3S INSTITUTE
JEE ADVANCED | JEE MAIN | NEET | OLYMPIADS | MHT-CET | FOUNDATION

08-April-2023 (Evening Batch) : JEE Main Paper

MATHEMATICS

Section - A (Single Correct Answer)

1. C
2. C
3. D
4. C
5. A
6. D
7. C
8. A
9. D
10. B
11. B
12. D
13. A
14. C
15. B
16. A
17. B
18. D
19. B
20. D

Section - B (Numerical Value)

21. 6
22. 309
23. 150
24. 20
25. 9
26. 16
27. 12
28. 11
29. 180
30. 17

PHYSICS

Section - A (Single Correct Answer)

31. C

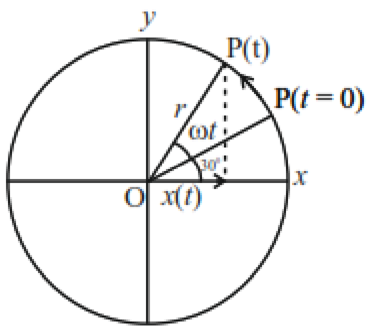
Sol. $V_P = \frac{KQ}{r}$

$$50 = \frac{9\times10^9 \times 5\times10^{-9}}{r}$$

$$r = \frac{45}{50} = \frac{9}{10} = 0.9m = 90cm$$

32. A

Sol.



x(t) = r cos(ωt + 30°)

x(t) = r cos(ωt + π/6)

33. C

Sol. A. Torque $\Rightarrow \vec{\tau} = \vec{r} \times \vec{F}$

$$[\tau] = [L][MLT^{-2}]$$

$$\Rightarrow ML^2\,T^{-2}$$

B. $\text{Stress} = \frac{F}{A} \Rightarrow \frac{MLT^{-2}}{L^2}$

$[\text{stress}] = ML^{-1}T^{-2}$

C. Pressure gradient $= \frac{\Delta P}{\Delta X}$

$$\Rightarrow \frac{[F/A]}{[L]} \Rightarrow \frac{MLT^{-2}}{L^3}$$

$$\Rightarrow ML^{-2}T^{-2}$$

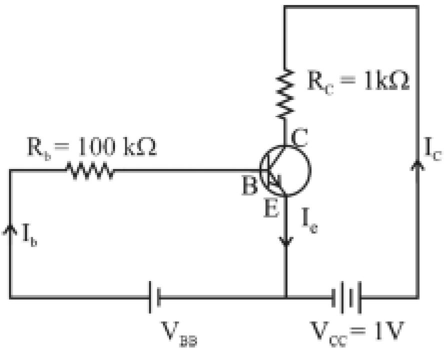
D. Coefficient of viscosity $\Rightarrow F = 6\pi\eta rv$

$MLT^{-2} = [\eta]\ L^2T^{-1}$

$[\eta] = ML^{-1}T^{-1}$

34. D

Sol.



Considering the transistor in saturation mode

$V_{CE} = 0$

Using KVL

$-I_cR_c + V_{CC} = 0$

$$I_c = \frac{V_{CC}}{R_C} = \frac{1}{1\times10^3}$$

$$I_c = 10^{-3}\,A$$

$$\beta = \frac{I_c}{I_b}$$

$$I_b = \frac{10^{-3}}{100} \Rightarrow 10^{-5}\,A \Rightarrow I_b = 10\mu A$$

35. A

Sol. $y = x - \dfrac{x^2}{20}$

For maximum height,

$$\frac{dy}{dx} = 0 \Rightarrow 1 - \frac{2x}{20} = 0$$

$x = 10$

So, $y_{max} = 10 - \dfrac{100}{20} = 5m$

36. D

Sol. $N = N_0\left(\dfrac{1}{2}\right)^n$

$$\frac{N_0}{8} = N_0\left(\frac{1}{2}\right)^n$$

$n = 3$

3 half lives = 3 days

1 half life = 1 day

5 days = 5 half life

$$N = N_0\left(\frac{1}{2}\right)^n$$

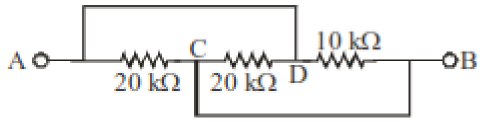
$$8\times10^{-3} = N_0\left(\frac{1}{2}\right)^5$$

$N_0 = 256 \times 10^{-3}$ kg

$N_0 = 256$ g

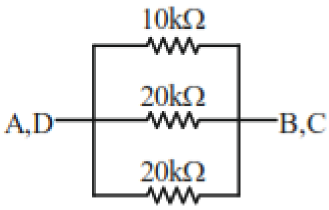
37. A

Sol.



