Section – I

1.(a) $Q = \sqrt{P^2 + R^2}$
$= \sqrt{P^2 + P^2} = \sqrt{2}\,P$

2.(c) $KE_1 = KE_2$
or, $\frac{P_1^2}{2m} = \frac{P_2^2}{2 \times 4m}$
or, $\left(\frac{P_1}{P_2}\right)^2 = \frac{1}{4} = \left(\frac{1}{2}\right)^2$
or, $\frac{P_1}{P_2} = 1:2$

3.(c) When man drinks water from pond then change in wt = change in upthrust ie level remain same.

4.(b) Expansivity of brass is more than steel so system is cooled.

5.(b) Heat lost = Heat gained
or, $mS_1(30 - 26) = mS_2(26 - 20)$
or, $\frac{S_1}{S_2} = \frac{6}{4} = \frac{3}{2}$

6.(d) $\phi = \frac{2\pi x}{\lambda}$
or, $\phi = \frac{2\pi x}{v} f$
or, $f = \frac{1.6\pi \times 330}{2\pi \times 0.4} = 660$ Hz

7.(c) $\frac{\sin 90°}{\sin\theta} = \frac{v_2}{v_1}$
or, $v_2 = \frac{v}{\sin\theta} = v\operatorname{cosec}\theta$

8.(d) $I = \frac{I_0}{2}\cos^2\theta$
$= \frac{I_0}{2} \times \cos^2 60°$
$= \frac{I_0}{2} \times \left(\frac{1}{2}\right)^2$
$= \frac{I_0}{8}$

9.(a) $E = \frac{V}{r}$
$r = \frac{V}{E} = \frac{3000}{500} = 6m$

10.(c) $V = E + Ir$
$= 6 + 2 \times 0.5 = 7V$

11.(c) $M = m \times l$
or, $m = \frac{M}{l}$
$l = \pi R$
or, $R = \frac{l}{\pi}$
∴ $M' = m \times 2R$
$= \frac{M}{l} \times 2 \times \frac{l}{\pi}$
$= \frac{2M}{\pi}$

12.(a) $X_C = \omega L = 2\pi fL$
For dc f = 0
So, $X_L = 0$

13.(b) $KE_{max} = hf - \phi$
i.e. independent of intensity.

14.(a) D_2 is reverse based and D_1 is forward based.
$I = \frac{2}{R} = \frac{2}{20} = 0.1A$

15.(b)
16.(b)
17.(c)
18.(c)
19.(d)
20.(a)
21.(b)
22.(c)
23.(c)
24.(d)
25.(c)
26.(b)
27.(b)
28.(a)

29.(b) $\tan^2\theta + \cot^2\theta = 2$
On solving:
$\tan^2\theta = 1^2 = \tan^2\frac{\pi}{4}$
$\boxed{\theta = n\pi \pm \frac{\pi}{4}}$

30.(d)

31.(a) $\frac{x-3}{4} = \cos\theta$ and $\frac{y-2}{4} = \sin\theta$
Squaring & adding:
$\frac{(x-3)^2}{16} + \frac{(y-2)^2}{16} = 1$ (Circle)

32.(c) Let $f(x) = e^x$
$\int [f(x)]^2 dx = \int e^2x\,dx = \frac{e^{2x}}{2} + c$
$= \frac{[f(x)]^2}{2} + c$

33.(a) $\lim_{x \to 3^+} [x] = 3$

34.(c) $y = \frac{2\sin^2\frac{x}{2}}{2\sin\frac{x}{2}.\cos\frac{x}{2}}$

$y = \tan\frac{x}{2}$

$\frac{dy}{dx} = \sec^2\frac{x}{2} \cdot \frac{1}{2}$

35.(b) $= \frac{1}{abc}\begin{vmatrix} 1/a.a & a & abc \\ 1/b.b & b & abc \\ 1/c.c & c & abc \end{vmatrix}$

$= \frac{1}{abc} . abc \begin{vmatrix} 1 & 1 & 1 \\ 1 & b & 1 \\ 1 & c & 1 \end{vmatrix} = 0 \ [C_1 = C_3]$

36.(a) n = 4

We have: $nb^2 = (n + 1)^2 ac$

$\boxed{4b^2 = 25ac}$

37.(c)

38.(d) $3x = -1$ and $3x = 1$

$-\frac{1}{3} \le x \le \frac{1}{3}$

39.(a) $\sqrt{2}\, e^{i\theta} = \sqrt{2}\,(\cos\theta + i\sin\theta)$

$\sqrt{2}^{\,i.\frac{\pi}{4}} = \sqrt{2}\left(\cos\frac{\pi}{4} + i\sin\frac{\pi}{4}\right)$

$= \sqrt{2}\left(\frac{1}{\sqrt{2}} + i . \frac{1}{\sqrt{2}}\right) = (1 + i) = (1, 1)$

40.(b) It satisfies pythagoraus theorem.

