RACE # 5

1. Column-I **Column-II**

P ← (A) No. of electrons in Na(11) having m = 0 (P) 7

R ← (B) No. of electrons in S(16) having $(n + \ell) = 3$ (Q) 15

Q – (C) No. of maximum possible electrons having $s = +1/2$ spin in Cr(24) (R) 8

(S) 12

(A) Na(11) = $1s^2, 2s^2, 2p^6, 3s^1$

$\ell = 0 \quad 0 \quad 1 \quad 0$

$m = 0 \quad 0 \quad -1, 0, +1 \quad 0$

total = 7

$S = (16) = 1s^2, 2s^2, 2p^6, 3s^2, 3p^4$

$n =$	1	2	2	3	3
$l =$	0	0	1	0	1
$n + l =$	1	2	3	3	4

$\longrightarrow$ total $= 8$

$Cr\,(24) = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^5, 4s^1$

$l = \underbrace{0 \quad 0 \quad 1 \quad 0 \quad 1}_{18e^-} \quad \underbrace{2 \quad 0}_{\text{for maximum all contain } +1/2 = 6}$

$18e^- \rightarrow +\frac{1}{2} = 9$

$18e^- \rightarrow -\frac{1}{2} = 9$

$9 + 6 = 15$

2. Imagine a universe in which the four quantum no. can have the same possible values as in our universe except that angular quantum no. (l) can have integral values from 0, 1, 2 .... n + 1.

Find the no. of electron n = 1 & 2 shell.

for $n = 1$, $l = 0, 1, 2$

$$\begin{array}{ccc} s & p & d \\ \downarrow & \downarrow & \downarrow \\ 2 & +6 & +10 \end{array} = 18e^-$$

For $n = 2$

$$l = \begin{array}{cccc} 0, & 1, & 2, & 3 \\ \downarrow & \downarrow & \downarrow & \downarrow \\ s & p & d & f \end{array}$$

$$2 + 6 + 10 + 14 = 32e^-$$

3. The total number of subshells in n^{th} main energy level are :

(A) n^2 (B) $2n^2$ (C) $2n + 1$ ~~(D)~~ n.

total No of subshell for given shell (n) = n

4. Which of the following orbital does not make sense :

(A) 4d ~~(B)~~ 3f always (C) 5p (D) 7s

$n = 4$, $l = 2$

$n = 3$, $l = 3$

$n > l$

$n = 5$, $l = 1$

$n = 7$, $l = 0$

5. The correct order of the maximum spin of $[_{25}Mn^{4+}, {}_{24}Cr^{3+}, {}_{26}Fe^{3+}]$ is :

(A) $Fe^{3+} > Cr^{3+} = Mn^{4+}$ (B) $Fe^{3+} = Cr^{3+} > Mn^{4+}$ (C) $Cr^{3+} = Mn^{4+} > Fe^{3+}$ (D) $Fe^{3+} > Mn^{4+} > Cr^{3+}$

$Mn(24) = [Ar], 3d^5, 4s^2$

$Mn^{+4} = [Ar], 3d^3$ $\boxed{\uparrow}\boxed{\uparrow}\boxed{\uparrow}\boxed{\ }\boxed{\ }$ $n = 3$

$Fe(26) = [Ar], 3d^6, 4s^2$

$Fe^{+3} = [Ar], 3d^5$ $\boxed{\uparrow}\boxed{\uparrow}\boxed{\uparrow}\boxed{\uparrow}\boxed{\uparrow}$ $n = 5$

$Cr(24) = [Ar], 3d^5, 4s^1$

$Cr^{+3} = [Ar], 3d^3$ $\boxed{\uparrow}\boxed{\uparrow}\boxed{\uparrow}\boxed{\ }\boxed{\ }$ $n = 3$

then magnetic moment order

$Fe^{+3} > Mn^{+4} = Cr^{+3}$

6. A neutral atom of an element has 2K, 8L, 9M and 2N electrons. Which of the following is/are correctly matched :

(A) Total number of s electrons - 8
(B) Total number of p electrons - 12
(C) Total number of d electrons -1
(D) Number of unpaired electrons in element - 3

K	L	M	N
2	8	9	2
$1s^2$	$2s^2$	$3s^2$	$4s^2$
	$2p^6$	$3p^6$	
		$3d^1$	

total No of electrons = 8

total No of -P electrons = 12

total No of d electrons = 1

No of unpaired e^- = 1

7. Spin only magnetic moment of $_{25}Mn^{x+}$ ion is $\sqrt{15}$ B.M. Then, What is the value of x .

$Mn(25) = [Ar], 3d^5, 4s^2$

$\mu = \sqrt{15}$

$\sqrt{n(n+2)} = \sqrt{15}$

$n = 3$

for n unpaired $\bar{e} = 3$ ✓

$Mn^{+4} = [Ar], 3d^3, 4s^0$

8. (a) If the value of Azimuthal Quantum Number ℓ for an electron in a particular subshell is 3, then the minimum value of shell number associated with this electron can be x

$\ell = 3$, $n = 4, 5, 6, 7 \ldots$

minimum value $= 4$ (X)

(b) Orbital angular momentum of an electron is $\sqrt{3}\frac{h}{\pi}$. Then, the number of orientations of this orbital in space is y :

Give the value of (y-x)

orbital angular momentum = $\sqrt{l(l+1)}\frac{h}{2\pi}$

$$\sqrt{l(l+1)}\frac{h}{2\pi} = \sqrt{3}\frac{h}{\pi}$$

$l = 3$

No of orientation = No of orbital

$= 2l+1$

$= 2\times3+1 = 7$ (y)

$(y-x) = 7-4 = 3$

MATCH THE COLUMN

9.