$V_A = V_D$

$V_C = V_B$



All resistors are in parallel. So,

$$\frac{1}{R_{eq}} = \frac{1}{10} + \frac{1}{20} + \frac{1}{20}$$

$R_{eq} = 5$ kΩ.

38. C

Sol. Force = mg = 5000 g

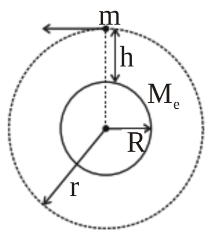
Area of cross section = 250 cm^2 = 250×10^{-4} m^2

$$\text{maximum pressure} = \frac{\text{Force}}{\text{area of cross section}}$$

$$= \frac{5000g}{250\times10^{-4}} = \frac{20\times g}{10^{-4}} = 2\times10^6\,Pa$$

39. D

Sol.



$L = mvr$

$v = \sqrt{\frac{GM_e}{r}}$

$L = m\sqrt{\frac{GM_e}{r}} \cdot r$

$L \propto r^{\frac{1}{2}}$

Now distance from centre is increased by 8 times.

So new distance from centre = r + 8r = 9r

Now angular momentum $L' \propto (9r)^{1/2}$

$\frac{L}{L'} = \frac{r^{1/2}}{(9r)^{1/2}} = \frac{1}{3}$

$L' = 3L$

40. C

Sol. Kinetic energy $= \frac{f}{2}kT$, T is absolute temperature.

If K_1 is kinetic energy at 27°C.

K_2 is kinetic energy at new temperature T.

$\frac{K_1}{K_2} = \frac{T_1}{T_2} \Rightarrow \frac{1}{2} = \frac{300}{T}$

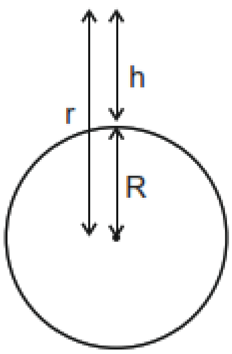
T = 600 K

T = 327°C

41. A

Sol. For point outside the surface of earth

$g = \frac{GM}{r^2}$



r = distance from center of earth

$\Rightarrow g(h) = \frac{GM}{(R+h)^2} \Rightarrow g(h) = \frac{GM}{R^2\left(1+\frac{h}{R}\right)^2}$

$\Rightarrow g(h) = \frac{GM}{R^2}\left(1+\frac{h}{R}\right)^{-2}$

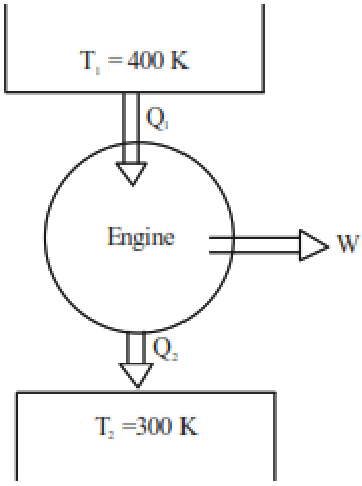
If h <<< R, $\left(1+\frac{h}{R}\right)^{-2} \approx 1 - \frac{2h}{R}$

$\Rightarrow g(h) = \frac{GM}{R^2}\left(1-\frac{2h}{R}\right)$

$\Rightarrow g(h) = g_{surface}\left(1-\frac{2h}{R}\right), \frac{GM}{R^2} = g_{surface}$

42. C

Sol.



Efficiency of carnot engine

$\eta = 1 - \frac{T_2}{T_1} = \frac{W}{Q_1}$

$\Rightarrow \frac{W}{Q_1} = 1 - \frac{300}{400} = \frac{1}{4}$

$\Rightarrow \frac{2kJ}{Q_1} = \frac{1}{4}$

$\Rightarrow \quad Q_1 = 8$ kJ

43. A or C

Sol. Area under velocity time graph gives displacement of body in given time.

