Some Basic Concepts of Chemistry

SOLUTIONS

Exercise – I (JEE-Main Pattern)

SECTION–A

1. Ans. (3)

$$1\text{amu} = \frac{1}{N_A}\text{gm} = \frac{1}{1000 \times N_A}\text{kg}$$

2. Ans. (2)

	CO_2	:	N_2O
Let mass =	2m		5m
Moles =	$\frac{2m}{44}$	:	$\frac{5m}{44}$
Molecules =	$\left(\frac{2m}{44} \times N_A\right)$	:	$\left(\frac{2M}{44} \times N_A\right)$; ratio of molecules = 2 : 5

3. Ans. (4)

(A) moles of C_2H_6 = $\frac{5}{30}$; moles of C-atom = $\frac{15}{30} \times 2 = 1$

(B) moles of $Na_2C_2O_4$ = $\frac{40.2}{134} = 0.3$; moles of C-atom = 0.3 × 2 = 0.6

(C) moles of $C_6H_{12}H_6$ = $\frac{72}{180}$; moles of C-atom = 0.4 × 6 = 2.4

(D) moles of C_5H_{10} = $\frac{35}{70}$; moles of C-atom = 0.5 × 5 = 2.5

4. Ans. (3)

moles of glucose = $\frac{0.9}{180}$ = 5×10^{-3}

moles of H-atom = $5 \times 10^{-3} \times 12$ = 0.06 moles

No. of H-atoms = $(0.06 \times N_A)$

(1) No. of H-atoms $\frac{0.048}{32} \times 4 \times N_A = 0.006 \times N_A$

(2) No. of H-atoms $\frac{0.17}{17} \times 3 \times N_A = 0.03 \times N_A$

(3) No. of H-atoms = $\frac{0.30}{30} \times 6 \times N_A = 0.06 \times N_A$

(4) moles of H-atoms = $\frac{0.03}{2} \times 2 \times N_A = .03 \times N_A$

5. Ans. (3)

wt. of NaI = $\frac{0.5}{100} \times 3 = \frac{1.5}{100}$ gm

moles of NaI = $\frac{\frac{1.5}{100}}{150} = 10^{-4}$ {mol. wt. (NaI) = 150}

moles of $I^{\ominus} = 10^{-4}$

No. of $I^{\ominus}$ ions = $6.02 \times 10^{23} \times 10^{-4} = 6.02 \times 10^{19}$

6. Ans. (1)

$NO_2(M = 46)$ $NO(M = 30)$

let % by mole = x% (100 – x)%

$$34 = \frac{x \times 46 + (100 - x) \times 30}{x + (100 - x)} \left\{ M_{av} = \frac{M_1 n_1 + M_2 n_2}{n_1 + n_2} \right\}$$

x = 25

7. Ans. (2)

Moles of carbon = $\frac{1.2 \times 10^{-3}}{12} = 10^{-4}$

No. of carbon atoms = $10^{-4} \times 6.02 \times 10^{23}$

$= 6.02 \times 10^{19}$

8. Ans. (3)

	Mg^{24}	Mg^{25}	Mg^{26}
mole% =	79	(21 – x)	x(let)

$$24.31 = \frac{79 \times 24 + (21 - x) \times 25 + x + 26}{79 + (21 - x) + x}$$

$2431 = 2421 + x \Rightarrow x = 10$

9. Ans. (2)

$$2Al + \frac{3}{2}O_2 \longrightarrow Al_2O_3$$

$\downarrow$ $\downarrow$

$\left(\frac{4}{3} \times \frac{1}{2}\right)$mole $\frac{1}{2}$mole

Moles of Al = $\frac{2}{3}$ $\Rightarrow$ wt. of Al = $\frac{2}{3} \times 27$ = 18gm

