ANSWERS TO PAPER – I

PHYSICS

1. As angle between voltage and current is 90°

∴ Power = 0

∴ **(d)**

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

∴ **(a)**

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

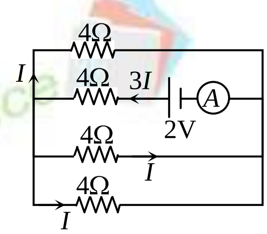
∴ **(a)**

4. As in +β particle emission proton is converted into neutron

∴ neutron to proton ratio increases

∴ **(a)**

5. Applying Kirchoff's voltage law in a loop



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

$$2 = 16I$$

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

∴ **(b)**

6. **(a)**

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

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

∴ **(c)**

8. Frequency of 1st source [λ_1 = 100 cm] $f_1 = \frac{v}{\lambda_1}$

Frequency of second source [λ_2 = 90 cm] $f_2 = \frac{v}{\lambda_2}$

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

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

∴ **(d)**

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

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

$\therefore$ **(d)**

10. We know that, $\frac{mv^2}{r_n} = \frac{1}{4\pi\varepsilon_0}\frac{Ze^2}{r_n^2}$ …(i) and according to Bohr's model $mvr_n = \frac{nh}{2\pi}$

putting v = in (i) we get $\frac{mn^2h^2}{4\pi^2m^2r_n^3} = \frac{1}{4\pi\varepsilon_0}\frac{Ze^2}{r_n^2}$

$$r_n = \frac{n^2\varepsilon_0 h^2}{\pi m Z e^2} \Rightarrow r_n \propto n^2$$

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, $E = V/d$

$\therefore$ $E = \frac{0.5}{5.0\times10^{-7}} = 1\times10^6$ V/m

$\therefore$ **(a)**

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

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

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

Heat produced = 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, $y = x\tan\theta - \frac{1}{2}\frac{gx^2}{u^2\cos^2\theta}$

$\tan\theta = 1$ … (i)

$u\cos\theta = \sqrt{g}$ … (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 $P + h\rho d + \frac{2T}{r}$

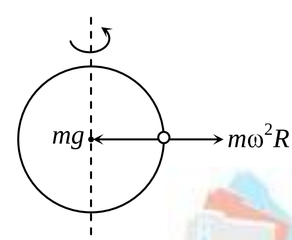
$\therefore$ **(b)**

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



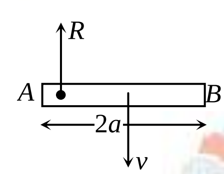
$\frac{3}{5}mg = mg - m\omega^2 R$

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

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

$\therefore$ **(a)**

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

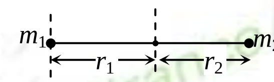


$\therefore$ $mva = \frac{4ma^2}{3}\omega$

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

$\therefore$ **(d)**

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



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

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

$\therefore$ **(a)**

22. **(c)**

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

$\tan\theta = 2$

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

$\therefore$ **(a)**

24. As $C = \dfrac{5F}{9} - \dfrac{5 \times 32}{9}$ $\quad\therefore\quad$ $\dfrac{dC}{dF} = \dfrac{5}{9}$

$\therefore$ **(b)**

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

$\therefore$ **(c)**

26. **(c)**

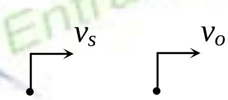
27. As temperature and surface area is same

$\therefore$ **(a)**

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

$\therefore$ **(a)**

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



$\therefore$ **(c)**

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

$\therefore$ **(a)**

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

$\therefore$ **(c)**

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

$\therefore$ **(d)**

33. **(c)**

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

In second case

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

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

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

$\therefore$ **(b)**

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

$\therefore$ **(a)**

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

$\therefore$ **(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 = $\dfrac{\mu_0 ne}{2r}$

$\therefore$ **(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)**

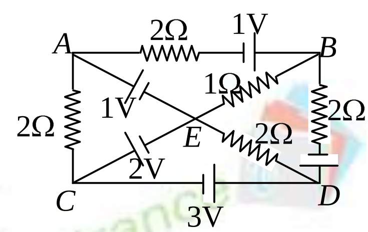
44. Taking potential of point *A* to be zero

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*

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

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

$\therefore$ **(a)**

47. $\lambda = \frac{h}{mv} = \frac{6.63\times10^{-34}}{10^{-31}\times10^{5}} = 6.6\times10^{-8}\text{ m}$

$\therefore$ **(b)**

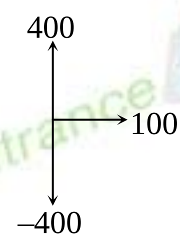
48. As K.E. of an electron does not depend on intensity

$\therefore$ **(b)**

49. Drawing the phasor diagram, potential drop across Resistor = 100 V

$\therefore$ I = 2 amp

$\therefore$ **(a)**



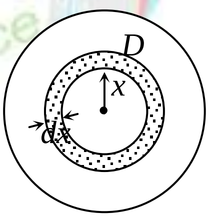
50. If I_1 is the current in coil of radius R_1 then magnetic field at the centre of small coil = $\frac{\mu_0 I_1 N_1}{2R_1}$

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

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

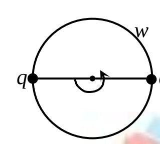
$\therefore$ **(c)**

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)**

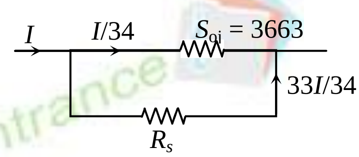
56. Magnetic field can change only direction

