

## ANSWERS TO PAPER – I

### PHYSICS

1. As angle between voltage and current is  $90^\circ$

$$\therefore \text{Power} = 0$$

$\therefore$  (d)

2. As they collide elastically so their velocity hence kinetic energy gets exchanged. So  $B$  will rise to  $4h$  and  $A$  will rise to  $h$

$\therefore$  (a)

3. Electric field =  $1000 \text{ N/C}$ ,  $dV = -E \cdot dr = -1000 \times 1 \times 10^{-2} = -10 \text{ V}$

$\therefore$  (a)

4. As in  $+\beta$  particle emission proton is converted into neutron

$\therefore$  neutron to proton ratio increases

$\therefore$  (a)

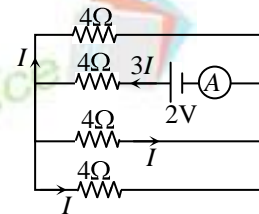
5. Applying Kirchoff's voltage law in a loop

$$2 - 12I = 4I = 0$$

$$2 = 16I$$

$$I = \frac{1}{8} \quad \therefore \quad 3I = \frac{3}{8} \text{ A}$$

$\therefore$  (b)



6. (a)

7. For a pure inductor circuit potential,  $V = V_0 \sin \omega t$  and current

$$i = i_0 \sin\left(\omega t + \frac{\pi}{2}\right) \text{ thus angle} = \frac{\pi}{2}$$

$\therefore$  (c)

8. Frequency of 1<sup>st</sup> source [ $\lambda_1 = 100 \text{ cm}$ ]  $f_1 = \frac{v}{\lambda_1}$

$$\text{Frequency of second source } [\lambda_2 = 90 \text{ cm}] \quad f_2 = \frac{v}{\lambda_2}$$

$$\therefore \text{Beat frequency} = f_1 - f_2 = \frac{v}{\lambda_1} - \frac{v}{\lambda_2}$$

$$= 396 \left( \frac{1}{90} - \frac{1}{100} \right) \times 100 = \frac{396 \times 10 \times 100}{90 \times 100} = 44 \text{ Hz.}$$

$\therefore$  (d)

9.  $v_{rms} = \sqrt{\frac{3RT}{M}} \because M \text{ and } R \text{ are constant for the same gas.}$

$$\therefore v_{rms} \propto \sqrt{T} \Rightarrow \frac{v}{2v} = \sqrt{\frac{300}{T}}, \quad T = 1200 \text{ K.}$$

$\therefore$  (d)

10. We know that,  $\frac{mv^2}{r_n} = \frac{1}{4\pi\epsilon_0} \frac{Ze^2}{r_n^2}$  ... (i) and according to Bohr's model  $mvr_n = \frac{nh}{2\pi}$

putting  $v$  = in (i) we get  $\frac{mn^2h^2}{4\pi^2m^2r_n^3} = \frac{1}{4\pi\epsilon_0} \frac{Ze^2}{r_n^2}$

$$r_n = \frac{n^2\epsilon_0h^2}{\pi mZe^2} \Rightarrow r_n \propto n^2$$

where  $h$  = Plank's constant,  $m$  = mass of electron

$Z$  = atomic weight,  $n$  = principal quantum number

$\therefore$  (d)

11. Refractive index,  $\mu = A + \frac{B}{\lambda^2}$  (Cauchy's law)

So, refractive index depends upon the wavelength of the light.

$\therefore$  (b)

12. We know that,  $E = V/d$

$$\therefore E = \frac{0.5}{5.0 \times 10^{-7}} = 1 \times 10^6 \text{ V/m}$$

$\therefore$  (a)

13. As the capacitors are identical, they will finally have charge  $Q/2$  each.

$$\text{Initial energy of the system} = E_i = \frac{Q^2}{2C}$$

$$\text{Final energy of the system} = E_f = 2 \left[ \frac{(Q/2)^2}{2C} \right] = \frac{Q^2}{4C}$$

$$\text{Heat produced} = \text{loss in energy} = E_i - E_f = \frac{Q^2}{4C}$$

$\therefore$  (b)

14.  $E = -\frac{dV}{dx} = -8x$  at  $(1, 0, 2) \vec{E} = -8\hat{i}$

$\therefore$  (a)