10. Ans. (2)

$n = \frac{4.4}{44} = 0.1$

V = 0.1 × 22.7 = 2.27 L

11. Ans. (3)

Values of ℓ

$0 \le \ell \le (n - 1)$

Values of m

$-\ell$ to $+\ell$

(C) $n = 3, \ell = 2, m = -3, m_s = \frac{1}{2}$

for $\ell = 2$, m should be from –2 to +2

12. Ans. (4)

$Na_4[Fe(CN)_6]$

Mole of Na = 2 × 4 = 8

Number of Na atom = $8 \times N_A$

13. Ans. (3)

$n_{NH_3} = \frac{1.7}{17} = 0.1$

neutron in nitrogen = ${}_7N^{14}$

= 14 – 7 = 7

neutron in Hydrogen = ${}_1H^1$

= 1 – 1 = 0

Total number of neutron = 7 + 0 = 7

Number of neutron = $\frac{1}{10} N_A \times 7$

14. Ans. (3)

$$(n + \ell) \text{ value} : \underset{\substack{\Downarrow \\ 5}}{\overset{3d}{(3+2)}} \quad \underbrace{\overset{4s}{(4+0)}}_{4} \quad \underbrace{\overset{3p}{(3+1)}}_{4} \quad \underbrace{\overset{3s}{(3+0)}}_{3}$$

for same value of (n + l), higher n value will have higher energy.

energy order 3d > 4s > 3p > 3s

15. Ans. (3)

$n_{CaCO_3} = \frac{10}{100} = \frac{1}{10}$

No. of molecule of $CaCO_3 = \frac{1}{10}$ Na

Number of proton in one molecule of

$CaCO_3 = 20 + 6 + 3 \times 8 = 50$

Total number of proton = $50 \times \frac{1}{10} \times N_A$

16. Ans. (3)

n_x	:	n_y
$\frac{W}{30}$	:	$\frac{W}{20}$
20	:	30
2	:	3

X_2 Y_3

17. Ans. (3)

$M_W = 2 \times V.D$

$= 2 \times 15 = 30$

$C_2H_6 \rightarrow M_W = 30 \Rightarrow \%C = \frac{24}{30} \times 100 = \frac{4}{5} \times 100 = 80\%$

18. Ans. (2)

$\rightarrow$ Glucose = $C_6H_{12}O_6 \Rightarrow$ empirical formula = CH_2O

CH_3COOH
$\downarrow$
CH_2O

19. **Ans. (2)**

$2Al + \frac{3}{2}O_2 \rightarrow Al_2O_3$

$\frac{3}{2}$ mole $\xrightarrow{O_2}$ 2 mole Al

1 mole $\rightarrow \frac{2}{3} \times 2 = \frac{4}{3}$ mole Al

$\frac{1}{2}$ mole $O_2 \rightarrow \frac{4}{3} \times \frac{1}{2} = \frac{2}{3}$ mole Al

$W_{A_1} = \frac{2}{3} \times 27 = 18$ g

20. **Ans. (4)**

$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$

$n_{NH_3} = \frac{6.8}{17} = 0.4$

4 mole NH_3 react with = 5 mole O_2

1 mole NH_3 react with = $\frac{5}{4}$ mole O_2

0.4 mole NH_3 = $\frac{5}{4} \times 0.4$ mole O_2

= 0.5 mole O_2

SECTION-B

1. **Ans. (3)**

$\underbrace{CH_3COOH}_{\text{molar mass}=60}$

60 gm CH_3COOH has 32 gm O

6 gm CH_3COOH will have 3.2 gm O-atoms

$\simeq 3$ gm (round off)

2. **Ans. (180)**

$\underbrace{CuSO_4\ 5H_2O}_{\text{molar mass}=249.5}$

249.5 gm $CuSO_4.5H_2O$ has 90 gm H_2O

499 gm $CuSO_4.\ 5H_2O$ will have 180 gm H_2O

3. **Ans. (55)**

Weight of carbon = $\left(\frac{3300 \times 200}{1000}\right)$gm

Moles of carbon = $\left(\frac{3300 \times 200}{1000 \times 12}\right) = 55$

4. **Ans. (36)**

Let's first balance the equation:

$4HCl + MnO_2 \rightarrow MnCl_2 + 2H_2O + Cl_2$

$\text{moles} = \frac{21.75}{87}$

= 0.25 moles

moles of HCl = 4 × moles of MnO_2 = 4 × 0.25 = 1

wt. of HCl = 36.5 gm

$\simeq 36$ gm (round off)

5. Ans. (59)

$$2H_3PO_4 \longrightarrow H_4P_2O_7 + H_2O$$

$\downarrow$ $\qquad\qquad$ $\downarrow$

$\underbrace{2\times0.3}_{0.6\,\text{moles}}$ $\qquad$ 53.4 gm

$= \dfrac{53.4}{178}$ moles

= 0.3 moles

Mass of H_3PO_4 = 0.6 × 98 = 58.80

$\simeq$59(round off)

6. Ans. (2)

Element	Mass per 100 g	Mole	Simplest ratio
C	58.77	58.77/12	5
H	13.81	13.81/1	14
N	27.42	27.42/14	2

E.F. = $C_5H_{14}N_2$ = 102 = M.F.

