AVIRAL CLASSES
CREATING SCHOLARS
FOR JEE (Main & advance), PMTs & FOUNDATION

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FINAL TEST SERIES NEET -2017
TEST-06

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[PHYSICS]

1. $V(x, y, z) = 6x - 8xy - 8y + 6yz$

$$\vec{E} = -\hat{i}\frac{\partial V}{\partial x} - \hat{j}\frac{\partial V}{\partial y} - \hat{k}\frac{\partial V}{\partial z}$$

$$= \hat{i}[6-8y] - \hat{j}(-8x-8+6z] - \hat{k}[6y]$$

$$\vec{E}(1,1,1) = 2\hat{i} + 10\hat{j} - 6\hat{k}$$

$$|\vec{E}| = \sqrt{2^2+10^2+6^2} = \sqrt{4+100+36}$$

$$= \sqrt{140} = 2\sqrt{35} \text{ newton/coulomb}$$

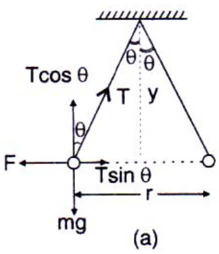
$$F = q|\vec{E}| = 2\times 2\sqrt{35} \text{ newton} = 4\sqrt{35}\,\text{N}$$

2. Net electric flux emitted from a spherical surface of radius a is :

$$\phi_{net} = \frac{q_{in}}{\varepsilon_0} \qquad \text{[According to Gauss's law]}$$

or $ES = (Aa)(4\pi a^2) = \frac{q_{in}}{\varepsilon_0}$, hence $q_{in} = 4\pi\varepsilon_0 Aa^3$

3. Let m be the mass of each ball and q be the charge on each ball.



(a)

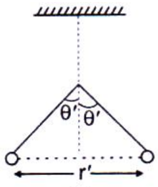
Force of replusion, $F = \frac{1}{4\pi\varepsilon_0}\frac{q^2}{r^2}$

In equilibrium, $T\cos\theta = mg$ .....(i)

$T\sin\theta = F$ .....(ii)

Dividing eq. (ii) by (i), we get :

$$\tan\theta = \frac{F}{mg} = \frac{\frac{1}{4\pi\varepsilon_0}\frac{q^2}{r^2}}{mg}$$



(b)

From figure (a),

$$\frac{r/2}{y} = \tan\theta = \frac{\frac{1}{4\pi\varepsilon_0}\frac{q^2}{r^2}}{mg} \qquad \text{.....(iii)}$$

From figure (b),

$$\tan\theta' = \frac{\frac{1}{4\pi\varepsilon_0}\frac{q^2}{r'^2}}{mg}$$

$$\text{or } \frac{r'/2}{y/2} = \frac{\frac{1}{4\pi\varepsilon_0}\frac{q^2}{r'^2}}{mg} \qquad \text{....(iv)}$$

Dividing eq. (iv) b (iii), we get

$$\frac{2r'}{r} = \frac{r^2}{r'^2} \text{ or } r'^3 = \frac{r^3}{2} \text{ or } r'\frac{r}{2^{1/3}}$$

Hence, correct answer is (a)

$\therefore \quad Bqv = \frac{mv^2}{R}$ or $v = \frac{BqR}{m}$ .....(ii)

Substituting eqn. (ii) and in eqn. (i), we get;

$$\frac{1}{2}m\left[\frac{BqR}{m}\right]^2 = qV \text{ or } \frac{q}{m} = \frac{2V}{B^2R^2}$$

Since, V, B are constants,

$$\frac{q}{m} \propto \frac{1}{R^2} \text{ or } \frac{\text{charge on the ion}}{\text{mass of the ion}} \propto \frac{1}{R^2}$$

