Section – I

1.(d) Using parallel axis theorem,

$$I = \frac{2}{5}MR^2 + MR^2 = \frac{7}{5}MR^2$$

2.(b) We have, for simple pendulum

$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$T^2 = 4\pi^2 . \frac{l}{g}$$

$T^2 \propto l \rightarrow$ parabola

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

$L = 0$

4.(a) $\cos\phi = \frac{R}{Z}$

for highly inductive circuit, Z is more, so $\cos\phi$ is less.

5.(c) $P = \frac{V^2}{R}$

If cut in two equal parts, then

$$R' = \frac{R}{2}$$

$$P' = \frac{v^2}{\frac{R}{2}} = 2P$$

6.(b) $f_b = 258 - 256 = 2$ Hz

$$T = \frac{1}{f_b} = \frac{1}{2} = 0.5 \text{ sec}$$

7.(d) $\vec{F} = q(\vec{V} \times \vec{B}) = q(\vec{k} \times \vec{j}) = -\vec{i}$ (west)

8.(a) $\eta = \left(1 - \frac{T_2}{T_1}\right)$

If T_1 increases, η increases.

9.(b) $\frac{1}{f} = \frac{1}{f+x} + \frac{1}{f+y}$

on solving, $f^2 = xy$

10.(a) $\frac{r}{2r} = (\frac{A_2}{A_1})^{1/3}$

$$\frac{1}{8} = \frac{A_2}{56}$$

$A_2 = 7$

11.(a) Change in wt. = Change in upthrust

or, $mg = (\Delta v)\sigma g$

or, $m = (3 \times 2) \times 0.01 \times 1000$

$= 60$ kg

12.(c) $W = nRdT$

$$du = nC_v dT = n \times \frac{3}{2}RdT = \frac{3W}{2}$$

13.(c) $f_0 = \frac{v}{2l_0}$

$$f_0' = \frac{v}{4 \times \frac{l_0}{2}} = \frac{v}{2l_0} = f_0$$

14.(c) Charge at corner contribute one eighth to cube so

$$\text{flux}(\phi) = \frac{1}{8}\frac{Q}{\epsilon_0} = \frac{Q}{8\epsilon_0}$$

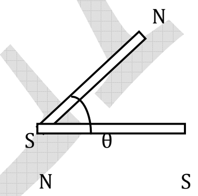
15.(b) $P = \frac{V^2}{R}$

$$R \propto \frac{1}{P}$$

In series, $P' = I^2R$

So, $R_{25} > R_{100}$ so, $P'_{25} > P'_{100}$ i.e. brightness of 25W will be more than 100W

16.(a)



$$M = \sqrt{M^2 + 2M^2\cos120° + M^2}$$

$$= \sqrt{M^2 + 2M^2\left(-\frac{1}{2}\right) + M^2}$$

$= M$

17.(c) $\beta = 60$

$$\text{Voltage gain} = \frac{V_{out}}{V_{in}} = \frac{I_cR_{out}}{I_bR_{in}}$$

$$= \beta \times \frac{5000}{500}$$

$= 600$

18.(a)

19.(b)

20.(a)

21.(b)

22.(c)

23.(d)

24.(a)

25.(d)

26.(c)

27.(c)

28.(c)

29.(a)

30.(d)

31.(b)

32.(a)

33.(b)

34.(d)

35.(d)

36.(a)

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

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

$\therefore$ $\vec{a}^2 + 2\,\vec{a}.\vec{b} + \vec{b}^2 = \vec{c}^2$

i.e $9 + 2*3*5 \cos\theta + 25 = 49$

or, $30 \cos\theta = 15$

$\theta = \pi/3$

38.(a)

39.(b) Let, $a = x^2 + x + 1$, $b = x^2 - 1$, $c = 2x + 1$

For x = 1, a = 3, b= 0, c = 3 (Impossible)

For x = 2, a = 7, b = 3, c = 5

A is the largest angle.

$\cos A = \frac{b^2+c^2-a^2}{2bc}$

A = 120°

40.(b) Given, $r_1 = 2r_2 = 3r_3$

$\frac{\Delta}{s-a} = \frac{2\Delta}{s-b} = \frac{3\Delta}{s-c}$

$\Rightarrow \frac{1}{s-a} = \frac{2}{s-b} = \frac{3}{s-c}$

s-b = 2s-2a and 3(s-b) = 2(s-c)

i.e. s = 2a – b and s = 3b – 2c

or, 2a – b = 3b – 2c

or, 2a + 2c = 4b

a + c = 2b

41.(b)

42.(b)

43.(b)

44.(b) Vectors (p, q) and (5, 1) are parallel if (p, q) = (5, 1)

i.e. $p = 5\lambda$ and q = 1

$\therefore$ p = 5q

45.(b) 2R sinAcosB – 2R sinBcosA = 0

$\Rightarrow$ sin(A-B) = 0

A – B = 0

a – b = 0

46.(b)

47.(a)

48.(c)

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

Section – II

61.(c) From work-energy theorem

$$\frac{\frac{1}{2}m\left[v^2 - \left(\frac{19v}{20}\right)^2\right]}{\frac{1}{2}m(v^2 - 0)} = \frac{F \times s}{F \times ns}$$

$1 - \frac{361}{400} = \frac{1}{n}$

$n = \frac{400}{39}$

$n \approx 11$

62.(a) wt = upthrust

$6g = \frac{V}{3}\sigma g$

$V = \frac{18}{\sigma}$

Second case:

$(6 + m)g = V\sigma g$

$6 + m = \frac{18}{\sigma}.\sigma$

m = 12 kg

63.(b) Here, $0 = 9 - 2t$

$t = 4.5$ sec

Body will come to rest after 4.5s and starts to move west.

