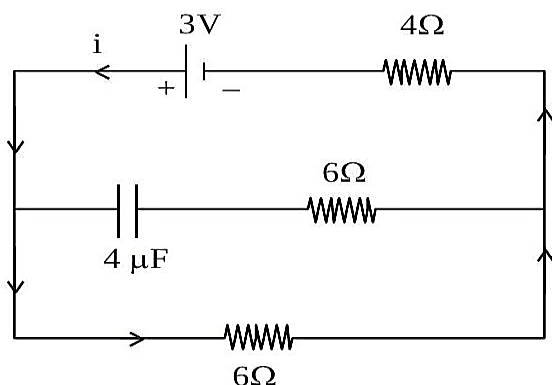


1. (d) Binding energy per nucleon is almost same for nuclei of mass number ranging 30 to 170.
2. (a)
3. (a)



No current will flow in capacitor in steady state, current flowing in the circuit in steady state

$$I = \frac{3}{6 + 4} = \frac{3}{10}$$

Potential difference on 6Ω resistance

$$V = 6 \times \frac{3}{10} = 1.8 \text{ volt}$$

Capacitor will have same potential so charge,

$$q = CV = (4\mu\text{F}) \cdot (1.8 \text{ volt}) = 7.2\mu\text{C}.$$

$$4. \text{ (b) } V_e = \sqrt{\frac{2GM}{R}} \Rightarrow V_e \propto \sqrt{\frac{M}{R}}$$

As $\frac{M}{R}$ increases $\Rightarrow V_e$ increases

Statement (a) is correct

$$\text{Also } V_e \propto \frac{1}{\sqrt{R}}$$

As V_e depends upon R

$\Rightarrow$ Statement (b) is incorrect

$$5. \text{ (c) } KE = PE$$

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

$$A^2 - x^2 = x^2 \Rightarrow A^2 = 2 \times 2$$

$$\Rightarrow x = \pm \frac{A}{\sqrt{2}}$$

$$6. \text{ (d) Velocity of train A}$$

$$V_A = 90 \frac{\text{km}}{\text{hr}} = 90 \times \frac{5}{18} = 25 \text{ m/s}$$

Velocity of train B

$$V_B = 54 \frac{\text{km}}{\text{hr}} = 54 \times \frac{5}{18} = 15 \text{ m/s}$$

Velocity of train B w.r.t. train A = $\vec{V}_B - \vec{V}_A$

$$= 15 - (-25) \text{ m/s}$$

$$= 40 \text{ m/s}$$

$$\text{Time of crossing} = \frac{\text{length of train}}{\text{relative velocity}}$$

$$(8) = \frac{\ell}{40}$$

$$\ell = 8 \times 40 = 320 \text{ meter.}$$

7. (b) As gas is suddenly compressed, the processes is adiabatic.

Equation of gas for adiabatic process is $PV^\gamma = \text{constant}$.

$$\Rightarrow P_1 V_1^\gamma = P_2 V_2^\gamma$$

$$\Rightarrow P_0 V_0^\gamma = P_2 \left(\frac{V_0}{4}\right)^\gamma$$

$$\Rightarrow P_2 = P_0 (4)^\gamma$$

8. (d) Terminal velocity of a spherical body in liquid

$$\Rightarrow V_t \propto r^2$$

$$\Rightarrow \frac{\Delta V_t}{V_t} = 2 \cdot \frac{\Delta r}{r}$$

$$\Rightarrow \frac{\Delta V_t}{V_t} \times 100\% = 2 \frac{(0.1)}{5} \times 100 = 4\%$$

$$\text{Also } V_t \propto r^2$$

Reason R is false

9. (b) Direction of propagation of EM wave will be in the direction of $\vec{E} \times \vec{B}$.

10. (d) Distance (s) = $(2.5)t^2$

$$\text{Speed (v)} = \frac{ds}{dt} = \frac{d}{dt} \{(2.5)t^2\}$$

$$v = 5t$$

$$\text{At } t = 5, v = 5 \times 5 = 25 \text{ m/s.}$$

11. (a) $\vec{F} = -e(\vec{v} \times \vec{B})$

Force will be along -ve y-axis.

As magnetic force is $\perp$ to velocity, path of electron must be a circle.

$$12. (c) g = \frac{GM}{R^2} = \frac{4}{3} \pi G \rho R$$

$$\therefore \frac{g_2}{g_1} = \frac{\rho_2}{\rho_1} \times \frac{R_2}{R_1} = \frac{1}{2} \times 1.5 = \frac{3}{4}$$

13. (a) For resonance, $\phi = 0$, hence both inductor & capacitor must be present. Also, power factor is zero for pure inductor or pure capacitor hence both the component consumes zero average power.

$$14. (a) F_c = m\omega^2 r = 200 \times (0.2)^2 \times 70 = 560 \text{ N}$$

$$15. (b) \text{ Minimum length of antenna should be } \frac{\lambda}{4}.$$

16. (a)

UV rays have maximum frequency hence are most effective for emission of electrons from a metallic surface.

$$KE_{\max} = hf - hf_0$$

17. (b) Divide $q = 10\mu\text{C}$ into two parts x & $q - x$.

$$F = \frac{Kx(q-x)}{r^2}$$

For F to be maximum

$$\frac{dF}{dx} = \frac{K}{r^2} (q - 2x) = 0$$

$$x = \frac{q}{2}$$

18. (a)

X and $\frac{a}{y^2}$ have same dimensions

Y and b have same dimensions

$$\therefore [a] = [ML^5 T^{-2}]$$

$$[b] = [L^3]$$

$$\frac{[a]}{[b]} = [ML^2 T^{-2}] \text{ has dimensions of energy}$$

$$19. (b) \text{ Given that } \frac{A_1}{A_2} = \frac{2}{1}$$

$$\frac{I_{\max}}{I_{\min}} = \left(\frac{A_1 + A_2}{A_1 - A_2} \right)^2 = \frac{9}{1} = 9:1$$

20. (b) Mean free path

$$\lambda = \frac{RT}{\sqrt{2} \pi d^2 N_A P}$$

$$\lambda \propto T$$

$$\frac{1500 \text{ d}}{\lambda} = \frac{273}{373}$$

$$\lambda = 2049 \text{ d}$$

21. (5)