17. Magnetic field due to a circular loop at the centre of the loop is :

$$B_1 = \frac{\mu_0}{4\pi}\frac{2\pi I_c}{R}$$

Magnetic field due to a straight wire at the centre of the loop is :

$$B_2 = \frac{\mu_0}{4\pi}\frac{2I_l}{H}$$

Both these fields act in opposite directions, hence total magnetic field at the centre of the loop is :

$B = B_1 - B_2$

$$= \frac{\mu_0 2\pi I_c}{4\pi R} - \frac{\mu_0 2\pi I_l}{4\pi H}$$

$B = 0$ (given)

$$\therefore \quad \frac{\mu_0 2\pi I_c}{4\pi R} = \frac{\mu_0 2\pi I_l}{4\pi H}$$

or $\quad \mathrm{H} = \frac{I_l R}{\pi I_c}$

18. According to Fleming's left hand rule, direction of force is along OY-axis which is perpendicular to wire,

$\vec{F} = e(\vec{v} \times \vec{B})$

$\vec{B}$ due to current i is acting inwards, i.e., into the paper, while velocity $\vec{v}$ is along OX.

$$\therefore \quad \vec{F} = Q\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ v & 0 & 0 \\ 0 & 0 & -B \end{vmatrix}$$

$$= -\hat{j}(-vB)\mathrm{Q} = +\hat{j}(QvB)$$

i.e., $\vec{F}$ is along OY direction.

19. Cyclotron frequency,

$$v = \frac{qB}{2\pi m} = \frac{1.6 \times 10^{-19} \times 1}{2 \times 3.14 \times 9.1 \times 10^{-31}}$$

28×10^9 Hz = 28 GHz.

20. $B_1 = \frac{\mu_0}{4\pi} \times \frac{2\pi I}{a} \times \frac{1}{2}$ (due to semicircular part)

$B_2 = \frac{\mu_0}{4\pi} \times \frac{2I}{a}$ (due to parallel parts of currents)

There two fields are at right angles to each other. Hence, resultant field,

$$B = \sqrt{B_1^2 + B_2^2} = \frac{\mu_0}{4\pi a}\sqrt{\pi^2 + 4}$$

21. Electric field between the plates of a charged capacitor is given by

$$E = \frac{q}{K\varepsilon_0 A}$$

where q = Charge on the plates of capacitor

ε_0 = Permitivity of free space

A = Area of the plates

K = Dielectric constant of the medium between the plates

It is clear from the expression that electric field inside a capacitor remains constant if medium remains same i.e., it does not vary with distance. If medium changes the K changes. As a result of this, E decreases with increases in K but decreased value again remain same in the charged medium. Hence in the given problem, E remains constant at a higher value n the medium of air, but in the medium of slabs E decreases As $K_2 > K_1$, so decrease in value of E in medium of K_2 is more than that found in medium of K_1. So correct option (c)

22. $U_i = \frac{1}{2}CV^2 = \frac{Q^2}{2C}$ $\quad (\because Q = CV)$

and $U_f = \frac{Q^2}{2C'} = \frac{Q^2}{2KC} = \frac{C^2V^2}{2KC} = \frac{U_i}{K}$

$$\Delta U = U_f - U_i = \frac{1}{2}CV^2\left[\frac{1}{K} - 1\right]$$

As the capacitor is isolated, so charge will remain conserved. Further, pot. diff. $\frac{Q}{C'} = \frac{Q}{KC} = \frac{V}{K}$

23. Initial energy stored $= \frac{1}{2}(2\mu\mathrm{F}) \times V^2$

Energy dissipated on connection across 8μF

$$= \frac{1}{2}\frac{C_1C_2}{C_1 + C_2}V^2 = \frac{1}{2} \times \frac{2\mu\mathrm{F} \times 8\mu\mathrm{F}}{10\mu\mathrm{F}} \times V^2$$

$$= \frac{1}{2} \times (1.6\mu\mathrm{F})V^2$$

$\therefore$ % loss of energy $= \frac{1.6}{2} \times 100 = 80\%$

$$C_2 = \frac{K_2\varepsilon_0(A/2)}{d} = \frac{K_2\varepsilon_0 A}{2d}$$

$$\therefore \quad C = C_1 + C_2 = \frac{\varepsilon_0 A}{d}\left(\frac{K_1+K_2}{2}\right)$$

