

1. (d)

$$50 V + S = 49 S + S$$

$$S = 50(S - V)$$

$$.5 = 50(S - V)$$

$$S - V = \frac{0.5}{50} = \frac{1}{100} = 0.01 \text{ mm}$$

2. (b) Work done against frictional force

$$= \mu N \times 10$$

$$= 0.1 \times 5 \times 10 = 5 \text{ J}$$

3. (d)

$$\text{K.E.} = hf - \phi$$

$$\tan \theta = h$$

4. (d)

5. (c) $(X) \rightarrow (Y) + (Z) + (P)$

$$M \text{ M/3 M/3 M/3}$$

$$\Delta Mc^2 = \frac{1}{2} \frac{M}{3} V^2 + \frac{1}{2} \frac{M}{3} V^2 + \frac{1}{2} \frac{M}{3} V^2$$

$$V = c \sqrt{\frac{2\Delta M}{M}}$$

6. (a, c)

Steeper curve (B) is adiabatic

$$\text{Adiabatic} \Rightarrow PV^\gamma = \text{const.}$$

$$\text{Or } P \left(\frac{T}{P} \right)^\gamma = \text{const.}$$

$$\frac{T^\gamma}{P^{\gamma-1}} = \text{const.}$$

Curve (A) is isothermal

$$T = \text{const}$$

$$PV = \text{const.}$$

7. (b) Magnetic moment = $i\pi r^2$

$$\mu = \frac{evr}{2}$$

$$\mu\alpha\left(\frac{1}{n}\right)n^2$$

$$\mu\alpha n$$

$$x = 1$$

8. (b) Rising half to peak

$$t = T/6$$

$$t = \frac{2\pi}{6\omega} = \frac{\pi}{3\omega} = \frac{\pi}{300\pi} = \frac{1}{300} = 3.33 \text{ ms}$$

9. (a)

$$\frac{dy}{dx} = \tan \theta = \frac{x}{2} = \mu = \frac{1}{2}$$

$$x = 1, y = 1/4$$

$$10. (b) p = \frac{E}{c} = \frac{6.48 \times 10^5}{3 \times 10^8} = 2.16 \times 10^{-3}$$

11. (a) Intensity of emergent light

$$= \frac{I_0}{2} \cos^2 45^\circ = \frac{I_0}{4}$$

$$12. (d) R_p = \frac{R_E}{3}, M_p = \frac{M_E}{6}$$

$$V_e = \sqrt{\frac{2GM_e}{R_e}}$$

$$V_p = \sqrt{\frac{2GM_p}{R_p}}$$

$$\frac{V_e}{V_p} = \sqrt{2}$$

$$V_p = \frac{V_e}{\sqrt{2}} = \frac{11.2}{\sqrt{2}} = 7.9 \text{ km/sec}$$

13. (b)

$$\frac{2k\lambda q}{r} = m\omega^2 r$$

$$\omega^2 = \frac{2k\lambda q}{mr^2}$$

$$\left(\frac{2\pi}{T}\right)^2 = \frac{2k\lambda q}{mr^2}$$

$$T = 2\pi r \sqrt{\frac{m}{2k\lambda q}}$$

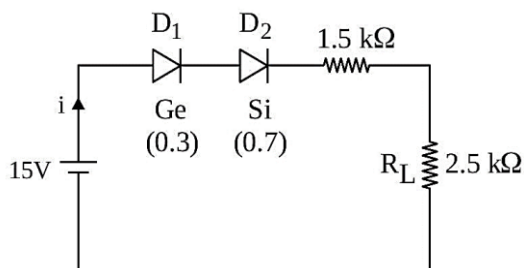
14. (a)

$$m = kc^P G^{-1/2} h^{1/2}$$

$$M^1 L^0 T^0 = [LT^{-1}]^P [M^{-1} L^3 T^{-2}]^{-1/2} [ML^2 T^{-1}]^{1/2}$$

By comparing $P = 1/2$

15. (a)



$$i = \frac{14}{4} = 3.5 \text{ mA}$$

$$V_L = iR_{L_L} = 3.5 \times 2.5 \text{ volt} = 8.75 \text{ volt}$$

16. (c)

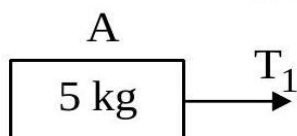
$$f_1 = 3, f_2 = 5$$

$$n_1 = 3, n_2 = 2$$

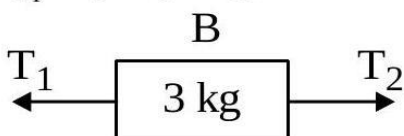
$$f_{\text{mixture}} = \frac{n_1 f_1 + n_2 f_2}{n_1 + n_2} = \frac{9 + 10}{5} = \frac{19}{5}$$

$$\gamma_{\text{mixture}} = 1 + \frac{2 \times 5}{19} = \frac{29}{19} = 1.52$$

17. (a) $a_A = a_B = a_C = \frac{F}{5+3+2} = \frac{80}{10} = 8 \text{ m/s}^2$



$$T_1 = 5 \times 8 = 40$$



$$T_2 - T_1 = 3 \times 8 \Rightarrow T_2 = 64$$

18. (d)

$$\frac{v^2}{R} = W$$

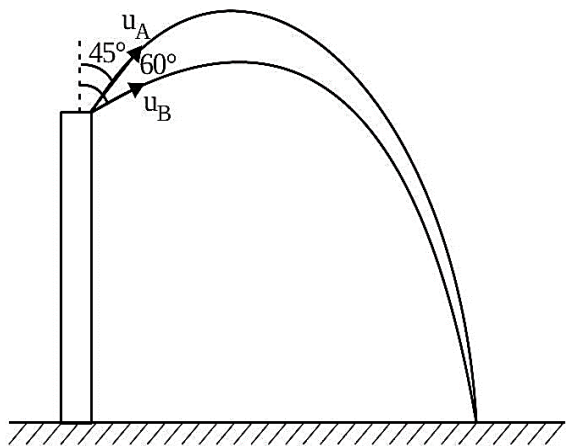
$$\frac{v^2}{\frac{1}{2} \left(\frac{R}{2} \right)} = W'$$

From (i) & (ii), we get

$$W' = 4 W$$

19. (d) Maxwell's equation

20. (d)



For u_A & u_B time of flight and range can not be same. So above options are incorrect.

