Nishant Jindal

GENERAL CHEMISTRY

DO YOUR SELF – 1

1. Which of the following set(s) is/are isosters: Same number of atoms and e^-

(A) N_2O, CO ✗ (B) N_2, CO_2 ✗ (C) $B_3N_3H_6, C_6H_6$ ✓ (12, 12) (D) HF, Ne ✗

2. Which of the following is/are homogeneous mixture.

(A) Milk + water ✓ (B) Tap water ✗ (C) Milk ✗ (D) Oil + water ✗

Nishant Jindal

GENERAL CHEMISTRY

$n-p$ value same

3. Which of the following set of species is isodiapher :

(A) ${}_{15}P^{31}$, ${}_{8}O^{18}$ (B) ${}_{6}C^{14}$, ${}_{8}O^{16}$ (C) ${}_{11}Na^{23}$, ${}_{13}Al^{27}$ (D) ${}_{24}Cr^{50}$, ${}_{19}K^{39}$

$p = 6$ 8 $p = 11$ $p = 13$

$n = 8$ 8 $n = 12$ $n = 14$

$(n-p) = 2$ 0 $(n-p) = 12-11 = 1$ $n-p = 1$

4. Which of the following is a heterogeneous mixture?

(A) Sugar solution (B) Petroleum (C) Air (D) Blood

GENERAL CHEMISTRY

5. Which of the following set contains only isoelectronic ions?

(A) Zn^{+2}, Ca^{+2}, Ga^{+3}, $A\ell^{+3}$

(B) K^{+}, Ca^{+2}, Sc^{+3}, $C\ell^{-}$

(C) P^{-3}, S^{-2}, $C\ell^{-}$, Zn^{+2}

(D) Ti^{+4}, Ar, Cr^{+3}, V^{+5}

18 18 18

GENERAL CHEMISTRY

Orbital : An orbital is defined as that zone in space where electron is most likely to be found. The orbitals are characterized by a set of 3 quantum numbers (n, l, m).

$e^- \rightarrow$ Q.N

QUANTUM NUMBERS

Quantum numbers give complete information about an electron or orbital in an atom.

General representation of an atom.

$\boxed{\text{Atom} \rightarrow \text{Shell} \rightarrow \text{Subshell} \rightarrow \text{Orbital} \rightarrow \text{Electron}}$

Home rooms – al – book

1. Principal Quantum number (n) : Neils bohr

(i) Permissible value of $n \rightarrow 1$ to ∞

1 to ∞

(ii) It represents shell number/energy level. Orbit

(iii) The energy states corresponding to different principal quantum numbers are denoted by letters K, L, M, N etc.

n	:	1	2	3	4	5	6
Designation of shell	:	K	L	M	N	O	P

Nishant Jindal

GENERAL CHEMISTRY

(iv) It indicates the distance of an electron from the nucleus.

(v) It also determines the energy of the electron. In general higher the value of ' n ', higher is the energy.

(vi) It give an idea of total number of orbitals & electron (which may) present in a shell & that equal to

n^2 & $2n^2$ respectively.

Home — rooms — al — book.

shell → subshell — orbital — e^-

Energy : Value of n increases, energy level of shell increases but energy gap decreases.

$$n = 1 \qquad 2 \qquad 3 \qquad 4 \qquad 5 \ldots\ldots \infty$$

Order of Energy $= E_1 < E_2 < E_3 < E_4 < E_5 \ldots\ldots \infty$

$$E_2 - E_1 > E_3 - E_2 > E_4 - E_3 > E_5 - E_4 \ldots\ldots$$

Nishant Jindal

★ number of subshells in a particular shell = number shell

number of orbital in a shell = n^2

number of e^- in a shell = $2n^2$

Que find the number of subshells, orbitals and e^- in 4th shell.

4th shell = 4 subshell

no of orbitals = $n^2 = 4^2 = 16$

no of $e^- = 2n^2$
$= 2 \times 4^2$
$= 32$

Sommerfeld

2. Azimuthal Quantum number (l) : (Secondary Q.N | Subsidary Q.N | angular Q.N

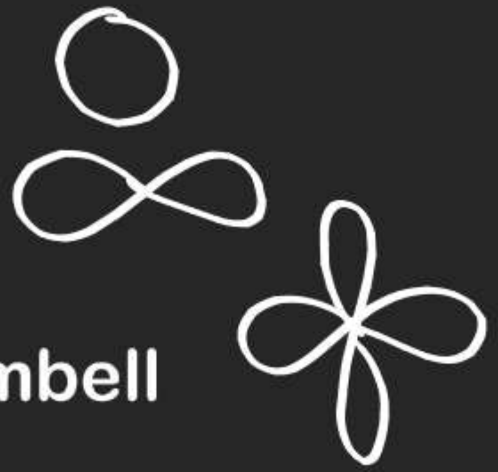
(i) The values of l depends upon the value of ' n ' and possible values are ' 0 to $(n-1)$ '.

