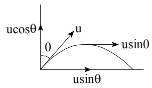
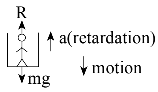
Section – I

1.(c) At highest point,
$P' = musin\theta = Psin\theta$



2.(d) $mg – R = –ma$
$R = mg + ma$
$= m(9 + a)$
$= 80(10 + 5)$
$= 1200$ N



3.(c) $V_{min} = \sqrt{lg}$ at top of vertical circle
or, $\omega_{min}\, l = \sqrt{lg}$
or, $2\pi f_{min} = \sqrt{\frac{g}{l}}$
or, $f_{min} = \frac{1}{2\pi}\sqrt{\frac{g}{l}}$

4.(b) $P = \sqrt{2mK.E.}$
$\Rightarrow P \propto \sqrt{m}$ for same K.E.
$\therefore \frac{P_1}{P_2} = \sqrt{\frac{m}{4m}} = \frac{1}{2}$

5.(d) Breaking force(F) = Breaking stress (S) × Area (A)
For same material, S = constant
$\therefore F \propto A \propto R^2$
Then, $\frac{F'}{F} = \left(\frac{2R}{R}\right)^2$
or, $F' = 4F$

6.(b) $I = MK^2$; K = radius of gyration
$\frac{\Delta I}{I} = \frac{2\Delta K}{K} = 2\,\alpha\Delta\theta$

7.(b) When R.H = 100%, the due point = room temperature

8.(b) For point source,
$I \propto \frac{1}{r^2}$
or, $A^2 \propto \frac{1}{r^2}$ ($\because I \propto A^2$)
or, $A \propto \frac{1}{r}$

9.(a) $l_2 – l_1 = l_3 – l_2$
or, $l_3 = 2l_2 – l_1$
or, $l_3 = 2 \times 65 – 21.5$
or, $l_3 = 108.5$ cm

10.(d) The shift of letter due to refraction is
$s = t\left(1 - \frac{1}{\mu}\right)$; t = real depth, μ = refractive index
∵ 'μ' is less for red light, so least shifted letter is red.

11.(c) Deflection reduced to half means, current range increases by 2 times, then
$S = \frac{G}{n-1}$; $n = \frac{I}{I_g}$
or, $G = (n-1)S$
or, $G = (2 - 1) \times 40 = 40\ \Omega$

12.(b) In thermocouple, the direction of thermo current is form metal occurring earlier in series to that occurring later through cold junction.

13.(b) Iron ring has high magnetic permeability.

14.(d)

15.(a) $\lambda = \frac{h}{p}$
or, $p = \frac{h}{\lambda}$
or, $p = \frac{6.62 \times 10^{-34}}{0.01 \times 10^{-10}} = 6.62 \times 10^{-22}$ kg m/s

16.(d) $r_n = (0.53) \times n^2$ Å
or, 2.12 Å $= 0.53\, n^2$ Å
or, $n = \frac{2.12}{0.53} = 2$

17.(a) Heat produced $= \frac{1}{2}CV^2$
$= \frac{1}{2} \times 4 \times 10^{-6} \times 400^2 = 0.32$ J

18.(d) $3Fe + \overset{+1\times 8}{4H_2O} \longrightarrow Fe_3O_4 + 4H_2$ (+8 → 0)
Fe loose 8 electron & Hydrogen gain 8 e.

19.(b) $:\ddot{F} – \ddot{O} – \ddot{F}:$ 2-bond pair, 8 lone pair

20.(a) Elements Li Na K
Size Li < Na < K
IE_1 Li > Na > K

21.(b) Pauli's exclusion principle states that two electron in the same orbital should have opposite spin.

22.(c) CH_3COO^- Na^+
H^+ OH^-
⇓ ↓
CH_3COOH
anionic hydrolysis

23.(a) Double bond comes first in priority than chloro.

24.(b)

25.(c) With the same anion, smaller the size of cation, higher is the lattice energy size $Na^+ < K^+ < Rb^+ < Cs^+$
Hence, NaF has maximum lattice energy.

