ARJUNA NEET BATCH

Structure of Atom

LECTURE - 11

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Quick Recap

① Principle Quantam No. (n) :- Shell / orbit / Level / Period no.

⇒ K L M N

$\downarrow$ $\downarrow$ $\downarrow$ $\downarrow$

1 2 3 4

$n \rightarrow$ no. of waves

O.A.M.

$n = -$ive

$n = 1$ to ∞

⇒ $n \uparrow$ size $\uparrow$ $r \propto \frac{n^2}{Z}$

$mvr = \frac{nh}{2\pi}$ or $n\hbar$

→ Size

→ $E = -13.6 \frac{Z^2}{n^2}$ Energy of shell $\Delta E \downarrow$

(2) Azimuthal Q.No. or (l) or Subsidiary Qu. No.

$\Rightarrow l \Rightarrow 0$ to $n-1$ $\quad l \not> n$

$\Rightarrow$ $l \rightarrow 0, 1, 2, 3$

Subshell $\rightarrow$ s, p, d, f

$\Rightarrow$ s $\rightarrow$ spherical

$\Rightarrow$ p $\rightarrow$ dumbell

d $\rightarrow$ double dumbell

f $\rightarrow$ Complicated

$\Rightarrow$ Energy

Uni electronic

$\Rightarrow n \uparrow \; E \uparrow$

if n is same $\bar{E}$ same

Multielectronic

$\Rightarrow n+l \uparrow \; E \uparrow$

if $n+l$ is same $n \uparrow \; E \uparrow$

Orbital A.M.

$\sqrt{l(l+1)}\,\hbar$ or $\sqrt{l(l+1)}\,h/2\pi$

Objective of today's class

QUANTAM NUMBERS ,RULES FOR WRITING ELECTRONIC CONFIGURATION

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QUANTUM NUMBER

(3) Magnetic Quantam Numbers:- $(m) \Rightarrow -l$ to $+l$

$\Rightarrow$ Proposed by ZEEMAN and LANDE.

$\Rightarrow$ It gives us information about the orientation of $e^{\ominus}$ within the subshell from which an $e^{\ominus}$ belongs.

$\Rightarrow$ ℓ $\boxed{m}$ ($-\ell$ to $+\ell$)

s (0) 0 $\longrightarrow$ 1 orbital

p (1) $-1, \boxed{0}, +1 \longrightarrow$ 3 orbitals $\rightarrow p_x, p_y, p_z$

p_z

d_{xz}

d (2) $-2, -1, \boxed{0}, +1, +2 \rightarrow$ 5 orbitals $\rightarrow$

d_{x-y} d_{z^2} d_{yz} $d_{x^2-y^2}$

$\rightarrow$ f (3) $-3, -2, -1, 0, +1, +2, +3 \rightarrow$ 7 orbitals

$n = 3$
$l = 1 \Rightarrow 3p_z$
$m = 0$

Eg. $n = 2$
$l = 0$ $\quad$ $2s$
$m = 0$

$\Rightarrow$ No. of values of m = No. of orbitals

$\Rightarrow$ Every subshell contain 1 orbital with $\boxed{m = 0}$

$\Rightarrow$ Representation of orbital $(nl)_m$

$\Rightarrow$ No. of orbitals in a shell $\Rightarrow \boxed{n^2}$

$\Rightarrow$ No. of $e^{\ominus}$s in a shell = $\boxed{2n^2}$

⇒ No. of orbitals in a subshell ⇒ $(2l+1)$

⇒ No. of $e^{\ominus}$s in a subshell ⇒ $2(2l+1) \Rightarrow 4l+2$

Eg:-

Subshell	l	$(2l+1)$ No. of orbital in a subshell	$(4l+2)$ No. of $e^{\ominus}$ in a subshell
s	0	$\longrightarrow$ 1	$\longrightarrow$ $2e^{\ominus}$
p	1	$\longrightarrow$ 3	$\longrightarrow$ $6e^{\ominus}$
d	2	$\longrightarrow$ 5	$\longrightarrow$ $10e^{\ominus}$
f	3	$\longrightarrow$ 7	$\longrightarrow$ $14e^{\ominus}$

