



TITLE

Date: / /

Mo Tu We Th Fr Sa Su

splitting of nuclear energy levels. (Zeeman effect) :-

The splitting of spectral lines on applied magnetic field is called the Zeeman effect. The different energy levels are called the Zeeman energy levels.

A spinning nucleus behaves like a tiny bar magnetic placed along the axis of the spin. The strength of the magnet is determined in terms of magnetic moment (M_N), which is given by -

$$M_N = g_N \cdot \beta_N \sqrt{I(I+1)}$$

— (1)

where g_N is the nuclear factor.
for proton (^1_1H).

$$g_N = 5.85$$

β_N is the unit of the nuclear magnetic moment called nuclear magnetone.

for proton (^1_1H)

$$\beta_N = 5.05 \times 10^{-27} \text{ J T}^{-1}$$

where $T = \text{tesla}$;

(a unit of magnetic field strength)



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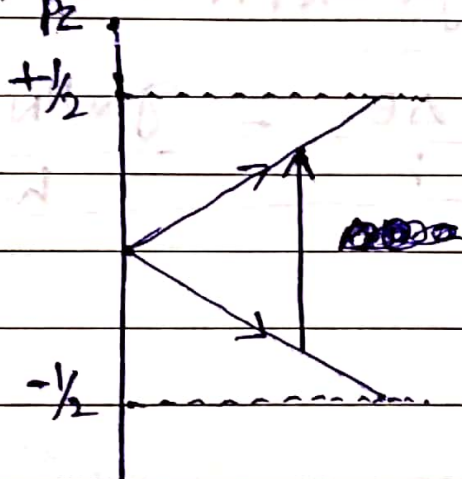
Thus -

$$\mu_N = 5.85 \times \cancel{10^{-27}} \frac{\sqrt{3}}{2} \beta_N.$$

In case of ^1_1H nucleus -

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

The possible values of m are $+\frac{1}{2}$ & $-\frac{1}{2}$ and hence, there are only two possible orientations of the angular momentum vector.



