

01 UNCERTAINTY PRINCIPLE

$$\Delta x \cdot \Delta p \geq \frac{h}{4\pi}$$

$$\Delta x \cdot m\Delta v \geq \frac{h}{4\pi}$$

Q. According to Heisenberg's uncertainty principle, $\Delta x \cdot \Delta p \geq \frac{h}{4\pi}$ which of the following is correct ?

- If $\Delta x = 0$ then $\Delta p = \infty$
- If $\Delta v = 0$ then $\Delta p = 0$
- If $\Delta p = 0$ then $\Delta x = \infty$
- All are correct

Q. Find uncertainty in velocity, if uncertainty position is equal to uncertainty in momentum.

- $\frac{h}{2\sqrt{m}}$
- $\frac{1}{2m} \sqrt{\frac{h}{\pi}}$
- $\frac{1}{m} \sqrt{\frac{h}{\pi}}$
- $\frac{1}{2} \sqrt{\frac{h}{m\pi}}$

Q. The uncertainty involved in the measurement of velocity within a distance of 0.1 \AA is:

- $5.79 \times 10^5 \text{ m/s}$
- $5.79 \times 10^7 \text{ m/s}$
- $5.79 \times 10^8 \text{ m/s}$
- $5.79 \times 10^9 \text{ m/s}$

PRINCIPLE QUANTUM NUMBER

In n^{th} Shell ,
 Number of subshells = n
 Number of orbitals = n^2
 Max. number of electrons = $2n^2$

Q. Find angular momentum of
 (i) 2s orbital (ii) 3d orbital
 (iii) 4p orbital (iv) e^- in 4th orbit

AZIMUTHAL QUANTUM NUMBER

- It describes shell or orbit
 $n = 1, 2, 3, 4, \dots$
 K, L, M, N, \dots
- It describes size & energy of shell.
 $r \propto n^2$ $E \propto \frac{1}{n^2}$
- It defines the angular momentum
 $mvr = \frac{nh}{2\pi}$

Q. Find maximum no. of e^- having
 (i) $n=4, s = -1/2$ (ii) $n=3, l=1, m=0$
 (iii) $n=2, l=0$ (iv) $n=3, l=1$

MAGNETIC QUANTUM NUMBER

- It describes subshell value from 0 to $n-1$
 $l=0 \rightarrow s$ $l=2 \rightarrow d$
 $l=1 \rightarrow p$ $l=3 \rightarrow f$
- Orbital angular momentum
 $= \sqrt{l(l+1)} \hbar, \hbar = \frac{h}{2\pi}$
- Maximum no. of orbital in a subshell = $2l + 1$
 Maximum no. of electrons in a subshell = $4l + 2$

Q. Which of the following set of quantum numbers is correct?

n	l	m	s
1) 4	0	0	$-1/2$
2) 5	2	3	$-1/2$
3) 2	-1	0	$-1/2$
4) 6	3	0	$-1/2$

SPIN QUANTUM NUMBER

Value of $m = -l \leq m \leq l$
 Total values of $m = 2l + 1$

$n = 4$

- $l = 0$ $m = 0$
- $l = 1$ $m = -1, 0, +1$
- $l = 2$ $m = -2, -1, 0, +1, +2$
- $l = 3$ $m = -3, -2, -1, 0, +1, +2, +3$

SPIN
 — CLOCKWISE (+ 1/2)
 — ANTICLOCKWISE (- 1/2)

STRUCTURE OF ATOM

Q. Find angular momentum of
 (i) 2s orbital (ii) 3d orbital
 (iii) 4p orbital (iv) e^- in 4th orbit

Q. Find maximum no. of e^- having
 (i) $n=4, s = -1/2$ (ii) $n=3, l=1, m=0$
 (iii) $n=2, l=0$ (iv) $n=3, l=1$

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If $l=2$

- Orbital = d
- No. of orbitals = $2(2+1)=5$
 $(d_{xy}, d_{xz}, d_{yz}, d_{x^2-y^2}, d_{z^2})$
- Total $e^-s = 2(2l+1) = 10 e^-s$
- Orbital angular momentum = $\sqrt{2(2+1)} \hbar = \sqrt{6} \hbar$

ENERGY OF ORBITALS

- Mono electronic species
 Energy defined upon n
 $1s < 2s = 2p < 3s = 3p = 3d$
- Multi electronic species
 $3s < 3p < 4s < 3d$

(n+l) rule

$\rightarrow As (n + l) \uparrow, E \uparrow$
 $\rightarrow If (n + l)$ is same, then $n \uparrow E \uparrow$

Orbital	2s	3d
(n+l) value	$n = 2$ $l = 0$ $n+l = 2$	$n = 3$ $l = 2$ $n+l = 5$

SHAPE OF ORBITALS

- s orbital - Spherical shape
- p orbital - dumb bell shape
- d orbital - double dumb bell shape

NODES

$\Psi \rightarrow e^-$ wave function
 $\Psi^2 \rightarrow$ probability of finding the electrons

- * Node \rightarrow Probability of finding the electron is zero.
- * Node plane \rightarrow Plane; where $\Psi^2 = 0$
- * Radial nodes $\rightarrow n-l-1$
- * Angular nodes = l
- * Total nodes = $n-1$

FILLING OF ATOMIC ORBITAL

- Aufbau principle**
 Electrons are filled in the increasing order of energy
 $1s < 2s < 2p < 3s < 3p < 4s < 3d \dots$
- Pauli's exclusion principle**
 No two electrons can have same four quantum numbers
 $1s^3$ - against Pauli's exclusion principle
- Hund's rule**
 Pairing is only takes place after each orbital is singly occupied.
 $\uparrow \downarrow \uparrow \uparrow$ - Against Hund's rule

