

$$Q1. R = |r|^2 = \left| \frac{\sqrt{\epsilon_0} - \sqrt{\hat{\epsilon}}}{\sqrt{\epsilon_0} + \sqrt{\hat{\epsilon}}} \right|^2$$

ここで、この式に $\hat{\epsilon} = \epsilon' - i\epsilon''$ を代入し、分母・分子を $\sqrt{\epsilon_0}$ で割ると、

$$= \left| \frac{1 - \sqrt{\epsilon' - i\epsilon''}}{1 + \sqrt{\epsilon' - i\epsilon''}} \right|^2 \quad \text{--- (1)}$$

ここで、これを、 $\epsilon' - i\epsilon''$ を極形式に直すと、

$$\epsilon' - i\epsilon'' = \sqrt{\epsilon'^2 + \epsilon''^2} \left(\frac{\epsilon'}{\sqrt{\epsilon'^2 + \epsilon''^2}} - i \frac{\epsilon''}{\sqrt{\epsilon'^2 + \epsilon''^2}} \right)$$

ここで、 $\frac{\epsilon'}{\sqrt{\epsilon'^2 + \epsilon''^2}} = \cos \theta$, $\frac{\epsilon''}{\sqrt{\epsilon'^2 + \epsilon''^2}} = \sin \theta$ とすれば、

$$\sqrt{\epsilon' - i\epsilon''} = \left(\sqrt{\epsilon'^2 + \epsilon''^2} \right)^{\frac{1}{2}} \left(\cos \theta - i \sin \theta \right)^{\frac{1}{2}}$$

ここで、 $\left(\epsilon'^2 + \epsilon''^2 \right)^{\frac{1}{4}} = Q$ とし、ド・モアワールの定理を用いると、

$$\sqrt{\epsilon' - i\epsilon''} = Q \left(\cos \frac{\theta}{2} - i \sin \frac{\theta}{2} \right)$$

ここで、これを、(1)式に代入すると、

$$R = \left| \frac{1 - Q \left(\cos \frac{\theta}{2} - i \sin \frac{\theta}{2} \right)}{1 + Q \left(\cos \frac{\theta}{2} - i \sin \frac{\theta}{2} \right)} \right|^2$$

$$= \frac{\left| \left\{ 1 - Q \cos \frac{\theta}{2} \right\} + \left\{ Q \sin \frac{\theta}{2} \right\} i \right|^2}{\left| \left\{ 1 + Q \cos \frac{\theta}{2} \right\} - \left\{ Q \sin \frac{\theta}{2} \right\} i \right|^2}$$

$$= \frac{\left(1 - Q \cos \frac{\theta}{2} \right)^2 + \left(Q \sin \frac{\theta}{2} \right)^2}{\left(1 + Q \cos \frac{\theta}{2} \right)^2 + \left(Q \sin \frac{\theta}{2} \right)^2}$$

$$= \frac{\left(1 - 2Q \cos \frac{\theta}{2} + Q^2 \cos^2 \frac{\theta}{2} \right) + \left(Q^2 \sin^2 \frac{\theta}{2} \right)}{\left(1 + 2Q \cos \frac{\theta}{2} + Q^2 \cos^2 \frac{\theta}{2} \right) + \left(Q^2 \sin^2 \frac{\theta}{2} \right)}$$

ここで、

ここから

$$Q = (\epsilon'^2 + \epsilon''^2)^{\frac{1}{4}} = \{ (76.7)^2 + (12.2)^2 \}^{\frac{1}{4}}$$

$$= 8.78$$

$$Q^2 = 77.1$$

$$\cos^2 \frac{\theta}{2} = \frac{1 + \cos \theta}{2} = \frac{1 + \frac{\epsilon'}{\sqrt{\epsilon'^2 + \epsilon''^2}}}{2} = \frac{1 + \frac{76.7}{\sqrt{(76.7)^2 + (12.2)^2}}}{2}$$

$$= 0.998$$

$$\cos \frac{\theta}{2} = 0.999$$

$$\sin^2 \frac{\theta}{2} = \frac{1 - \cos \theta}{2} = 0.002$$

ここから

$$2Q \cos \frac{\theta}{2} = 2 \times 8.78 \times 0.999 = 17.5$$

$$Q^2 \cos^2 \frac{\theta}{2} = 77.1 \times 0.998 = 76.9$$

$$Q^2 \sin^2 \frac{\theta}{2} = 77.1 \times 0.002 = 0.154$$

よって

$$R = \frac{(1 - 17.5 + 76.9) + (0.154)}{(1 + 17.5 + 76.9) + (0.154)}$$

$$= 0.639$$



ここが正解

もう簡単に出ます