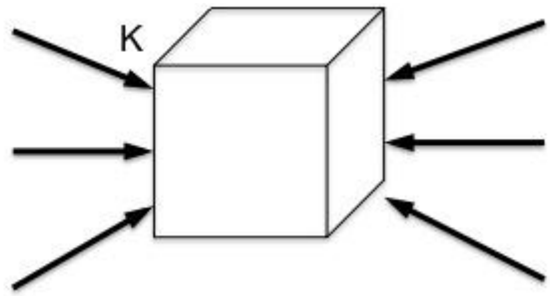


Given the vector field K in the diagram, consider the closed surface intergral of the flux of vector K: ∯ K . dA , with the closed surface being the surface of the cube. What is the sign of this closed surface integral?

>0 , <0 , 0

Briefly explain your reasoning for the previous question.

Consider a closed surface integral of the flux of the Poynting vector S. Mathematically, this would look like a closed double integral: ∯ S . dA.

If the Poynting vector S points OUTWARD everywhere on the surface, what is that telling you about the sign of the integral ∯ S . dA ?

>0 , <0 , 0
We can't decide without knowing the specific shape of the surface.

Briefly explain your reasoning for the previous question.

Griffiths section 9.3.2 talks about an E&M wave propagating at normal incidence from one linear media into another. Consider in particular the PHASE of the REFLECTED wave E_R(tilde). How would that phase compare with the phase of the incident wave, E_I(tilde)?

Phases must be the same
Phases must differ by exactly Pi
Phases are either the same or off by Pi
Phases could be completely independent, no clear relation without knowing more.
Something else (Explain below)

Which of the following explains your reasoning?

Because the direction of travel of the reflected wave is always opposite to the incoming wave (k_r=- k_Inc)
Boundary conditions make the reflected E vector point **opposite** to the incident E vector at the boundary
Boundary conditions make the reflected E vector point **parallel** to the incident E vector at the boundary
It depends on the relative indices of refraction
Other (please explain in the space below)

Given the following expression for the E field of a traveling electromagnetic wave in vacuum: $\vec{\mathbf{E}}_I(\vec{r},t) = E_{0I} e^{i\delta} e^{i(kz-\varpi t)}\,\hat{x}$ **What is the x-component of the physical E field?**

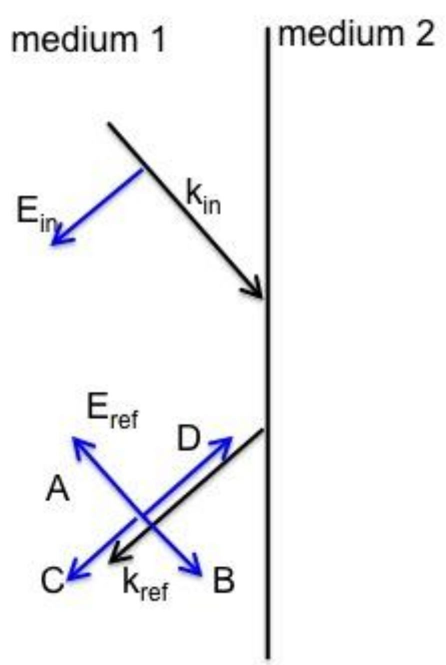
- $E_{oI}\cos\delta$
- $E_{oI}\cos\delta\cos(kz-\omega t)$
- $E_{oI}\cos(kz-\omega t+\delta)$
- E_{oI}
- Something else! (Explain below)

What is the *amplitude* of the physical E field?

- E_{oI}
- $E_{oI}\cos\delta$
- $E_{oI}\cos(\delta+kz-\omega t)$
- $E_{oI}\, e^{-kz}$
- Something else! (Explain below)

If the EM-wave in the previous pair of questions travels in a conductor, the k-vector is COMPLEX. Does your answer to the previous question change? If so, how? If not, why not?

An electromagnetic wave propagates from medium 1 to medium 2 (n2>n1). The incident wave enters at a 45 degree angle, as shown. What is the direction of the reflected E field? (See figure, select the appropriate labeled blue arrow)

