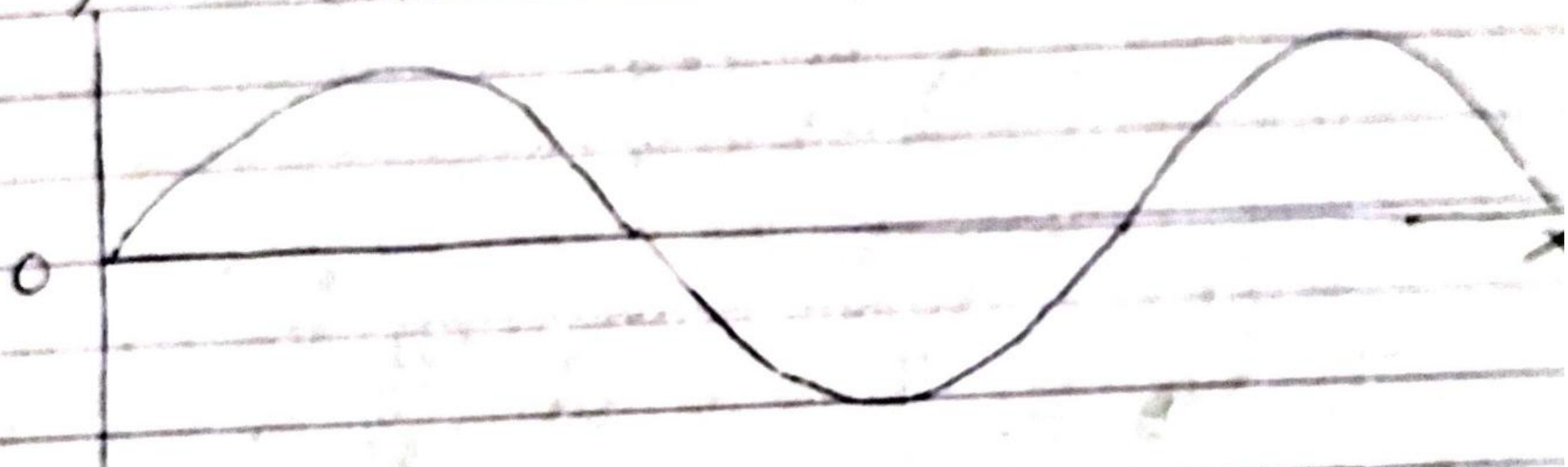
P.G. Sem. III : Core course X

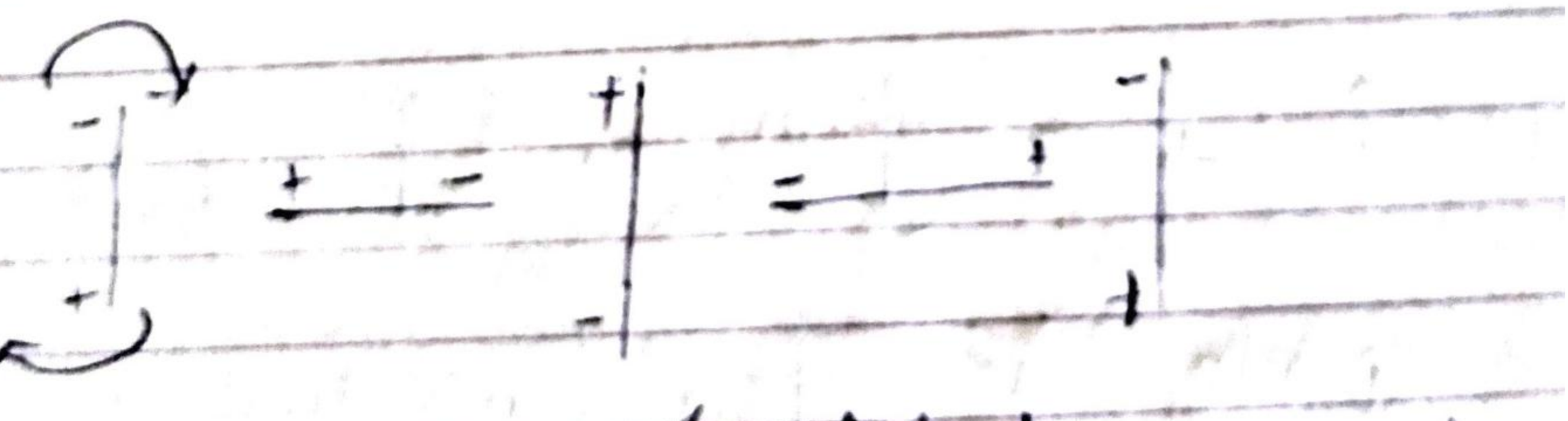
Unit I: Interaction of Radiation with Polarizing molecules :-