15. Equation of trajectory,  $y = x \tan \theta - \frac{1}{2} \frac{gx^2}{u^2 \cos^2 \theta}$

$\tan \theta = 1 \dots (i)$

$u \cos \theta = \sqrt{g} \dots (ii)$

$$T = \frac{2u \sin \theta}{g} = \frac{2\sqrt{g}}{g} = \frac{2}{\sqrt{g}}$$

$\therefore$  (b)

16. Pressure at depth  $h = P + hgd$

$\therefore$  Pressure inside the bubble will be  $P + hgd + \frac{2T}{r}$

$\therefore$  (b)

17. (c)

18. As  $T \propto R^{3/2}$ ,  $T_1 = KR^{3/2}$ ,  $T_2 = KR^{3/2}(1.01)^{3/2}$ ,  $\frac{T_2 - T_1}{T_1} \times 100 = 1.5\%$

$\therefore$  (b)

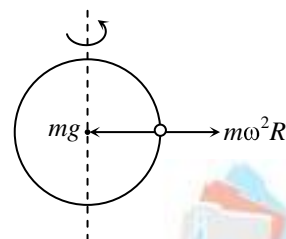
19.  $mg' = mg - m\omega^2 R$

$$\frac{3}{5}mg = mg - m\omega^2 R$$

$$m\omega^2 R = \frac{2mg}{5}$$

$$\omega = \sqrt{\frac{2g}{5R}}$$

$\therefore$  (a)

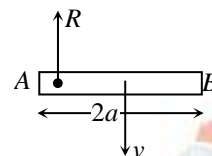


20. When the end A is stopped, reaction force is acted upon end A hence angular momentum about end A is conserved

$$\therefore mva = \frac{4ma^2}{3}\omega$$

$$\omega = \frac{3v}{4a}$$

$\therefore$  (d)



21.  $r_1 = \frac{m_2 r}{m_1 + m_2}$  and  $r_2 = \frac{m_1 r}{m_1 + m_2}$

$I = m_1 r_1^2 + m_2 r_2^2$

$I = \left[ \frac{m_1 m_2^2}{(m_1 + m_2)^2} + \frac{m_2 m_1^2}{(m_1 + m_2)^2} \right] r^2 = \frac{m_1 m_2}{m_1 + m_2} r^2$

∴ (a)



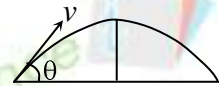
22. (c)

23.  $\frac{2v^2 \sin \theta \cos \theta}{g} = \frac{2 \times v^2 \sin^2 \theta}{2g}$

$\tan \theta = 2$

Range =  $\frac{v^2 \sin 2\theta}{g} = \frac{2v^2 \sin \theta \cos \theta}{g} = \frac{4v^2}{5g}$

∴ (a)



24. As  $C = \frac{5F}{9} - \frac{5 \times 32}{9}$  ∴  $\frac{dC}{dF} = \frac{5}{9}$

∴ (b)

25. As internal energy can be increased by doing work also.

∴ (c)

26. (c)

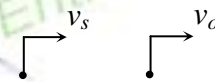
27. As temperature and surface area is same

∴ (a)

28. As density is maximum at 4°C and volume in both case increases

∴ (a)

29.  $f' = \frac{v \pm v_0}{v \pm v_s}$ ,  $f' = \frac{332 - 10}{332 - 10} f = 1000$



∴ (c)

30. The particle may move along x-axis and y-axis

∴ (a)

31. Intensity =  $\frac{40}{\pi r^2}$ ,  $\frac{40}{\pi(25)^2} \times 3 = \frac{40}{\pi(50)^2} \times t$   $t = 3 \times (2)^2 = 12$  s

$\therefore$  (c)

32. As  $P_1 + P_2 = P_{eq}$ ,  $\frac{100}{80} = \frac{100}{20} + P_2$ ,  $P_2 = 100 \left[ \frac{1}{80} - \frac{1}{20} \right] = 100 \left[ \frac{-3}{80} \right] = -3.75$  D

$\therefore$  (d)

33. (c)

34. Let  $F$  is the upward force then  $Mg - F = M\alpha$

In second case

$$F - (M - m)g = (M - m)\alpha,$$

$$Mg - F = M\alpha$$

$$Mg - (M - m)g = (2M - m)\alpha,$$

$$mg = 2M\alpha - m\alpha$$

$$m = \frac{2M\alpha}{g + \alpha}$$

$\therefore$  (b)