26.(a) $Zn + NaOH \longrightarrow Na_2ZnO_2 + H_2$

27.(d)

28.(c)

29.(a) $\lim_{x \to 0^+} \frac{\sin x}{\sqrt{x}} = \lim_{x \to 0^+} \frac{\sin x}{x} \cdot \frac{x}{\sqrt{x}}$
$= \left(\lim_{x \to 0^+} \frac{\sin x}{x}\right) \cdot \left(\lim_{x \to 0^+} \frac{x}{\sqrt{x}}\right)$
$= 1 . \lim_{x \to 0^+} (\sqrt{x})$
$= 0$

30.(d) $\lim_{x \to 3^-} \frac{|x – 3|}{x – 3} = \lim_{x \to 3} \frac{–(x – 3)}{(x – 3)} = –1$
$\lim_{x \to 3^+} \frac{|x – 3|}{(x – 3)} = \lim_{x \to 3} \frac{(x – 3)}{(x – 3)} = 1$
$\therefore \lim_{x \to 3^-} \frac{|x – 3|}{x – 3} \neq \lim_{x \to 3^+} \frac{|x – 3}{x – 3}$
So, limit doesnot exist

31.(b) Let f is even
$f(–x) = f(x)$
$f'(–x) . (–1) = f'(x)$
$\Rightarrow f'(–x) = –f'(x)$
$\therefore$ f ' is an odd function.

32.(d) $f(x) = x^2 - 2x$
$f'(x) = 2x - 2$
For the increasing $f'(x) > 0$
$\Rightarrow 2x - 2 > 0$
or, $x - 1 > 0$
or, $x > 1$

33.(b) $\int a^{f(x)} f'(x)\, dx = \frac{a^{f(x)}}{\log a} + c$
$\therefore \int a^{\sin x}.\cos x\, dx = \frac{a^{\sin x}}{\log a} + c$

34.(d) The area of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ is πab.
So, $\frac{x^2}{9} + \frac{y^2}{16} = 1$ is $\pi.3.4 = 12\pi$ sq. unit

35.(b) $\left(\frac{i-1}{i+1}\right)^n = \left(\frac{i-1}{i+1} \times \frac{i-1}{i-1}\right)^n = \left\{\frac{(i-1)^2}{-2}\right\}^n$
$= \left(\frac{i^2 - 2i + 1}{-2}\right)^n = i^n$
For n = 2
$= -1$(real number)
$\therefore$ n = 2

36.(c) Since $A^5 = I$
$\Rightarrow A^{-1}.A^5 = A^{-1}.I$
$\Rightarrow A^4 = A^{-1}$

37.(b) Here, a, b, c are in H.P.
Then $b = \frac{2ac}{a+c} \Rightarrow ab + bc = 2ac$
Here, $(2a - b)(2c - b) = 4ac - 2ab - 2bc + b^2$
$= 4ac - 2(ab + bc) + b^2$
$= 4ac - 2.2ac + b^2$
$= b^2$
$\therefore b = \sqrt{(2a - b)(2c - b)}$
So, 2a – b, b, 2c – b are in G.P.

38.(c) $P(n, 4) = 20\, P(n, 2)$
$\frac{n!}{(n-4)!} = 20 \frac{n!}{(n-2)!}$
or, $(n-2)! = (n-4)!\,.\,20$
or, $(n-2)(n-3)(n-4)! = (n-4)!\,.\,20$
$(n-2)(n-3) = 1.20$
$n^2 - 5n + 6 = 20$
$n^2 - 5n - 14 = 0$
$(n-7)(n+2) = 0$
$\therefore$ n = 7. (n = –2 neglecting)

39.(c) ${}^8C_1 + {}^8C_3 + {}^8C_5 + {}^8C_7$
= sum of coefficient of even terms in the expansion of $(1 + x)^8$
$= 2^{8-1}$
$= 2^7$
= 128

40.(a) If the roots of $ax^2 + bx + c = 0$ are in the ratio m : n, then $mn\, b^2 = (m + n)^2 ac$
$\Rightarrow 3.4\, b^2 = (3 + 4)^2 ac$
$\Rightarrow 12b^2 = 49\, ac$

41.(c) Since, vectors (p, q) and (5, 1) are parallel if (p, q) = λ(5, 1)
$\Rightarrow p = 5\lambda, q = \lambda$
$\therefore p = 5q$

42.(b) $\vec{a}.\vec{b} = (\vec{i} + 2\vec{j} + 3\vec{k})\,.\,(2\vec{i} + 3\vec{j} + 4\vec{k})$
$= 2 + 6 + 12$
$= 20$
$|\vec{b}| = |2\vec{i} + 3\vec{j} + 4\vec{k}| = \sqrt{29}$
$\therefore$ Projection of $\vec{a}$ on $\vec{b}$
$= \frac{\vec{a}.\vec{b}}{|\vec{b}|} = \frac{20}{\sqrt{29}}$