Distance covered in 0.5 sec = $S_{4.5sec} - S_{4sec}$

$= 9 \times 4.5 - \frac{1}{2} \times 2(4.5)^2 - \{ 9 \times 4 - \frac{1}{2} \times 2 \times 4^2 \}$

$S' = 0.25$ m

After 4.5 sec, distance moved in 0.5 sec is

$S'' = \frac{1}{2} at^2 = \frac{1}{2} \times 2 \times (0.5)^2 = 0.25$m

Distance covered in 5th sec = S' + S'' = 0.25 + 0.25 =0.5 m

64.(b) $\Delta P.E. = \{ -\frac{GMm}{R+R} - \left(-\frac{GMm}{R}\right) \}$

$= \frac{GMm}{R}\left(1 - \frac{1}{2}\right) = \frac{gR^2.m}{R} . \frac{1}{2} = \frac{mgR}{2}$

65.(b) $\frac{\delta_w}{\delta_a} = \frac{(w_{\mu_g} - 1) A}{(\mu_g - 1)A} = \frac{\left(\frac{\mu_g}{\mu_w} - 1\right)}{\mu_g - 1} = \frac{\frac{\frac{3}{2}}{\frac{4}{3}} - 1}{\frac{3}{2} - 1} = \frac{1}{4}$

66.(c) $T_2 V_2^{\gamma - 1} = T_1 V_1^{\gamma - 1}$

$T_2 = 300\left(\frac{V}{2V}\right)^{5/3-1}$

$= 188.9K$

$W = nC_v (T_1 - T_2)$

$= 2 \times \frac{3}{2} R(300-188.9) = 2769$ J

67.(d) $B = \frac{\mu_0 qf}{2R}$

$R = \frac{\mu_0 qf}{2B} = \frac{4\pi \times 10^{-7} \times 2 \times 10^{-6} \times 6.25 \times 10^{12}}{2 \times 6.28}$

$= 1.25$ m

68.(b) $\frac{N}{N_0} = \left(\frac{1}{2}\right)^{t/t_{1/2}}$

$\frac{25}{100} = \left(\frac{1}{2}\right)^{32/t_{1/2}}$

$T_{1/2} = 16$ min

Again, $\frac{N'}{N_0} = \left(\frac{1}{2}\right)^{t'/t_{1/2}}$

$\frac{1}{2} = \left(\frac{1}{2}\right)^{t'/16}$

$t' = 16$ min

69.(c) $I = \frac{\Delta V}{R} = \frac{3-1}{100} = 20$ mA

70.(d) $\frac{\epsilon_0 A}{d} = \frac{\epsilon_0 A}{d - t(1 - \frac{1}{\epsilon_r}) + 1.6}$

$d = d - 2(1 - \frac{1}{\epsilon_r}) + 1.6$

$2(1 - \frac{1}{\epsilon_r}) = 1.6$

$\epsilon_r = 5$

71.(b) $f_{27} = 300$ Hz

$\frac{f_0}{f_{27}} = \sqrt{\frac{T_0}{T_{27}}} = \sqrt{\frac{273}{300}}$

$f_0 = 286$ Hz

$f_b = 300 - 286 = 14$ Hz

72.(d) $Q = \frac{k_1 A d\theta}{l} \times t_1 = \frac{k_2 A d\theta}{l} \times t_2$

$k_1 t_1 = k_2 t_2$

$\frac{k_1}{k_2} = \frac{t_2}{t_1} = \frac{40}{20} = 2:1$

73.(a) $I = \frac{10-6}{10} = 0.4$ A

For 10 V cell, $V = E - Ir = 10 - \frac{2}{5} \times 5 = 8$ V

For 6 V cell, $V = E + Ir = 6 + \frac{2}{5} \times 3 = 7.2$ V

74.(a) $l = 2\pi r$

$r = \frac{l}{2\pi}$

$M = IA = I(\pi r^2) = I \pi . \left(\frac{l}{2\pi}\right)^2 = \frac{Il^2}{4\pi}$

75.(c)

76.(a)

77.(c)

78.(b)

79.(d)

80.(d)

81.(c)

82.(b) $((A \times B) \cap (A \times C)) = A \times (B \cap C)$

$n((A \times B) \cap (A \times C)) = 8$

$n(B \cap C) = 2$

$n(A) = 4$

83.(d) $-1 + 1 - 1 + 1 \ldots$ to $(2n + 1)$ terms

$= -1$ ($\because$ no. of terms is odd)

