Section – I

1.(d) V = aT

or, $a = \frac{V}{T}$

In time t,

$v = at = \frac{V}{T}.t$

work done (W) $= \frac{1}{2}Mv^2$

or, $W \propto v^2$

or, $W \propto \frac{V^2}{T^2}t^2$

2.(a) $L = \vec{r} \times m\vec{v}$ about origin

L = 0

3.(c)

4.(b) $I_{max} = I + 2\sqrt{I\,I}\cos 0^o + I$

$= 2I + 2I = 4I$

5.(b) When charge is placed on soap bubble then radius of it increases.

6.(c) $R_{eq} = \frac{\rho_{eq} l_{eq}}{A}$

or, $\rho_{eq} = (R_1 + R_2)\frac{A}{2l}$

$= \left(\frac{\rho_1 l}{A} + \frac{\rho_2 l}{A}\right)\frac{A}{2l} = \frac{\rho_1 + \rho_2}{2}$

7.(a) $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$

or, $0 = d(u^{-1}) + d(v^{-1})$

or, $\frac{d(u^{-1})}{du}du + \frac{d(v^{-1})}{dv}dv = 0$

or, $-\frac{du}{u^2} - \frac{dv}{v^2} = 0$

or, $\frac{dv}{du} = \left(\frac{v}{u}\right)^2$

or, $dv = \left(\frac{f}{u-f}\right)^2 L$

8.(b) $\alpha = 0.96$

$\beta = \frac{\alpha}{1-\alpha} = \frac{0.96}{1-0.96} = 24$

9.(d) $\frac{A_2}{A_1} = \left(\frac{r_2}{r_1}\right)^2 = \left(\frac{0.53\times 2^2}{0.53\times 1^2}\right)^2 = 16:1$

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

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

Here,

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

$= -a^2\omega\cos\omega t\sin\omega t + a^2\omega\cos\omega t\sin\omega t = 0$

$\therefore \vec{r}\perp\vec{v}$

11.(c) Braking force = Breaking stress × A

Here wire is cut in two equal halves then elongation will be half to break i.e. 1 mm

12.(d) $T = \frac{1}{f_b} = \frac{1}{12} < 0.1$ sec i.e. persistence of hearing.

13.(d) $F = 9 \times 10^9 \frac{Q_1Q_2}{r^2}$

If $r' = \frac{r}{3}$ then $F' = 9 \times 10^9 \frac{Q_1Q_2}{\left(\frac{r}{3}\right)^3} = 9F$

14.(d) $KE = \frac{hc}{\lambda} - \frac{hc}{\lambda_o} = hc\left[\frac{1}{\lambda} - \frac{1}{\lambda_o}\right]$

$= 6.62\times10^{-34}\times3\times10^8\left(\frac{1}{3000\times10^{-10}} - \frac{1}{4000\times10^{-10}}\right)$

$= 1.65\times10^{-19}J$

$\therefore V_S = \frac{KE}{e} = \frac{1.65\times10^{-19}}{1.6\times10^{-19}} = 1V$

15.(b) N has higher ionization potential than O due to more stable half-filled 2p orbitals.

16.(b) $N_{HNO_3} = \frac{\%\text{ by vol} \times 10}{\text{Eq. wt}} = \frac{0.63 \times 10}{63} = 0.1N$

$\therefore$ pH = –log[0.1] = 1

17.(c) During reduction of $Cr_2O_7^{--}$ by Fe^{++} O.N. of Cr reduces from +6 to +3. So, it involves 3 electrons.

18.(a) No. of Spectral lines $= \frac{n(n-1)}{2} = \frac{5\times4}{2} = 10$

19.(b) Ionic compounds dissolves in water when hydration energy is more than lattice energy.

20.(c) $Zn+HNO_3 \rightarrow Zn(NO_3)_2+NO_2+H_2O$

HNO_3 doesn't give H_2 gas with Zn.

21.(c) Cl_2+Hot & Conc. NaOH→NaCl+$NaClO_3$+H_2O

With hot and conc. NaOH, Cl_2 gives $NaClO_3$.

22.(a) Pyrolusite is MnO_2 and is ore of Mn.

23.(c) $Cu_2O+Cu_2S \rightarrow Cu+SO_2$

In Bessemer converter, copper gives self-reduction and Cu_2O acts as reducing agent.