35. As force is maximum at extreme position  $\therefore$  Acceleration is maximum at that point

$\therefore$  (a)

36.  $7\beta_1 = d_1 = 7 \frac{\lambda_1 D}{2d}$  and  $7\beta_2 = d_2 = 7 \frac{\lambda_2 D}{2d}$   $\therefore \frac{d_1}{d_2} = \frac{\lambda_1}{\lambda_2}$

$\therefore$  (a)

37. Work done is area under  $PV$  diagram =  $PV$

$\therefore$  (a)

38. (b)

39.  $V_D = 4i$ ,  $V_M = 4j$ ,  $V_{DM} = 4i - 3j$ ,  $|V_{DM}| = 5$

$\therefore$  (c)

40. As net external force on the system is zero hence centre of mass does not move

$\therefore$  (b)

41. Current through loop =  $ne$

$\therefore$  Magnetic field at centre =  $\frac{\mu_0 ne}{2r}$

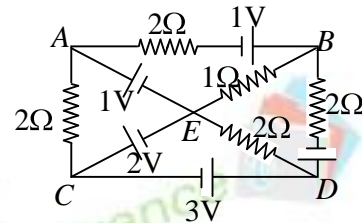
$\therefore$  (b)



42. As  $\frac{V_1}{V_2} = \frac{n_1}{n_2}$ ,  $V_2 = \frac{n_2}{n_1} V_1 = 240 \text{ V}$   
 $\therefore$  (a)

43. (d)

44. Taking potential of point A to be zero  
 Potential of E = -1V  
 Potential of C = -1 + 2 = 1V  
 Potential of D = 1 + 3 = 4V  
 $\therefore$  (a)



45. As  $eV = \frac{hc}{\lambda}$ ,  $\lambda = \frac{hc}{eV}$   
 So if voltage is doubled cut off wavelength is halved.  
 $\therefore$  (b)

46. Let  $N_0$  is initial no of nucleus of X

$$X_t = \frac{N_0}{(2)^{t/2}}, \quad Y_t = N_0 \left[ 1 - \frac{1}{(2)^{t/2}} \right], \quad N_0 \left[ 1 - \frac{1}{(2)^{t/2}} \right] = 7 \frac{N_0}{(2)^{t/2}}$$

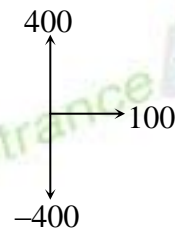
$$1 = \frac{8}{(2)^{t/2}}, \quad (2)^{t/2} = 8, \quad t = 6$$

$\therefore$  (a)

47.  $\lambda = \frac{h}{mv} = \frac{6.63 \times 10^{-34}}{10^{-31} \times 10^5} = 6.6 \times 10^{-8} \text{ m}$   
 $\therefore$  (b)

48. As K.E. of an electron does not depend on intensity  
 $\therefore$  (b)

49. Drawing the phasor diagram, potential drop across Resistor = 100 V  
 $\therefore I = 2 \text{ amp}$   
 $\therefore$  (a)



50. If  $I_1$  is the current in coil of radius  $R_1$  then magnetic field at the centre of small coil =  $\frac{\mu_0 I_1 N_1}{2R_1}$

Flux through circular coil  $\phi = \frac{\mu_0 I_1 N_1}{2R_1} \times \pi R_2^2 N_2$

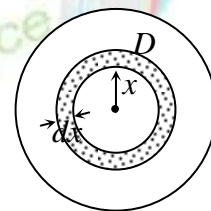
$$M = \frac{\phi}{I_1} = \frac{\mu_0 N_1 N_2 \pi R_2^2}{2R_1}$$

$\therefore$  (b)

51. Potential difference across the ring of radius  $x$  and width  $dx$

$$= \int_0^R B dx \omega x = \frac{B \omega R^2}{2}$$

$\therefore$  (d)



52. As  $M \propto \frac{1}{T^2}$ ,  $M$  is pole strength and  $T$  is time period

$$M_1 T_1^2 = 4 M_2 T_2^2, \quad M_1 \times 4 = 4 M_2 T_2^2, \quad T_2 = 1$$

$\therefore$  (c)

53. (c)

54. As cyclotron frequency  $f_0 = \frac{qB}{2\pi M}$

$\therefore$  (c)