So, $\dfrac{y}{x+z} = \dfrac{14}{5+2} = 2$

7. Ans. (0)

$n_{Na} = \dfrac{5.75}{23} = 0.25$ mole

$\simeq 0$ (round off)

8. Ans. (6)

$n = \dfrac{\text{wt. of Mof}}{\text{wt. of Eof}} = \dfrac{84}{14} = 6$

9. Ans. (71)

1 mole = $\dfrac{\text{wt.}}{\text{mw}} = \dfrac{\text{wt.}}{71} = 71$

Element = uncombine state

But if not mentioned we always consider molecular form (Cl_2).

10. Ans. (68)

m_{Hg} = 13.6 × 1000 g (mass of mercury)

$n_{Hg} = m_{Hg}/200$ = 68 mole

Exercise – II (JEE-Main PYQs)

1. Ans. (1)

Number of orbitals in given shell = n^2

So, in 5^{th} shell number of orbitals = $(5)^2 \Rightarrow 25$

2. Ans. (3)

Hydrogen ${}_1H^1$ = 10%

weight of hydrogen in a person is = $75 \times \dfrac{10}{100}$ = 7.5 kg

${}_1H^1 \leftrightarrow {}_1H^2$

weight of ${}_1H^2$ in a person is $\Rightarrow 7.5 \times 2$

$\Rightarrow$ 15 kg

weight gain by person after replacement = 7.5 kg

3. **Ans. (3)**

Organic compound = $C_xH_yO_z$

$\frac{12\,x}{y} = \frac{6}{1}$

$\boxed{y = 2x}$ ...(1)

$C_xH_y + \left(x + \frac{y}{4}\right) O_2 \rightarrow xCO_2 + \frac{y}{2}\, H_2O$

To burn 1 molecule of $C_xH_y \rightarrow \left(x + \frac{y}{4}\right)$ molecule of O_2 required

Or

$\left(2x + \frac{2y}{4}\right)$ oxygen atom

$\boxed{Z = \frac{2x+\frac{2y}{4}}{2}}$ ...(2)

From (1) and (2) $Z = \frac{3x}{2}$

Empirical formula $= C_xH_{2x}O_{\frac{3x}{2}}$

$\Rightarrow C_{2x}\, H_{4x}\, O_{3x}$

$\Rightarrow C_2H_4O_3$

4. **Ans. (3)**

Chloro-hydrocarbon = C_xH_yCl

$\frac{3.55}{100} = \frac{35.5}{\text{M wt of chlorohydrocarbon}}$

M wt. of chloro-hydrocarbon = 1000 g

$n = \frac{1}{1000} = 10^{-3}$

Chlorine atoms in chloro-hydrocarbon = $10^{-3} \times N_A$

$= 6.023 \times 10^{20}$

5. **Ans. (1)**

$2C_{57}H_{110}O_6 + 163O_2 \longrightarrow 114CO_2 + 110\, H_2O$

2×890 g $\rightarrow 110 \times 18$g H_2O [molar mass of $C_{57}H_{110}O_6$ = 890 gm]

$1g \rightarrow \frac{110\times18}{890\times2}$

445 g $C_{57}H_{110}O_6$ give $\rightarrow \frac{110\times18}{890\times2} \times 445 = 495$ gm

6. **Ans. (2)**

$$C_xH_y + O_2 \longrightarrow XCO_2 + \frac{y}{2}H_2O$$

Wt of carbon $= \frac{88}{44} \times 12 = 24$ g

Wt of hydrogen $= \frac{9}{18} \times 2 = 1$g

7. **Ans. (4)**

Electronic Configuration of element X with atomic number 71 is $[Xe]4f^{14}6s^25d^1$.

The last electron will enter in 5d orbital.