21. (45)

$$P_i = 2300 \times 5 \text{ watt}$$

$$P_0 = 2300 \times 5 \times 0.9 = 230 \times I_2$$

$$I_2 = 45 \text{ A}$$

22. (10)

$$\rho \left(\frac{4}{3} \pi r^3 \right) 1000 = \frac{4}{3} \pi R^3 \rho$$

$$R = 10r$$

$$E_1 = 1000 \times 4 \pi r^2 \times S$$

$$E_2 = 4 \pi (10r)^2 S$$

$$\frac{E_1}{E_2} = \frac{10}{1}, x = 10$$

23. (24)

$$I_1 \omega_1 + I_2 \omega_2 = (I_1 + I_2) \omega_0 \text{ (C.O.A.M.)}$$

$$\text{gives } \omega_0 = 8 \text{ rad/s}$$

$$E_1 = \frac{1}{2} I_1 \omega_1^2 + \frac{1}{2} I_2 \omega_2^2 = 216 \text{ J}$$

$$E_2 = \frac{1}{2} (I_1 + I_2) \omega_0^2 = 192 \text{ J}$$

$$\therefore \Delta E = 24 \text{ J}$$

24. (20)

$$\frac{1}{f+20} - \frac{1}{-(f+20)} = \frac{1}{f}$$

$$\frac{2}{f+20} = \frac{1}{f} \quad f = 20 \text{ cm}$$

$$\text{Or } x_1 x_2 = f^2 \text{ gives } f = 20 \text{ cm}$$

25. (4)

$$\vec{N} = |\vec{A}| \hat{B} = \frac{5(4\hat{i} + 3\hat{j})}{5} = 4\hat{i} + 3\hat{j}$$

$$\therefore x = 4$$

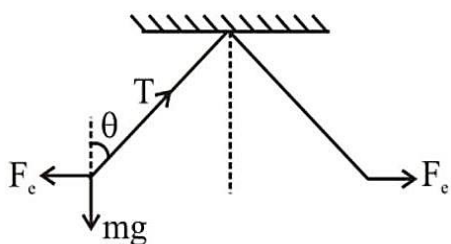
26. (40)

$$B = 4 \times \frac{\mu_0 i}{4\pi(1/2)} \left(\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}} \right)$$

$$= 4 \times 10^{-7} \times 5 \times 2 \times \sqrt{2}$$

$$= 40\sqrt{2} \times 10^{-7} \text{ T}$$

27. (2)



$$T \cos \theta = mg$$

$$T \sin \theta = F_e$$

$$\tan \theta = \frac{F_e}{mg} \quad \tan \theta = \frac{F_e}{\rho_B V g} \dots (i)$$

$$\tan \theta = \frac{F_e}{k} \dots (ii)$$

From Eq. (i) & (ii)

$$\rho_B Vg = (\rho_B - \rho_L)kVg$$

$$1.4 = 0.7k$$

$$k = 2$$

28. (8)

Acceleration due to gravity $g' = \frac{g}{4}$

$$T = 2\pi \sqrt{\frac{4\ell}{g}}$$

$$T = 2\pi \sqrt{\frac{4 \times 4}{g}}$$

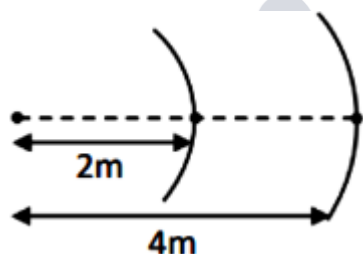
$$T = 2\pi \frac{4}{\pi} = 8 \text{ s}$$

29. (3)

We know for point source, $I \propto \frac{1}{r^2} = \frac{K}{4\pi r^2}$

$$r_1 = 2m, r_2 = 4m = 2r_1$$

$$I_0 = 16 \times 10^{-8} \text{ W/m}^2$$



at 2 m,

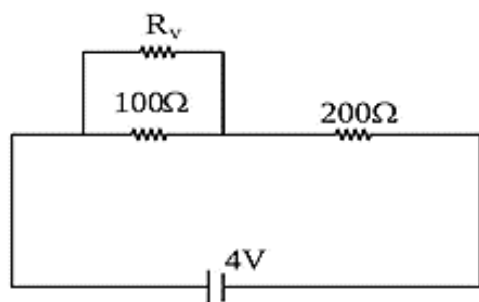
$$I_1 = \frac{I_0}{(2)^2} = \frac{16 \times 10^{-8}}{4}$$

$$I_1 = 4 \times 10^{-8}$$

$$I_2 = \frac{I_0}{4^2} = \frac{16 \times 10^{-8}}{16} = 10^{-8}$$

$$|I_2 - I_1| = 3 \times 10^{-8} \text{ W/m}^2, x = 3$$

30. (200)



$$\frac{R_v \cdot 100}{R_v + 100} = \frac{200}{3}$$

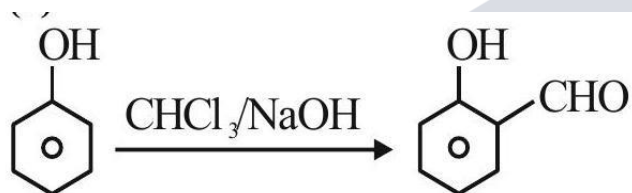
$$3R_v = 2R_v + 200$$

$$R_v = 200$$

31. (d) Different Extraction

Different layers are formed which can be separated in funnel. (Theory based).

32. (d)



33. (d)

Statement - I : Rate of $S_N2 \propto [R-X][Nu^-]$

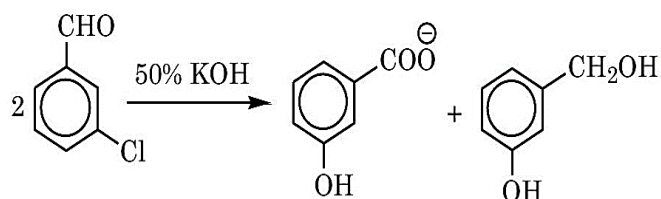
S_N2 reaction is favoured by high concentration of nucleophile (Nu^-) & less crowding in the substrate molecule.

Statement - II: Solvolysis follows S_N1 path.

Both are correct Statements.

