Physics :

1. Sol. (d)

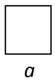
Potential difference between *O* and *A* is

$V_0 - V_A = \frac{1}{2}Bl^2\omega$

O and *B* is $V_0 - V_B = \frac{1}{2}Bl^2\omega$

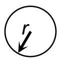
So, $V_A - V_B = 0$

2. Sol. (d)



Initially

It's area $A_1 = a^2$; and flux linked $\phi_1 = BA_1$



Finally $4a = 2\pi r$

It's area $A_2 = \pi r^2 = \pi\left(\frac{2a}{\pi}\right)^2 = \frac{4a^2}{\pi}$ and flux linked

$\phi_2 = BA_2$

Induced emf $|e| = \frac{\Delta\phi}{\Delta t} = \frac{\phi_2 - \phi_1}{\Delta t} = \frac{B(A_2 - A_1)}{\Delta t} = \frac{Ba^2}{t}\left(\frac{4}{\pi} - 1\right)$

So induced charged $|q| = \frac{|e|}{R}.t = \frac{Ba^2}{R}\left(\frac{4}{\pi} - 1\right)$

3. Sol. (b)

Power $P = \frac{e^2}{R}$;

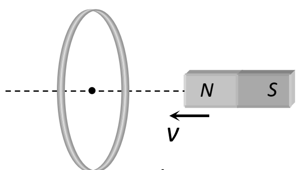
Here *e* = induced *emf* = $-\frac{d\phi}{dt} = -NA\left(\frac{dB}{dt}\right)$

$\because\ R \propto \frac{l}{r^2}$; where *R* = resistance, *r* = radius of wire,

l = length of wire $\propto$ number of turns *N* (if area of each turn is constant) $\Rightarrow P \propto \frac{N^2r^2}{l} \propto Nr^2$

$\Rightarrow \frac{P_1}{P_2} = 1$.

4. Sol. (b)



Coil

$\left(\frac{d\phi}{dt}\right)_{In\ first\ case} = e$

$\left(\frac{d\phi}{dt}\right)_{relative\ velocity\ 2v} = 2\left(\frac{d\phi}{dt}\right)_{I\ case} = 2e$

5. Sol. (d)

If bar magnet is falling vertically through the hollow region of long vertical copper tube then the magnetic flux linked with the copper tube (due to 'non-uniform' magnetic field of magnet) changes and eddy currents are generated in the body of the tube by Lenz's law the eddy currents opposes the falling of the magnet which therefore experience a retarding force. The retarding force increases with increasing velocity of the magnet and finally equals the weight of the magnet. The magnet then attains a constant final terminal velocity *i.e.* magnet ultimately falls with zero acceleration in the tube.

The resistance of copper solenoid is much higher than that of copper tube, hence the induced current in it, due to motion of magnet, will be much less than that in the tube. Consequently the opposition to the motion of magnet will be less and the magnet will fall with an acceleration (a) less than *g*.

(*i.e.* $a < g$).

6. Sol. (a)

Inward magnetic field (×) increasing. Therefore, induced current in both the loops should be anticlockwise. But as the area of loop on right side is more, induced *emf* in this will be more compared to the left side loop

$\left(e = -\frac{d\phi}{dt} = -A.\frac{dB}{dt}\right)$.

Therefore net current in the complete loop will be in a direction shown below. Hence only option (a) is correct.

7. Sol. (b)

The emf induced across the rod *AB* is $e = Bv_{\perp}l$.

Here $v_\perp$ = v sin 30° = component of velocity perpendicular to length.

