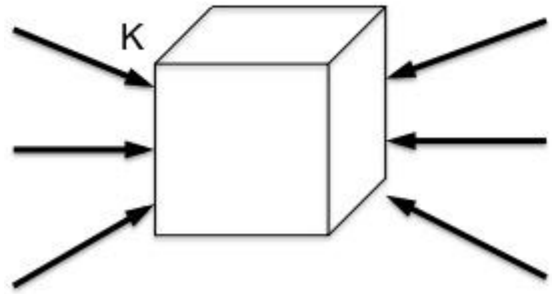
Given the vector field K in the diagram, consider the closed surface intergral of the flux of vector K: ∯ K . dA , with the closed surface being the surface of the cube. What is the sign of this closed surface integral?



<0

Briefly explain your reasoning for the previous question.

(Inward flux is negative. The dot product gives you a minus sign, since dA points out)

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 ,

Briefly explain your reasoning for the previous question.

See above. Outwards (positive) Poynting flux means energy inside is DECREASING.

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 are either the same or off by Pi

Which of the following explains your reasoning?

It depends on the relative indices of refraction

(If n2>n1, then the reflected wave will have a phase off by pi, a minus sign)

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

$E_{oI} \cos(kz-\varpi t+\delta)$

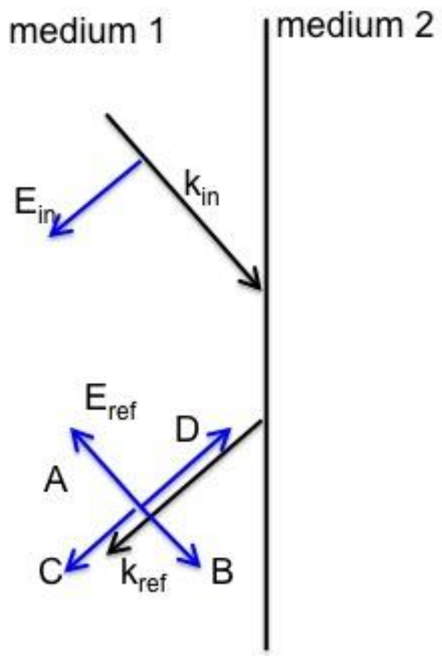
What is the *amplitude* of the physical E field?

E_{oI}

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?
Yes, the imaginary part of k now causes a “decaying exponential envelope” which you might label as part of the “amplitude” (although it does depend on z)

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)



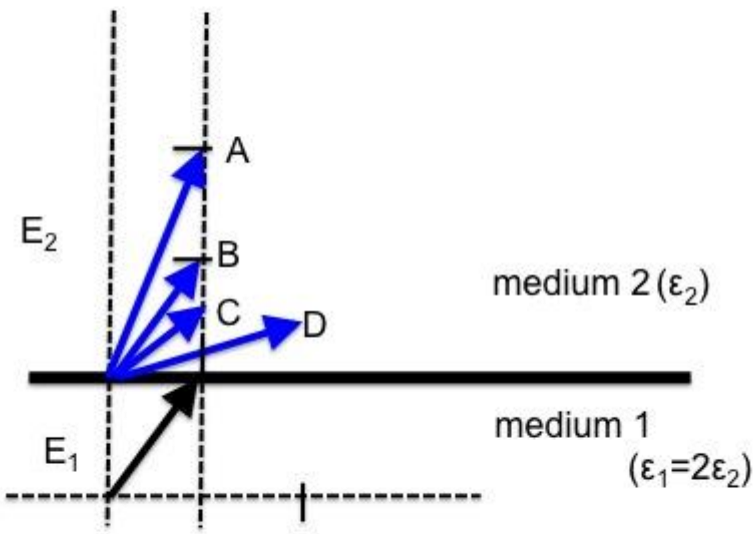
This one is subtle, I would claim “A” since n2>n1, the wave must flip. I think about the limit of incident angle getting very small to convince myself that it is “A” and not “B”.

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:

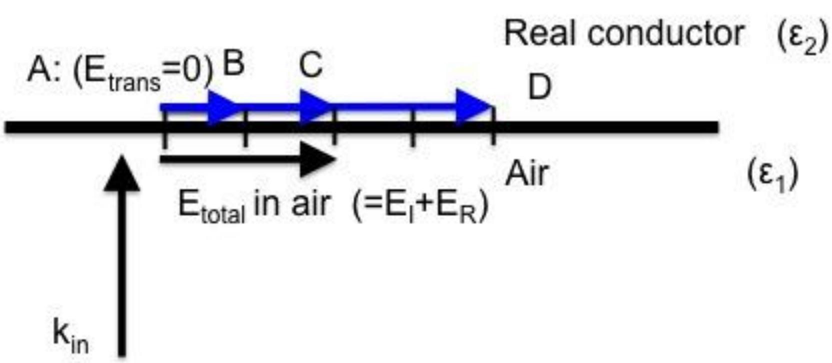
$$E_1^{//} = E_2^{//} \qquad \varepsilon_1 E_1^{\perp} = \varepsilon_2 E_2^{\perp}$$

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



Continuity of E(parallel) eliminates choice D.
Then, Since e1 = 2 e2, that makes E2(perp) twice as big. (so, A)

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?



This is just "continuity of E parallel", I claim C. Notice that ER and ET are not equal, and E1 and ET are not equal, it is "Etotal" which is equal.

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.

$d \ll c/\omega \ll r$

(See Griffiths for more)

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

I think E=0 here, since grad(V)=0, and dA/dt is zero.

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

B is 0

If A depends on x only, and points in the x direction only, it has no curl (look at the front flyleaf)

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

I think so – just invent a “lambda” (see Griffiths for notation) which is just a complicated function of time only. It will have no “grad”, so doesn’t impact A, but d(lambda)/dt will be nonzero, and thus the new V–field will have a time dependence.

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,
NOT possible if the events are time-like OR light-like.
See Griffiths or lecture notes discussion about “simultaneity” . Space-like separation means that the time ordering can be altered, but not for light-like or time-like event pairs!