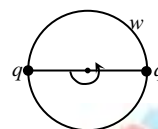
55.  $I = 2q \frac{\omega}{2\pi}$

$$M = \frac{2q\omega}{2\pi} \times \pi R^2 = \frac{2q\omega R^2}{2}$$

Angular momentum  $L = 2 \times \omega R \times mR = 2m\omega R^2$

$$\therefore \frac{M}{L} = \frac{q\omega R^2}{2m\omega R^2} = \frac{q}{2m}$$

$\therefore$  (a)





56. Magnetic field can change only direction

∴ (b)

57. If  $T_i$  is inversion temperature then  $T_i - 270 = 270 - 20$ ,  $T_i = 520^\circ\text{C}$

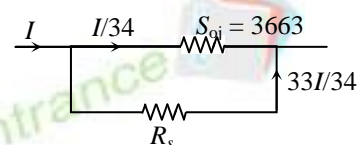
∴ (b)

58. As potential difference across each resistance is same

$$\therefore 3663 \times \frac{I}{34} = \frac{33I}{34} \times R_s, \quad \frac{3663}{33} = R_s$$

$$R_s = 111\Omega$$

∴ (b)



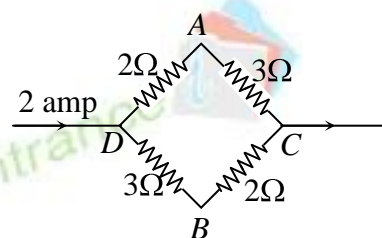
59. Assuming potential at C to be zero

Potential at A = 3V

Potential at B = 2V

$$V_A - V_B = 1V$$

∴ (b)



60. Let internal resistance be  $r_i$

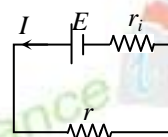
$$\text{Current in loop } I = \frac{E}{r + r_i}$$

$$V = E - Ir_i$$

$$V = E - \frac{Er_i}{r + r_i}$$

$$\therefore r_i = \left( \frac{E - V}{V} \right) r$$

∴ (c)

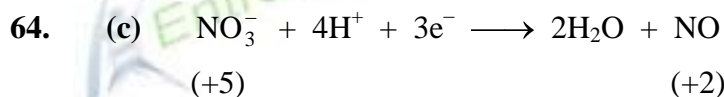




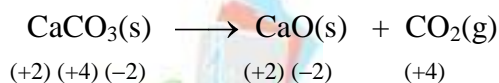
61. (d)



63. (b)



65. (a) In ionic reactions only ions are exchanged and oxidation states remain same.



66. (d)

67. (b)  $\frac{n_{\text{O}_2}}{n_{\text{N}_2}} = \sqrt{\frac{2}{32}}$

$$\frac{125}{x} = \frac{1}{4}$$

$$x = 0.5, w\text{H}_2 = 0.5 \times 2 = 1 \text{ gm}$$

68. (a)

69. (b) Greater the 's' character, more acidic is the hybridised carbon atom.

70. (c) Alkali metals form oxides, peroxides and superoxides. Reactivity with water increases due to rapid decrease in ionisation energy on moving down the group.

71. (c)

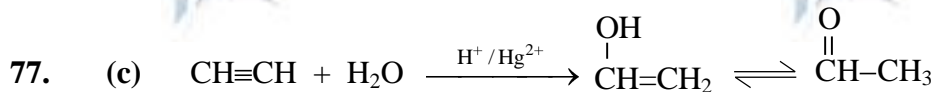
72. (c)

73. (b)

74. (a)

75. (d) Conjugated diene are generally highly stable; hence in the case of such types of diene heat of hydrogenation is minimum.

76. (b) Terminal alkynes react with amm.  $\text{AgNO}_3$  or  $\text{Ag}(\text{NH}_3)_2^+\text{OH}^-$  to give white precipitate.



