# 1.

## (a)

$$
\begin{aligned}
\nabla\times\vec{E} =& \mathrm{i}\vec{k}\times E\\
\frac{\partial\vec{B}}{\partial t} =& -\mathrm{i}\omega\vec{B}\\
\omega\vec{B} =& \vec{k}\times E\\
\vec{B} =& \frac{\vec{k}}{\omega}\times E
\end{aligned}
$$

when $\vec{k}\parallel\hat{z}$

$$
\begin{aligned}
\vec{B} =& \frac{k}{\omega}\hat{z}\times E\\
=& \frac{n}{c}\hat{z}\times E
\end{aligned}
$$

Since the material is non-magnetic, both $\vec{E}$ and $\vec{B}$ are continious across the surface

$$
\begin{aligned}
E_{0i}+E_{0r} =& E_{0t}\\
E_{0i}-E_{0r} =& nE_{0t}\\
E_{0t} =& \frac{2}{n+1}E_{0i}\\
E_{0r} =& -\frac{n-1}{n+1}E_{0i}
\end{aligned}
$$

## (b)

Define

$$
\begin{aligned}
\tilde{a} =& a_0(z)\mathrm{e}^{\mathrm{i}\phi_a(z)}\\
\tilde{b} =& b_0(z)\mathrm{e}^{\mathrm{i}\phi_b(z)}\\
a(z,t)b^*(z,t) =& \tilde{a}\tilde{b}^*\\
\langle a(z,t)b^*(z,t)\rangle =& \tilde{a}\tilde{b}^*\\
\langle a^*(z,t)b(z,t)\rangle =& \tilde{a}^*\tilde{b}\\
\langle a(z,t)b(z,t)\rangle =& \tilde{a}\tilde{b}\left\langle\mathrm{e}^{-2\mathrm{i}\omega t}\right\rangle = 0\\
\langle a^*(z,t)b^*(z,t)\rangle =& \tilde{a}^*\tilde{b}^*\left\langle\mathrm{e}^{-2\mathrm{i}\omega t}\right\rangle = 0\\
\langle\Re(a(z,t))\Re(b(z,t))\rangle =& \frac{1}{4}(\langle a(z,t)b^*(z,t)\rangle + \langle a^*(z,t)b(z,t)\rangle + \langle a(z,t)b(z,t)\rangle + \langle a^*(z,t)b^*(z,t)\rangle)\\
=& \frac{1}{4}\left(\tilde{a}^*\tilde{b}+\tilde{a}\tilde{b}^*\right)\\
=& \frac{1}{2}\Re\left(\tilde{a}^*\tilde{b}\right)\\
=& \frac{1}{2}\Re(a(z,t)b^*(z,t))
\end{aligned}
$$

## 2.

### (a)

### (b)

### (c)

### (d)

### (e)

### (f)

### (g)

## 3.

### (a)

### (b)

### (c)

### (d)

### (e)

### (f)

## 4.