1. (d) modulation index $= \frac{V_{max}-V_{min.}}{V_{max}+V_{min}} \times 100\%$

$= \frac{6-2}{6+2} \times 100\% = 50\%$

2. (b) $B = \frac{N\mu_0 i}{2R}$

$B_1 = \frac{N_1\mu_0 i}{2R_1}$

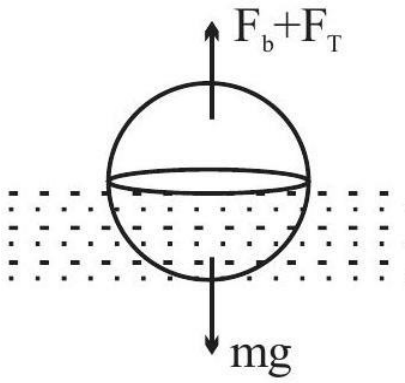
For $N_2 = 5$

Radius of coil $= R_2 = \frac{N_1 \times R_1}{N_2}$

$B_2 = \frac{N_2\mu_0 i}{R_2}$

$\frac{B_2}{B_1} = \frac{N_2}{N_1} \cdot \frac{R_1}{R_2} = \frac{N_2}{N_1} \times \frac{N_2}{N_1}; \ \frac{B_2}{B_1} = \frac{25}{4}$

3. (a)



Boyant force + surace tension $=$ mg

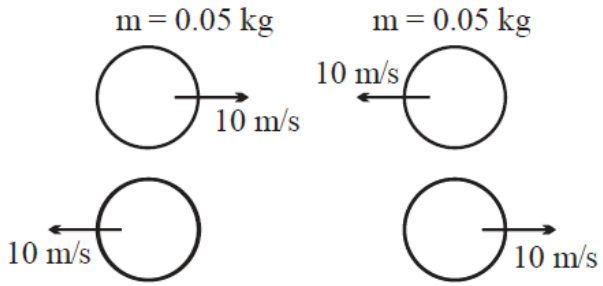
$\sigma \frac{V}{2} g + 2\pi RT = \rho Vg$

$2\pi RT = \frac{(2\rho-\sigma)}{2} \cdot \frac{4}{3}\pi R^3 \ g; \ V = \frac{4}{3}\pi R^3\Big]$

$R^3 = \frac{3\ T}{(2\rho-\sigma)g} \Rightarrow R = \sqrt{\frac{3 \times 7.5 \times 10^{-2}\ N-m^{-1}}{(2\rho-\sigma) \times 10}}$

$R = \frac{3}{20\sqrt{(2\rho-\sigma)}} m = \frac{15}{\sqrt{2\rho-\sigma}} cm$

4. (b)



Change in momentum of any one ball

$|\Delta\vec{P}| = 2 \times 0.05 \times 10$

$|\Delta\vec{P}| = 1$

$|\vec{F}_{av}| = \frac{|\Delta\vec{P}|}{\Delta t}$

$F_{av.} = 200\ N$

5. (a) Let addition force required is $= \vec{F}$

$\vec{F} + 5\hat{i} - 6\hat{i} + 7\hat{j} - 8\hat{j} = 0$

$\vec{F} = \hat{i} + \hat{j}, |\vec{F}| = \sqrt{2}$

Angle with x-axis: $\tan\theta = \frac{\text{y component}}{\text{x component}} = \frac{1}{1}$

$\theta = 45°$

6. (a) Capacitance of isolated Conducting sphere $= 4\pi\varepsilon_0 R_1$

By enclosing inside another sphere of radius

R_2, new capacitance $= \frac{4\pi\varepsilon_0 R_1 R_2}{(R_2 - R_1)}$

Given: $\frac{4\pi\varepsilon_0 R_1 R_2}{(R_2 - R_1)} = n \times 4\pi\varepsilon_0 R_1$

$$\Rightarrow \frac{R_2}{(R_2 - R_1)} = n \Rightarrow \frac{\frac{R_2}{R_1}}{\left(\frac{R_2}{R_1} - 1\right)} = n$$

$$\Rightarrow \frac{R_2}{R_1} = n\frac{R_2}{R_1} - n \Rightarrow \frac{R_2}{R_1} = \frac{n}{(n-1)}$$