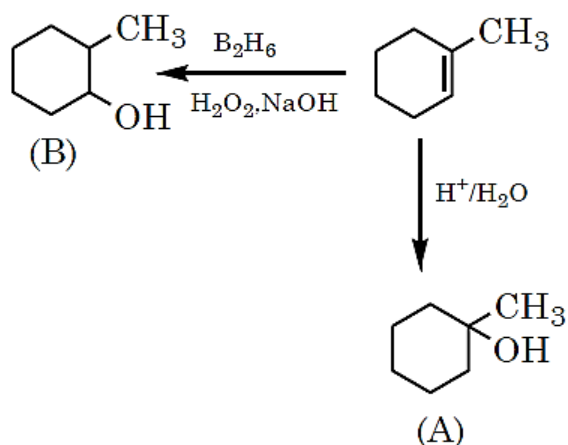
34. (b) Meta-chlorobenzaldehyde will undergo

Cannizzaro reaction with 50%KOH to give m - chlorobenzoate ion and m-chlorobenzyl alcohol.

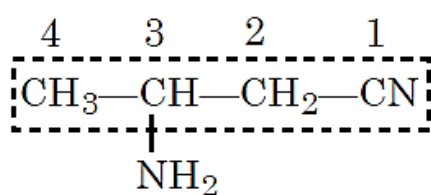


35. (b) Due to lower Bond dissociation enthalpy of H_2Te it ionizes to give H^+ more easily than H_2S .

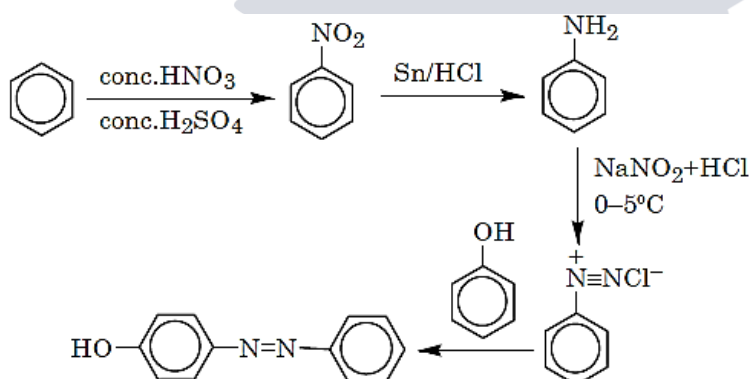
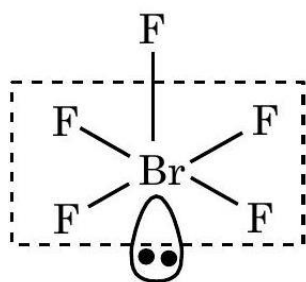
36. (b)



37. (c)

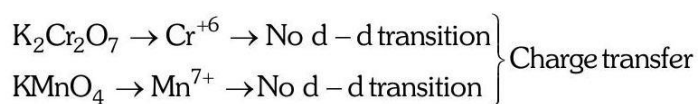


38.(c)

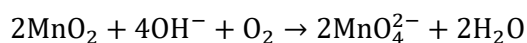

39. (c) BrF_5


Square Pyramidal.

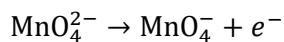
40. (a)



41. (b) Alkaline oxidative fusion of MnO_2 :



Electrolytic oxidation of MnO_4^{2-} in alkaline medium.

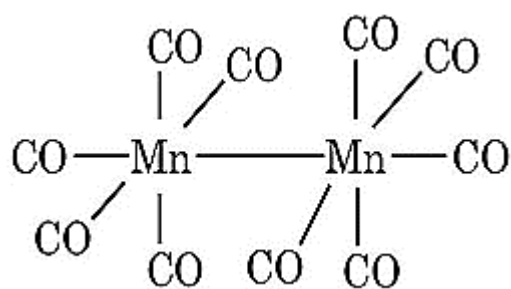


42. (b) Mole fraction of C = $\frac{n_C}{n_A + n_B + n_C}$

43. (c) Chemical reactivity of elements decreases along the period therefore statement –I is false.

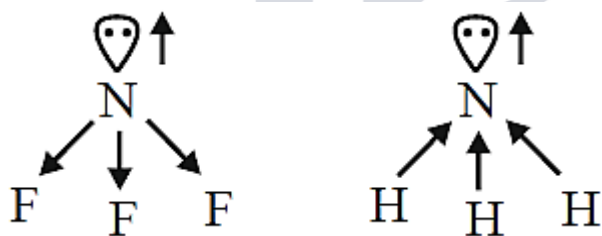
Group - 1 elements form basic nature oxides while group - 17 elements form acidic oxides therefore statement - II is true.

44. (a) $\text{Mn}_2(\text{CO})_{10}$



Octahedral around Mn

45. (b)



46. (c) More no. of hyperconjugable Hydrogens, more stable is the carbocations.

47. (a)

ΔT_f is maximum when $i \times m$ is maximum.

$$(1) m_1 = \frac{180}{60} = 3, i = 1 + \alpha$$

Hence

$$\Delta T_f = (1 + \alpha) \cdot k_f = 3 \times 1.86 = 5.58^\circ\text{C} (\alpha < 1)$$

$$(2) m_2 = \frac{180}{60} = 3, i = 0.5, \Delta T_f = \frac{3}{2} \times k_f' = 7.68^\circ\text{C}$$

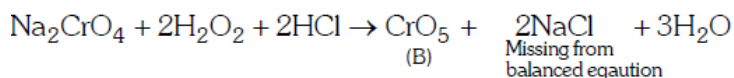
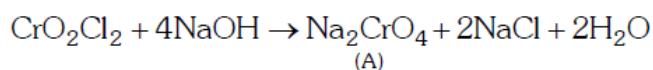
$$(3) m_3 = \frac{180}{122} = 1.48, i = 0.5, \Delta T_f = \frac{1.48}{2} \times k_f' = 3.8^\circ\text{C}$$

$$(4) m_4 = \frac{180}{180} = 1, i = 1, \Delta T_f = 1 \cdot k_f' = 1.86^\circ\text{C}$$

As per NCERT, $k_f'(\text{H}_2\text{O}) = 1.86\text{K} \cdot \text{kgmol}^{-1}$

$k_f'(\text{Benzene}) = 5.12\text{K} \cdot \text{kgmol}^{-1}$

48. (a)



49. (c) On moving down the group, bond strength of M – H bond decreases, which reduces the thermal stability but increases reducing nature of hydrides, hence A and B are correct statements.

50. (b) Higher the value of $\oplus$ ve SRP (Std. reduction potential) more is tendency to undergo reduction, so better is oxidising power of reactant.