24.(b) The process of coating Zn using zinc dust is called sherardising.

25.(b) $CH_3CH_2–O–CH_2CH_3$ and $CH_3CH_2CH_2–O–CH_3$ are metamers.

26.(c) Obvious

27.(d) All (a), (b) and (c) form phenoxide ion but C_6H_5COOH doesn't form as C – COOH bond is not cleavaged.

28.(a) $CH_3MgBr + NH_3 \rightarrow CH_4 + Mg(NH_2)Br$

29.(a) p : 2 + 3 = 5
q : 3 + 7 = 8
~p : 2 + 3 ≠ 5 and 3 + 7 = 8 stands for $\sim p \wedge q$

30.(b) $\vec{a} + \vec{b} = 3\vec{i} + 3\vec{j} + 4\vec{k}$

$\therefore \quad |\vec{a} + \vec{b}| = \sqrt{3^2 + 3^2 + 4^2} = \sqrt{34}$

31.(a) $\lim\limits_{x\to 0} \dfrac{\frac{\tan x}{x}}{\frac{\log(1+x)}{x}} = \dfrac{1}{1} = 1$

32.(b) For x < 0, $\dfrac{d}{dx}\log|x| = \dfrac{d}{dx}\log(-x)$

$= \dfrac{1}{(-x)}(-1) = \dfrac{1}{x}$

For x > 0, $\dfrac{d}{dx}\log|x| = \dfrac{d}{dx}\log x = \dfrac{1}{x}$

For all x ≠ 0 $\dfrac{d}{dx}\log|x| = \dfrac{1}{x}$

33.(d) $3.2 - 4 = 2.2 + \lambda$
or, $6 - 4 = 4 + \lambda$
or, $\lambda = -2$

34.(a) $\sin\left(3\sin^{-1}\dfrac{2}{5}\right) = \sin 3\theta$

$\left(\text{Let } \theta = \sin^{-1}\dfrac{2}{5} \text{ or } \sin\theta = \dfrac{2}{5}\right)$

$= 3\sin\theta - 4\sin^3\theta = 3.\dfrac{2}{5} - 4\left(\dfrac{2}{5}\right)^3 = \dfrac{118}{125}$

35.(d) Minimum value at $x = -\dfrac{b}{2a} = -\dfrac{8}{2} = -4$

Minimum value = 16 – 32 + 17 = 1

36.(c) $|A| \neq 0$

37.(b) $d = \pm\dfrac{(3+4+3-5)}{\sqrt{9+4+1}} = \dfrac{5}{\sqrt{14}}$

38.(a) $\left(\dfrac{1}{2}\right)^2 + \left(\dfrac{1}{3}\right)^2 + n^2 = 1$

or, $n^2 = 1 - \dfrac{1}{4} - \dfrac{1}{9} = \dfrac{36-9-4}{36} = \dfrac{23}{36}$

$\therefore \quad n = \dfrac{\sqrt{23}}{6}$

39.(b) Obvious

40.(b) $I = \int 2^x dx = \dfrac{2^x}{\log 2} + c$

41.(a) Put $e^x\,dx = t \qquad \therefore e^x dx = dt$

$I = \int \sin t\, dt = -\cos t + c = -\cos e^x + c$

42.(c) $\dfrac{a\cos\alpha.\sin\alpha - a\sin\alpha.\cos\alpha + c\cos\alpha}{\cos\alpha\sqrt{\tan^2\alpha + 1}}$

Line x tanα – y + c = 0 = c cosα

43.(d) $\dfrac{x^2}{r-1} + \dfrac{y^2}{r+1} = -1 \ (r > 1)$

So imaginary ellipse

44.(d) $\overline{X} = a + \dfrac{\Sigma d}{n} = 66 + \dfrac{(-50)}{10} = 61$

45.(b) $(2s - 2a) . \dfrac{\Delta}{s(s-a)} = \dfrac{2\Delta}{s}$

46.(a) $2^x\left(1 + \dfrac{x}{2}\right)^n$

For validity $\left|\dfrac{x}{2}\right| < 1 \Rightarrow |x| < 2$

47.(b) m = 4, n = 10 $\quad P(S) = \dfrac{m}{n} = \dfrac{4}{10}$

48.(b) $4^{1/2 + 1/4 + 1/8 + \dots} = 4^{\frac{1/2}{1-1/2}} = 4^1 = 4$

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

Section – II

61.(c) $\dfrac{T_1}{T_2} = \dfrac{m(g+a)}{m(g-a)} = \dfrac{10+5}{10-5} = \dfrac{3}{1}$

