AVIRAL CLASSES
IIT-JEE | NEET | FOUNDATIONS

ULTIMATE TEST SERIES JEE MAIN -2020

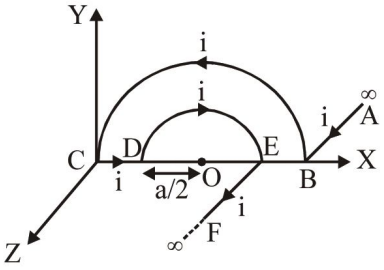
TEST-06 ANSWER KEY

Test Date :13-03-2020

[PHYSICS]

1. **B**
2. **A**
3. **C**

4. As f ↑, X_C ↓ ⇒ Brightness of B_1 ↑
   As f ↑, X_L ↑ ⇒ Brightness of B_2 ↓

5. 

$$\vec{B}_{AB} = \frac{\mu_0 i}{4\pi(3a/2)}(-\hat{j})$$

$$\vec{B}_{BC} = \frac{\mu_0 i}{4(3a/2)}(+\hat{k})$$

$$\vec{B}_{CD} = 0$$

$$\vec{B}_{DE} = \frac{\mu_0 i}{4(a/2)}(-\hat{k})$$

$$\vec{B}_{EF} = \frac{\mu_0 i}{4\pi(a/2)}(-\hat{j})$$

$$\vec{B}_O = \frac{2\mu_0 i}{3\pi a}(-\hat{j}) + \frac{\mu_0 i}{3a}(-\hat{k})$$

$$B_O = \sqrt{\left(\frac{2\mu_0 i}{3\pi a}\right)^2 + \left(\frac{\mu_0 i\pi}{3\pi a}\right)^2}$$

$$B_O = \frac{\mu_0 i}{3\pi a}\sqrt{4+\pi^2}$$

6. For RC circuit

$$Q = \varepsilon C\left[1 - e^{-\frac{t}{RC}}\right]$$

for large t, $Q = \varepsilon C$

For LR circuit

$$I = \frac{\varepsilon}{R}\left[1 - e^{-\frac{tR}{L}}\right]$$

for large t, $I = \frac{\varepsilon}{R}$

7. $(B_{axis})_1$ ⟷ $(B_{equatorial})_2$

$$B_P = \frac{\mu_0}{4\pi}\frac{2M}{d^3} - \frac{\mu_0}{4\pi}\frac{M}{d^3}$$

$$B_P = \frac{\mu_0}{4\pi}\frac{M}{d^3} = 10^{-7} \times \frac{1000}{1000 \times 10^{-6}}$$

$B_P = 10^{-1}$ T or 0.1 T

8.

$$L = \frac{NBA}{i} = \frac{N(\mu_0 n i)\pi r^2}{i} = \frac{\mu_0 N^2 \pi r^2}{\ell_0}$$

$$N = \sqrt{\frac{L\ell_0}{\mu_0 \pi r^2}}$$

$$\text{length of wire } \ell = N \times 2\pi r = \sqrt{\frac{L\ell_0}{\mu_0 \pi r^2}} \times 2\pi r$$

$$\ell = \sqrt{\frac{4\pi L \ell_0}{\mu_0}}$$

9.

$$I' = 6\left[\frac{I}{(6)^3}\right] = \frac{I}{36}$$

$$M' = 2\left[\frac{M}{6}\right] = \frac{M}{3}$$

$$T' = 2\pi\sqrt{\frac{I'}{M'BH}} = 2\pi\sqrt{\frac{I/36}{M/3BH}}$$

$$T' = \frac{T}{\sqrt{12}} = \frac{T}{2\sqrt{3}}$$

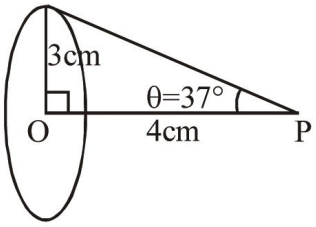
10.

$$I = -\left[\frac{\phi_2 - \phi_1}{R_q t}\right]$$

$$= -\left[\frac{n\omega_2 - n\omega_1}{5Rt}\right]$$

$$= -\frac{n(\omega_2 - \omega_1)}{5Rt}$$

11.



$$B_P = B_O \sin^3\theta$$

$$54\mu T = B_O \sin^3(37°)$$

$$B_0 = \frac{54\mu T \times 125}{27}$$

$$B_O = 250\ \mu T$$

12. Conceptual

13.

$$I_{RMS} = \frac{100\ V}{1000\ \Omega} = 0.1\ A$$

$$X_C = X_L = \frac{1}{\omega C} = \frac{10^6}{200 \times 2}\Omega$$

$$= 2500\ \Omega$$

$$V_L = V_C = I_{RMS}\ X_C$$

$$= 0.1 \times 2500\ \Omega$$

$$= 250\ \Omega$$

14. Displacement current through capacitor = Charging/discharging current

$$Id = \frac{d\theta}{dt} = 2K\varepsilon_0 \cos 2Kt$$

15. **A**

16. **C**

17.

