Section - I

1.(b) $\vec{r} = a\cos\omega t\hat{i} + a\sin\omega t\hat{j}$

$\vec{v} = \frac{d\vec{r}}{dt} = -a\omega\sin\omega t\hat{i} + a\omega\cos\omega t\hat{j}$

$\therefore\ \vec{r}.\vec{v} = (a\cos\omega t\hat{i} + a\sin\omega t\hat{j})\,(-a\omega\cos\omega t\hat{i} + a\omega\cos\omega t\hat{j})$

$= -a^2\omega\sin\omega t\cos\omega t + a^2\omega\sin\omega t\cos\omega t$

$= 0$ So, $\vec{r}\perp\vec{v}$

2.(c) $R = \frac{4u_xu_y}{g} = \frac{2 \times 3 \times 4}{10} = 2.4$ m

3.(c) $mgh = \frac{K}{2}e^2$ so

or, $\frac{h_2}{h_1} = \left(\frac{e_2}{e_1}\right)^2$

or, $h_2 = 2\left(\frac{6}{4}\right)^2 = 2 \times \frac{9}{4} = 4.5$ m

4.(b) $\omega t = mg' = mg(1 - R\omega^2\cos^2\theta)$

When ω increases, wt decreases.

5.(c) Pyrometer can measure temperature of body at any distance

6.(c) $P = \frac{\omega}{t} = \frac{mL_f}{t}$

$= \frac{3 \times \times 4.2}{60}$ J/s

$= 16.8$ W

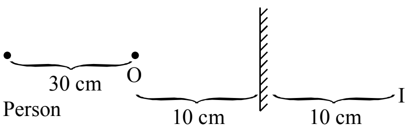
7.(c) $\phi = \frac{2\pi x}{\lambda}$

or, $x = \frac{\phi\lambda}{2\pi} = 60 \times \frac{\pi}{180} \times \frac{\lambda}{2\pi} = \frac{\lambda}{6}$

8.(a) $f_b = f_2 - f_1 = 454 - 450 = 4$ Hz

$T = \frac{1}{f_b} = \frac{1}{4} = 0.25$ s

9.(d)



$\therefore$ Distance = 30 + 10 + 10 = 50 cm

10.(b) $\mu = A + \frac{B}{\lambda^2}$, $\lambda_r > \lambda_v$

So, $\mu_r < \mu_v$

11.(c) Positively charged glass rod attract –vely charged body and neutral body.

12.(c) $C = 4\pi\varepsilon_0 r$

So, $\frac{C'}{C} = \frac{R}{r}$ .....(i)

Now $\frac{4\pi}{3}R^3 = n \times \frac{4\pi}{3}r^3$

or, $\frac{R}{r} = n^{1/3}$

So $\frac{C'}{C} = n^{1/3} :1$

13.(b) $V = E - Ir$

$= 1.5 - 1 \times 0.5 = 1V$

14.(a) $B = \frac{\mu_0 I}{2\pi a}$

$\therefore\ \frac{B'}{B} = \frac{a}{a'}$

or, $B' = \frac{10}{40} \times 0.04 = 0.01$ T

15.(c) $M_R = \sqrt{M^2 + 2M^2\cos\theta + M^2}$

$= \sqrt{2M^2 + 2M^2\cos 60°} = \sqrt{3M^2} = \sqrt{3}$ M

16.(c) $Bqv = \frac{mv^2}{r}$

or, $r = \frac{mv}{Bq}$

or, $\frac{r_p}{r_\alpha} = \frac{m_p}{e} \times \frac{2e}{4m_p} = \frac{1}{2}$

17.(c) $R = \frac{\Delta V}{\Delta I} = \frac{0.7 - 0.5}{1 \times 10^{-3}}$

$= 0.2 \times 10^3 = 200\Omega$

18.(a) CN > –C(=O)– CN at 1 & –C(=O)– at 4

19.(b) $CH_3CH_2 - O - CH_2CH_3 \Rightarrow CH_3 - O - CH_2CH_2CH_3$

20.(d) $CaCl_2$ decreases m.p. of NaCl to 660°C.

