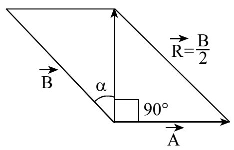
Section – I

1.(c) $P = Fv = mav = \frac{mv^2}{t} = m\left(\frac{x}{t}\right)^2 \times \frac{1}{t}$

or, $P = m\frac{x^2}{t^3}$

or, $x \propto t^{3/2}$

2.(c)

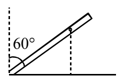


$\cos\alpha = \frac{R}{B} = \frac{B}{2.B} = \cos 60°$

$\alpha = 60°$

$\therefore \quad \theta = 90° + \alpha = 150°$

3.(d)



PE = mgh

$= mg\frac{l}{2}\cos 60°$

$= \frac{mgl}{4}$

4.(d) $\Delta E = T\Delta A = T\{8\pi(2r)^2 - 8\pi r^2\}$

$= 24\pi r^2 T$

5.(a) dQ = du + dw, dw = 0 so

or, dQ = du

dQ < 0 is du decreases i.e. temperature fall.

6.(c) % increase = $\gamma\Delta\theta \times 100\%$

$\gamma > \beta > \alpha$ so

7.(c) u = f + x

$m = \frac{v}{u} = \left(\frac{fu}{u-f}\right) \times \frac{1}{u}$

$= \frac{f}{u-f} = \frac{f}{f+x-f} = \frac{f}{x}$

8.(a)

9.(b) $v = \sqrt{\frac{E}{\rho}}$, E = Elasticity ρ = density

10.(c) **For open**

$f = \frac{v}{2l}$

When dipped in water

$f' = \frac{v}{4l/2} = \frac{v}{2l} = f$

11.(c) $F = \frac{1}{4\pi\varepsilon}\frac{Q_1Q_2}{r^2} = \frac{1}{4\pi\varepsilon_0\varepsilon_r}\frac{Q_1Q_2}{r^2}$

For brass $\varepsilon_r = \infty$ so F = 0

12.(c) $Q = CV = \varepsilon_r C\frac{V}{8}$

or, $\varepsilon_r = 8$

13.(d) $\frac{R'}{R} = \left(\frac{l + 2l}{l}\right)^2 \Rightarrow R' = 9R$

14.(a) $\frac{H_1}{H_2} = \frac{\frac{V^2}{R_1}}{\frac{V^2}{R_2}} = \frac{R_2}{R_1}$

15.(b) $H = Be\cos\delta$

or, $Be = \frac{H}{\cos 30°} = \frac{2H}{\sqrt{3}}$

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

or, $Bqr = mr\omega$

or, $Bq = 2\pi fm \Rightarrow f = \frac{Bq}{2\pi m}$

17.(c) $V_{in} = IR_{in}$

or, $I_b = \frac{0.01}{1000} = 10 \times 10^{-6}$ A

$\beta = \frac{I_c}{I_b}$

$I_c = 50 \times 10 \times 10^{-6} = 500\ \mu A$

18.(a)

$$\underset{+2}{\underset{\downarrow}{S_2O_3^{--}}} \longrightarrow \underset{+2.5}{\underset{\downarrow}{S_4O_6^{--}}}$$

Increase in +ve charge ⇒ oxidation

19.(b)

20.(c) In period, Iomization energy increases but for second Iomisation energy incase of oxygen electron is remove from half filled $2p^3$ orbital which is more stable so second iomization energy for oxygen > Fluorine.

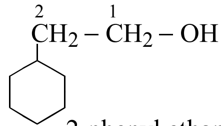
21.(b) Last electron of fluorine is m $2p_y$

n = 2 $\quad$ l = 1 $\quad$ m = 0

22.(d) HPO_4^{--}

$$\underset{\text{must be acid}}{HPO_4^{--}} \longrightarrow \underset{\text{conjugate base}}{H^+ + PO_4^{---}}$$

23.(d)



2-phenyl ethanol

24.(d)

$$CH_2 - CH = CH_2 + \overset{+}{H} \longrightarrow CH_3 - \overset{+}{C}H - CH_3$$

2°-carbocations

25.(a) The blue colour of solution is due to ammoniated electron which absorb energy in the visible region of light thus import blue colour

$Na^+ (x + y) NH_3 \rightarrow [Na(NH_3)x]^+ + [e(NH_3)y]^-$

26.(b) In aqueous solution of Ca salt

Ca^{++} & H^+

Since H^+ has more tendency to gain electron if get reduced first.