Hence $e = Bvl\sin 30^o = (2)(4)(1)\left(\frac{1}{2}\right) = 4V$

The free electrons of the rod shift towards right due to the force $q(\vec{v}\times\vec{B})$. Thus the left side of the rod is at higher potential. or $V_A - V_B = 4V$

8. Sol. (a)

By using $|e_2| = M\frac{di_1}{dt}$; $i_2 = \frac{e_2}{R_2} = \frac{M}{R_2}\frac{di_1}{dt}$

$\Rightarrow\ 0.4 = \frac{0.5}{5}\times\frac{di_1}{dt}$; $\frac{di_1}{dt} = 4\ A/sec$

9. Sol. (a)

$\because\ L \propto N^2 r$; $\frac{L_1}{L_2} = \left(\frac{N_1}{N_2}\right)^2 \times \frac{r_1}{r_2}$

$\Rightarrow\ \frac{L}{L_2} = \left(\frac{1}{2}\right)^2 \times \left(\frac{r}{r/2}\right) = \frac{1}{2}$; $L_2 = 2L$

10. Sol. (c)

$U = \frac{1}{2}Li^2 = \frac{1}{2}\times 2\left(\frac{10}{2}\right)^2 = 25J$

11. Sol. (a)

$i = i_0\left(1 - e^{-\frac{t}{\tau}}\right)$ Where $i = \frac{1}{2}i_0$ and $\tau = \frac{L}{R}$.

Thus $\frac{1}{2}i_0 = i_0\left(1 - e^{-\frac{t}{\tau}}\right)$ or $\frac{1}{2} = e^{-\frac{t}{\tau}}$ or $2 = e^{+\frac{t}{\tau}}$

Thus

$t = \tau\log_e 2 = \frac{50\times 10^{-3}}{0.025}\times 0.693 = 1.34\times 10^{-3}s = 1.34$ milli second.

12. Sol. (d)

13. Sol. (b)

14. Sol. (c)

By using $V = V_0\sin\omega t \Rightarrow \frac{V_0}{\sqrt{2}} = V_0\sin\frac{2\pi t}{T}$

$\Rightarrow\ \frac{1}{\sqrt{2}} = \sin\left(\frac{2\pi}{T}\right)t\ \ \Rightarrow\ \sin\frac{\pi}{4} = \sin\left(\frac{2\pi}{T}\right)t$

$\Rightarrow\ \frac{\pi}{4} = \frac{2\pi}{T}t\ \ \Rightarrow\ t = \frac{T}{8}sec.$

15. Sol. (d)

The given current is a mixture of a dc component of 3*A* and an alternating current of maximum value 6*A*

Hence *r.m.s.* value $= \sqrt{(dc)^2 + (r.m.s.\text{ value of ac})^2}$

$= \sqrt{(3)^2 + \left(\frac{6}{\sqrt{2}}\right)^2}$

$= \sqrt{(3)^2 + (3\sqrt{2})^2} = 3\sqrt{3}A$.

16. Sol. (c)

$i_{WL} = i_{rms}\sin\phi\ \Rightarrow\ \sqrt{3} = 2\sin\phi \Rightarrow \sin\phi = \frac{\sqrt{3}}{2}$

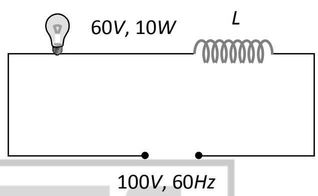
$\Rightarrow\ \phi = 60^o$. So, p.f. $= \cos\phi = \cos 60^o = \frac{1}{2}$.

17. Sol. (c)

As current flows in a single direction, the device allows current only during positive half cycle only

$\therefore\ i_{rms} = \frac{i_0}{2} = \frac{V_0}{2R} = \frac{150}{2\times 20} = 3.75A$.

18. Sol. (a)



Resistance of the bulb $R = \frac{60\times 60}{10} = 360\ \Omega$.

For maximum illumination, voltage across the bulb $V_{Bulb} = V_R = 60V$

By using $V = \sqrt{V_R^2 + V_L^2}\ \Rightarrow\ (100)^2 = (60)^2 + V_L^2$

$\Rightarrow\ V_L = 80V$

Current through the inductance (*L*) = Current through the bulb $= \frac{10}{60} = \frac{1}{6}A$

Also $V_L = iX_L = i(2\pi\nu L)$

$\Rightarrow\ L = \frac{V_L}{(2\pi\nu)i} = \frac{80}{2\times 3.14\times 60\times\frac{1}{6}} = 1.28H.$