21.(c) $KCl.MgCl_2.6H_2O$

22.(d) $CuSO_4 + NH_4OH \rightarrow Cu(NH_3)_4SO_4 + H_2O$

excess — deep blue sol^n (clear colour)

23.(b)

24.(a) H – C ≡ N → S

+1 +2 –3 0 = zero

25.(c)

Structure $^{-}O - C(=O) - O^{-}$

26.(d) $F^- > Na^+ > Mg^{++} > Al^{+++}$

iso-electronic species

27.(c)

	3s	4s	3d	3p
n	3	4	3	3
e	0	0	2	1
(n + e)	3	4	5	4

28.(b) Can donate H^+ & also accept H^+ so Bronsted & lowery.

29.(b) $y = e^x$

$\frac{dy}{dx} = e^x = y$

30.(b) $\int \frac{(e^x + 1)(e^x - 1)}{(e^x + 1)} dx = e^x - x + c$

31.(a) $|\omega| + |\omega^2| = 1 + 1 = 2$

32.(a) $\lim_{x \to \frac{\pi}{2}} \frac{2\sin 2x}{-1}$ [∵ L-Hospital's rule]

$= -2\sin\pi = 2$

33.(d) Roots of $x^2 + x + 1 = 0$ are ω & ω^2.

$x^{3n} = (\omega)^{3n} = 1$

34.(a)

35.(d) Obvious

36.(a) $\frac{\vec{a}.\vec{b}}{|\vec{a}|} = \frac{2.5 + 1.(-3) + 2.1}{\sqrt{2^2 + 2^2 + 1}} = 3$

37.(d) Centre $= \left(\frac{6-4}{2}, \frac{4+4}{2}\right) = (1, 4)$

38.(c) $(x - 2)(x - 3) = 0$

$x = 2$ or $x = 3$ (Parallel lines)

39.(c) $y^2 - 2y + 1 = -8x - 17 + 1$

$(y - 1)^2 = -8(x - 2)$

Comparing it with $(y - k)^2 = 4a(x - h)$

Length of the latus rectum = 4a = 8

40.(a) $h^2 = p^2 + b^2$

$9 = 2 + 7 = 9$

41.(a) $\frac{1 - \tan^2 7.5}{1 + \tan^2 7.5} = \cos 2 \times 7.5 = \frac{\sqrt{3} + 1}{2\sqrt{2}}$

42.(d) We have: $(1 + x)^n = c_0 + c_1x + c_2x^2 + ... + c_nx^n$

Putting x = 4:

$5^n = c_0 + 4.c_1 + 4^2.c_2 + ... + 4^n.c_n$

43.(d) Each letters can be posted in 3 boxes.

Total number of ways = 3^4

44.(d) Centre $(-g, -f) = (3, -2)$

$3 = \frac{2 + a}{2}$ and $-2 = \frac{1 + b}{2}$

$a = 4$ $\quad -5 = b$

45.(b) $A = \frac{16ab}{3} = \frac{16 \times 1 \times 1}{3} = \frac{16}{3}$

46.(c) $\frac{dr}{dt} = 0.7$ cm/sec

$\frac{dc}{dt} = \frac{d}{dt}(2\pi r) = 2\pi.\frac{dr}{dt}$

$= 2 \times \frac{22}{7} \times 0.7 = 4.4$ cm/sec

47.(d)

48.(d) Let the ratio be K : 1

In XY–plane, z = 0

$\frac{K(-1) + 1.3}{K + 1} = 0$

K = 3 $\quad$ K : 1 = 3:1

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

Section – II

61.(a) $18 = h_1 - h_2$

or, $18 = ut + \frac{1}{2}gt^2 - \frac{1}{2}gt^2$

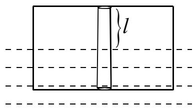
or, $t = \frac{18}{10} = 1.8s$

62.(c) At top $v_1 = \sqrt{gr}$

At horizontal position $v_2 = \sqrt{3gr}$

$a_r = \frac{v^2}{r} = \frac{3gr}{r} = 3g$

63.(c) ωt = upthrust



or, $Ah \times \rho_i = A(h - l)\,\sigma_w$

or, $10 \times 900 = (10 - l) \times 1000$

or, $9 = 10 - l$

or, $l = 1$ m

64.(d) For A

$dQ = nc_pdT$

$= n \times \frac{5R}{2} \times 42$ ....(i)

For B

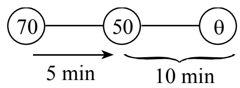
$dQ = du = nc_vdT$

$= n \times \frac{3R}{2} dT$ .... (ii)

Now $n \times \frac{5R}{2} \times 42 = n \times \frac{3R}{2} dT$

or, $dT = \frac{5 \times 42}{3} = 70$ K

65.(b)



