FINAL TEST SERIES JEE -2020
TEST-04 ANSWER KEY

Test Date :26-12-2019

[PHYSICS]

1. Potential at earthed conductor becomes zero.

2. Due to slab.

$C \rightarrow KC, \quad E = \frac{1}{2} CV^2$

$V \rightarrow V/K, \quad E = E/K$

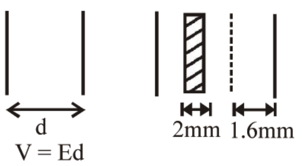
$Q = CV = \text{constant}$

$V \rightarrow$ Decrease, Energy decrease.

$Q \rightarrow$ Remain constant

3. Potential at earthed conductor becomes zero and by induction charge will not remain uniform.

4.



$$Ed = V = (d + 1.6 - 2)E + \frac{E}{K}.2$$

$$\frac{2}{K} = \frac{4}{10} \quad \boxed{K = 5}$$

5. Flux donot depend upon shape

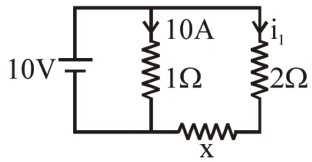
6. $w = \vec{F}\cdot\vec{d}$

$= q_0\vec{E}\cdot\vec{d}$

$= q_0\left(E_0\hat{i}\right)\cdot\left(a\hat{i} - a\hat{j}\right)$

$= q_0E_0a$

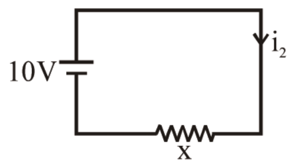
7.



(when switch is opened)

$10 \times 1 = i_1 \times (2 + x)$

$$i_1 = \frac{10}{2+x} \qquad ....(1)$$



$$i_2 = \frac{10}{x}$$

$\therefore i_2 = 2i_1$

$$\frac{10}{x} = 2\left(\frac{10}{2+x}\right)$$

$x = 2\Omega$

8. $V = x\ell$

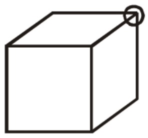
$IR = x \times 100$

$I(R + R) = x \times \ell'$

$$\frac{1}{2} = \frac{100}{\ell'}$$

$\Rightarrow \ell' = 200$ cm

9. Faces which are related to the corner will have zero flux ($E \perp A$).



10. Deviation $y = \frac{1}{2}\left(\frac{qE}{m}\right)\left(\frac{x^2}{v^2}\right)$

But putting the values we get y = 1.76 mm

11. As charge moves towars 'A' more number of field lines will be related with 'A' hence ϕ_B will decreases.

12. $F = -\frac{dU}{dx}$

$$\boxed{F = \vec{p}\cdot\frac{d\vec{E}}{dx}}$$

as $\theta = 90$
$F = 0$
$\theta \neq 90$
$F \neq 0$

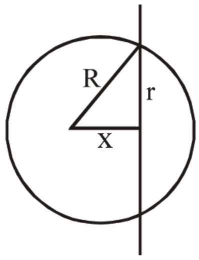
If dipole is aligned with EF lines hence $\tau = 0$

13. $\begin{pmatrix}\text{Energy loss} \\ \text{during the process}\end{pmatrix} = \frac{c_1c_2}{2(c_1+c_2)}(V_1 - V_2)^2$

for no loss of energy $V_1 - V_2 = 0 \Rightarrow V_1 = V_2$

If $Q_1R_2 \neq Q_2R_1$ then there is alway a loss in energy of the system hence option (4) is correct.

14. Charge enclosed $q_{en} = \sigma\pi(R^2 - x^2)$



Here $r = \sqrt{R^2 - x^2}$

$$\phi_{sphere} = \frac{\sigma\pi(R^2 - x^2)}{\epsilon_0}$$

15. Work done = change in energy

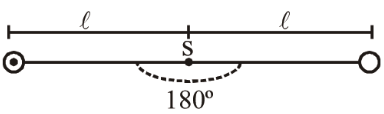
$$eEd = \frac{1}{2}m(V\cos 60°)^2 = \frac{1}{4}\left(\frac{1}{2}mV^2\right)$$

but $\frac{1}{2}mV^2 = K$

$$E = \frac{K}{4\,ed}$$

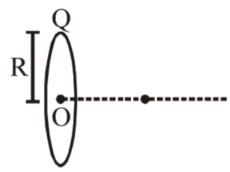
16. Potential difference does not depend upon charge of outer sphere.