43.(b) For coincident lines,
$h^2 = ab \Rightarrow 4^2 = 2.k$
$\Rightarrow k = 8$

44.(a) Here, $x^2 + y^2 - 2ax - 2ay + a^2 = 0$
Center: (–g, –f) = (a, a)
Radius $= \sqrt{g^2 + f^2 - c} = \sqrt{a^2 + a^2 - a^2} = a$
Hence, touches both axes

45.(a) Let the equation of ellipse be
$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$
Then it passes through (0, 1), then $b^2 = 1$
Also, $2a = 2(2b) \Rightarrow a = 2b$
$\therefore$ Equation of ellipse is $x^2 + 4y^2 = 4$

46.(a) Any plane parallel to
$3x - 4y + 5z = 7$ is $3x - 4y + 5z + k = 0$
Which passes through (3, 4, 5)
$3.3 - 4.4 + 5.5 + k = 0$
$k = -18$
$\therefore$ Required plane $\Rightarrow 3x - 4y + 5z - 18 = 0$

47.(a) $\frac{1}{ab} + \frac{1}{bc} + \frac{1}{ca} = \frac{a+b+c}{abc}$
$= \frac{2s}{4R\Delta}\left[\because R = \frac{abc}{\Delta}\right]$
$= \frac{1}{2R.\Delta\sqrt{s}}$
$= \frac{1}{2Rr}\left[\because r = \frac{\Delta}{s}\right]$

48.(b) We have, $\sin^{-1}x + \cos^{-1}x = \frac{\pi}{2}$
$\therefore \cos^{-1}x = \frac{\pi}{2} - \frac{\pi}{5} = \frac{3\pi}{10}$

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

Section – II

61. (d) $\omega = a - bt$
$\therefore \alpha = \frac{d\omega}{dt} = -b$ (uniform retardation)
At t = 0 sec, $\omega = \omega_0 = a$
Then, $\omega^2 = \omega_0^2 + 2\alpha\theta$
or, $\omega_0^2 = -2\alpha\theta$ ($\because \omega = 0$ as it comes to rest)
or, $a^2 = -2 \times -b \times \theta$
or, $\theta = \frac{a^2}{2b}$

62.(b) Velocity of efflux (v) $= \sqrt{2gh} = \sqrt{2\times10\times5} = 10$ m/s
Then, volume per second (V) = Av $= 1\times10^{-4}\times10$
$= 10^{-3}$ m³/s

63.(d) $y = 3\sin\omega t + 4\cos\omega t$
(y_1, y_2)
Phase diff between y_1 and y_2 $(\phi) = \frac{\pi}{2}$
$\therefore A = \sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos\phi}$
$= \sqrt{3^2 + 4^2 + 2\times3\times4\times\cos\frac{\pi}{2}} = 5$ cm

64.(b) $P = \sigma A T^4 = \sigma \times 4\pi R^2 \times T^4 = 450W$
When radius is halved and temperature is doubled
$$P' = \sigma \times 4\pi \left(\frac{R}{2}\right)^2 \times (2T)^4$$
or, $P' = 4\sigma \times 4\pi R^2 \times T^4$
or, $P' = 4P$
or, $P' = 4 \times 450 = 1800$ W

65.(a) $v_{sound} = \sqrt{\frac{\gamma RT}{M}}$
$c_{rms} = \sqrt{\frac{3RT}{M}}$
$\therefore \frac{c_{rms}}{v_{sound}} = \sqrt{\frac{3}{\gamma}}$
or, $c_{rms} = \sqrt{\frac{3}{1.4}} \times 300$
or, $c_{rms} = 440$ m/s

66.(d) $u_0 = u_s = v'$ (say)
Then, $f' = \frac{v + u_0}{v - u_s} \times f$
or, $2f = \frac{v + v'}{v - v'} \times f \quad (\because f' = 2f)$
or, $2v - 2v' = v + v'$
or, $v = 3v'$
or, $v' = \frac{v}{3}$