19. Sol. (c)

$X_L = 2\pi\nu L = 2\times 3.14\times 50\times 95.5\times 10^{-3} = 29.98\ \Omega \approx 30\Omega$

Impedance $Z = \sqrt{R^2 + X_L^2} = \sqrt{(40)^2 + (30)^2} = 50\ \Omega$

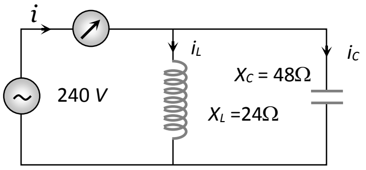
20. Sol. (c)

$V_L = V_C$;

This is the condition of resonance and in resonance $V = V_R = 220\ V$.

In the condition of resonance current through the circuit $i = \frac{V_{rms}}{R} = \frac{220}{100} = 2.2A.$

21. **Sol. (a)**



$$i_L = \frac{240}{24} = 10\,A$$

$$i_C = \frac{240}{48} = 5\,A$$

Hence $i = i_L - i_C = 5A$

22. **Sol. (d)**

23. **Sol. (b)**

24. **Sol. (b)**

1. rms value = $\frac{x_0}{\sqrt{2}}$

2. $x_0 \sin\omega t \cos\omega t = \frac{x_0}{2}\sin 2\omega t \Rightarrow rms$ value $= \frac{x_0}{2\sqrt{2}}$

3. $x_0 \sin\omega t + x_0 \cos\omega t \Rightarrow rms$ value $= \sqrt{\left(\frac{x_0}{\sqrt{2}}\right)^2 + \left(\frac{x_0}{\sqrt{2}}\right)^2}$

$$= \sqrt{x_0^2} = x_0$$

25. **Sol. (b)**

$$P = Vi\cos\phi = V\left(\frac{V}{Z}\right)\left(\frac{R}{Z}\right) = \frac{V^2R}{Z^2} = \frac{V^2R}{(R^2+\omega^2L^2)}$$

26. **Sol. (a)**

27. **Sol. (a)**

28. **Sol. (b)**

29. **Sol. (b)**

30. **Sol. (b)**

$$I_{av} = \frac{c\varepsilon_0 E_0^2}{2} = \frac{3\times10^8 \times 8.85\times10^{-15}\times 36^2}{2} = 1.72\ W/m^2$$

31. **Sol. (c)**

$$\lambda = \frac{hc}{E} = \frac{6.6\times10^{-34}\times3\times10^8}{14.4\times10^3\times1.6\times10^{-19}} = 0.8\times10^{-10}\,m = 0.8\,\AA$$

This wavelength belongs to *X*-ray region.

32. **Sol. (b)**

Intensity of electromagnetic wave given is by

$$I = \frac{P_{av}}{4\pi r^2} = \frac{E_m^2}{2\mu_0 c}$$

$$E_m = \sqrt{\frac{\mu_0 c P_{av}}{2\pi r^2}}$$

$$= \sqrt{\frac{(4\pi\times10^{-7})\times(3\times10^8)\times800}{2\pi\times3.5^2}} = 62.6\ \ V/m$$

33. **Sol. (d)**

In one second

$$p = \frac{2U}{c} = \frac{2S_{av}A}{c} = \frac{2\times6\times40\times10^{-4}}{3\times10^8}$$

$$= 1.6\times10^{-10}\,kg-m/s^2$$

34. **Sol. (c)**

$$I_D = \frac{dq}{dt} = \frac{d}{dt}q_0\sin2\pi nt = 2\pi nq_0\cos2\pi nt$$

35. **Sol. (d)**

$$B = \frac{\mu_0\varepsilon_0 r}{2}\frac{dE}{dt} = \frac{1}{2\times9\times10^{16}}\times10^{10} = 5.56\times10^{-8}\,T$$

$$\left(\because e = \frac{1}{\sqrt{\mu_0\varepsilon_0}}\right)$$

36. **Sol. (a)**

37. **Sol. (c)**

38. **Sol. (d)**

39. **Sol. (c)**

40. **Sol. (a)**

41. **Sol. (a)**

42. **Sol. (a)**

43. **Sol. (d)**

44. **Sol. (d)**

45. **Sol. (d)**

Chemistry :