Let power of each part is P_1 , then

$$P_1 + P_1 = P = \frac{1}{f}$$

$$2P_1 = \frac{1}{0.1} = 10$$

$$P_1 = 5 \text{ D}$$

22. (4125)

$$E = E_1 - E_2 = \frac{hc}{\lambda_1} - \frac{hc}{\lambda_2} = hc \left(\frac{1}{\lambda_1} - \frac{1}{\lambda_2} \right)$$

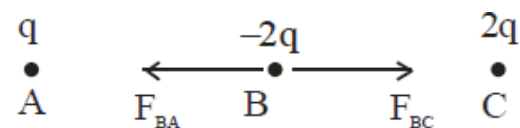
$$= 6.6 \times 10^{-34} \times 3 \times 10^8 \left(\frac{1}{500 \times 10^{-9}} - \frac{1}{600 \times 10^{-9}} \right)$$

$$= 6.6 \times 10^{-20} \text{ J}$$

$$= \frac{6.6 \times 10^{-20}}{1.6 \times 10^{-19}} \text{ eV} = 4.125 \times 10^{-1} \text{ eV}$$

$$= 4125 \times 10^{-4} \text{ eV}$$

23. (5440)



$$F_{BA} = \frac{Kq(2q)}{\left(\frac{3}{4}R\right)^2} = \frac{32Kq^2}{9R^2}$$

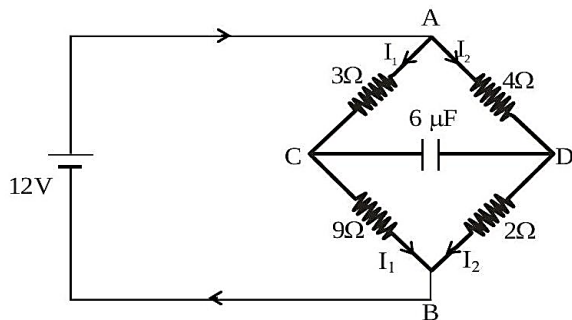
$$F_{BC} = \frac{K(2q)(2q)}{\left(\frac{R}{4}\right)^2} = \frac{64Kq^2}{R^2}$$

$$F_B = F_{BC} - F_{BA} = \frac{544Kq^2}{9R^2}$$

$$= \frac{544 \times 9 \times 10^9 \times (2 \times 10^{-6})^2}{9 \times (2 \times 10^{-2})^2} = 5440 \text{ N}$$

$$24. (75) I_1 = \frac{12}{3+9} = 1 \text{ A}$$

$$I_2 = \frac{12}{4+2} = 2 \text{ A}$$



$$V_A - V_C = 3I_1 = 3 \text{ V}$$

$$V_A - V_D = 2 \times 4 = 8 \text{ V}$$

Subtracting eq. (1) from eq. (2)

$$V_C - V_D = 5 \text{ V} \Rightarrow V = 5 \text{ V}$$

$$U = \frac{1}{2} CV^2 = \frac{1}{2} \times 6 \times 5^2 = 75 \mu\text{J}$$

25. (60)

$$\Delta Q = -\frac{\Delta \Phi}{R} = -\left(\frac{\Phi_2 - \Phi_1}{R}\right)$$

$$\Phi_1 = NBA$$

$$\Phi_2 = -NBA$$

$$\therefore \Delta Q = \frac{2NBA}{R} = \frac{2 \times 100 \times 1.5 \times 24 \times 10^{-4}}{12}$$

$$= 6 \times 10^{-2} \text{ C} = 60 \text{ mC}$$

$$26. (500) f = \frac{1}{2\ell} \sqrt{\frac{T}{\mu}} \quad (T: \text{Tension})$$

$$\frac{f_2}{f_1} = \sqrt{\frac{T_2}{T_1}}$$

$$\left(\frac{50}{30}\right)^2 = \frac{mg}{180 \text{ g}} \Rightarrow m = \frac{25}{9} \times 180 = 500 \text{ gram}$$

27. (15) $\tau = I\alpha$

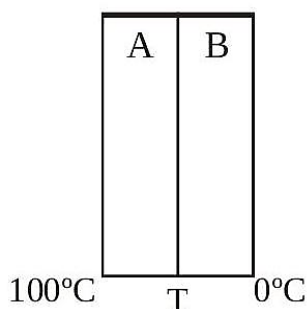
$$\Rightarrow FR = mR^2\alpha$$

$$\alpha = \frac{F}{mR} = \frac{52.5}{5 \times 0.7} = 15 \text{ rad s}^{-2}$$

28. (3) $E_1 = \frac{1}{2}mu^2 - 0 = \frac{1}{2}mu^2 = E$

$$E_2 = \frac{1}{2}m(2u)^2 - \frac{1}{2}mu^2 = \frac{3}{2}mu^2 = 3E$$

29. (40)



Let the temperature of contact surface is T, then $H_A = H_B$

$$\frac{K_A A (T_A - T)}{L} = \frac{K_B A (T - T_B)}{L}$$

$$84(100 - T) = 126(T - 0)$$

$$2(100 - T) = 3T$$

$$200 - 2T = 3T$$

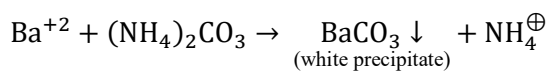
$$T = 40^\circ\text{C}$$

30. (2) For equilibrium

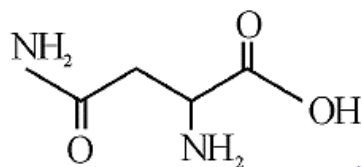
$$Mg = I\ell B$$

$$I = \frac{mg}{\ell B} = \frac{40 \times 10^{-3} \times 10}{50 \times 10^{-2} \times 0.4} = 2 \text{ A}$$

31. (b) In wet testing, $(\text{NH}_4)_2\text{CO}_3$ is used as group reagent for 5th group cations (Ba^{2+} , Ca^{2+} , Sr^{2+})



32. (c) Asparagine has only one basic functional group in its chemical structure.



Others are basic amino acid with more than one basic functional group.