67.(b) $\beta = \frac{\lambda D}{d}$ in air
Then, $\beta' = \frac{\lambda' D}{\frac{d}{2}}$; λ' = wavelength in water
or, $\beta' = \frac{\lambda D}{\mu \times \frac{d}{2}} \quad (\because \lambda' = \frac{\lambda}{\mu})$
or, $\beta' = \frac{\lambda D}{\frac{4}{3} \times \frac{d}{2}}$
or, $\beta' = \frac{3}{2} \lambda \frac{D}{d}$
or, $\beta' = \frac{3}{2}\beta$

68.(a) $E = B_H v l \sin 90° = 1 \times 10^{-5} \times 10 \times 30 \times 10^{-2}$
$= 3 \times 10^{-5}$ V

69.(c) $X = \frac{1}{\omega c}$
When capacitance and frequency is doubled, then
$X' = \frac{1}{(2\omega)(2c)}$
or, $X' = \frac{1}{4\omega c}$
or, $X' = \frac{X}{4}$

70.(a) For zero tension,
$BIl = mg$
or, $I = \frac{mg}{Bl}$
or, $I = \frac{100 \times 10^{-3} \times 10}{0.2 \times 50 \times 10^{-2}} = 10A$

71.(a) $\lambda = \frac{h}{\sqrt{2mqV}}$
for some V,
$\lambda \propto \frac{1}{\sqrt{mq}}$
$\therefore \frac{\lambda_\alpha}{\lambda_p} = \sqrt{\frac{m_p q_p}{m_\alpha q_\alpha}} = \sqrt{\frac{m_p \times e}{4m_p \times 2e}} = \frac{1}{\sqrt{8}}$

72.(a) $T_{1/2} = 5700$ yrs
$\frac{N}{N_0} = \left(\frac{1}{2}\right)^{t/T_{1/2}}$
or, $\frac{5}{80} = \left(\frac{1}{2}\right)^{t/5700}$
or, $\left(\frac{1}{2}\right)^4 = \left(\frac{1}{2}\right)^{t/5700}$
or, $t = 4 \times 5700 = 22800$ yrs

73.(a) 10% of $P = \frac{E}{t}$
or, $\frac{10}{100} \times P = \frac{n}{t}\frac{hc}{\lambda}$
or, $\frac{n}{t} = \frac{P}{10} \times \frac{\lambda}{hc}$
or, $\frac{n}{t} = \frac{100 \times 4000 \times 10^{-10}}{10 \times 6.62 \times 10^{-34} \times 3 \times 10^8}$
or, $\frac{n}{t} = 2 \times 10^{19}$ photons/sec

74.(a) $\frac{1}{4\pi\varepsilon_0}\frac{q}{r} - \frac{1}{4\pi\varepsilon_0}\frac{q}{3r} = V$
$\frac{2q}{3r \times 4\pi\varepsilon_0} = V$
or, $\frac{q}{4\pi\varepsilon_0 r} = \frac{3V}{2}$
Then electric field intensity at point P is
$E = \frac{1}{4\pi\varepsilon_0}\frac{q}{(3r)^2}$
or, $E = \frac{1}{4\pi\varepsilon_0 r}\frac{q}{9r}$
or, $E = \frac{3V}{2} \times \frac{1}{9r}$ or, $E = \frac{V}{6r}$

75.(b) As $E°(Fe^{+3}/Fe^{+2})$ is more
$\therefore$ Fe^{+3} will get reduced and Fe will get oxidized.
Thus, Fe^{+3} will decrease.

76.(a) $Mg + NaOH = H_2SO_4$
$\frac{W \times 1000}{E} + V_b N_b = V_a N_a$
$\frac{27 \times 1000}{12} + 45 \times 0.5 = 75 \times N_a$
$NH_2SO_4 = 0.6$
$M = \frac{0.6}{2} = 0.3$ M

77.(b) $S = \sqrt[5]{\frac{K_{sp}}{108}} = 1.96 \times 10^{-7}$ M
$[S^{--}] = 3 \times 1.96 \times 10^{-7}$
$= 5.91 \times 10^{-7}$ M

78.(b) 143.5 gm of AgCl contains 108 gm Ag
2.87g AgCl contains $\frac{108 \times 2.87}{143.5}$
$= 2.16$ gm Ag

79.(b)

$$R-CH=CH_2+B_2H_6 \xrightarrow{HO-OH} R-CH_2-CH_2-OH+B(OH)_3$$

80.(c) Sublimation does not occur in blast furnace during smelting of iron.

