1. **(a)** From ideal gas equation

$PV = nRT$

$\because$ volume is constant

$P \propto T$

It is clear from graph that for all the gases lines of graphs meet at same value.

At X-axis (temperature axis) P is zero but temperature is negative and it will be equal to 0 K or $-273°C$

2. **(c)** To measure the potential difference between two-point, voltmeter is used. But this voltmeter should be with higher resistance so that it cannot draw any current. Now to measure the potential difference across 600Ω voltmeter of 4000Ω is much better than 1000Ω voltmeter.

3. **(b)** As we know that impulse is given by

$I = \Delta P = F \times \Delta t$

or $I =$ Area of $f - t$ graph

For fig (a) $\rightarrow I = \frac{1}{2} \times$ base $\times$ height

$= \frac{1}{2} \times 0.5 \times 1 = 0.25$ N $-$ sec.

For fig (b) $I =$ length $\times$ width

$= 2 \times 0.5 = 1$ N-sec

For fig (c) $I = \frac{1}{2} \times$ base $\times$ height

$= \frac{1}{2} \times 1 \times 0.75 = 0.375$ N-sec.

For fig (d) $I = \frac{1}{2} \times$ base $\times$ height

$= \frac{1}{2} \times 2 \times 0.5 = 0.5$ N $-$ sec.

Impulse is highest for that figure, whose area under F-t is maximum and i.e. figure(b)

4. **(a)**

$$\Delta E = 13.6Z^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$Z = 4$ (hydrogen like atom)

$n_1 = 2, n_2 = 4$

$$\Delta E = 13.6(4)^2\left(\frac{1}{4} - \frac{1}{16}\right)$$

$$= 13.6 \times \left(\frac{16-4}{64}\right) \times 16$$

$$\Delta E = 13.6 \times \frac{12}{64} \times 16$$

$$\Delta E = 40.8\text{eV}$$

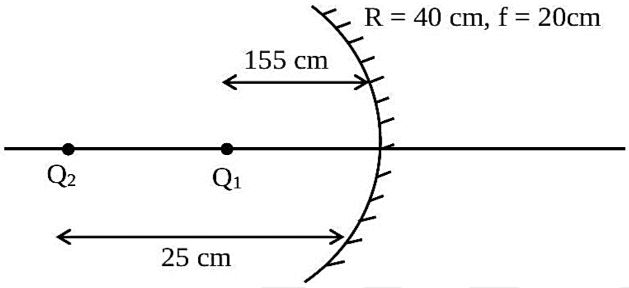
5. **(b)** Ratio of average electric energy density and total Avg energy density.

Avg electric energy density $= \frac{1}{4}\varepsilon_0 E_0^2$

Total Avg energy density $= \frac{1}{2}\varepsilon_0 E_0^2$

$$\Rightarrow \frac{\frac{1}{4}\varepsilon_0 E_0^2}{\frac{1}{2}\varepsilon_0 E_0^2} = \frac{2}{4} = \frac{1}{2}$$

6. **(c)**



Using Mirror formula

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$
$$\frac{1}{v} = \frac{1}{f} - \frac{1}{f}$$
$$v = \frac{4f}{u-f}$$

For object $A(O_1) u_i = -15\text{ cm}, f = -20\text{ cm},\ V_1 = ?$

$$v_1 = \frac{u_1 f}{u_1 - f} = \frac{(-15)(-20)}{(-15)-(20)} = \frac{+300}{5}$$

$$v_1 = +60\text{ cm}$$

For object $B(O_2) u_2 = -25\text{ cm}, f = -20\text{ cm} v_2 = ?$

$$v_2 = \frac{u_2 f}{u_2 - f} = \frac{(-25)(-20)}{(-25)-(-20)} = \frac{500}{-5}$$

$$v_2 = -100\text{ cm}$$

Hence, the distance between images formed by the mirror is

$$d = 160\text{ cm}$$

7. **(c)** When, a uniform wire of resistance R is shaped into a regular n-sided polygon, the resistance of each side will be

$$\frac{R}{n}=R_1$$

Let $R_1 \& R_2$ be the resistance between adjacent corners of a regular polygon

$\therefore$ The resistance of $(n-1)$ side, $R_2=\frac{(n-1)R}{n}$

Since two parts are parallel, therefore R_{eq}

$$R_{eq}=\frac{R_1R_2}{R_1+R_2}=\frac{\left(\frac{R}{n}\right)\left(\frac{n-1}{n}\right)R}{\left(\frac{R}{n}\right)+\left(\frac{n-1}{n}\right)R}$$

$$R_{eq}=\frac{(n-1)R^2}{n^2}\times\frac{n}{R+nR-R}$$

$$R_{eq}=\frac{(n-1)R}{n^2}$$

8. **(b)** Given $\eta=\frac{1}{3}$

When $T_2 \rightarrow (T_2+x)$ i.e., temp. of cold reservior

$$\eta'=\frac{1}{6}$$

Temp. of hot reservior $(T_1)=99^\circ C$

$=99+273=372^\circ K$

As we know,

$$\eta=1-\frac{T_2}{T_1}=\frac{1}{3}$$

$$\eta'=1-\frac{(T_2-x)}{T_1}=\frac{1}{6}$$

$$\eta'=\frac{T_1-(T_2+x)}{T_1}=\frac{1}{6}$$

From equqation (a)

$$\frac{1}{3}=1-\frac{T_2}{372}$$
$$\frac{1}{3}=\frac{372-T_2}{372}$$

$$372-\frac{372}{3}=T_2$$

$T_2=248$ K

By putting the value of T_2 in equation (b)

$$\frac{T_1-(T_2-x)}{T_1}=\frac{1}{6}$$

$$\frac{372-(248+x)}{372}=\frac{1}{6}$$

$$372-24-x=\frac{372}{6}$$

$$124-x=62$$

$$124-62=x$$

$$x=62\ K$$

9. **(c)** As we know, capacitance of spherical conductor

$$C=4\pi\varepsilon_0 R$$

So, capacitance does not depend on its charge, it depends only on the radius of the conductor (R).

Therefore, assertion is false, R is true.

10. (c)

$$[M]=[G]^x[h]^y[c]^z$$

$$[M]=[M^{-1}\ L^3\ T^{-2}]^x[ML^2\ T^{-1}]^4[LT^{-1}]^z$$

$$[M^2\ L^0\ T^0]=[M^{-x+y}][L^{3x+2y+z}][T^{-2x-y-z}]$$

$$y-x=1$$

$$3x+2y+z=0$$

$$-2x-y-z=0$$

On solving, $x=-\frac{1}{2}, y=\frac{1}{2}, z=\frac{1}{2}$

So $m=\sqrt{\frac{hc}{G}}$

11. (d) Zener diode act as a voltage regulator & it is used in reverse bias.

Similarly, it behaves as a pn juction diode in forward bias.

