1. (c) $\vec{E} = 20\sin\omega\left(t-\frac{x}{C}\right)\hat{j}N/C$

Average energy density of an em wave $= \frac{1}{2}\epsilon_0 E_0^2$

Energy stored $= \left(\frac{1}{2}\epsilon_0 E_0^2\right)$ (volume)

$$= \frac{1}{2} \times 8.85 \times 10^{-12} \times (20)^2 \times (5 \times 10^{-4})J$$

$= 8.85 \times 10^{-13}$ J

2. (c) Area under the graph from $t = 0$ to $t = 20sec = 200$ m

Area under the graph from $t = 20$ to $t = 25sec = 50$ m

So distance covered $= (200 + 50)m = 250$ m

Displacement $= (200 - 50)m = 150$ m

$$\frac{250}{150} = \frac{5}{3}$$

3. (c) $g = \frac{GM}{R^2} = \frac{G}{R^2} \times \rho \times \frac{4\pi}{3}R^3 = \left(\frac{4\pi}{3}G\right)\rho R$

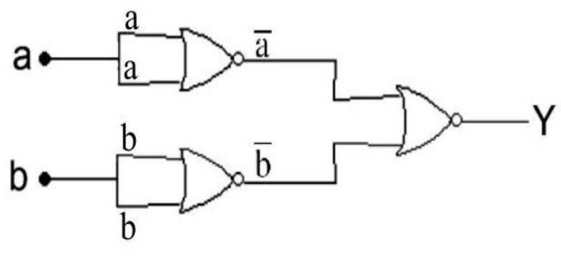
$$\frac{g_A}{g_B} = \frac{R \times \rho}{4R \times \frac{\rho}{3}} = \frac{3}{4}$$

4. (d) $f_{smax} = \mu mg = m\omega^2 R \Rightarrow R = \frac{\mu g}{\omega^2}$

So, if ω becomes $\frac{\omega}{2}$, R will become 4R.

So, distance from the center will be 4 cm.

5. (a)



$Y = \overline{\bar{a} + \bar{b}} = a \cdot b$

The truth table for the given circuit will be

a	b	output
0	0	0

0	1	0
1	0	0
1	1	1

Hence it will be equivalent to AND gate.

6. **(b)** Initially

$Q_1 = CV = (b)V$

$E_1 = 1/2CV^2 = 1/2(b)V^2 = V^2$

Finally

Charge on each capacitor, $Q_2 = \frac{Q_1}{2} = \frac{2\,V}{2} = V$

$E_2 = 2\left(\frac{1}{2}\frac{Q_2^2}{C}\right) = \frac{V^2}{2} \quad \therefore \frac{E_2}{E_1} = \frac{1}{2}$

7. **(a)** Parallel combination

$$H_p = \left[\frac{V^2}{\left(\frac{R}{2}\right)}\right]t = \frac{2\,V^2t}{R}$$

Series combination

$$H_s = \left(\frac{V^2}{2R}\right)t \quad \therefore \frac{H_p}{H_s} = 4$$

8. **(a)** $d_r = \sqrt{2\,h_rR} \;\therefore h_r = \frac{d_r^2}{2R}$

$$= \frac{(4\text{ km})^2}{2(6400\text{ km})} = \left(\frac{1}{800}\right)\text{km} = 1.25\text{ m}$$

9. **(c)** $X_C = \frac{1}{\omega C} = \frac{1}{(2\pi f)C}$

$\therefore X_C \propto \frac{1}{f}$

$\therefore$ Curve A

$X_L = \omega L = (2\pi f)L$

$\therefore X_L \propto f$

$\therefore$ Curve B

10. **(a)** $\Delta Q = \Delta U + \Delta W$

$\therefore \Delta U = \Delta Q - \Delta W$

$= mL_V - P\Delta V$

$= (1\text{Kg})(2257 \times 10^3 \text{ J/kg})$

$-(1 \times 10^5 \text{ Pa})(1.671 \text{ m}^3 - 1 \times 10^{-3} \text{ m}^3)$

$= 2257 \times 10^3 \text{ J} - 167 \times 10^3 \text{ J}$

$= 2090\text{KJ}$

11. (b) i_C = Critical angle

$$\frac{v}{C} = \frac{1}{\mu} = \sin i_C = \sin 45^\circ = \frac{1}{\sqrt{2}}$$

$$\Rightarrow v = \frac{C}{\sqrt{2}} = \frac{3 \times 10^8}{\sqrt{2}} \text{ m/s} = 2.12 \times 10^8 \text{ m/s}$$

12. (d) From the equation of photoelectric effect

$$eV_0 = \frac{hc}{\lambda} - \phi_0 = \frac{hc}{\lambda} - \frac{hc}{\lambda_0}$$

$$\& \frac{eV}{4} = \frac{hc}{2\lambda} = \frac{hc}{\lambda_0}$$

$$\Rightarrow \frac{1}{4}\left(\frac{hc}{\lambda} - \frac{hc}{\lambda_0}\right) = \frac{hc}{2\lambda} - \frac{hc}{\lambda_0}$$

$$\frac{1}{\lambda_0} - \frac{1}{4\lambda_0} = \frac{1}{2\lambda} - \frac{1}{4\lambda}$$

$$\frac{3}{4\lambda_0} = \frac{1}{4\lambda}$$

$$\Rightarrow \lambda_0 = 3\lambda$$

13. (a)

As $X_m = 2 \times 10^{-2}$

$\mu_r = 1 + X_m = 1.02$

$\Rightarrow B = \mu_r B_0 = 1.02\ B_0$

So percentage increase in magnetic field $= \frac{B-B_0}{B_0} \times$ no% $= 2\%$

14. (a) $I_S = \frac{NBA}{C} \& V_S = \frac{NBA}{CG}$

$\Rightarrow V_S = \frac{I_S}{G}$, If G (galvanometer resistance) is constant, then $V_S \propto I_S$ so percentage change in V_S is also 25%.

15. (d) For a particle executing SHM

$KE = \frac{1}{2} m\omega^2 (A^2 - x^2)$

When $x = 0$, KE is maximum & when $x = A$, KE is zero and KEV/Sx graph is parabola

16. (d) $\frac{X - X_{freez}}{X_{boil} - X_{freez}} = \frac{t-32}{212-32}$

$\frac{-95-(-15)}{65-(-15)} = \frac{t-32}{180}$

$\frac{-80}{80} = \frac{t-32}{180}$

$t = -180 + 32$

$t = -148^\circ f$

17. (b) $1AU = 1.496 \times 10^{11}$ m

1 parsec $= 3.08 \times 10^{16}$ m

1 light year $= 9.46 \times 10^{15}$ m

So, Au < ly < Per sec

18. (b)

$v_{rms}(\text{ mono }) = \sqrt{\frac{3RT}{4\times10^{-3}}}$

$v_{rms}(\text{dia}) = \sqrt{\frac{3RT}{71\times10^{-3}}}$

$v_{rms}(\text{ ply }) = \sqrt{\frac{3RT}{146\times10^{-3}}}$

So correct relation is

$v_{rms}(\text{ mono }) > v_{rms}(\text{ dia }) > v_{rms}(\text{ poly })$

19. (b) $F = nmv$

where n = number of bullets fired per second $n = \frac{f}{mv} = \frac{125}{10\times10^{-3}\times250} = 50$

20. (c) $T_{1/2}(A) = T_{av}(B)$

$\frac{\ln 2}{\lambda_A} = \frac{1}{\lambda_B}$

$\lambda_A = \lambda_B \ell 2$

21. (3) $6 = {}^4C_2 \Rightarrow n_2 = 4$

$h\nu = E_4 - E_1$

$\therefore v = 13.6\left(\frac{1}{1^2} - \frac{1}{4^2}\right) \times \frac{1}{4.25 \times 10^{-15}}$

$= 3 \times 10^{15}$ Hz

22. (4) $P = (1.8 - 1)\left(\frac{1}{20} + \frac{1}{20}\right)$ by lens maker's formula