$n > l$ $n \leq l$ ×

(ii) It gives the $\boxed{\text{name of subshells}}$ associated with the energy level and number of subshells within an energy level.

(iii) The different value of 'l' indicates the shape of orbitals and designated as follows :

Value	Notation	Name	Shape
$l = 0$	s	Sharp	Spherical
$l = 1$	p	Principal	Dumbell
$l = 2$	d	Diffused	Double Dumbell
$l = 3$	f	Fundamental	Complex



0 to (n-1)

energy of subshell with in a shell

$s < p < d < f$

$\boxed{\text{Closness towards}}$ nucleus (with in a shell)

$s > p > d > f$

Nishant Jindal

	ℓ
s	0
p	1
d	2
f	3

s Sharpe 

p principal 

d = diffuse 

f = fundamental complex

Nishant Jindal

number of orbitals in a subshell $= (2l+1)$

number of e^- in a subshell $= 2(2l+1)$

	no of orbitals	number of e^-
s	1	2
p	3	6
d	5	10
f	7	14

Nishant Jindal

	ℓ
s	0
p	1
d	2
f	3
g	4
h	5

Home — rooms — Al

$\downarrow$ Shell (n)

n^2

$2n^2$

$\downarrow$ Subshell — orbitals

(ℓ)

$(2\ell+1)$

$2(2\ell+1)$

$n = 4^{th}$ shell

$l = 0$ to $n-1$
$= 0$ to $4-1$
$= 0$ to 3

number of orbital $= n^2$
$= 4^2$
$= 16$

number of $e^- = 2n^2$
$= 2 \times 4^2$
$= 32$

no of orbitals $(2l+1)$	0 s	1 p	2 d	3 f
	$2\times0+1$	$2\times1+1$	$2\times2+1$	$2\times3+1$

$1 + 3 + 5 + 7 = 16$

GENERAL CHEMISTRY

(iv) It also determines the energy of orbital along with n.

(v) For a particular energy level/shell energy of subshell is in the following order : -

$$\boxed{s < p < d < f}$$

Closeness towards nucleus :

$$\boxed{s > p > d > f.}$$

(vi) It gives the total number of orbitals in a subshell & that equals to $(2l + 1)$ and number of electron in a subshell $= 2(2l + 1)$

Nishant Jindal

GENERAL CHEMISTRY

$-l$ to $+l$

3. Magnetic Quantum number (m) : Zeeman | Linde

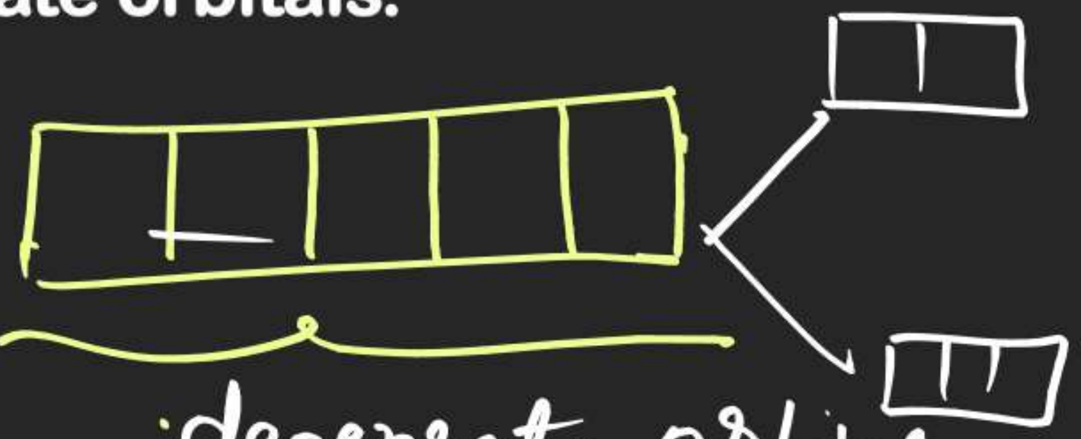
(i) The value of m depends upon the value of l and it may have integral value $-l$ to $+l$ including zero.