7. (d) Kinetic energy gained by a charged particle accelerated by a potential V is qV

$KE = qV$

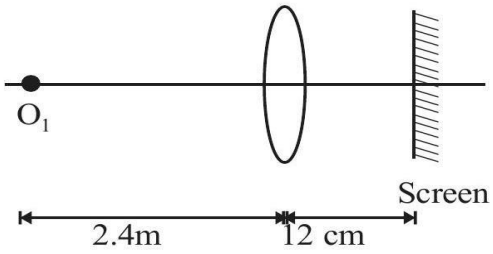
$$\Rightarrow \frac{p^2}{2\,m} = qV \Rightarrow p = \sqrt{2mqV}$$

$p = \frac{h}{\lambda}$, thus $\lambda = \frac{h}{\sqrt{2mqV}}$

now $\frac{\lambda_p}{\lambda_d} = \sqrt{\frac{m_d V_d}{m_p V_p}}$

$\Rightarrow \frac{1}{\sqrt{2}} = \sqrt{\frac{2\,V_d}{V_p}} \Rightarrow \frac{V_p}{V_d} = 4$

8. (b)



Applying lens formula

$\frac{1}{0.12} + \frac{1}{2.4} = \frac{1}{f} \Rightarrow \frac{1}{f} = \frac{210}{24}$

Upon putting the glass slab, shift of image is

$\Delta x = t\left(1 - \frac{1}{\mu}\right) = \frac{1}{3}$ cm

Now $v = 12 - \frac{1}{3} = \frac{35}{3}$ cm

Again apply lens formula

$\frac{1}{0.12} + \frac{1}{u} = \frac{1}{f} = \frac{210}{24}$

Solving $u = -5.6$ m

Thus shift of object is

$5.6 - 2.4 = 3.2$ m

9. (a) $E_y = 540\sin\pi \times 10^4(x - ct)Vm^{-1}$

$E_0 = 540Vm^{-1}$

$B_0 = \frac{E_0}{C} = \frac{540}{3 \times 10^8} = 18 \times 10^{-7}$ T

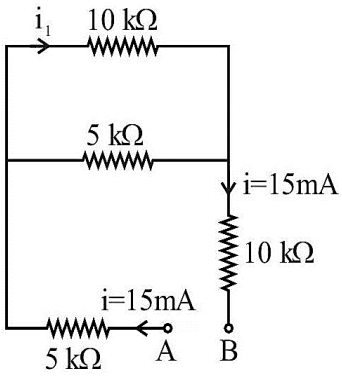
10. (b) Metal detector works on the principle of transmitting an electromagnetic signal and analyses a return signal from the target. So it works on the principle of resonance in AC circuit.

11. (c)

$f = \frac{1}{T} = \frac{eB}{2\pi m}$

$$= \frac{1.6 \times 10^{-19} \times 10^{-4}}{2\pi \times 9 \times 10^{-31}} = 2.8 \times 10^{6} \text{ Hz}$$

12. (d)



$$i_1 = \frac{5}{10+5} \times 15 \text{ mA} = 5 \text{ mA}$$

$$V_A - 5i - 10i_1 - 10i = V_B$$

$$V_A - V_B = 75 + 50 + 150 = 275 \text{ V}$$

13. (d) $T = 2\pi\sqrt{\frac{L}{g}}, g' = \frac{GM}{9R^2} = \frac{g}{9} = \frac{\pi^2}{9}$

$$2 = 2\pi\sqrt{\frac{L}{\pi^2} \times 9}$$

$$\Rightarrow 1 = \pi\sqrt{L} \times \frac{3}{\pi} \Rightarrow L = \frac{1}{9} \text{ m}$$