$P' = \left(\frac{1.8}{1.5} - 1\right)\left(\frac{1}{20} + \frac{1}{20}\right)$

Dividing $\frac{P}{P'} = \frac{0.8}{1.2-1} = 4$

23. (1152)

$V = \frac{\omega}{k} = \frac{2\pi \times 60}{2\pi \times 0.5} = \frac{160}{0.5}$ m/s

$= \frac{160}{0.5} \times \frac{18}{5}$ km/h

$= 1152$ km

24. (32)

$W = \int_0^4 (2 + 3x)dx$

$= \left[2x + \frac{3x^2}{2}\right]_0^4$

$= 8 + 3 \times 8$

$= 32$ J

25. (300) For equilibrium along the plane

$mg\sin\theta = \frac{1}{4\pi\epsilon_0} \times \frac{q_0^2}{(h\operatorname{cosec} 30^\circ)^2}$

$\therefore h^2 = \frac{1}{4\pi\epsilon_0} \times \frac{q_0^2}{mg\operatorname{cosec} 30^\circ}$

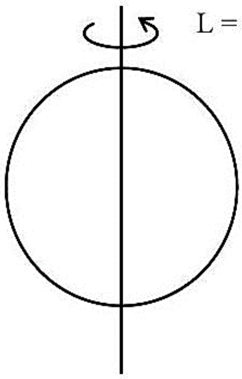
$= 9 \times 10^9 \times \frac{(2 \times 10^{-6})^2}{0.02 \times 10 \times 2}$

$\therefore h = 3 \times 10^4 \times \frac{2 \times 10^{-6}}{0.2}$

$= 0.3$ m

$= 300$ mm

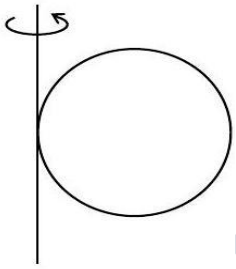
26. (35)



L = Angular momentum

m = 500 g = 0.5 kg
R = 5cm
ω = 10 rad/sec

moment of inertia about tangent $= \mathrm{I_T}$



$$\mathrm{I_t} = \mathrm{x} \times 10^{-2}\ \mathrm{L}$$

$$\frac{7}{5}\mathrm{mR^2} = \mathrm{x} \times 10^{-2}\frac{2}{5}\mathrm{mR^2}\omega$$

$$\frac{7}{2\omega} = \mathrm{x} \times 10^{-2} = \frac{7}{2 \times 10}$$

27. (2) Let the original length be ' ℓ_0 '

When $\mathrm{T_1} = 100$ N, Extension $= \ell_1 - \ell_0$

When $\mathrm{T_2} = 120$ N, Extension $= \ell_2 - \ell_0$

Then $100 = \mathrm{K}(\ell_1 - \ell_0)$

And $120 = \mathrm{K}(\ell_2 - \ell_0)$

$$\frac{1}{2} \Rightarrow \frac{5}{6} = \frac{\ell_1 - \ell_0}{\ell_2 - \ell_0}$$

$$5\ell_2 - 5\ell_0 = 6\ell_1 - 6\ell_0$$

$$\ell_0 = 6\ell_1 - 5\ell_2$$

$$\ell_0 = 6\ell_1 - 5\left(\frac{11\ell_1}{10}\right)$$

$$\ell_0 = 6\ell_1 - \frac{11\ell_1}{2}$$

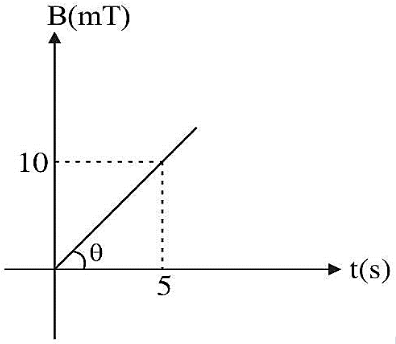
$\ell_0 = \frac{\ell_1}{2}$

$\therefore x = 2$

28. (8) $m = \tan\theta = \frac{10}{5} = 2$

$B = mt$

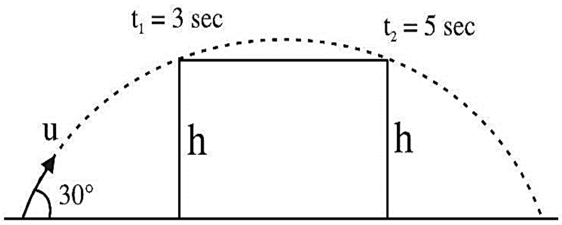
$B = 2t$



$$\varepsilon = \left|\frac{d\phi}{dt}\right| = \frac{d(BA)}{dt} = \frac{AdB}{dt}$$

$$\varepsilon = \frac{4\,d(2t)}{dt} = 4 \times 2 = 8\text{mVolt}$$

29. (80) Time of flight $t_1 + t_2 = 3 + 5 = 8\text{sec}$

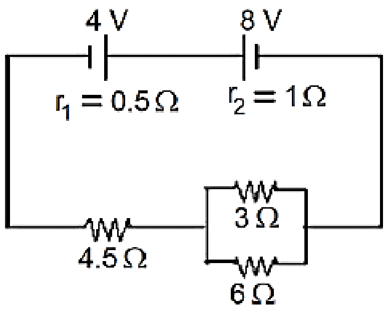


$$T = \frac{2u\sin 30^\circ}{g}$$

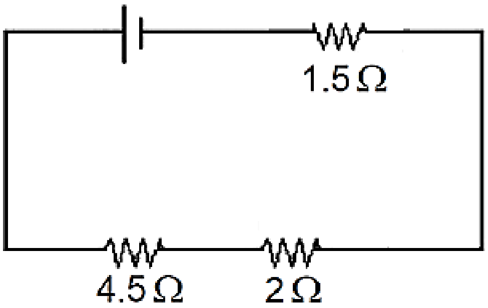
$$8 = \frac{2u\sin(30^\circ)}{10}$$

$$u = 80\ \text{m/s}$$

30. (1)

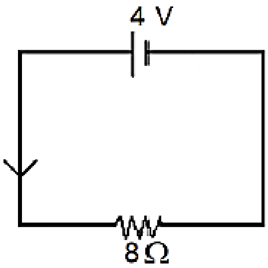


$E_2 - E_1 = 8 - 4 = 4V$

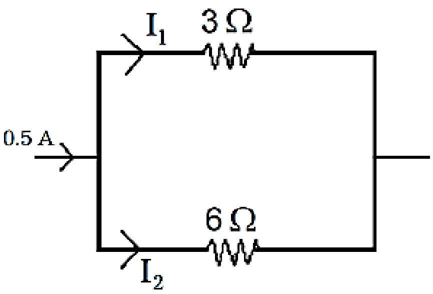


$\frac{1}{3} + \frac{1}{6} = \frac{1}{2} = \frac{1}{R}$

$R = 2\Omega$



$I = \frac{4}{8} = 0.5A$

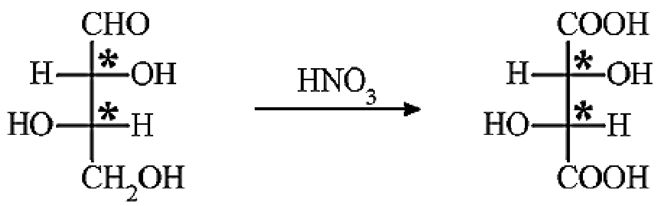


$I_1 = \left(\frac{6}{3+6}\right) \times 0.5$

$I_1 = \frac{2}{3} \times 0.5 = \frac{1}{3}$ A

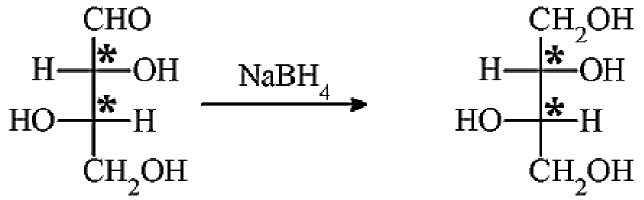
$I_1 = \frac{x}{3} = \frac{1}{3} \therefore x = 1$

31. (b)



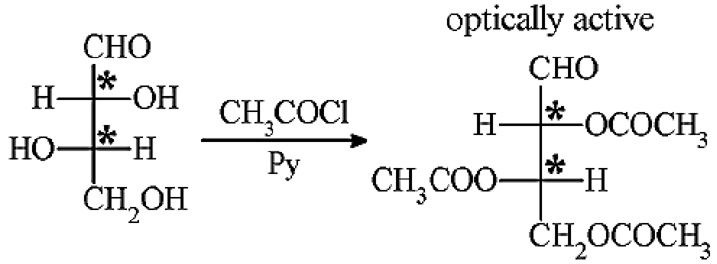
(x) (A)

L-tetrose with two chiral centre



(B)

optically active



(x) gives positive schiff's test due $-CHO$ group

(x) is L-tetrose

32. **(d)** Ethene undergoes addition polymerisation to high density polythene in the presence of catalyst such as $AlEt_3$ and $TiCl_4$ (Ziegler - Natta catalyst) at a temperature of 333 K to 343 K and under a pressure of 6-7 atmosphere.