81.(d)

82.(c) Here, $4\cos^2\theta = 1$

$2\cos^2\theta = \frac{1}{2}$

$\Rightarrow 2\cos^2\theta - 1 = \frac{1}{2} - 1$

$\Rightarrow \cos 2\theta = -\frac{1}{2} = \cos\left(\frac{2\pi}{3}\right)$

$\therefore 2\theta = 2n\pi \pm \frac{2\pi}{3}$

$\Rightarrow \theta = n\pi \pm \frac{\pi}{3}$

83.(c) $\cos^{-1}x - \sin^{-1}x \geq 0$

$\Rightarrow \cos^{-1}x \geq \sin^{-1}x$

$\Rightarrow \frac{\pi}{2} \geq 2\sin^{-1}x$

$\Rightarrow \frac{\pi}{4} \geq \sin^{-1}x$

But $-\frac{\pi}{2} \leq \sin^{-1}x$

$\therefore -\frac{\pi}{2} \leq \sin^{-1}x \leq \frac{\pi}{4}$

$-1 \leq x \leq \frac{1}{\sqrt{2}} \Rightarrow x \in \left[-1, \frac{1}{\sqrt{2}}\right]$

84.(d) $\sum_{n=2}^{\infty} \frac{1}{n!} = \frac{1}{2!} + \frac{1}{3!} + \frac{1}{4!} + ...$

$= \left(1 + \frac{1}{1!} + \frac{1}{2!} + \frac{1}{3!} + ...\right) - 2$

$= \sum_{n=2}^{\infty} \frac{1}{n!} - 2$

$= e - 2$

85.(b) $\int_0^1 \frac{dx}{\sqrt{1+x} - \sqrt{x}} = \int_0^1 (\sqrt{1+x} + \sqrt{x})\, dx$

$= \left[\frac{(1+x)^{3/2}}{\frac{3}{2}} + \frac{x^{3/2}}{\frac{3}{2}}\right]_0^1$

$= \frac{2}{3}[2\sqrt{2} + 1 - 1] = \frac{4\sqrt{2}}{3}$

86.(c) Since –2 and 3 are roots of f(x),

So, $f(-2) = (-2)^2 + p(-2) + q = 0 \Rightarrow q - 2p = -4$

$f(3) = 3^2 + p(3) + q = 0 \Rightarrow q + 3p = -9$

$\therefore 5p = -5$

$p = -1, q = -6$

$\therefore p + q = -7$

87.(d) $(A \cap B)^c = A^c \cup B^c$ [De' morgan law]

88.(b) Orthocenter of the right angled triangle is the point of intersection of perpendicular side i.e. The vertex which is right angle.

89.(a) The number of circular permulation of different thing taking r at a time

$= \frac{p(n, r)}{r}$ (When clockwise and anticlock wise order are treated as different)

$= \frac{p(7, 4)}{4} = 210$

90.(d) $\frac{d}{dx}\sin x^2 = \frac{d}{dx^2}\sin x^2 . \frac{dx^2}{dx} = 2x\cos x^2$

91.(d) $\tan\theta = \frac{y}{x} = \frac{-1}{1} = -1$

$\therefore \theta = -\tan^{-1}(1) = -\frac{\pi}{4}$

92.(b) $|x + 3| < 4$

or, $-4 < x + 3 < 4$

or, $-7 < x < 1$

93.(d) The roots of $x^2 + x + 1 = 0$ are ω and ω^2

$\therefore \alpha^2 + \beta^2 = \omega^2 + (\omega^2)^2 = \omega^2 + \omega^4$

$= \omega^2 + \omega = -1$

94.(a) Gradient = slope

$\therefore$ Slope of x-axis is 0

95.(b) $\cos^{-1}(-x) = \pi - \cos^{-1}(x)$

$\therefore \cos^{-1}\left(-\frac{\sqrt{2}}{2}\right) = \pi - \cos^{-1}\left(\frac{\sqrt{2}}{2}\right)$

$= \pi - \cos^{-1}\left(\frac{1}{\sqrt{2}}\right)$

$= \pi - \frac{\pi}{4}$

$= \frac{3\pi}{4}$

96.(d) $A = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{bmatrix} = 2\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = 2I$

$\therefore A^5 = (2I)^5$

$A^5 = 32I$

$= 16.2I$

$A^5 = 16A$

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

…The End…