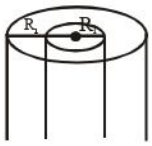
$$V = IR \quad \therefore (V_L = V_C)$$

$$200 = I\ (100)$$

$$I = 2\ A$$

18. **B**

19.



$x < R_1 \quad \Rightarrow B = 0$

$R_1 < x < R_2 \Rightarrow B \propto x$

$x > R_2 \quad \Rightarrow B \propto 1/x$

20. C

INTEGER

21. 0

22. 1

23. On equitorial position field due to magnet pair cancel each other

24. 4

25.

$$\vec{B}_{\text{due to straight parts}} = 2\left[\frac{\mu_0 I}{4\pi R}\right]\odot$$

$$\vec{B}_{\text{due to circular part}} = \frac{\theta}{2\pi}\left(\frac{\mu_0 I}{2R}\right)\otimes$$

for B_{net} to be zero at centre

$$2\left(\frac{\mu_0 I}{4\pi R}\right) = \frac{\theta}{2\pi}\left(\frac{\mu_0 I}{2R}\right)$$

$\Rightarrow \theta = 2$ radian

[CHEMISTRY]

26. SiO_2 used as flux with basic impurities.

27. Poling process is used when metal contains impurity of metal oxide.

28. $[Ni(CO)_4]$ sp^3 hybridisation tetrahedral.

29. NH_4^+ ion does not have any lone pair, so not used as ligand.

30. cis isomer do not have plane of symmetry and will show optical isomerism.

31. Alkanes, cyloalkanes and oximes show geometrical isomerism.

32. Nax NaCN, and Na_2S are formed but NaCN is not form.

33. In froth floatation NaCN is used as depressant.

34. A

35. Fact

36. A

37. (2)$[Cr(en)_3]^{3+}$ is optically acitve and exist as pair of enantiomers?

38. A

39. sp^3d^2 and d^2sp^3.

40. Fact

41. Fact

42. C.N of metal = 6 so
geometry will be octahedral not tetrahedral

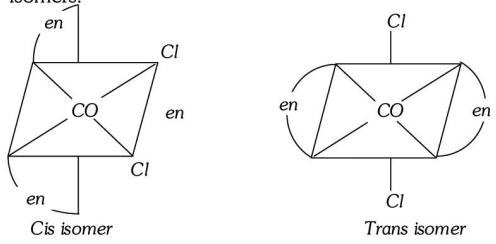
43. (1) In thesynergic bond π^* molecular of orbial ligand is used.

44. (4) d^5 configuration show 5 unpaired electron.

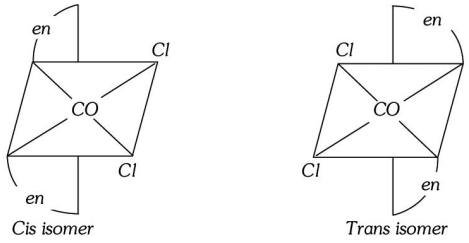
45. Fact

INTEGER

46. $[Co(en)_2Cl_2]$ has 2 geometrical isomers & 2 optical isomers.

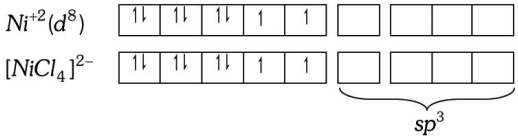


Again Cis isomer can give 2 optical isomers.



47. $[NiCl_4]^{2-}$

O.N. of $Ni = +2$



Which has two unpaired electrons that is why it is paramagnetic.

48. In this complex chloride ion in the form of ionic isomerism and show primary valency.

$AgNO_3$ is added in excess then result precipitation will occur.

49. Mn^{+3}

	$3d^5$					$4s^0$
	↑	↑	↑	↑		

50. Oxidation number of chromium in potassium dichromate is +6 so it oxidise 6 moles of ferrous sulphate in acidic medium.