Shell No. (n)	No of Subshell	No. of orbitals in a shell (n^2)	No. of $e^{\ominus}s$ in a shell ($2n^2$)
1	1	1 (1s) $\rightarrow$	$\longrightarrow$ 2 $e^{\ominus}$
2	2 (s, p)	4 (2s, 2p)	$\longrightarrow$ 8 $e^{\ominus}$
3	3 (s, p, d)	9 (3s, 3p, 3d)	$\longrightarrow$ 18 $e^{\ominus}$
4	4 (s, p, d, f)	16 (4s, 4p, 4d, 4f)	$\longrightarrow$ 32 $e^{\ominus}$

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	H																	He
2	Li	Be											B	C	N	O	F	Ne
3	Na	Mg											Al	Si	P	S	Cl	Ar
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Cu	Ni	Cu	Zr	Ga	Ge	As	Se	Br	Kr
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
6	Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
7	Fr	Ra																

$\uparrow\downarrow$

$1 \rightarrow 1S \rightarrow \underset{1S}{\boxed{\uparrow\downarrow}} \rightarrow 1 \text{ orbital} \rightarrow 2e^{\ominus}$

$2 \rightarrow 2S, 2p \rightarrow \underset{2S}{\boxed{\uparrow\downarrow}} \quad \underset{2p}{\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}} \rightarrow 4 \text{ orbital} \rightarrow 8e^{\ominus}$

$3 \rightarrow 3S, 3p, 3d \rightarrow \underset{3S}{\boxed{\uparrow\downarrow}} \quad \underset{3p}{\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}} \quad \underset{3d}{\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}} \rightarrow 9 \text{ orbital}$

$18e^{\ominus}$

(4) SPIN QUANTAM NUMBER (S) :→ (S)

⇒ Proposed by Uhlemback and Goldsmith..

⇒ This Quantam no is not derived from Schrodinger Wave Equation but theoritically proposed.

⇒ This Quantam Number tells about orientation of $e^{\ominus}$ in the orbital.

$$S \Rightarrow +\frac{1}{2}(\uparrow) \quad \text{or} \quad -\frac{1}{2}(\downarrow)$$

upspin (clockwise)

downspin (Anticlockwise)

⇒ $+\frac{1}{2}$ and $-\frac{1}{2}$ are Quantam mechanical spin.

⇒ SPIN MULTIPLICTY :→ $2\underline{S}+1$

⇒ SPIN ANGULAR MOMENTUM ⇒ $\sqrt{\underline{s}(\underline{s}+1)}\,\frac{h}{2\pi}$ or

$\sqrt{s(s+1)}\,\hbar$

⇒ $S \Rightarrow \pm\frac{n}{2}$ $n \Rightarrow$ no. of unpaired $e^{\ominus}$

Eg. | ↿ | ↿ | ↿ | $2p^3$

$S \Rightarrow 3/2$

S.M. ⇒ $\cancel{2}\times\frac{3}{\cancel{2}}+1$

⇒ 4

RULES FOR WRITING ELECTRONIC CONFIGURATION

(1) **PAULI EXCLUSION PRINCIPLE** :- An orbital can accomodate maximum of 2 $e^{\ominus}$ in opposite spins.

$\boxed{\text{OR}}$

No two $e^{\ominus}$s in atom can have same value of all the four Quantam Numbers.

