Section - I

1.(d) The distance covered by particle is zero means particle is at rest so displacement is also zero.

2.(b) The resultant of 3 vectors acting on a body in a plane must be zero.

3.(c) $t = \sqrt{\frac{2h}{g}}$, remain same

4.(d) Modulus of elasticity depends on nature of matter.

5.(b) $\frac{\Delta l}{l} = \alpha\Delta\theta = 1\%$

$\frac{\Delta A}{A} = \beta\Delta\theta = 2\alpha\Delta\theta = 2 \times 1\% = 2\%$

6.(c) $dQ = du + d\omega$

or, $\gamma du = du + Pdv$ or, $du = \frac{PV}{\gamma - 1}$

7.(a) $dQ = du + dw$, Here $dw = 0$ & $dQ < 0$ means –ve so du is also negative i.e. internal energy decreased.

8.(a) $v \propto T^{1/2}$

or, $\frac{\Delta v}{v} = \frac{1}{2}\frac{\Delta T}{T}$ or, $\Delta T = \frac{1}{100} \times 2 \times 273 = 5.5°C$

9.(b) Here $kx = \frac{2\pi x}{3}$

or, $\frac{2\pi x}{\lambda} = \frac{2\pi x}{3}$ or, $\lambda = 3$ cm

Distance between nodes $= \frac{\lambda}{2} = 1.5$ cm

10.(c) $H = \frac{1}{2}cv^2 = \frac{1}{2} \times 2 \times 10^{-6} \times 100^2 = 0.01$ J

11.(d) $I = venA = v'e\,nA'$

or, $v \times \pi r^2 = v'\pi (2r)^2$ or, $v' = \frac{v}{4}$

12.(b) Potential gradient $= \frac{V_P}{l} = \frac{IR_P}{l}$

r = resistance per unit length
If emf is tripled then current become three times so the potential gradient also become three times.

13.(d) $L = 2\pi R$ $R = \frac{L}{2\pi}$

$M = IA = I\pi R^2 = I\pi\left(\frac{L}{2\pi}\right)^2 = \frac{IL^2}{4\pi}$

14.(b) $\beta = \frac{D\lambda}{d}$

β increases if 'd' decreases

15.(b) $m = -2 = \frac{v}{4}$ $v = -24$

Now, $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$

or, $\frac{1}{10} = \frac{1}{u} - \frac{1}{2u} = \frac{2-1}{2u}$

or, $u = \frac{10}{2} = 5$ cm

16.(d) $Bqv = \frac{mv^2}{r}$ or, $P = Bqr$

17.(b) Resistance is high then no current flows so act as capacitor.

18.(b) The energy is given by $(n + l)$ value and if $(n + l)$ is same then orbital with lower n value have less energy.

19.(d) In NH_4Cl there is ionic bond between NH_4^+ and Cl^- and covalent and co-ordinate covalent bond in NH_4^+.

20.(a) All the species are isoelectronic and species with least nuclear charge have largest size. So, the order of size is
$S^{--} > Cl^- > K^+ > Ca^{++}$

21.(c) In $Fe(CO)_5$ O.N. of iron is zero so it has least O.N.

22.(d) H_3O^+ is positive ion so it is lewis acid and can donate proton so it is Bronsted acid but being ion it is not Arrhenius acid.

23.(c) HCO_3^- and OH^- -ion cann't exist together because they react as $HCO_3^- + OH^- \longrightarrow CO_3^{--} + H_2O$

24.(b) Mg and Mn are only metals that gives H_2 gas with dilute HNO_3

25.(b) Zn^{++} ion lies in group IIIB metal ions and can give precipitate only in alkaline medium.

26.(c) All metal nitrates are soluble in water.

27.(b) The structure of glyoxal is

$$H-\overset{\overset{\displaystyle O}{||}}{C}-\overset{\overset{\displaystyle O}{||}}{C}-H$$ IUPAC name ethanedial

28.(c) The reaction of sodium alkoxide with alkylhalide to give ether is called Williamson's reaction.

29.(d) $y = \log_{x^{1/2}}x = \frac{1}{\frac{1}{2}}\log_x x$

$y = 2.1$

$\frac{dy}{dx} = 0$

30.(a) $1 + 1 + 1 = 3$
$1 + 1 + 3 = 5$
$1 + 3 + 5 = 9$
$3 + 5 + 9 = 17$

31.(d) $\lim_{x\to 0}\frac{a^x - 1}{x} + \lim_{x\to 0}\frac{b^x - 1}{x} + \lim_{x\to 0}\frac{c^x - 1}{x}$
$= \log a + \log b + \log c = \log(abc)$

32.(b) $\int_0^a a^2dx - \int_0^a x^2dx$

$= a^2(x)_0^a - \left(\frac{x^3}{3}\right)_0^a$

$= a^2(a - 0) - \left(\frac{a^3}{3} - 0\right) = \frac{2a^3}{3}$

33.(b) $2^x = e^{kx}$
$e^{\log 2^x} = e^{kx}$
$e^{x\log 2} = e^{kx}$
$k = \log_e 2$

34.(d) $O(A \times B) = mn$

35.(a) $n = 18$
For the greatest coeff. $r = \frac{n}{2} = \frac{18}{2} = 9$
Greatest coefficient = C(n, r) = C(18, 9)

36.(a) Squaring and adding, we get
$x^2 + y = a^2$ (circle)

37.(a) It is obvious.

