Maxwell's eqn's (in matter):

$$\nabla \cdot \vec{\mathrm{D}} = \rho_f \qquad \vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$$

$$\nabla \cdot \vec{B} = 0 \qquad \vec{\nabla} \times \vec{H} = \vec{J}_f + \frac{\partial \vec{D}}{\partial t}$$

With (defined) fields:

$$\vec{\mathrm{D}} = \varepsilon_0 \vec{E} + \vec{\mathrm{P}}, \qquad \vec{H} = \frac{1}{\mu_0}\vec{B} - \vec{M}$$

With no free charges around, True (A) or False(B):

$$\nabla \cdot \vec{E} = 0 \ ?$$

Assume medium 1 has a slow EM wave velocity, and medium 2 has a higher wave velocity, $v_2 > v_1$. (Also assume non-magnetic material)

How do ε_1 and ε_2 compare?

A. $\varepsilon_1 \cong \varepsilon_2$
B. $\varepsilon_1 > \varepsilon_2$
C. $\varepsilon_1 < \varepsilon_2$
D. Not enough information to tell!

9.45

In matter with no free charges or currents, we have:

$$\begin{cases} \text{i)} \ \nabla \cdot \vec{D} = 0 \\ \text{ii)} \ \nabla \cdot \vec{B} = 0 \\ \text{iii)} \ \vec{\nabla} \times \vec{E} = -\dfrac{\partial \vec{B}}{\partial t} \\ \text{iv)} \ \vec{\nabla} \times \vec{H} = +\dfrac{\partial \vec{D}}{\partial t} \end{cases}$$

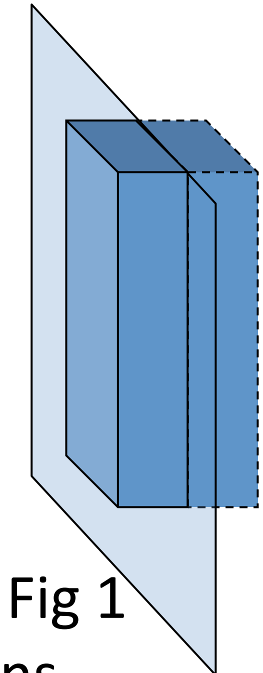


Fig 1

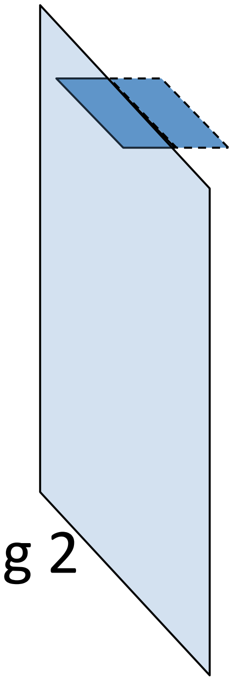


Fig 2

To figure out formulas for <u>boundary conditions,</u> match the picture to the PDE(s) above.

A) Fig 1 goes with i and iii *(i.e. the ones involving D and E),*
Fig 2 goes with ii and iv *("" B and H)*

B) Fig 1 goes with i and ii *("" div),*
Fig 2 goes with iii and iv *("" curl)*

C) Fig 1 goes with ii only *("" B field),*
Fig 2 goes with iii only *("" E field)*

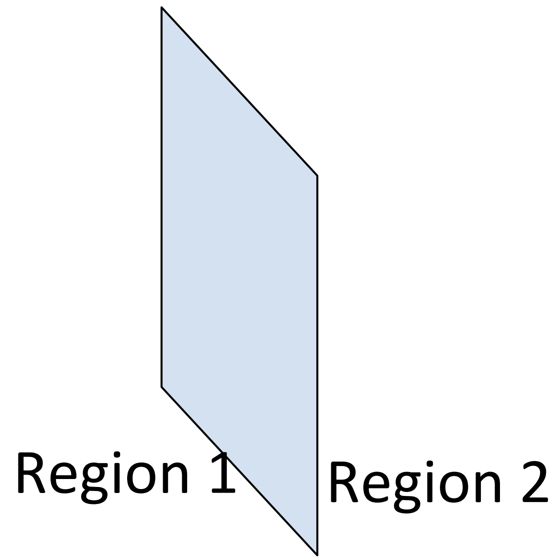
D) Something else!

E) Frankly, I don't really understand this question.

9.46

$$\begin{cases} \text{i)}\ \nabla\cdot\vec{\mathrm{D}}=0 \\ \text{ii)}\ \nabla\cdot\vec{B}=0 \\ \text{iii)}\ \vec{\nabla}\times\vec{E}=-\dfrac{\partial\vec{B}}{\partial t} \\ \text{iv)}\ \vec{\nabla}\times\vec{H}=+\dfrac{\partial\vec{D}}{\partial t} \end{cases}$$

$$\begin{cases} \text{1)}\ B_1^{\perp}=\mathrm{B}_2^{\perp} \\ \text{2)}\ \mathrm{E}_1^{\perp}=\mathrm{E}_2^{\perp} \\ \text{3)}\ \mathbf{B}_1^{//}=\mathbf{B}_2^{//} \\ \text{4)}\ \mathbf{E}_1^{//}=\mathbf{E}_2^{//} \end{cases}$$



Match *the* Maxwell equation (i-iv) in matter (no free charges) with the corresponding *boundary condition* (1-4) it generates:

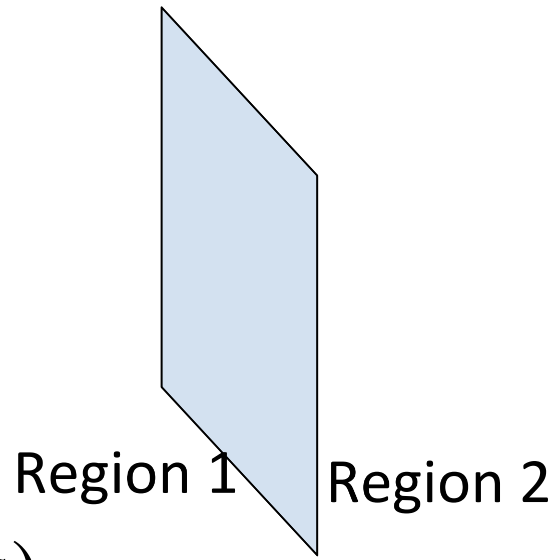
A) i ➔ 4, ii ➔ 1 iii ➔ 2 iv ➔ 3
B) i ➔ 2, ii ➔ 1 iii ➔ 4 iv ➔ 3
C) Wait, only SOME of the BC's on the right are correct!
D) Something else!!
E) Frankly, I don't really understand this question.

9.47

$$\begin{cases} \text{i)} \ \nabla \cdot \vec{\mathrm{D}} = 0 \\ \text{ii)} \ \nabla \cdot \vec{B} = 0 \\ \text{iii)} \ \vec{\nabla} \times \vec{E} = -\dfrac{\partial \vec{B}}{\partial t} \\ \text{iv)} \ \vec{\nabla} \times \vec{H} = +\dfrac{\partial \vec{D}}{\partial t} \end{cases}$$

$$\begin{cases} 1) \ B_1^{\perp} = \mathrm{B}_2^{\perp} \\ 2) \ \varepsilon_1 \mathrm{E}_1^{\perp} = \varepsilon_2 \mathrm{E}_2^{\perp} \\ 3) \ \mathbf{B}_1^{//} / \mu_1 = \mathbf{B}^{//} / \mu_2 \\ 4) \ \mathbf{E}_1^{//} = \mathbf{E}_2^{//} \end{cases}$$

(For linear materials)

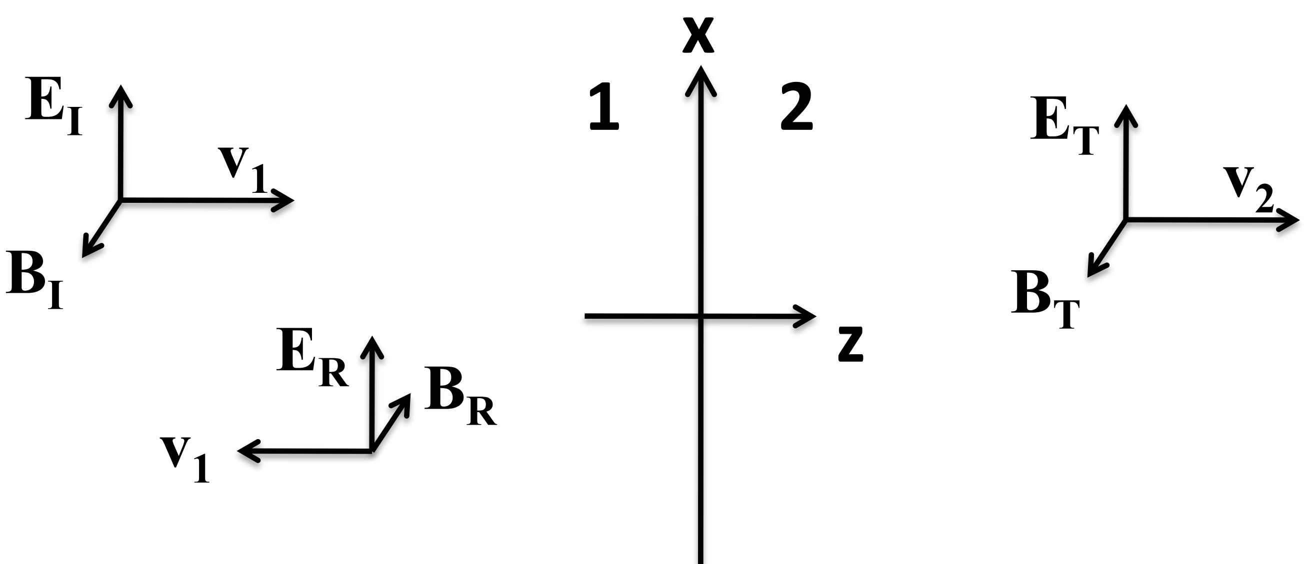


Match *the* Maxwell equation (i-iv) in matter (no free charges) with the corresponding *boundary condition* (1-4) it generates:

B) i ➔ 2, ii ➔ 1 iii ➔ 4 iv ➔ 3

9.38

A plane wave normally incident on an interface between 2 linear (non-magnetic) dielectrics ($n_1 \neq n_2$)



$$E_I = \tilde{E}_{0I} \exp\left[i\left(k_1 z - \omega_1 t\right)\right] \qquad E_T = \tilde{E}_{0T} \exp\left[i\left(k_2 z - \omega_2 t\right)\right]$$

$$E_R = \tilde{E}_{0R} \exp\left[i\left(-k_1 z - \omega_1 t\right)\right]$$

How do k_1 and k_2 compare? How do ω_1 and $\omega_2$compare?

A) k1=k2, ω1=ω2 B) k1 ≠ k2, ω1 ≠ ω2

C) k1 = k2, ω1 ≠ ω2 D) k1 ≠ k2, ω1 = ω2