Hence, ox. Power: $-\text{BrO}_4^- > \text{IO}_4^- > \text{ClO}_4^-$

51. (4)

cis $-\text{[Cr(ox)}_2\text{Cl}_2\text{]}^{3-} \rightarrow$ can show optical isomerism (no POS & COS)

$[\text{Co(en)}_3]^{3+} \rightarrow$ can show (no POS & COS)

cis $-\text{[Pt(en)}_2\text{Cl}_2\text{]}^{2+} \rightarrow$ can show (no POS & COS)

cis $-\text{[Co(en)}_2\text{Cl}_2\text{]}^+ \rightarrow$ can show (no POS & COS)

trans $-\text{[Pt(en)}_2\text{Cl}_2\text{]}^{2+} \rightarrow$ can't show (contains POS & COS)

trans $-\text{[Cr(ox)}_2\text{Cl}_2\text{]}^{3-} \rightarrow$ can't show (contains POS & COS)

52. (17)

Rate of reaction (ROR)

$$= -\frac{1}{2} \frac{\Delta[\text{N}_2\text{O}_5]}{\Delta t} = \frac{1}{4} \frac{\Delta[\text{NO}_2]}{\Delta t} = \frac{\Delta[\text{O}_2]}{\Delta t}$$

$$\text{ROR} = -\frac{1}{2} \frac{\Delta[\text{N}_2\text{O}_5]}{\Delta t} = -\frac{1}{2} \frac{(2.75 - 3)}{30} \text{ mol L}^{-1} \text{ min}^{-1}$$

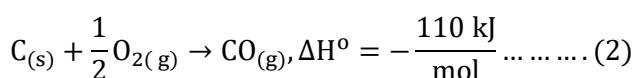
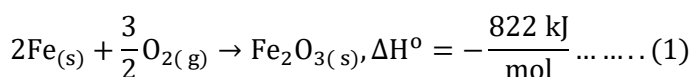
$$\text{ROR} = -\frac{1}{2} \frac{(-0.25)}{30} \text{ mol L}^{-1} \text{ min}^{-1}$$

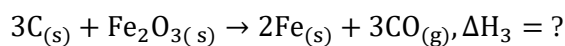
$$\text{ROR} = \frac{1}{240} \text{ mol L}^{-1} \text{ min}^{-1}$$

$$\text{Rate of formation of NO}_2 = \frac{\Delta[\text{NO}_2]}{\Delta t} = 4 \times \text{ROR}$$

$$= \frac{4}{240} = 16.66 \times 10^{-3} \text{ mol L}^{-1} \text{ min}^{-1} \approx 17 \times 10^{-3}.$$

53. (492)





$$(c) = 3 \times (b) - (a)$$

$$\Delta H_3 = 3 \times \Delta H_2 - \Delta H_1$$

$$= 3(-110) + 822$$

$$= 492 \text{ kJ/mole}$$

54. (3)

A. RNA is regarded as the reserve of genetic information. (False)

B. DNA molecule self-duplicates during cell division. (True)

C. DNA synthesizes proteins in the cell. (False)

D. The message for the synthesis of particular proteins is present in DNA. (True)

E. Identical DNA strands are transferred to daughter cells. (True)

55. (1000)

1M Benzoic acid + 1M Sodium Benzoate
(V_a ml) (V_s ml)

Millimole $V_a \times 1$ $V_s \times 1$

pH = 4.5

$$\text{pH} = \text{pKa} + \log \frac{[\text{salt}]}{[\text{acid}]}$$

$$4.5 = 4.2 + \log \left(\frac{V_s}{V_a} \right)$$

$$\frac{V_s}{V_a} = 2 \dots \dots \dots (1)$$

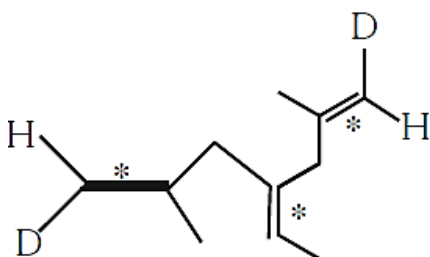
$$V_s + V_a = 300 \dots \dots (2)$$

$$V_a = 100 \text{ ml}$$

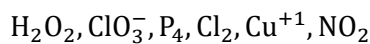
56. (4)

3 stereocenters, symmetrical

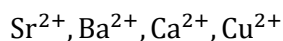
Total Geometrical isomers $\rightarrow$ 4. EE, ZZ, EZ (two isomers)



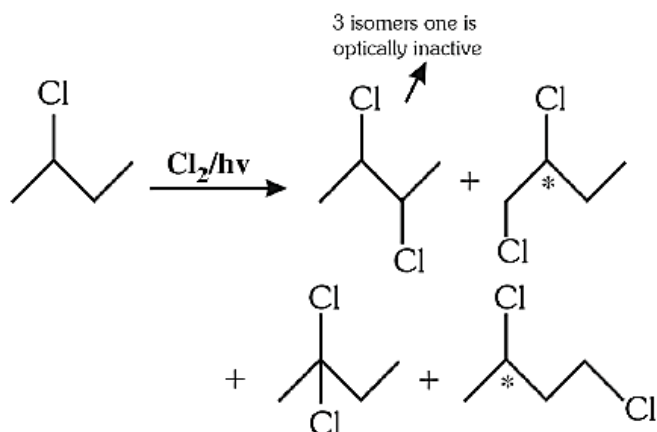
57. (6) Intermediate oxidation state of element can undergo disproportionation.



58. (4) All the following metal ions will respond to flame test.



59. (6)



60. (10)

$$5^{\text{th}} \text{ excited state} \Rightarrow n_1 = 6$$

$$1^{\text{st}} \text{ excited state} \Rightarrow n_2 = 2$$

$$\Delta n = n_1 - n_2 = 6 - 2 = 4$$

Maximum number of spectral lines

$$= \frac{\Delta n(\Delta n + 1)}{2} = \frac{4(4 + 1)}{2} = 10$$

$$61. (d) \begin{vmatrix} 1 & 1 & 1 \\ 1 & 2 & \lambda^2 \\ 1 & 3 & \lambda \end{vmatrix} = 0$$

$$\Rightarrow 2\lambda^2 - \lambda - 1 = 0$$

$$\lambda = 1, -\frac{1}{2}$$

$$\begin{vmatrix} 1 & 1 & 5 \\ 2 & \lambda^2 & 9 \\ 3 & \lambda & \mu \end{vmatrix} = 0 \Rightarrow \mu = 13$$