46. SOL. (b)

47. SOL. (a)

48. SOL. (c)

9 + 1 + 3.5 = 13.5

∵ 13.5 g contains $\frac{9}{12}$ mole

∴ 108 g contains $\frac{9 \times 108}{12 \times 13.5}$ = 6 mole carbon

i.e., $C_6H_8N_2$

49. SOL. (b)

$$M = \frac{5}{34 \times 100/1000} = 1.47 \approx 1.5$$

50. SOL. (c)

51. SOL. (d)

$$m = \frac{15}{98 \times \frac{(100 \times 1.1 - 15)}{1000}} = 1.6$$

52. SOL. (d)

As^{3+} is oxidized to As^{5+} while S^{2-} to S^{6+}.

53. SOL. (a)

54. SOL. (b)

55. SOL. (d)

None is correct

White phosphorus dissolved in NaOH on boiling in inert atmosphere.

$$P_4 + 3NaOH + 3H_2O \longrightarrow \underset{(Sodium\ hypophosphite)}{3NaH_2PO_2} + \underset{(phosphate)}{PH_3}$$

Let the oxidation state of phosphorus be x.

$PH_3 \Rightarrow x + 3 = 0 \Rightarrow x = -3$

In NaH_2PO_2,

$+1 + 2(+1) + x + 2(-2) = 0$

$+3 + x - 4 = 0 \Rightarrow x = +1$

Thus the given reaction is disproportionation as oxidation state changes from 0 to – 3 and +1. But none of the given option is correct.

56. SOL. (a)

57. SOL. (c)

58. SOL. (c)

59. SOL. (c)

$$Ca\overset{-1}{Cl^-}O\overset{+1}{Cl^-}$$

60. SOL. (a)

61. SOL. (b)

62. SOL. (d)

63. SOL. (d)

$$C_aH_b + \underset{Excess'}{\left(a + \frac{b}{4}\right)}O_2 \longrightarrow \underset{10a}{aCO_2} + \underset{5b}{(b/2)H_2O}$$

10a = 40 ⇒ a = 4

5b = 50 ⇒ b = 10

64. SOL. (a)

V = KT; one differentiating at constant

P, $\left(\frac{dV}{dT}\right)_p = K$

65. SOL. (b)

66. SOL. (c)

67. SOL. (c)

Calculate $m = \frac{\rho RT}{P}$ and then V.D. = m/2.

68. SOL. (a)

69. SOL. (a)

70. SOL. (c)

71. SOL. (a)

72. SOL. (b)

$$C^* = \sqrt{\frac{2RT}{M}}, \bar{C} = \sqrt{\frac{8RT}{\pi M}}, C = \sqrt{\frac{3RT}{M}}$$

73. SOL. (c)

74. SOL. (b)

For real gases, $\left(P + \frac{a}{V^2}\right)$ (V – b) =RT

At high pressure, P >> a/V^2

Thus neglecting a/V^2 gives

P (V – b) = RT or PV = RT + Pb

or $\frac{PV}{RT} = Z = \frac{RT + Pb}{RT}$

∴ $Z = 1 + \frac{Pb}{RT}$

75. SOL. (a)

76. SOL. (d)

77. SOL. (d)

78. SOL. (c)

$FeCl_2$ and $SnCl_2$ (both are reducing agent and have lower oxidation no.)

79. SOL. (c)

For Bohr orbit, angular momentum is

$mvr_n = \frac{nh}{2\pi}$; $v = \frac{nh}{2\pi m r_n}$ … (i)

Kinetic energy, K.E. = $\frac{1}{2}mv^2$ … (ii)

By putting the value of v from (i) or (ii),

$$K.E. = \frac{1}{2} m \times \frac{n^2h^2}{4\pi^2 m^2 r_n^2} = \frac{n^2h^2}{8\pi^2 m r_n^2}$$

For second Bohr orbit, n = 2

$r_n = a_0 \times n^2$ (a_0 = Bohr radius)