29. The given network of capacitors is equivalent to a balanced Wheatstone bridge with middle capacitor as the ineffective capacitor. So, the effective capacitance $= \frac{C}{2} + \frac{C}{2} = C$

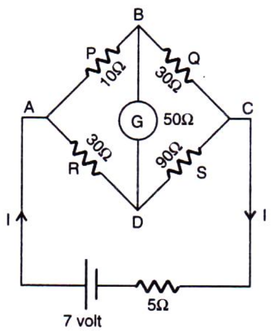
30. C

31. Potentiometer E $\propto$ I

Hence, $\frac{E_1+E_2}{E_1-E_2} = \frac{50}{10} = \frac{5}{1}$

or $\frac{E_1}{E_2} = \frac{5+1}{5-1} = \frac{6}{4} = \frac{3}{2}$

32. The situation of the problem is shown in the figure.



For a balanced Wheaststone's bridge

$$\frac{P}{Q} = \frac{R}{S}$$

$$\therefore \quad \frac{10\Omega}{30\Omega} = \frac{30\Omega}{90\Omega}$$

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

Thus, it is a balaned Wheatstone's bridge. Hence, no current flows in the galvanometer. Hence, resistance 50 Ω becomes ineffective

$\therefore$ The equivalent resistance of the circuit is

$$R_{eq} = 5\Omega + \frac{(10\Omega+30\Omega)(30\Omega+90\Omega)}{(10\Omega+30\Omega)+(30\Omega+90\Omega)}$$

$$= 5\Omega + \frac{(40\Omega)(120\Omega)}{160\Omega}$$

= 5 Ω + 30 Ω = 35Ω

$\therefore$ Current drawn from the cell is

$$I = \frac{7\text{volt}}{35\text{ohm}} = \frac{1}{5}\text{amp} = 0.2\text{amp}$$

Hence, correct answer is (a)

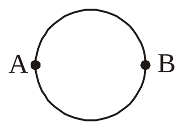
33. Given that $\frac{P}{Q} = \frac{5}{R}$

In first case, $\frac{5}{R} = \frac{l_1}{100-l_1}$, ...(i)

In second case, when R is shunted with an equal resistance R, then

$$\frac{5}{\frac{R.R}{R+R}} = \frac{1.6l_1}{100-1.6l_1}$$

34. Wire of length 2π × 0.1m and resistance 12Ω/m is bent to a circle.



Resistance of each part

= 12 × π × 0.1 = 1.2πΩ

$\therefore$ Total resistance = 0.6πΩ

35. $I = \frac{2E}{R+R_1+R_2}$

According to given condition, $E - IR_2 = 0$

or $\frac{E}{R_2} = I = \frac{2E}{R+R_1+R_2}$

or $R_1 + R_2 + R = 2R_2$

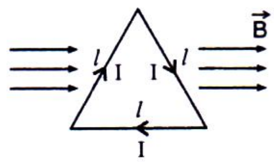
or $R = R_2 - R_1$

36. C

37. Susceptibility of diamagnetic substance is negative. Susceptibility of para and ferromagnetic substance is positive.

38. Magnetic field due to bar magnets exerts force on moving charges only. Since, the charge is at rest, zero force acts on it.

39. The current flowing clockwise in the equilateral triangle has a magnetic field in the direction $\hat{k}$



$\tau = BiNA \sin\theta$

$= BiNA \sin 90^o$

$= Bi \times \frac{\sqrt{3}}{4} l^2$

[CHEMISTRY]

46. (A)

47. (A)

Total strength of all H-bonds = 30.8 – 14.4 = 16.4 kJ mol^{-1}. There are six nearest neighbours, but each hydrogen bond involves 2 molecules. Hence, effective neighbours = 3

Hence, strength of H-bond $\frac{16.4}{3} = 5.47 \text{kjmol}^{-1}$

48. (D)

In metal excess defect, *F*-centres are produced in an ionic crystal which are responsible for the appearance of colour in solid alkali metal halides.