33. (a) Statement I is correct, Ellingham diagram can be constructed for formation of oxides, sulphides and halides of metals.

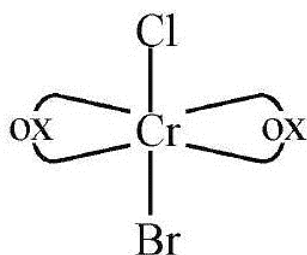
Statement II is incorrect because Ellingham diagram consists of $\Delta_f G^\circ$ vs T for formation of oxides of elements.

34. (c) Tyndall effect is observed only when the following two conditions are satisfied

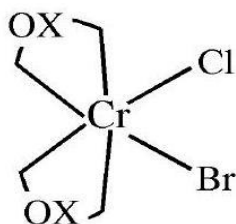
- (a) The diameter of the dispersed particle is not much smaller than the wave length of light used.
(b) Refractive indices of dispersed phase and dispersion medium differ greatly in magnitude.

35. (b) $[\text{Cr}(\text{Ox})_2\text{ClBr}]^{-3}$

No. of isomers -

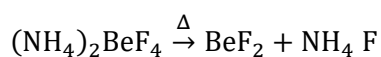


This structure has plane of symmetry, so no optical isomerism will be shown.

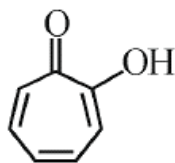


This structure does not contain plane of symmetry, so two forms as well as 1 will be shown.

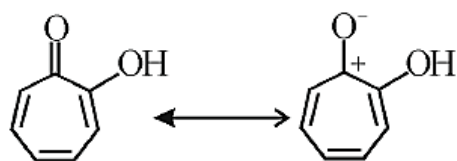
36. (a) As per NCERT (s block), the better method of preparation of BeF_2 is heating $(\text{NH}_4)_2\text{BeF}_4$



37. (b) Since the isotopes have the same electronic configuration, they have almost same chemical properties. The only difference is in their rates of reactions, mainly due to their different enthalpy of bond dissociation.

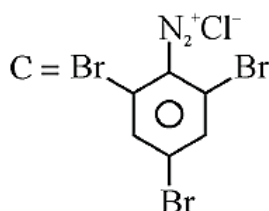
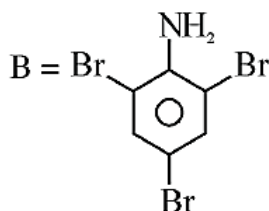
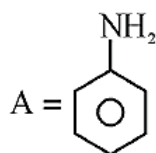


38. (b) Tropolone is an aromatic compound and has 8π electrons ($6\pi e^-$ are endocyclic and $2\pi e^-$ are exocyclic) and π electrons of $> \text{C}=\text{O}$ group in tropolone is not involved in aromaticity.

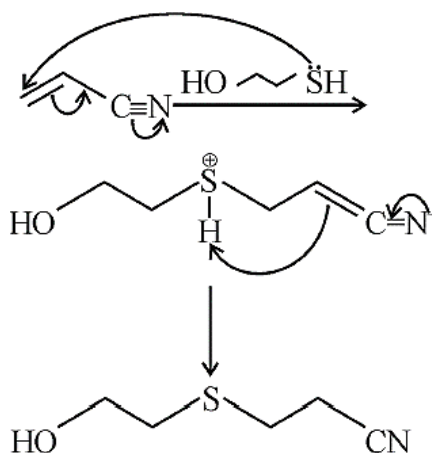


aromatic compound ($6\pi e^-$)

39. (d)



40. (a)



41. (d) Greenhouse gases are CO_2 , CH_4 , water vapour, nitrous oxide, CFC_s and ozone.

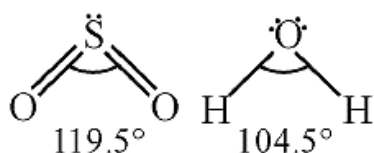
42. (b) Hexamethylenediamine on reaction with adipic acid forms Nylon 6, 6 which shows H-bonding due to presence of amide group.

$\text{AlEt}_3 + \text{TiCl}_4$ is Ziegler-Natta catalyst used to prepare high density polyethylene.

2-chloro-1, 3-butadiene (chloroprene) is monomer of neoprene which is a rubber (an elastomer)

Phenol - formaldehyde forms Bakelite which is heavily branched (cross-linked) polymer

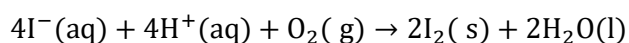
43. (b)



Both are bent in shape.

Bond angle of $\text{SO}_2(\text{sp}^2)$ is greater than that of $\text{H}_2\text{O}(\text{sp}^3)$ due to higher repulsion of multiple bonds.

44. (d) Only I^- among halides can be oxidised to Iodine by oxygen in acidic medium



45. (a) Adiabatic boundary does not allow heat exchange thus heat generated in container can't escape out thereby increasing the temperature.

In case of Diathermic container, heat flow can occur to maintain the constant temperature.

46. (c) Acidic strength $\propto -I$ effect

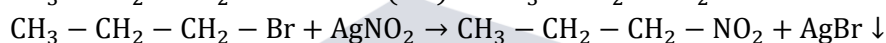
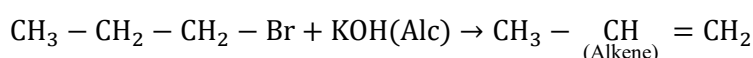
$$\propto \frac{1}{+I} \text{ effect}$$

F, Cl exerts $-I$ effect, Methyl exerts $+I$ effect, C is least acidic.

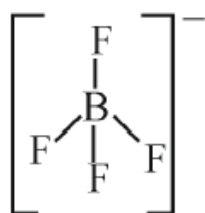
Among A and B; since inductive effect is distance dependent, Extent of $-I$ effect is higher in A followed by B even though F is stronger electron withdrawing group than Cl. Thus, A is more acidic than B.

47. (a) For a given metal $\Delta_f H^\circ$ always becomes less negative from fluoride to iodide.