Infinite solution $\lambda = 1$ & $\mu = 13$

For unique solⁿ $\lambda \neq 1$

For no solⁿ $\lambda = 1$ & $\mu \neq 13$

If $\lambda \neq 1$ and $\mu \neq 13$

Considering the case when $\lambda = -\frac{1}{2}$ and $\mu \neq 13$ this will generate no solution case

$$62. (b) 3\sin \alpha \cos \beta + 3\sin \beta \cos \alpha$$

$$= 2\sin \alpha \cos \beta - 2\sin \beta \cos \alpha$$

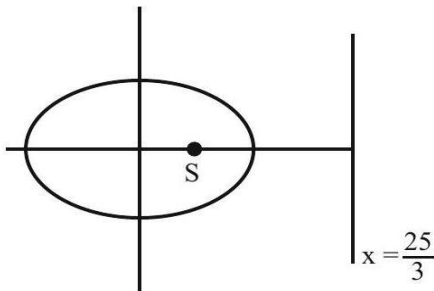
$$5\sin \beta \cos \alpha = -\sin \alpha \cos \beta$$

$$\tan \beta = -\frac{1}{5}\tan \alpha$$

$$\tan \alpha = -5\tan \beta$$

63. (d) $A = (10,0)$

$$B = \left(0, \frac{50}{7}\right) \} P = (3,5)$$



$$ae = 3$$

$$\frac{a}{e} = \frac{25}{3}$$

$$a = 5$$

$$b = 4$$

$$\text{Length of LR} = \frac{2b^2}{a} = \frac{32}{5}$$

64. (a)

$$|\vec{b}|^2 = 6; |\vec{a}||\vec{b}|\cos \theta = 3\sqrt{2}$$

$$|\vec{a}|^2|\vec{b}|^2\cos^2 \theta = 18$$

$$|\vec{a}|^2 = 6$$

$$\text{Also } 1 + \alpha^2 + \beta^2 = 6$$

$$\alpha^2 + \beta^2 = 5$$

to find

$$(\alpha^2 + \beta^2)|\vec{a}|^2|\vec{b}|^2\sin^2 \theta$$

$$= (5)(6)(6)\left(\frac{1}{2}\right)$$

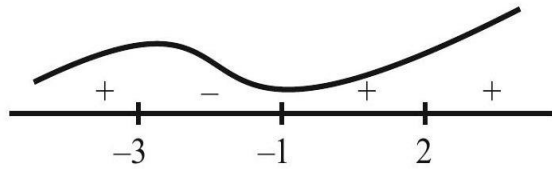
$$= 90$$

65. (c)

$$f'(x) = (x+3)^2 \cdot 3(x-2)^2 + (x-2)^3 \cdot 2(x+3)$$

$$= 5(x+3)(x-2)^2(x+1)$$

$$f'(x) = 0, x = -3, -1, 2$$



$$f(-4) = -216$$

$$f(-3) = 0, f(2) = 49 \times 8 = 392$$

$$M = 392, m = -216$$

$$M - m = 392 + 216 = 608$$

66. (c)

$$1^{\text{st}} \text{ GP} \Rightarrow t_1 = a, t_3 = b = ar^2 \Rightarrow r^2 = \frac{b}{a}$$

$$t_{11} = ar^{10} = a(r^2)^5 = a \cdot \left(\frac{b}{a}\right)^5$$

$$2^{\text{nd}} \text{ G.P.} \Rightarrow T_1 = a, T_5 = ar^4 = b$$

$$\Rightarrow r^4 = \left(\frac{b}{a}\right) \Rightarrow r = \left(\frac{b}{a}\right)^{1/4}$$

$$T_p = ar^{p-1} = a \left(\frac{b}{a}\right)^{\frac{p-1}{4}}$$

$$t_{11} = T_p \Rightarrow a \left(\frac{b}{a}\right)^5 = a \left(\frac{b}{a}\right)^{\frac{p-1}{4}}$$

$$\Rightarrow 5 = \frac{p-1}{4} \Rightarrow p = 21$$

67. (a) Cocus of point P(x, y) whose distance from Giv

$$X + 2y + 7 = 0 \text{ and } 2x - y + 8 = 0 \text{ are equal is } \frac{x+2y+7}{\sqrt{5}} = \pm \frac{2x-y+8}{\sqrt{5}}$$

$$(x + 2y + 7)^2 - (2x - y + 8)^2 = 0$$

Combined equation of lines

$$(x - 3y + 1)(3x + y + 15) = 0$$

$$3x^2 - 3y^2 - 8xy + 18x - 44y + 15 = 0$$

$$x^2 - y^2 - \frac{8}{3}xy + 6x - \frac{44}{3}y + 5 = 0$$

$$x^2 - y^2 + 2hxy + 2gx + 2fy + c = 0$$

$$h = \frac{4}{3}, g = 3, f = -\frac{22}{3}, c = 5$$

$$g + c + h - f = 3 + 5 - \frac{4}{3} + \frac{22}{3} = 8 + 6 = 14$$

68. (b)

$$|\vec{b}| = 1 \text{ and } |\vec{b} \times \vec{a}| = 2$$

$$(\vec{b} \times \vec{a}) \cdot \vec{b} = \vec{b} \cdot (\vec{b} \times \vec{a}) = 0$$

$$|(\vec{b} \times \vec{a}) - \vec{b}|^2 = |\vec{b} \times \vec{a}|^2 + |\vec{b}|^2 \\ = 4 + 1 = 5$$

69. (b)

$$y = f(x) \Rightarrow \frac{dy}{dx} = f'(x)$$

$$\left(\frac{dy}{dx}\right)_{(1, f(a))} = f'(a) = \tan \frac{\pi}{6} = \frac{1}{\sqrt{3}} \Rightarrow f'(a) = \frac{1}{\sqrt{3}}$$

$$\left(\frac{dy}{dx}\right)_{(3, f(c))} = f'(c) = \tan \frac{\pi}{4} = 1 \Rightarrow f'(c) = 1$$

$$27 \int_1^3 ((f'(t))^2 + 1) f''(t) dt = \alpha + \beta\sqrt{3}$$

$$I = \int_1^3 ((f'(t))^2 + 1) f''(t) dt$$

$$f'(t) = z \Rightarrow f''(t) dt = dz$$

$$z = f'(c) = 1$$

$$z = f'(a) = \frac{1}{\sqrt{3}}$$

$$I = \int_{1/\sqrt{3}}^1 (z^2 + 1) dz = \left(\frac{z^3}{3} + z \right)_{1/\sqrt{3}}^1$$

$$= \left(\frac{1}{3} + 1 \right) - \left(\frac{1}{3} \cdot \frac{1}{3\sqrt{3}} + \frac{1}{\sqrt{3}} \right)$$