49. (D)

Permitted coordination number for ccp is 8, but 2A atoms are missing.

$\therefore$ Contribution of $A = 6 \times \frac{1}{8} = \frac{6}{8}$

Contribution of $B = 6 \times \frac{1}{2} = 3$

So, $A_{6/8}B_3$ or A_6B_{24}

50. (C)

Using, $\Delta T_f = i \times K_f \times m$

$$m = \frac{1000 w_1}{m_1 w_2} = \frac{1000 \times 5}{142 \times 45} = 0.782$$

$$i = \frac{\Delta T_f}{m K_f} = \frac{3.82}{0.782 \times 1.86} = 2.63$$

51. (A)

Only non-ideal solutions form azeotropic mixtures (constant boiling mixtures). Among the given only CCl_4 and $CHCl_3$ form non-ideal solution, thus, they form azeotropic mixture

52. $\frac{p^o - p_s}{p^o} = x_{\text{solute}}$

$$\frac{0.8 - 0.6}{0.8} = x_{\text{solute}} = 0.25$$

53. (d) Moles of solute $= \frac{25}{250} = 0.1 \text{ mol}$

Solvent (H_2O) = 100 mL = 100 g = 0.1 kg (since density of water is 1 g mL^{-1})

Thus, $\text{molality} = \frac{\text{mol}}{\text{kg}} = \frac{0.1}{0.1} = 1.0 \text{ mol kg}^{-1}$

Total amount of solution = 100 + 25 = 125 g solution

$$= \frac{125 \text{ g}}{1.25 \text{ gmL}^{-1}} = 100 \text{ mL} = 0.1 \text{L}$$

$\therefore$ $\text{Molarity} = \frac{\text{mol}}{L} = \frac{0.1}{0.1} = 1.0$

54. (C)

Elevation in boiling point and depression in freezing point, both are the colligative properties, i.e., depend only upon the number of particles. In other words, as the number of particles increases, boiling point increases but freezing point decreases. Since, the order of boiling point is

$C < B < A < D$

$\therefore$ The order of freezing point is

$D < A < B < C$

or $D < B > A < C$

55. (D)

Both will furnish equal number of ions in solution. So if value of '*i*' is same, the solutions will exert equal osmotic pressure.

$Ca(NO_3)_2 \rightleftharpoons Ca^{2+} + 2NO_3^-$: $i = 3$

$Na_2SO_4 \rightleftharpoons 2Na^+ + SO_4^{2-}$: $i = 3$

56. (A)

$\Delta T_f = iK_f m$

or $i = \frac{\Delta T_f}{K_f \times m} = \frac{0.00732}{1.86 \times 0.0020} = 1.9 \approx 2$

57. (A)

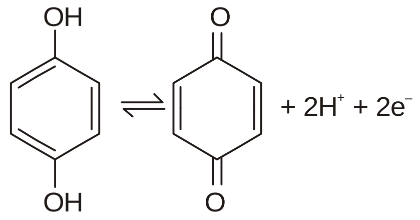
Freezing point of a substance is the temperature at which the solid and the liquid forms of the substance are in equilibrium. When freezing starts, liquid solvent is in equilibrium with the solid solvent (and both have the same vapour pressure)

58. (A)

$$k = \frac{2.303}{20} \log \frac{100}{90} \quad \text{.....(i)}$$

$$k = \frac{2.303}{x} \log \frac{100}{81} \quad \text{.....(ii)}$$

Eqn. (i) = (ii)


(*A*) (*B*)