Since,

$$\Delta E = -g_N \beta_N \mu_N = h\nu.$$

$$E_{+1/2} = -\frac{1}{2} g_N \mu_N \beta_N$$

$$\& E_{-1/2} = -(-\frac{1}{2} g_N \mu_N \beta_N)$$

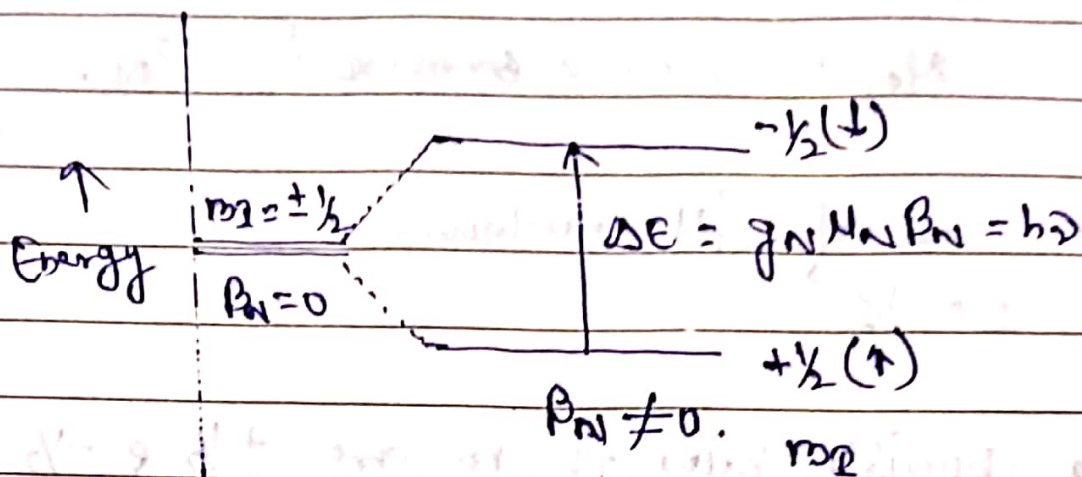
$$= +\frac{1}{2} g_N \mu_N \beta_N$$



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Since,

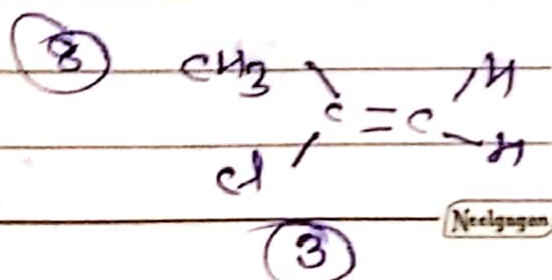
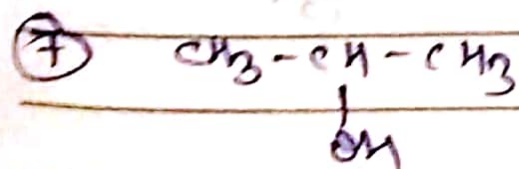
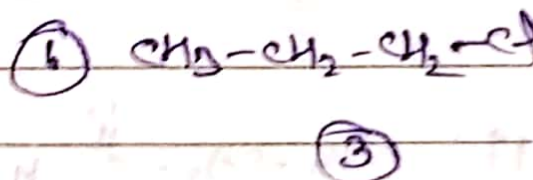
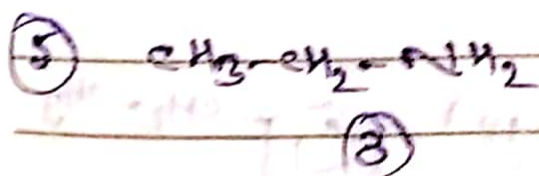
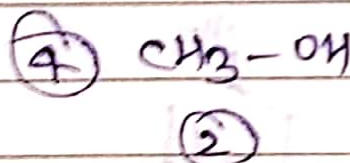
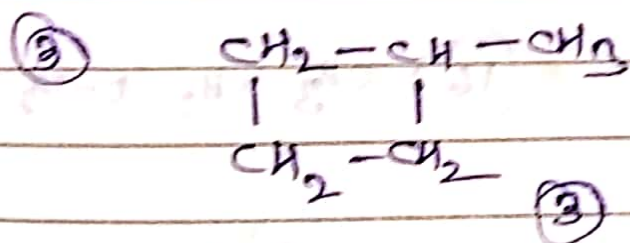
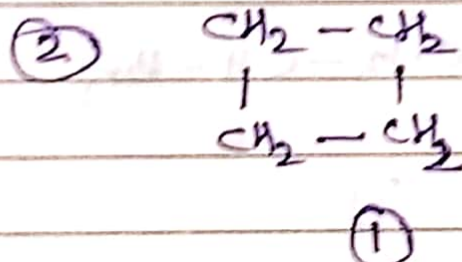
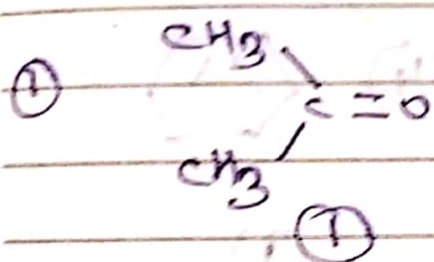
$$\Delta E = g_N \mu_N B_N = h \bar{\omega}$$

$$\omega = \frac{\Delta E}{h} = \frac{g_N \mu_N B_N}{h}$$

*. Number of Signals :-

The no. of signals in the NMR spectrum tells the no. of different sets of equivalent protons in a molecule. Each signal corresponds to a set of equivalent protons. ~~in a molecule~~.

It may be noted that the magnetic equivalent protons are chemically equivalent protons.



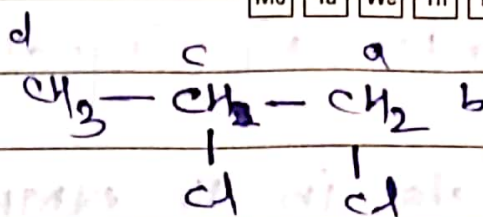
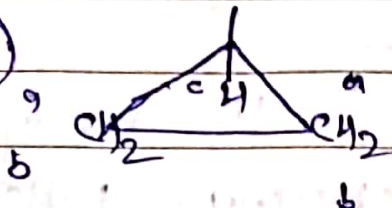
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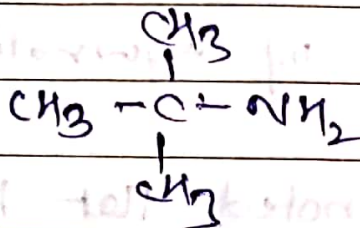
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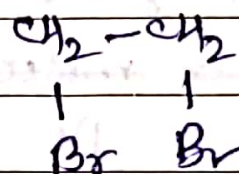
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(11)



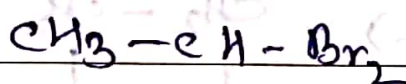
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(2)

(1)

(13)



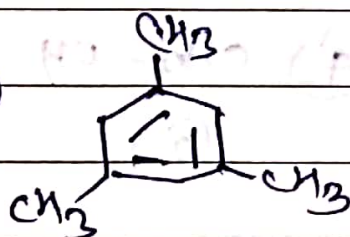
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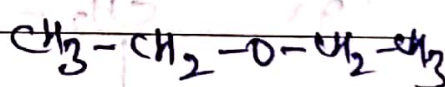
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(1)

(15)



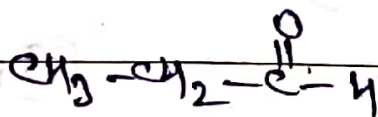
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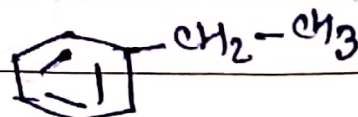
(2)

(2)

(17)



(18)



(3)

(3)

Q. How many ^1H NMR signals are there in the following?

