \cdots\cdots & 1 \le x < \sqrt{2} \\ (2-3) \quad 4x - 7 + x \cdots\cdots & \sqrt{2} \le x < \sqrt{3} \\ 0 & \sqrt{3} \le x < 2 \\ 3 & x = 2 \end{cases}$$

discontinous at $x = 1, \sqrt{2}, \sqrt{3}, 2$

Not differentiable at $x = 0, \frac{7}{4}, 1, \sqrt{2}, \sqrt{3}$

48. A,D

$f : R \to (0, \infty) \Rightarrow f(x) > 0$

$\lim_{x \to 2} \frac{f(x).g(x)}{f'(x).g(x)} = 1$

$\Rightarrow \lim_{x \to 2} \frac{f'(x)g(x) + f(x)g'(x)}{f''(x)g'(x) + f'(x)g''(x)} = 1$

$\Rightarrow \lim_{x \to 2} \frac{f(2)g'(x)}{f'(2)g'(2)} = 1$

$\Rightarrow \lim_{x \to 2} \frac{f(2)}{f'(2)} = 1$

$f''(2) > 0$ f(x) has local minimum at x = 2

f(x) is convex at x = 2, curve will be above any tangent.

49. A,B

$f(x) = a\cos(|x^3 - x|) + b\,|x|\sin(|x^3 + x|)$

$= a\cos(x^3 - x) + b\,|x|\sin|x(x + 1)|$

50. A,C,D

$z = x + iy = \frac{1}{a + ibt}$

$x + iy = \frac{a - ibt}{a^2 + b^2t^2}$

$x = \frac{a}{a^2 + b^2t^2}, \quad y = \frac{-bt}{a^2 + b^2t^2},$

$x^2 + y^2 = \frac{x}{a}$

$x^2 - \frac{x}{a} + y^2 = 0$

$\left(x - \frac{1}{2a}\right)^2 + y^2 = \left(\frac{1}{2a}\right)^2$

centre $\left(\frac{1}{2a}, 0\right)$

rad $= \frac{1}{2a}, a > 0$

If $a = 0, \quad x = 0, \quad b \ne 0, y \ne 0$

$b = 0, y = 0, \quad x = \frac{1}{a}$

51. B P (x > y)

x > y →

Points of T_1 > Points of T_2

In three cases x > y

$T_1 \rightarrow$ A = Wins (1) and (2) match $P(A) = \frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

B = Wins (1) but (2) draw $P(B) = \frac{1}{2} \times \frac{1}{6} = \frac{1}{12}$

C = draw (1) but wins (2) $P(C) = \frac{1}{6} \times \frac{1}{2} = \frac{1}{12}$

$P(x > y) = \frac{1}{4} + \frac{1}{12} + \frac{1}{12} = \frac{5}{12}$

52. C

P(x = y)

A = Both the matches are draw $P(A) = \frac{1}{6} \times \frac{1}{6} = \frac{1}{36}$

B = T_1 wins first but losses second $P(B) = \frac{1}{2} \times \frac{1}{3} = \frac{1}{6}$

C = T_1 looses first but wins second P(C)

$= \frac{1}{3} \times \frac{1}{2} = \frac{1}{6}$

$P(x = y) = \frac{1}{36} + \frac{1}{6} + \frac{1}{6} = \frac{13}{36}$

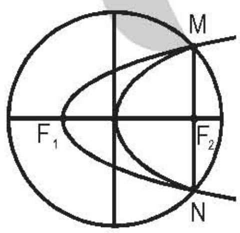
53. A $\frac{x^2}{9} + \frac{y^2}{8} = 1$

$e = \frac{1}{3}$

$F_1(-1,0)$ $F_2(1,0)$

$y^2 = 4x$

$\frac{x^2}{9} + \frac{4x}{8} = 1$



$\frac{x^2}{9} + \frac{x}{2} = 1$

$2X^2 + 9X - 18 = 0$

$2X^2 + 12X - 3X - 18 = 0$

$(2X - 3)(X + 6) = 0$

$x = \frac{3}{2}$

$M\left(\frac{3}{2}, \sqrt{6}\right)$ $N\left(\frac{3}{2}, -\sqrt{6}\right)$

Let ortho centre $(x_1, 0)$

$\therefore \frac{\sqrt{6}}{\frac{3}{2} - x_1} \times \frac{\sqrt{6}}{-1 - \frac{3}{2}} = -1$; $6 = \frac{5}{2}\left(\frac{3}{2} - x_1\right)$

$\frac{12}{5} = \frac{3}{2} - x_1$; $x_1 = \frac{3}{2} - \frac{12}{5}$

$= -\frac{9}{2 \times 5} = -\frac{9}{10}$

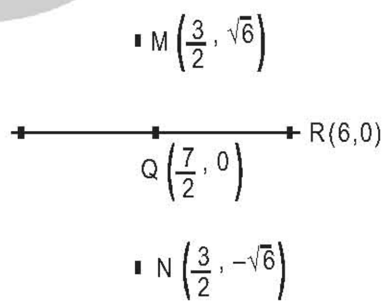
54. C

$M\left(\frac{3}{2}, \sqrt{6}\right)$

Tangent at point M

$\frac{x\frac{3}{2}}{9} + \frac{y\sqrt{6}}{8} = 1$

R(6, 0)



Q $0 - \sqrt{6} = -\frac{\sqrt{6}}{2}\left(x - \frac{3}{2}\right)$

$x - \frac{3}{2} = 2$; $x = \frac{7}{2}$; $Q\left(\frac{7}{2}, 0\right)$

Area of $\Delta MQR = \frac{1}{2} \times \frac{5}{2} \times \sqrt{6} = \frac{5\sqrt{6}}{4}$

Area of quadrilateral $MF_1NF_2 = 2 \times \sqrt{6}$

$\therefore$ ratio $= \frac{5}{8}$.