14. (b) $v_s = \sqrt{\frac{\gamma RT}{M}}$

$$v_{rms} = \sqrt{\frac{3RT}{M}}$$

$$\frac{v_s}{v_{rms}} = \sqrt{\frac{\gamma}{3}} = \frac{1}{\sqrt{2}} \Rightarrow \frac{\gamma}{3} = \frac{1}{2} \Rightarrow \gamma = \frac{3}{2}$$

$$\gamma = 1 + \frac{2}{f_{mix}}$$

$$f_{mix.} = \frac{2 \times 3 + n \times 5}{n+2} = \frac{6 + n \times 5}{(n+2)}$$

$$\gamma = 1 + \frac{2(n+2)}{6 + n \times 5} = \frac{6 + 5n + 2n + 4}{6 + 5n}$$

$$\gamma = \frac{7n + 10}{6 + 5n} = \frac{3}{2}$$

$$14n + 20 = 18 + 15n$$

$n = 2$

15. (b) Efficiency $\eta = 1 - \frac{T_L}{T_H}$

$$\eta_1 = 1 - \frac{147 + 273}{447 + 273} = 1 - \frac{420}{720}$$

$$\eta_1 = \frac{300}{720}$$

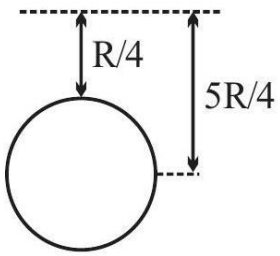
$$\eta_2 = 1 - \frac{47 + 273}{947 + 273} = 1 - \frac{320}{1220}$$

$$\eta_2 = \frac{900}{1220}$$

$$\frac{\eta_1}{\eta_2} = \frac{300}{720} \times \frac{1220}{900} = \frac{122}{72 \times 3}$$

$$\frac{\eta_1}{\eta_2} = 0.56$$

16. (a)



$$g_{eff} = \frac{g}{\left(1 + \frac{h}{R}\right)^2}; g_{eff} = \frac{g}{\left(1 + \frac{1}{4}\right)^2} = \frac{16\,g}{25}$$

$$\text{change} = \frac{g_{eff} - g}{g} \times 100 = \frac{\frac{16}{25} - 1}{1} \times 100$$

$$= \frac{-9}{25} \times 100 = -36\%$$

Hence % decrease in the weight $= 36\%$

17. (b) $P_i = P_f$ (no any external force)

$0.2 \times 10 = 10 \times v$

$v = 0.2$ m/sec

Loss in K.E. $= \frac{1}{2} \times (0.2) \times 10^2 - \frac{1}{2} \times 10(0.2)^2$

$$= \frac{1}{2} \times 10 \times (0.2)[10 - 0.2]$$

$= 9.8$ J

18. (d) $R = H$

$$\frac{2v_x \times v_y}{g} = \frac{v_y^2}{2g}$$

$$v_x = \frac{v_y}{4}; u\cos\theta = \frac{u\sin\theta}{4}$$

$$\tan\theta = 4$$

19. (d) $E_H = I^2 R \times t$

$$\frac{\Delta E}{E} \times 100 = \frac{2\Delta I}{I} \times 100 + \frac{\Delta R}{R} \times 100 + \frac{\Delta T}{T} \times 100$$

$$= 2 \times 2 + 1 + 3 = 8$$

20. (b)

$$E_n = \frac{-Rch}{n^2}(1)$$
$$E_{photon} = E_n - E_1$$
$$E = n$$
$$E_1 = \frac{-Rch}{(1)^2}(1)$$

$$\frac{-Rch}{(n)^2} + \frac{Rch}{1} = \frac{hc}{\lambda}$$

$$\frac{-R}{n^2} + R = \frac{1}{\lambda}$$

$$R - \frac{1}{\lambda} = \frac{R}{n^2}$$

$$\frac{\lambda R - 1}{\lambda} = \frac{R}{n^2}$$

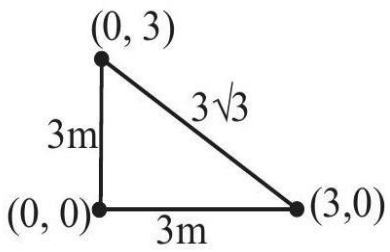
$$n^2 = \frac{\lambda R}{\lambda R - 1} \Rightarrow n = \sqrt{\frac{\lambda R}{\lambda R - 1}}$$