Area under acceleration time graph gives change in velocity in the given time.

So Statement I false

Statement II True

44. B

Sol. X rays are emitted when target metal is bombarded with high energy electron.

45. C

Sol. Fringe width $(\beta) = \frac{D\lambda}{d}$

$$\Rightarrow \frac{\beta_2}{\beta_1} = \frac{\lambda_2}{\lambda_1}$$

$$\Rightarrow \frac{\beta_2}{2mm} = \frac{600nm}{400nm} = \frac{3}{2}$$

46. B

Sol. Electromagnets are made of soft iron because it has high permeability and low retentivity.

So, Both A and R are correct and R is the correct explanation of A.

47. A

Sol. Intensity of light $\propto$ number of photons $\propto$ no of photo electrons $\propto$ photo current

So, A is correct

$KE_{max} = h\nu - \phi$

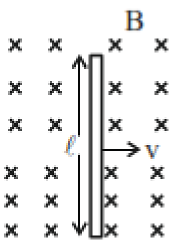
KE_{max} depends on frequency

So, C is correct

So, A and C are correct

48. A

Sol.



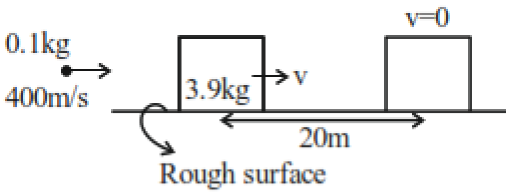
Induced emf $= Blv$

$$\Rightarrow 0.08 = 0.4\left(\frac{10}{100}\right)v$$

$$\Rightarrow v = \left(\frac{0.08 \times 10}{0.4}\right) \Rightarrow v = 2 \text{ m/s}$$

49. D

Sol.



$P_i = P_f$ (Collision)

$$\Rightarrow (0.1)(400) = (0.1 + 3.9)v$$

$$\Rightarrow v = \frac{0.1 \times 400}{4} = 10 \text{ m/s}$$

$$a = \frac{\mu mg}{m} = \mu g$$

Apply equation of motion,

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

$$\Rightarrow 0 = (10)^2 - 2\mu g \times 20$$

$$\Rightarrow 40\mu g = 100$$

$$\Rightarrow \mu = \frac{100}{2 \times 10 \times 20} = \frac{1}{4}$$

50. D

Sol. Power radiated form a linear antenna of length

$$l \propto \left(\frac{l}{\lambda}\right)^2$$

Section - B (Numerical Value)

51. 4

Sol. Quality factor $= \frac{X_L}{R} = \frac{\omega L}{R}$

$$\omega = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{1 \times 6.25 \times 10^{-6}}} = \frac{10^3}{2.5} = 400/\text{sec}$$

$$\text{Q-factor} = \frac{400 \times 1}{100} = 4$$

52. 60

Sol. $f = \frac{nv}{2l}$, for fundamental mode n = 1

$$f = \frac{v}{2l}$$

$$f \propto \frac{1}{l}$$

$$\frac{f_1}{f_2} \propto \frac{l_2}{l_1}$$

$$\frac{120}{180} = \frac{l_2}{90}$$

$l_2 = 60$ cm

53. 27

Sol. $\frac{1}{\lambda}=R\left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right]$ for H-atom

For balmer series, $n_1 = 2$

$$\frac{1}{\lambda}=R\left[\frac{1}{4}-\frac{1}{n_2^2}\right]$$

For H_α, $n_2 = 3$
& H_β, $n_2 = 4$

$$\frac{1}{\lambda_{H_\alpha}}=R\left[\frac{1}{4}-\frac{1}{9}\right]=\frac{5R}{36}$$

$$\frac{1}{\lambda_{H_\beta}}=R\left[\frac{1}{4}-\frac{1}{16}\right]=\frac{3R}{16}$$

$$\frac{\frac{1}{\lambda_{H_\alpha}}}{\frac{1}{\lambda_{H_\beta}}}=\frac{\frac{5R}{36}}{\frac{3R}{16}}$$