38.(d) Length at major axis = 2a
$= 2 \times 5 = 10$

39.(d) $(\vec{i} + \vec{j} + \vec{k}) \cdot \frac{2\vec{i} + \vec{j} + \vec{k}}{\sqrt{6}} = \frac{2 + 1 + 1}{\sqrt{6}}$

40.(b) $a = 2b\left(\frac{a^2 + b^2 - c^2}{2ab}\right)$
$c^2 = b^2$
$\boxed{c = b}$

41.(b) A = 2ab
= 24.3
= 24 sq. units

42.(c) $\cos^2\theta + \sec^2\theta = (\cos\theta - \sec\theta)^2 + 2\cos\theta\sec\theta$
$= (\cos\theta - \sec\theta)^2 + 2 \geq 2$

43.(d) Put $\cot^{-1}x = \theta$
$\cot\theta = \frac{x}{1} = \frac{b}{p}$
$h = \sqrt{1 + x^2}$
Now, $\sin\theta = \frac{1}{\sqrt{1 + x^2}}$

44.(d) Obvious

45.(b) $PQ = \sqrt{(5 - 7)^2 + (-3 + 5)^2 + (8 - 9)^2} = 3$
d.c's of line are $\frac{5 - 7}{3}, -\frac{3 + 5}{3}, \frac{8 - 9}{3}$
i.e. $-\frac{2}{3}, \frac{2}{3}, -\frac{1}{3}$

46.(c) The equation of the plane is
$\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$
$\frac{x}{2} + \frac{y}{-3} + \frac{z}{4} = 1$
$6x - 4y + 3z = 12$

47.(c) r + r + 2 = 2n
r = (n – 1)

48.(c) It is obvious.

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

Section – II

61.(c) $v = at = 1.25 \times 8 = 10$ m/s
$h = \frac{1}{2}at^2 = \frac{1}{2} \times 1.25 \times 8^2 = 40$ m
When released
$h = -ut + \frac{1}{2}gt^2$
or, $40 = -10t + \frac{1}{2} \times \cot^2$
or, $5t^2 - 10t - 40 = 0$
or, $t^2 - 2t - 8 = 0$
or, $t^2 - 4t + 2t - 8 = 0$
or, $t(t - 4) + 2(t - 4) = 0$
or, $(t - 4)(t + 2) = 0$
$\therefore$ t = 4s

62.(a)
Wt. of hanging part
= frictional force
or, $x.mg = \mu(l - x)mg$
or, $\frac{l - x}{x} = \frac{1}{\mu}$
or, $\frac{l}{x} = \frac{1 + \mu}{\mu}$
or, $\frac{x}{l} = \frac{\mu}{\mu + 1}$
$\% = \frac{x}{l} \times 100\% = \frac{\mu}{\mu + 1} \times 100\%$
$= \frac{0.25}{0.25} \times 100\% = 20\%$

63.(d) f = ma
or, $a = \frac{\sqrt{4^2 + 3^2}}{10} = 0.5$ m/s^2
$v = at = 0.5 \times 10 = 5$ m/s
$\therefore$ $KE = \frac{1}{2}mv^2 = \frac{1}{2} \times 10 \times 5^2 = 125$ J

64.(a) $v = \sqrt{\frac{GM}{r}} = \sqrt{\frac{GM}{R + R}} = \sqrt{\frac{GM}{2R}}$
$\therefore$ $KE = \frac{1}{2}mv^2 = \frac{1}{2}m\frac{gR^2}{2R} = \frac{1}{4}mgR$

65.(c) $d\omega = Pdv$
$= 10^5(1671 - 1) \times 10^{-6}$
= 167 J = 40 cals
$\therefore$ $du = dQ - d\omega$
= 540 – 40 = 500 cals

66.(a) $Q = \int_0^{10} dQ = \int_0^{10} msd\theta$
$= \int_0^{10} \times 0.6\theta^2 d\theta$
$= 6\left(\frac{\theta^3}{3}\right)^{10} = 2(10^3 - 0^3)$
= 2000 cal