84.(c) We have, $\begin{vmatrix} 1 & 1 & 1 \\ a & b & c \\ a^3 & b^3 & c^3 \end{vmatrix}$ apply $C_2: C_2 - C_1$, $C_3: C_3 - C_1$

$= \begin{vmatrix} 1 & 1 & a \\ a & b-a & c-a \\ a^3 & b^3-a^3 & c^3-a^3 \end{vmatrix}$

$= (b-a)(c-a) \begin{vmatrix} 1 & 0 & 0 \\ a & 1 & 1 \\ a^3 & b^2+ab+a^2 & c^2+ac+a^2 \end{vmatrix}$

Apply $C_3: C_3 - C_2$ we get

$= (b-a)(c-a) \begin{vmatrix} 1 & 0 & 0 \\ a & 1 & 1 \\ a^3 & b^2+ab+a^2 & c^2-b^2+ac-ab \end{vmatrix}$

$= (b-a)(c-a)(c^2 - b^2 + ac - ab)$

$= (b-a)(c-a)(c-b)(a+b+c)$

85.(b) By using section formula, we get, $\vec{a} = \frac{2\vec{c}+(\vec{a}+2\vec{b}).3}{2+3}$

$2\vec{c} + 3\vec{a} = 6\vec{b} = 5\vec{a}$

$$\vec{c} = \vec{a} - 3\vec{b}$$

86.(b) We have to formed at most three different digits from the integers 1,2,3,4,5,6.

Here the single digits can be formed by 6 ways, the double digits is formed by 6×5=30 ways. The triple digits can be formed by 6×5×4 =120 ways.

Thus required number is 6+30+120 = 150 ways.

87.(c) $t_n = (2n-1)^3$

and $S_n = (2n-1)^3$

$= \sum 8n^3 - \sum 12n^2 + \sum 6n - \sum 1$

$= 8\sum n^3 - 12\sum n^2 + 6\sum n - \sum 1$

$= 8\left[\frac{n(n+1)}{2}\right]^2 - 12\frac{n(n+1)(2n+1)}{6} + 6\frac{n(n+1)}{2}$

$= n^2(2n^2 - 1)$

88.(a) Use the fact that the equation of the common tangent of the parabolas $y^2 = 4ax$ and $x^2 = 4by$ is $a^{1/3}x + b^{1/3}y + a^{2/3}b^{2/3} = 0$

89.(c) For the hyperbola $\frac{x^2}{\frac{144}{25}} - \frac{y^2}{\frac{81}{25}} = 1$

a =12/5 and b=9/5. The eccentricity e is given by $b^2 = a^2(e^1-1)$

$81/25 = 144/25(e^2-1)$

$e^2 = 225/144$

e =15/12

So, the focus is (ae, 0) =(12/5*15/12, 0) =(3,0)

For the ellipse a =4 and ae =3

So, $b^2 = a^2(1-e^2) = 16-9 = 7$

90.(a) $-x^2 + y^2 = 0$

91.(d)

92.(b) The length of perpendicular from the given point (2,5,7) to the plane 6x + 6y +3z =11 is

$P = \left|\frac{ax_1+by_1+cz_1+d}{\sqrt{a^2+b^2+c}}\right| = \left|\frac{6.2+6.5+3.7-11}{\sqrt{6^2+6^2+3}}\right| = \frac{52}{9}$

93.(c) Taking:

$\frac{r_1}{(s-b)(s-c)} = \frac{\Delta}{(s-a)(s-b)(s-c)}.\frac{s}{s}$

$= \frac{\Delta.s}{\Delta^2}$

$= \frac{1}{\frac{\Delta}{s}} = \frac{1}{r}$

We have, $\frac{r_1}{(s-c)(s-b)} + \frac{r_2}{(s-c)(s-a)} + \frac{r_3}{(s-b)(s-a)}$

$= \frac{1}{r} + \frac{1}{r} + \frac{1}{r} = \frac{3}{r}$

94.(b) $\frac{6^x-3^x-2^x+1}{x^2}$

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

$= \frac{(3|x-1)(2^x-1)}{x^2} = \frac{(3|x-1)}{x}.\frac{(2^x-1)}{x}$

= (log 3)(log 2)

95.(b) $\int_0^{\frac{\pi}{2}} \frac{cosxdx}{2-1+sin^2x} = \int_0^1 \frac{dy}{1+y^2} if y = sinx$

$[\tan^{-1}y]_0^1 = \pi/4$

96.(a) Here, $f(x) = (x+1)^{\frac{1}{3}} - (x-1)^{\frac{1}{3}}$

$f'(x) = \frac{1}{3}\left[(x+1)^{\frac{-2}{3}} - (x-1)^{\frac{-2}{3}}\right] = \frac{1}{3}$

Since $f'(x)$ does not exists at $x = 1$

But $f'(x) = 0 \Rightarrow (x-1)^{\frac{2}{3}} = (x+1)^{\frac{2}{3}}$

$x = 0$

Thus $f'(x)$ 0 for any other value of x[0, 1]

The value of $f(x)$ at $x = 2$ is

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

Hence the greatest value of $f(x)$ is 1.

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

…Best of Luck…