[MATHEMATICS]

51. **Ans. (2)**

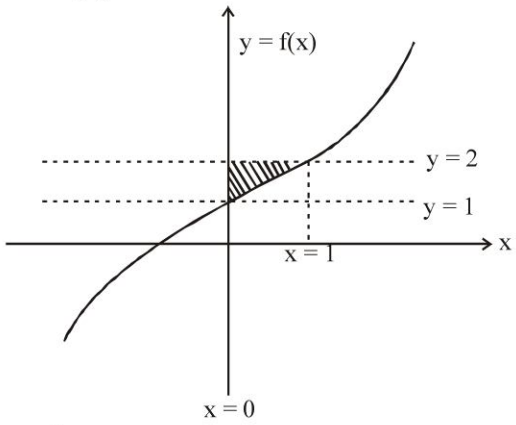
x coty y dy + ln siny dx + ln cosx dy–y tan x dx=0

$$\int d(x\ln\sin y)+\int d(y\ln\cos x)=\int 0$$

x ln sin y + y ln cos x = c

$(\sin y)^x \cdot (\cos x)^y = c$

52. **Ans. (2)**

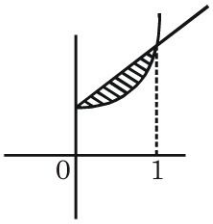


$$A=\int_0^1 2-\left(x^3-3x^2+3x+1\right)$$

$$A=\int_0^1\left(-x^3+3x^2-3x+1\right)dx$$

$$A=-\frac{x^4}{4}+x^3-\frac{3x^2}{2}+x\Big|_0^1=\frac{1}{4}$$

53.



Ans. (3)

$x=\sqrt{y-1}$

$y=x+1$

$$\int_0^1\left(x+1-x^2-1\right)dx$$

$$=\frac{1}{6}$$

54. **Ans. (2)**

$$\frac{dy}{dx}+x\sin^2 y=\sin y\cos y$$

$$\text{cosec}^2 y\frac{dy}{dx}+x=\cot y$$

Let $-\text{coty}=v$

$$\frac{dv}{dx}+v=x$$

$$\therefore\quad -\cot y.e^x=\int xe^x dx$$

$$\Rightarrow\quad \text{coty}=(x-1)+Ce^{-x}$$

55. **Ans. (1)**

$$\int_0^2 f(x)dx=\int_0^1\sqrt{1-x}\,dx+\int_1^2(7x-6)^{-1/3}\,dx$$

$$=\frac{55}{42}$$

56. **Ans. (2)**

Put $e^x=t$

$$I=\int_1^e e^t\left(\frac{1+t\ell nt}{t}\right)dt=\int_1^e e^t\left(\ell nt+\frac{1}{t}\right)dt=e^e$$

57. **Ans. (2)**

$$\int_0^1\left(4x^6+\left(4x^3-f(x)\right)f(x)-4x^6\right)dx=\frac{4}{7}$$

$$\int_0^1\left(f(x)-2x^3\right)^2 dx=0\Rightarrow f(x)=2x^3$$

58. Ans. (2)

$$\frac{d\left(\int_x^y dt\right)}{dy} = x \Rightarrow \frac{d(y-x)}{dy} = x$$

$$\int \frac{dx}{1-x} = \int dy \Rightarrow y = -\ell n|1-x| + C$$

59. Ans. (2)

$P_n = e - nP_{n-1}$ $\quad P_{10} = e - 10P_9$

$e - P_{10} = 10e - 90P_8$ $\quad P_9 = e - 9P_8$

$-9e = P_{10} - 90P_8$ $\quad \frac{e - P_{10}}{10} = e - 9P_8$

60. Ans. (4)

$a = 2; b = 1; c = -5$

$a + 2b - c = 9$

61. Ans. (4)

$$f'(f(x)).f'(x) = \underbrace{\lambda\left[7x^6 + 2\right]}_{\substack{\text{either +ve or -ve} \\ \text{depending on } \lambda.}}$$

$\therefore$ $f(x)$ has to be either $\uparrow$ or $\downarrow$

62. Ans. (4)

$\frac{x^2}{18} - \frac{y^2}{9} = 1$ $\quad y = -x + k$

$\therefore$ $m = -1$.

for tangent : $k^2 = 18(-1)^2 - 9 \Rightarrow k^2 = 9$

$\Rightarrow$ sum of squares of possible values = 18.