12. (b)

As we know,

$$Y=\frac{\text{stress}}{\text{strain}}$$

$Y = \frac{FL}{A\Delta L}$

Given : $Y = 2 \times 10^{11}\ \mathrm{N/m^2}$

$L = 6\ \mathrm{m}\ \ g_p = \frac{g}{4}$
$A = 3\ \mathrm{mm}^2$
$M = 4\ \mathrm{kg}$
$F = mg_p$
$F = 4 \times \frac{10}{4} = 10\ \mathrm{N}$

Hence $2 \times 10^{11} = \frac{10 \times 6}{3 \times 10^{-6} \times \Delta L}$

$\Delta L = 0.1\ \mathrm{mm}$

13. (a) μ = ratio of modulation index

$A_m = X, A_c = y$

$A_m = X, A_c = 2y$

$\mu_1 = \frac{A_m}{A_c} = \frac{X}{y}$

$\mu_2 = \frac{A_m}{A_c} = \frac{x}{2y}$

Hence $\frac{eq^n(a)}{eq^n(b)} = \frac{\mu_1}{\mu_2} = \frac{x/y}{x/2y} = \frac{2y}{y}$

$\frac{\mu_1}{\mu_2} = \frac{2}{1}$

14. (d) Using photoelectric equation

$hf - hf_0 = eV_0$

As per question

$h(2f_0) - h(f_0) = eV_1$

$h(2f_0 - f_0) = eV_1$

$hf_0 = eV_1$

$h(5f_0) - hf_0 = eV_2$

$h(5f_0 - f_0) = eV_2$

$4hf_0 = eV_2$

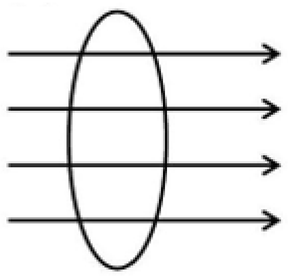
Equation $\frac{2}{1} \Rightarrow \frac{4hf_0}{hf_0} = \frac{eV_2}{eV_1}$

$$\frac{V_2}{V_1} = 4$$

As we know

$$KE_{max} = eV = \frac{1}{2}mv_{max}^2$$
$$v_{max} \propto \sqrt{V}$$
$$\therefore \frac{v_2}{v_1} = \sqrt{\frac{V_2}{V_1}} = \sqrt{4} = 2$$
$$\frac{v_1}{v_2} = \frac{1}{2}$$

15. (c)



$\phi = BA\cos\theta$

This show

(a) by changing B

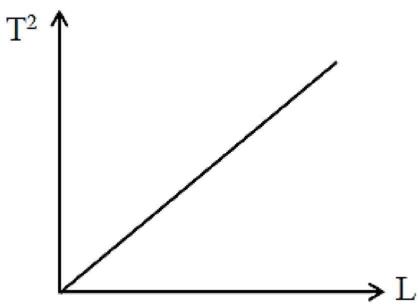
(b) by changing A

(c) Angle (θ) between B and plane of coil.

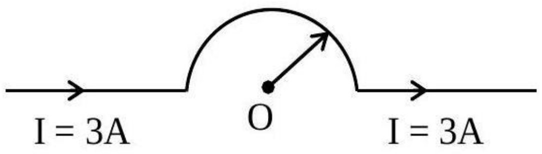
16. (a) As we know, time period of simple pendulum is

$$T = 2\pi\sqrt{\frac{L}{g}}$$
$$\text{or } T^2 = \frac{4\pi^2}{g} L \Rightarrow T^2 \propto L$$

Thus, the graph between T^2 & L is a straight line



17. (b)



Given: $R = \frac{\pi}{10}$ m, $I = 3$ A, $\mu_0 = 4\pi \times 10^{-7}$ N/A^2

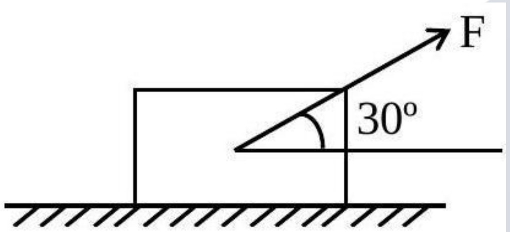
Magnetic field due to semi-circular arc is

$$B = \frac{\mu_0 I}{4R}$$

$$B = \frac{\mu_0 \times 3}{4 \times \left(\frac{\pi}{10}\right)} = \frac{4\pi \times 10^{-7} \times 3}{4 \times \frac{\pi}{10}}$$

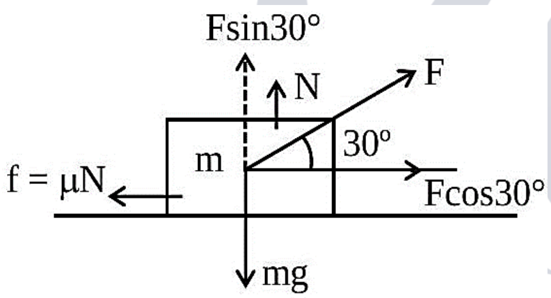
$B = 3\mu T$

18. (c)



Givne $m = 10$ kg, $\mu_s = 0.25, \theta = 30^\circ, g = 10$ m/sec.

F.B.D. (Free Body Diagram)



$F\cos 30^\circ = f$
$F\sin 30^\circ + N = mg \Rightarrow N = Mg - F\sin 30^\circ$

From equation (a)

$F\sin 30^\circ = \mu_S N$

$F\cos 30^\circ = \mu_s(mg - F\sin 30^\circ)$

$F\cos 30^\circ = \mu_s mg - \mu_s F\sin 30^\circ$

$F(\cos 30^\circ + \mu_s \sin 30^\circ) = \mu_s mg$

$$F = \frac{\mu_s mg}{\cos 30^\circ + \mu_s \sin 30^\circ} = \frac{0.25 \times 10 \times 10}{\sqrt{3}/2 \times 0.25 \times 1/2}$$

$$F = \frac{25}{\sqrt{3}/2 + \frac{0.25}{2}} = \frac{50}{1.73 + 0.25} = \frac{50}{1.98} = 25.2 \text{ N}$$

19. (c) Given:

$$\frac{v_A}{v_B} = \frac{1}{2}$$

$$\frac{r_A}{r_B} = \frac{1}{3}$$

$$\frac{g_A}{g_B} = ?$$

As we know,

$$v = \sqrt{\frac{2GM}{R}}$$

Hence,

$$\frac{v_A}{v_B} = \frac{\sqrt{\frac{2GM_A}{R_A}}}{\sqrt{\frac{2GM_B}{R_B}}} = \sqrt{\frac{M_A R_B}{M_B R_A}} = \frac{1}{2}$$

Given : $\frac{R_A}{R_B} = \frac{1}{3}$

Therefore,

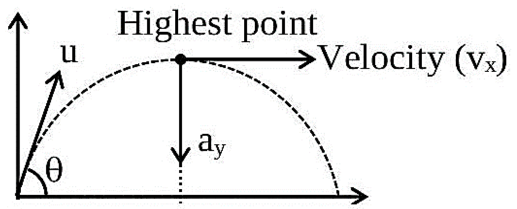
$$\frac{g_A}{g_B} = \frac{M_A R_A^2}{M_B R_B^2}$$
$$= \frac{1}{4} \times \frac{1}{3} \times 9$$
$$= \frac{3}{4}$$

20. (d) At highest point height is maximum and vertical component of velocity is zero.

So momentum is zero.

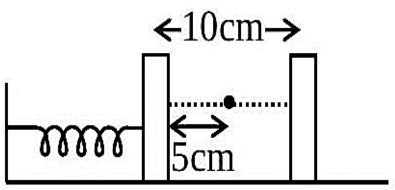
At highest point horizontal component of velocity will not be zero but vertical component of velocity is equal to zero and because of this K.E. will not be equal to zero.

Gravitational potential energy is maximum at highest point and equal to $mgH = mg\left(\frac{u^2 \sin^2\theta}{2g}\right)$



Therefore the correct option is (d).

