Section – I

1.(a) $S = S_A - S_B$

$= \frac{1}{2} a\ 10^2 - \frac{1}{2} a \times 9^2$

$= 100 - 81 = 19$ m

2.(a) $F = \frac{vdm}{dt} = \frac{vn}{t} m$

$= 400 \times \frac{30}{60} \times 50 \times 10^{-3} = 10$ N

3.(a) $v = \sqrt{5gr}$

or, $\sqrt{2gh} = \sqrt{5gr}$

or, $h = \frac{5r}{2} = \frac{5 \times 4}{2} = 10$ m

4.(b) Young's modulus depends on nature of material.

5.(d) $\frac{\Delta l}{l} = \alpha\Delta\theta = 0.2\%$

$\frac{\Delta V}{V} = \gamma\Delta\theta = 3\alpha\Delta\theta = 3 \times 0.2\% = 0.6\%$

6.(b) $P = \sigma A(T^4 - T_0^4) = ms\frac{d\theta}{dt}$

or, $\frac{d\theta}{dt} = \frac{\sigma A(T^4 - T_0^4)}{ms}$

Cube & sphere of equal surface area then mass of sphere is more than cube so rate of coding is less.

7.(c) $\frac{f_1}{f_2} = \frac{1}{2l}\sqrt{\frac{T_1}{m}} \times \frac{2 \times 2l}{1}\sqrt{\frac{m}{T_2}}$

or, $\frac{100}{150} = 2\sqrt{\frac{T_1}{T_2}}$

or, $\frac{T_1}{T_2} = \frac{1}{9}$

8.(c) $y_1 = a\sin\omega t$

$y_2 = a\cos\omega t = a\sin(90° + \omega t)$

$\therefore\ a_R = \sqrt{a^2 + a^2} = \sqrt{2}\ a$

9.(a) $F = K\frac{2 \times 6}{r^2}$ … (1)

2nd case

$F' = K\frac{(2-4)(6-4)}{r^2} = -K\frac{4}{r^2}$ …. (2)

$\frac{F'}{F} = -\frac{4K}{r^2} \times \frac{r^2}{12K} = -\frac{1}{3}$

$\therefore\ F' = -\frac{1}{3} \times 12 = -4N$

10.(b) $F = EQ = \frac{\sigma}{\varepsilon_0} Q$

If one plate is removed then

$F' = E'Q$

$= \frac{\sigma}{2\varepsilon_0} Q = \frac{F}{2}$

11.(c) $I = \frac{dQ}{dt} = 10t + 3$

t = 2s, $I = 10 \times 2 + 3 = 23$ A

12.(d) $\frac{V^2}{R} \times t_1 = \frac{V_2^2}{R} \times t_2$

or, $t_2 = \left(\frac{220}{110}\right)^2 \times 5$ min

$= 20$ min

13.(d) $B_H = B_e\cos\delta$

or, $B_0 = B_e \cos 60°$

$\therefore\ B_e = 2B_0$

14.(a) $m = -\frac{1}{n} = \frac{v}{u}$

or, $v = -\frac{u}{n}$

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

or, $-\frac{1}{f} = \frac{1}{u} - \frac{n}{u}$

or, $-\frac{1}{f} = -\left(\frac{n-1}{u}\right)$

or, $u = (n - 1) f$

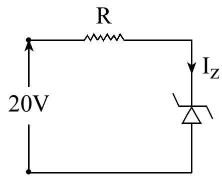
15.(d) $\frac{I_1}{0} = \frac{0}{I_2}$

or, $0 = \sqrt{I_1 I_2}$

16.(b) $KE_{max} = hf - \phi$, depends on frequency.

17.(d) $I_z = \frac{20 - 5}{R}$

or, $R = \frac{15}{10 \times 10^{-3}} = 1.5\ K\Omega$



18.(b) $C_2O_4^{--} - 2e^- \rightarrow 2CO_2$

19.(a) $NH_3 + CaOCl_2 \rightarrow 3CaCl_2 + 3H_2O + N_2$

20.(a) Mg or Zn used in cathodic protection.

21.(b) Valency = 3

$EW = \frac{\text{Wt. of metal}}{\text{Wt. of oxygen}} \times 8 = \frac{53}{47} \times 8 = 9.02$

$AW = V \times EW = 3 \times 9.02 = 27$

22.(b) Chloride and sulphate ion acts as a permanent hardness and bicarbonate acts as a temporary hardness.

23.(b)

24.(c) 18g of $H_2O = 3 \times N_A$ atoms

6g of $H_2O = \frac{3 \times N_A \times 6}{18} = N_A$ atoms

25.(b) O = C = O polar covalent bond.