48. (b)

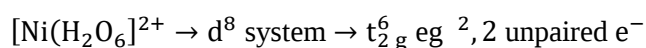
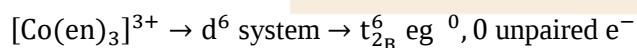


49. (a)



Number of covalent bond formed by Boron is 4 Oxidation number of fluorine is -1, Oxidation number of B + 4 $\times$ (-1) = -1, Thus, Oxidation number of B = +3

50. (b) Complex with maximum number of unpaired electron will exhibit maximum attraction to an applied magnetic field



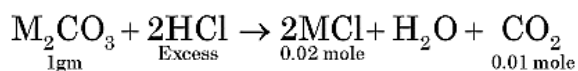
$$51. (40) \text{ mole of AgBr} = \frac{0.376}{188}$$

$$\text{mole of Br}^- = \text{mole of AgBr} = \frac{0.376}{188}$$

$$\text{mass of Br}^- = \frac{0.376}{188} \times 80$$

$$\% \text{ of Br}^- = \frac{0.376 \times 80}{188 \times 0.4} \times 100 = 40\%$$

52. (100)



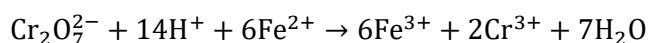
From principle of atomic conservation of carbon atom,

$$\text{Mole of M}_2\text{CO}_3 \times 1 = \text{Mole of CO}_2 \times 1$$

$$\frac{1\text{gm}}{\text{molar mass of M}_2\text{CO}_3} = 0.01 \times 1$$

$$\therefore \text{Molar mass of M}_2\text{CO}_3 = 100\text{gm/mole}$$

53. (23)



$$x = 14$$

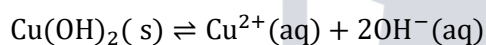
$$y = 2$$

$$z = 7$$

$$\text{Hence } (x + y + z) = 14 + 2 + 7 = 23$$

54. (17) Formula of borax is $\text{Na}_2\text{B}_4\text{O}_5(\text{OH})_4 \cdot 8\text{H}_2\text{O}$

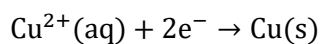
55. (25)



$$K_{\text{sp}} = [\text{Cu}^{2+}][\text{OH}^-]^2$$

$$\text{pH} = 14; \text{pOH} = 0; [\text{OH}^-] = 1\text{M}$$

$$\therefore [\text{Cu}^{2+}] = \frac{K_{\text{sp}}}{[1]^2} = 10^{-20}\text{M}$$



$$E = E^\circ - \frac{0.059}{2} \log_{10} \frac{1}{[\text{Cu}^{2+}]}$$

$$= 0.34 - \frac{0.059}{2} \log_{10} \frac{1}{10^{-20}}$$

$$= -0.25 = -25 \times 10^{-2}$$

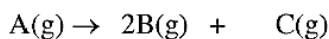
56. (448)

57. (2200)

$$t_{\frac{1}{2}} = 10 \text{ minutes}$$

$$(P_A)_{30\text{min}} = (P_A)_0 \left(\frac{1}{2}\right)^{30/10}$$

$$(P_A)_{30\text{min}} = 100 \text{ mmHg}$$



$$\text{at } t = 0 \quad 800\text{mm} \quad 0 \quad 0$$

$$\text{at } t = 30 \quad 100\text{mm} \quad 1400\text{mm} \quad 700\text{mm}$$

Total pressure after 30 minutes = 2200 mmHg

58. (0) Orbital angular momentum = $\sqrt{1(1+1)} \frac{h}{2\pi}$

Value of l for s = 0

59. (17) $\sqrt{3}a = 4r$

$$\sqrt{3} \times 4 = 4r$$

$$r = 1.732\text{\AA}$$

$$= 17.32 \times 10^{-1}$$

60. (116)

$$\text{Amount of solvent} = 100 - (29.25 + 19) = 51.75 \text{ g}$$

$$\Delta T_b = \left[\frac{2 \times 29.25 \times 1000}{58.5 \times 51.75} + \frac{3 \times 19 \times 1000}{95 \times 51.75} \right] \times 0.52$$

$$\Delta T_b = 16.075$$

$$\Delta T_b = (T_b)_{\text{solution}} - (T_b)_{\text{solvent}}$$

$$(T_b)_{\text{solution}} = 100 + 16.07$$

$$= 116.07^\circ\text{C}$$

61. (a)

$$\begin{vmatrix} 2 & 1 & -1 \\ 2 & -5 & \lambda \\ 1 & 2 & -5 \end{vmatrix} = 0$$

$$2(25 - 2\lambda) - (-10 - \lambda) - (4 + 5) = 0$$

$$50 - 4\lambda + 10 + \lambda - 9 = 0$$

$$51 = 3\lambda \Rightarrow \lambda = 17$$

$$\begin{vmatrix} 2 & 1 & 5 \\ 2 & -5 & \mu \\ 1 & 2 & 7 \end{vmatrix} = 0$$

$$2(-35 - 2\mu) - (14 - \mu) + 5(4 + 5) = 0$$

$$-70 - 4\mu - 14 + \mu + 45 = 0$$

$$\Rightarrow -3\mu = 39$$

$$-\mu = 13$$

$$(\lambda + \mu)^2 + (\lambda - \mu)^2 = 2(\lambda^2 + \mu^2)$$

$$= 2(17^2 + 13^2) = 916$$

62. (c) $\left(2x^3 - \frac{1}{3x^2}\right)^5$

$$T_{r+1} = {}^5C_r (2x^3)^{5-r} \left(\frac{-1}{3x^2}\right)^r = {}^5C_r \frac{(2)^{5-r}}{(-3)^r} (x)^{15-5r}$$

$$\therefore 15 - 5r = 5$$

$$\therefore r = 2$$

$$T_3 = 10 \left(\frac{8}{9}\right) x^5$$

So, coefficient is $\frac{80}{9}$

63. (c) Points $(0, -1, 2)$ and $(-1, 2, 1)$ parallel to the line of $(5, 1, -7)$ and $(1, -1, -1)$

$$\text{Nector} = \begin{vmatrix} i & j & k \\ 4 & 2 & -6 \\ -1 & 3 & -1 \end{vmatrix}$$

$$\vec{n} = 16\hat{i} + 10\hat{j} + 14\hat{k}$$

$$16x + 10y + 14z = d$$

Point $(0, -1, 2)$

$$0 - 10 + 28 = d \Rightarrow d = 18$$

$8x + 5y + 7z = 9$ is equation of plane.