21. (50) Given



At any instant total energy for free oscillation remains constant $= \frac{1}{2}kA^2$

$$\Rightarrow \frac{1}{2}kA^2 = 0.25\ J$$

$$\Rightarrow \frac{1}{2}kA^2 = 0.25\ J \Rightarrow K = \frac{0.25 \times 2}{A^2}$$

$$\Rightarrow k = \frac{0.50}{(10\ cm)^2} = \frac{0.50}{(10 \times 10^{-2})} = \frac{0.50 \times 10^4}{100}$$

$$k = 0.50 \times 100 = 50\ N/m$$

22. (44) Area (A) $= 70\ cm^2 = 70 \times 10^{-4}\ m^2$

$B = 0.4\ T$

$$f = \frac{500\ \text{revolution}}{60\ \text{minute}} = \frac{500}{60}\frac{\text{rev.}}{\text{sec.}}$$

Induced emf in rotating coil is given by
$e = N\omega BA \sin\theta$

$$= 600 \times 2 \times \frac{22}{7} \times \frac{500}{60} \times 0.4 \times 70 \times 10^{-4} \sin 30^\circ$$

$$= 600 \times 2 \times \frac{22}{7} \times \frac{500}{6} \times 0.4 \times 70 \times 10^{-4} \times \frac{1}{2}$$

$= 44\text{Volt}$

23. (4)

Given $t = 10 \times 10^{-6}$ m

$\mu = 1.2$

$\lambda = 500 \times 10^{-9}$ m

When the glass slab inserted infront of one slit then the shift of central fringe is obtained by

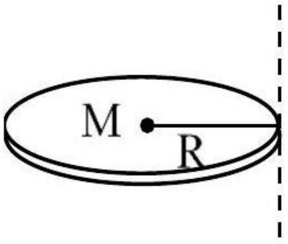
$$t = \frac{n\lambda}{(\mu - 1)}$$

$$\Rightarrow 10 \times 10^{-6} = \frac{n \times 500 \times 10^{-9}}{(1.2 - 1)}$$

$$10 \times 10^{-6} = \frac{n \times 500 \times 10^{-9}}{0.2}$$

$$n = 4$$

24. (3)



By using parallel axis theorem

$$I' = I_0 + MR^2$$

$$I' = \frac{MR^2}{2} + MR^2$$

$$I' = \frac{3MR^2}{2} \text{sssss}$$

Given $I' = \frac{x}{2}MR^2$

$$\therefore \frac{3MR^2}{2} = \frac{x}{2}MR^2$$

$$x = 3$$

25. (200)

By using 3rd equation of motion

$$v^2 = u^2 + 2as$$

$$(0)^2 = u^2 + 2\text{ as}$$

$$u^2 = -2\text{ as}$$

$$S = \frac{u^2}{2a} - \frac{(20)^2}{2 \times a} = 500$$

acceleration of the train, $a = -\frac{400}{1000} = -0.4\text{ m/sec}$

Now, if the brakes are applied at $S = 250$ m i.e. half of the distance

$$v^2 = u^2 + 2\text{ as}$$

$$v^2 = (20)2 + 2(-0.4) \times 250$$

$v^2 = 400 - 2 \times \frac{4}{10} \times 250$

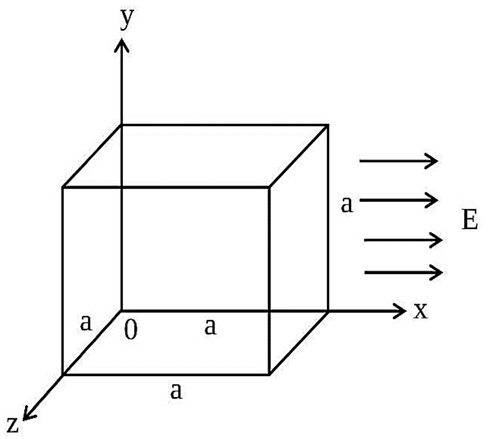
$v^2 = 200$

$v = \sqrt{200}$

Given $\Rightarrow v = \sqrt{x}$

$x = 200$

26. (288)



$\phi = \vec{E} \cdot \vec{A}$

$E = E_0 a i$

$\phi = E_0 a \cdot a^2 = E_0 a^3$
$q_{enc.} = \phi \varepsilon_0$
$q_{enc.} = E_0 a^3 \varepsilon_0$
$= 4 \times 10^4 \times 8 \times 10^{-6} \times 9 \times 10^{-12}$
$q_{enc.} = 288 \times 10^{-14} C$

Hence the value of Q is 288.

27. (132 J) Given:

$F = (5 + 3y^2)$ in the y direction

Work done is given by

$W = \int_{y_1}^{y_2} F \cdot dy$

$y_1 = 2$ m, $y_2 = 5$ m

$W = \int_2^5 (5 + 3y^2) dy$

$W = \int_2^5 5dy + \int_2^5 3y^2 dy$

$W = [5y]_2^5 + \left[\frac{3y^3}{3}\right]_2^5$

$W = (5 \times 5 - 5 \times 2) + (125 - 8)$

$W = (25 - 10) + 117$

$W = 132 \text{Joule}$

28. **(2)** By using equation of continuity

$A_1 v_1 = A_2 v_2$

$750 \times 10^{-4} \times v_1 = 500 \times 10^{-6} \times 30 \times 10^{-2}$

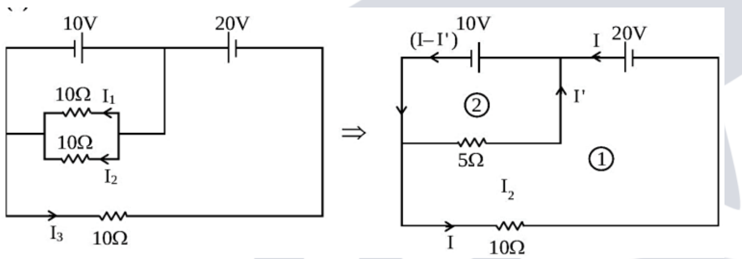
$v_1 = 20 \times 10^{-4}\ \text{m/sec}$

$v_1 = 2 \times 10^{-3}\ \text{m/sec}$

Given: $\frac{dh}{dt} = v = x \times 10^{-3}\ \text{m/sec.}$

Therefore $x = 2$

29. **(2)**



Apply KVL in loop (a)

$20 - 10 - 10I = 0$

Or $I = 1 \text{Amp}$

Apply KVL in loop (b)

$-10 + 5I' = 0$

Or $I' = 2 \text{Amp}$

On comparing $I_3 = 1\ A$

$I_2 = I_1 = \frac{I'}{2} = 1 \text{Amp}$

So, the value of $\left|\frac{I_1 + I_3}{I_2}\right| = \left|\frac{1+1}{1}\right| = 2$ Amp.

30. **(6MeV)**

For Nucleus A

$Z = 17 =$ Nummber of protons

Given $(Z = N)\ \therefore N = 17$

$A = 34 = Z + N$

$E_{bn} = 1.2\text{MeV}$

$\frac{(E_B)_1}{A} = 1.2\text{MeV}$

$(E_B)_1 = (1.2\text{MeV}) \times A$

$(E_B)_1 = (1.2\text{MeV}) \times 34$

$(E_B)_1 = 40.8\text{MeV} \rightarrow$ Binding energy of Nucleus A.