8. Ans. (2)

As the value of $(n+\ell)$ increases energy increases. In case of same value of $(n+\ell)$ energy increases with increase in value of 'n'.

			$(n+\ell)$
(I)	n = 4,	$\ell = 2$	6
(II)	n = 3,	$\ell = 2$	5
(III)	n = 4,	$\ell = 1$	5
(IV)	n = 3,	$\ell = 1$	4

So, increasing order of energy.

(iv) < (ii) < (iii) < (I)

9. Ans. (2)

no. of orbitals in a given shell (n) = n^2

So, in 5^{th} shell no. of orbitals = $(5)^2$

= 25

10. Ans. (4)

$Zn + 2HCl \longrightarrow ZnCl_2 + H_2$

$Zn + 2NaOH \longrightarrow Na_2ZnO_2 + H_2$

The ratio of volume H_2 is 1 : 1

11. Ans. (3)

The third option statement is Avogadro's Law

12. Ans. (3)

$$C_xH_yO_z + O_2 \longrightarrow \underset{\substack{2.64g \\ .06mol}}{CO_2} + \underset{\substack{1.08g \\ .06mol}}{H_2O}$$

n_{CO_2} = .06 ml $\Rightarrow$ n_C = .06 mol = .06 × 12g = .72g

n_{H_2O} = .06 mol $\Rightarrow$ n_H = .12 mol = .12 × 1 g = .12g

mass of O in 0°C = 1.80 – .72 – .12

= .96 gm

$$\% \text{ of O in O.C.} = \frac{96}{1.8} \times 100 = 53.33\%$$

13. Ans. (1)

Cl_2

$$n = \frac{PV}{RT} = \frac{1 \times 20 \times 10^{-3}}{.083 \times 273}$$

$$\text{Number of chlorine atom} = \frac{1 \times 20 \times 10^{-3}}{.083 \times 273} \times 2 \times 6.023 \times 10^{23}$$

= 1.06×10^{21}

$\approx 1...... \times 10^{21}$

14. Ans. (18)

$C_2H_6 + \frac{7}{2}O_2 \rightarrow 2CO_2 + 3H_2O$

$\frac{3}{30}$ 0.3 mol

= 0.1 mol molecule = $.3 \times 6.023 \times 10^{23}$

$= 18.069 \times 10^{22}$

(Answer after rounding off) = 18

15. Ans. (4)

Given mass of organic compound = 120

mass of $CO_2(g)$ = 330 g

mass of H_2O (ℓ) = 270 g

mass of carbon = $n_{CO_2} \times 12$

$= \frac{330}{44} \times 12 = 90g$

% of carbon = $\frac{90}{120} \times 100 = 75\%$

mass of hydrogen = $n_{H_2O} \times 2$

$= \frac{270}{18} \times 2 = 30g$

% of hydrogen = $\frac{30}{120} \times 100 = 25\%$

16. Ans. (3)

$C_{15}H_{30} + \frac{45}{2}O_2 \rightarrow 15CO_2 + 15H_2O$

Mass of fuel = 0.756×1000 g

No. of moles of fuel = $\frac{0.756 \times 1000}{210}$

Wt. of oxygen = $\frac{0.756 \times 1000}{210} \times \frac{45}{2} \times 32 = 2592g$

Wt. of CO_2 = $\frac{0.756 \times 1000}{210} \times 15 \times 44 = 2376$ g

17. Ans. (11)

Percentage of Carbon

$= \frac{12}{44} \times \frac{\text{mass of } CO_2 \text{ formed}}{\text{mass of compound taken}} \times 100$

$60 = \frac{12}{44} \times \frac{\text{mass of } CO_2 \text{ formed}}{0.5} \times 100$

