AVIRAL CLASSES

IIT-JEE | NEET | FOUNDATIONS

ULTIMATE TEST SERIES JEE MAIN -2020
TEST-05 ANSWER KEY

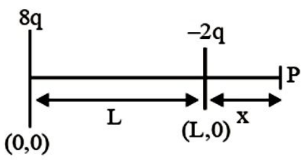
Test Date :11-03-2020

[PHYSICS]

1. C

2. On axial point, electric field is along the direction of dipole moment.

3. $\frac{2kp}{x^3} = \frac{kp}{y^3} \Rightarrow \frac{x}{y} = 2^{1/3}$

4. 

at point P

$$\frac{8Kq}{(L+x)^2} - \frac{2Kq}{x^2} = 0$$

$$\Rightarrow \frac{8Kq}{(L+x)^2} = \frac{2Kq}{x^2} \Rightarrow x = L$$

5. $n = \frac{E\lambda}{hc} = \frac{1\times10^{-7}\times200\times10^{-9}}{6.6\times10^{-34}\times3\times10^{8}} = 1 \times 10^{11}$

Number of electrons ejected $= \frac{10^{11}}{10^3} = 10^8$

$$\therefore V = \frac{q}{4\pi\epsilon_0 r} = \frac{(10^8\times1.6\times10^{-19})\times9\times10^9}{4.8\times10^{-2}} = 3V$$

6. D
7. A
8. B
9. C
10. A
11. D
12. D
13. D
14. A
15. A

16. $I_g = \frac{3}{50+2950} \propto 30$, $I_g' = \frac{3}{50+R} \propto 20$

$$\Rightarrow \frac{50+R}{50+2950} = \frac{3}{2} \Rightarrow 50 + R = 4500$$

$$\Rightarrow R = 4450\Omega$$

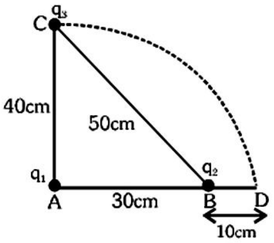
17. $\phi_{total} = \phi_{curved} + \phi_{plane\ surfaces} = \frac{q}{\epsilon_0}$

$$\phi + 2\phi_A = \frac{q}{\epsilon_0} \Rightarrow \phi_A = \frac{1}{2}\left(\frac{q}{\epsilon_0} - \phi\right)$$

18. $V_A - V_B = \left[V - \left(\frac{V}{8}\times4\right)\right] - \left[V - \left(\frac{V}{4}\times1\right)\right]$

$$= -\frac{V}{2} + \frac{V}{4} = -\frac{V}{4} \Rightarrow V_B > V_A \Rightarrow \text{Ans (4)}$$

19.



$$U_i = \frac{1}{4\pi \epsilon_0}\left[\frac{q_1q_3}{(0.4)} + \frac{q_1q_2}{(0.3)} + \frac{q_2q_3}{(0.5)}\right]$$

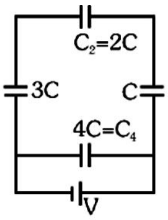
$$U_f = \frac{1}{4\pi \epsilon_0}\left[\frac{q_1q_3}{(0.4)} + \frac{q_1q_2}{(0.3)} + \frac{q_2q_3}{(0.1)}\right]$$

Therefore $\Delta U = U_f - U_i = \frac{1}{4\pi \epsilon_0} \; q_2q_3 \left(\frac{1}{0.1} - \frac{1}{0.5}\right)$

$$= \frac{q_2q_3}{\pi \epsilon_0}\,(10^{-2}) = \frac{q_3}{4\pi \epsilon_0}\,(8q_2)$$

$\Rightarrow K = 8q_2$

20.



$Q_4 = 4CV$

$Q_2 = \left(\frac{6}{11}C\right) V = \frac{6CV}{11}$

$$\Rightarrow \frac{Q_2}{Q_4} = \frac{6CV}{11} \times \frac{1}{4CV} = \frac{3}{22}$$

INTEGER

21. 6
22. 8
23. 7
24. 0

25. As voltage drop across 8Ω= $\sqrt{2 \times 8}$

$= 4V \left(\because P = \frac{V^2}{R}\right)$

Therefore voltage drop across 3Ω = 3V

[$\because$ 4V is divided in ratio of resistances between 1Ω and 3Ω]

Hence power dissipated in 3Ω = $\frac{(3)^2}{3}$ = 3 watt

[CHEMISTRY]