64. (d) $x^2 - \sqrt{2}x + 2 = 0$

$$x = \frac{\sqrt{2} \pm \sqrt{2-8}}{2} = \frac{\sqrt{2} \pm \sqrt{6}i}{2}$$

$$\alpha = \frac{\sqrt{2} + \sqrt{6}i}{2} = \sqrt{2}e^{\frac{i\pi}{3}} \& \beta = \sqrt{2}e^{\frac{-i\pi}{3}}$$

$$\alpha^{14} = 2^7 e^{\frac{i14\pi}{3}} = 128 \left[e^{\frac{i2\pi}{3}} \right]$$

$$\beta^{14} = 128 \left[e^{\frac{-i2\pi}{3}} \right]$$

$$\alpha^{14} + \beta^{14} = 128(b) \cos\left(\frac{2\pi}{3}\right) = -128$$

65. (d) $ar^5 + ar^7 = 2$

$$(ar^2)(ar^4) = \frac{1}{9}$$

$$a^2 r^6 = \frac{1}{9}$$

Now, $r > 0$

$$ar^5(1 + r^2) = 2$$

Now, $ar^3 = \frac{1}{3}$ or $-\frac{1}{3}$ (rejected)

$$r^2 = 2$$

$$r = \sqrt{2}$$

$$a = \frac{1}{6\sqrt{2}}$$

$$\text{Now, } 6(a_2 + a_4)(a_4 + a_6)$$

$$6(ar + ar^3)(ar^3 + ar^5)$$

$$6a^2r^4(1 + r^2)$$

$$6\left(\frac{1}{36 \cdot 2}\right)(d)(9) = 3$$

66. (b) upon solving we get coordinates as (6,8), (1,2) and (5, -7)

So centroid: (α, β) is

$$\alpha = \frac{6 + 1 + 5}{3} = 4$$

$$\beta = \frac{8 + 2 - 7}{3} = 1$$

$$\alpha + 2\beta = 6$$

$$2\alpha - \beta = 7$$

$$\text{Ans. } x^2 - 13x + 42 = 0$$

67. (d) $|\vec{a}| = 2, |\vec{b}| = 3$

$$|(\vec{a} + 2\vec{b}) \times (2\vec{a} - 3\vec{b})|^2$$

$$|-3\vec{a} \times \vec{b} + 4\vec{b} \times \vec{a}|^2$$

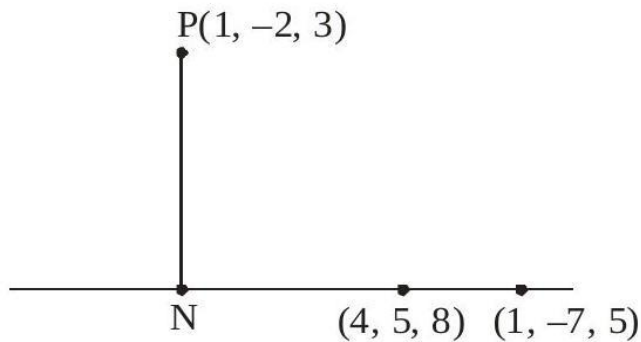
$$|-3\vec{a} \times \vec{b} - 4\vec{a} \times \vec{b}|^2$$

$$|-7\vec{a} \times \vec{b}|^2$$

$$\left(-7|\vec{a}| \times |\vec{b}| \sin\left(\frac{\pi}{4}\right)\right)^2$$

$$49 \times 4 \times 9 \times \frac{1}{2} = 882$$

68. (c)



Equation of line

$$\frac{x-4}{4-1} = \frac{y-5}{5-(-7)} = \frac{z-8}{8-5}$$

$$\frac{x-4}{3} = \frac{y-5}{12} = \frac{z-8}{3}$$

Let point N(3λ + 4, 12λ + 5, 3λ + 8)

$$\overrightarrow{PN} = (3\lambda + 4 - 1)\hat{i} + (12\lambda + 5 - (-2))\hat{j} + (3\lambda + 8 - 3)\hat{k}$$

$$\overrightarrow{PN} = (3\lambda + 3)\hat{i} + (12\lambda + 7)\hat{j} + (3\lambda + 5)\hat{k}$$

And parallel vector to line (say $\vec{a} = 3\hat{i} + 12\hat{j} + 3\hat{k}$)

Now, $\overrightarrow{PN} \cdot \vec{a} = 0$

$$(3\lambda + 3)3 + (12\lambda + 7)12 + (3\lambda + 5)3 = 0$$

$$162\lambda + 108 = 0 \Rightarrow \lambda = \frac{-108}{162} = \frac{-2}{3}$$

So point N is (2, -3, 6)

$$\text{Now distance is } = \left| \frac{2(b) - 2(-3) + 6 + 5}{\sqrt{4+4+1}} \right| = 7$$

69. (c)

$$\lim_{x \rightarrow 0} \frac{e^{ax} - \cos(bx) - \frac{cx e^{-cx}}{2}}{\frac{(1 - \cos 2x)}{4x^2} \times 4x^2} = 17$$

On expansion,

$$\lim_{x \rightarrow 0} \frac{\left(1 + ax + \frac{a^2 x^2}{2}\right) - \left(1 - \frac{b^2 x^2}{2}\right) - \frac{cx}{2}(1 - cx)}{2x^2} = 17$$

$$\lim_{x \rightarrow 0} \frac{\left(a - \frac{c}{2}\right)x + x^2 \left(\frac{a^2}{2} + \frac{b^2}{2} + \frac{c^2}{2}\right)}{2x^2} = 17$$