$r_n = 4a_0$

$$K.E. = \frac{(2)^2 h^2}{8\pi^2 m(4a_0)^2}$$

Thus, $K.E. = \dfrac{h^2}{32\pi^2 m a_0^2}$

80. SOL. (d)

Angular momentum = $\dfrac{nh}{2\pi} = \dfrac{5h}{2\pi} = \dfrac{2.5h}{\pi}$

81. SOL. (d)

$$\Delta u = \frac{0.1}{100} \times 10 = 10^{-2} m\sec^{-1};$$

Now $\Delta u \cdot \Delta x = \dfrac{h}{4\pi m}$

$\Delta x = \dfrac{6.625 \times 10^{-34}}{4 \times 10^{-2} \times 3.14 \times 200 \times 10^{-3}}$ = 2.64×10^{-32} m

82. SOL. (c)

83. SOL. (b)

84. SOL. (a)

85. SOL. (d)

86. SOL. (a)

(1) n = 4, l = 1 ⇒ 4p

(2) n = 4, l = 0 ⇒ 4s

(3) n = 3, l = 2 ⇒ 3d

(4) n = 3, l = 1 ⇒ 3p

Increasing order of energy is

3p < 4s < 3d < 4p

(4) < (2) < (3) < (1)

87. SOL. (a)

88. SOL. (a)

2nd excited state means third energy level.

$$E_3 = \frac{E_1}{3^2} = -\frac{13.6}{9} = -1.51 eV$$

89. SOL. (d)

The emission is in visible (VIBGYOR) region. Thus, Balmer series ile either (c) or (d).

In (c) only one emission. The third line will be in the jump from 5 to 2.

90. SOL. (b)

Biology :

91. (c)
92. (a)
93. (d)
94. (c)
95. (d)
96. (a)
97. (b)
98. (c)
99. (d)
100. (a)
101. (d)
102. (b)
103. (c)
104. (c)
105. (a)
106. (c)
107. (c)
108. (a)
109. (d)
110. (a)
111. (c)
112. (c)
113. (b)
114. (d)
115. (a)
116. (b)
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118. (d)
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130. (d)
131. (d)
132. (c)
133. (c)
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135. (c)
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138. (b)
139. (d)
140. (d)
141. (a)
142. (b)
143. (a)
144. (a)
145. (a)
146. (a)
147. (b)
148. (d)
149. (d)
150. (a)
151. (b)
152. (b)
153. (c)
154. (a)
155. (c)
156. (c)
157. (b)
158. (c)
159. (c)
160. (b)
161. (d)
162. (b)
163. (a)
164. (c)
165. (c)

Tetanus toxoid is a vaccine consisting of growth products of *clostridium tetani* treated with formaldehyde serving as an active immunizing agent. Hence it is weakened germs.

166. (a)

B and T-lymphocytes produce antibodies against pathogen in the body, if due to some reason B and T lymphocytes are damaged the body will not be able to produce antibodies against a pathogen. Each B cell and T cell is specific for a particular antigen.

167. (b)

168. (c)

169. (b)

Passive immunity is conferred by the transfer of antibodies from one individual to another. Antibody is a type of blood plasma proteins.

170. (a)

171. (d)

172. (a)

Gibberlins and auxins are known to induce parthenocarpy in plants. If a tomato plant is treated with a low concentration of auxin and gibberellic acid it will produce fruits without fertilization. i.e., parthenocarpic fruits.

173. (c)

174. (c)

Allopolyploid means a mixture of two different genetic forms. Intergeneric hybridization of cereal crops. i.e., *Secale cereal* and *Triticum aestivum* forms *Triticale* (manmade)

175. (a)

Jatropha is a genus of flowering plants in the spurge family euphorbiaceae. Currently the oil from *Jatropha curcas* seeds is used for making biodiesel fuel in Phillippines and in Brazil.

176. (a)

Azolla is a freshwater fern harboring a blue green alga – *anabaena* in its leaf cavities. The alga fixes atmospheric nitrogen and releases nitrogenous compounds in leaf cavities. This symbiotic system is the main source of algal biofertilizer in rice fields.

177. (d)

178. (c)

179. (d)

180. (a)