27.(b) Higher boiling point of H_2O is due to formation of H-bond.

28.(c) $10HNO_3 + I_2 \rightarrow 2HIO_3 + 4H_2O + 10NO_2$
Conc.

29.(c) $\frac{dy}{dz} = \frac{\frac{de^x}{dx}}{\frac{d\sin^{-1}x}{dx}} = \frac{e^x}{\frac{1}{\sqrt{1-x^2}}}$

30.(b) $\int_8^{10} f(x)\,dx = \int_0^{10} f(x)\,dx - \int_0^8 f(x)\,dx$
$= 17 - 12 = 5$

31.(c) $|z_1| = \sqrt{3^2 + 4^2} = 5$
$|z_2| = \sqrt{4^2 + (-3)^2} = 5$
$\therefore \quad |z_1| = |z_2|$

32.(d) $\lim_{x \to 0} \frac{5^x - 1}{x} + \lim_{x \to 0} \frac{3^x - 1}{x}$
$= \log_e 5 + \log_e 3 = \log_e(5 \times 3)$

33.(c) Obvious

34.(a)

35.(c) Obvious

36.(b) Putling $x = a\sec\theta$ & $y = b\tan\theta$
$\frac{a^2\sec^2\theta}{a^2} - \frac{b^2\tan^2\theta}{b^2} = 1$
$\sec^2\theta - \tan^2\theta = 1$
$1 = 1$

37.(d) $\vec{a} + \vec{b} + \vec{c} = 0$
$\vec{a} + \vec{i} - \vec{j} + \vec{j} + \vec{k} = 0$
$\vec{a} = -\vec{i} - \vec{k}$

38.(a) $ax + by = 2ab$
$\frac{x}{2b} + \frac{y}{2a} = 1$
Area of $\Delta = \frac{1}{2} \cdot 2a.2b = |2ab|$

39.(c) Putting $x = 1$ & $y = 2$
$2^2 = 4.1$ i.e. $4 = 4$
(an the parabola)

40.(d) $\frac{1}{\sin A} = \frac{2R}{a} = \frac{2}{a}\frac{abc}{4\Delta} = \frac{bc}{2\Delta}$

41.(d) $\sin^2 25 + \sin^2(90 - 25)$
$= \sin^2 25 + \cos^2 25 = 1$

42.(b) Total number of ways $= 4 \times 3 \times 3 \times 2$
$= 72$ ways

43.(c) $\left(x - \frac{1}{x}\right)^{2n}$
Total no. of terms $= 2n + 1$
No. of terms independent of $x = 1$
No. of terms dependent of $x = (2n + 1) - 1 = 2n$

44.(b) Centre $(0, 0)$ & $r = 5$
$5 = \left|\frac{0 + 0 + k}{\sqrt{3^2 + 4^2}}\right|$
$k = 25$

45.(c) $A = \int_0^\pi \sin x$
$= [-\cos x]_0^\pi = -[\cos\pi - \cos 0]$
$= -[-1 - 1] = 2$ sq. units

46.(b) $2.\frac{dy}{dx} = -2x$ At $x = 1$: $\frac{dy}{dx} = -1$

47.(b) $\cos^{-1}\sin\frac{\pi}{6} = \cos^{-1}\frac{1}{2} = \frac{\pi}{3}$

48.(b) Direction cosines of the line PQ are:
$\frac{x_2 - x_1}{r}, \frac{y_2 - y_1}{r}, \frac{z_2 - z_1}{r}$
$\frac{5-7}{3}, -\frac{3+5}{3}, \frac{8-9}{3}$ i.e. $-\frac{2}{3}, \frac{2}{3}, -\frac{1}{3}$