For limit to be exist $a - \frac{c}{2} = 0$

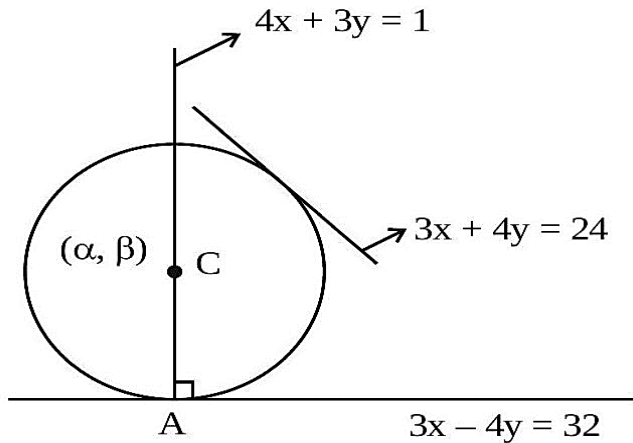
$$a = \frac{c}{2}$$

$$\text{and } \frac{a^2 + b^2 + c^2}{4} = 17$$

$$a^2 + b^2 + 4a^2 = 17 \times 4$$

$$5a^2 + b^2 = 68$$

70. (7)



First find point A by solving $4x + 3y = 1$ and $3x - 4y = 32$

After solving, point A is $(4, -5)$

centre (α, β) lie on $4x + 3y = 1$

$$4\alpha + 3\beta = 1 \Rightarrow \beta = \frac{1 - 4\alpha}{3}$$

Now distance from centre to line $3x - 4y - 32 = 0$ and $3x + 4y - 24 = 0$ are equal.

$$\left| \frac{3\alpha - 4\left(\frac{1 - 4\alpha}{3}\right) - 32}{5} \right| = \left| \frac{3\alpha + 4\left(\frac{1 - 4\alpha}{3}\right) - 24}{5} \right|$$

after solving $\alpha = 1$ and $\alpha = \frac{28}{3}$

For $\alpha = 1$, centre $(1, -1) \Rightarrow \text{radius} = 5$

For $\alpha = \frac{28}{3}$, centre $\left(\frac{28}{3}, \frac{-109}{2}\right)$

$\Rightarrow \text{radius} \approx 49.78$ (rejected)

Hence, $\alpha = 1, \beta = -1, r = 5$

$$\alpha - \beta + r = 7$$

71. (a)

First arrange in alphabetical order i.e. ADMNOY

$$A_{\text{-----}} = 5!$$

$$D_{\text{-----}} = 5!$$

$$MA_{\text{-----}} = 4!$$

$$MD_{\text{-----}} = 4!$$

$$MN_{\text{-----}} = 4!$$

$$MA_{\text{----}} = 3!$$

$$MOD_{\text{---}} = 3!$$

$$MONA_{\text{--}} = 2!$$

$$\begin{array}{cccccc} M & O & N & D & A & Y \\ \hline \end{array}$$

$$= 327$$

72. (b)

$$f(x) = 4\sin^{-1}\left(\frac{x^2}{x^2 + 1}\right)$$

$$\frac{x^2 + 1 - 1}{x^2 + 1} = 1 - \frac{1}{x^2 + 1} \Rightarrow [0, 1)$$

$$\text{Range of } f(x) = [0, 2\pi)$$

73. (a) $(p \wedge (\sim q) \vee ((\sim p) \wedge q) \vee ((\sim p) \wedge (\sim q)))$

$$(p \wedge (\sim q)) \vee ((\sim p) \wedge (q \vee (\sim q)))$$

$$(p \wedge (\sim q)) \vee ((\sim p) \wedge t)$$

$$(p \wedge (\sim q)) \vee (\sim p)$$

$$(\sim p) \vee (p \wedge \sim q)$$

$$(\sim p \vee p) \wedge (\sim p \vee \sim q)$$

$$t \wedge (\sim p \vee \sim q)$$

$$= \sim p \vee \sim q$$

74. (c)

$$np - npq = 1$$

$$\Rightarrow np^2 = 1$$

$$2^n C_2 p^2 q^{n-2} = 3^n C_1 p q^{n-1}$$

$$\Rightarrow np - p = 3q$$

$$(\therefore q = 1 - p)$$

$$\Rightarrow p = \frac{1}{2}$$

$$\text{Hence } n = 4$$

$$P(x > 1) = 1 - (p(x = 0) + p(x = 1))$$

$$= 1 - \left({}^4C_0 \left(\frac{1}{2} \right)^4 + {}^4C_1 \left(\frac{1}{2} \right)^1 \left(\frac{1}{2} \right)^3 \right) = \frac{11}{16}$$

75. (d)

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

$$|A| = 2,$$

$$1(6 - 1) - 2(2\alpha - 1) + 3(\alpha - 3) = 2$$

$$5 - 4\alpha + 2 + 3\alpha - 9 = 2$$

$$-\alpha - 4 = 0$$

$$\alpha = -4$$

$$8|\text{Adj}(2\text{Adj}(2A))|$$

$$8|\text{Adj}(2 \times 2^2 \text{Adj}(A))|$$

$$8|\text{Adj}(2^3 \text{Adj} A)|$$

$$8|2^6 \text{Adj}(\text{Adj} A)|$$

$$2^3(2^6)^3 |\text{Adj}(\text{Adj})|$$

$$2^3 \cdot 2^{18} |A|^4$$

$$2^{21} \cdot 2^4 = 2^{25} = (2^5)^5 = (32)^5$$

$$n = 5$$

$$\alpha = -4$$

76. (b) Let $Z = x + iy, x \in R, y \in R$

$$x - iy = i(x^2 - y^2 + (2xy)i + x)$$

$$x = -2xy$$

$$-y = -y^2 + x^2 + x$$

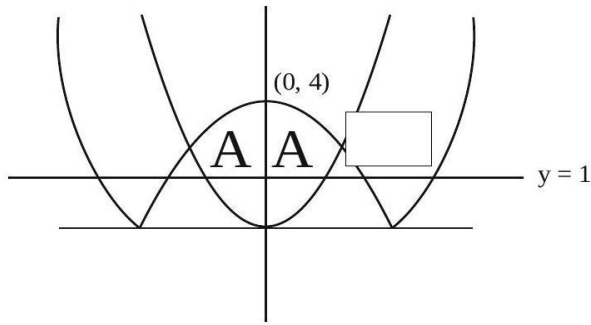
$$\Rightarrow x = 0, y = -\frac{1}{2} \text{ (from (1))}$$

$$\text{If } x \neq 0, \text{ then } y = 0, 1$$

$$\text{If } y = -\frac{1}{2}, \text{ then } x = \frac{1}{2}, -\frac{3}{2}$$

$$Z = 0 + i0, 0 + i, \frac{1}{2} - \frac{i}{2}, -\frac{3}{2} - \frac{i}{2}$$

77. (b)



$$\text{Required area} = 2 \left[\int_1^2 \sqrt{y} dy + \int_2^4 \sqrt{4-y} dy \right] = \frac{4}{3} [4\sqrt{2} - 1]$$