21. (100)

$$\frac{dv}{ds} = 5$$

$$a = v\frac{dv}{ds} = 20 \times 5 = 100\ m/sec^2$$

22. (2)



$\vec{r}_{com} = \frac{M(0\hat{i}+0\hat{j})+M(3\hat{i})+M(3\hat{j})}{3M}$

$\vec{r}_{com} = \hat{i}+\hat{j}$

$|\vec{r}_{com}| = \sqrt{2} = \sqrt{x}$

$x = 2$

23. (90)

Energy released by water

$= 0.3 \times 25 \times 4200 = 31500$ J

let mkg ice melts

$m \times 3.5 \times 10^5 = 31500$

$m = \frac{31500 \times 10^{-5}}{3.5} = 9000 \times 10^{-5}$

$m = 0.09$ kg $= 90$gm

$x = 90$

24. (5)

$\frac{13.6\left(\frac{1}{2^2}-\frac{1}{3^2}\right)}{13.6\left(\frac{1}{2^2}-0\right)} = \frac{x}{x+4}; \frac{\frac{1}{4}-\frac{1}{9}}{\frac{1}{4}} = \frac{x}{x+4}$

$\frac{5}{9} = \frac{x}{x+4}$

$5x + 20 = 9x$

$4x = 20$

$x = 5$

25. (18)

$1.2 = (\text{ Potential Gradient }) \times 36$

$1.8 = (\text{ Potential Gradient }) \times x$

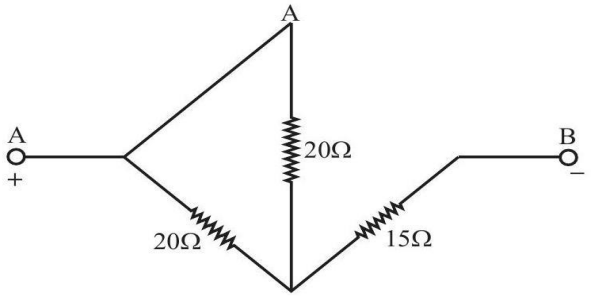
On dividing, we get

$\frac{2}{3} = \frac{36}{x}$

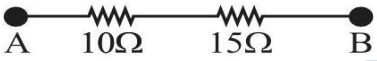
$x = 18 \times 3 = 54$ cm

Hence difference $= 54 - 36 = 18$ cm

26. (25)



The forward biased diode will conduct while the reverse biased will not



∴ Equivalent resistance $= 10 + 15 = 25\Omega$

27. (60) $A_{resultant} = \sqrt{A_1^2 + A_2^2 + 2\,A_1\,A_2 \cos\phi}$

$\Rightarrow \sqrt{3}\,A = \sqrt{A^2 + A^2 + 2\,A^2 \cos\phi}$

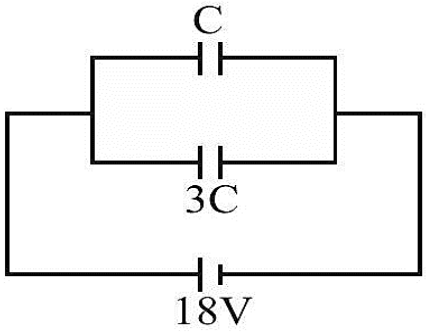
$\Rightarrow 3\,A^2 = 2\,A^2 + 2\,A^2 \cos\phi$

$\Rightarrow \cos\phi = \frac{1}{2}$

$\therefore \phi = 60^\circ$

∴ Phase difference $= 60$ degree

28. (6)



Initial charge on $C = 18CV$

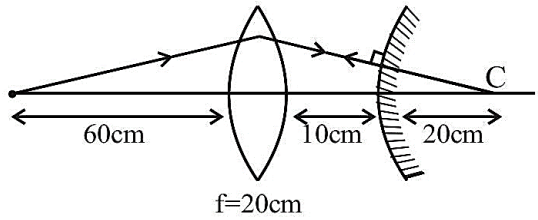
initial charge on $3C = 54CV$

Let final common potential difference $= V'$

$9CV' + 3CV' = 18CV + 54CV$

$\Rightarrow 12CV' = 72CV \Rightarrow V' = 6\ V$

29. (10)