Mass of CO_2 formed = $\frac{60 \times 44 \times 0.5}{12 \times 100}$ g

= 1.1 gram

= 11×10^{-1} gram

18. Ans. (4)

Solute (X) = 2 g

Solvent (H_2O) = 1 mole = 18 g

Total mass = 2 + 18 = 20 g

% mass of X = $\frac{2}{20} \times 100 = 10\%$

19. Ans. (4)

$\mu = \sqrt{n(n+2)}BM$

$4.90 = \sqrt{n(n+2)}$

n = 4

20. Ans. (2)

(A) n = 3; l = 0; m = 0 ; 3s orbital

(B) n = 4; l = 0; m = 0 ; 4s orbital

(C) n = 3; l = 1; m = 0 ; 3p orbital

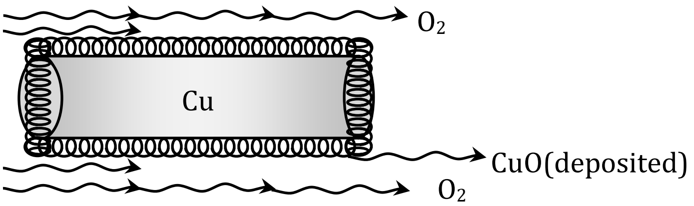
(D) n = 3; l = 2; m = 0 ; 3d orbital

As per Hund's rule energy is given by (n+*l*) value. If value of (n+*l*) remains same then energy is given by n only.

Exercise - III (JEE Advanced Pattern)

SECTION–I

1. Ans. (B)



$$Cu(s) + \frac{1}{2} O2(g) \rightarrow CuO(s)$$

Initial: 4 gm

$\frac{4}{64}$ moles

Finally : $\left(\frac{1}{16} - x\right)$ moles   x moles

$\left(\frac{1}{16} - x\right) \times 64$ gm $(x \times 80)$ gm

$$\left(\frac{1}{16} - x\right) \times 64 + 80x = 4.9$$

$16x = 0.9 \Rightarrow x = \frac{0.9}{16}$

%oxidized = $\frac{x}{1/16} \times 100 = 90\%$

% unoxidized = 10%

2. Ans. (D)

1 gram ion = 1 mole ion = N_A ion

1 mol $Al^{3\oplus}$ ion = $N_A \times 3$ ion

Charge (e) on 1 mol $Al^{3\oplus}$ ion = $N_A \times 3 \times$ e coulomb.

3. Ans. (C)

$KClO_3 \xrightarrow{\Delta} KCl \quad + \quad \frac{3}{2}O_2 \uparrow$

1 mole $\qquad \frac{3}{2}$ mol

1×122.5 g $\qquad \frac{3}{2} \times 32$

$1 \longrightarrow \frac{\frac{3}{2}\times 32}{122.5} = 0.3918$

% Loss = 0.3918 × 100 = 39.18 or 39.17

4. Ans. (D)

% by wt. of H_2O ($H_2O\%$) = $\frac{\text{wt.of } H_2O}{\text{Total wt.}} \times 100$

$50 = \frac{18x}{142+18x} \times 100$

71 + 9x = 18x

x = 71/9 = 7.88 ≈ 8

5. Ans. (B)

	X	Y
%	50	50
	50/10	50/20
	2	1

So, E.F. = X_2Y

6. Ans. (B)

Element	C	H	N	O
%	70.8	6.2	4.1	18.9
Mole	$\frac{70.8}{12} \simeq 6$	$\frac{6.2}{1} \simeq 6$	$\frac{4.1}{14} \simeq 0.3$	$\frac{18.9}{16} \simeq 1.2$
Simplest ratio	20	20	1	4

So, E.F. = $C_{20}H_{20}NO_4$

7. Ans. (D)

	^{63}Cu	^{65}Cu
% abundance	x	100 – x

Avg. mass = $\frac{M_1x_1+M_2x_2}{x_1+x_2}$

$63.546 = \frac{63\times x+65(100-x)}{100}$

6354.6 = 63x + 6500 – 65 x

2x = 145.4 ⇒ x = 72.7 %

8. **Ans. (A)**

$3Fe_2O_3(s) \longrightarrow 2Fe_3O_4(s) + \frac{1}{2}O_2(g)$

$\frac{x}{160}$ moles $\qquad \frac{1}{6} \times \frac{x}{160}$

$\frac{x}{6\times160} \times 32 = 0.04 = 1.5 - 1.46 =$ weight of O_2

$\rightarrow$ x = 1.29

$\rightarrow$ $\% = \frac{1.2}{1.5} \times 100 = 80\%$

9. **Ans. (D)**

$n_{O_2} = \frac{16}{32} = \frac{1}{2}$ No. of O_2 atoms $= \frac{1}{2} \times N_A \times 2 = N_A$