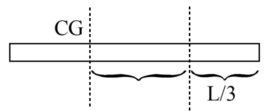
49.(a)	50.(d)	51.(b)	52.(c)	53.(a)	54.(c)
55.(d)	56.(b)	57.(b)	58.(a)	59.(b)	60.(a)

Section – II

61.(b) Vel. of thief relative to police is
$v_1 = 155 - 45 = 110$ km/hr
$= 30$ m/s
Vel. of bullet relative to thief is
$v_2 = 180 - 30 = 150$ m/s

62.(a) $mg - T = ma$
or, $T = mg - ma$
or, $T_{max} = m(g - a_{min})$
or, $\frac{3}{4}mg = m(g - a_{min})$
or, $a_{min} = \frac{g}{4}$

63.(c)



$h = \frac{L}{2} - \frac{L}{3}$
$= \frac{L}{6}$

$I = I_{cm} + Mh^2$
$= \frac{1}{12}ML^2 + M\left(\frac{L}{6}\right)^2$
$= \frac{ML^2}{12} + \frac{ML^2}{36}$
$= \frac{ML^2}{9}$

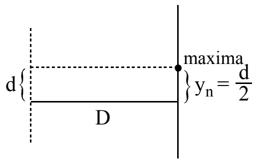
64.(d) $\frac{t_2}{t_1} = \frac{x_2{}^2 - x_1{}^2}{x_2{}^2 - x_1{}^2} = \frac{42^2 - 40^2}{21^2 - 20^2} = \frac{(42 + 40) \times 2}{(21 + 20) \times 1}$
$\therefore \quad t_2 = 4 \times 10 = 40$ hrs

65.(c) 40% of $mgh = mLf$
or, $h = \frac{80 \times 4200}{0.4 \times 10} = 84000$ m $= 84$ km

66.(c) $m = \frac{I_1}{0} = \frac{0}{I_2}$

or, $0 = \sqrt{I_1 I_2} = \sqrt{8 \times 2} = 4$ cm

67.(a)



$\frac{y_n d}{D} = n\lambda$

or, $\frac{d^2}{2D} = n\lambda$

or, $n = \frac{d^2}{2D\lambda}$

68.(a) **For A**

$f_A = f + 3\%$ of $f = 1.03f$

For B

$f_B = f - 3\%$ of $f = 0.97f$

Now

$f_A - f_B = 6$

or, $1.03f - 0.97f = 6$

or, $f = \frac{6}{0.06} = 100$ Hz

69.(a) $Q = CV = C'V$

or, $\frac{\varepsilon_0 A}{d} = \frac{\varepsilon_0 A}{d - t\left(1 - \frac{1}{\varepsilon_r}\right)} + 1.6$

or, $d = d - 2\left(1 - \frac{1}{\varepsilon_r}\right) + 1.6$

or, $2\left(1 - \frac{1}{\varepsilon_r}\right) = 1.6$

or, $1 - \frac{1}{\varepsilon_r} = 0.8$

or, $\frac{1}{\varepsilon_r} = 0.2$

or, $\varepsilon_r = 5$

70.(d) $R = \frac{\rho l}{A} = \frac{\rho l^2}{V} = \frac{\rho l^2}{m} \times$ density

$\therefore$ $R_1 : R_2 : R_3 = \frac{l_1^2}{m_1} : \frac{l_2^2}{m_2} : \frac{l_3^2}{m_3}$

$= \frac{25}{1} : \frac{9}{3} : \frac{1}{5}$

$= 25 : 3 : \frac{1}{5}$

$= 125 : 15 : 1$

71.(b) $Q = I^2RT = msd\theta$

or, $\frac{d\theta_2}{d\theta_1} = \frac{I_2^2}{I_1^2}$

or, $d\theta_2 = \left(\frac{2I}{I}\right)^2 \times 3 = 12°C$

72.(a) $E = -\left(\frac{\phi_2 - \phi_1}{t}\right) = -\left(\frac{B_2AN - B_1AN}{t}\right)$