17. In absence of gravity only electrostatic force will work.



$T = \frac{K(Q)(Q)}{(2\ell)^2}$ and angle between strings = 180º

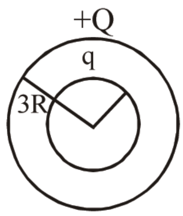
18. $TE_i = TE_f$



$$\frac{KQq}{R} = \frac{1}{2}mv^2$$

$$v = \sqrt{\frac{2KQq}{mR}}$$

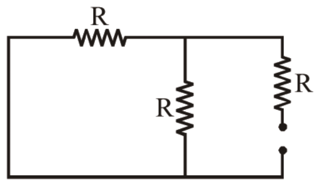
19. If inner sphere is earthed then its potential will be zero.
Let charge on inner sphere is q.



$$V_{inner} = \frac{KQ}{3R} + \frac{Kq}{R} = 0$$

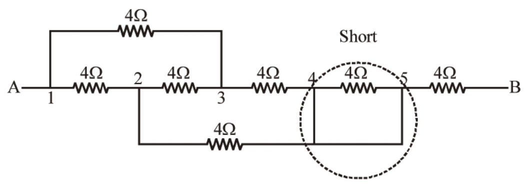
$$q = -\frac{Q}{3}$$

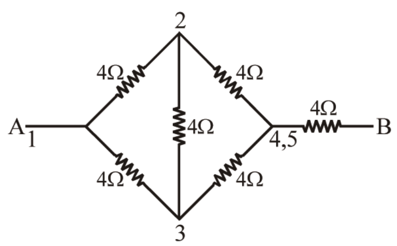
20. Net resistance across capacitor is $\frac{3R}{2}$



$$\tau = R_N C = \frac{3}{2}RC$$

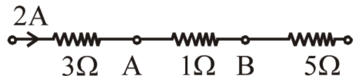
21.





$= 8\Omega$

22. Given circuit can be redrawn as



$V_A - V_B = IR = 2 \times 1 = 2V$

23. 6

24. 5

25. T.P.D. = $E - Ir = E - \left(\frac{E}{r}\right)r = 0$

(here 4Ω is shot circuited so it is use less)

[CHEMISTRY]

26. $\Delta S = \ominus ve$, $\Delta H = \ominus ve$

27. Fe^{+3} ion, according to Hardy – Schulze law.

28. $E_{cell} = E^0_{cell} = \frac{0.0591}{2}\log_{10}\frac{[Zn^{+2}]}{[Cu^{+2}]}$

29. Only C reduceses H^+ therefore element A, B and D are below in E.C.S. than hydrogen
⇒ A reduceses only ion of D therefor it's position in E.C.S. is above than D.
⇒ Increaseing order of SRP→C < H < B < A < D

30. In this reaction :
Intermediates ⇒ N_2O_2 and N_2O

31. specific resistance (k = $\frac{1}{\rho} = \frac{1}{R} \times \frac{l}{a}$)

$$\pi_m = \frac{k \times 1000}{molarity}$$

32. $\alpha = \frac{\wedge_m}{\wedge_m^\infty}$

$$K_a = \frac{C\alpha^2}{1-\alpha}$$

33. $kt_{1/4} = 2.303\log_{10}\frac{a}{3a/4}$

34. $SO_3^{2-} \Rightarrow 1(x) + 3(-2) = -2 \therefore x = +4$
$S_2O_4^{2-} \Rightarrow 2(x) + 4(-2) = -2 \therefore x = +3$
$S_2O_6^{2-} \Rightarrow 2(x) + 6(-2) = -2 \therefore x = +5$

35. $t_{1/2} = \dfrac{0.693}{K}$

$\log\dfrac{a}{a-x} = \dfrac{kt}{2.303}$

36. Central atom nitrogen (O.N. = +3) present in intermediate oxidation state so it can act as oxidant as well as reductant.