For lens

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

$\Rightarrow \frac{1}{v} - \frac{1}{(-60)} = \frac{1}{20} \Rightarrow \frac{1}{v} + \frac{1}{60} = \frac{1}{20}$

$v = 30\ cm$

For final image to be formed on the object itself, after refraction from lens the ray should meet the mirror perpendicularly and the image by lens should be on the centre of curvature of mirror

$R = 30 - 10 = 20\ cm$

Focal length of mirror $= R/2 = 10\ cm$

30. (250)

$\phi = 8t^2 - 9t + 5$

$emf = -\frac{d\phi}{dt} = -(16t - 9)$

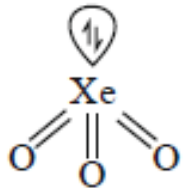
At $t = 0.25\ s$

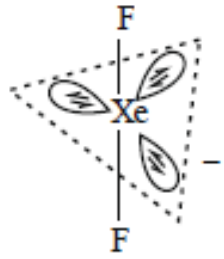
$Emf = -[(16 \times 0.25) - 9] = 5\ V$

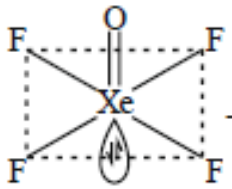
$Current = \frac{Emf}{Resistance} = \frac{5\ V}{20\Omega}$

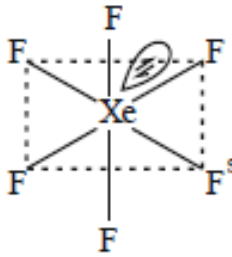
$= \frac{1}{4}\ A = \frac{1000}{4}\ mA = 250\ mA$

31. (a)

(A)  – sp^3 – pyramidal

(B)  – sp^3d – linear

(C)  –sp^3d^2–square pyramidal

(D)  sp^3d^3–distorted octahedral

32. (b) $\frac{\Delta T_{fx}}{\Delta T_{fy}} = \frac{k_f \cdot m_x}{k_f \cdot m_y} = \frac{\frac{1/M_x}{1}}{\frac{1/M_y}{1}}$

$\Rightarrow \frac{1}{4} = \frac{M_y}{M_x}$

$\Rightarrow M_x : M_y = 1 : 0.25$

33. (d)

$H_2C_2O_4 \rightleftharpoons H^+ + HC_2O_4^- \quad K_{a_1}$

$HC_2O_4^- \rightleftharpoons H^+ + C_2O_4^{2-} \quad K_{a_2}$

$H_2C_2O_4 \rightleftharpoons 2H^+ + C_2O_4^{2-} \quad K_{a_3} = K_{a_1} \times K_{a_2}$

34. (a) $\Lambda_m = \kappa \times \frac{1000}{M}$

$\Rightarrow \Lambda_m \propto \frac{1}{M}$

$\frac{\Lambda_{m_1}}{\Lambda_{m_2}} = \frac{M_2}{M_1} = \frac{\frac{20}{80}}{\frac{80}{20}} = \frac{1}{4} \times \frac{2}{1} = \frac{1}{2}$

$\Rightarrow \Lambda_{m_2} = 2\Lambda_{m_1}$

35. (a) For micelle formation, $\Delta S > 0$ (hydrophobic effect) This is possible because, the decrease in entropy due to clustering is offset by increase in entropy due to desolvation of the surfactant, Also $\Delta H > 0$

36. (d) 1 1st I.E. $\underset{(2p^3)}{N} > \underset{(2p^4)}{O} > \underset{(2\,s^2)}{Be} > \underset{(2p^1)}{B}$

37. (b) Statement $-$I is incorrect because cast iron is obtained by heating pig iron with scrap iron Statement-II is also incorrect because pig iron has more carbon content ($\sim 4\%$) than cast iron ($\sim 3\%$)

38. (c) High purity ($> 99.95\%$) dihydrogen is obtained by electrolysis of warm aqueous $Ba(OH)_2$ solution between Ni-electrodes

39. (c) In II'A' group density decreases down the group till Ca and after that it increases.