For Nucleus B

$Z = 12, A = 26$

$E_{bn} = 1.8\text{MeV}$

$\frac{(E_b)_2}{A} = 1.8\text{MeV}$

$(E_b)_2 = (1.8\text{MeV}) \times A$

$(E_b)_2 = (1.8\text{MeV}) \times 26$

$(E_b)_2 = 46.8\text{MeV} \rightarrow$ Binding energy of nucleus B

Therefore, difference in binding energy of B and A is

$$\begin{aligned}\Delta E_b &= (E_b)_2 - (E_b)_2 \\ &= 46.8\text{MeV} - 40.8\text{MeV} = 6\text{MeV}\end{aligned}$$

31. (b) Electron gain enthalpies $\rightarrow$

$\rightarrow S > Se > Te > 0$
$\rightarrow Cl > F > Br > I$

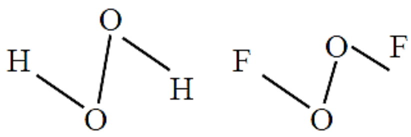
32. (a)
33. (d)

$$\frac{x}{m} = Kp^{1/n}$$
$$\log\frac{x}{m} = \log k + \frac{1}{n}\log P$$
$$Y = 3x + 2.505, \frac{1}{n} = 3, \log K = 2.505)$$

34. (b) Bond length $\uparrow$ Bond energy $\downarrow$
35. (c) KOH absorb CO_2

So, its concentration should be checked.

36. (c)



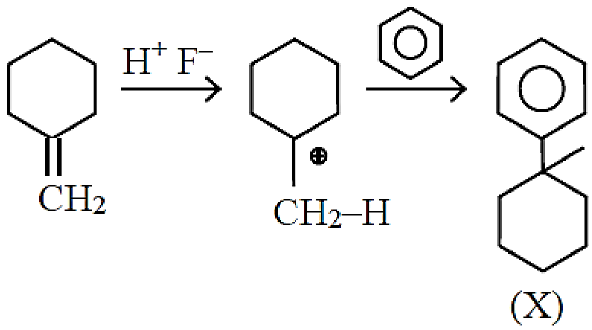
→ $(O-O)$BL in H_2O_2 in longer then $(O-O)$BL in O_2 F_2

→ $(O-H)$BL in H_2O_2 in shorter than (O-F) BL in O_2 F_2

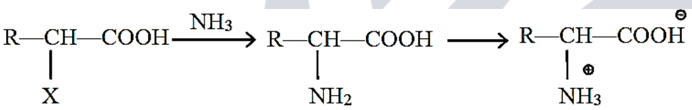
37. (a) $2Cu^{+} \rightarrow Cu^{2+} + Cu$

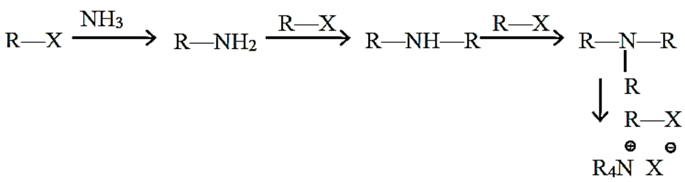
The stability of Cu^{2+} (aq) rather than Cu^{+}(aq), is due to the much more negative $\Delta_{hyd}H$ of Cu^{2+}(aq) than Cu^{+}(aq), which more than compensates for the second ionisation enthalpy of Cu.

38. (d)



39. (a) $NO_2^{-}$is ambidentante ligand, so. $[Co(NH_3)_5No_2]^{+2}$ will show 2 Isomer.
40. (c)
41. (a)



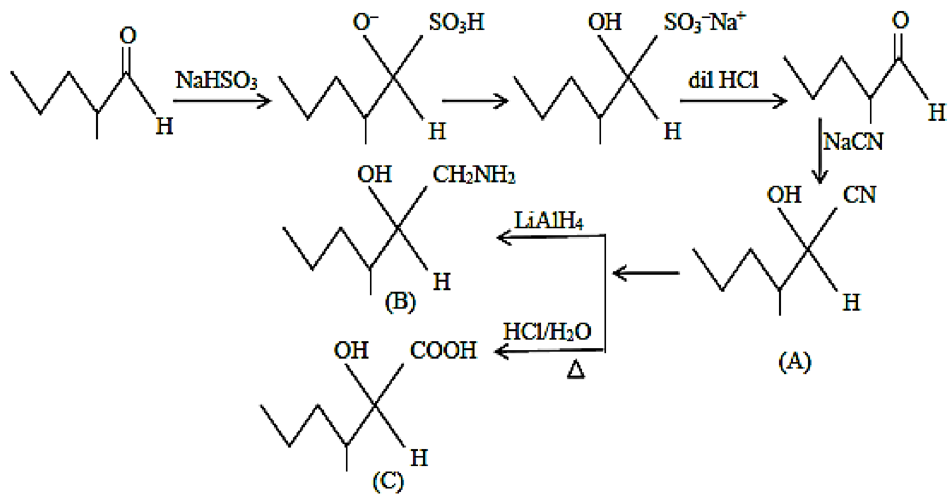


42. (a)
43. (b) Gypsum is used for making fireproof wall board.
44. (b)
45. (b)

PCI(g)PCl(g) + Cl(g)

(Case 1 : At constant P - volume will increase so reaction will shift in forward direction then answer will be A
Case 2 : At constant volume no change in active mass so reaction will not shift in any direction then answer will be D.

46. (a) Nessler's Reagent → K_2HgI_4
47. (d)

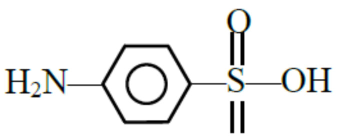


48. (d)

49. (d)

$K^{+} = 18$
$Cl^{2} = 18$
$Ca^{+2} = 18$
$Sc^{+3} = 18$

50. (a)



Sulphanilic acid

Does not show esterification test. Presence of both sulphur and nitrogen give red colour in Lassigne's test.

51. (1006) (Bomb calorimeter → const volume Heat released By combustion of 1 mole

$$C_2H_6(\Delta U) = -\frac{20 \times .05}{0.3} \times 30 = -1000 \text{ kJ}$$

$$C_2H_6(\text{ g}) + 7/2O_2(\text{ g}) \rightarrow 2CO_2(\text{ g}) + 3H_2O(\text{l})$$

$$\Delta ng = 2 - (2 + 7/2) = -(7/2)$$

$$\Delta H = \Delta U + \Delta nRT$$

$$= -1000 - 7/2 \times 8.3 \times 300 \text{ kJ}$$

$$= -1000 - 6.225$$

$$= -1006 \text{ kJ}$$

So heat released $= 1006 \text{ kJ mol}^{-1}$

52. (3)

A. Chloroliazepoxide (Tranquilizer)

B. Veronal (Tranquilizer)

C. Valium (Tranquilizer)

D. Salvarsan (Antibiotic)

53. (1) Copper mate → Cu_2S

54. (4)

$$d = \frac{Z \times M}{N_A a^3}$$

$$\frac{d_{FCC}}{d_{BCC}} = \frac{\frac{4 \times M_w}{N_A \times (2)^3}}{\frac{2 \times M_w}{N_A \times (2.5)^3}} = 3.90$$