$n_{O_3} = \frac{16}{48} = \frac{1}{3}$ No. of O_3 atoms $= \frac{1}{3} \times N_A \times 3 = N_A$

10. **Ans. (C)**

Let the atomic weight of A and B are a & b

wt. of 0.05 moles of B_2A_3 = 9 g

wt. of 0.1 mole of B_2A = 10 g

then wt. of 1 moles of B_2A_3 = 180 and

wt. of 1 mole of B_2A = 100

$\because$ wt. of 1 mole of compound = mol wt.

mol. wt. of B_2A_3 : 2b + 3a = 180 ...(i)

mol. wt. of B_2A : 2b + a = 100 ...(ii)

From (i) & (ii) a = 40

b = 30

SECTION-II

11. **Ans. (D)**

12. **Ans. (C)**

13. **Ans. (B)**

(11 to 13)

(P) 60 gm hydrocarbon having 20; Handreste

	C		H	
Mass	80%		20%	wt of H = 12 gm Mole of H = 12
Moles ratio	$\frac{80}{12}$	:	$\frac{20}{1}$	No. of H-atoms = 12 N_A
				Moles of C = $\frac{48}{12}$ = 4 mol
	1	:	3	No. of C-atoms = $4N_A$ Total atoms = $15N_A$

(Q) 240 gm NH_2CONH_2 $\%C = \frac{12}{60}\times 100 = 20$

Molar of $NH_2CONH_2 = \frac{12}{60}\times 100 = 4$ $\%N = \frac{28}{60}\times 100 = 20$

Molar of N atom = 8 $\Rightarrow$ N-atoms = $8N_A$

Molar of H atom = 16 $\Rightarrow$ H-atoms = $16N_A$

Molar of C atom = 4 $\Rightarrow$ C-atoms = $4N_A$

Molar of O atom = 4 $\Rightarrow$ $\frac{O-\text{atoms}=4N_A}{\text{Total}=32N_A}$

(R) 120 gm CH_3COOH molar of $\%\ C=\frac{24}{60}\times 100=40\%$

CH_3COOH = 2 molar $\%\ O=\frac{32}{60}\times 100=\frac{160}{3}$

C-atoms = $4N_A$ $\%\ H=\frac{4}{60}\times 100=\frac{20}{3}$

H-atoms = $8N_A$

O-atoms = $4N_A$

(S) 120 gm $C_6H_{12}O_6$

Moles of $C_6H_{12}O_6 = \frac{120}{180}=\frac{2}{3}$

Moles of C = 4 : C-atoms = $4N_A$ $\%\ C=\frac{96}{180}\times 100$

Moles of H = 8 : H-atoms = 8 N_A $\%\ H=\frac{12}{180}\times 100$

Moles of O = 4 : O-atoms = $4N_A$ $\%\ O=\frac{96}{180}\times 100$

SECTION–III

14. Ans. (A)

$Y_3Al_5O_{12}$. (Molar mass = 594)

$\%\ Y = \frac{3\times 89}{594}\times 100 = 44.95\%$

$\%\ Al = \frac{135}{594}\times 100 = 22.72\%$

$\%\ O = \frac{192}{594}\times 100 = 32.32\%$

15. Ans. (C)

$C_6H_8O_6$ (17.6 mg)

Molar of vitamin C (daily) = $\frac{17.6\times 10^{-3}}{176}=10^{-4}$

In 1 gm vitamin C molar = $\frac{1}{176}=5.68\times 10^{-3}$

O-atoms = $10^{-4} \times 6 \times 6 \times 10^{23} = 36 \times 10^{19}$

$= 3.6 \times 10^{20}$

SECTION-IV

16. **Ans. (6.02)**

let the monovalent metal be : M, the carbonate will be : M_2CO_3

let atomic wt. of metal = x

$\% \, O = 48 = \frac{48}{(2x+60)} \times 100 \qquad \Rightarrow x = 20$

Molar mass of M_2CO_3 = 100

Moles of metal carbonate = $\frac{5\times10^{-3}}{100}$

Molar of metal atom = $\frac{5\times10^{-3}}{100} \times 2 = 10^{-4}$

No. of metal atoms = $10^{-4} \times 6.022 \times 10^{23}$

17. **Ans. (11.00)**

$$\underset{\text{Let x moles}}{P_4S_3} + 8O_2 \rightarrow \underset{\substack{\downarrow \\ 0 \text{ moles} \\ (284\,x)\text{gm}}}{P_4O_{10}} + \underset{\substack{\downarrow \\ 3x \text{ moles} \\ (192\,x)\text{gm}}}{3SO_2}$$

Since, at least 9.6 gm of each product should be formed, so let us keep the less amount of product equal to 9.6 gm. The other product will be more than this.