x = 27

54. 125

Sol. $n = 8 \times 10^{28}\ m^{-3}$
Area $= 2 \times 10^{-6}\ m^2$
I = 3.2 A
$I = neAv_d$

$$V_d=\frac{I}{neA}=125\times10^{-6}\ m/s$$

55. 4

Sol. Stress = Y × strain

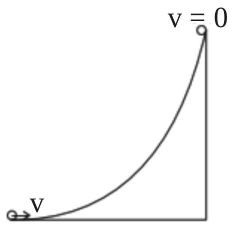
$$\text{Stress} = Y \times \frac{\Delta l}{l}$$

$$= Y \times \frac{l\alpha\Delta T}{l} = Y\alpha\Delta T$$

Compressive Tension = Stress × Area of cross section
$= YA\alpha\Delta T = 4 \times 10^4$ N

56. 75

Sol.



At highest point $KE_f = 0$

Initial KE = Translational KE + Rotational KE

$$=\frac{1}{2}mv^2+\frac{1}{2}I\omega^2$$

In case of rolling $v = R\omega$

$$=\frac{1}{2}mv^2+\frac{1}{2}\times\frac{2}{3}mR^2\times\frac{v^2}{R^2}=\frac{5}{6}mv^2$$

Apply energy conservation

$KE_i + PE_i = KE_f + PE_f$

$$\frac{5}{6}mv^2=mgh$$

$$h=\frac{5}{6\times10}\times9m=\frac{15}{20}m=75cm$$

57. 30

Sol. Given

M = 5 kg

P_i = 10 kg m/s (initial momentum)

Impulse $= F\Delta t = \Delta P = P_f - P_i$

$2 \times 5 = P_f - 10$

P_f = 20 kg m/s (final momentum)

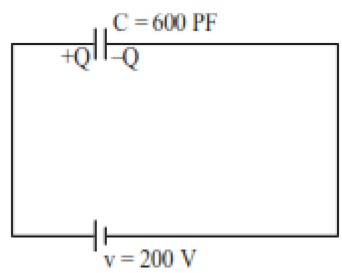
Increase in KE = $KE_f - KE_i$

$$=\frac{P_f^2}{2m}-\frac{P_i^2}{2m}$$

$$=\frac{400}{2\times5}-\frac{100}{2\times5}=40-10=30J$$

58. 6

Sol.

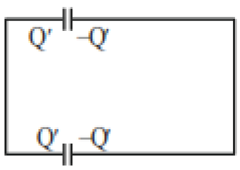


$Q = CV = 600 \times 10^{-12} \times 200 = 12 \times 10^{-8}$ C

Initial energy $=\frac{1}{2}CV^2$

$$= \frac{1}{2} \times 600 \times 10^{-12} \times (200)^2 = 12\mu J$$

When connected to another uncharged capacitor



Charge will be equally distributed on identical capacitor

$$Q' = \frac{Q}{2} = 6 \times 10^{-8}$$

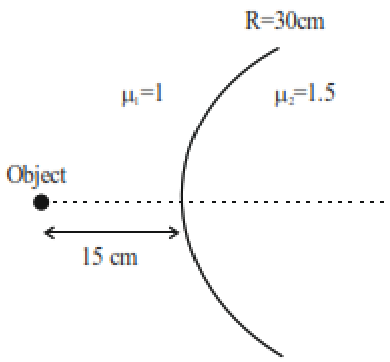
Final energy $= 2 \times \frac{Q'^2}{2C} = \frac{Q'^2}{C}$

$$\frac{(6 \times 10^{-8})^2}{600 \times 10^{-12}} = 6\mu J$$

Energy lost = Initial energy - Final energy = (12 – 6) μJ = 6μJ

59. 30

Sol.



$$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$$

$$\frac{1.5}{v} - \frac{1}{-15} = \frac{1.5-1}{30} = \frac{1}{60}$$

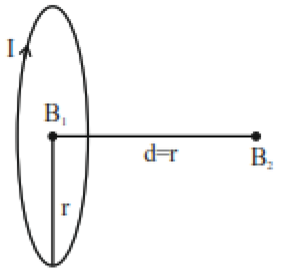
$$\frac{1.5}{v} + \frac{1}{15} = \frac{1}{60}$$

$$\frac{1.5}{v} = \frac{1}{60} - \frac{1}{15} = \frac{-1}{20}$$

$$\frac{1.5}{v} = -\frac{1}{20} \Rightarrow v = -30 \text{ cm}$$

60. 8

Sol.