62.(b) Change in K.E = work done against friction

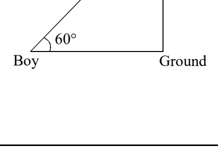
$\dfrac{P^2}{2m} = F\times S$ or, $\dfrac{p^2}{2m} = \mu mgs$

$\therefore \quad S = \dfrac{P^2}{2\mu m^2 g}$

63.(c) $\dfrac{50}{100} \times \dfrac{1}{2} mv^2 = ms\Delta\theta$

$\therefore \quad \Delta\theta = \dfrac{v^2}{4s} = \dfrac{300^2}{4\times150} = 150^0C$

64.(b)



$\sin 60^0 = \dfrac{h}{vt}$

$\therefore \quad h = vt \sin 60^0$

65.(d) $\frac{f'}{f} = \frac{v}{v - u_s} = \frac{v}{v - \frac{v}{10}} = \frac{10}{9}$

66.(b) $\alpha = \frac{\Delta i_c}{\Delta i_e} = \frac{\Delta i_e - \Delta i_b}{\Delta i_e}$

$10 - \Delta I_b = 9.5$

$\therefore \quad \Delta i_b = 0.5mA$

67.(c) $\mu = \frac{\sin\left(\frac{A + \delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)} = \frac{\sin\left(\frac{A + A}{2}\right)}{\sin\left(\frac{A}{2}\right)}$

$= \frac{2\sin\frac{A}{2}\cos\frac{A}{2}}{\sin\frac{A}{2}}$

$\cos\frac{A}{2} = \frac{\mu}{2} \quad \Rightarrow A = 2\cos^{-1}\left(\frac{\mu}{2}\right)$

68.(a) $C' = \frac{\varepsilon_o A}{2d} = \frac{C}{2} = 25\mu F$

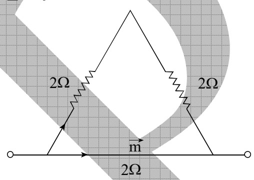
$E_i = qV = CV^2 = 50\times10^{-6}\times100^2 = 50\times10^{-2}$ J

$E_f = q'V = C'V^2 = 25\times10^{-6}\times100^2 = 25\times10^{-2}$J

$\Delta E = E_i - E_f = 25\times10^{-2}$J

69.(b) Each arm of resistor has resistance 2Ω and resistance 2Ω & 4Ω are is parallel.

$R_{eq} = \frac{2\times4}{2+4} = 1.3\Omega$



70.(b) w = H

or, $i^2Rt = ms\Delta\theta$

$\Delta\theta \propto i^2$

$\left(\frac{\Delta\theta_2}{\Delta\theta_1}\right) = \left(\frac{i_2}{i_1}\right)^2 = 4$

$\therefore \quad \Delta\theta_2 = 4\Delta\theta_1 = 4\times3 = 12^0C$

71.(c) $\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mE}} \quad \therefore E = \frac{h^2}{2m\lambda^2}$

$= \frac{(6.62\times10^{-34})^2}{2\times9.1\times10^{-31}\times(1.224\times10^{-10})^2}$

$= 1.6\times10^{-17}J = 100eV$

72.(a) $\frac{N}{N_O} = \left(\frac{1}{2}\right)^{\frac{t}{T_{\frac{1}{2}}}} = \left(\frac{1}{2}\right)^{\frac{5T_{\frac{1}{2}}}{T_{\frac{1}{2}}}} = \frac{1}{32}$

$\therefore \quad \% = \frac{N}{N_o}\times100\% = \frac{1}{32}\times100\% = 3\%$

73.(a) $E = B\pi r^2 f$

$\therefore f = \frac{E}{B\pi r^2} = \frac{3.14\times10^{-3}}{5\times10^{-4}\times\pi\times(0.5)^2} = 8$ rev/s

74.(b)

75.(c) $N_{H_2SO_4} = \frac{W \times 1000}{V \times E} = \frac{0.1 \times 1000}{250 \times 40} = 0.01N$

pH = –log[0.01] = 2

76.(c) Attract each other as according to K.T. of gas no force of attraction exists bet^n gaseous molecules.