26. A

27.

$$\overset{(5)}{E^\circ_{MnO_4^-|Mn^{2+}}} = 1.51 \text{ V}$$

$$\overset{(2)}{E^\circ_{Mn^{2+}|MnO_2}} = -1.23 \text{ V}$$

$$\overset{(3)}{E^\circ_{MnO_4^-|MnO_2}} = \frac{1.51 \times 5 - 1.23 \times 2}{3}$$

$$= \frac{7.55 - 2.46}{3} = 1.69 \text{ V}$$

28. B
29. B
30. D
31. C
32. D
33. B
34. D
35. C
36. C
37. A
38. B

39. We know that

oxidising nature ∝ S.R.P.

Reducing nature $\propto \frac{1}{\text{S.R.P.}}$

→ In the given values, F_2 has highest S.R.P. therefore it is strongest oxidising agent.

→ In the given values Iodine has least S.R.P. therefore I^- is strongest reductant

40. O^{-2} ions form CCP, therefore 4 O^{-2} ions are present per unit cell.

$\therefore$ No. of tetrahedral voids = 8

Tetrahedral voids occupied by $A^{+2} = \frac{1}{4} \times 8 = 2$

Also, no. of octahedral voids present = 4

Octahedral voids occupied by $B^{+} = 4$

$\therefore$ Formula of oxide could be = $A_2B_4O_4$ or AB_2O_2

41. **C**

42. **A**

43. **C**

44. **C**

45. For the cell reaction

$$Fe + 2Fe^{3+} \rightarrow 3Fe^{2+}$$

Anode reaction is

$$Fe \rightarrow Fe^{2+} + 2e^{-}$$

cathode reaction is

$$2Fe^{3+} + 2e^{-} \rightarrow 2Fe^{2+}$$

$E^{\circ}_{Cell} = E^{\circ}_{Cathode} - E^{\circ}_{Anode}$ (E° is reduction potential)

$= 0.771 - (-0.441)$

$E^{\circ}_{Cell} = 1.212V$

INTEGER

46. 4

47. **6**

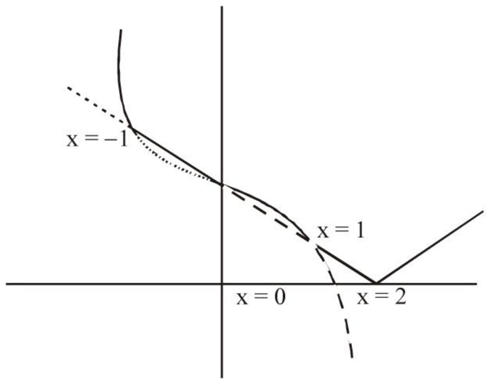
48. 8

49. **1**

50. 0

[MATHEMATICS]

51. **Ans. (4)**



52. **Ans. (2)**

Given $f\left(\frac{5x-3y}{5-3}\right) = \frac{5f(x)-3f(y)}{5-3}$

Which satisfies section formula for abscissa on L.H.S. and ordinate on R.H.S.

Hence f(x) must be linear function

let f(x) = ax + b

f(0) = b = 1 $\Rightarrow$ f(x) = 2x + 1

f'(0) = a = 2

period of sin (2x + 1) is π

53. **Ans. (3)**

$$\left(\tan^{-1} x - 2\right)\left(\cot^{-1} x - 1 - \frac{\pi}{2}\right) > 0$$

$$\Rightarrow \left(\tan^{-1} x + 1\right)\left(\tan^{-1} x - 2\right) < 0$$

$$\Rightarrow -1 < \tan^{-1} x < 2$$

$$\Rightarrow -\tan 1 < x < \tan 2$$

54 **Ans. (2)**

Since $f''(x) > 0$

$\Rightarrow f'(x)$ is always increasing

$g'(x) = 2f'(2x^3-3x^2)\times(6x^2-6x) + f'(6x^2-4x^3-3)(12x-12x^2)$

$= 12(x^2-x)\,(f'(2x^3-3x^2)-f'(6x^2-4x^3-3))$

$=12x(x-1)][f'(2x^3-3x^2)-f'(6x^2-4x^3-3))]$

For increasing $g'(x) > 0$

Case-I $x < 0$ or $x > 1$

$\Rightarrow f(2x^3-3x^2) > f'(6x^2-4x^3-3)$

$\Rightarrow 2x^3-3x^2 > 6x^2-4x^3-3$

$(\because f'(x)$ is increasing $)$

$$\Rightarrow (x-1)^2\left(x+\frac{1}{2}\right) > 0 \Rightarrow x > -\frac{1}{2}$$

$$\therefore\ x \in \left(-\frac{1}{2}, 0\right) \cup (1, \infty)$$

55 **Ans. (4)**

$$\begin{vmatrix} 4+x^2 & -6 & -2 \\ -6 & 9+x^2 & 3 \\ -2 & 3 & 1+x^2 \end{vmatrix} = x\left(x^3\right)\left(14+x^2\right)$$