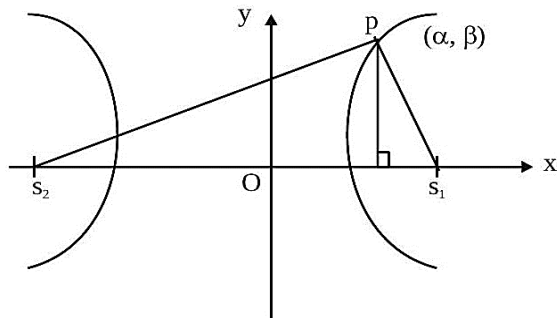
$$= \frac{4}{3} - \frac{10}{9\sqrt{3}} = \frac{4}{3} - \frac{10}{27}\sqrt{3}$$

$$\alpha + \beta\sqrt{3} = 27 \left(\frac{4}{3} - \frac{10}{27}\sqrt{3} \right) = 36 - 10\sqrt{3}$$

$$\alpha = 36, \beta = -10$$

$$\alpha + \beta = 36 - 10 = 26$$

70. (c)



$$\frac{x^2}{9} - \frac{y^2}{4} = 1$$

$$a^2 = 9, b^2 = 4$$

$$b^2 = a^2(e^2 - 1) \Rightarrow e^2 = 1 + \frac{b^2}{a^2}$$

$$e^2 = 1 + \frac{4}{9} = \frac{13}{9}$$

$$e = \frac{\sqrt{13}}{3} \Rightarrow s_1 s_2 = 2ae = 2 \times 3 \times \sqrt{\frac{13}{9}} = 2\sqrt{13}$$

$$\text{Area of } \Delta PS_1 S_2 = \frac{1}{2} \times \beta \times S_1 S_2 = 2\sqrt{13}$$

$$\Rightarrow \frac{1}{2} \times \beta \times (2\sqrt{13}) = 2\sqrt{13} \Rightarrow \beta = 2$$

$$\frac{\alpha^2}{9} - \frac{\beta^2}{4} = 1 \Rightarrow \frac{\alpha^2}{9} - 1 = 1 \Rightarrow \alpha^2 = 18 \Rightarrow \alpha = 3\sqrt{2}$$

$$\text{Distance of P from origin} = \sqrt{\alpha^2 + \beta^2}$$

$$= \sqrt{18 + 4} = \sqrt{22}$$

A

B

3 W

3 W

7 R

2 R

71. (c) E_1 : A is selected

 E_2 : B is selected

E : white ball is drawn

$$P(E_1/E) =$$

$$\frac{P(E) \cdot P(E/E_1)}{P(E_1) \cdot P(E/E_1) + P(E_2) \cdot P(E/E_2)} = \frac{\frac{1}{2} \times \frac{3}{10}}{\frac{1}{2} \times \frac{3}{10} + \frac{1}{2} \times \frac{3}{5}}$$

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

72. (d)

$$f(x) = ae^{2x} + be^x + cx \quad f(0) = -1$$

$$\begin{aligned} a + b &= -1 \\ f'(x) &= 2ae^{2x} + be^x + c \quad f'(\ln 2) = 21 \\ 8a + 2b + c &= 21 \end{aligned}$$

$$\int_0^{\ln 4} (ae^{2x} + be^x) dx = \frac{39}{2}$$

$$\left[\frac{ae^{2x}}{2} + be^x \right]_0^{\ln 4} = \frac{39}{2} \Rightarrow 8a + 4b - \frac{a}{2} - b = \frac{39}{2}$$

$$\begin{aligned} 15a + 6b &= 39 \\ 15a - 6a - 6 &= 39 \\ 9a &= 45 \Rightarrow a = 5 \\ b &= -6 \\ c &= 21 - 40 + 12 = -7 \\ a + b + c &= 8 \\ |a + b + c| &= 8 \end{aligned}$$

73. (a)

$$L_1 \perp L_2$$

$$L_3 \perp L_1, L_2$$

$$3 - 1 + 2P = 0$$

$$P = -1$$

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & -1 & 2 \\ 3 & 1 & -1 \end{vmatrix} = -\hat{i} + 7\hat{j} + 4\hat{k}$$

$$\therefore (-\delta, 7\delta, 4\delta) \text{ will lie on } L_3$$

$$\text{For } \delta = 1 \text{ the point will be } (-1, 7, 4)$$

74. (d)

75. (a)

$$f\left(\frac{x}{y}\right) = \frac{f(x)}{f(y)} \quad f'(a) = 2024$$

$$f'(a) = 1$$

Partially differentiating w. r. t. x

$$f'\left(\frac{x}{y}\right) \cdot \frac{1}{y} = \frac{1}{f(y)} f'(x)$$

$$y \rightarrow x$$

$$f'(a) \cdot \frac{1}{x} = \frac{f'(x)}{f(x)}$$

$$2024f(x) = xf'(x) \Rightarrow xf'(x) - 2024f(x) = 0$$

76. (b)

$$z^{1985} + z^{100} + 1 = 0 \text{ \& } z^3 + 2z^2 + 2z + 1 = 0$$

$$(z + 1)(z^2 - z + 1) + 2z(z + 1) = 0$$

$$(z + 1)(z^2 + z + 1) = 0$$

$$\Rightarrow z = -1, z = w, w^2$$

Now putting $z = -1$ not satisfy

Now put $z = w$

$$\Rightarrow w^{1985} + w^{100} + 1$$

$$\Rightarrow w^2 + w + 1 = 0$$

Also, $z = w^2$

$$\Rightarrow w^{3970} + w^{200} + 1$$

$$\Rightarrow w + w^2 + 1 = 0$$

Two common root

77. (d)

$$2 - p, p, 2 - \alpha, \alpha$$

Binomial coefficients are

$${}^nC_r, {}^nC_{r+1}, {}^nC_{r+2}, {}^nC_{r+3} \text{ respectively}$$

$$\Rightarrow {}^nC_r + {}^nC_{r+1} = 2$$

$$\Rightarrow {}^{n+1}C_{r+1} = 2 \dots \dots \dots (1)$$

$$\text{Also, } {}^nC_{r+2} + {}^nC_{r+3} = 2$$

$$\Rightarrow {}^{n+1}C_{r+3} = 2 \dots \dots \dots (2)$$

From (1) and (2)

$${}^{n+1}C_{r+1} = {}^{n+1}C_{r+3}$$

$$\Rightarrow 2r + 4 = n + 1$$

$$n = 2r + 3$$

$${}^{2r+4}C_{r+1} = 2$$

Data Inconsistent

78. (b)

