

RACE # 5

1. Column-I

- P ← (A) No. of electrons in Na(11) having $m = 0$
- R ← (B) No. of electrons in S(16) having $(n + \ell) = 3$
- Q ← (C) No. of maximum possible electrons having $s = +1/2$ spin in Cr(24)

Column-II

(P) 7

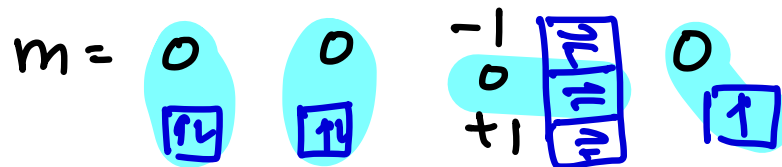
(Q) 15

(R) 8

(S) 12



$l = 0 \quad 0 \quad 1 \quad 0$



total = 7

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

$$n = 1 \quad 2 \quad 2 \quad 3 \quad 3$$

$$l = 0 \quad 0 \quad 1 \quad 0 \quad 1$$

$$n+l = 1 \quad 2 \quad 3 \quad 3 \quad 4$$

total = 8

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

$$l = 0 \quad 0 \quad 1 \quad 0 \quad 1 \quad 2 \quad 0$$

$$9 + 6 = 15$$

$$18e^- \begin{cases} +\frac{1}{2} = 9 \\ -\frac{1}{2} = 9 \end{cases}$$

for maximum
all contain
 $+\frac{1}{2} = 6$

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

s p d
↓ ↓ ↓

$$2 + 6 + 10 = 18 e^-$$

For $n = 2$

$l = 0, 1, 2, 3$

↓ ↓ ↓ ↓
s p d f

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

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

✓
 $n=4$
 $l=2$

✓ ~~(B)~~ 3f

✓
 $n=3$
 $l=3$

always

$n > l$

(C) 5p

✓
 $n=5$
 $l=1$

(D) 7s

✓
 $n=7$
 $l=0$

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

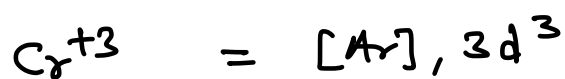
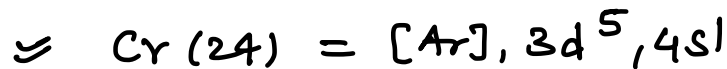
(A) $\text{Fe}^{3+} > \text{Cr}^{3+} = \text{Mn}^{4+}$ (B) $\text{Fe}^{3+} = \text{Cr}^{3+} > \text{Mn}^{4+}$ (C) $\text{Cr}^{3+} = \text{Mn}^{4+} > \text{Fe}^{3+}$ (D) $\text{Fe}^{3+} > \text{Mn}^{4+} > \text{Cr}^{3+}$



$$n = 3$$



$$n = 5$$



$$n = 3$$

then magnetic moment order



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
2
 $1s^2$

L
8
 $2s^2$
 $2p^6$

M
9
 $3s^2$
 $3p^6$
 $3d^1$

N
2
 $4s^2$

$3d^1 \rightarrow$

1				
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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 ${}_{25}\text{Mn}^{x+}$ ion is $\sqrt{15}$ B.M. Then, What is the value of x .



for n unpaired $e^- = 3$ ✓



$$\mu = \sqrt{15}$$

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

$$n = 3$$

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

$$\ell = 3, \quad n = 4, 5, 6, 7, \dots$$

$$\text{minimum value} = 4 (x)$$

(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)

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

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

$$l = 3$$

$$\begin{aligned} \text{No of orientation} &= \text{No of orbital} \\ &= 2l+1 \\ &= 2 \times 3 + 1 = 7 \quad (y) \end{aligned}$$

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

MATCH THE COLUMN

9. Column-I

RS

RS

PQ

PQ

(A) N_2

(B) CO

(C) $C_6H_{12}O_6$

(D) CH_3COOH

$e = 14$

$p = 14$

$e^- = 8 + 6 = 14$

Column-II

(P) 40% carbon by mass

(Q) Empirical formula CH_2O

(R) Vapour density = 14

(S) $14N_A$ ($N_A = 6.023 \times 10^{23}$) electrons in a mole

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

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

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

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

10. Column-I

(A) Vapour density (P, S)

(B) 1 mol (Q, R)

(C) 12 g carbon (R)

(D) 96500 C (Q)

Column-II

(P) Unitless

(Q) 6.023×10^{23} electrons

(R) 6.023×10^{23} atoms

(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} atoms

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

$$\begin{aligned} 96500 \text{ Coulomb means} &= 1 \text{ mole electrons} \\ &= 6.022 \times 10^{23} \text{ electrons} \end{aligned}$$

11. Column-I

- (A) N^{3-} (1 mol) $p = 7+3=10$, $p=7$
(B) O^{2-} (1 mol) $e^- = 8+2=10$, $p=8$
(C) CH_4 (1 mol) $e^- = 6+4=10$, $p=10$
(D) H_2O (1 mol) $e^- = 2+8=10$, $p=10$

Column-II

- (P) 10 mol electrons
(Q) 8 mol protons
(R) 6.023×10^{24} electrons
(S) 10 mol protons

N^{3-} (A) moles of $e^- = 1 \times 10 = 10$, moles of protons = 1×7
No of $e^- = 10 \cdot N_A = 10 \times 6.02 \times 10^{23} = 6.02 \times 10^{24}$

O^{2-} (B) 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

③ moles of $e^- = 1 \times 10 = 10$, No of $e^- = 10 N_A$
 $= 6.02 \times 10^{24}$

moles of $p = 1 \times 10 = 10$

$\text{H}_2\text{O}(\text{l})$

④ moles of $e^- = 1 \times 10 = 10$, no of $e^- = 10 N_A$
 $= 6.022 \times 10^{24}$

No. of protons $= 1 \times 10 = 10$



12. Column-I

- (P, S) (A) 0.5 mol SO_2 (g)
 (P) (B) 1 g of H_2 (g)
 (P, Q) (C) 0.5 mol O_2 (g)
 (R, S) (D) One gram mole of O_2 (g)

Column-II

- (P) Occupy 11.2 L at NTP
 (Q) Weighs 16 g
 (R) Number of atoms = $2 \times 6.023 \times 10^{23}$
 (S) Weighs 32 g

(A) 0.5 mole SO_2

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

(B) moles of $\text{H}_2 = \frac{1}{2} = 0.5$

- 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 = $0.5 \times 32 = 16 \text{ g}$
- volume = $0.5 \times 22.4 = 11.2 \text{ L}$

(D) moles = 1

- mass = $1 \times 32 = 32 \text{ g}$
- 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

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