33. **(a)**

$$CH_3COO^- + FeCl_3 \rightarrow Fe(CH_3COO)_3 \text{ or } [Fe_3(OH)_2(CH_3COO)_6]^+$$

Blood red colour

$$\downarrow \Delta$$

$$Fe(OH)_2(CH_3COO)\downarrow$$

Red–brown precipitate

$$2NO_3^- + 4H_2SO_4 + 6Fe^{2+} \rightarrow 6Fe^{3+} + 2NO\uparrow + 4SO_4^{2-} + 4H_2O$$

$$[Fe(H_2O)_6]^{2+} + NO \rightarrow \underset{\text{Brown}}{[Fe(H_2O)_5(NO)]^{2+}} + H_2O$$

34. **(b)** There is a characteristic minimum frequency, or "threshold frequency," for each metal below which the photoelectric effect is not seen. The ejected electrons leave with a specific amount of kinetic energy at a frequency $\mathbf{v} > v_0$ with an increase in light frequency of these electron kinetic energies also rise.

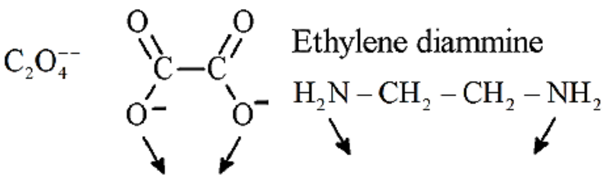
35. **(c)** $AgNO_3 + KI \rightarrow AgI\downarrow + KNO_3$

$$AgI \rightarrow \underset{S}{Ag^+} + \underset{S+0.625}{I^-}$$

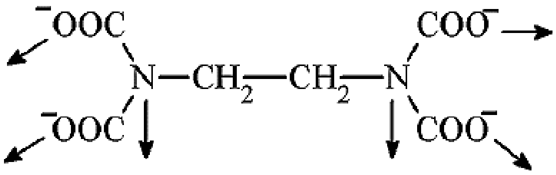
AgI is a insoluble salt so concentration Ag^+ and I^- will be negligible.

36. (d)

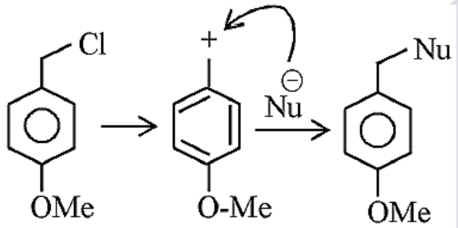
37. (a) NO_2^-, NCS^- are ambidentate ligand



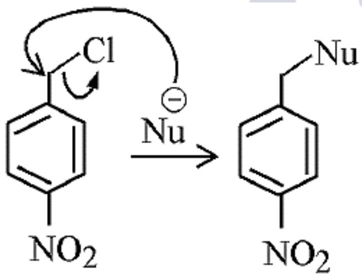
EDTA Ethylene diamine tetra acetate



38. (c)



Electron Donating group
$S_N{}^1$ Mech.: I^{st} order

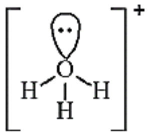
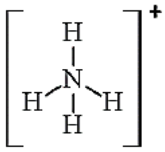
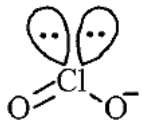


Electron withdrawing group
S_N^2 Mech: 2^{nd} order

39. (c) First I.E.

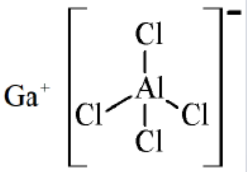
$F > N > O > C > Be > B > Li$
Li – 520 kJ/mol
Be – 899 kJ/mol
B – 801 kJ/mol
C – 1086 kJ/mol
N – 1402 kJ/mol
O – 1314 kJ/mol
F – 1681 kJ/mol

40. (a)

Molecule/Ion	Hybridisation	Shape	
H_3O^+	sp^3	Pyramidal	
Acelylide	sp	linear	$\bar{C} \equiv \bar{C}$
NH_4^+	sp^3	tetrahedral	
ClO_2^-	sp^3	Bent	

41. (a) Gallous tetrachloro aluminate $Ga^+AlCl_4^-$

$$2Ga + Ga^+GaCl_4^- + 2Al_2Cl_6 \overset{190^\circ}{\rightarrow} 4Ga^+AlCl_4^-$$

Structure of $\overset{+}{Ga}\bar{A}^-Cl_4$ 

Ga is cationic part of salt $GaAlCl_4$.

42. (a)

$$2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 3SO_2$$

$$2Cu_2O + Cu_2S \rightarrow \underset{\text{Blister copper}}{6Cu} + SO_2$$

Due to evolution of SO_2, the solidified copper formed has a blistered look and is referred to as blister copper.

43. (a)

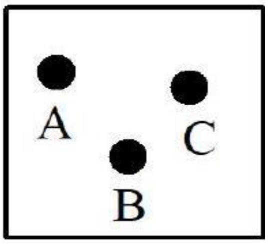
K^+- Sodium - Potassium Pump

KCl - Fertiliser

KOH - absorber of CO_2

Li - used in thermonuclear reactions

44. (a)



According to the observation, A is more mobile and interacts with the mobile phase more than C, and C is more drawn to the mobile phase than B.

Hence, the correct order of elution in the silico gel column chromatography is $-\mathrm{B} < \mathrm{C} < \mathrm{A}$

45. (a) $[\mathrm{MA_3\ B_3}]$ type of compound exists as facial and meridonial isomer.

46. (a)

$$\underset{\text{Steam}}{\mathrm{CH_4(g) + H_2O(g)}} \xrightarrow[1270\,\mathrm{K}]{\mathrm{Ni}} \mathrm{CO(g) + 3H_2(g)}$$

$$\mathrm{NaNO_2(aq) + NH_4Cl(aq) \rightarrow N_2(g) + NaCl(aq) + 2H_2O(\ell)}$$

47. (c) Clean water would have BOD value of less than 5ppm.

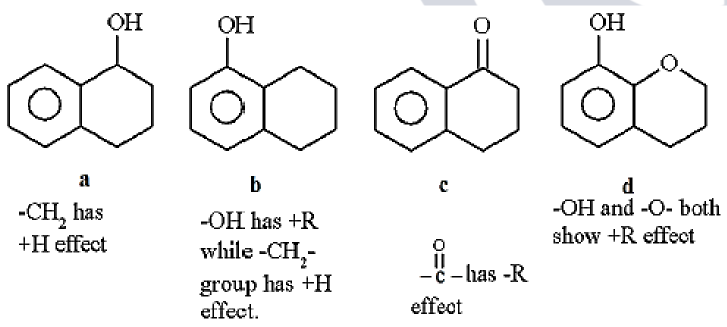
Maximum limit of Zn in clean water

$= 5.0\mathrm{ppm}$ or $\mathrm{mgdm^{-3}}$

Maximum limit of $\mathrm{NO_3^-}$ in clean water

$= 50\mathrm{ppm}$ or $\mathrm{mgdm^{-3}}$

48. (c) Benzene becomes more reactive towards EAS when any substituent raises the electron density.