79. (d)

$$f(x) = \frac{x}{(1+x^4)^{1/4}}$$

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

$$f(f(f(f(x)))) = \frac{x}{(1+4x^4)^{1/4}}$$

$$18 \int_0^{\sqrt{2\sqrt{5}}} \frac{x^3}{(1+4x^4)^{1/4}} dx$$

$$\text{Let } 1+4x^4 = t^4$$

$$16x^3 dx = 4t^3 dt$$

$$\frac{18}{4} \int_1^3 \frac{t^3 dt}{t}$$

$$= \frac{9}{2} \left(\frac{t^3}{3} \right)_1^3$$

$$= \frac{3}{2} [26] = 39$$

80. (b) $x \sin \theta = y \sin \left(\theta + \frac{2\pi}{3} \right) = z \sin \left(\theta + \frac{4\pi}{3} \right) \neq 0$

$$\Rightarrow x, y, z \neq 0$$

Also,

$$\sin \theta + \sin \left(\theta + \frac{2\pi}{3} \right) + \sin \left(\theta + \frac{4\pi}{3} \right) = 0 \forall \theta \in \mathbb{R}$$

$$\Rightarrow \frac{1}{x} + \frac{1}{y} + \frac{1}{z} = 0$$

$$\Rightarrow xy + yz + zx = 0$$

(i) $\text{Trace}(R) = x + y + z$

If $x + y + z = 0$ and $xy + yz + zx = 0$

$$\Rightarrow x = y = z = 0$$

Statement (i) is False

(ii) $\text{Adj}(\text{Adj}(R)) = |R|R$

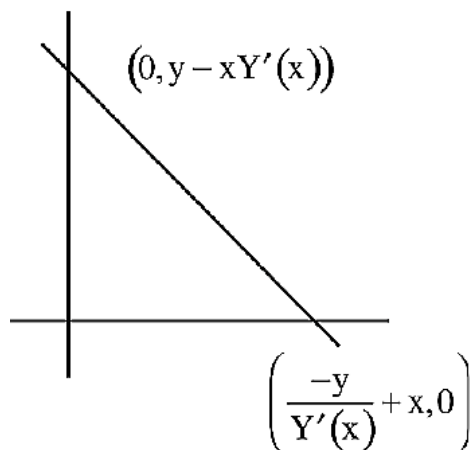
Trace (Adj(Adj(R)))

$$= xyz(x + y + z) \neq 0$$

Statement (ii) is also False

81. (20)

$$A = \frac{1}{2} \left(\frac{-y}{Y'(x)} + x \right) (y - xY'/x) = \frac{-y^2}{2Y'(x)} + 1$$



$$\Rightarrow (-y + xY'(x))(y - xY'(x)) = -y^2 + 2Y'(x) = -y^2 + 2Y'(x)$$

$$-y^2 + xyY'(x) + xyY'(x) - x^2[Y'(x)]^2$$

$$2xy - x^2Y'(x) = 2$$

$$\frac{dy}{dx} = \frac{2xy - 2}{x^2} + 2Y'(x)$$

$$\frac{dy}{dx} - \frac{2}{x}y = \frac{-2}{x^2}$$

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

$$y \cdot \frac{1}{x^2} = \frac{2}{3}x^{-3} + c$$

$$\text{Put } x = 1, y = 1$$

$$1 = \frac{2}{3} + c \Rightarrow c = \frac{1}{3}$$

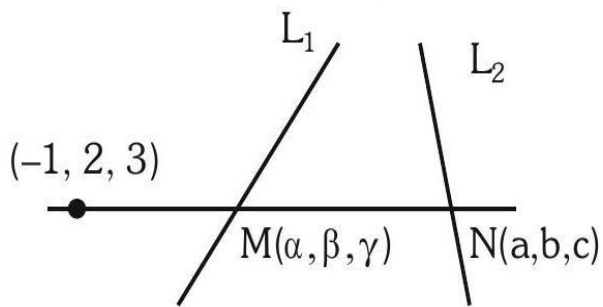
$$Y = \frac{2}{3} \cdot \frac{1}{X} + \frac{1}{3}X^2$$

$$\Rightarrow 12Y(2) = \frac{5}{3} \times 12 = 20$$

82. (196)

$$M(3\lambda + 1, 2\lambda + 2, -2\lambda - 1) \therefore \alpha + \beta + \gamma = 3\lambda + 2$$

$$N(-3\mu - 2, -2\mu + 2, 4\mu + 1) \therefore a + b + c = -\mu + 1$$



$$\frac{3\lambda + 2}{-3\mu - 1} = \frac{2\lambda}{-2\mu} = \frac{-2\lambda - 4}{4\mu - 2}$$

$$3\lambda\mu + 2\mu = 3\lambda\mu + \lambda$$

$$2\mu = \lambda$$

$$2\lambda\mu - \lambda = \lambda\mu + 2\mu$$

$$\lambda\mu = \lambda + 2\mu$$

$$\Rightarrow \lambda\mu = 2\lambda$$

$$\Rightarrow \mu = 2 \ (\lambda \neq 0)$$

$$\therefore \lambda = 4$$

$$\alpha + \beta + \gamma = 14$$

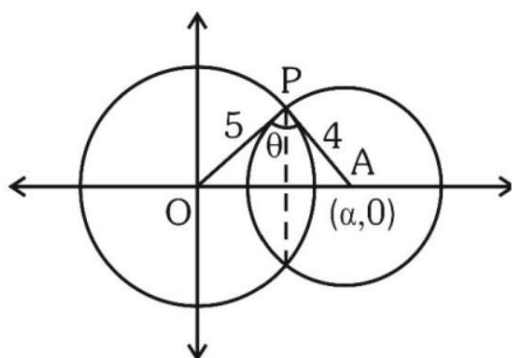
$$a + b + c = -1$$

$$\frac{(\alpha + \beta + \gamma)^2}{(a + b + c)^2} = 196$$

83. (1575)

$$C_1: x^2 + y^2 = 25, C_2: (x - \alpha)^2 + y^2 = 16$$

$$5 < \alpha < 9$$



$$\theta = \sin^{-1}\left(\frac{\sqrt{63}}{8}\right)$$

$$\sin \theta = \frac{\sqrt{63}}{8}$$

$$\text{Area of } \Delta OAP = \frac{1}{2} \times \alpha \left(\frac{\beta}{2}\right) = \frac{1}{2} \times 5 \times 4 \sin \theta$$