Magnetic field at centre (B_1) $= \frac{\mu_0 I}{2r}$

Magnetic field on axis $= \frac{\mu_0 I r^2}{2(r^2 + d^2)^{3/2}}$

Value of d = r (given)

$$B_2 = \frac{\mu_0 I}{4\sqrt{2}r}$$

$$\frac{B_1}{B_2} = \frac{\mu_0 I}{2r} \times \frac{4\sqrt{2}r}{\mu_0 I} = \frac{2\sqrt{2}}{1} = \frac{\sqrt{8}}{1}$$

x = 8

CHEMISTRY

Section - A (Single Correct Answer)

61. C

Sol. All non zero digits are significant.
0.00253
Significant figures = 3(2, 5, 3)
1.0003
Zeros between non-zero digit are significant.
Thus, 1.0003 has 5 significant figures.
15.0
Significant number = 3
163
Significant number = 3
Options C – A, C and D

62. C

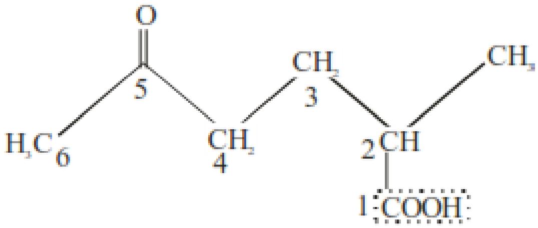
Sol. Ozone destruction

$$CF_2Cl_2 \xrightarrow{hv} Cl^{\bullet} + C^{\bullet}F_2Cl(g)$$

$$Cl^{\bullet} + O_3 \rightarrow ClO^{\bullet} + O_2$$

$ClO^{\bullet} + O^{\bullet} \rightarrow Cl^{\bullet} + O_2$

63. B

Sol. 

IUPAC NAME

2–Methyl–5–oxohexanoic acid

64. C

Sol. Vanderwaal constant – 'a'

(i) Ar = 1.34

(ii) CH_4 = 2.25

(iii) H_2O = 5.46

(iv) C_6H_6 = 18.57

'a' symbolises force of attraction and directly proportional to surface area

65. C

Sol. Methyl orange is weak base.

Benzenoid structure $\rightleftharpoons$ Quinonoid structure

(yellow coloured) (Red coloured) (more intense)

Statement I – FALSE

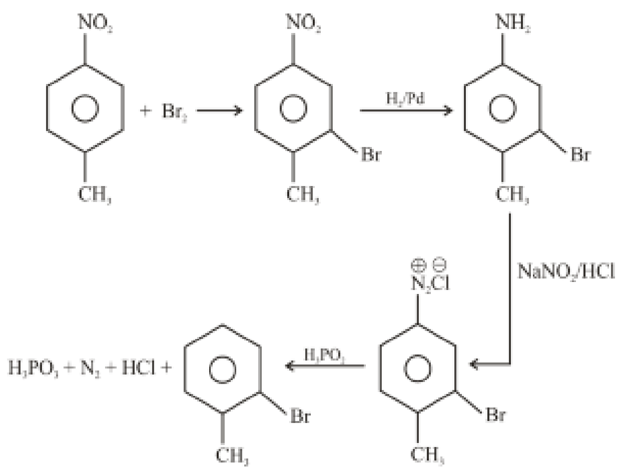
Statement II – FALSE

66. D

Sol. In redox titration, indicators are sensitive to oxidation potential and in acid base titration, indicators are sensitive to change in pH of solution. Both statement are false.

67. D

Sol.



68. B

Sol. By using positive catalyst :

(i) ΔH does not change

(ii) Activation energy decreases

69. B

Sol. Urea acts as a stabilizer in the decomposition of H_2O_2.

70. D

Sol. Drugs that bind to the receptor site and inhibit its natural function are called antagonists.