$= \frac{(0.05 - 0.1)\ 0.1 \times 0.05 \times 100}{0.05}$

$= 0.5$ V

73.(b) For Balmer

$\frac{1}{\lambda_B} = R\left[\frac{1}{2^2} - \frac{1}{3^2}\right] = \frac{5R}{31}$

or, $\lambda_B = \frac{36}{5R}$ .... (i)

For Lyman series

$\frac{1}{\lambda_L} = R\left[\frac{1}{1} - \frac{1}{4}\right] = \frac{3R}{4}$

$\lambda_L = \frac{4}{3R}$ .....(ii)

$\frac{\lambda_L}{\lambda_B} = \frac{4}{3R} \times \frac{5R}{36}$

$\therefore$ $\lambda_L = \frac{5}{27} \times 6563 = 1215$ Å

74.(c) **For X**

$A_x = \lambda N = \frac{0.693}{T_{1/2}} \left(\frac{1}{2}\right)^{t/T_{1/2}} N_0$

$= \frac{0.693}{1} \times \left(\frac{1}{2}\right)^{2/1} = \frac{0.693}{4} N_0$

For Y

$A_Y = \lambda N = \frac{0.693}{T_{1/2}} \times \left(\frac{1}{2}\right)^{t/T_{1/2}} N_0$

$= \frac{0.693}{4} N_0$

$\therefore$ $\frac{A_X}{A_Y} = \frac{0.693\ N_0}{4} : \frac{0.693}{4} N_0 = 1:1$

75.(b)

At anode	At cathode
SO_4^{--} → does not oxidize OH^- oxidize to give O_2	Due to high tendency of Cu^{++} to reduce than H^+ Cu – deposite at cathode

76.(c) 1000 ml 1N $CuSO_4$ liberate 127g Iodine

$N = \frac{W \times 1000}{E \times V}$

$1 = \frac{W \times 1000}{127 \times 400}$

$\therefore$ W = 50.8 gm

77.(b) pH = 4 thus $H^+ = 10^{-4}$

Now, diluted so $H^+ = \frac{10^{-4}}{10^3} = 10^{-7}$

$pH = -\log(10^{-7} + 10^{-7})$

$= 6.69 \Rightarrow$ less than 7

78.(c) Fe (no. of mole) $= \frac{558.5}{55.85} = 10$ moles $= 10 \times N_A$

No. of moles in 60g carbon $= \frac{60}{12} = 5$ moles $= 5 \times N_A$

79.(b)

$$CH_3-CH_3 \xrightarrow{Cl_2} CH_3CH_2Cl \xrightarrow{\text{alc. KOH}} CH_2=CH_2 \xrightarrow{P_3/CC_4} HCHO$$

(A) = Ethane Formal dehyde

80.(c)

$$Zn \xrightarrow[HNO_3]{\text{dil.}} \underset{\text{Colourless sol}^n}{Zn(NO_3)_2} \xrightarrow[NaOH]{\text{aq}} \underset{\text{White ppt}}{Zn(OH)_2} \xrightarrow[NaOH]{\text{excess}} Na_2ZnO_2 \xrightarrow{H_2S} \underset{\text{White ppt.}}{ZnS}$$

81.(c) $KBr + H_2SO_4 \rightarrow K_2SO_4 + HBr$

$$\overset{-1}{HBr} + O \longrightarrow H_2O + \overset{0}{Br_2}$$

Oxidises to Br_2

82.(a) $f\left(\frac{x}{y}\right) + f(xy)$

$= \cos(\log(x/y)) + \cos(\log(xy))$

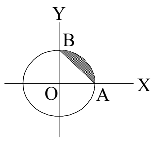
$= \cos(\log x - \log y) + \cos(\log x + \log y)$

$= 2\cos(\log x).\cos(\log y)$

$= 2\, f(x).f(y)$

From the given condition, we get = 0

83.(c)