Correct order

$c < a < b < d$

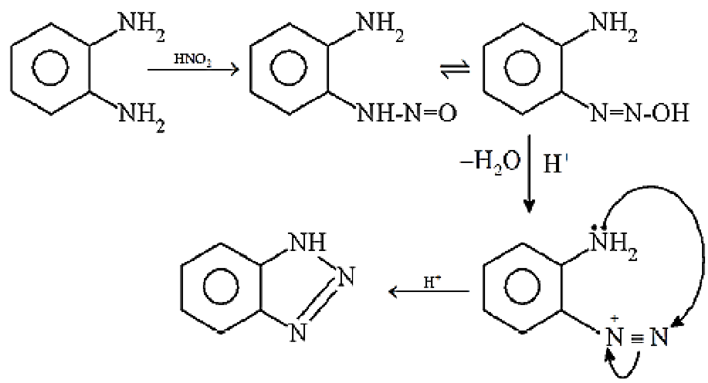
49. (b) $\mathrm{Fe_4[Fe(CN)_6]_3}$ Prussian Blue-water insoluble

$\mathrm{K_3[Co(NO_2)_6]}$ very poorly water soluble

$\mathrm{(NH_4)_3[As(MO_3O_{10})_4]}$ water insoluble ammonium arseno molybdate

$[Fe_3(OH)_2(OAc)_6]Cl$ is water soluble.

50. (a) Orthophenyl amine



51. (44)

$CO_{(g)} + H_2O_{(g)} \rightleftharpoons CO_{2(g)} + H_{2(g)}$

t = 0   1 mol   1 mol   0   0

at equ. $1-x$ $1-x$ x   x

at equilibrium 40% by mass water reacts with CO

$$x = 0.4 \quad 1-x = 0.6$$

$$K_C = \frac{[CO_2][H_2]}{[CO][H_2O]} = \frac{0.4 \times 0.4}{0.6 \times 0.6} = 0.44$$

$$K_C \times 10^2 = 44$$

52. (1)

Spin magnetic moment of $[Cr(CN)_6]^{3-}(t_{2g}^3 e_g^0)$ $\mu_1 = \sqrt{3(3+2)} = \sqrt{15}$BM

Spin magnetic moment of $[Cr(H_2O)_6]^{3+}(t_{2g}^3 e_g^0)$

$\mu_2 = \sqrt{3(3+2)} = \sqrt{15}$BM

$$\frac{\mu_1}{\mu_2} = \frac{\sqrt{15}}{\sqrt{15}} = 1$$

53. (4)

$d = 3$ g/cc

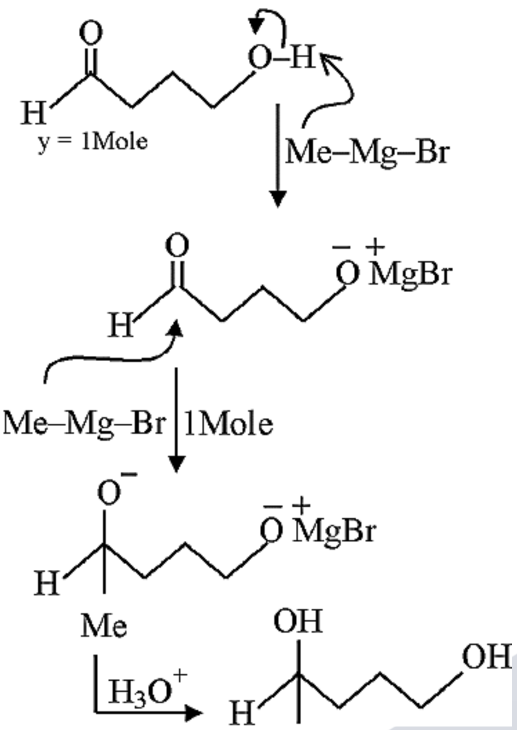
$M = 12$ g/mol

$a = 300\text{pm} = 3 \times 10^{-8}$ cm

$$Z = \frac{d \times N_A \times a^3}{M} = \frac{3 \times 6.02 \times 10^{23} \times (3 \times 10^{-8})^3}{12}$$

$= 4.06 \approx 4$

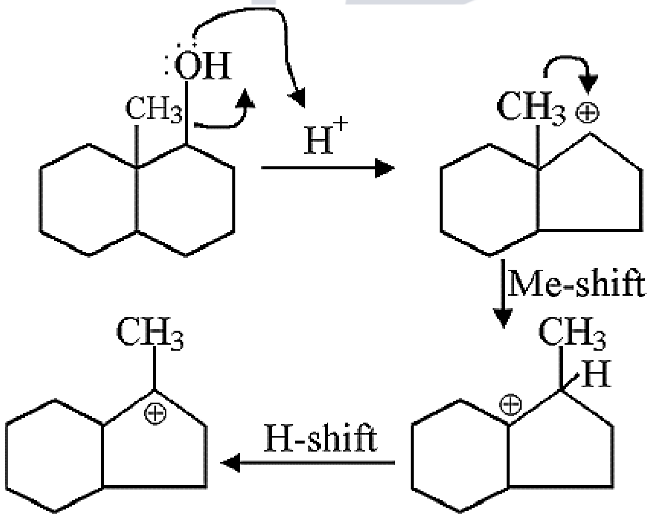
54. (2)



$\therefore x = 2$ mole

$\frac{x}{y} = \frac{2}{1} = 2$

55. (7)



including this structure there are 7
Hyperconjugation structure

56. (4)

$Fe_2O_3 + 2Al \rightarrow Al_2O_3 + 2Fe$

Molar mass 160 g27 g

$$(\Delta H_f^0)_{reaction} = \left[(\Delta H_f^0)_{Al_2O_3} + 2(\Delta H_f^0)_{Fe}\right] - \left[(\Delta H_f^0)_{Fe_2O_3} + 2(\Delta H_f^0)_{Al}\right]$$
$$= [-1700 + 0] - [-840 + 0]$$
$$= -860 \text{ kJ/mol}$$

Total mass of mixture $= Fe_2O_3 + Al(1:2 \text{ molar ratio})$

$$= 160 + 2 \times 27$$
$$= 214 \text{ g/mol}$$

Heat evolved per gram $= \frac{860}{214} = 4$ kJ/g

57. (36)

Total mass of sugar in mixture of 25% of 200 and 40% of 500 g

Sugar solution $= 0.25 \times 200 + 0.40 \times 500$

$= 50 + 200 = 250$ g

Total mass of solution $= 200 + 500 = 700$ g

Mass of sugar in solution $= \frac{250}{700} \times 100 = 35.7\%$
$\approx 36\%$

58. (333)

$KClO_3 + 6FeSO_4 + 3H_2SO_4 \rightarrow KCl + 3Fe_2(SO_4)_3 + 3H_2O$

$$\text{ROR} = -\frac{\Delta[KClO_3]}{\Delta t} = \frac{-1}{6}\frac{\Delta[FeSO_4]}{\Delta t}$$
$$= \frac{+1}{3}\frac{\Delta[Fe_2(SO_4)_3]}{\Delta t}$$

$$\frac{\Delta[Fe_2(SO_4)_3]}{\Delta t} = \frac{1}{2}\frac{-\Delta[FeSO_4]}{\Delta t}$$

$$= \frac{1}{2}\frac{(10 - 8.8)}{30 \times 60}$$

$= 0.333 \times 10^{-3}$

$= 333 \times 10^{-6}$ mollitre^{-1}sec^{-1}

59. (75) Isotonic solutions,

$$\pi_{K_2SO_4} = \pi_{Glucose}$$
$$i \times 0.004 \times RT = 0.01 \times RT$$
$$i = 2.5$$

For K_2SO_4 for dissociation $i = 1 + (n - 1)\alpha\}$

$$\text{DOD}(\alpha) = \frac{i - 1}{n - 1} = \frac{2.5 - 1}{3 - 1} = 0.75$$

% dissociation = 75

60. (2)