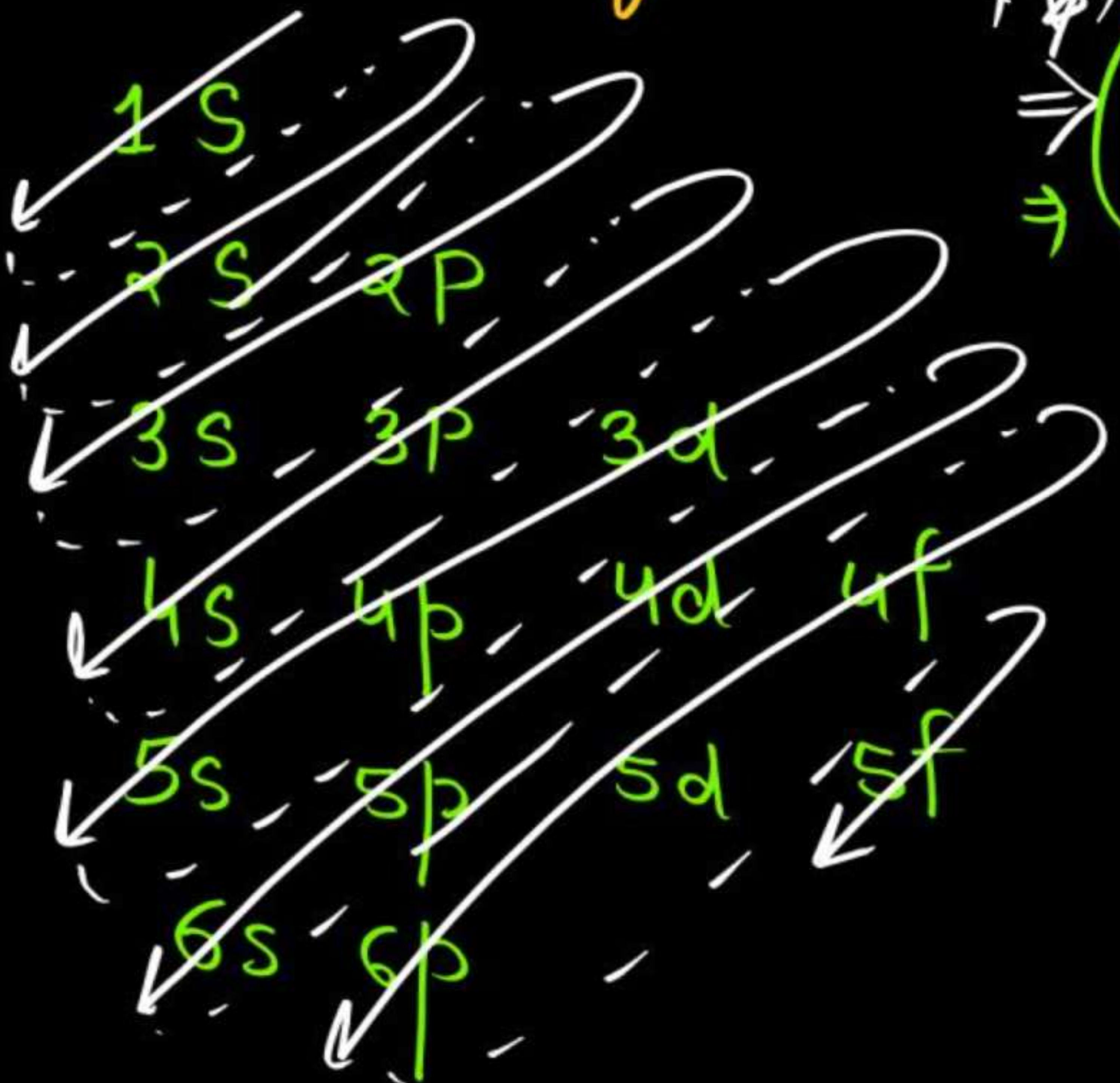
Eg $3s^2 \longrightarrow \boxed{\uparrow\downarrow}$ 3s

$$\begin{array}{cccccc} & & \checkmark & \checkmark & \checkmark & \checkmark \\ \uparrow & \longrightarrow & n, & l, & m, & s \\ & & \downarrow & \downarrow & \downarrow & \downarrow \\ & & 3 & 0 & 0 & +1/2 \\ & & \downarrow & \downarrow & \downarrow & \\ \downarrow & \longrightarrow & 3 & 0 & 0 & -1/2 \end{array}$$

Eg. $\boxed{\uparrow\uparrow} \rightarrow \times$

$\rightarrow \boxed{\uparrow\downarrow\uparrow} \rightarrow \times$

(2) **AUFBAU PRINCIPLE:-** In ground state of an atom, electrons are filled in increasing order of their Energy.