56. **Ans. (4)**

$|\text{adj } 3P| = |3P|^3 = 3^{12}|P|^3 = -3^{12}.2^3$

57. **Ans. (2)**

$2p - 3q + 12r = 5$

$b = p^2 + q^2 + r^2$

$c = pq - qp + qr - qr + 3r^2 = 3r^2$

$b + c = p^2 + q^2 + 4r^2$

use : $\left(2\hat{i} - 3\hat{j} + 6\hat{k}\right).\left(p\hat{i} - q\hat{j} + 2r\hat{k}\right) \le \sqrt{2^2+3^2+6^2}\sqrt{p^2+q^2+4r^2}$

$$\frac{25}{49} \le p^2 + q^2 + 4r^2$$

58. **Ans. (3)**

$f'(1) + f''(1) = f(1) = 5$

59. **Ans. (2)**

$$f(x) = \prod_{r=1}^{100}(x-r)^{r.(101-r)}$$

$$\ell n f(x) = \sum_{r=1}^{100} r(101-r)\,\ell n(x-r)$$

differentiate

$$\frac{f'(x)}{f(x)} = \sum_{r=1}^{100}\frac{r(101-r)}{x-r} \Rightarrow \frac{f'(101)}{f(101)} = \sum_{r=1}^{100} r = 5050$$

60. **Ans. (3)**

$F(x) - 2017 + x = x(x-1)(x-2)....(x-2017)$

$\therefore F(2018) = 1.2.3.....2018 - 1$

$= 2018! - 1$

61. **Ans. (4)**

Both $\cot^{-1}2x$ and $\cos^{-1}x$ are always non negative, hence no solution.

62. **Ans. (4)**

$$AA^T = \begin{bmatrix} x & y & z \\ y & z & x \\ z & x & y \end{bmatrix}\begin{bmatrix} x & y & z \\ y & z & x \\ z & x & y \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$\Rightarrow x^2 + y^2 + z^2 = 1;\ xy + yz + zx = 0.$

$\because (x + y + z)^2 = x^2 + y^2 + z^2 + 2(xy + yz + zx)$

$\Rightarrow x + y + z = 1$ or -1(reject)

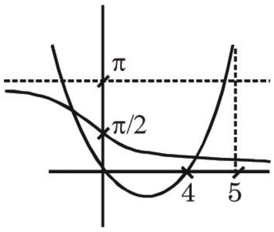
$\therefore x + y + z = 1$

$\therefore x^3 + y^3 + z^3$

$= (x + y + z)(x^2 + y^2 + z^2 - xy - yz - zx) + 3xyz$

$= 1(1 - 0) + 3.1 = 4.$

63. **Ans. (3)**



at x = 5 : 25 – 4(5) = 5

(more than $\frac{\pi}{2}$)

64. **Ans. (2)**

$$f(x)=\begin{cases}\sin x & x\in\left[0,\frac{\pi}{2}\right]\\ 2-\sin x & x\in\left(\frac{\pi}{2},\pi\right]\\ 2+\sin x & x\in\left(\pi,\frac{3\pi}{2}\right]\\ -\sin x & x\in\left(\frac{3\pi}{2},2\pi\right)\end{cases}$$

continuous ∀ x, non derivable at x = π.

65. **Ans. (3)**

$\lim_{x\to 1} x^{\log_x e} = e$

66. **Ans. (1)**

Determinant value of every odd order skew symmetric matrix is zero.