$192x = 9.6 \Rightarrow x = 0.05$ mole

wt of $P_4S_3 = 0.05 \times 220 = 11$ gm

18. **Ans. (9)**

Here we need only $m_s = \left(-\frac{1}{2}\right)$, electrons

Cr_{24} =	$1s^2$	$2s^2$	$2p^6$	$3s^2$	$3p^6$	$4s^1$	$3d^5$
	⇅	⇅	⇅ ⇅ ⇅	⇅	⇅ ⇅ ⇅	↑	↑ ↑ ↑ ↑ ↑
$m_s = \left(-\frac{1}{2}\right)$ electron =	1	1	3	1	3	0	0

if $\uparrow = +\frac{1}{2}$spin

$\downarrow = -\frac{1}{2}$spin

then total electrons with $-\frac{1}{2}$spin $= 9$

19. **Ans. (8)**

$n = 1$ to ∞ , $\ell = 0$ to $(n + 1)$

$$\boxed{\begin{array}{ll} n = 1 & ,\ell = 0,1,2 \\ n = 2 & ,\ell = 0,1,2,3 \end{array}}$$

$\ell = 0$ (s)

$\ell = 1$ (p)

$\ell = 2$ (d)

$\ell = 3$ (f)

Aufbau's diagram

$(1s^2 \quad 1p^6) \quad (2s \quad 1d \; 2p)$

$8e^-$ can be filled for 2nd shell start filling electron
$(1s^1\ 1p^0)$, $(1s^2\ 1p^0)$, $(1s^2\ 1p^1)$, $(1s^2\ 1p^2)$, $(1s^2\ 1p^3)$, $(1s^2\ 1p^4)$
$(1s^2\ 1p^5)$ $(1s^2\ 1p^6)$ = Represents Total 8 different elements

20. Ans. (0)

Here if $(n + \ell)$ rule not followed and filling of electron takes shell after shell then orbital energy order

$\Rightarrow$ 1s 2s 2p 3s 3p 3d 4s 4p ....

$\Rightarrow$ Electronic configuration of Fe

$$\boxed{Fe_{26} = 1s^2\, 2s^2\, 2p^6\, 3s^2\, 3p^6\, 3d^8}$$

Now <u>Hunds rule is not obeyed</u> then box diagram

↑↓	↑↓	↑↓ ↑↓ ↑↓	↑↓	↑↓ ↑↓ ↑↓	↑↓ ↑↓ ↑↓ ↑↓
$1s^2$	$2s^2$	$2p^6$	$3s^2$	$3p^6$	$3d^8$

$\Rightarrow$ Zero unpaired electron

Exercise - IV (JEE Advanced PYQs)

1. Ans. (3)

We have 25.2, 25.25 and 25.0 ml.

$$\text{Average} = \frac{25.2 + 25.25 + 25.0}{3}$$

$$= \frac{75.45}{3}$$

$= 25.15 \simeq 25.1$ significant figures = 3

(If two or more numbers having different precision are to be added or subtracted, the answer should be taken as the number of decimal places in the number having less decimal places).
The number of significant figures in the average titre value is 3.

2. Ans. (9)

for n = 3 ; $\ell = 0, \; 1, 2$

$\ell = 0 \longrightarrow m = 0$

$\ell = 1 \longrightarrow m = -1, 0, +1$

$\ell = 2 \longrightarrow m = -2, -1, 0, +1, +2$

Tota orbitals (no. of values of 'm') = 9 since $m_s = -\frac{1}{2}$, it means only one e^- must be present in each orbital since the other e^- will be having $m_s = +\frac{1}{2}$

Hence maximum no. of e^-s = 9

Answer = 9

3. **Ans. (6)**

$n = 4$; $\ell = 0, 1, 2, 3$

Also $|m_1| = 1$; $m_\ell = (+1)$ and (-1)

$\ell = 0 \longrightarrow m = 0$

$\ell = 1 \longrightarrow m = -1, 0, +1$

only circled values are permitted

$\ell = 2 \longrightarrow m = -2, -1, 0, +1, +2$

$\ell = 3 \longrightarrow m = -3, -2, -1, 0, +1, +2, +3$

$\Rightarrow$ Total permitted values of $m_\ell = 6$

$\Rightarrow$ Since $m_s = -\frac{1}{2}$, only one e^- will counted in each orbital

Total $e^- = 6 \times 1 = 6$

Answer = 6.

