These problems are due Friday, February 15.

1. Consider two particles on the $z$-axis. There is a $+q$ located at $z = a$ and a $-q$ at $z = -a$. We can think of the particle at $+a$ as being inside an infinite hemisphere $z \geq 0$. Use Poynting’s second theorem to find the total flux of momentum through this hemisphere. (Hint: You should get a very simple answer that is not zero!)

2. The heat flow equation

$$k\nabla^2 T(r, t) - \frac{\partial}{\partial t} T(r, t) = 0$$

describes the flow of heat through a solid. The constant $k$ depends on the material, and $T(r, t)$ is the temperature of the material at time $t$ and position $r$. If, for example, you knew the temperature of the material as a function of $r$ at time $t = 0$, say $T(r, 0)$, then the solution of the above equation with boundary value $T(r, 0)$ would give the distribution of temperature for all subsequent times.

Find the Green’s function for this equation. To be more specific, find the $G(r, t)$ such that

$$\left(k\nabla^2 - \frac{\partial}{\partial t}\right) G(r, t) = \delta(r)\delta(t)$$

Use the method of fourier transforms just as we did in class. Assume that the material is infinite in all directions. Is there an ambiguity about the “sign of the time”? If so, why not?