$$\Rightarrow \begin{pmatrix} 1s < 2s < 2p < 3s < 3p < 4s < 3d \\ 1 \quad 2 \quad 3 \quad 3 \quad 4 \quad 4 \quad 5 \end{pmatrix}$$

$$\underset{5}{4p} < \underset{5}{5s} < \underset{6}{4d} < \underset{6}{5p} < \underset{6}{6s} <$$

$$\underset{7}{4f} < \underset{7}{5d} < \underset{7}{6p} < \underset{8}{5f}$$

$_1H \rightarrow 1s^{1}$ $\underset{1s}{\boxed{\uparrow}}$

$_2He \rightarrow 1s^{2}$ $\underset{1s}{\boxed{\uparrow\downarrow}}$

$_3Li \rightarrow 1s^{2}, 2s^{1}$ $\underset{1s}{\boxed{\uparrow\downarrow}}$ $\underset{2s}{\boxed{\uparrow}}$

$_4Be \rightarrow 1s^{2}, 2s^{2}$ $\boxed{\uparrow\downarrow}$ $\boxed{\uparrow\downarrow}$

$_5B \rightarrow 1s^{2}, 2s^{2}, 2p^{1}$ $\boxed{\uparrow\downarrow}$ $\boxed{\uparrow\downarrow}$ $\boxed{\uparrow}\boxed{}\boxed{}$

$_6C \rightarrow 1s^{2}, 2s^{2}, 2p^{2}$ $\boxed{\uparrow\downarrow}$ $\boxed{\uparrow\downarrow}$ $\boxed{\uparrow}\boxed{\uparrow}\boxed{}$

Eg. $_{26}Fe$

$\Rightarrow 1s^{2}, 2s^{2}, 2p^{6}, 3s^{2},$

$3p^{6}, 4s^{2}, 3d^{6}$

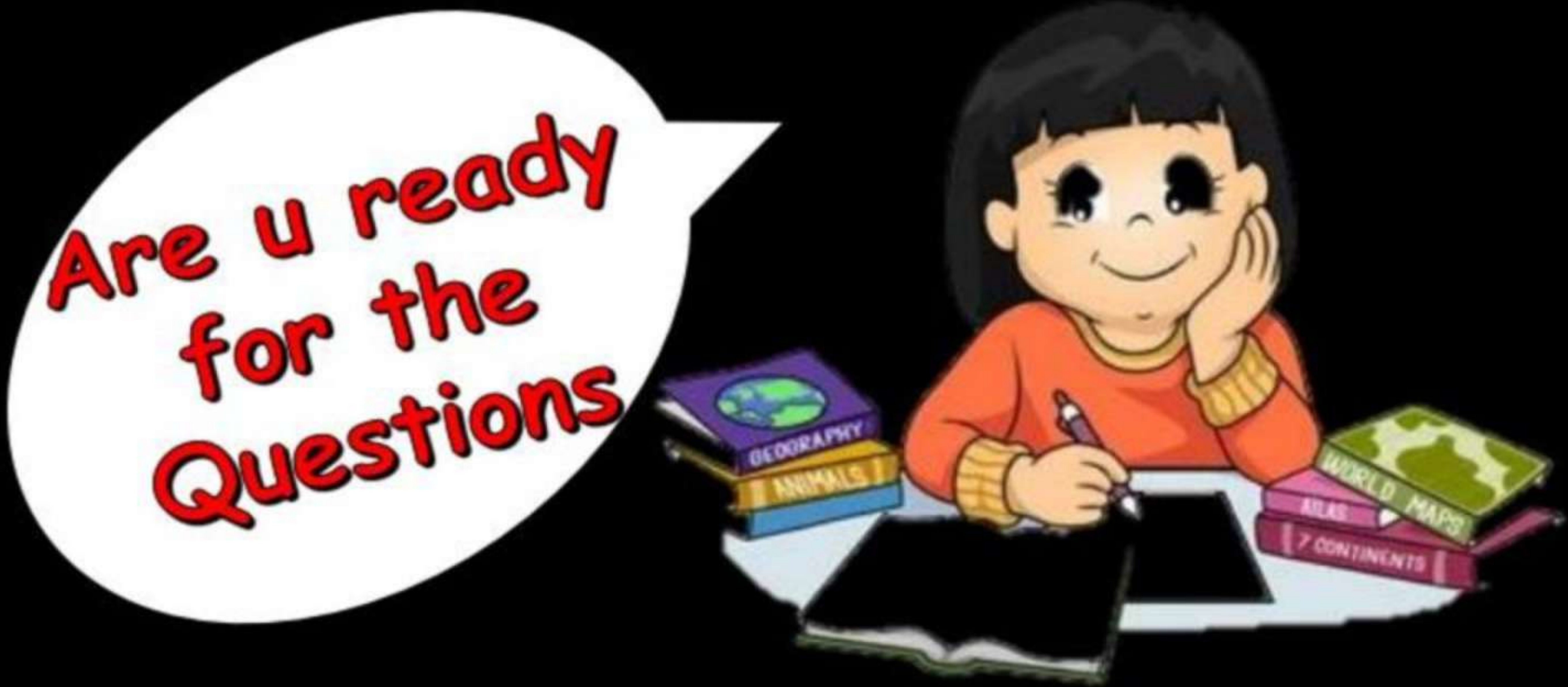
(3) HUND'S RULE OF MAXIMUM MULTIPLICITY :-