77.(a) $HgCl_2 + 2NaOH \rightarrow HgO\downarrow + 2NaCl + H_2O$
(yellow ppt)

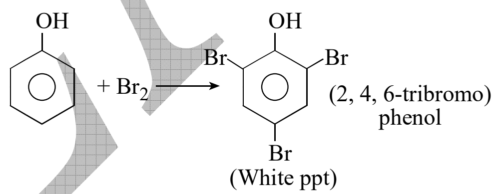
78.(d) $O_3 \longrightarrow O_2 + O$

$2HF + O \longrightarrow$ No rx^n

79.(c) Alcohol ($C_nH_{2n+2}O$) and acid ($C_nH_{2n}O_2$) are not isomer.

80.(b) In presence of Hg^{++}-ions as catalyst, ethyne gives partial addition product forming vinyl chloride.

81.(a)



Here, Phenol acts as o-p-director.

82.(b) Circle: $x^2 + y^2 = r^2$

$2x + 2y\frac{dy}{dx} = 0$

$x + y\frac{dy}{dx} = 0$

83.(c) $f(x) = x + \sin x$

$f'(x) = 1 + \cos x$

$f''(x) = -\sin x$

For maxima or minima,

$f'(x) = 0$

$\cos x + 1 = 0 \quad \Rightarrow x = \pi$

When $x = \pi$, $f''(x) = 0$. So the given function is neither maximum nor minimum.

84.(b) $\int x e^{2x} dx$

$= x\int e^{2x} dx - \int\left(\frac{dx}{dx}\int e^{2x} dx\right) dx$

$= \frac{xe^{2x}}{2} - \frac{e^{2x}}{4} + c = \left(\frac{2x - 1}{4}\right)e^{2x} + c$

Thus $f(x) = \frac{2x - 1}{4}$

85.(a) We have, $C_0 + 2C_1 + 3C_2 + \dots + (n+1)C_n$

$= \sum_{r=0}^{n} (r+1)\, C_r$

$= \sum_{r=0}^{n} rC_r + \sum_{r=0}^{n} C_r = n\, 2^{n-1} + 2^n = (n+2)\, 2^{n-1}$

86.(b) $P(W_1 \cap R_2) = P(W_1).P(R_2) = \frac{3}{5} \cdot \frac{2}{4} = \frac{6}{10}$

$P(R_1 \cap R_2) = P(R_1).P(R_2) = \frac{2}{5} \cdot \frac{1}{4} = \frac{2}{20}$

Required probability: $P(E) = \frac{6}{20} + \frac{2}{20} = \frac{2}{5}$

87.(c) $(1 + \omega)^7 = A + B\omega$

$(-\omega^2)^7 = A + B\omega$ or, $-\omega^2 = A + B\omega$

i.e. $A + B\omega + \omega^2 = 0$. So, A = 1, B = 1

88.(d) Applying $C_1 \to C_1 + C_2 + C_3$,

$$\begin{vmatrix} \log \frac{x}{y} \cdot \frac{y}{z} \cdot \frac{z}{x} & \log \frac{y}{z} & \log \frac{z}{x} \\ \log \frac{y}{z} \cdot \frac{z}{x} \cdot \frac{x}{y} & \log \frac{z}{x} & \log \frac{x}{y} \\ \log \frac{z}{x} \cdot \frac{x}{y} \cdot \frac{y}{z} & \log \frac{x}{y} & \log \frac{y}{z} \end{vmatrix} = \begin{vmatrix} 0 & \log \frac{y}{z} & \log \frac{z}{x} \\ 0 & \log \frac{z}{x} & \log \frac{a}{y} \\ 0 & \log \frac{x}{y} & \log \frac{y}{z} \end{vmatrix} = 0$$

89.(c) $x = 1 + a + a^2 + \dots = \frac{1}{1-a} \Rightarrow a = 1 - \frac{1}{x}$

$y = 1 + b + b^2 + \dots = \frac{1}{1-b} \Rightarrow b = 1 - \frac{1}{y}$

$z = 1 + c + c^2 + \dots = \frac{1}{1-c} \Rightarrow c \Rightarrow 1 - \frac{1}{z}$

As a, b, c are in AP, $\frac{1}{x}, \frac{1}{y}, \frac{1}{z}$ are in A.P.

and So, x, y, z are in H.P.