67.(a) $y = r\sin\omega t$

or, $\frac{r}{2} = r\sin\omega t$

or, $\sin 30 = \sin\omega t$

or, $30 \times \frac{\pi}{180} = \frac{2\pi}{T} \cdot t$

or, $t = \frac{T}{12} = \frac{12}{12} = 1s$

68.(b) $C = C'$

or, $\frac{\varepsilon_0 A}{d} = \frac{\varepsilon_0 A}{d - t\left(1 - \frac{1}{\varepsilon_r}\right) + 3.5 \times 10^{-5}}$

or, $d = d - 4 \times 10^{-5}\left(1 - \frac{1}{\varepsilon_r}\right) + 3.5 \times 10^{-5}$

or, $4 \times 10^{-5}\left(1 - \frac{1}{\varepsilon_r}\right) = 3.5 \times 10^{-5}$

or, $4 - \frac{4}{\varepsilon_r} = 3.5$

or, $\frac{4}{\varepsilon_r} = 0.5$

or, $\varepsilon_r = \frac{4}{0.5} = 8$

69.(b) $I = \frac{2E}{3 + 2r} = \frac{E}{3 + \frac{r}{2}}$

or, $\frac{2}{3 + 2r} = \frac{1}{3 + \frac{r}{2}}$

or, $6 + r = 3 + 2r$

or, $r = 3\Omega$

70.(b) $\frac{V^2}{R} = mL_f$

or, $m = \frac{210^2}{50 \times 80 \times 4200}$

$= 2.6 \times 10^{-3}$ kg $= 2.6$ g

71.(a) $B_a = \frac{1}{8} B_c$

or, $\frac{\mu_0 NIR^2}{2(R^2 + x^2)^{3/2}} = \frac{1}{8} \times \frac{\mu_0 NI}{2R}$

or, $8R^3 = (R^2 + x^2)^{3/2}$

or, $2R = (R^2 + x^2)^{1/2}$

or, $4R^2 = R^2 + x^2$

or, $x^2 = 3R^2$

or, $x = \sqrt{3}\, R$

72.(b) $x = 1.5\,\beta = 1.5\,\frac{D\lambda}{d}$

$= \frac{1.5 \times 1 \times 6.5 \times 10^{-7}}{10^{-3}}$

$= 9.75 \times 10^{-4}$ m $= 0.975$ mm

73.(c) $E = \frac{hc}{\lambda} = \frac{6.62 \times 10^{-34} \times 3 \times 10^8}{975 \times 10^{-10}} = 12.73$ eV

Here $E_n = E_1 + E$

$= -13.6 + 12.73 = -0.87$ eV

Now, $E_n = -\frac{13.6}{n^2}$

or, $n = \sqrt{\frac{13.6}{0.87}} = 4$

74.(d) 206g of Pb^{206} is formed from 238g

3xg of Pb^{206} is formed from $= \frac{238}{206} \times 3x$

$= 3.47x$

Total mass $(m_0) = 4x + 3.47x$

$= 7.47x$

$m = 4x$

Now $\frac{m}{m_0} = \left(\frac{1}{2}\right)^{\frac{t}{T_{1/2}}}$

or, $\frac{4}{7.47} = \left(\frac{1}{2}\right)^{\frac{t}{T_{1/2}}}$

or, $t = \frac{ln\left(\frac{4}{747}\right)}{ln\left(\frac{1}{2}\right)} \times 4.5 \times 10^9$

$= 4 \times 10^9$ years

75.(c) 16g of CH_4 = 4g of H_2 = 36g of H_2O

32g of $CH_4 = \frac{36}{16} \times 32 = 72$g of H_2O

76.(c) 11200cc of H_2 gas is given by 96500 c charge

1 cc of H_2 gas is given by $\frac{96500}{11200}$ c charge

$= 8.6$ c charge

Current (i) $= \frac{q}{t} = \frac{8.6}{1} = 8.6$ A

77.(b) pH = 2 pH = 11

$Na = 10^{-2}$ $Nb = 10^{-3}$

$N_{mix} = \frac{10^{-2} - 10^{-3}}{2} = 4.5 \times 10^{-3}$

(w.r.t. acid)

$pH = -\log 4.5 \times 10^{-3} = 2.34$

78.(c) $\frac{\text{Volume of } CO_2 \text{ at STP}}{\text{Eq. volume of } CO_2 \text{ at STP}} = \frac{V \times N}{1000}$

$\frac{224}{11200} = \frac{100 \times N}{1000}$

$\therefore N = \frac{1}{5}$

79.(d) Eq. wt. of acid $= \frac{\text{wt. of Al salt} \times 9}{\text{wt. of Al}} - 8$

$= \frac{21.3 \times 9}{2.7} - 8 = 63$

80.(c) The gas formed is Cl_2 and gives a mixture of NaCl and $NaClO_3$ with hot and conc. NaOH

$4HCl + MnO_2 \rightarrow Cl_2 + MnCl_2 + 2H_2O$

$3Cl_2 + 6NaOH \rightarrow 5NaCl + NaClO_3 + 3H_2O$

81.(b) The gas is acetylene which on catalytic hydration gives vinyl alcohol which rearranges forming acetaldehyde.