From 1st & 2nd

$\frac{\left(\frac{d\theta}{dt}\right)_{1^{st}}}{\left(\frac{d\theta}{dt}\right)_{2^{nd}}} = \frac{\theta_1 - \theta_0}{\theta_2 - \theta_0}$

or, $\frac{\frac{20}{5}}{\frac{50 - \theta}{10}} = \frac{60 - 20}{\frac{50 + \theta}{2} - 20}$

or, $\frac{20 \times 2}{50 - \theta} = \frac{40 \times 2}{50 + \theta - 40}$

or, $100 - 2\theta = 10 + \theta$

or, $3\theta = 100 - 10 = 90°$

$\theta = 30°C$

66.(c) Diagonal (l) $= \sqrt{a^2 + a^2 + a^2} = \sqrt{3}a$

Potential (V) $= \frac{8Q}{4\pi\varepsilon_0 l/2}$

$= \frac{4Q}{\pi\varepsilon_0 l} = \frac{4Q}{\lambda\varepsilon_0\sqrt{3}a}$

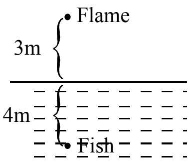
$= \frac{4}{\sqrt{3}} \frac{Q}{\pi\varepsilon_0 a}$

67.(c) $f_0 = \frac{1}{2l}\sqrt{\frac{T}{m}} = \frac{1}{2l}\sqrt{\frac{Y \times \text{strain}}{\rho}}$

$= \frac{1}{2 \times 1.25}\sqrt{\frac{2 \times 10^{11} \times 1}{100 \times 8000}}$

$= 200$ Hz

68.(a)



${}_a\mu_w = \frac{\text{Apparent in air}}{\text{Real height}}$

or, $\frac{4}{3} = \frac{x}{3}$

or, $x = 4$m

Actual height from fish = 4 + 4 = 8 m

69.(a) $\frac{\lambda}{d} = \frac{x}{D(f)}$

or, $d = \frac{f\lambda}{x} = \frac{0.5 \times 5.89 \times 10^{-7}}{2 \times 10^{-3}}$

$= 1.47 \times 10^{-4}$ m

70.(d) A & B are connected by connecting wire so resistance is zero.

71.(b) $E_s = -M\frac{dI_p}{dt}$

$= 0.5\frac{(3-2)}{0.01} = 50$ V

72.(c) $Z = \sqrt{R^2 + (X_L - X_C)^2}$

$= \sqrt{300^2 + \left(\omega L - \frac{1}{\omega c}\right)^2}$

$= \sqrt{300^2 + \left(1000 \times 0.9 - \frac{1}{1000 \times 2 \times 10^{-6}}\right)^2}$

$= 500\ \Omega$

73.(d) 1st case

$2E - E = \frac{hc}{\lambda}$

or, $E = \frac{hc}{\lambda}$ ..... (i)

2nd case

$\frac{4E}{3} - E = \frac{hc}{\lambda'}$

or, $\frac{E}{3} = \frac{hc}{\lambda'}$

or, $\frac{hc}{3\lambda} = \frac{hc}{\lambda'} \Rightarrow \lambda' = 3\lambda$

74.(a) % on decayed $= \left(\frac{1}{2}\right)^{t/T_{1/2}} \times 100\%$

$= \left(\frac{1}{2}\right)^{\frac{5T_{1/2}}{T_{1/2}}} \times 100 = 3\%$

75.(d) When same amount of electricity is passed then volume of gas evolved is equivalent volume.

76.(d) $\frac{\text{Volume of } NH_3 \text{ evolve}}{\text{eq. volume of } NH_3} = \frac{V_{ca(OH)_2} \times N_{ca(OH)_2}}{1000}$

or, $\frac{112}{22400} = \frac{10 \times N_{Ca(OH)_2}}{1000}$

$\therefore$ $N_{Ca(OH)_2} = 0.5$ N

77.(d) Solubility of CaF_2 in NaF is

$Ca^{++} = \frac{K_{sp}}{(F^-)^2}$ from NaF

$= \frac{4 \times 10^{-12}}{10^{-2}} = 4 \times 10^{-14}$ mole/L

78.(b) 6.023×10^{22} atoms of Ca.