63. Ans. (1)

Given equation can be simplified as

$$\frac{ydx - xdy}{x^2} + \left(\frac{1+x^2}{x^2}\right)dx + \sin y\, dy = 0$$

$$\Rightarrow \frac{y}{x} + \frac{1}{x} - x + \cos y = c$$

$\because$ $x = 1; y = 0 \Rightarrow c = 1$

$\Rightarrow y + 1 - x^2 + x\cos y = x.$

64. Ans. (4)

$$I = \int_{-\pi/2}^{\pi/2} \frac{e^x.\cos^2 x}{\left(1+e^x\right)}dx \qquad ...(i)$$

king

$$I = \int_{-\pi/2}^{\pi/2} \frac{\cos^2 x}{1+e^x}dx \qquad ...(ii)$$

(i) + (ii)

$$2I = \int_{-\pi/2}^{\pi/2} \cos^2 x\, dx \Rightarrow I = \frac{\pi}{4}$$

65. Ans. (3)

$x^4 = x^2 + 12 \Rightarrow x^2 = 4 \Rightarrow x = 2, -2$

$$A = \int_{-2}^{2} x^2 + 12 - x^4 dx = 2\int_0^2 x^2 + 12 - x^4 dx$$

$$= 2\left(\frac{x^3}{3} + 12x - \frac{x^3}{5}\right)\Bigg|_0^2 = \frac{608}{15}$$

66. Ans. (3)

$$f(a) = \int_0^a \frac{du}{(1+u^2)^{3/2}}$$

Let $u = \tan\theta$

$du = \sec^2\theta d\theta$

$$f(a) = \int_0^{\tan^{-1}a} \frac{\sec^2\theta}{\sec^3\theta}d\theta$$

$$= \int_0^{\tan^{-1}a} \cos\theta d\theta = \left[\sin\theta\right]_0^{\tan^{-1}a} = \frac{a}{\sqrt{1+a^2}}$$

$$3\sqrt{2}\, f\left(2\sqrt{2}\right) = 3\sqrt{2}\frac{2\sqrt{2}}{\sqrt{1+\left(2\sqrt{2}\right)^2}} = 3\sqrt{2}\frac{2\sqrt{2}}{3} = 4$$

67. **Ans. (3)**

$$y'+\frac{1}{x}y=y^{\frac{1}{2}}$$

$$\Rightarrow y^{-\frac{1}{2}}y'+\frac{1}{x}y^{\frac{1}{2}}=1$$

Put $y^{\frac{1}{2}}=v\Rightarrow v'=\frac{1}{2}y^{-\frac{1}{2}}y'$

$$2v'+\frac{1}{x}v=1\Rightarrow v'+\frac{1}{2x}v=\frac{1}{2}$$

Here $P=\frac{1}{2x}, Q=\frac{1}{2}$

$$IF=e^{\int Pdx}=e^{\int\frac{1}{2x}dx}=e^{\frac{1}{2}\ln|x|}=|x|^{\frac{1}{2}}$$

So, $v\times IF=\int IF\times Q$

$$v\times|x|^{\frac{1}{2}}=\int|x|^{\frac{1}{2}}\times\frac{1}{2}\Rightarrow y^{\frac{1}{2}}|x|^{\frac{1}{2}}=\frac{2|x|^{\frac{3}{2}}}{3}\times\frac{1}{2}+c$$

$$y^{\frac{1}{2}}=\frac{1}{3}x+cx^{-\frac{1}{2}}$$

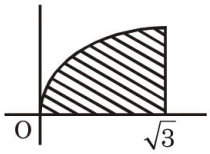
Now, $y(1)=0\Rightarrow 0=\frac{1}{3}+c\Rightarrow c=-\frac{1}{3}$

$$\therefore y=\left(\frac{1}{3}x-\frac{1}{3}x^{-\frac{1}{2}}\right)^2\Rightarrow y=\frac{x^3-2x^{\frac{3}{2}}+1}{9x}$$

$$\Rightarrow y=\frac{1}{9}\left(x^2-2x^{\frac{1}{2}}+\frac{1}{x}\right)$$

$\therefore$ [9f(9)] = 75

68. **Ans. (4)**



$$y=\sqrt{3}\sin\left(\frac{\pi x}{2\sqrt{3}}\right)$$

$$\Rightarrow \theta=\int_0^{\sqrt{3}}\sqrt{3}\sin\left(\frac{\pi x}{2\sqrt{3}}\right)dx$$

$$\theta=\frac{-6}{\pi}\left(\cos\left(\frac{\pi x}{2\sqrt{3}}\right)\right)_0^{\sqrt{3}}=\frac{6}{\pi}$$

$$\Rightarrow \tan\left(\frac{1}{\theta}\right)=\tan\left(\frac{\pi}{6}\right)=\frac{1}{\sqrt{3}}$$