41.(b) $S_{10} = t_{10} - t_9$

$= (10^3 - 100) - (9^3 - 100)$

$= 271$

42.(d)

43.(c) Total number of ways = 2 × 2 × 2 × .... 10 times

$= 2^{10}$

44.(a) We have:

$(1 + x)^n = {}^nC_0 + {}^nC_1x + {}^nC_2x^2 + ... + {}^nC_nx^n$

Putting x = 3:

$4^n = {}^nC_0 + {}^nC_1.3 + {}^nC_2.3^2 + ... + {}^nC_n.3^n$

45.(b) Putting cosx = 1 ⇒ cosx = 1

Min. value = 4 – 3 = 1

46.(b) $A = \int_0^{\pi/4} \sec^2x dx = [\tan x]_0^{\pi/4}$

$= \tan\frac{\pi}{4} - \tan 0 = 1 - 0 = 1$

47.(c) $P(E) = \frac{m}{n} = \frac{1}{216}$

48.(d) A = {1, 3, 5, 7 .....}

B = {2, 4, 6, 8 ....}

No common elements. Disjoint sets.

49.(a)	**50.(a)**	**51.(c)**	**52.(c)**	**53.(b)**	**54.(b)**
55.(a)	**56.(b)**	**57.(a)**	**58.(b)**	**59.(a)**	**60.(a)**

Section – II

61.(b) $t = \frac{100 - 50}{v_1 - v_2} = \frac{50}{10 - 5} = 10$ sec

62.(d) $\frac{T_p}{T_e} = \sqrt{\frac{g_e}{g_p}} = \sqrt{\frac{M_e}{R_e^2} \times \frac{R_p^2}{M_p}}$

$= \sqrt{\frac{M \times (2R)^2}{R^2 \times 2M}} = \sqrt{2}$

∴ $T_p = 2\sqrt{2}$ sec

63.(d) Heat lost by water = Heat gained by ice

or, $mS_i(0 + 14) + mL_f + m \times 10 = 200(25 - 10)$

$m = \frac{200 \times 15}{0.5 \times 14 + 80 + 10} = 30.9g$

64.(c) $T_2V_2^{\gamma-1} = T_1V_1^{\gamma-1}$

or, $T_2 = 288\left(\frac{V}{8V}\right)^{5/3-1}$

$= 288\left(\frac{1}{2}\right)^{3 \times 2/3}$

$= \frac{288}{4} = 72K$

$\Delta T = T_1 - T_2 = 288 - 72$

$= 216°C$

65.(d) $\frac{mv^2}{r} = \mu mg$

or, $\mu = \frac{v^2}{rg} = \frac{12.5^2}{20 \times 10}$

$= 0.78 = 0.8$

66.(c) For jeep

$f' = \frac{v - v_m}{v - v_p} \times f$

$= \frac{330 - v_m}{330 - 22} \times 176$

For motor cycle

$f'' = \frac{v - v_m}{v} \times f$

$= \frac{330 - v_m}{330} \times 165$

For no beats f ' = f"

or, $\frac{330 - v_m}{30} \times 176 = \frac{330 - v_m}{330} \times 165$

or, $(330 - v_m)\ 1.14 = 330 + v_m$

or, $v_m = 22$ m/s

67.(d) $E_1 = \frac{1}{2}CV^2$

$= \frac{1}{2} \times 300 \times 10^{-6} \times 200^2$

$= 6$ J

If distance is halved

$C' = 2C = 600 \times 10^{-6}F$

$Q = C'V'$

$V' = \frac{CV}{C'} = \frac{3 \times 10^{-6} \times 200}{6 \times 10^{-6}} = 100V$