90.(b) $\sin\left\{\tan^{-1} \frac{1-x^2}{2x} + \cos^{-1} \frac{1-x^2}{1+x^2}\right\}$

$= \sin\left\{\cot^{-1} \frac{2}{1-x^2} + \tan^{-1} \frac{2x}{1-x^2}\right\} = \sin\frac{\pi}{2} = 1$

91.(c) $\cos A = \sin B - \cos C$

$\cos A + \cos C = \sin B$

$2\cos\frac{A+C}{2} \cdot \cos\frac{A-C}{2} = 2\sin\frac{B}{2}\cos\frac{B}{2}$

or, $\sin\frac{B}{2}\cos\frac{A-C}{2} = \sin\frac{B}{2} \cdot \cos\frac{B}{2}$

Either, $\sin\frac{B}{2} = 0$

or, $\cos\frac{A-C}{2} = \cos\frac{B}{2}$

$\therefore$ B = 0, not possible

So, $\frac{A-C}{2} = \frac{B}{2}$

$\therefore$ A = B + C. So Δ is rt angled

92.(a) As the eq^n represent a pair of lines so, we have

$1.1.1 + 2.f.g.0 - 1.f^2 - 1.g^2 - 0 = 0$

$1 - f^2 - g^2 = 0$

$\therefore f^2 + g^2 = 1$

93.(c) Centre of 1st circle = (−g, −f)

Radius of 1st circle $= \sqrt{g^2 + f^2}$

Centre of 2nd circle = (−g′, − f ′)

Radius of 2nd circle $= \sqrt{g'^2 + f'^2}$

As the circles touch externally, we have

$\sqrt{(g - g')^2 + (f - f')^2} = \sqrt{g^2 + f^2} + \sqrt{g'^2 + f'^2}$

Squaring,

$g^2 + g'^2 + f^2 + f' - 2(gg' + ff')$

$= g^2 + f^2 + g'^2 + f'^2 + 2\sqrt{(g^2 + f^2)(g'^2 + f'^2)}$

or, $-2(gg' + ff') = 2\sqrt{(g^2 + f^2)(g'^2 + f'^2)}$

Squaring,

$g^2g'^2 + 2fgf'g' + f^2f'^2 = g^2g'^2 + g^2f'^2 + f^2g'^2 + f^2f'^2$

i.e. $g^2f'^2 - 2fgf'g' + g'^2f^2 = 0$

i.e. $(gf' - g'f)^2 = 0$

i.e. $gf' - g'f = 0$

94.(b) $7 = \text{mean} = \frac{\Sigma x}{n} = \frac{\Sigma x}{18}$

Total = $\Sigma x = 126$

After correction: $\Sigma x_i = 126 - 21 + 12 = 117$

Corrected mean $= \frac{117}{18} = 6.5$

95.(a) We must have $k = \frac{1}{p^2}$ but p = 1. So k = 1

96.(c) $\vec{a}.(\vec{b} + \vec{c}) = 0 \quad \vec{a}.\vec{b} + \vec{a}.\vec{c} = 0$

$\vec{b}.(\vec{c} + \vec{a}) = 0 \quad \vec{b}.\vec{c} + \vec{a}.\vec{b} = 0$

$\vec{c}.(\vec{a} + \vec{b}) = 0 \quad \vec{a}.\vec{c} + \vec{b}.\vec{c} = 0$

Adding $2(\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}) = 0$

We have,

$|\vec{a} + \vec{b}| = 6$ so, $a^2 + b^2 + 2\vec{a}.\vec{b} = 36$

$|\vec{b} + \vec{c}| = 8$ so, $b^2 + c^2 + 2\vec{b}.\vec{c} = 64$

$|\vec{c} + \vec{a}| = 10$ so, $c^2 + a^2 + 2\vec{c}.\vec{a} = 100$

So, $2(a^2+b^2+c^2)+2(\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}) = 36 + 64 + 100$

$a^2+b^2+c^2 + (\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}) = 100$

$a^2 + b^2 + c^2 + 2(\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}) = 100$

$(\vec{a} + \vec{b} + \vec{c}) = 100 \qquad |\vec{a} + \vec{b} + \vec{c}| = 10$

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