4. **Ans. (4)**

$\Rightarrow K_B = \frac{R}{N_A}$

$R = K_B \times N_A$

$= 1.380 \times 10^{-23} \times 6.023 \times 10^{23}$

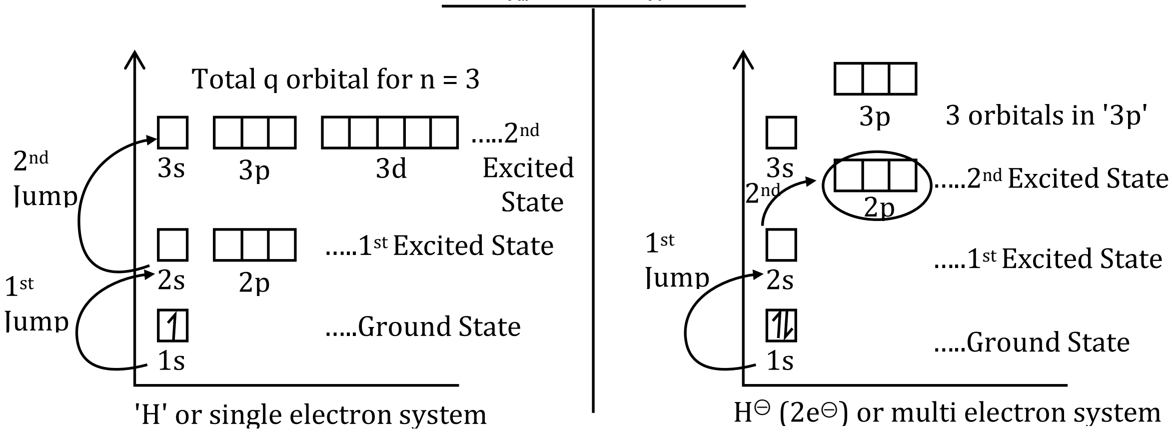
$= 8.31174$

$\simeq 8.312$

Significant figures = 4

5. **Ans. (3)**

Energy level diagrams



$\Rightarrow$ For a single $e^\ominus$ system, the value of degeneracy (number of orbitals having same energy) is equal to total number of orbitals in s shell

For H ; in n = 3 , total orbitals = $3^2 = 9$

$\Rightarrow$ This means total 9 degenerate orbitals are present in second excited state (n=3) of H. (Given in question)

$\Rightarrow$ Now H^1 is like He (a multi electron system) and in multi-electronic system, energy of subshells is based on AUFBAU's RULE

Hence the e^- present in is will 1^{st} excite to 2s and then to 2p.

$\Rightarrow$ Hence 2^{nd} excited state for H^1 = 2p

In 2p, only 3 degenerate orbitals are present.

Answer = 3

6. Ans. (2992)

$$\underset{\substack{1584g\\=12mol}}{(NH_4)_2SO_4} + Ca(OH)_2 \longrightarrow \underset{\substack{gypsum(M=172)\\12mol}}{CaSO_4.2H_2O} + \underset{24mole}{2NH_3}$$

$$\underset{952g=4mol}{NiCl_2 \cdot 6H_2O} + \underset{24mol}{6NH_3} \longrightarrow \underset{\substack{(M=232)\\4mol}}{[Ni(NH_3)_6]Cl_2} + 6H_2O$$

Total mass = 12 (172) + 4(232) = 2992 g

7. Ans. (6.47)

$PbS + O_2 \longrightarrow Pb + SO_2$

mol of Pb = mol of O_2

$= \dfrac{1000}{32}$ mol

$\therefore$ mass of Pb $= \dfrac{1000}{32} \times 207$ gm

$= \dfrac{207}{32}$ kg = 6.47 kg