26.(a) F can oxidesed O of SiO_2 of glass.

27.(a) $100 \times 0.5 = (100 + x) \times 0.1$

$x = 400\ cm^3$

28.(c) CH_3CaO^- ion is obtained from weak acid CH_3COOH

29.(b) $\int_0^1 |\sin\pi x|\, dx = \int_0^1 \sin\pi x\, dx$ dx
$= [\frac{-\cos\pi x}{\pi}]_0^1 = \frac{2}{\pi}$

30.(d) Maximum value of LHS is 5.

31.(b) As usual

32.(c) $A \cap B = A \cap C$ 1
AUB = AUC ….. 2
From (1) and (2) B = C

33.(c) 9 × 10 × 5 = 450

34.(c) Coefficient of T_{r+2} = coefficient of T_{3r} ⇒ $2n_{c_{r+1}} = 2n_{c_{3r-1}}$
(r + 1) + (3r – 1) = 2n
4r = 2n ⇒ n = 2r

35.(d) $(1 + w - w^2)(1 + w^2 - w)$
$= (-w^2 - w^2)(-w-w)$
$= 4w^3 = 4$

36.(c) $s_1 = 9 + 16 - 12 + 24 + 3 = 40$

37.(d) $[\vec{a} \times \vec{b}\ \ \vec{b} \times \vec{c}\ \ \vec{c} \times \vec{a}] = [\vec{a}\,\vec{b}\,\vec{c}]^2 = 4^2 = 16$

38.(b)

39.(c) Since roots are α, β
$(x-a)(x-b) - c = (x-\alpha)(x-\beta)$
$(x-\alpha)(x-\beta) + c = (x-a)(x-b)$
∴ Roots are a, b

40.(d) $(A^2 - A + I)A^{-1} = 0.A^{-1}$
$= A(A.A^{-1}) - AA^{-1} + IA^{-1} = 0$
$A^{-1} = I - A$

41.(b) $D = \begin{vmatrix} 1 & 1 & 1 \\ 1 & 1+x & 1 \\ 1 & 1 & 1+y \end{vmatrix}$
Applying $C_2 \to C_2 - C_1$ and $C_3 \to C_3 - C_1$
$= \begin{vmatrix} 1 & 0 & 0 \\ 1 & x & 0 \\ 1 & 0 & y \end{vmatrix} = xy$
So, D is aviable by both x and y

42.(b) n (AUB) = n (A) + n(B)- n $(A \cap B)$
= 400- n (AnB)
= max .n (AUB) = n (U) = 360

43.(b) A.M ≥ G.M ⇒ $\frac{x^2 + \frac{1}{x^2}}{2} \geq \sqrt{x^2 \times \frac{1}{x^2}}$
$\Rightarrow x^2 + \frac{1}{x^2} \geq 2$

44.(d) x = -x for x < 0
L HL $\lim_{x\to 0} \frac{-x}{x} = -1$
x = x for x > 0
RHL $\lim_{x\to 0} \frac{x}{x} = 1$

45.(a) cos1°.cos 2°… cos89°.cos90°.cos91°…. cos179°
[∵ cos 90° = 0, Result = 0]

46.(a) Let third vertex c is at (h, k)
Then, coordinate of centroid
$\frac{2+(-2)+h}{3}, \frac{-3+1+k}{3} = (\frac{h}{3}, \frac{k-2}{3})$
Lies on line
2x + 3y = 1
$2.\frac{h}{3} + 3(\frac{k-2}{3}) = 1$
2h + 3k – 6 = 3
2h + 3k = 9

47.(a) 2ae = 2b (given)
$= a^2e^2 = a^2(1 - e^2)$
$= e = 1/\sqrt{2}$

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

ENGLISH

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

Section – II

61.(c) A - - - - - - - - C ⏟ 8 m B_{pit}
Time taken to walk last 8 m is
$t = \frac{8}{1} = 8s$
Remaining distance = 18 – 8 = 10m
In 14s man move 2 m
Time taken to move 10 m is
$t' = \frac{14}{2} \times 10 = 70s$
Total time = 70 + 8 = 78s

62.(a) $F = v\frac{dm}{dt} = 0.2 \times 2 = 0.4$ N

63.(b) $\frac{g_d}{g_h} = \frac{g\left(1 - \frac{x}{R}\right)}{g\left(\frac{R}{R+h}\right)^2} = \frac{1 - \frac{R}{20R}}{\left(\frac{R}{R + \frac{R}{20}}\right)^2}$
or, $gd = \frac{19}{20} \times \frac{441}{400} \times 9 = 9.43\ m/s^2$