$Pb^{2+} + 2e^- \rightarrow Pb \; \Delta G_1^0 = -2FE_1^0$

$Pb^{4+} + 4e^- \rightarrow Pb \; \Delta G_2^0 = -4FE_2^0$

$Pb^{2+} \rightarrow Pb^{4+} + 2e^- \; \Delta G_3^0 = -2FE_3^0$

$\Delta G_3^0 = \Delta G_1^0 - \Delta G_2^0$

$-2FE_3^0 = 2\,F(2n - m)$

$E_3^0 = m - 2n = m - xn$

Hence $x = 2$

61. (d) $I = \int_{-\ln 2}^{\ln 2} e^x \left(\ln\left(e^x + \sqrt{1 + e^{2x}}\right)\right) dx$

Put $e^x = t \Rightarrow e^x dx = dt$

$I = \int_{1/2}^{2} \ln\left(t + \sqrt{1 + t^2}\right) dt$

Applying integration by parts.

$$= \left[t\ln\left(t + \sqrt{1+t^2}\right)\right]_{\frac{1}{2}}^{2} - \int_{1/2}^{2} \frac{t}{t + \sqrt{1+t^2}}\left(1 + \frac{2t}{2\sqrt{1+t^2}}\right) dt$$

$$= 2\ln(2 + \sqrt{5}) - \frac{1}{2}\ln\left(\frac{1+\sqrt{5}}{2}\right) - \int_{1/2}^{2} \frac{t}{\sqrt{1+t^2}} dt$$

$$= 2\ln(2 + \sqrt{5}) - \frac{1}{2}\ln\left(\frac{1+\sqrt{5}}{2}\right) - \frac{\sqrt{5}}{2}$$

$$= \ln\left(\frac{(2+\sqrt{5})^2}{\left(\frac{\sqrt{5}+1}{2}\right)^{\frac{1}{2}}}\right) - \frac{\sqrt{5}}{2}$$

62. (d) The equation of plane through $(-2,3,5)$ is

$a(x + 2) + b(y - 3) + c(z - 5) = 0$

it is perpendicular to $2x + 4y + 5z = 8 \,\&\, 3x - 2y + 3z = 5$

$\therefore\; 2a + 4\,b + 5c = 0$

$3a - 2b + 3c = 0$

$$\therefore \frac{a}{\begin{vmatrix} 4 & 5 \\ -2 & 3 \end{vmatrix}} = \frac{-b}{\begin{vmatrix} 2 & 5 \\ 3 & 3 \end{vmatrix}} = \frac{c}{\begin{vmatrix} 2 & 4 \\ 3 & -2 \end{vmatrix}}$$

$\Rightarrow \frac{a}{22}=\frac{b}{9}=\frac{c}{-16}$

$\therefore$ Equation of Plane is

$22(x+2)+9(y-3)-16(z-5)=0$

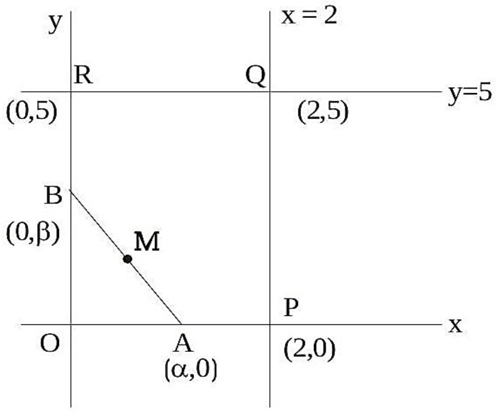
$\Rightarrow 22x+9y-16z+97=0$

Comparing with $\alpha x+\beta y+\gamma x+97=0$

We get $\alpha+\beta+\gamma=22+9-16=15$

63. (b) $\frac{ar(OPQR)}{or(OAB)}=\frac{4}{1}$

Let M be the mid-point of AB.



$M(h,k)\equiv\left(\frac{\alpha}{2},\frac{\beta}{2}\right)$

$\Rightarrow \frac{10-\frac{1}{2}\alpha\beta}{\frac{1}{2}\alpha\beta}=4$

$\Rightarrow \frac{5}{2}\alpha\beta=10\Rightarrow\alpha\beta=4$

$\Rightarrow (2\,h)(2\,K)=4$

$\therefore$ Locus of M is $xy=1$

Which is a hyperbola.

64. (b) $\omega A=\{a_1,a_2,a_3,a_4,a_5\}$

$B=\{b_1,b_2,b_3,b_4,b_5\}$

Given, $\sum_{i=1}^{5}ai=25,\sum_{i=1}^{5}bi=40$

$\frac{\sum_{i=1}^{5}a_i^2}{5}-\left(\frac{\sum_{i=1}^{5}a_i}{5}\right)^2=12,\frac{\sum_{i=1}^{5}b_i^2}{5}-\left(\frac{\sum_{i=1}^{5}b_i}{5}\right)^2=20$

$\Rightarrow \sum_{i=1}^{5} a_i^2 = 185$, $\sum_{i=1}^{5} b_i^2 = 420$

Now, $C = \{C_1, C_2, \ldots . C_{10}\}$

$$\text{s.f. } C_i = \underset{\substack{\text{First five} \\ \text{elements}}}{a_i - 3} \quad \text{or} \quad \underset{\substack{\text{Last five} \\ \text{elements}}}{b_i + 2}$$

$\therefore$ Mean of C, $\bar{C} = \frac{(\sum a_i - 15) + (\sum b_i + 10)}{10}$

$$\bar{C} = \frac{10 + 50}{10} = 6$$

$$\therefore \sigma^2 = \frac{\sum_{i=1}^{10} C_i^2}{10} = (\bar{C})^2$$

$$= \frac{\sum(a_i - 3)^2 + \sum(b_i + 2)^2}{10} - (6)^2$$

$$= \frac{\sum a_i{}^2 + \sum b_i{}^2 - 6\sum a_i + 4\sum b_i + 65}{10} - 36$$

$$= \frac{185 + 420 - 150 + 160 + 65}{10} - 36$$

$= 32$

$\therefore$ Mean + Variance $= \bar{C} + \sigma^2 = 6 + 32 = 38$

65. (d) Here $f(x) = [x(x-1)] + \{x\}$

$f(o^+) = -1 + 0 = -1$ $f(o) = 0$	$f(1^+) = 0 + 0 = 0$ $f(a) = 0$ $f(1^-) = -1 + 1 = 0$

$\therefore$ f(x) is continuous at x = 1, discontinuous at x = 0

66. (b) $x + y + z = 15$

Total no. of solution $= {}^{15+3-1}C_{3-1} = 136$

Let $x = y \neq z$

$2x + z = 15 \Rightarrow z = 15 - 2t$

$\Rightarrow r \in \{0,1,2, \ldots 7\} - \{5\}$

$\therefore$ 7 solutions

$\therefore$ there are 21 solutions in which exactly

Two of $x_1 y_1 z$ are equal

There is one solution in which $x = y = z$

Required answer $= 136 - 21 - 1 = 114$

67. (d) Without loss of generality

Let $|a_1| \le |a_2| \le |a_3|$

$|\vec{a}|^2 = |a_1|^2 + |a_2|^2 + |a_3|^2 \ge (a_3)^2$

$\Rightarrow\ |\vec{a}| \ge |a_3| = \max\{|a_1|, |a_2|, |a_3|\}$

A is true

$|\vec{a}|^2 = |a_1|^2 + |a_2|^2 + |a_3|^2 \le |a_3|^2 + |a_3|^2 + |a_3|^2$

$\Rightarrow |\vec{\mathbf{a}}|^2 \le 3|a_3|^2$

$\Rightarrow\ |\vec{a}| \le \sqrt{3}|a_3| = \sqrt{3}\max\{|a_1|, |a_2|, |a_3|\}$

$\le 3\max\{|a_1|, |a_2|, |a_3|\}$

(B) is true

68. (d) $W_1 = z_i i = (5+4i)i = -4+5i$

$W_2 = z_2(-i) = (3+5i)(-i) = 5-3i$

$W_1 - W_2 = -9+8i$

Principal argument $= \pi - \tan^{-1}\left(\frac{8}{9}\right)$

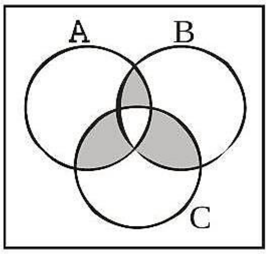
69. (c) $|A| = 48$

$|B| = 25$

$|C| = 18$

$|A \cup B \cup C| = 60$ [Total]