67. **Ans. (4)**

$$A^n=\begin{bmatrix}1-3n & -9n\\ n & 1+3n\end{bmatrix}=\begin{bmatrix}1&0\\0&1\end{bmatrix}+n\begin{bmatrix}-3&-9\\1&3\end{bmatrix}$$

$$\text{So } 2B+C=\begin{bmatrix}2&0\\0&2\end{bmatrix}+\begin{bmatrix}-3&-9\\1&3\end{bmatrix}=\begin{bmatrix}-1&-9\\1&5\end{bmatrix}$$

⇒ trace = 4

68. **Ans. (3)**

The period of cosπx, $\cos\left(\frac{\pi x}{2}\right)$, $\cos\left(\frac{\pi x}{2^2}\right)$......

are $\frac{2\pi}{\pi}, \frac{2\pi}{\left(\frac{\pi}{2}\right)}, \frac{2\pi}{\left(\frac{\pi}{2^2}\right)}$..... respectively

L.C.M. of 2, 2^2, 2^3 is 2^3

Period = 2^3

69. **Ans. (4)**

$18(\tan^{-1}x)^2 - 6\pi\tan^{-1}x - 3\pi\tan^{-1}x + \pi^2 = 0$

$6\tan^{-1}x(3\tan^{-1}x - \pi) - \pi(3\tan^{-1}x - \pi) = 0$

$\tan^{-1}x = \frac{\pi}{6}$ and $\frac{\pi}{3}$

$x = \sqrt{3}$ and $\frac{1}{\sqrt{3}}$

$\therefore \alpha\beta = 1$

Now, $\log_{\sqrt{3}}(8+1) = \log_{\sqrt{3}}\left(\sqrt{3}\right)^4 = 4$

70. **Ans. (B)**

$A = (d_1, d_2, d_3, d_4)$

$A^4 = \left(d_1^4, d_2^4, d_3^4, d_4^4\right) = I$

$\Rightarrow d_1^4 = d_2^4 = d_3^4 = d_4^4 = I$

$\Rightarrow d_1, d_2, d_3, d_4$ are forth roots of unity as $d_1 + d_2 + d_3 + d_4 = 0$

$\Rightarrow \left(2.\frac{4!}{2!2!}\right) + 4! = 36$ ways are there to assign values to d_1, d_2, d_3, d_4.

Also $d_1d_2d_3d_4$ is product of 4^{th} roots of unity which is –1 or 1

when 1, –1, 1, –1 or i, –i, i, –i are used.

INTEGER

71. **Ans. (3)**

$|A-\lambda I|=0$

$$\begin{vmatrix} 1-\lambda & 1 & 2 \\ 0 & 2-\lambda & 1 \\ 1 & 0 & 2-\lambda \end{vmatrix}=0$$

$$(1-\lambda)\left[(2-\lambda)^2-0\right]-(0-1)+2(0-(2-\lambda))=0$$

$$(1-\lambda)(2-\lambda)^2+1-4+2\lambda=0$$

$$(1-\lambda)(\lambda^2-4\lambda+4)-3+2\lambda=0$$

$$\lambda^2-4\lambda+4-\lambda^3+4\lambda^2-4\lambda-3+2\lambda=0$$

$$\lambda^3=5\lambda^2-6\lambda+1=(5\lambda-1)(\lambda-1)$$

$$A^3=(5A-I)(A-I)$$

a = 5, b = 1 or a = 1, b = 5

$\Rightarrow$ a + b = 6

72. **Ans. (3)**

$$\begin{vmatrix} -x & x & 2 \\ 2 & x & -x \\ x & -2 & -x \end{vmatrix}=0 \Rightarrow x=2,-2$$

$\Rightarrow$ n = 2 $\Rightarrow$ $\Delta(n)=0$

73. **Ans. (1)**

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

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

x = 1, –5(reject)

74. **Ans. (2)**

$$\frac{f(x)}{x}=\sqrt{x\sqrt{x\sqrt{x.......\infty}}}=\sqrt{x.\frac{f(x)}{x}}=\sqrt{f(x)}$$

$f^2(x)=x^2 f(x) \Rightarrow f(x)=x^2 \Rightarrow f'(x)=2x$

$\Rightarrow f'(3)=6$

75. **Ans. (2)**

$$(f'(x))^2-f(x)f''(x)=0 \Rightarrow \frac{d}{dx}\left(\frac{f(x)}{f'(x)}\right)=0$$

$$\Rightarrow \frac{f(x)}{f'(x)}=\text{constant}$$

$$\Rightarrow \frac{f(x)}{f'(x)}=\frac{1}{2} \Rightarrow f(x)=e^{2x}$$

The equation $e^{2x}=x^2$ has one solution.