78. (a) $\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{CA} = \vec{0}$

$$\alpha = 2, \beta = 4, \gamma - \delta = 3$$

$$\frac{1}{2} |\overrightarrow{AB} \times \overrightarrow{AC}| = 5\sqrt{6}$$

$$(\delta - 9)^2 + (2\delta + 12)^2 + 100 = 600$$

$$\Rightarrow \delta = 5, \gamma = 8$$

$$\text{Hence } \overrightarrow{CB} \cdot \overrightarrow{CA} = 60$$

79. (b) Condition of co-planarity

$$\begin{vmatrix} x_2 - x_1 & a_1 & a_2 \\ y_2 - y_1 & b_1 & b_2 \\ z_2 - z_1 & c_1 & c_2 \end{vmatrix} = 0$$

Where a_1, b_1, c_1 are direction cosine of 1st line and a_2, b_2, c_2 are direction cosine of 2nd line.

Now, solving options

Point $(-3, 1, 5)$ & point $(-1, 2, 5)$

$$(a) \begin{vmatrix} -3 & 1 & 5 \\ 1 & 2 & 5 \\ -2 & -1 & 0 \end{vmatrix}$$

$$= -3(5) - (10) + 5(-1 + 4) \\ = -15 - 10 + 15 = -10$$

(b) Point $(-1, 2, 5)$

$$\begin{vmatrix} -3 & 1 & 5 \\ -1 & 2 & 5 \\ -2 & -1 & 0 \end{vmatrix}$$

$$= 3(5) - (10) + 5(1 + 4)$$

$$-25 + 25 = 0$$

(c) Point $(-1, 2, 5)$

$$\begin{vmatrix} -3 & 1 & 5 \\ -1 & 2 & 4 \\ -2 & -1 & 0 \end{vmatrix}$$

$$-3(d) - (8) + 5(1 + 4)$$

$$-12 - 8 + 25 = 5$$

(d) Point $(-1, 2, 5)$

$$\begin{vmatrix} -3 & 1 & 5 \\ -1 & 2 & 5 \\ 4 & 1 & 0 \end{vmatrix}$$

$$-3(-5) - (-20) + 5(-1 - 8)$$

$$15 + 20 - 45 = -10$$

80. (a)

$$\int_0^{\pi/4} e^{-x} \tan^{50} x dx$$

$$[-e^{-x} (\tan x)^{50}]_0^{\pi/4} + \int_0^{\pi/4} e^{-x} (50) (\tan x)^{49} \sec^2 x$$

$$= -e^{-\pi/4} + 0 + 50 \int_0^{\pi/4} e^{-x} (\tan x)^{49} (\tan^2 x + 1)$$

$$= -e^{-\pi/4} + 50 \left(\int_0^{\pi/4} e^{-x} (\tan x)^{51} + (\tan x)^{49} \right) dx$$

$$\text{Now, } \frac{-e^{-\pi/4} + \int_0^{\pi/4} e^{-x} (\tan x)^{50} dx}{\int_0^{\pi/4} e^{-x} (\tan^{49} x + \tan^{51} x) dx}$$

$$\frac{50 \int_0^{\pi/4} e^{-x} ((\tan x)^{51} + (\tan x)^{49}) dx}{\int_0^{\pi/4} e^{-x} (\tan^{49} x + \tan^{51} x) dx} = 50$$

81. (269) $\bar{x} = 50$

$$\sum x_i = 500$$

$$\sum x_{i \text{ correct}} = 500 + 20 + 25 - 45 - 50 = 450$$

$$\sigma^2 = 144$$

$$\frac{\sum x_i^2}{10} - (50)^2 = 144$$

$$\sum x_{i \text{ correct}}^2 = (144 + (50)^2) \times 10 - (45)^2 - (50)^2 + (20)^2 + (25)^2 = 22940$$

$$\text{Correct variance} = \frac{\sum (x_{i \text{ correct}})^2}{10} - \left(\frac{\sum x_{i \text{ correct}}}{10} \right)^2$$

$$= 2294 - (45)^2$$

$$= 2294 - 2025 = 269$$

82. (7)

$$R = \{(-4,4), (-3,3), (3,-2), (0,1), (0,0), (1,1), (4,4), (3,3)\}$$

$$\text{For reflexive, add } \Rightarrow (-2,-2), (-4,-4), (-3,-3)$$

$$\text{For symmetric, add } \Rightarrow (4,-4), (3,-3), (-2,3), (1,0)$$

83. (10)

$$f(x) = \sum_{k=1}^{10} kx^k$$

$$f(x) = x + 2x^2 + \dots + 10x^{10}$$

$$f(x) \cdot x = x^2 + 2x^3 + \dots + 9x^{10} + 10x^{11}$$

$$f(x)(1-x) = x + x^2 + x^3 + \dots + x^{10} - 10x^{11}$$

$$f(x) = \frac{x(1-x^{10})}{(1-x)^2} - \frac{10x^{11}}{(1-x)}$$

$$f(x) = \frac{x - x^{11} - 10x^{11} + 10x^{12}}{(1-x)^2} \Rightarrow \frac{10x^{12} - 11x^{11} + x}{(1-x)^2}$$

$$\text{Hence } 2f(b) + f'(b) = 119.2^{10} + 1$$

$$\Rightarrow \text{So, } n = 10$$

84. (16) For number to be divisible by '6' unit digit should be even and sum of digit is divisible by 3.