$|A \cap B \cap C| = 5$



$|A \cup B \cup C| = \sum|A| - \sum|A \cap B| + |A \cap B \cap C|$

$\Rightarrow \sum|A \cap B| = 48 + 25 + 18 + 5 - 60$

$= 36$

No. of men who received exactly 2 medals

$= \sum|A \cap B| - 3|A \cap B \cap C|$

$= 36 - 15$

$= 21$

70. (a) $M\begin{bmatrix} a & b \\ c & d \end{bmatrix}$, where a, b, c, d, $\in \{0,1,2\}$

$n(s) = 3^4 = 81$

we first bound $p(\bar{A})$

$|m| = 0 \Rightarrow ad = bc$

$ad = bc = 0 \Rightarrow$ no. of $(a, b, c, d) = (3^2 - 2^2)^2 = 25$

$ad = bc = 1 \Rightarrow$ no. of $(a, b, c, d) = 1^2 = 1$

$ad = bc = 2 \Rightarrow$ no. of $(a, b, c, d) = 2^2 = 4$

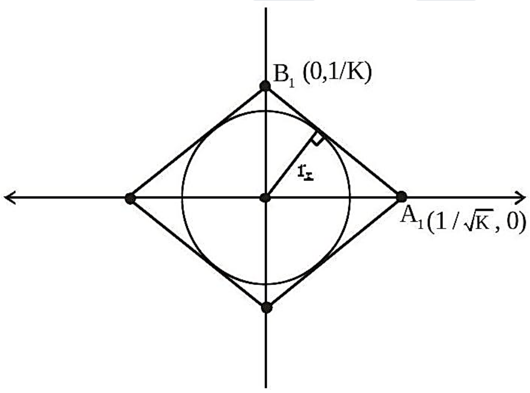
$ad = bc = 4 \Rightarrow$ no. of $(a, b, c, d) = 1^2 = 1$

$: P(\bar{A}) = \frac{31}{81} \Rightarrow p(A) = \frac{50}{81}$

71. (a) $Kx^2 + K^2y^2 = 1$

$$\frac{x^2}{1/K} + \frac{y^2}{1/K^2} = 1$$

Now



Equation of

$A_1\ B_2; \frac{x}{1/\sqrt{K}} + \frac{y}{1/K} = 1 \Rightarrow \sqrt{K}x + Ky = 1$

$r_K = \perp$ r distance of (0,0) from line A_1B_1

$$r_k = \left|\frac{(0 + 0 - 1)}{\sqrt{K + K^2}}\right| = \frac{1}{\sqrt{K + K^2}}$$

$$\frac{1}{r_K^2} = K + K^2 \Rightarrow \sum_{k=1}^{20} \frac{1}{r_K^2} = \sum_{K=1}^{20} (K + K^2)$$

$$= \sum_{K=1}^{20} K + \sum_{K=1}^{20} K^2$$

$$= \frac{20 \times 21}{2} + \frac{20.21.41}{6}$$

$$= 210 + 10 \times 7 \times 41$$

$$= 210 + 2870$$

$$= 3080$$

72. (a) $\log_{x+\frac{7}{2}}\left(\frac{x-7}{2x-3}\right)^2 \geq 0$

Feasible region: $x + \frac{7}{2} > 0 \Rightarrow x > -\frac{7}{2}$ And $x + \frac{7}{2} \neq 1 \Rightarrow x \neq -\frac{5}{2}$
And $\frac{x-7}{2x-3} \neq 0$ and $2x - 3 \neq 0$

$$x \neq 7\ x \neq \frac{3}{2}$$

Taking intersection: $x \in \left(\frac{-7}{2}, \infty\right) - \left\{-\frac{5}{2}, \frac{3}{2}, 7\right\}$
Now $\log_2 b \geq 0$ if $a > 1$ and $b \geq 1$
Or

$a \in (0,1)$ and $b \in (0,1)$

C-I; $x + \frac{7}{2} > 1$ and $\left(\frac{x-7}{2x-3}\right)^2 \geq 1$

$x > -\frac{5}{2}$ $(2x-3)^2 - (x-7)^2 \leq 0$

$(2x - 3 + n - 7)(2x - 3 - x + 7) \leq 0$

$(3x - 10)(x + 4) \leq 0$

$x \in \left[-4, \frac{10}{3}\right]$

Intersection: $x \in \left(\frac{-5}{2}, \frac{10}{3}\right]$

C-II $x + \frac{7}{2} \in (0,1)$ and $\left(\frac{x-7}{2x-3}\right)^2 \in (0,1)$

$$0 < x + \frac{7}{2} < 1$$

$$\left(\frac{x-7}{2x-3}\right)^2 < 1$$

$-\frac{7}{2} < x < \frac{-5}{2}$ $(x-7)^2 < (2x-3)^2$

$$x \in (-\infty, -4) \cup \left(\frac{10}{3}, \infty\right)$$

No common values of x.
Hence intersection with feasible region
We get $x \in \left(\frac{-5}{2}, \frac{10}{3}\right] - \left\{\frac{3}{2}\right\}$

Integral value of x are $\{-2,-1,0,1,2,3\}$
No. of integral values $= 6$

73. (a) $x^2 + (y-2)^2 \le 2^2$ and $x^2 \ge 2y$

Solving circle and parabola simultaneously:

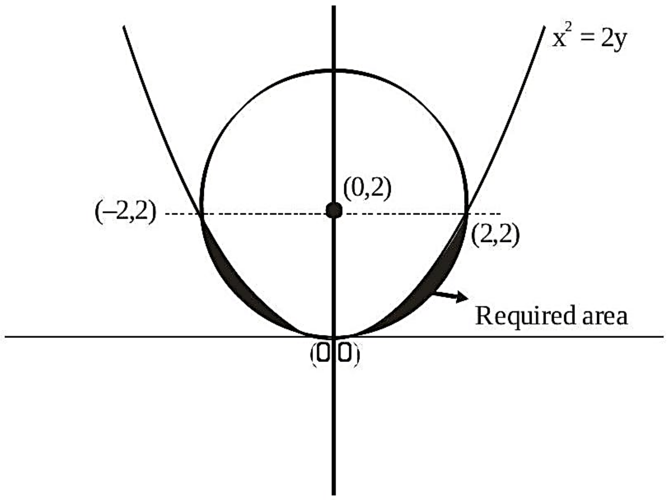
$2y + y^2 - 4y + 4 = 4$

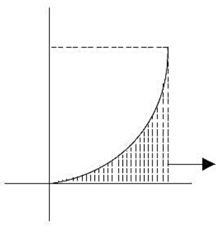
$y^2 - 2y = 0$

$y = 0,2$

Put $y = 2$ in $x^2 = 2y \rightarrow x = \pm 2$

$\Rightarrow (2,2)$ and $(-2,2)$





$$= 2 \times 2 - \frac{1}{4} \cdot \pi \cdot 2^2 = 4 - \pi$$

Required area $= 2\left[\int_0^2 \frac{x^2}{2} dx - (4-\pi)\right]$

$= 2\left[\left.\frac{x^3}{6}\right|_0^2 - 4 + \pi\right]$

$= 2\left[\frac{4}{3} + \pi - 4\right]$

$= 2\left[\pi - \frac{8}{3}\right]$

$= 2\pi - \frac{16}{6}$

74. (c)