(ii) It gives the number of orbitals in a given subshell and orientation of different orbitals in space. e.g. for $n = 4$, $l = 0$ to 3.

l	0	1	2	3
m	0	$+1, 0, -1$	$+2, 1, 0, -1, -2$	$+3, +2, +1, 0, -1, -2, -3$
Possible Orientation	1	3	5	7
Orbitals	s	p_x, p_y, p_z	$d_{z^2}, d_{x^2-y^2}$, d_{xy}, d_{yz}, d_{xz}	Not in syllabus

(iii) The orbitals having same value of n and l but different value of m, have same energy in absence of external electric & magnetic field. The orbitals having same energy of a particular subshell is known as Degenerate orbitals.

d subshell

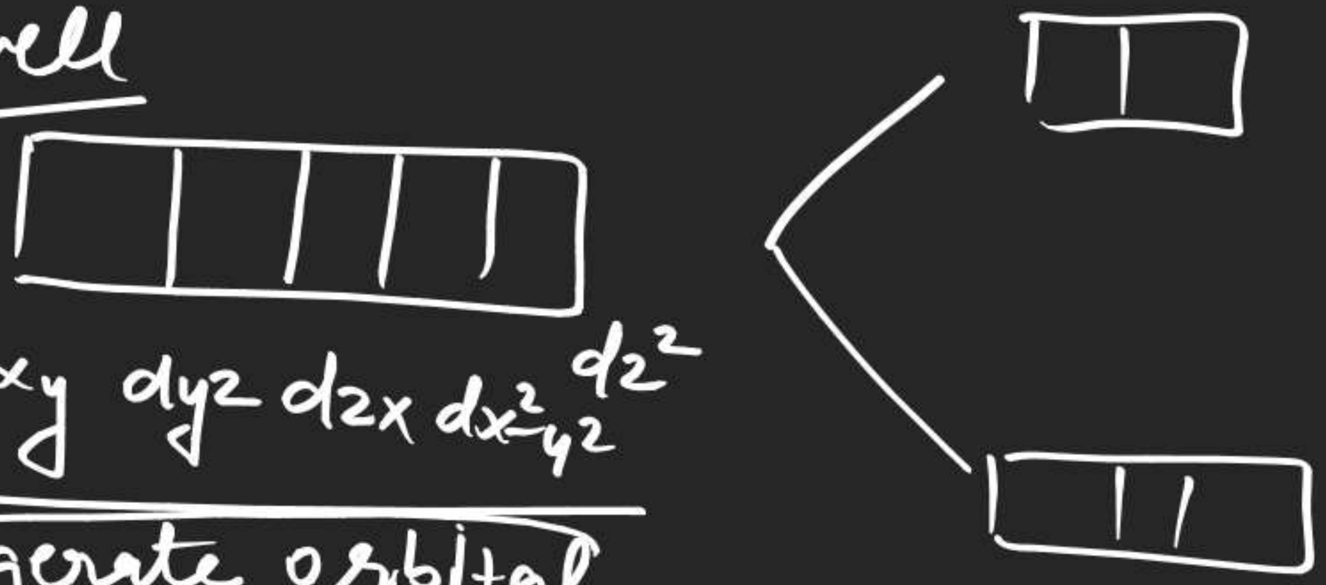


degenerate orbital

Stark effect

Zeeman effect

d Subshell



degerate orbital

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

4. Spin Quantum number (s) : Kroning

(i) While moving around the nucleus, the electron always spins about its own axis either clockwise or anticlockwise. The spin quantum number represents the direction of electron spin (rotation) around its own axis (clockwise or anticlockwise).

(ii) There are two possible values of ' s ' are $+\frac{1}{2}$ & $-\frac{1}{2}$ and represented by the two arrows : ↑ (spin up) and ↓ (spin down).

$s = \pm 1/2$ ↑
Spin up

↓
$s = \pm 1/2$
Spin down

d_{xy}	d_{yz}	d_{zx}	$d_{x^2-y^2}$	d_{z^2}
-2	-1	0	$+1$	$+2$

degenrate orbital $\longrightarrow$

	$3d_{xy}$	$3d_{yz}$
$n =$	3	3
$l =$	2	2
$m =$	-2	$+2$

Nishant Jindal

	l
s	0
p	1
d	2
f	3

$-2 \quad -1 \quad 0 \quad +1 \quad +2$

$3d_{yz}$

$n = 3$

$l = 2$

$m = 0$

$3d_{x^2-y^2}$

$n = 3$

$l = 2$

$m = ?$

Nishant Jindal

Sub shell	l	orbitals $m(-l, 0, +l)$
s	0	0
p	1	p_x p_y p_z -1 0 $+1$
d	2	-2 -1 0 $+1$ $+2$ d_{xy} d_{yz} d_{zx} $d_{x^2-y^2}$ d_{z^2}
f	3	

$4d_{xy}$ $\quad$ $4d_{yz}$

$n = 4$ $\quad$ $n = 4$

$l = 2$ $\quad$ $l = 2$

$m = 0$ $\quad$ -2

Nishant Jindal

$4d_{xy}$ $3d_{xy}$

$n = 4$ $n = 3$

H·W $\Rightarrow$ Q·N