$\therefore$ **(b)**

57. If T_i is inversion temperature then $T_i - 270 = 270 - 20$, $T_i = 520\,°C$

$\therefore$ **(b)**

58. As potential difference across each resistance is same

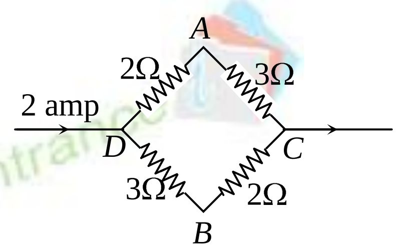


$\therefore$ $3663 \times \frac{I}{34} = \frac{33I}{34} \times R_s$, $\frac{3663}{33} = R_s$

$R_s = 111\Omega$

$\therefore$ **(b)**

59. Assuming potential at C to be zero



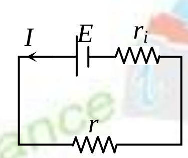
Potential at A = 3V

Potential at B = 2V

$V_A - V_B = 1V$

$\therefore$ **(b)**

60. Let internal resistance be r_i



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

$V = E - Ir_i$

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

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

$\therefore$ **(c)**

CHEMISTRY

61. **(d)**

62. **(a)** $:\ddot{O}=\ddot{O}:\rightarrow \ddot{O}: \;\longleftrightarrow\; \ddot{O}=\overset{+}{\ddot{O}}-\overset{-}{\ddot{O}}: \;\longleftrightarrow\; \overset{+}{:\ddot{O}}-\ddot{O}-\overset{-}{\ddot{O}}:$

63. **(b)**

64. **(c)** $\underset{(+5)}{NO_3^-} + 4H^+ + 3e^- \longrightarrow 2H_2O + \underset{(+2)}{NO}$

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

$$\underset{(+2)\,(+4)\,(-2)}{CaCO_3(s)} \longrightarrow \underset{(+2)\,(-2)}{CaO(s)} + \underset{(+4)}{CO_2(g)}$$

66. **(d)**

67. **(b)** $\frac{n_{O_2}}{n_{n_2}} = \sqrt{\frac{2}{32}}$

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

$x = 0.5$, $wH_2 = 0.5 \times 2 = 1$ 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. $AgNO_3$ or $Ag(NH_3)_2^+OH^-$ to give white precipitate.

77. **(c)** $CH\equiv CH + H_2O \xrightarrow{H^+/Hg^{2+}} \overset{OH}{\overset{|}{C}}H=CH_2 \rightleftharpoons \overset{O}{\overset{||}{C}}H-CH_3$

78. **(b)**

79. **(b)**

80. **(a)**

81. **(b)**

82. **(c)** In $AgNO_3 + NaCl \longrightarrow AgCl\downarrow + NaNO_3$, only ions are exchanged hence this reaction is an ionic reaction.

83. **(a)**

84. **(a)**

85. **(a)**

86. **(b)**

87. **(b)**

88. **(a)** $K_2Cr_2O_7$ K_2CrO_4

$2 + 2x + 4 = 0$ $2 + x - 8 = 0$

$x = +6$ $x = +6$

89. **(d)** Electronegativity difference for –O–H bond is maximum among given compounds.

90. **(d)** Decreasing order of stability of free radicals obtained in halogenation of alkanes is (3° > 2° > 1°).

91. **(a)**

92. **(c)**

93. **(b)**

94. **(c)**

95. **(c)** $\overset{+2}{Fe}\overset{+3}{C_2}O_4 + MnO_4^- \xrightarrow{H^+} \overset{3+}{Fe}\overset{+4}{C}O_2 + Mn^{2+}$

n = 3 n = 5

$\therefore$ 5 × mole of MnO_4^- = 3 × mole of FeC_2O_4

$\therefore$ Mole of $MnO_4^- = \frac{3}{5} \times 1 = \mathbf{\frac{3}{5}}$.

96. **(c)**

$$Fe^{+2} \longrightarrow Fe^{+3} + e^-$$
$$S_2^{-2} \longrightarrow 2S^{+4} + 10e^-$$
$$FeS_2 \longrightarrow 2S^{+4} + Fe^{+3} + 11e^-$$

$\therefore$ Equivalent mass of $FeS_2 = \frac{\text{molar mass}}{11}$.

97. **(d)**

98. **(b)**

99. **(b)** For a bcc structure, Z = 2

$$M = \frac{\rho \times a^3 \times N_A}{Z} = \frac{8.0 \times (250 \times 10^{-10}) \times 6.02 \times 10^{23}}{2} = \mathbf{37.6\ g\ mol^{-1}}.$$

100. **(a)** $K_p = \frac{P_{Cl_2} \times P_{PCl_3}}{P_{PCl_5}}$

Since, at equilibrium moles of each component is same, so partial pressure be same i.e. $P_{Cl_2} = P_{Cl_3} = P_{Cl_5} = \frac{2}{6} \times 3 = 1$

$\therefore\ K_p = \mathbf{1}$.

101. **(b)**

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

103. **(c)** $\because\ \frac{P^o - P}{P^o} = X_{solute}$ or $1 - \left(\frac{P^o - P}{P^o}\right) = 1 - X_{solute} = X_{solvent} = \frac{P}{P^o}$.

105. **(a)** $\Delta H = \Delta U + \Delta n_g RT$

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

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

107. **(b)** $Mn^{7+} + 5e^- \longrightarrow Mn^{2+}$

Thus, 5 moles of electron = 5 faraday.

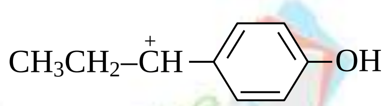
108. **(a)** Using the relation rate $\propto$ (conc. of reactant)^n where 'n' is order of the reaction.
In the question, since rate is directly proportional to the conc. of reactant, hence the reaction is of first order.

109. **(b)** Total geometrical isomers = $2^n = 2^2 = 4$.

110. **(c)**

111. **(d)**

112. **(b)** H^+ 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)**