55. (6) $[Mn(H_2O)_6]^{+2}$

$Mn^{+2} = [Ar] 4S^{\circ}, 3d^5$

$\rightarrow t_{2g}{}^{1,1,1} eg^{1,1}$

$\mu = \sqrt{n(n+2)}$

$\sqrt{5 \times 7} = \sqrt{35} = 6$

56. (14)

$$[Ag^+] = 10^{-5}$$
$$[NO_3^-] = 10^{-5}$$
$$[Br^-] = \frac{Ksp}{[Ag^+]} = 4.9 \times 10^{-8}$$
$$\wedge_m = \frac{k}{1000 \times M}$$

For Ag^+

$$6 \times 10^{-3} = \frac{K_{Ag^+}}{1000 \times 10^{-5}}$$
$$K_{Ag^+} = 6 \times 10^{-8}$$
$$= 6000 \times 10^{-8}$$

for Br^-

$$8 \times 10^{-3} = \frac{K_{Br^-}}{1000 \times 4.9 \times 10^{-8}}$$

$K_{Br^-} = 39.2 \times 10^{-8}$

for NO_3^-

$$7 \times 10^{-3} = \frac{K_{NO_3^-}}{1000 \times 10^{-5}}$$

$K_{NO_3^-} = 7 \times 10^{-5}$

$= 7000 \times 10^{-8}$

Conductivity of solution

$= (6000 + 7000 + 39.2) \times 10^{-8}$

$= 13039.2 \times 10^{-8} \mathrm{Sm}^{-1}$

57. (372)

$i = 1 + (n-1)\alpha$

$(i = 1 + 0.2(2-1) = 1.2$

$\Delta T_f = iKf$

$\Delta T_f = 1.2 \times 1.86 \times \frac{5 \times 1000}{60 \times 500}$

$\Delta t_f = 3.72$

$\Delta T_f = 372 \times 10^{-2}$

58. (75) Assume reaction starts with 1 mole A

$\left(t_{1/2} = \frac{a}{2k}, K = \frac{1}{2 \times 50}\right)$

For 75% completion

$a - \frac{a}{4} = kt$

$t = \frac{3}{4}a = \frac{3}{4} \times \frac{100}{a} = 75$

59. (6)
60. (139)

(10ml solute in 90ml solvent
mass of solute $= 10 \times 3.2 = 32$ g
mass of solvent $= 90 \times 1.6$ g
$m = \frac{32 \times 1000}{160 \times 90 \times 1.6} = 1.388$
$m = 138.8 \times 10^{-2} = 139$

61. (a) $2x^2ydy - (1 - xy^2)dx = 0$

$\Rightarrow 2x^2y\frac{dy}{dx} - 1 + xy^2 = 0$

$\Rightarrow 2y\frac{dy}{dx} - \frac{1}{x^2} + \frac{y^2}{x} = 0$

$\Rightarrow 2y\frac{dy}{dx} + \frac{y^2}{x} = \frac{1}{x^2}$ (L.D.E)

$y^2 = t \Rightarrow 2y\frac{dy}{dx} = \frac{dt}{dx}$

$\frac{dt}{dx}+\frac{t}{x}=\frac{1}{x^2}$

$f=e^{\int\frac{1}{x}dx}=x$

$\Rightarrow t\times x=\int x\cdot\frac{1}{x^2}dx$

$\Rightarrow y^2\cdot x=\ln x+c$

Also, $y(b)=\sqrt{\log_e 2}$

$\log_e^2 2=\log_e 2+c\Rightarrow c=\log_e 2$

$\Rightarrow y^2x=\ln x+\ln 2$

$\Rightarrow y^2x=\ln 2x$

$2x=\exp(x^1y^2)$

Compare it with given solution we get,

$\alpha=2,6=1,\gamma=2$

$\Rightarrow \alpha+b-\gamma=2+1-2=1$

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

$\frac{1}{2}\sum_{n=1}^{\infty}\frac{2n(2n-1)+8n+8}{(2n)!}$

$\frac{1}{2}\sum_{n=1}^{\infty}\frac{1}{(2n-2)!}+2\sum_{n=1}^{\infty}\frac{1}{(2n-1)!}+4\sum_{n=1}^{\infty}\frac{1}{(2n)!}$

$e=1+1+\frac{1}{2!}+\frac{1}{3!}+\frac{1}{4!}+\cdots.$

$e^{-1}=1-1+\frac{1}{2!}-\frac{1}{3!}+\frac{1}{4!}+\cdots$

$\left(e+\frac{1}{e}\right)=2\left(1+\frac{1}{2!}+\frac{1}{4!}+\cdots\ldots\right)$

$e-\frac{1}{e}=\left(1+\frac{1}{3!}+\frac{1}{5!}+\cdots..\right)$

Now

$\frac{1}{2}\left(\sum_{n=1}^{\infty}\frac{1}{(2n-2)!}\right)+2\sum_{n=1}^{\infty}\frac{1}{(2n-1)!}+4\sum_{n=1}^{\infty}\frac{1}{(2n)!}$

$=\frac{1}{2}\left[\frac{e+\frac{1}{e}}{2}\right]+2\left[\frac{e-\frac{1}{e}}{2}\right]+4\left(\frac{e+\frac{1}{e}-2}{2}\right)$

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

$= \frac{13}{4}e + \frac{5}{4e} - 4$

63. (d)
64. (c)

$\vec{r} \times \vec{a} = \vec{c} \times \vec{a}$
$\Rightarrow (\vec{r} - \vec{c}) \times \vec{a} = 0 \Rightarrow \vec{r} - \vec{c} = \lambda\vec{a}(\vec{r} - \vec{c}\&\vec{a}\text{are parallel})$
$\Rightarrow \vec{r} = \vec{c} + \lambda\vec{a}$
$\Rightarrow \vec{r} \cdot \vec{b} = \vec{c} \cdot \vec{b} + \lambda\vec{a} \cdot \vec{b}$
$0 = (1-3) + \lambda(2+5) \Rightarrow \lambda = \frac{2}{7}$

Hence, $\vec{r} = \vec{c} + \frac{2\vec{a}}{7}$

$\vec{r} \Rightarrow \frac{11}{7}\hat{\imath} - \frac{11}{7}\hat{k}$

$|\vec{r}| = \sqrt{\left(\frac{11}{7}\right)^2 + \left(-\frac{11}{7}\right)^2} \Rightarrow r = \frac{11\sqrt{2}}{7}$

65. (c)

For $x = 2, \Rightarrow f(b) + f(-1) = 3$

For $x = \frac{1}{2} \Rightarrow f\left(\frac{1}{2}\right) + f(-1) = \frac{3}{2}$

For $x = -1 \Rightarrow f(-1) + f\left(\frac{1}{2}\right) = 0$
$(b) - (c) \Rightarrow f(b) - f(-1) = \frac{3}{2}$