Area of sector OAB $= \frac{1}{4}.\pi ab$

Area of $\Delta AOB = \frac{1}{2}\,a.b$

Required area $= \frac{\pi ab}{4} - \frac{ab}{4} = \frac{ab}{4}(\pi - 2)$

84.(b) $\sin^{-1}\frac{4}{5} + \cos^{-1}\frac{x}{5} = \frac{\pi}{2}$

$x = 4\left[\because \sin^{-1}x + \cos^{-1}x = \frac{\pi}{2}\right]$

85.(c) $f'(x) = m$

$1 = f'(0) = m$

$f(0) = c$

$1 = c$

$f(x) = 1x + 1$

$f(2) = 2 + 1 = 3$

86.(a) $\alpha = \omega$ and $\alpha^2 = \omega$

$\alpha^{31} = \omega^{31} = \omega^{30}.\omega = \omega$

$\alpha^{62} = \omega^{62} = \omega^{60}.\omega^2 = \omega^2$

Roots are same, so the equation is $x^2 + x + 1 = 0$

87.(a) $\left[e^x.\frac{1}{x}\right]_1^2$ $\left[\int e^x\,[f(x) + f'(x)]\,dx = e^x.f(x) + c\right]$

$= \left(e^2.\frac{1}{2}\right) - (e.1) = e\left(\frac{e}{2} - 1\right)$

88.(b) $\frac{dv}{dt} = 10$ cubic inches/sec.

$\frac{d}{dt}\left(\frac{4}{3}\pi r^3\right) = 10$

$\frac{4}{3}\pi.3r^2.\frac{dr}{dt} = 10$

$\frac{dr}{dt} = \frac{10}{4\pi.1} = \frac{5}{2\pi}$ inch/sec

89.(c) $\vec{a}\,.\,(\vec{b} \times \vec{c}) = |\vec{a}|\,.\,|\vec{b} \times \vec{c}|\cos\theta$

$= |\vec{a}|\,|\vec{b}|\,|\vec{c}|\sin\frac{\pi}{2}$

$= |\vec{a}|\,|\vec{b}|\,|\vec{c}|$

90.(a) Parallel plane: $x + 2y + 4z = k$

Passes through (2, 3, 4)

$2 + 6 + 16 = k$ i.e. $k = 24$

Required plane: $x + 2y + 4z = 24$

91.(b) $x^2 = 4y$

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

At $x = a$: $\frac{dy}{dx} = \frac{a}{2}$

$\tan\theta = \frac{a}{2}$

$\theta = \tan^{-1}\left(\frac{a}{2}\right)$

92.(a) $\frac{\sin(B + C)}{\sin(A + B)} = \frac{\sin(A - B)}{\sin(B - C)}$

$\sin^2B - \sin^2C = \sin^2A - \sin^2B$

93.(c) Total $= {}^4C_4 + {}^4C_3 + {}^4C_2 + {}^4C_1$

$= 2^4 - 1 = 15$

94.(b) $\left[-\frac{\frac{1}{(n+1)}}{1} - \frac{\left(\frac{1}{n+1}\right)^2}{2} - \frac{\left(\frac{1}{n+1}\right)^3}{3} \;..... \infty\right]$

$= -\log_e\left(1 - \frac{1}{n+1}\right) = -\log\left(\frac{n}{n+1}\right)$

$= \log\left(\frac{n+1}{n}\right) = \log\left(1 + \frac{1}{n}\right)$

$= \frac{1}{n} - \frac{1}{2n^2} + \frac{1}{3n^3} - .....\infty$

95.(b) Coincident lines: $h^2 = ab$

$(-2k)^2 = 3.5$

$k = \pm\frac{\sqrt{15}}{2}$

96.(c) $a = b^{y/x}$, $c = b^{y/z}$

We have: $b^2 = ac$

$b^2 = b^{y/x}.b^{y/z}$

$2 = \frac{y}{x} + \frac{y}{z}$

$y = \frac{2xy}{x+z}$ (H.P.)

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

...The End...