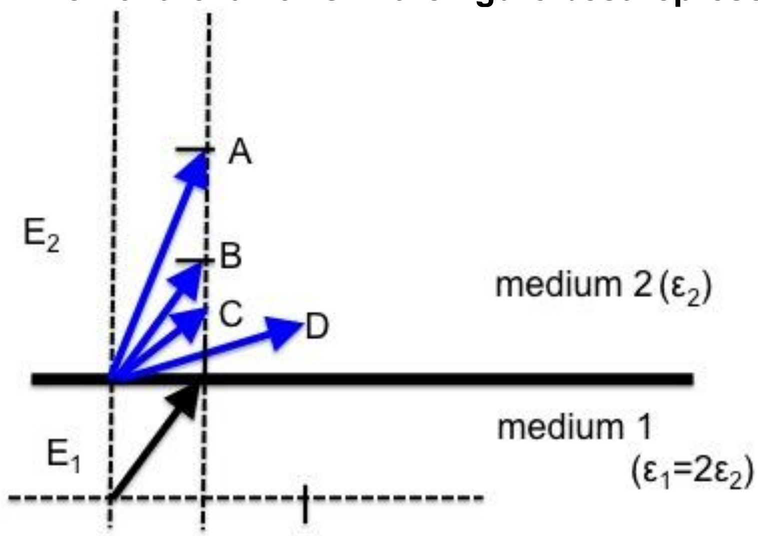


Some other direction (please explain below)

Medium 1 has permittivity ε_1, medium 2 has permittivity ε_2, $\varepsilon_1=2\varepsilon_2$. The direction of the electric field in medium 1 (E_1) is given in the Figure below. (Assume this E-field is JUST BELOW the boundary)
Use the boundary conditions:

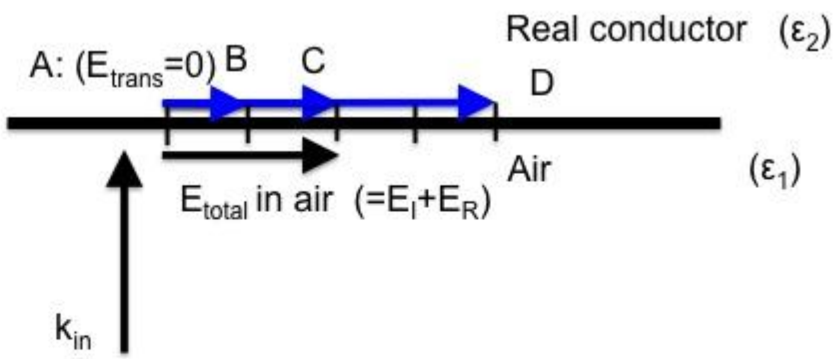
$$E_1^{//} = E_2^{//} \qquad \varepsilon_1 E_1^{\perp} = \varepsilon_2 E_2^{\perp}$$

Which of the arrows in the figure best represents E_2 in medium 2?



Some other direction (please elaborate below)

Now suppose a plane wave with a sinusoidally oscillating E-field enters normally from the air into a real conductor (not perfectly conducting). Etotal is the electric field in the air infinitesimally below the boundary (arrow below the boundary showing the direction of Etotal). Which of the vectors shown just ABOVE the boundary correctly represents the E field of the transmitted wave in the conductor right in the boundary?



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Optional: if you want to comment on any of the last few questions, here is a space

When we worked out the radiation from pointlike dipoles (in Chapter 11), of characteristic size "d", we made some approximations. Choose from the list below the assumptions that we were making. Don't "peek" at Griffiths, see if you can reconstruct the reasoning for yourself.

- $r \ll \omega /c \ll d$
- $r \ll c/\omega \ll d$
- $d \ll \omega /c \ll r$
- $d \ll c/ \omega \ll r$
- $d \ll r \ll \omega /c$
- $d \ll r \ll c/ \omega$
- $r \ll d \ll \omega /c$
- $r \ll d \ll c/ \omega$
- NONE of these is correct!

Suppose, in a region of space, that V=0, while A points in the x-hat direction and depends only on x (not on y, z, or t).
What direction does the E field point?

- E is 0
- x-hat
- y-hat
- z-hat
- Other/not determined.

In the previous question, which direction does the B field point?

- B is 0
- x-hat
- y-hat
- z-hat
- Other/not determined/more complicated (explain)

In the previous set of questions, is it possible (in principle) to pick another gauge such that you leave the physical E and B unchanged, but now have a V'(x,y,z,t) which explicitly depends on time, without ALSO changing the A field in any way.

- Yes, you have the freedom to do this
- No, you do not have enough freedom to do this
- It depends on the specific function A(x) which was not given.

Feel free to comment on any of the above questions.
Two events (1 and 2) occur. Event 1 happens BEFORE event 2 in frame S. Does there exist a reference frame S' where event 1 happens AFTER event 2? Choose all that apply.

Yes for sure, but only if the events are space-like separated, are space-like,
NOT possible if the events are space-like separated, are time-like,
No way, not in any circumstance