75. (d) $(1 - x^2y^2)dx = ydx + xdy, y(a) = 2$

$y(b) = \propto = ?$

$dx = \frac{d(xy)}{1-(xy)^2} \int dx = \int \frac{dxy}{1-(xy)^2}$

$$x = \frac{1}{2}\ln\left|\frac{1+xy}{1-xy}\right| + C$$

Put $x = 1$ and $y = 2$:

$$1 = \frac{1}{2}\ln\left|\frac{1+2}{1-2}\right| + C$$

$$C = 1 - \frac{1}{2}\ln 3$$

Now put $x = 2$:

$$2 = \frac{1}{2}\ln\left|\frac{1+2\alpha}{1-2\alpha}\right| + 1 - \frac{1}{2}\ln 3$$

$$1 + \frac{1}{2}\ln 3 = \frac{1}{2}\ln\left|\frac{1+2\alpha}{1-2\alpha}\right|$$

$$2 + \ln 3 = \ln\left(\frac{1+2\alpha}{1-2\alpha}\right)$$

$$\left|\frac{1+2\alpha}{1-2\alpha}\right| = 3e^2$$

$$\frac{1+2\alpha}{1-2\alpha} = 3e^2, -3e^2$$

$$\frac{1+2\alpha}{1-2\alpha} = 3e^2 \Rightarrow \alpha = \frac{3e^2-1}{2(3e^2+1)}$$

And $\frac{1+2\alpha}{1-2\alpha} = -3e^2 \Rightarrow \alpha = \frac{3e^2+1}{2(3e^2-1)}$

76. (c) $A^T = \alpha A + I$

$A = \alpha A^T + I$

$A = \alpha(\alpha A + I) + I$

$A = \alpha^2 A + (\alpha + 1)I$

$A(1 - \alpha^2) = (\alpha + 1)I$

$$A = \frac{I}{1-\alpha}$$

$$|A| = \frac{1}{(1-\alpha)^2}$$

$|A^2 - A| = |A||A - I|$

$$A - I = \frac{I}{1-\alpha} - I = \frac{\alpha}{1-\alpha} I$$

$$|A - I| = \left(\frac{\alpha}{1-\alpha}\right)^2$$

Now $|A^2 - A| = 4$

$|A||A - I| = 4$

$$\Rightarrow \frac{1}{(1-\alpha)^2}\frac{\alpha^2}{(1-\alpha)^2} = 4$$

$$\Rightarrow \frac{\alpha}{(1-\alpha)^2} = \pm 2$$

$\Rightarrow 2(1-\alpha)^2 = \pm\alpha$

$(C_1) 2(1-\alpha)^2 = \alpha$ | $(C_2) 2(1-\alpha)^3 = -\alpha$

$2\alpha^2 - 5\alpha + 2 = 0 <^{\alpha_1}_{\alpha_2}$ | $2\alpha^2 - 3\alpha + 2 = 0$

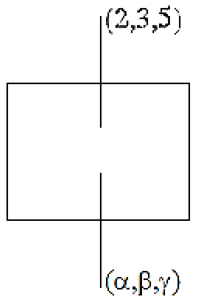
$\alpha_1 + \alpha_2 = \frac{5}{2}$ $\alpha \notin R$

Sum of value of $\alpha = \frac{5}{2}$

77. (a)

$$\frac{\alpha-2}{2} = \frac{\beta-3}{1} = \frac{\gamma-5}{-3} = -2\left(\frac{2\times 2 + 3 - 3\times 5 - 6}{2^2 + 1^2 + 1 - 3^2}\right) = 2$$

$\frac{\alpha-2}{2} = 2$ $\alpha = 6$	$\beta - 3 = 2$ $\beta = 5$	$\gamma - 5 = -6$ $\gamma = -1$



$\alpha + \beta + \gamma = 10$

78. (d) n_1 and n_2 are normal vector to the plane $\hat{i} + \hat{j}, \hat{i} + \hat{k}$ and $\hat{i} - \hat{j}; \hat{j} - \hat{k}$ respectively

$$\vec{n}_1 = \begin{vmatrix} \hat{i} & \hat{j} & \hat{j} \\ 1 & 1 & 0 \\ 1 & 0 & 1 \end{vmatrix} = \hat{i} - \hat{j} - \hat{k}$$

$\vec{n}_2 = \begin{vmatrix} \hat{i} & \hat{j} & \hat{j} \\ 1 & -1 & 0 \\ 1 & 0 & -1 \end{vmatrix} = \hat{i} + \hat{j} + \hat{k}$

$\vec{a} = \lambda|\vec{n}_2 \times \vec{n}_2|$

$= \lambda \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & -1 & -1 \\ 1 & 1 & 1 \end{vmatrix} = \lambda(-2\hat{j} + 2\hat{k})$

$\vec{a} \cdot \vec{b} = \lambda|0 + 4 + 2| = 6$

$\Rightarrow \lambda = 1$

$\vec{\alpha} = -2\hat{\mathbf{j}} + 2\hat{\mathbf{k}}$

$\cos\theta = \dfrac{\vec{a} \cdot \vec{b}}{|a||b|}$

$\cos\theta = \dfrac{6}{2\sqrt{2} \times 3} = \dfrac{1}{\sqrt{2}}$

$\theta = \dfrac{\pi}{4}$

Now $|\vec{a} \cdot \vec{b}|^2 + |\vec{a} \times \vec{b}|^2 = |a|^2|\ b|^2$

$36 + |\vec{a} \times b^2| = 8 \times 9 = 72$

$|\vec{a} \times b|^2 = 36$

$|\vec{a} \times \vec{b}| = 6$

79. (c)

$3\cos^4\theta - 5\cos^2\theta - 2\sin^6\theta + 2 = 0$

$\Rightarrow 3\cos^4\theta - 3\cos^2\theta - 2\cos^2\theta - 2\sin^6\theta + 2 = 0$

$\Rightarrow\ 3\cos^4\theta - 3\cos^2\theta + 2\sin^2\theta - 2\sin^6\theta = 0$

$\Rightarrow 3\cos^2\theta(\cos^2\theta - 1) + 2\sin^2\theta(\sin^4\theta - 1) = 0$

$\Rightarrow\ \ -3\cos^2\theta\sin^2\theta + 2\sin^2\theta(1 + \sin^2\theta)\cos^2\theta - 1$

$\Rightarrow\ \sin^2\theta\cos^2\theta(2 + 2\sin^2\theta - 3) = 0$

$\Rightarrow\ \sin^2\theta\cos^2\theta(2\sin^2\theta - 1) = 0$

(C1) $\sin^2\theta = 0 \rightarrow 3$ solution; $\theta = \{0, \pi, 2\pi\}$

(C2) $\cos^2\theta = 0 \rightarrow 2$ solution; $\theta = \left\{\frac{\pi}{2}, \frac{3\pi}{2}\right\}$

(C3) $\sin^2\theta = \frac{1}{2} \rightarrow 4$ solution; $\theta = \left\{\frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}\right\}$

No. of solution = 9

80. (c) Mean = 200

$$\Rightarrow \frac{\frac{100}{2}(2\times 2+99d)}{100}=200$$

$$\Rightarrow 4+99d=400$$

$$\Rightarrow d=4$$

$$y_i=i(xi-i)$$

$$=i(2+(i-1)4-i)=3i^2-2i$$

$$\text{Mean}=\frac{\Sigma y_i}{100}$$

$$=\frac{1}{100}\Sigma_{i=1}^{100}3i^2-2i$$

$$=\frac{1}{100}\left\{\frac{3\times 100\times 101\times 201}{6}-\frac{2\times 100\times 101}{2}\right\}$$

$$=101\left\{\frac{201}{2}-1\right\}=101\times 99.5$$

$$=10049\cdot 50$$

81. (2736) Coefficient of x = ${}^9C_1 2^8$

Of x^2 = ${}^9C_2 2^7$

Of x^7 = ${}^9C_7\cdot 2^2$

$$\text{Mean}=\frac{{}^9C_1\cdot 2^8+{}^9C_2\cdot 2^7 \ldots\ldots + {}^9C_7\cdot 2^2}{7}$$

$$=\frac{(1+2)^9-{}^9C_0\cdot 2^9-{}^9C_8\cdot 2^1-{}^9C_9}{7}$$

$$=\frac{3^9-2^9-18-1}{7}$$

$$=\frac{19152}{7}=2736$$

82. (2175)

$$S=109+\frac{108}{5}+\frac{107}{5^2}\ldots\ldots+\frac{1}{5^{108}}$$

$$\frac{S}{5}=\frac{109}{5}+\frac{108}{5^2}\ldots\ldots+\frac{2}{5^{108}}+\frac{1}{5^{109}}$$

$$\frac{4S}{5}=109-\frac{1}{5}-\frac{1}{5^2}\ldots\ldots-\frac{1}{5^{108}}-\frac{1}{5^{109}}$$