78. (b)

79. (b)

80. (a)

81. (b)

82. (c) In  $\text{AgNO}_3 + \text{NaCl} \longrightarrow \text{AgCl}\downarrow + \text{NaNO}_3$ , only ions are exchanged hence this reaction is an ionic reaction.
83. (a)
84. (a)
85. (a)
86. (b)
87. (b)
88. (a)  $\text{K}_2\text{Cr}_2\text{O}_7$                        $\text{K}_2\text{CrO}_4$   
 $2 + 2x + 4 = 0$                        $2 + x - 8 = 0$   
 $x = +6$                                        $x = +6$
89. (d) Electronegativity difference for  $-\text{O}-\text{H}$  bond is maximum among given compounds.
90. (d) Decreasing order of stability of free radicals obtained in halogenation of alkanes is  $(3^\circ > 2^\circ > 1^\circ)$ .
91. (a)
92. (c)
93. (b)
94. (c)
95. (c)  $\overset{+2}{\text{Fe}}\overset{+3}{\text{C}_2}\text{O}_4 + \overset{-}{\text{Mn}}\overset{-}{\text{O}}_4 \xrightarrow{\text{H}^+} \overset{+3}{\text{Fe}}\overset{+4}{\text{CO}}_2 + \overset{2+}{\text{Mn}}$   
 $n = 3$                        $n = 5$   
 $\therefore 5 \times \text{mole of MnO}_4^- = 3 \times \text{mole of FeC}_2\text{O}_4$   
 $\therefore \text{Mole of MnO}_4^- = \frac{3}{5} \times 1 = \frac{3}{5}$ .
96. (c)  $\text{Fe}^{+2} \longrightarrow \text{Fe}^{+3} + \text{e}^-$   
 $\text{S}_2^{-2} \longrightarrow 2\text{S}^{+4} + 10\text{e}^-$   
 $\text{FeS}_2 \longrightarrow 2\text{S}^{+4} + \text{Fe}^{+3} + 11\text{e}^-$   
 $\therefore \text{Equivalent mass of FeS}_2 = \frac{\text{molar mass}}{11}$ .
97. (d)
98. (b)
99. (b) For a bcc structure,  $Z = 2$   

$$M = \frac{\rho \times a^3 \times N_A}{Z} = \frac{8.0 \times (250 \times 10^{-10})^3 \times 6.02 \times 10^{23}}{2} = 37.6 \text{ g mol}^{-1}$$
100. (a)  $K_p = \frac{P_{\text{Cl}_2} \times P_{\text{PCl}_3}}{P_{\text{PCl}_5}}$

Since, at equilibrium moles of each component is same, so partial pressure be same

$$\text{i.e. } P_{\text{Cl}_2} = P_{\text{Cl}_3} = P_{\text{Cl}_5} = \frac{2}{6} \times 3 = 1$$

$$\therefore K_p = 1.$$

101. (b)

$$102. (c) \quad t = \frac{2.303}{K} \log \frac{a_o}{a_t} = \frac{2.303}{K} \log \frac{20}{2.5} = \frac{2.303}{0.0693} \log 8 = \mathbf{30 \text{ min.}}$$

$$103. (c) \quad \therefore \frac{P^\circ - P}{P^\circ} = X_{\text{solute}} \text{ or } 1 - \left( \frac{P^\circ - P}{P^\circ} \right) = 1 - X_{\text{solute}} = X_{\text{solvent}} = \frac{P}{P^\circ}.$$

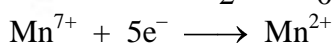
105. (a)

$$\Delta H = \Delta U + \Delta n_g RT$$

$$\Rightarrow \Delta H - \Delta U = \Delta n_g RT = \frac{-3 \times 8.314 \times 298}{1000} = \mathbf{-7.43 \text{ kJ mol}^{-1}}.$$

$$106. (d) \quad E_{\text{cell}} = E_{\text{cell}}^\circ - \frac{0.059}{2} \log \frac{1}{0.1}; \quad E_{\text{cell}}^\circ = \mathbf{0.54V}.$$

107. (b)



Thus, 5 moles of electron = 5 faraday.

108. (a)

Using the relation rate  $\propto$  (conc. of reactant)<sup>n</sup> where 'n' is order of the reaction.

In the question, since rate is directly proportional to the conc. of reactant, hence the reaction is of first order.

109. (b)

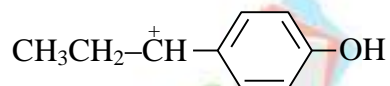
$$\text{Total geometrical isomers} = 2^n = 2^2 = 4.$$

110. (c)

111. (d)

112. (b)

H<sup>+</sup> will attack the double bond and would give



which would be resonance stabilized.

113. (d)

114. (c)

115. (b)

116. (c)

118. (c)

119. (b)

120. (c)