69. **Ans. (3)**

$y = e^x - e^{-x}$

$$\Rightarrow \frac{dy}{dx}=e^x+e^{-x}, g'(y)=\frac{1}{dy/dx}=\frac{1}{e^x+e^{-x}}$$

when y = 2

$e^x - e^{-x} = 2 \Rightarrow e^x = 1 \pm \sqrt{2}$

$x = \ln(1+\sqrt{2})$

$$g'(2)=\frac{1}{e^{\ln(\sqrt{2}+1)}+e^{-\ln(\sqrt{2}+1)}}=\frac{1}{2\sqrt{2}}$$

70. **Ans. (2)**

$$\vec{n}=\begin{vmatrix} i & j & k \\ 1 & 0 & -1 \\ 1 & -1 & 0 \end{vmatrix}=-i-j-k$$

Now, equation of plane is

$(-1)(x - 1) - 1(y - 1) - 1(z - 1) = 0$

$$\frac{x}{3}+\frac{y}{3}+\frac{z}{3}=0$$

Plane meets coordinate axes at A(3, 0, 0), B(0, 3, 0), C(0, 0, 3)

Volume of tetrahedron is

$$\frac{1}{6}[3i\ \ 3j\ \ 3k]=\frac{9}{2}\text{ cubic units}$$

INTEGER

71.

$$\text{Put } x = y - \frac{1}{y}$$

$$\Rightarrow 1 \Rightarrow \int_{-\infty}^{\infty} f\left(y-\frac{1}{y}\right)\left(1+\frac{1}{y^2}\right)dy$$

$$= \int_{-\infty}^{0} f\left(y-\frac{1}{y}\right)dy + \int_{-\infty}^{0} f\left(y-\frac{1}{y}\right)\frac{dy}{y^2}$$

$$\text{Putting } z = -\frac{1}{y} = \int_{-\infty}^{0} f\left(y-\frac{1}{y}\right)dy + \int_{0}^{\infty} f\left(z-\frac{1}{z}\right)dz = 1$$

72.

$$\left|\ell nt\left(\frac{t^3}{3}-t\right)\right|_0^{|x|} - \int_0^{|x|}\frac{1}{t}\left(\frac{t^3}{3}-t\right)dt = \frac{5|x|}{6}$$

$$\ell n|x|\left(\frac{|x|^3}{3}-|x|\right) - \frac{|x|^2}{3} + |x| = \frac{5|x|}{6}$$

$$\ell n|x|\left(\frac{|x|^2}{3}-1\right) - \frac{|x|}{3} + 1 = \frac{5}{6}$$

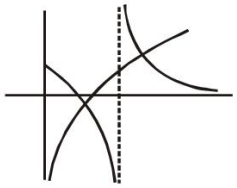
$$\ell n|x|\left(\frac{|x|^2}{3}-1\right) = \frac{|x|}{3} - \frac{1}{6}$$

$$\ell n|x|(|x|^2 - 3) = \frac{2|x|-1}{2}$$

$$\Rightarrow \quad \ell n|x| = \frac{2|x|-1}{2(|x|^2-1)}$$

$|x| = t = t > 0$

$$\ell nt = \frac{2t-1}{2(t^2-1)}$$



$\Rightarrow$ 2 solutions for $|x|$

$\Rightarrow$ 4 solutions.

73.

$$f\left(\frac{8}{\pi x}\right) = \frac{8}{x} \Rightarrow \left(f\left(\frac{8}{\pi x}\right)\right)'' = \frac{16}{x^3}$$

74.

$$\frac{dx}{dy} - \frac{x}{y} = -y$$

$$\frac{x}{y} = -y + c \Rightarrow x = 2y - y^2$$

$y = 3$ when $x = -3$

75.

$f(x) = x^a(1-x)^b$

$f'(x) = ax^{a-1}(1-x)^b + x^a(-b(1-x)^{b-1})$

$= (a(1-x) - bx)x^{a-1}(1-x)^{b-1}$

in the interval [0, 1]

$$a(1-x) - bx = 0 \Rightarrow x = \frac{a}{a+b}$$

f_{max} at $x = \frac{a}{a+b}$ then $p = 1, q = 1$

Then $p + q = 2$