Correct order of density is

$Sr > Be > Mg > Ca$

40. (b) Neutral Oxides $-N_2O, NO, CO$

Acidic Oxides - B_2O_3, N_2O_5, SO_3, P_4O_{10}

41. (a) Stronger the ligand, larger the splitting & higher the energy of absorption.

$$\underset{(A)}{[Ni(en)_3]^{+2}} > \underset{(B)}{[Ni(NH_3)_6]^{+2}} > \underset{(C)}{[Ni(H_2O)_6]^{+2}}$$

42. (c)

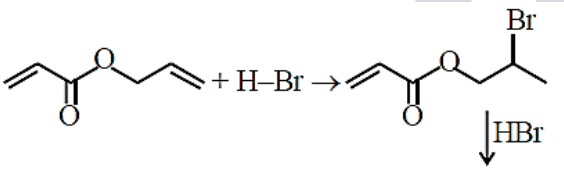
A-Sulphate - III (Laxative effect)

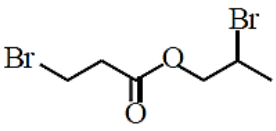
B-Fluoride - II (Bending of bones)

C-Nictoine - I (pesticides)

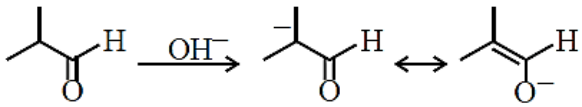
D-Sodium Arsinite - IV (herbicide)

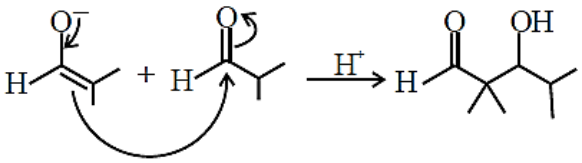
43. (d)



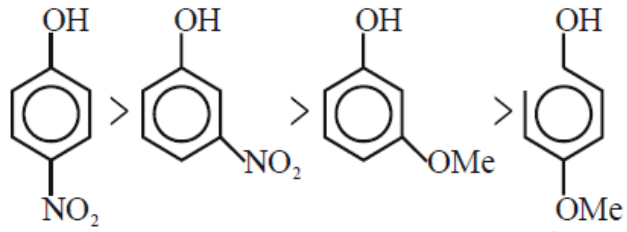


44.(b)

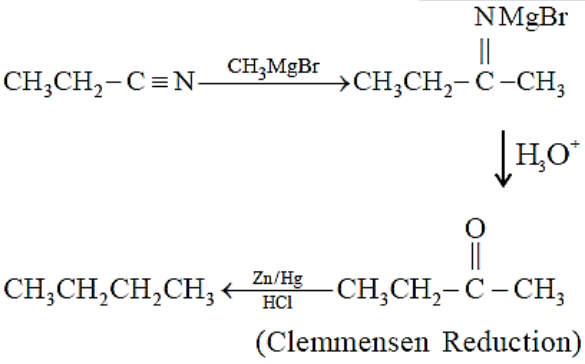




45. (a) The correct order of acid strength is



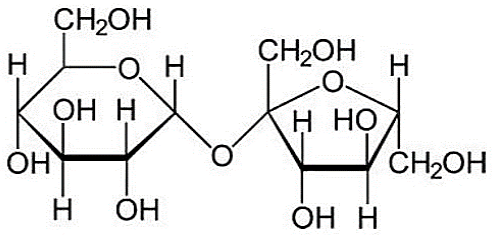
46. (a)



47. (b) LDPE → Toys

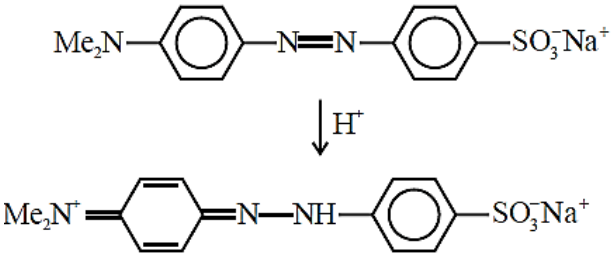
HDPE → Buckets (As per NCERT)