Acc. to this Rule In ground state of an atom during filling of degenerate orbitals (having equal energy) no pairing takes place, until each orbital can accomodate single $e^{\ominus}$

$$1s^2 \quad 2s^2 \quad 2p^4$$

$$\boxed{\uparrow\downarrow} \quad \boxed{\uparrow\downarrow} \quad \boxed{\uparrow\downarrow}\boxed{\uparrow\;}\boxed{\uparrow\;}$$

$$\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\quad} \rightarrow \times$$


Are u ready for the Questions
GEOGRAPHY
ANIMALS
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ATLAS
7 CONTINENTS

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HoWo

Q. In the ground state, an element has 13 $e^{\ominus}$ in its M shell. The element is

(a) Mn (b) Co

(c) Ni (d) Fe

H.W.

Q. For principal quantum no(n = 5). The total no. of orbital having $l = 3$.

(a) 7 (b) 14

(c) 9 (d) 18

H.W-

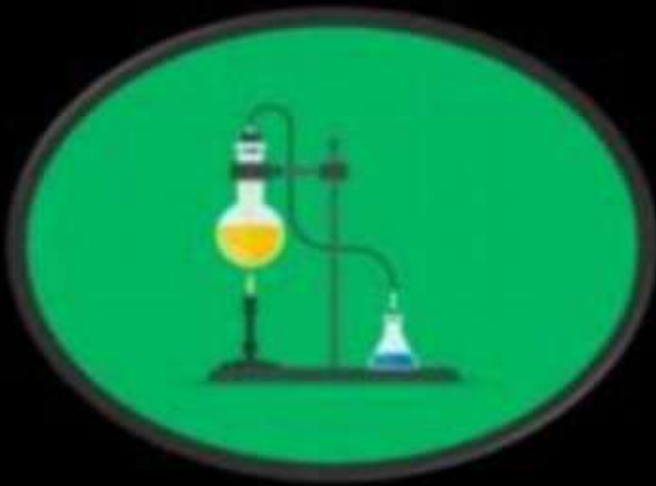
Q. Radial nodes present in 3s & 3p

(a) 0,2 (b) 2,1

(c) 1,1 (d) 2,2

Q. In an atom which has 2K, 8L, 18M & 2N $e^{\ominus}$ in the ground state. The total no of $e^{\ominus}$ having magnetic quantum no. (m = 0) is