64.(a) $dQ = msd\theta$
$Q = \int dQ = \int_0^{10} m \times 0.6\theta^2 d\theta$
$= 10 \times 0.6 \int_0^{10} \theta^2 d\theta$
$= 6\left(\frac{\theta^3}{3}\right)_0^{10} = 2(10^3 - 0^3) = 2000$ cal

65.(c) $V = KT^{2/3}$
$\Delta V = \frac{2}{3} KT^{2/3 - 1}\, \Delta T = \frac{2}{3} KT^{-1/3}\, \Delta T$
∴ $W = P\Delta V$
$W = \frac{RT}{V}\Delta V = \frac{RT}{KT^{2/3}} \times \frac{2}{3} KT^{-1/3}\, \Delta T$
$= \frac{2}{3} R\, \Delta T = \frac{2}{3} R \times 60 = 40$ R

66.(b) $\frac{f_2}{f_1} = \sqrt{\frac{T_2}{T_1}} = \sqrt{\frac{363}{300}}$

or, $f_2 = 400 \times 1.1 = 440$ Hz

67.(a) $W = \vec{F}.\vec{r}$

$= Q\vec{E}.\vec{r}$

$= Q(E_1\hat{i} + E_2\hat{j}).(a\hat{i} + b\hat{j})$

$= Q(E_1a + E_2b)$

68.(b) If potential of B and D are equal then

$\frac{R_{AB}}{R_{BC}} = \frac{R_{AD}}{R_{DC}}$

or, $\frac{6}{12} = \frac{\frac{12x}{12+x}}{6}$

or, $3 = \frac{12x}{12+x}$

or, $36 + 3x = 12x$

or, $x = \frac{36}{9} = 4\Omega$

69.(d) $B = B_1 - B_2$

$= \frac{\mu_0 I_1 N_1}{2r_1} - \frac{\mu_0 I_2 N_2}{2r_2}$

$= \frac{\mu_0}{2}\left(\frac{0.2 \times 10}{0.2} - \frac{0.3 \times 10}{0.4}\right)$

$= \frac{\mu_0}{2}\left(10 - \frac{15}{2}\right) = \frac{\mu_0}{2} \times \frac{5}{2}$

$= \frac{5\mu_0}{4}$

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

$R = \frac{V^2}{P} = \frac{220^2}{100} = 484\ \Omega$

$I = \frac{P}{V} = \frac{100}{220} = \frac{5}{11}$ A

For 440V

$I = \frac{V}{Z}$

or, $Z = \frac{440}{5} \times 11 = 968\ \Omega$

Now $Z = \sqrt{R^2 + X_L^2}$

or, $X_L = \sqrt{Z^2 - R^2}$

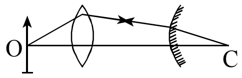
or, $2\pi fL = \sqrt{968^2 - 484^2}$

or, $L = \frac{838.3}{2\pi \times 50} = 2.7$H

71.(d) $\frac{\beta'}{\beta} = \frac{\frac{D\lambda'}{d}}{\frac{D\lambda}{d}} = \frac{\lambda'}{\lambda} = \frac{1}{\mu}$

$\therefore\ \beta' = \frac{\beta}{\mu} = \frac{0.4}{\frac{4}{3}} = 0.3$ mm

72.(c)



For lens

$v = \frac{fu}{u - f} = \frac{20 \times 30}{30 - 20} = 60$ cm

This image lies at c of convex mirror.

So d= v – r = 60 – 10 = 50 cm

73.(c) Energy of photon (E) $= \frac{hc}{\lambda}$

$= \frac{6.62 \times 10^{-34} \times 3 \times 10^8}{50 \times 10^{-9}}$

$= 24.8$ eV

Energy required to remove electron from hydrogen, $E' = 0 - E_1$

$= 0 - (-13.6)$ eV

$= 13.6$ eV

KE of electron $KE = E - E'$

$= 24.8 - 13.6$

$= 11.2$ eV

74.(d) First case

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

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

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

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

or, $T_{1/2} = \frac{t}{2} = \frac{\frac{3}{4}}{2} = \frac{3}{8}$ s

75.(b) $Cu + conc^n\ H_2SO_4 \rightarrow CuSO_4 + SO_2 + H_2O$

$SO_2 + 2H_2S \rightarrow 3S + 2H_2O$

O.A. R.A.

