



TITLE

Date: / /

Mo Tu We Th Fr Sa Su

NMR

(Nuclear Magnetic resonance spectroscopy)

$$\text{frequency } (\nu) = 3 \times 10^6 - 3 \times 10^8 \text{ sec}^{-1}$$

$$\lambda = \frac{c}{\nu} = \frac{3 \times 10^8 \text{ m sec}^{-1}}{3 \times 10^6 \text{ sec}^{-1}}$$

$$= 10^8 \times 10^{-6} \text{ m}$$

$$= 10^2 \text{ m}$$

$$\lambda = 100 \text{ m} - 1 \text{ cm.}$$

$$E = h\nu = 6.626 \times 10^{-34} \text{ J sec} \times 3 \times 10^6 \text{ sec}^{-1}$$

$$= 19.87 \times 10^{-28} \text{ J.}$$

$$= 19.87 \times 10^{-26} \text{ J.}$$

Introduction:-

NMR involves the interaction between oscillating electro-magnetic radiation and the magnetic properties of certain magnetic nuclei i.e. the nucleus of H-atom (proton).

The magnetic isotopes are — ^1H , ^{13}C , ^{19}F , ^{14}N , ^{17}O , ^{31}P , ^{33}S .



NMR

Introduction :-

The NMR spectroscopy concerned with absorption of light usually radio wave by some spinning nucleus (nuclei) in a molecule when placed in a magnetic field. The spectrum results from the transition of nucleus from one spin state to another. Each energy state is called the Zeeman energy levels. The energy needed to induce the transition falls in the region of very large wavelength (very small frequency i.e. 10^6 to 10^8 Hz).

Nuclear spin Angular momentum :-

Certain nuclei (proton & neutron), like electron spin around their axis and hence possess 'spin angular momentum'.

given by -

$$\omega_N = \sqrt{I(I+1)} \cdot \frac{h}{2\pi} \quad \text{--- (1)}$$

where,

I =

Nuclear spin number.

h =

Planck's constant.



TITLE

Date: / /

Mo Tu We Th Fr Sa Su

The spin quantum no. for the nucleus

may have values $0, \frac{1}{2}, 1, 2, \dots$ etc. depending upon the no. of neutrons & protons having parallel & anti-parallel spin.

for proton ${}^1_1\text{H}$

$$I = \frac{1}{2}$$

for ${}^2_1\text{D}$

$$I = 1$$

for ${}^{12}_6\text{C}$

$$I = 0$$

(1). For nuclei in which the sum of protons & neutrons are even (At. no. & mass no. even)

Then

$$I = 0 \text{ value.}$$

eg ${}^{12}_6\text{C}$, ${}^4_2\text{He}$, ${}^{16}_8\text{O}$, ${}^{32}_{16}\text{S}$ etc.

${}^{12}_6\text{C}$

$$A = 12$$

$$Z = 6$$

$$A = 6$$

$$Z = 6$$

$$n = 6$$

$$A = p + n$$

$$12 = 6 + 6$$

even

(2) For nuclei in which the sum of protons & neutrons are even but the no. of protons is ~~even~~ odd. (mass no. even, & At. no. odd).

Then $P = 1, 2, 3, \dots$

eg - ${}^2_1\text{D}$, ${}^{10}_5\text{B}$, ${}^{14}_7\text{N}$ etc

${}^{10}_5\text{B}$

$$Z = 5$$

$$A = 10$$

$$n = 5$$

$$p = 5$$

$$e = 5$$

$$p + n = 5 + 5 = 10 \text{ even.}$$

$$p = 5 \text{ odd.}$$

(3) For nuclei in which the sum of protons and neutrons is odd (mass no. odd).

$P = \frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \dots$ etc

eg - ${}^1_1\text{H}$, ${}^{23}_{11}\text{Na}$, ${}^{35}_{17}\text{Cl}$

${}^1_1\text{H}$

$$Z = 1$$

$$A = 1$$

$$e = 1$$

$$p = 1$$

$$n = 0$$

${}^{23}_{11}\text{Na}$

${}^{23}_{11}\text{Na}$

$$Z = 11$$

$$A = 23$$

$$e = 11$$

$$p = 11$$

$$n = 12$$