$CaC_2 + H_2O \longrightarrow C_2H_2 + Ca(OH)_2$

$HC \equiv CH \xrightarrow[HgSO_4]{dil.\ H_2SO_4} CH_2 = \overset{\overset{OH}{|}}{C}H \longrightarrow CH_3 - \overset{\overset{O}{||}}{C} - H$ (acetaldehyde)

82.(b) $\int_0^{\pi/2} e^x(\sin x + \cos x)\,dx = [e^x \sin x]_0^{\pi/2}$

$= e^{\pi/2}.\sin\frac{\pi}{2} - e^0\sin 0 = e^{\pi/2}$

83.(d) $f'(x) = |\sin x|$

$f'\left(\frac{3\pi}{4}\right) = \left(\sin\frac{3\pi}{4}\right) = \frac{1}{\sqrt{2}}$

84.(a) Put $\cos^{-1}x = \theta$

$\cos\theta = \frac{x}{1} = \frac{b}{h}$

$P = \sqrt{1 - x^2}$ $\quad \sin\cot^{-1}\tan\theta$

$= \sin\cot^{-1}\frac{\sqrt{1 - x^2}}{x}$

Put $\cot^{-1}\frac{\sqrt{1 - x^2}}{x} = \beta$ and find $\sin\beta$

85.(b) $2s = 2r_1$

$s = s\tan\frac{A}{2}$

$\tan 45 = \tan\frac{A}{2}$

$A = 90°$ (Rt. angled Δ)

86.(a) $\frac{\alpha}{\beta} + \frac{\beta}{\alpha} + 2$

$= \frac{w}{w^2} + \frac{w^2}{w} + 2$

$= \frac{1}{w} + w + 2 = (w^2 + w) + 2 = -1 + 2 = 1$

87.(b) $3\alpha + 4\alpha = -\frac{q}{p}$

$\alpha = -\frac{q}{7p}$

and $(3\alpha.4\alpha) = \frac{r}{p}$

$12\left(-\frac{q}{7p}\right)^2 = \frac{r}{p}$

$\boxed{12q^2 = 49pr}$

88.(a) $114 + \frac{2}{8} + \frac{3}{16} + \frac{4}{32} + \ldots\ldots.. \infty$

Let $p = 2$

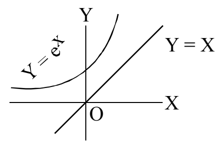
Taking: $s_\infty = \frac{1}{4} + \frac{2}{8} + \frac{3}{6} + \ldots\ldots. \infty$

Using: $s_\infty = \frac{a}{1 - r} + \frac{d.r}{(1 - r)^2}$

We get, $s_\infty = 1$

So, $p = 2' = 2$

89.(a)



From the graph
No solution
i.e. $(P \cap Q) = \phi$

90.(c) Coplanar if: $\begin{vmatrix} a & 1 & 1 \\ 1 & b & 1 \\ 1 & 1 & c \end{vmatrix} = 0$

On expanding: $\boxed{abc + 2 = a + b + c}$

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

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

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

Putting n = 1, 2, 3 …… and adding

Sum = e + 2e = 3e

92.(c) An solving: $(2x + \lambda)^2 = 2x$

$4x^2 + 2x(2\lambda - 1) + \lambda^2 =$

Does not intersect if

$b^2 - 4ac < 0$

$[2(2\lambda - 1)]^2 - 4.4\lambda^2 < 0$

$\lambda > \frac{1}{4}$

93.(a) $10 - \alpha > 0$ and $\alpha - 4 > 0$

$\Rightarrow \quad \alpha < 4$

94.(d) y-intercept $= 2\sqrt{f^2 - c}$

$= 2\sqrt{\frac{49}{4} - 12} = 1$ units

95.(b) $\frac{x + y}{y} = \frac{15}{6} = \frac{5}{2}$

$\frac{2}{3}x = y$

$\frac{dy}{dx} = \frac{2}{3}$

$\frac{dy}{dt} = \frac{dy}{dt}.\frac{dx}{dt} = \frac{2}{3}.9 = 6$ ft/sec

96.(c) $y^2 = x$

$x^2 = y$

$A = \int_0^1 (\sqrt{x} - x^2)\,dx = \frac{1}{3}$

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

…The End…