$$\Rightarrow \alpha\beta = 40 \times \frac{\sqrt{63}}{8}$$

$$\alpha\beta = 5 \times \sqrt{63}$$

$$(\alpha\beta)^2 = 25 \times 63 = 1575$$

84. (10)

$$\alpha = \sum_{k=0}^n \frac{{}^nC_k \cdot {}^nC_k}{k+1} \cdot \frac{n+1}{n+1}$$

$$= \frac{1}{n+1} \sum_{k=0}^n {}^{n+1}C_{k+1} \cdot {}^nC_{n-k}$$

$$\alpha = \frac{1}{n+1} \cdot {}^{2n+1}C_{n+1}$$

$$\beta = \sum_{k=0}^{n-1} {}^nC_k \cdot \frac{{}^nC_{k+1}}{k+2} \cdot \frac{n+1}{n+1}$$

$$\frac{1}{n+1} \sum_{k=0}^{n-1} {}^nC_{n-k} \cdot {}^{n+1}C_{k+2}$$

$$= \frac{1}{n+1} \cdot {}^{2n+1}C_{n+2}$$

$$\frac{\beta}{\alpha} = \frac{{}^{2n+1}C_{n+2}}{{}^{2n+1}C_{n+1}} = \frac{2n+1-(n+2)+1}{n+2}$$

$$\frac{\beta}{\alpha} = \frac{n}{n+2} = \frac{5}{6}$$

$$n = 10$$

85. (9)

$$S_n = 3 + 7 + 11 + \dots \dots n \text{ terms}$$

$$= \frac{n}{2} (6 + (n-1)4) = 3n + 2n^2 - 2n$$

$$= 2n^2 + n$$

$$\sum_{k=1}^n S_k = 2 \sum_{k=1}^n K^2 + \sum_{k=1}^n K$$

$$= 2 \cdot \frac{n(n+1)(2n+1)}{6} + \frac{n(n+1)}{2}$$

$$= n(n+1) \left[\frac{2n+1}{3} + \frac{1}{2} \right]$$

$$= \frac{n(n+1)(4n+5)}{6}$$

$$\Rightarrow 40 < \frac{6}{n(n+1)} \sum_{k=1}^n S_k < 42$$

$$40 < 4n + 5 < 42$$

$$35 < 4n < 37$$

$$n = 9$$

86. (11376)

If 4 questions from each section are selected

Remaining 3 questions can be selected either in (1, 1, 1) or (3, 0, 0) or (2, 1, 0)

$$\therefore \text{Total ways} = {}^8C_5 \cdot {}^6C_5 \cdot {}^6C_5 + {}^8C_6 \cdot {}^6C_5 \cdot {}^6C_4 \times 2 + {}^8C_5 \cdot {}^6C_6 \cdot {}^6C_4 \times 2 + {}^8C_4 \cdot {}^6C_6 \cdot {}^6C_5 \times 2 + {}^8C_7 \cdot {}^6C_4 \cdot {}^6C_4$$

$$= 56 \cdot 6 \cdot 6 + 28 \cdot 6 \cdot 15 \cdot 2 + 56 \cdot 15 \cdot 2 + 70 \cdot 6 \cdot 2$$

$$+ 8 \cdot 15 \cdot 15$$

$$= 2016 + 5040 + 1680 + 840 + 1800 = 11376$$

87. (960)

$$\text{Total number of relation both symmetric and reflexive} = 2^{\frac{n^2-n}{2}}$$

$$\text{Total number of symmetric relation} = 2^{\left(\frac{n^2+n}{2}\right)}$$

$\Rightarrow$ Then number of symmetric relation which are not reflexive

$$\Rightarrow 2^{\frac{n(n+1)}{2}} - 2^{\frac{n(n-1)}{2}}$$

$$\Rightarrow 2^{10} - 2^6$$

$$\Rightarrow 1024 - 64$$

$$= 960$$

88. (a)

$$x = 0 \text{ and } x^2 + 3|x| + 5|x-1| + 6|x-2| = 0$$

Here all terms are +ve except at $x = 0$

So there is no value of x

Satisfies this equation

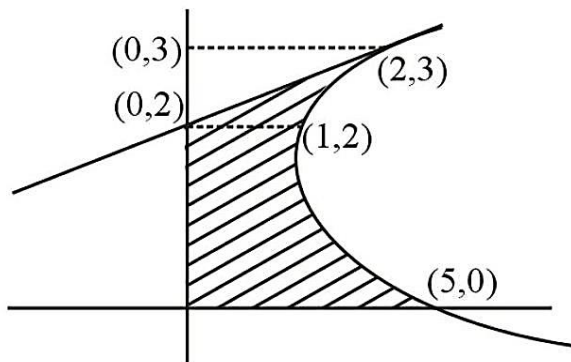
Only solution $x = 0$

No of solution 1 .

89. (5) Solving the equations

$$(y - 2)^2 = x - 1 \text{ and } x - 2y + 4 = 0$$

$$X = 2(y - 2)$$



$$\frac{x^2}{4} = x - 1$$

$$x^2 - 4x + 4 = 0$$

$$(x - 2)^2 = 0$$

$$x = 2$$

$$\text{Enclose area (w.r.t. y-axis)} = \int_0^3 x dy - \text{Area of } \Delta.$$

$$= \int_0^3 ((y - 2)^2 + 1) dy - \frac{1}{2} \times 1 \times 2$$

$$= \int_0^3 (y^2 - 4y + 5) dy - 1$$

$$= \left[\frac{y^3}{3} - 2y^2 + 5y \right]_0^3 - 1$$

$$= 9 - 18 + 15 - 1 = 5$$

90. (29)

x_i	f_i	$f_i x_i$	$f_i x_i^2$
0	3	0	0
1	2	2	2

5	3	15	75
6	2	12	72
10	6	60	600
12	3	36	432
17	3	51	867
	$\Sigma f_i = 22$		$\Sigma f_i x_i^2 = 2048$

$$\therefore \Sigma f_i x_i = 176$$

$$\text{So } \bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{176}{22} = 8$$

$$\text{for } \sigma^2 = \frac{1}{N} \Sigma f_i x_i^2 - (\bar{x})^2$$

$$= \frac{1}{22} \times 2048 - (8)^2$$

$$= 93.090964$$

$$= 29.0909$$