48. (b) Theoretical



49. (b)

50.(a)



51. (46)

N_2	+	$3H_2$	→	$2NH_3$
56L		excess		O
−10L		−30L		+20L
46L				20L

52. (1665)

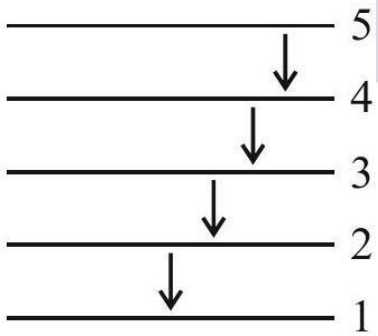
Moles of $C_3H_8 = \frac{11}{44} = 0.25$ moles

$PV = nRT$

$\Rightarrow 2 \times 10^6 \times 2 \times 10^{-3} = 0.25 \times 8.3 \times T$

$\Rightarrow T = 1927.710\ K = 1654.56°C$

53. (10) Since only a single H atom is present, maximum number of spectral lines $= 4$



54. (2) $\Delta H_{ionisation}$ of $CH_3COOH = |-57.3-(-55.3)|$

$= 2KJ/mol$

55. (2)

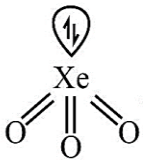
For first order reaction

$$k = \frac{1}{t}\ln\left(\frac{P_0}{P}\right)$$

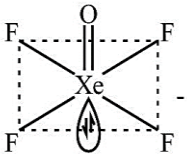
$$\ln\left(\frac{P_0}{P}\right) = kt$$

$$t_{1/2} = \frac{\ln 2}{k} = \frac{0.693}{3.465 \times 10^4} = 2 \times 10^{-5}$$

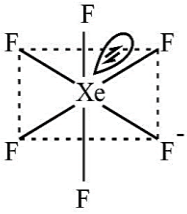
56. (3)



- one lone pair on central atom



- one lone pair on central atom



- one lone pair on central atom

57. (4)

$E^{0}_{Cr^{+3}|_{Cr^{+2}}} = -0.41\ V$

$[Cr^{+3}] = 4\ s^0 3\ d^3$

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

$= \sqrt{15}$ B.M ~ 4 B.M

58. (33)

$ROH + CH_3MgI \rightarrow ROMgI + CH_4(g)$

moles of CH_4 = moles of ROH

$\Rightarrow \frac{V}{22400} = \frac{m}{M \cdot M}$ (Assuming NTP Condition)

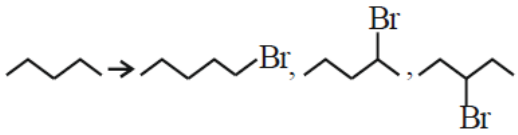
$\Rightarrow \frac{3.1}{22400} = \frac{4.5 \times 10^{-3}}{M.M}$

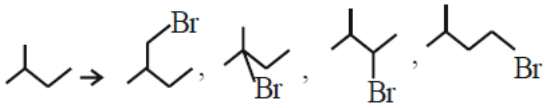
$\Rightarrow MM = 32.51$

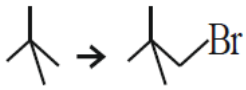
Nearest Integer $= 33$

59. (2) $\frac{R_{F_A}}{R_{F_B}} = \frac{\frac{2.08}{3.25}}{\frac{1.05}{3.25}} = \frac{2.08}{1.05} \approx 2$

60. (8) The Alkanes and their monobromodervative are

1. 

2. 

3. 

61. (c)
62. (c)
63. (b)
64. (d)
65. (b)
66. (a)
67. (c)
68. (b)
69. (b)
70. (d)
71. (b)
72. (a)
73. (d)
74. (d)
75. (c)
76. (a)
77. (a)
78. (d)
79. (b)
80. (d)
81. (107)
82. (25)
83. (24)
84. (15)
85. (3)
86. (8)
87. (5)
88. (25)
89. (170)
90. (130)