$CaCO_3 \xrightarrow{\Delta}$	$CaO + CO_2$
1 mole	1 mole
1 mole Ca	1 mole C
6.023×10^{23}	6.023×10^{23}
6.023×10^{22}	if 6.023×10^{22}

79.(c)

$\underset{X}{CH_3 - CH = CH_2} \xrightarrow{HBr} \underset{Y}{CH_3\overset{Br}{\overset{|}{C}}H - CH_3} \xrightarrow[\text{dry ether}]{Na} CH_3 - \overset{CH_3}{\overset{|}{C}H} - \overset{CH_3}{\overset{|}{C}H} - CH_3$

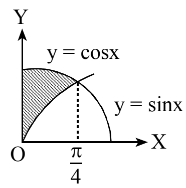
80.(b) $CoZnO_2$ (Rinmann's green)

81.(b) $Cl_2 + NaOH \longrightarrow NaCl + NaClO_3 + H_2O$
hot & conc.

82.(b) $(f + g)(1)$

$= e^1 + \log_e 1 = e$

83.(a)



Area (A) = $\int_0^{\pi/4} (\cos x - \sin x)\, dx$
$= (\sqrt{2} - 1)$

84.(a) $\tan\left[\frac{1}{2} . 2\tan^{-1} \times \frac{1}{2} . 2\tan^{-1} y\right]$
$= \tan \tan^{-1}\left(\frac{x + y}{1 - xy}\right) = \frac{x + y}{1 - xy}$

85.(c) $\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}} = \frac{a\sin t}{a(1 + \cos t)}$
$= \frac{2\sin\frac{t}{2}.\cos\frac{t}{2}}{2\cos^2\frac{t}{2}} = \tan\frac{t}{2}$

86.(d) $\alpha^2 + \beta^2 = 9$
$(\alpha + \beta^2) - 2\alpha\beta = 9$
$p^2 - 2.36 = 9$
$p^2 = 81$
$p = \pm 9$

87.(a) $I = \int\sqrt{\frac{1 + x}{1 - x}}\, dx$
$= \int\sqrt{\frac{1 + x}{\sqrt{1 - x^2}}}\, dx$
$= \int\frac{1}{\sqrt{1 - x^2}}\, dx + \int\frac{x}{\sqrt{1 - x^2}}\, dx$
$= \sin^{-1}x + \left(-\frac{1}{2}\right)\int\frac{(-2x)\, dx}{\sqrt{1 - x^2}}$
$= \sin^{-1}x - \sqrt{1 - x^2} + c$

88.(a) Area is maximum if it is a square
i.e. $4l = 144$
$l = 36$
Area $= (36)^2 = 1296$

89.(d) $|\vec{a} + \vec{b} + \vec{c}|^2 = a^2 + b^2 + c^2 + 2(\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a})$
$= 1 + 1 + 1 + 0$
$|\vec{a} + \vec{b} + \vec{c}| = \sqrt{3}$

90.(b) Mid point: $\left(\frac{2 + 6}{2}, \frac{3 + 7}{2}, \frac{4 + 8}{2}\right) = (4, 5, 6)$
Option (b) passes through this point

91.(b) $y = -x + k$
Comapairing it with
$y = mx - 2am - am^3$
$k = -2am - am^3$
$k = -2a(-1) - a.(-1)^3$
$k = 3a$
$= 3 \times 3$
$= 9$

92.(c) $b = \frac{a + c}{2}$
We have: $a\cos^2\frac{C}{2} + c\cos^2\frac{A}{2}$
$= \frac{a + b + c}{2} = \frac{2b + b}{2} = \frac{3b}{2}$

93.(c) $\frac{n!}{p!.q!} = \frac{6!}{3!.3!}$

94.(c) $t_n = \frac{2 + 4 + 6 + ... + n \text{ terms}}{n!}$
$t_n = \frac{n(n + 1)}{n(n - 1)!}$
$= \frac{(n - 1) + 2}{(n - 1)!}$
$= \frac{(n - 1)}{(n - 1)\,(n - 2)!} + \frac{2}{(n - 1)!}$
$e + 2e = 3e$

95.(a) $S_\infty = \frac{a}{1 - r} + \frac{d.r}{(1 - r)^2}$
$= \frac{1 + x}{(1 - x)^2}$

96.(a) In axis, putting $y = 0$
$by^2 + 2fy + c = 0$
Two lines intersect at unique point on y-axis
i.e. $b^2 - 4ac = 0$
$(2f)^2 - 4.bc = 0$ $\boxed{f^2 = bc}$

97.(b) 98.(c) 99.(c) 100.(a)

…The End…