$= 109 - \left(\frac{1}{5}\frac{\left(1-\frac{1}{5^{109}}\right)}{\left(1-\frac{1}{5}\right)}\right)$

$= 109 - \frac{1}{4}\left(1-\frac{1}{5^{109}}\right)$

$= 109 - \frac{1}{4} + \frac{1}{4} \times \frac{1}{5^{109}}$

$s = \frac{5}{4}\left(109 - \frac{1}{4} + \frac{1}{4.5^{109}}\right)$

$16S = 20 \times 109 - 5 + \frac{1}{5^{108}}$

$16\ S - (25)^{-54} = 2180 - 5 = 2175$

83. (32)

$\alpha(m, n) = \int_0^2 t^m (1+3t)^n dt$

If $11\alpha(10,6) + 18\alpha(11,5) = p(14)^6$ then P

$= 11\int_0^2 \underset{II}{t^{10}} \underset{I}{(1+3t)^6} + 10\int^2 t^{11}(1+3t)^5 dt$

$= 11\left[(1+3t)^6 \cdot \frac{t^{11}}{11} - \int 6(1+3t)^5 \cdot 3\frac{t^{11}}{11}\right]_0^2 + 18\int_0^2 t^{11}(1+3t)^5 dt$

$= (t^{11}(1+3t)^6)_0^2$

$= 2^{11}(7)^6$

$= 2^5(14)^6$

$= 32(14)^6$

84. (44)

Derangement of 5 students

$$\begin{aligned} D_5 &= 5!\left(1 - \frac{1}{1!} + \frac{1}{2!} - \frac{1}{3!} + \frac{1}{4!} - \frac{1}{5!}\right) \\ &= 120\left(\frac{1}{2} - \frac{1}{6} + \frac{1}{24} - \frac{1}{120}\right) \\ &= 60 - 20 + 5 - 1 \\ &= 40 + 4 \\ &= 44 \end{aligned}$$

85. (5) Let $\ell = (0\hat{i} + 0\hat{j} + 0\hat{k}) + \gamma(a\hat{i} + b\hat{j} + c\hat{k})$

$= \gamma(a\hat{i} + b\hat{j} + c\hat{k})$

$a\hat{i}+b\hat{j}+c\hat{k}=\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 1 & 2 & 3\\ 2 & 2 & 1\end{vmatrix}$

$=\hat{i}(2-6)-\hat{j}(1-6)+\hat{k}(2-4)$

$=-4\hat{i}-5\hat{j}-2\hat{k}$

$\ell=\gamma(-4\hat{i}+5\hat{j}-2\hat{k})$

P is intersection of ℓ and ℓ_1

$-4\gamma=1+\lambda, 5\gamma=-11+2\lambda, -2\gamma=-7+3\lambda$

By solving there equation $\gamma=-1$, $P(4,-5,2)$

Let $Q(-1+2\mu, 2\mu, 1+\mu)$

$\overrightarrow{PQ}\cdot(2\hat{i}+2\hat{j}+\hat{k})=0$

$-2+4\mu+4\mu+1+\mu=0$

$9\mu=1$

$\mu=\frac{1}{9}$

$Q\left(\frac{-7}{9},\frac{2}{9},\frac{10}{9}\right)$

$9(\alpha+\beta+\gamma)=9\left(\frac{-7}{9}+\frac{2}{9}+\frac{10}{9}\right)$

$=5$

86. (171) The number of integral term in the expression of $\left(3^{\frac{1}{2}}+5^{\frac{1}{4}}\right)^{680}$ is equal to

General term $= {}^{680}C_r\left(3^{\frac{1}{2}}\right)^{680-r}\left(5^{\frac{1}{4}}\right)^{r}$

$= {}^{680}C_r 3^{\frac{680-r}{2}} 5^{\frac{r}{4}}$

Values of r, where $\frac{r}{4}$ goes to integer

$r=0,4,8,12,\ldots\ldots\ldots\ldots 680$

All value of r are accepted for $\frac{680-r}{2}$ as well so No of integral terms $=171$.

87. (7)

p	q	r	Pvq	Pvr	(pvq) $\wedge$ (pvr)	qvr	(pvq) $\wedge$ (pvr) $\rightarrow$ qvr
T	T	T	T	T	T	T	T
T	T	F	T	T	T	T	T
T	F	T	T	T	T	T	T
T	F	F	T	T	T	F	F
F	T	T	T	T	T	T	T
F	T	F	T	F	F	T	T
F	F	T	F	T	F	T	T
F	F	F	F	F	F	F	T

Hence total no of ordered triplets are 7

88. (306) Hn $\Rightarrow \frac{x^2}{1+n} - \frac{y^2}{3+n} = 1$

$$e = \sqrt{1+\frac{b^2}{a^2}} = \sqrt{1+\frac{3+n}{1+n}} = \sqrt{\frac{2n+4}{n+1}}$$

$$e = \sqrt{\frac{2n+4}{n+1}}$$

$n = 48$ (smallest even value for which $e \in Q$)

$$e = \frac{10}{7}$$

$a^2 = n+1 \;\; b^2 = n+3$

$= 49\,, \;\; = 51$

$1 =$ length of LR $= \frac{2\,b^2}{a}$

$$L = 2 \cdot \frac{51}{7}$$

$$1 = \frac{102}{7}$$

$21\ell = 306$

89. (51) $x^2 - 7x - 1 = 0 <<^a_b$

By newton's theorem

$S_{n+2}-7\,S_{n+1}-S_n=0$

$S_{21}-7\,S_{20}-S_{19}=0$

$S_{20}-7\,S_{19}-S_{18}=0$

$S_{19}-7\,S_{18}-S_{17}=0$

$\frac{S_{21}+S_{17}}{S_{19}}=\frac{S_{21}+(S_{19}-7\,S_{18})}{S_{19}}$

$=\frac{S_{21}+S_{19}-7(\,S_{20}-7\,S_{19})}{S_{19}}$

$=\frac{50\,S_{19}+(S_{21}-7\,S_{20})}{S_{19}}$

$=51\cdot\frac{S_{19}}{S_{19}}=51$

90. (2) $A=\begin{bmatrix}0 & 1 & 2\\ a & 0 & 3\\ 1 & C & 0\end{bmatrix}$

$A^3=A$

$A^2=\begin{bmatrix}0 & 1 & 2\\ a & 0 & 3\\ 1 & c & 0\end{bmatrix}\begin{bmatrix}0 & 1 & 2\\ a & 0 & 3\\ 1 & c & 0\end{bmatrix}$

$A^2=\begin{bmatrix}a+2 & 2c & 3\\ 3 & a+3c & 2a\\ ac & 1 & 2+3c\end{bmatrix}$

$A^3=\begin{bmatrix}a+2 & 2c & 3\\ 3 & a+3c & 2a\\ ac & a & 2+3c\end{bmatrix}\begin{bmatrix}0 & 1 & 2\\ a & 0 & 3\\ 1 & c & 0\end{bmatrix}$

$A^3=\begin{bmatrix}2ac+3 & a+2+3c & 2a+4+6c\\ a(a+3c)+2a & 3+2ac & 6+3a+9c\\ a+2+3c & ac+c(2+3c) & 2ac+3\end{bmatrix}$

Given $A^3=A$

$2ac+3=0\ldots(a)$ and $a+2+3c=1$

$a+1+3c=0$

$a+1-\frac{9}{2a}=0$

$2a^2+2a-9=0$

$f(a)<0, f(b)>0$

$a\in(1,2]$

$n=2$