$(a) + (d) \Rightarrow 2f(b) = \frac{9}{2} \Rightarrow f(b) = \frac{9}{4}$

66. (c) $S = \{1,2,3, \ldots \ldots .10\}$

$P(S) =$ power set of S

$AR, B \Rightarrow (A \cap \vec{B}) \cup (\vec{A} \cap B) = \phi$

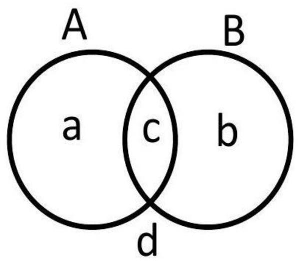
R1 is reflexive, symmetric

For transitive

$(A \cap \vec{B}) \cup (\vec{A} \cap B) = \phi; \{a\} = \phi = \{b\} A = B$

$(B \cap \vec{C}) \cup (\vec{B} \cap C) = \phi \therefore B = C$

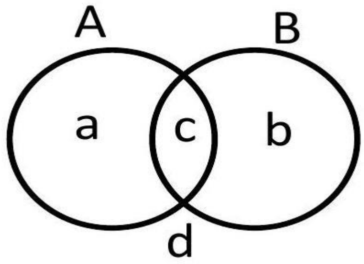
$\therefore A = C$ equivalence



$R_2 \equiv A \cup \vec{B} = \vec{A} \cup B$

$R_2 \rightarrow$ reflexive, symmetric

for transitive



$A \cup \vec{B} = \vec{A} \cup B \Rightarrow \{a, c, d\} = \{b, c, d\}$

$\{a\} = \{b\} \therefore A = B$

$B \cup \vec{C} = \vec{B} \cup C \Rightarrow B = C$

$\therefore A = C \ \therefore A \cup \vec{C} = \vec{A} \cup C \therefore$ Equivalence

67. (b)

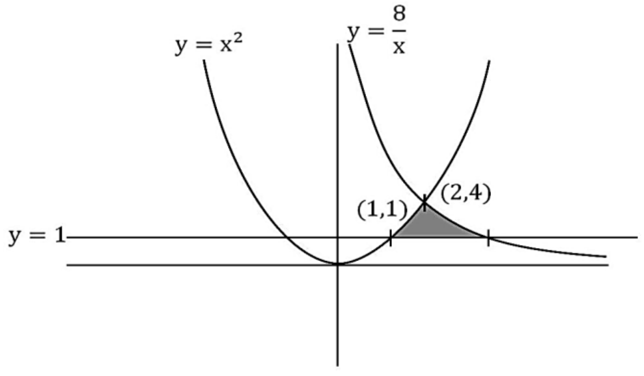
$$A = \int_1^4 \left(\frac{8}{y} - \sqrt{y}\right) dy$$

$$A = 8[\ln y]_1^4 - \frac{2}{3}\left(y^{\frac{3}{2}}\right)_1^4$$

$$\Rightarrow 8\ln 4 - \frac{2}{3}\left(4^{3/2} - 1\right)$$

$$\Rightarrow 8\ln 4 - \frac{2}{3}(8 - 1)$$

$$\Rightarrow 16\ln 2 - \frac{14}{3}$$



68. (c) $4 = \frac{1}{2}\begin{bmatrix} 1 & f_3 \\ -f^3 & 1 \end{bmatrix} = \begin{bmatrix} \frac{1}{2} & \frac{f_3}{2} \\ -\frac{f_3}{2} & \frac{1}{2} \end{bmatrix}$

$|4 - \lambda|\ | = 0$

$$\begin{vmatrix} \frac{1}{2} - \lambda & \frac{f_3}{2} \\ -\frac{f_3}{2} & \frac{1}{2} - \lambda \end{vmatrix} = 0 \Rightarrow \lambda^2 + \frac{1}{4} - \lambda + \frac{3}{4} = 0$$

$$\begin{aligned} &\lambda^2 - \lambda + 1 = 0 && \Rightarrow A^2 - A + 1 = 0 \\ &\text{and } A^4 = (A - I)^2 && \Rightarrow A^3 - A^2 + A = 0 \\ & && \Rightarrow A^4 = A^2 + I - 2A \\ & && \Rightarrow A^4 = A - I + I - 2A = -A \end{aligned}$$

$A^4 = -A$

$$\Rightarrow A^{30} = (A^4)^7 A^2 = -A^4 = -(A^4)A = -A^3 = A - A^2$$
$$A^{25} = (A^4)^6 A = A^6 A = A^7 = A^4 A^3 = -AA^3 = -A^4 = A$$

Put these values on all options, we, get,

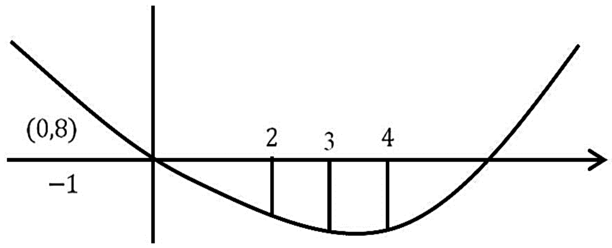
$\Rightarrow A^{30} + A^{25} - A = 1$

69. (c)

70. (d)

$$f(x) = \begin{cases} x^2 - 5x + 6 - 3x + 2 \cdot x\varepsilon(-\infty, 2) \cup [2, \infty] \\ -(x^3 - 5x + 6) - 3x - 2 \quad .x\varepsilon[2,3] \end{cases}$$

$$f(x) = \begin{cases} x^2 - 8x + 8 & x\varepsilon(-\infty, 2) \cup [3, \infty] \\ -x^2 + 2x - 4 & .x\varepsilon[2,3] \end{cases}$$



Absolute maximum $= |f(-1)| = |(-1)^2 - 8(-1) + 8| = 17$

Absolute minimum $= |f(c)| = 7$

Sum $= 17 + 7 = 24$

71. (a) Plane P, is passing through intersection of the two planes, so,

$$2x + 3y - z - 2 + \lambda(x + 2y + 3z - 6) = 0$$
$$x(2 + \lambda) + y(3 + 2\lambda) + z(3\lambda - 1) - 2 - 6\lambda = 0$$

It is perpendicular with plane, $2x + y - 2 + 1 = 0$

So, $(2 + \lambda)2 + (3 + 2\lambda)1 + (3\lambda - 1)(-1) = 0$

$\lambda = -8$

So, plane $p_1 - 6x - 13y - 25z + 46 = 0$
distance of plane p from the point $(-7,1,1)$

$$d = \frac{|+42 - 13 - 25 + 46|}{\sqrt{36 + 169 + 625}} = \frac{50}{\sqrt{30}} =$$

$$d^2 = \frac{2500}{830} = \frac{250}{83}$$

72. (d)

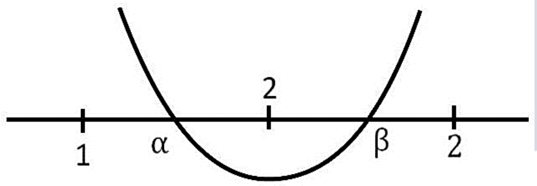
$\Rightarrow f(a) \cdot f(b) < 0$

$(k-6)(k-8) < 0$

Also, $f(b) \cdot f(c) < 0$

$(k-8)(k-6) < 0$

$k\varepsilon(6,8) \Rightarrow$ Integral value of k is 7



73. (a)

$3x^2 - 4y^2 = 36$ $3x + 2y = 1$

$$m = -\frac{3}{2}$$

$$m = +\frac{3\sec\theta}{\sqrt{12} \cdot \tan\theta}$$

$$\Rightarrow \frac{3}{\sqrt{12}} \times \frac{1}{\sin\theta} = \frac{-3}{2}$$

$$\sin\theta = -\frac{1}{\sqrt{3}}$$

$(\sqrt{12} \cdot \sec\theta, 3\tan\theta)$

$$\left(\sqrt{12} \cdot \frac{\sqrt{3}}{\sqrt{2}}, -3 \times \frac{1}{\sqrt{2}}\right) \Rightarrow \left(\frac{6}{\sqrt{2}}, \frac{-3}{\sqrt{2}}\right) = (x_0, y_0)$$

$$\Rightarrow \sqrt{2}(y_0 - x_0) = \sqrt{2}\left(\frac{-3}{\sqrt{2}} - \frac{6}{\sqrt{2}}\right) = -9$$