(a) 6
(b) 10
(c) 7
(d) 14

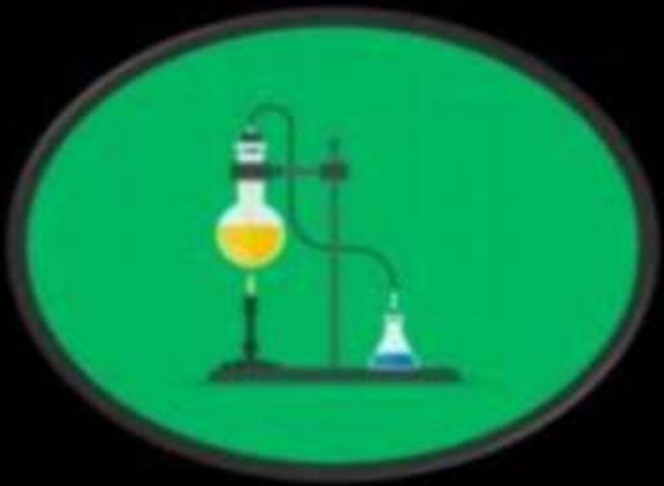


H.W.

Q. If each orbital can hold maximum of $3e^{\ominus}$ the no. of elements in 2^{nd} period of periodic table.

(a) 27 (b) 8

(c) 18 (d) 12



H.W :-

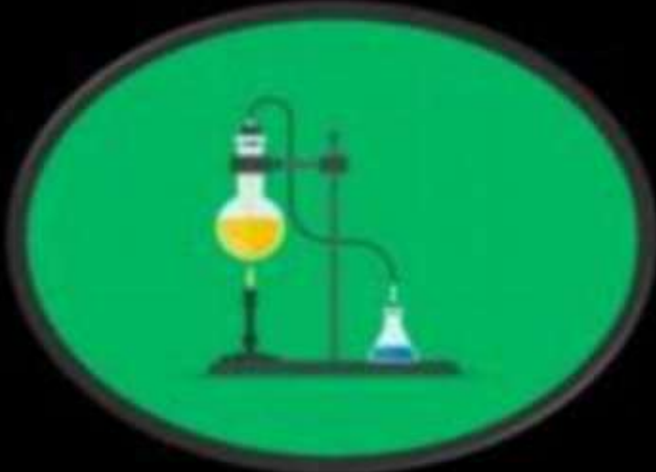
Q. Isoelectronic species are-

(a) CO, CN^-, NO^+, C_2^{2-}

(b) CO^-, CN, NO, C_2^{2-}

(c) CO^+, CN^+, NO^-, C_2

(d) CO, CN, NO, C_2



HW:

Q. Find the total no. of $e^{\ominus}$ is chromium(24) having

(i) $n = 3$

(ii) $n = 3$ $l = 2$

(iii) $m = 0$

h.w.

Q. Find n, l, m & s for last $e^{\ominus}$ of Na.

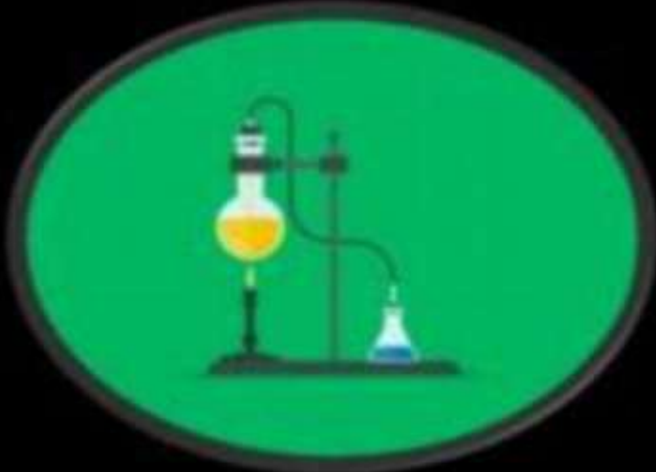
HW:-

Q. Following represents which orbital

(i) Ψ 4,2,0

(ii) Ψ 3,1,0

(iii) Ψ 4,1,0



H.W.

Q. Calculate spherical, angular & total nodes for following?

Orbital	Spherical/radial node	Angular nodes	Total
1s	→		
2s	→		
2p	→		
3s	→		
3p	→		
4s	→		
4p	→		
4d	→		
4f	→		

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thanks
for watching

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