Radiation have wave nature and, therefore, fluctuating electric field. A rotating dipole also generates a fluctuating electric field and transfer interacts with radiation.

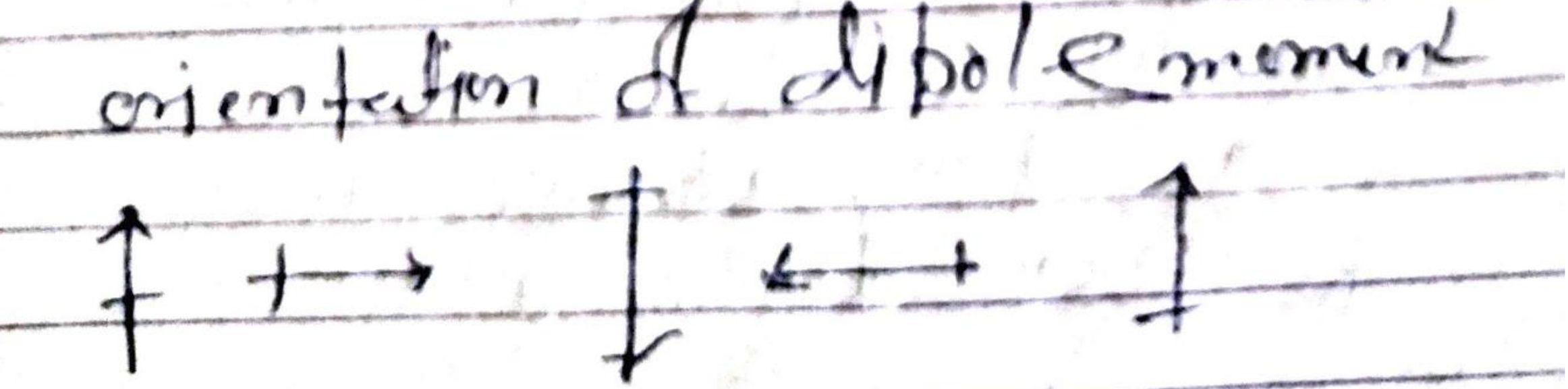
Wave nature of Radiation



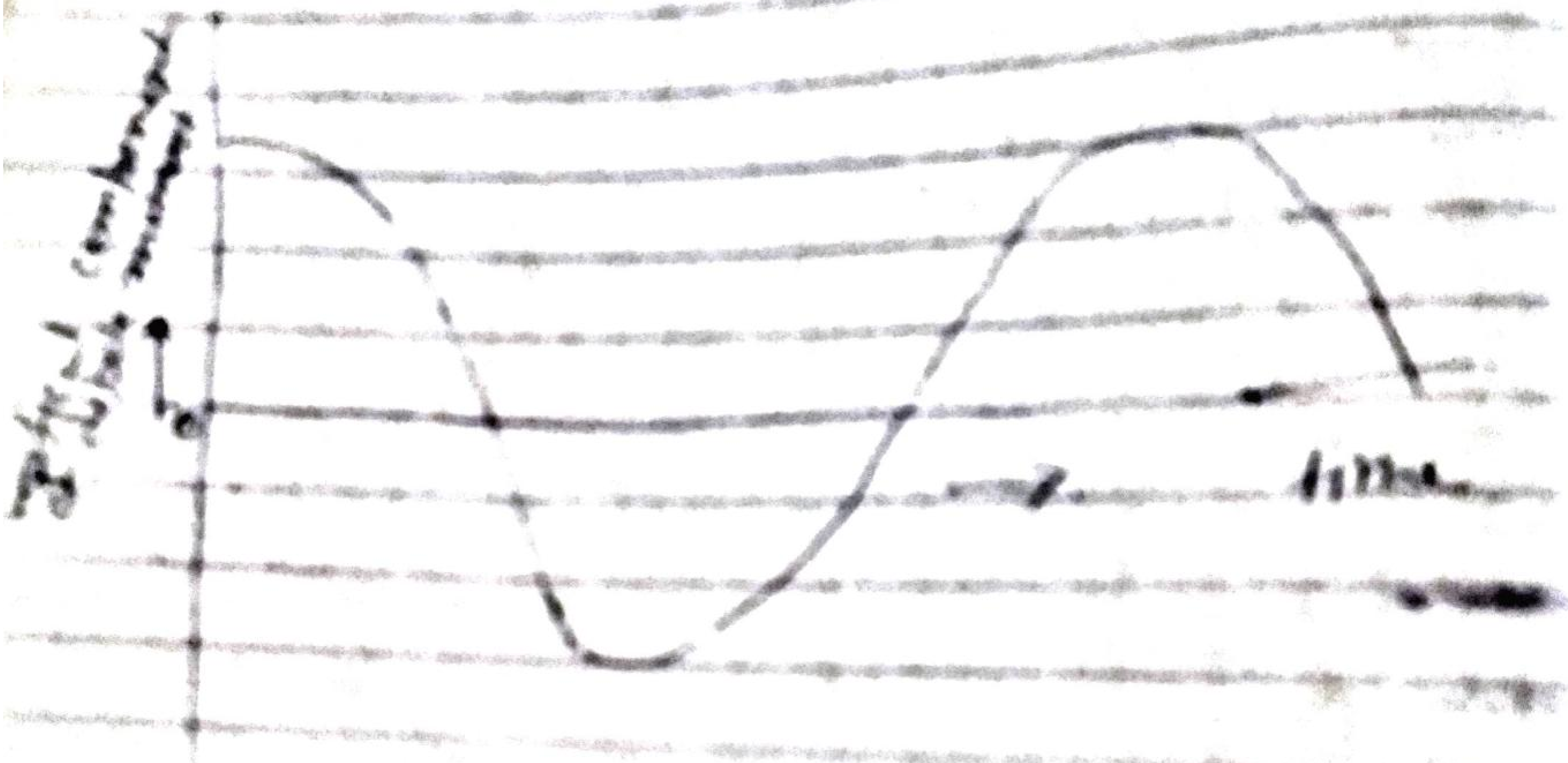
Polarisation of a dipole

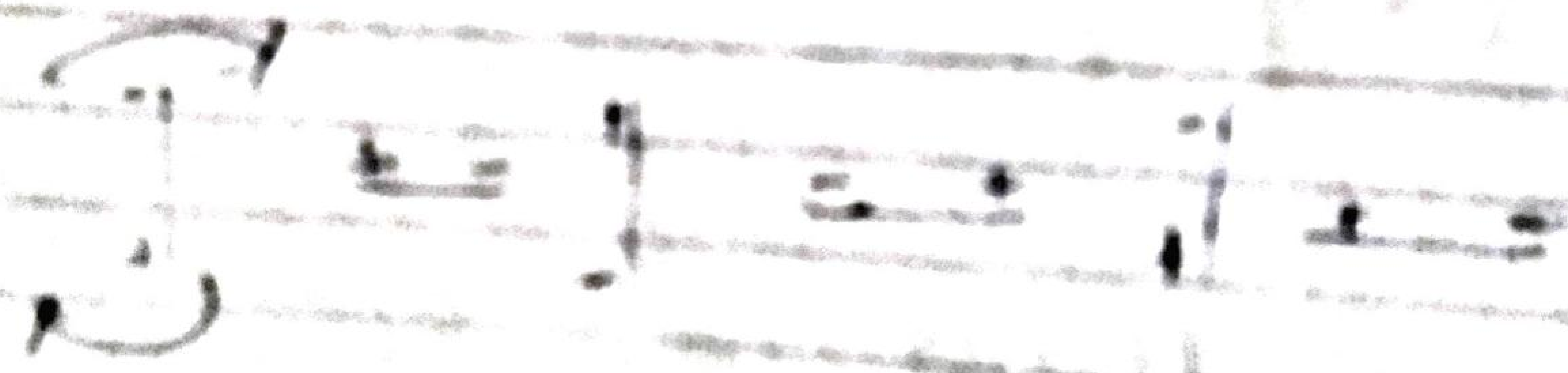


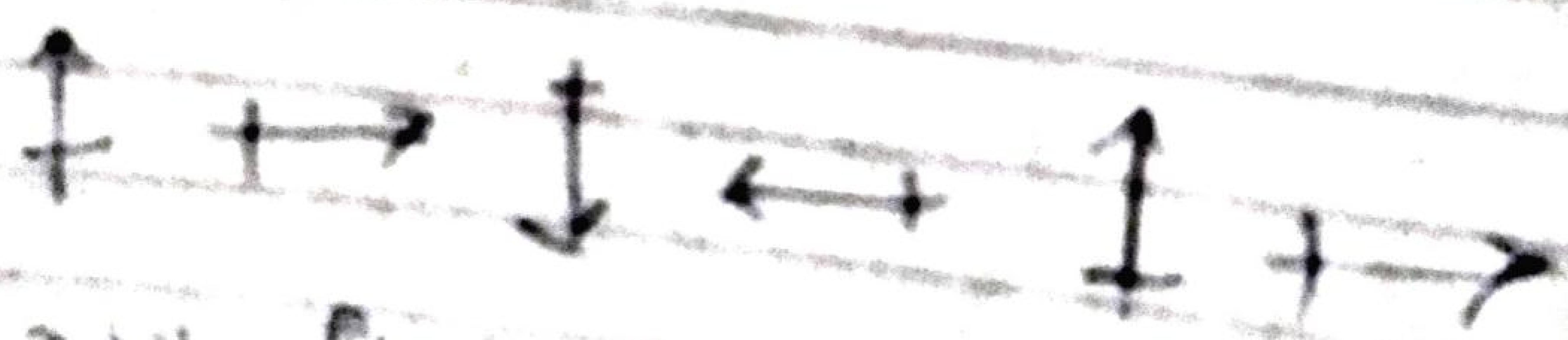
orientation of dipole moment



Dipole Fluctuations







Dipole fluctuation (in a particular direction) associated with the rotation of a diatomic molecule having a permanent dipole moment.

When a molecule with dipole rotates, the positive and negative ends change place periodically and as a result the vertical component of the dipole moments fluctuate regularly. This fluctuation is exactly similar in form to fluctuating electric field of radiation and so interaction takes place. The interaction leads to energy transition which is observed in the form of rotational spectra. A molecule which has no dipole, therefore, does not interact. Thus homonuclear diatomic molecules, such as, H_2, N_2 and O_2 etc. have no dipole moment and do not give pure rotational spectra. and are said to microwave inactive. Hetero-nuclear diatomic molecules such as, HCl, CO etc. have dipole, and so interact with micro wave radiation. and are said to be microwave active. Linear molecule like CO_2 CS_2 etc. have $\mu = 0$ and do not absorb in microwave.

For the same reason CH_4, SF_6 etc PHL inactive.

All molecules having permanent dipole moment are therefore MW active and those having no permanent dipole moment are MW inactive.

Thus,

MW active = HCl, CO, NO

MW inactive – CO_2, H_2, O_2, CH_4, SF_6 etc.