Final energy

$E_2 = \frac{1}{2}C'V'^2$

$= \frac{1}{2} \times 600 \times 10^{-6} \times 100^2$

$= 3\ J$

$\Delta E = E_1 - E_2$

$= 6 - 3 = 3J$

68.(b) $R_{CAD} = 1 + 3 = 4\Omega$

$I_1 = \frac{E}{R_{CAD}} = \frac{10}{4} = 2.5A$

$R_{CBD} = 3 + 1 = 4\Omega$

$I_2 = \frac{E}{R_{CBD}} = \frac{10}{4} = 2.5A$

$V_{CA} = I_1R_{CA} = 2.5 \times 1 = 2.5V$

$V_{CB} = I_2R_{CB} = 2.5 \times 3 = 7.5V$

$V = V_{CB} - V_{CA}$

$= 7.5 - 2.5 = 5V$

69.(b) $E = \frac{d\phi}{dt} = \frac{BAN\cos 0° - BAN\cos 180}{t}$

$= \frac{2BAN}{t} = \frac{2 \times 4 \times 10^{-5} \times 500 \times 10^{-4} \times 1000}{0.1}$

$= 0.04\ V = 40\ mV$

70.(a) 2nd excited to ground

$\frac{hc}{\lambda_3} = E_3 - E_1 = -\frac{Rhc}{9} + \frac{Rhc}{1}$

or, $\frac{hc}{\lambda_3} = Rhc\left(1 - \frac{1}{9}\right)$

or, $\lambda_3 = \frac{9}{8R}$

And first excited to ground

$\frac{hc}{\lambda_2} = E_2 - E_1 = -\frac{Rhc}{4} + Rhc$

or, $\frac{1}{\lambda_2} = \left(1 - \frac{1}{4}\right) R$

or, $\lambda_2 = \frac{4}{3R}$

$\therefore \frac{\lambda_3}{\lambda_2} = \frac{9}{8R} \times \frac{3R}{4} = 27:32$

71.(c) $\frac{90\% \text{ of } N_0}{N_0} = \left(\frac{1}{2}\right)^{t/T_{1/2}}$

or, $ln\ 0.9 = \frac{t}{T_{1/2}} ln\ 0.5$

or, $T_{1/2} = \frac{5 ln\ 0.5}{ln\ 0.9} = 32.9$ days

$\%\ left = \frac{N}{N_0} = \left(\frac{1}{2}\right)^{t/T_{1/2}} \times 100\%$

$= \left(\frac{1}{2}\right)^{20/32.9} \times 100\%$

$= 65\%$

72.(a) $\tan c = \frac{r}{h}$

or, $r = h\frac{\sin c}{\cos c} = \frac{h}{\mu}\sqrt{1 - \sin^2 c}$

$= \frac{h}{\sqrt{\mu^2 - 1}}$

$= \frac{4}{\sqrt{\frac{25 - 9}{9}}} = \frac{4 \times 3}{4} = 3m$

73.(c) Distance $= 2.5\beta$

$= 2.5\frac{D\lambda}{d}$

$= \frac{2.5 \times 2 \times 5000 \times 10^{-10}}{0.2 \times 10^{-3}} = 12.5 \times 10^{-3}$

$= 12.5$ mm

74.(a) For neutralization: $M_1V_1 = M_2V_2$ $0.1 \times 50 = 0.2 \times V_2$ $V_2 = 5/0.2 = 25$ mL

75.(b) When [A] doubles, rate increases 4 times → order w.r.t A = 2 When [B] doubles, rate increases 2 times → order w.r.t B = 1 Therefore, Rate = $k[A]^2[B]$

76.(c) Fe^{3+} has electronic configuration [Ar] $3d^5$ In $3d^5$, all 5 electrons are unpaired (Hund's rule)

77.(a) Formal charge = Valence electrons – Non-bonding electrons $-\frac{1}{2}$ (Bonding electrons) For S in SO_4^{2-}: FC $= 6 - 0 - \frac{1}{2}(8) = 6 - 4 = +2$

78.(a) E°cell = E°cathode – E°anode 1.10 = E°Cu^{2+}/Cu – (–0.76) E°Cu^{2+}/Cu = 1.10 – 0.76 = +0.34 V

79.(b) NH_3 has sp^3 hybridization with one lone pair. The lone pair-bond pair repulsion reduces the bond angle from tetrahedral angle (109.5°) to about 107°.

80.(b) Iodoform test is positive for compounds containing CH_3CO- group or $CH_3CH(OH)$- group. CH_3COCH_3 (acetone) contains CH_3CO- group.