74. (b)

$A=\{(1,2),(1,3),(1,4),(1,5),(1,6),(2,3),(2,4),(2,5),(2,6)(3,4),(3,5),(3,6)(4,5),(4,6),(5,6)\}$
$n(A)=15$
$B=\{(2,1),(2,3),(2,5),(4,1),(4,3),(4,5),(6,1),(6,3),(6,5)\}$
$n(B)=9$
$C=\{(1,2),(1,4),(1,6),(3,2),(3,4),(3,6),(5,2),(5,4),(5,6)\}$
$n(C)=9$
$((A\cup B)\cap C)=\{(1,2),(1,4),(1,6),(3,4),(3,6),(5,6)\}$
$\Rightarrow n((A\cup B)\cap C)=6$

75. (d)

$y=x^x$

$\ln y=x\ln x$

$\frac{1}{y}y'=1+\ln x$

$y'=y(1+\ln x)$

$y'=x^x(1+\ln x)$

At $x=2$ we have $y=4$

So $y'(2)=4(1+\ln 2)$

$$\begin{aligned}
&\text{Andy }=y'(1+\ln x)+\frac{y}{x}\\
&y'(2)=y'(1+\ln 2)+2\\
&y'(2)=y'(2)=y'(\ln 2)+2\\
&y''(2)=2y'(2)=(\ln 2-1)y'(2)+2\\
&=4(\ln 2-1)(\ln 2+2)+2\\
&=4(\ln 2)^2-2
\end{aligned}$$

76. (a) Put $x=\tan\theta\ \theta\in\left(0,\frac{\pi}{4}\right)$

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

$$2\tan^{-1}\left[\tan\left(\frac{\pi}{4}-\theta\right)\right]=\cos^{-1}[\cos(2\theta)]$$

$$\Rightarrow 2\left(\frac{\pi}{4}-\theta\right)=2\theta\Rightarrow\theta=\frac{\pi}{8}$$

$$\Rightarrow x=\tan\frac{\pi}{8}=\sqrt{2}-1\simeq 0.414$$

77. (b) $I=\int_{-\frac{\pi}{4}}^{\frac{\pi}{4}}\frac{xdx}{2-\cos 2x}+\frac{\pi}{4}\int_{-\frac{\pi}{4}}^{\frac{\pi}{4}}\frac{xdx}{2-\cos 2x}$

$$=0+\frac{\pi}{4}\cdot 2\int_0^{\frac{\pi}{4}}\frac{xdx}{2-\cos 2x}$$

$$= \pi/2\int_0^{\frac{\pi}{4}} \frac{\sec^2 x dx}{1+3\tan^2 x}$$

Now,

$\tan x = t$

$$= \frac{\pi}{2}\int_0^1 \frac{dt}{1+3t^2}$$

$$= \frac{\pi}{2}\left[\frac{\tan^{-1}(\sqrt{3}t)}{\sqrt{3}}\right]_0^1$$

$$= \frac{\pi}{2\sqrt{3}}\left(\frac{\pi}{3}\right) = \frac{\pi^2}{6\sqrt{3}}$$

78. (a)

$$\begin{vmatrix} \alpha & 1 & 1 \\ 1 & \alpha & 1 \\ 1 & 1 & \alpha \end{vmatrix} = 0$$

$\alpha(\alpha^2 - 1) - 1(\alpha - 1) + 1(1 - \alpha) = 0$

$\alpha^3 - 3\alpha + 2 = 0$

$\alpha^2(\alpha - 1) + \alpha(\alpha - 1) - 2(\alpha - 1) = 0$

$(\alpha - 1)(\alpha^2 + \alpha - 2) = 0$

$\alpha = 1, \alpha = -2,1$

For $\alpha = 1, \beta = 1$

$$\left.\begin{matrix} x + y + z = 1 \\ x + y + z = b \end{matrix}\right\} \text{infinite solution}$$

For $\alpha = 2, \beta = 1$

$\Delta = 4$

$$\Delta_1 = \begin{vmatrix} 1 & 1 & 1 \\ 1 & 2 & 1 \\ 1 & 1 & 2 \end{vmatrix} = 3 - 1 - 1 \Rightarrow x = \frac{1}{4}$$

$$\Delta_2 = \begin{vmatrix} 2 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 2 \end{vmatrix} = 2 - 1 = 1 \Rightarrow y = \frac{1}{4}$$

$$\Delta_3 = \begin{vmatrix} 2 & 1 & 1 \\ 1 & 2 & 1 \\ 1 & 1 & 1 \end{vmatrix} = 2 - 1 = 1 \Rightarrow z = \frac{1}{4}$$

For $\alpha = 2 \Rightarrow$ unique solution

79. (d)

Mean $\Rightarrow \bar{x} = \frac{\sum_{i=1}^{7} x_i}{7} = \frac{\frac{7}{2}[2a + 6\,d]}{7} = a + 3\,d = x_4$

Variance $= \frac{\sum_{i=1}^{7} (x_i - \bar{x})^2}{7} = (4)^2 \Rightarrow \frac{\sum_{i=1}^{7} (x_i - x_4)^2}{7} = 16$

$\Rightarrow \frac{(3d)^2 + (2d)^2 + d^2 + 0 + d^2 + (2d)^2 + (3d)^2}{7} = 16$

$= 4d^2 = 16 \Rightarrow d = 2$

$\Rightarrow \bar{x} = 9 + 3(b) = 15$

$\& x_0 = a + 5d = 9 + 5(b) = 19 \Rightarrow \bar{x} + x_0 = 34$

80. (b) $ab < 0 \left|\frac{1+ai}{b+i}\right| = 1$

$|1 + ia| = |b + i|$

$a^2 + 1 = b^2 + 1 \Rightarrow a = \pm b \Rightarrow b = -a$ as $ab < 0$

(a, b) lies on $|z - 1| = |2z|$

$|a + ib - 1| = 2|a + ib|$

$(a - 1)^2 + b^2 = 4(a^2 + b^2)$

$(a - 1)^2 = a^2 = 4(2a^2)$

$1 - 2a = 6a^2 \Rightarrow 6a^2 + 2a - 1 = 0$

$a = \frac{-2 \pm \sqrt{28}}{12} = \frac{-1 \pm \sqrt{7}}{6}$

$a = \frac{\sqrt{7} - 1}{6} \& b = \frac{1 - \sqrt{7}}{6}$

$[a] = 0$

$\therefore \frac{1 + [a]}{4b} = \frac{6}{4(1 - \sqrt{7})} = -\left(\frac{1 + \sqrt{7}}{4}\right)$

or $[a] = 0$

Similarly, it is not matching with $a = \frac{-1-\sqrt{7}}{6}$

81. (6) Plane is perp. To the line joining the

$(1,2,3) \& (-2,3,5)$

So, line will be along normal of plane.