$$(2,1,3), (2,3,4), (2,5,5), (2,2,5), (2,2,2), (4,1,1), (4,4,1), (4,4,4), (4,3,5)$$

$$2, 1, 3 \Rightarrow 312, 132$$

$$2, 3, 4 \Rightarrow 342, 432, 234, 324$$

$$2, 5, 5 \Rightarrow 552$$

$$2, 2, 5 \Rightarrow 252, 522$$

$$2, 2, 2 \Rightarrow 222$$

$$4, 1, 1 \Rightarrow 114$$

$$4, 4, 1 \Rightarrow 414, 144$$

$$4, 4, 4 \Rightarrow 444$$

$$4, 3, 5 \Rightarrow 354, 534$$

Total 16 numbers.

$$85. (825) [\sqrt{1}] + [\sqrt{2}] + [\sqrt{3}] + \dots + [\sqrt{120}]$$

$$\Rightarrow 1 + 1 + 1 + 2 + 2 + 2 + 2 + 2 + 3 + 3 + \dots +$$

$$3 = 7 \text{ times}$$

$$+4 + 4 + \dots + 4 = 9 \text{ times} + \dots + 10 + 10 + \dots + 10 = 21 \text{ times}$$

$$\Rightarrow \sum_{r=1}^{10} (2r+1) \cdot r$$

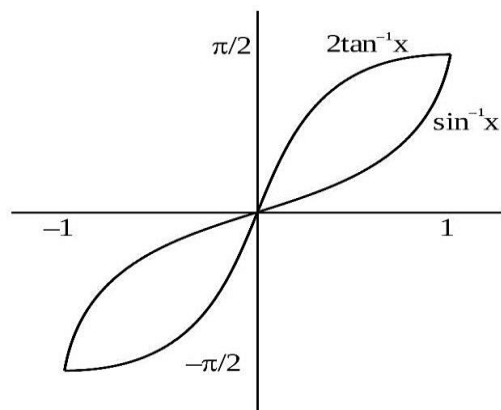
$$\Rightarrow 2 \sum_{r=1}^{10} r^2 + \sum_{r=1}^{10} r$$

$$\Rightarrow 2 \times \frac{10 \times 11 \times 21}{6} + \frac{10 \times 11}{2}$$

$$\Rightarrow 770 + 55$$

$$\Rightarrow 825$$

86. (2)



87. (6)

$$\frac{dy}{dx} + \frac{4x}{(x^2-1)}y = \frac{x+2}{(x^2-1)^{\frac{5}{2}}}, x > 1$$

$$\text{I.F.} = e^{\int \frac{4x}{x^2-1} dx}$$

$$\text{I.F.} = (x^2 - 1)^2$$

$$\Rightarrow d(y \cdot (x^2 - 1)^2) = \frac{x+2}{(x^2-1)^{\frac{5}{2}}} \cdot (x^2-1)^2$$

$$\Rightarrow \int d(y \cdot (x^2 - 1)^2) = \int \frac{x+2}{(x^2-1)^{\frac{1}{2}}} dx$$

$$y(x^2 - 1)^2 = \sqrt{x^2 - 1} + 2\ln(x + \sqrt{x^2 - 1}) + C$$

$$\Rightarrow C = -\sqrt{3}$$

$$\text{So } (x^2 - 1)^2 = \sqrt{x^2 - 1} + 2\ln(x + \sqrt{x^2 - 1}) - \sqrt{3}$$

$$\Rightarrow \alpha\beta\gamma = 6$$

88. (12)

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$

$$ae = 2 \& e = \frac{3}{2} \Rightarrow a = \frac{4}{3}$$

$$\text{also } b^2 = a^2 e^2 - a^2 \Rightarrow 4 - \frac{16}{9} \Rightarrow b^2 = \frac{20}{9}$$

$$\text{Slope of tangent} = \frac{3}{2}$$

So tangent equation will be

$$y = mx \pm \sqrt{a^2 m^2 - b^2}$$

$$\Rightarrow y = \frac{3x}{2} \pm \sqrt{\frac{16}{9} \cdot \frac{9}{4} - \frac{20}{9}}$$

$$\Rightarrow y = \frac{3x}{2} \pm \frac{4}{3} \Rightarrow |x_{\text{intercept}}| = \frac{8}{9}$$

$$|y_{\text{intercept}}| = \frac{4}{3}$$

$$\Rightarrow |6a| + |5b| = \frac{48}{9} + \frac{60}{9} = \frac{108}{9} = 12$$

89. (41)

$$f_n(x) = \int_0^{\frac{\pi}{2}} (1 + \sin x + \sin^2 x + \sin^3 x + \dots + \sin^{n-1} x) \cos x dx$$

$$(1 + 3\sin x + 5\sin^2 x + \dots + (2n-1)\sin^{n-1} x) \sin^{n-1} x \cdot \cos x dx$$

Multiply & divide by $\sqrt{\sin x}$

$$\int_0^{\frac{\pi}{2}} \left((\sin x)^{\frac{1}{2}} + (\sin x)^{\frac{3}{2}} + (\sin x)^{\frac{5}{2}} + (\sin x)^{\frac{7}{2}} + \dots + (\sin x)^{\frac{2n-1}{2}} \right) \cos x dx$$

$$(1 + 3\sin x + 5\sin^2 x + \dots + (2n-1)\sin^{n-1} x) \frac{\cos x}{\sqrt{\sin x}} dx$$

$$\text{Put } (\sin x)^{1/2} + (\sin x)^{3/2} + (\sin x)^{5/2} + \dots + (\sin x)^{n-1/2} = t$$

$$\frac{1}{2} \frac{(1 + 3\sin x + 5\sin^2 x + \dots + (2n-1)\sin^{n-1} x) \cos x}{\sqrt{\sin x}} dx = dt$$

$$f_n = 2 \int_0^n t dt$$

$$f_n = n^2$$

$$\begin{aligned} f_{21} - f_{20} &= (21)^2 - (20)^2 \\ &= 441 - 400 \\ &= 41 \end{aligned}$$

90. (12)

$$7^{103} = 7 \times 7^{102}$$

$$= 7 \times (49)^{51}$$

$$= 7 \times (51 - 2)^{51}$$

$$\text{Remainder: } 7 \times (-2)^{51}$$

$$\Rightarrow -7(2^3 \cdot (16)^{12})$$

$$\Rightarrow -56(17 - 1)^{12}$$

$$\text{Remainder} = -56 \times (-1)^{12} = -56 + 68 = 12$$