Column-I	Column-II
RS (A) N_2	(P) 40% carbon by mass
RS (B) CO	(Q) Empirical formula CH_2O
PQ (C) $C_6H_{12}O_6$	(R) Vapour density = 14
PQ (D) CH_3COOH	(S) $14N_A$ ($N_A = 6.023 \times 10^{23}$) electrons in a mole

$e = 14$

$p = 14$

$e^- = 8 + 6 = 14$

(A) vapour density $= \frac{28}{2} = 14$, no of $e^- = 1 \times 14 \times N_A$
$= 14N_A$

(B) vapour density $= \frac{28}{2} = 14$, no of $e^- = 1 \times 14 \times N_A$
$= 14N_A$

(C) $\% C = \frac{12 \times 6}{180} \times 100 = 40\%$, Empirical formula $= CH_2O$

(D) $\% C = \frac{2 \times 12}{60} \times 100 = 40\%$ empirical formula $= CH_2O$

10. **Column-I** | **Column-II**

Column-I		Column-II
(A) Vapour density	(P, S)	(P) Unitless
(B) 1 mol	(Q, R)	(Q) 6.023×10^{23} electrons
(C) 12 g carbon	(R)	(R) 6.023×10^{23} atoms
(D) 96500 C	(Q)	(S) $\frac{1}{2} \times$ Molecular mass

(A) vapour density is relative density so unitless

$$V.D = \frac{M_{wt}}{2}$$

(B) 1 mole = 6.023×10^{23} electrons, 6.022×10^{23} atom

(C) 12 gram Carbon = $\frac{12}{12}$ = 1 mol, atoms = $1 \times N_A$

96500 coulomb means = 1 mole electrons

$= 6.022 \times 10^{23}$ electrons

11. **Column-I** | **Column-II**

Column-I		Column-II
(A) N^{3-} (1 mol)	$e = 7+3 = 10$, $p = 7$	(P) 10 mol electrons
(B) O^{2-} (1 mol)	$e^- = 8+2 = 10$, $p = 8$	(Q) 8 mol protons
(C) CH_4 (1 mol)	$e^- = 6+4 = 10$, $p = 10$	(R) 6.023×10^{24} electrons
(D) H_2O (1 mol)	$e^- = 2+8 = 10$, $p = 10$	(S) 10 mol protons

(A) N^{-3} moles of $e^- = 1 \times 10 = 10$, moles of protons $= 1 \times 7$

No of $e^- = 10 \cdot N_A = 10 \times 6.02 \times 10^{23} = 6.02 \times 10^{24}$

(B) O^{-2} moles of $e^- = 1 \times 10 = 10$, No of $e^- = 10 \times 6 \times 10^{23} = 6 \times 10^{24}$

moles of $p = 1 \times 8 = 8$

CH_4

(C) moles of e = $1\times10 = 10$, No of e^- = $10 N_A$

$= 6.02\times10^{24}$

moles of p = $1\times10 = 10$

$H_2O(l)$

(D) moles of e = $1\times10 = 10$, no of e^- = $10 N_A$

$= 6.022\times10^{24}$

Moles of protons = $1\times10 = 10$

$A\rightarrow(P,R)$, $B\rightarrow(P,Q,r)$, $C\rightarrow(PRS)$, $D\rightarrow(P,RS)$

12. **Column-I** | **Column-II**

(P, S) (A) 0.5 mol SO_2 (g) | (P) Occupy 11.2 L at NTP

(P) (B) 1 g of H_2 (g) | (Q) Weighs 16 g

(P, Q) (C) 0.5 mol O_2 (g) | (R) Number of atoms = $2 \times 6.023 \times 10^{23}$

(R, S) (D) One gram mole of O_2(g) | (S) Weighs 32 g

(A) 0.5 mole SO_2

- mass = $0.5 \times 64 = 32g$
- volume = $0.5 \times 22.4 = 11.2$ L
- No of atoms = $0.5 \times N_A \times 3 = 1.5 \times N_A$

(B) moles of $H_2 = \frac{1}{2} = 0.5$

- volume = $22.4 \times 0.5 = 11.2$
- No of atoms = $0.5 \times N_A \times 2 = N_A$

(C) 0.5 moles of O_2

- mass = $0.5 \times 32 = 16g$
- volume = $0.5 \times 22.4 = 11.2$ L

(D) moles = 1

- mass = $1 \times 32 = 32g$
- No of atoms = $1 \times N_A \times 2 = 2 \times 6.02 \times 10^{23}$

13. An unknown compound contains 8% sulphur by mass. Calculate

(a) Least molecular weight of the compound and

(b) Molecular weight if one molecule contains 4 atoms of "S"

(A) 200, 400 (B) 300, 400 (C) 400, 1600 (D) 400, 1200

$$\% S = \frac{\text{Atomic mass of S} \times \text{atomicity}}{\text{Molecular mass}} \times 100$$

(a) for Least molecular mass atomicity = 1

$$8 = \frac{32 \times 1}{\text{Molecular mass}} \times 100 \Rightarrow \text{molecular mass} = 400$$

(b) atomicity = 4

$$8 = \frac{32 \times 4}{\text{Molecular mass}} \times 100 \Rightarrow \text{molecular mass} = 1600$$