81.(b) C_2H_4 structure: $H_2C{=}CH_2$ Sigma bonds: 4 C-H bonds + 1 C-C bond = 5σ bonds Pi bonds: 1 C=C double bond contains 1π bond

82.(d) Roots are 1 & 1

Equation is: $x^2 - 2x + 1 = 0$

$a = 1, b = -2, c = 1$

On substituting, we get

$= 0$

83.(d) Putting n = 1, 2, 3 .... in option (d), we get the result.

84.(b) Putting x = ω

$\omega^{99} + \frac{1}{\omega^{99}} = 1 + 1 = 2$

85.(a) $a^2.2\sin c\cos c + c^2.2\sin A\cos A$

$= a^2.2.\frac{c}{2R}\,.\,\cos C + c^2.2.\frac{a}{2R}\cos A$

$= \frac{ac}{R}(a\cos C + \cos A) = \frac{abc}{R} \times \frac{4}{4} = 4\Delta$

86.(c) A.M. ≥ G.M.

$\frac{\log_a b + \log_b a}{2} \geq \sqrt{(\log_a b)\,.\,(\log_b a)} = 1$

$(\log_a b + \log_b a) \geq 2$

Min. value = 2

87.(a) Parabola: $y^2 = 12x$

Putting y = 6, we get x = 3

Focal distance = $x_1 + a = 3 + 3 = 6$

88.(a) Parallel plane: $4x - 3y + 6z + d = 0$

Passes through (1, 2, 3)

i.e. $d = -16$

Required eq^n is: $4x - 3y + 6z - 16 = 0$

89.(a) $\frac{dr}{dt} = \frac{1}{4}$ and r = 5cm

Surface area (A) = $4\pi r^2$

$\frac{dA}{dt} = 4\pi.2r\frac{dr}{dt} = 10\pi\ \text{cm}^2/\text{sec}$

90.(c) $I = \int_0^{\pi/2} \frac{\sin x\, dx}{\sin x + \cos x}$ .... (i)

$= \int_0^{\pi/2} \frac{\sin\left(\frac{\pi}{2} - x\right) dx}{\sin\left(\frac{\pi}{2} - x\right) + \cos\left(\frac{\pi}{2} - x\right)}$

$= \int_0^{\pi/2} \frac{\cos x}{\sin x + \cos x} dx$ ....(ii)

Adding (i) & (ii):

$2I = \int_0^{\pi/2} \frac{\sin x\, dx}{\sin x + \cos x} + \int_0^{\pi/2} \frac{\cos x}{\sin x + \cos x} dx$

$2I = \int_0^{\pi/2} dx \quad \therefore \quad I = \frac{\pi}{4}$

91.(c) $\frac{2b^2}{a} = \frac{1}{2}(2b)$

$b = \frac{a}{2}$

$b^2 = a^2(1\ \ e^2)$

$\frac{a^2}{4} = a^2(1 - e^2) \quad e = \frac{\sqrt{3}}{2}$

92.(b) $\frac{dy}{dx} = y_1 = \frac{1}{2\sqrt{x^2 + m^2}}\,.\,2x = \frac{x}{\sqrt{x^2 + m^2}}$

$yy_1 = \sqrt{x^2 + m^2}\,.\,\frac{x}{\sqrt{x^2 + m^2}}$

$yy_1 = x$

93.(b) $\frac{dy}{dx} = 2Ae^{2x} - 2Be^{-2x}$

$\frac{d^2y}{dx^2} = 4Ae^{2x} + 4Be^{-2x}$

$\frac{d^2y}{dx^2} = 4y$

$\frac{d^2y}{dx^2} - 4y = 0$

94.(c) $A = \int_0^{\pi/4} \tan x\, dx + \int_0^{\pi/2} \cot x\, dx$

$= \log 2$

95.(d) $t_n = \frac{2 + 4 + 6 + ... + n \text{ terms}}{n!}$

$= \frac{n(n+1)}{n!} = \frac{(n-1)+2}{(n-1)!}$

$= \frac{1}{(n-1)!} + \frac{2}{(n-1)!}$

Sum = e + 2e = 3e

96.(c) $\overrightarrow{FC} + \overrightarrow{AD} + \overrightarrow{EB}$

$= 2\overrightarrow{AB} + 2\overrightarrow{AO} + 2\overrightarrow{OB}$

$= 2\overrightarrow{AB} + 2(\overrightarrow{AO} + \overrightarrow{OB})$

$= 2\overrightarrow{AB} + 2\overrightarrow{AB} = 4\overrightarrow{AB}$

97.(c) **98.(b)** **99.(d)** **100.(c)**

...Best of Luck...