Hence, $Q = [H^+]^2$

$$E = E^o = \frac{0.0591}{2}\log[H^+]^2$$

$= E^o - 0.0591 \log [H^+]$

$= E^o + 0.0591$ pH

$= 1.30 + 0.0591 \times 2 \approx 1.42V$

68. (C)

69. (D) $Pb(s) \rightleftharpoons Pb^{2+}(aq) + 2e^-$

$Hg_2^{2+}(aq) + 2e^- \rightarrow 2Hg(l)$

$Hg_2^{2+}(aq) + Pb(s) \rightarrow Pb^{2+}(aq) + 2Hg(l)$

$$\therefore \quad K = \frac{[Pb^{2+}]}{[Hg_2^{2+}]}$$

$[Pb^{2+}]$ in LHS is from $PbSO_4$

$\therefore \quad [Pb^{2+}] = \sqrt{K_{sp}(PbSO_4)} = \sqrt{2 \times 10^{-8}}$

$= 1.41 \times 10^{-4}$ M

$[Hg_2^{2+}]$ in RHS is from Hg_2SO_4

$\therefore \quad [Hg_2^{2+}] = \sqrt{K_{sp}(Hg_2SO_4)}$

$= \sqrt{1 \times 10^{-6}} = 1 \times 10^{-3}M$

$$\therefore \quad K = \frac{1.41 \times 10^{-4}}{1 \times 10^{-3}} = 1.41 \times 10^{-1}M$$

$$\therefore \quad E = E^o - \frac{0.0591}{2}\log 1.41 \times 10^{-1}$$

$= 0.92 + 0.025 = 0.95$ V

70. (B)

71. (D)

72. (C)

73. (C)

74. (A)

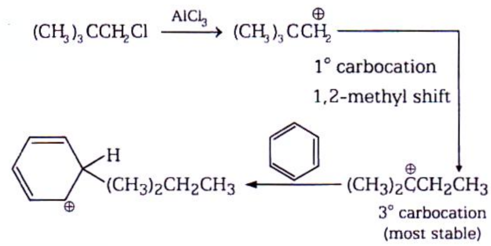
75. (C) By definition of Gold Number of 10 mL of gold sol is prevented from coagulation in presence of 1 mL of 10% NaCl by = 0.03 mg haemoglobin.

76. (A)

$CH_2=CH\overset{\oplus}{C}H_2$ (intermediate) is resonance stabilized

77. (C)

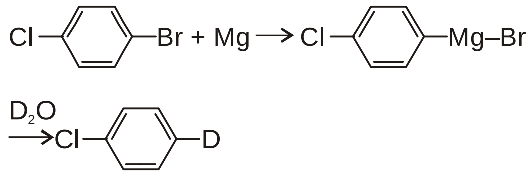
78. (A)



79. (C)

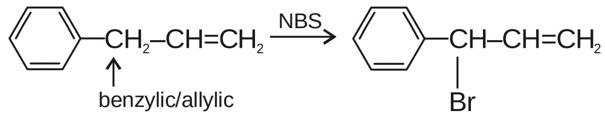
80. (C)

(C–Br) is more reactive than (C–Cl)

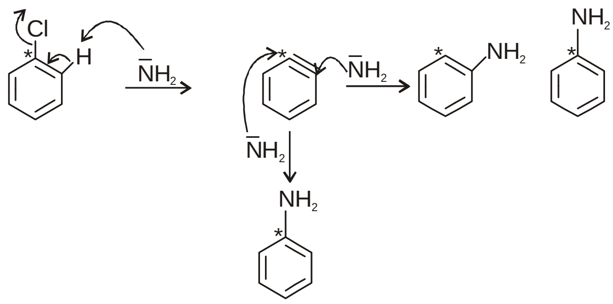


81. (A)

82. (A)



83. (C)



84. (C)

$$\text{Mole fraction of } CH_3OH = \frac{nB}{nB + nA}$$

$$= \frac{5.2}{5.2 + 1000/18}$$