71. A

Sol. For option (A)

Cr^{+3} : $3d^3$

$CN^- \rightarrow$ SFL

$\Rightarrow$ No. of unpaired electrons = 3

For option (B)

Fe^{+2} : $3d^6$

H_2O : WFL

$\Rightarrow$ No. of unpaired electrons = 4

For option (C)

Co^{+3} : $3d^6$

NH_3 : SFL

$\Rightarrow$ No. of unpaired electrons = 0

For option (D)

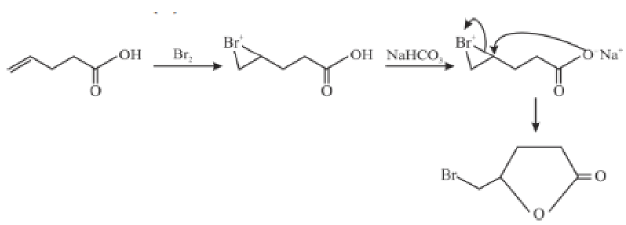
Ni^{+2} : $3d^8$

NH_3 : SFL

$\Rightarrow$ No. of unpaired electrons = 2

72. B

Sol.



73. A

Sol. In case of Hall's process, reduction of Al_2O_3 to Al can be done using graphite.

74. A

Sol. Due to bigger size of potassium, it forms more efficient lattices as compared to sodium with silicates.

The abundance of sodium in ocean is more due to the more soluble nature of salt of sodium as compared to potassium salts.

75. C

Sol. According to List I & List II option C is correct.

76. B

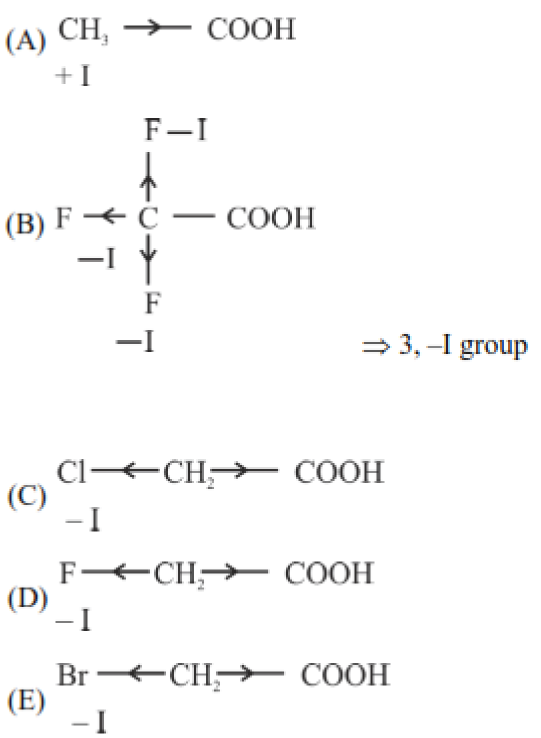
Sol. $\sqrt{v}\ \alpha\ Z$

77. D

Sol. Acidic strength $\alpha \dfrac{1}{+\text{I effect}}$

Acidic Strength α –I effect

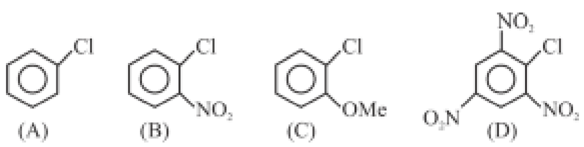
F > Cl > Br –I effect order



So Option D B > D > C > E > A.

78. D

Sol.



D > B > A > C

Option D is correct.

(–M) group increases reactivity where as (+M) group decreases reactivity of Halobenzene towards Nucleophilic substitution reaction.

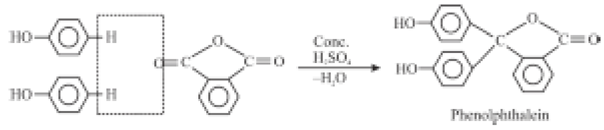
79. B

Sol. $\dfrac{\%\ CaO}{\%\ SiO_2 + \%\ Al_2O_3 + \%\ Fe_2O_3} = 1.9 - 2.1$

Option B is correct.

80. A

Sol.