$\vec{n} = (3, -1, -2)$ or $(-3,1,2)$

Compare it with eq. of plane, $\alpha x + \beta y + r_2 = 1$

$\alpha = 3, \beta = -1, r = -2$ or $\alpha = -3, \beta = 1, r = 2$

So, $\alpha\beta r = 6$ (in both cases)

82. (1) $\Rightarrow$ General Term, $T_{r+1} = {}^{22}C_r\left(x^{\frac{2}{3}}\right)^{22-r} \cdot \left(\frac{\alpha}{x^3}\right)^r$

$T_{r+1} = {}^{22}C_r \cdot x^{\frac{2(22-r)}{3}-3r}\alpha^r$

For term independent of x,

$\frac{2(22-r)}{3} - 3r = 0$

$44 - 2r = 9r \Rightarrow 11r = 44$

$T_{4+1} = {}^{22}C_4 \cdot \alpha^4 = 7315$
$7315.\ \alpha^4 = 7315 \Rightarrow \alpha^4 = 1 \Rightarrow |\alpha| = 1$

83. (16)

$y^2 = 8x + 4y + 4$

$(y-2)^2 = 8(x+1)$

$y^2 = 4ax$

$a = 2, X = x + 1, Y = y - 2$

focus (1,2)

$y - 2 = m(x - 1)$

Put (3,0) in the above line

$m = -1$

Length of focal chord $= 16$

84. (4)

$\Rightarrow$ Sixth Term, $T_{5+1} = {}^mC_5(10-3^x)^{\frac{m-5}{2}}3^{x-2} = 21$

So, $2\,{}^mC_2 = {}^mC_1 + {}^mC_3$

$2\frac{m(m-1)}{2} = m + \frac{m(m-1)(m-2)}{6}$

$\Rightarrow m = 2,7$ (But $m = 2$ is inadmissible)

$\Rightarrow m = 7$

Now, $T_{5+1} = {}^7C_5(10-3^x)^{\frac{7-5}{2}}3^{x-2} = 21$

$\Rightarrow \frac{10.3^x - (3^x)^2}{3^2} = 1$

$(3^x)^2 - 10.3^x + 9 = 0$

$3^x = 9, 1$

$\Rightarrow x = 0, 2$

Sum of squeals of values of $x = 0^2 + 2^2 = 4$

85. (10)

Plane: $8x + y + 2z = 0$

Given line AB: $\frac{x-2}{5} = \frac{y-4}{10} = \frac{z+3}{-4} = \lambda$

Any point on line $(5\lambda + 2, 10\lambda + 4, -4\lambda - 3)$

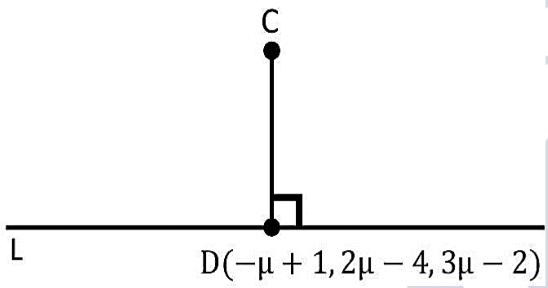
Point of intersection of line and plane

$8(5\lambda + 2) + 10\lambda + 4 - 8\lambda - 6 = 0$

$\lambda = -\frac{1}{3}$

$C\left(\frac{1}{3}, \frac{2}{3}, -\frac{5}{3}\right)$

$L: \frac{x-1}{-1} = \frac{y+4}{2} = \frac{z+2}{3} = \mu$



$\overline{CD} = \left(-\mu + \frac{2}{3}\right)\hat{\imath} + \left(2\mu - \frac{14}{3}\right)\hat{\jmath} + \left(3\mu - \frac{1}{3}\right)\hat{k}$

$\left(-\mu + \frac{2}{3}\right)(-1) + \left(2\mu - \frac{14}{3}\right)2 + \left(3\mu - \frac{1}{3}\right)3 = 0$

$\mu = \frac{11}{14}$

$\overrightarrow{CD} = \frac{-5}{42}, \frac{-130}{42}, \frac{85}{42}$

Direction ratio $\rightarrow (-1, -26, 17)$

$|a + b + c| = 10$

86. (39)

$\frac{a}{e}=8 \;\ldots..(1)$

$ae=2 \;\ldots..(2)$

$8e=\frac{2}{e}$

$e^2=\frac{1}{4} \Rightarrow e=\frac{1}{2}$

$a=4$

$b^2=a^2(1-e^2)$

$=16\left(\frac{3}{4}\right)=12$

$\frac{x\cos\theta}{4}+\frac{y\sin\theta}{2\sqrt{3}}=1$

$\sin\theta=\frac{1}{2}$

$\theta=30^{\circ}$

$P(2\sqrt{3},\sqrt{3})$

$Q\left(\frac{8}{\sqrt{3}},0\right)$

$(3PQ)^2=39$

87. (81)

We have,
For this, 4 will be fixed as unit place digit
Total number

Case I: 4 's → 6 times 1
Case II: 4 's → 4 times

$5's \rightarrow 1$ times $\frac{5!}{3!}=20$

9 's $\rightarrow 1$ times

Case III:

4's → 3times

$5's \rightarrow$ 3times $\frac{5!}{2!\,3!}=10$

Case IV: 4 's → times

9 's → times $\frac{5!}{2!\,3!}=10$

Case V: 4 's → 2times

$5's \rightarrow 2$ times $\frac{5!}{2!\,2!}=30$

$9's \rightarrow 2$ times

Case VI: 4 's → 1 times

5 's $\rightarrow$ 1 times $\frac{5!}{4!}=5$

9's $\rightarrow$ 4 times

Case VII: 4 's $\rightarrow$ 1 times

$5's \rightarrow 4$ times $\quad \frac{5!}{4!}=5$

$9's \rightarrow 1$ times

Total numbers $=81$

88. (105)

$${}^{15}C_2=\frac{15\times 14}{2}=105$$

89. (321)

3,7,11,15, , 399

$d_1=4$

2,5,8,11, ... , 359

$d_2=3$

2,7,12,17 , 197

$d_3=5$

$\operatorname{LCM}(d_1, d_2, d_3)=60$

Common terms are 47, 107, 167

Sum $=321$

90. (13)

$$I=\int_0^\pi \frac{5^{\cos x}(1+\cos x\cos 3x+\cos^2 x+\cos^3 x\cos 3x)}{1+5^{\cos x}}dx$$

$$I=\int_0^\pi \frac{5^{-\cos x}(1+\cos x\cos 3x+\cos^2 x+\cos^3 x\cos 3x)}{1+5^{-\cos x}}dx$$

$$2I=\int_0^\pi(1+\cos x\cos 3x+\cos^2 x+\cos^3 x\cos 3x)dx$$

$$21=2\int_0^{\frac{\pi}{2}}(1+\cos x\cos 3x+\cos^2 x+\cos^3 x\cos 3x)dx$$

$$I=\int_0^{\frac{\pi}{2}}(1+\sin x(-\sin 3x)+\sin^2 x-\sin^3 x\sin 3x)dx$$

$$2I=\int_0^{\frac{\pi}{2}}(3+\cos 4x+\cos^3 x\cos 3x-\sin^3 x\sin 3x)dx$$

$$2I=\int_0^{\frac{\pi}{2}} 3+\cos 4x+\left(\frac{\cos 3x+3\cos x}{4}\right)\cos 3x-\sin 3x\left(\frac{3\sin x-\sin 3x}{4}\right)dx$$

$$2I=\int_0^{\frac{\pi}{2}}\left(3+\cos 4x+\frac{1}{4}+\frac{3}{4}\cos 4x\right)dx$$

$$2I=\frac{13}{4}\times\frac{\pi}{2}+\frac{7}{4}\left(\frac{\sin 4x}{4}\right)_0^{\frac{\pi}{2}}\Rightarrow I=\frac{13\pi}{16}$$