76.(a) $Al_4C_3 + H_2O \rightarrow CH_4 + Al(OH)_3$

$CH_4 + Cl_2 \rightarrow CH_3 - Cl + HCl$

77.(a) 22400 cc of O_2 at NTP = 32g

140 cc of O_2 at NTP $= \frac{32 \times 140}{22400} = 0.2$

EW of metal $= \frac{\text{Wt. of metal}}{\text{Wt. of } O_2 \text{ gas}} \times 8$

$= \frac{0.5}{0.2} \times 8 = 20$

78.(b) pH = 11

$H^+ = 10^{-11}$

$OH^- = 10^{-3}$

In 1000 ml no. of moles of $OH^- = 10^{-3}$ moles

100 ml no. of moles of $OH^- = \frac{10^{-3}}{1000} \times 100$

$= 10^{-4}$ moles

$= 10^{-4} \times 6.023 \times 10^{23}$

$= 6.023 \times 10^{19}$

79.(b)

80.(b) In S, $l = 0$

$= \frac{h}{2\pi}\sqrt{0(0+1)} = 0$

81.(d) $Br^- = \frac{K_{sp}}{[Ag^+]} = \frac{5.0 \times 10^{-13}}{0.05} = 10^{-11}$ M

Thus the amount of KBr to be added

$= 10^{-11}$ mole

$= 10^{-11} \times 120g = 1.2 \times 10^{-9}g$

82.(b) $\int sinx.cosx.cos2x.cos4x.cosx.cos16x\,dx$

$= \frac{1}{32}\int \sin 32x\,dx = -\frac{\cos 32x}{1024} + c$

83.(d) $I_{n+1} = \int_0^{\frac{\pi}{4}} tan^{n+1}x\,dx = \int_0^{\frac{\pi}{4}} tan^{n-1}$ x (sec^2 x-1) dx

$= \int_0^{\frac{\pi}{4}} tan^{n-1}sec^2x\,dx - \int_0^{\frac{\pi}{4}} tan^{n-1}x\,dx$

$= [\frac{tan^n x}{n}]_0^{\pi/4} - I_{n-1} = \frac{1}{n} - I_{n-1}$

$\therefore I_{n+1} + I_{n-1} = \frac{1}{n}$

84.(c) $x = e^{y+x}$

Log x = (y +x) loge = y + x

$= \frac{dy}{dx} = \frac{1-x}{x}$

85.(d) $f'(x) = \frac{x^2}{1+x^2} \geq 0$

Hence f (x) is increasing for all x.

86.(b) $\lim_{x\to1}\frac{-1+\sqrt{f(x)}}{\sqrt{x}-1}$ ($\frac{0}{0}$ form)

Using L – HOSPITAL rule

$\lim_{x\to1}\frac{\frac{1}{2\sqrt{f(x)}}}{\frac{1}{2\sqrt{x}}} * f'(x)$

$= \frac{f^1(1)}{\sqrt{f(1)}} = \frac{2}{1} = 2$

87.(a) f (x) will be continuous when x = -x ⇒ 2x = 0

⇒ x = 0 at x = 0 LHL = RHL = f (0) = 0

88.(c) f (x) = log (x + $\sqrt{x^2+1}$)

f (-x) = log (-x + $\sqrt{(-x)^2+1}$

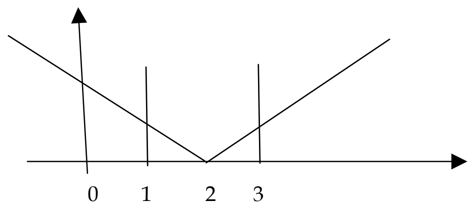
f (x) + f(-x) = log 1 = 0

89.(c) tany = tan($\frac{\pi}{4}$ +2x)

y = $\frac{\pi}{4}$ +2x

∴ $\frac{dy}{dx} = 2$

90.(d)



There is no boundary region

91.(c) $n_{c_{r+1}} + n_{c_{r-1}} + 2.n_{c_r}$

$(n_{c_{r-1}} + n_{c_r}) + (n_{c_r} + n_{c_{r+1}}) = n+2_{c_{r+1}}$

92.(b) a+b+c $^2 = a^2 + b^2 + c^2 + 2$ [a.b+b.c+c.a]

= 1 +1 + 1 + 0 = 3

93.(a) Z-2 ≥ Z – 4

$(x-2)^2 + y^2 \geq (x-4)^2 + y^2 = x \geq 3$

∴ R (Z) ≥ 3

94.(c) $\boxed{\frac{a}{1-r} = 20}$

S_∞ = Similarly $\frac{a^2}{1-r^2} = 100$

⇒ $r = \frac{3}{5}$

95.(b) $r - 3 < \sqrt{9+16} < r + 3$

$r - 3 < 5 < r + 3 = 2 < r < 8$

96.(d) The perpendicular tangents always intersect on directrix

$\boxed{Y = -a}$ ⇒ y = –3

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

…Best of Luck…