Section - B (Numerical Value)

81. 233

Sol. $K_2SO_4 \longrightarrow 2K^+ + SO_4^{2-}$

$0.1\ M \qquad 0.2M \quad 0.1M$

$BaSO_4 \rightleftharpoons Ba^{+2} + SO_4^{2-}$

$a\text{–}S \qquad S \qquad S + 0.1 \approx 0.1$

$K_{SP} = S \times 10^{-1}$

$\Rightarrow 1\times10^{-10} = S \times 10^{-1}$

$\Rightarrow S = 10^{-9}\ \text{mol L}^{-1}$

So, $S = 10^{-9} \times 233\ \text{g L}^{-1}$

So, Answer : 233

82. 556

Sol. Coagulating Value $\propto \dfrac{1}{\underset{\text{(C.P.)}}{\text{Coagulating power}}}$

$\Rightarrow \dfrac{(C.V)_{AlCl_3}}{(C.V)_{NaCl}} = \dfrac{(C.P)_{NaCl}}{(C.P)_{AlCl_3}}$

$\Rightarrow \dfrac{0.09}{50.04} = \dfrac{(C.P)_{NaCl}}{(C.P)_{AlCl_3}}$

$\Rightarrow (C.P)_{AlCl_3} = 556 (C.P)_{NaCl}$

So, Answer = 556

83. 3

Sol. Radial node = n – ℓ – 1

7s ⇒ R.N = 7 – 0 – 1 = 6

7p ⇒ R.N = 7 – 1 – 1 = 5

6s ⇒ R.N = 6 – 0 – 1 = 5

8p ⇒ R.N = 8 – 1 – 1 = 6

8d ⇒ R.N = 8 – 2 – 1 = 5

So, Answer is 3

84. 1411

Sol. $C_2H_4(g) + 3O_2(g) \longrightarrow 2CO_2(g) + 2H_2O(\ell)$

$\Delta U = -1406$ KJ mol^{-1}, T = 300 K

$\Delta H = \Delta U + \Delta n_g RT$

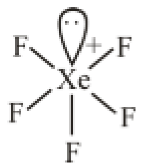
$\Delta H = -1406 + (-2) \times 8.3 \times 300 = -1406 - 4.98$

$= -1410.98$ KJ mol^{-1} ≈ -1411

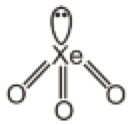
$\Delta H = T\Delta S = -1411$ KJ mol^{-1}

85. 4

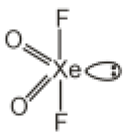
Sol. XeF_5^+



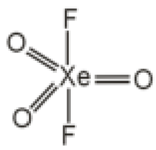
XeO_3



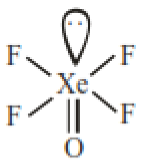
XeO_2F_2



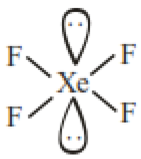
XeO_3F_2



$XeOF_4$



XeF_4



So, Answer is 4

86. 8

Sol. $\frac{(T_B)_x}{(T_B)_y} = \frac{2}{1} \qquad \frac{(\Delta H)_x}{(\Delta H)_y} = \frac{1}{2}$

$$\frac{(\Delta T_B)_x}{(\Delta T_B)_y} = m = \frac{(K_B)_x \times \text{molality}}{(K_B)_y \times \text{molality}}$$

$$= \frac{(T.B)_x^2}{(T.B)_y^2} \times \frac{\Delta H_y}{(\Delta H)_x} = (2)^2 \times 2 = 8$$

87. 10

Sol. $\overset{(0)}{Fe}(CO)_5 \qquad \overset{(+4)}{V}O^{2+} \qquad \overset{(+6)}{W}O_3$

So, Sum of oxidation state = 0 + 4 + 6 = 10

88. 4

Sol. $[Mn(NCS)_6]^{x-}$

Number of unpaired electron = 5

So, Mn must be in +2 oxidation state (Mn^{+2})

⇒ 2 + (–6) = –x

⇒ –4 = –x

⇒ x = 4

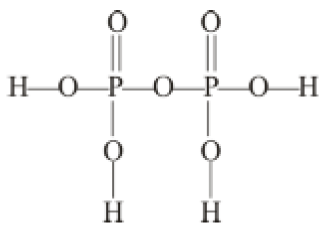
89. 1

Sol. Option B is incorrect

So, Answer is 1

90. 6

Sol.



$$\frac{\sigma}{\pi} = \frac{12}{2} = 6$$

So, Answer is 6

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