37. R.O.R. = $-\dfrac{d[A]}{dt} = -\dfrac{d[B]}{dt} = \dfrac{1}{2}\dfrac{d[C]}{dt} = \dfrac{d[D]}{dt}$

R.O.D. of A = $-\dfrac{d[A]}{dt}$

R.O.D. of B = $-\dfrac{d[B]}{dt}$

38. $R = k[NO_2]^1$

order of reaction = 1

$t_{1/2} = \dfrac{0.693}{k}$

39. fact (refer theory of catalyst

40. Only C is correct rest are incorrect

41. On iron surface iron itself act as anode an get oxidised an O_2 in water get reduced

42. $E^\circ = \dfrac{0.0591}{2}\log_{10} Keq.$

$0.2955 = \dfrac{0.0591}{2}\log Keq. \Rightarrow Keq. = 10^{10}$

43. **C**

44. $T^\circ_f - T_f = i \times k_f\, m$

45. $E = E^\circ - \dfrac{0.059}{2}\log\dfrac{[Cu^{2+}]}{[Ag^+]^2}$

As $[Ag]^+$ increase twice $\dfrac{[Cu^{2+}]}{[Ag^+]^2}$ become $\dfrac{1}{4}$ and E shows more change and on halving the $[Cu^{2+}]$

$\dfrac{[Cu^{2+}]}{[Ag^+]^2} = \dfrac{1}{2}$ of intial value

46. $kt = 2.303\log\dfrac{a}{a-x}$

47. 2

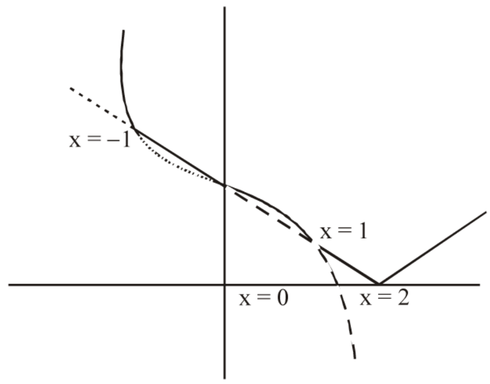
48. **4**

49. B is present in octahedral void

50. **9**

[MATHEMATICS]

51. **Ans. (4)**



52. **Ans. (2)**

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

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)**

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

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

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

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

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 $x > 1$

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

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

$(\because f'(x)\text{ is increasing})$

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

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

55. **Ans. (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 $a = 1, b = 5$

$\Rightarrow a + b = 6$

56. **Ans. (3)**

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

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

57. **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)

58. **Ans. (4)**

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

59. **Ans. (3)**

$C - (B \cap C)$

60. **Ans. (4)**

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

61. **Ans. (2)**

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

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

$\Rightarrow f'(3) = 6$

62. 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.

63. Ans. (3)

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

64. 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

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

65. Ans. (3)

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

66. Ans. (3)

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

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

67. A

68. Ans. (A,C)

$T_n = \cot^{-1}\left(4 + \frac{n(n+1)}{4}\right)$

$\therefore S_n = \sum_{n=1}^{n} T_n = \sum_{n=1}^{n}\tan^{-1}\left(\frac{\frac{1}{4}}{1+\left(\frac{n+1}{4}\right).\frac{n}{4}}\right)$

$= \sum_{n=1}^{n}\left(\tan^{-1}\left(\frac{n+1}{4}\right) - \tan^{-1}\left(\frac{n}{4}\right)\right)$

$\therefore S_\infty = \lim_{n\to\infty} S_n = \tan^{-1}(4)$

so, a = 4 and b = 1

69. Ans. (B)

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

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

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

$\Rightarrow d_1, d_2, d_3, d_4$ 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.

70. Ans. (A,B)

Let $A = \begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix}$

$\Rightarrow AB = BA$

$\Rightarrow \begin{bmatrix} a & a+b & a+b+c \\ d & d+e & d+e+f \\ g & g+h & g+h+i \end{bmatrix} = \begin{bmatrix} a+d+g & b+e+h & c+f+i \\ d+g & e+h & f+i \\ g & h & i \end{bmatrix}$

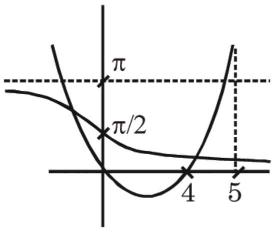
g = 0, d = h = 0, a = e = i, b = f

$\Rightarrow A = \begin{bmatrix} a & b & c \\ 0 & a & b \\ 0 & 0 & a \end{bmatrix}$

71. Ans. (4)

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

72. Ans. (3)



at x = 5 : 25 – 4(5) = 5

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

73. 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.

74. Ans. (4)

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

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

$\Rightarrow$ trace = 4

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