ECE 476/576

HW #1

1.3

$\mathbf{k} \times \mathbf{H} = -\omega \mathbf{D}$; $\mathbf{k} \cdot (\mathbf{k} \times \mathbf{H}) \equiv 0$; (a) $\therefore \mathbf{k} \cdot \mathbf{D} \equiv 0$; (b) $\mathbf{D} = (1/\omega)\mathbf{k} \times \mathbf{H}$;

$\mathbf{B} = (1/\omega)\,\mathbf{k} \times \mathbf{E}$, use $(\mathbf{A} \times \mathbf{B}) \times (\mathbf{C} \times \mathbf{D}) = \mathbf{C}[\mathbf{A} \cdot (\mathbf{B} \times \mathbf{D})] - \mathbf{D}[\mathbf{A} \cdot (\mathbf{B} \times \mathbf{C})]$

$\therefore \mathbf{D} \times \mathbf{B} = -(1/\omega^2)\{\mathbf{k}(\mathbf{k} \cdot (\mathbf{H} \times \mathbf{E})) - \mathbf{E}(\mathbf{k} \cdot (\mathbf{H} \times \mathbf{k})\}$;

Now $\mathbf{H} \times \mathbf{E} = -\mathbf{E} \times \mathbf{H}$ and $\mathbf{H} \times \mathbf{k} = \omega \mathbf{D}$ $\therefore \mathbf{D} \times \mathbf{B} = (1/\omega^2)\,\mathbf{k}[\mathbf{k} \cdot (\mathbf{E} \times \mathbf{H})]$;

$\mathbf{k} \times (\mathbf{k} \times \mathbf{E}) = \omega \mu_0 (\mathbf{k} \times \mathbf{H}) = -\omega^2 \mu_0 \mathbf{D}$;

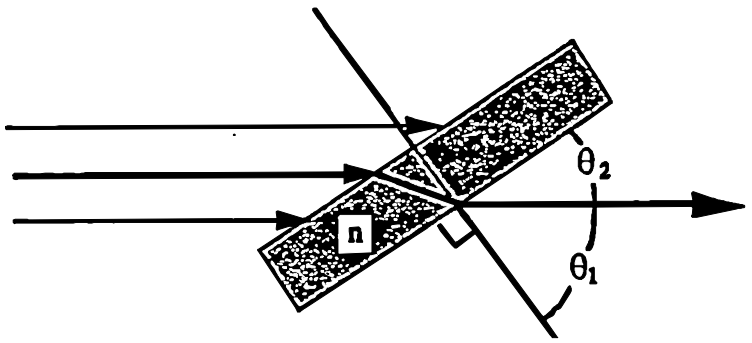
Now $\mathbf{D} \cdot [\mathbf{k}(\mathbf{k} \cdot \mathbf{E}) - k^2 \mathbf{E}] = -\omega^2 \mu_0 \mathbf{D} \cdot \mathbf{D}$, but $\mathbf{D} \cdot \mathbf{k} = 0$;

$$\therefore \boxed{k^2 = \omega^2 \mu_0 \frac{\mathbf{D} \cdot \mathbf{D}}{\mathbf{E} \cdot \mathbf{D}}}$$

1.5

	eV	Å	nm	Hz	cm^{-1}
GaAs	1.47	8434	843.4	3.56^{+14}	11,857
Ar^+	2.41	5145	514.5	5.83^{+14}	19,436
He:Ne	1.96	6328	632.8	4.74^{+14}	15,803
CO_2	0.117	$\lambda = 10.6\ \mu m$		2.83^{+13}	943
ISM(rf)	5.6^{-8}	$\lambda = 22.1$ meters		13.56^{+6}	4.5^{-4}
KrF	4.98	2490	249	1.2^{+15}	40,161

1.10



$\tan \theta_1 = n = 1.43$

$\therefore \theta_1 = 55°; \theta_2 = 35°$