...III&.

5. The optical index of refraction and the dielectric constant for glass are 1.45 and 6.5 respectively. Calculate the percentage of ionic polarizability.

Solution:

We have from Clausius-Massotti equation

$$\frac{\varepsilon_r - 1}{\varepsilon_r + 2} = \frac{N(\alpha_e + \alpha_i)}{3\varepsilon_0}.$$

At optical frequencies, we have

$$\frac{n^2 - 1}{n^2 + 2} = \frac{N\alpha_e}{3\varepsilon_0}$$

Now, dividing the second relation by the first, we have

$$\frac{n^2 - 1}{n^2 + 2} \times \frac{\varepsilon_r + 2}{\varepsilon_r - 1} = \frac{\alpha_e}{\alpha_0 + \alpha_i}$$

So, percentage of ionic polarizability is

$$\frac{\alpha_i}{\alpha_e + \alpha_i} \times 100 = \left[1 - \frac{\alpha_e}{\alpha_e + \alpha_i}\right] \times 100$$

$$= \left[1 - \left(\frac{1.1025}{4.1025}\right)\left(\frac{8.5}{5.5}\right)\right] \times 100 = 57.98\%$$

Exercise