Announcements

- Homework
  - Webwork due tonight
  - Short little webwork due Wednesday
  - Nothing due on Friday or next Monday
- No class on Wednesday! So support some seniors be watching their talks remotely!
- Lab this week is happening, but will be a very exploratory look at lenses, which we won't get to spend much time on in class.
- Test 3 on Friday!
  - Going to be the same method as Test 2
  - I'm over halfway through Test 2, and hoping to get things wrapped up in the next two days
  - Please remember that these are to be TEST questions. If it takes you more than 10 mins to work out a solution for a problem, it has too much in it or needs simplifying!
  - Chapters 20-23
  - I'll get a summary of objectives posted by tomorrow
- Polling: `rembold-class.ddns.net`

Review Question

An electromagnetic wave is traveling in the $+\hat{\mathbf{y}}$ direction and has an electric field of $\langle 0, 0, 3 \times 10^9 \rangle$ V/m. What is the magnitude and direction of the magnetic field?

A. $\langle 90, 0, 0 \rangle$ T

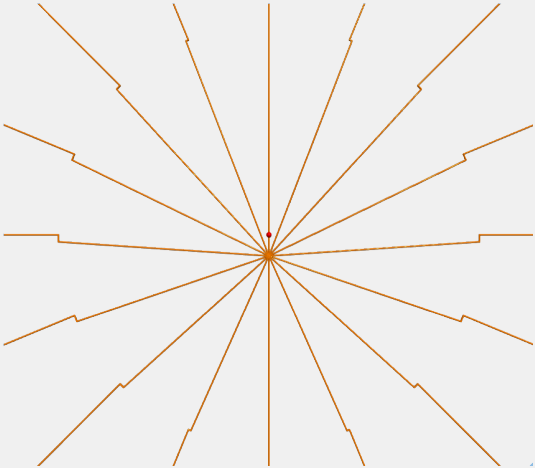
B. $\langle 0, -10, 0 \rangle$ T

C. $\langle 10, 0, 0 \rangle$ T

D. $\langle 0, -10, 90 \rangle$ T

Solution: $\langle 10, 0, 0 \rangle$ T

Propagating Radiation

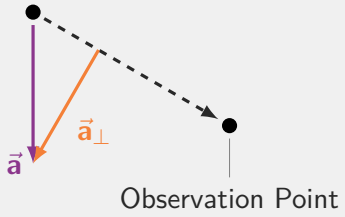


The Radiation Form

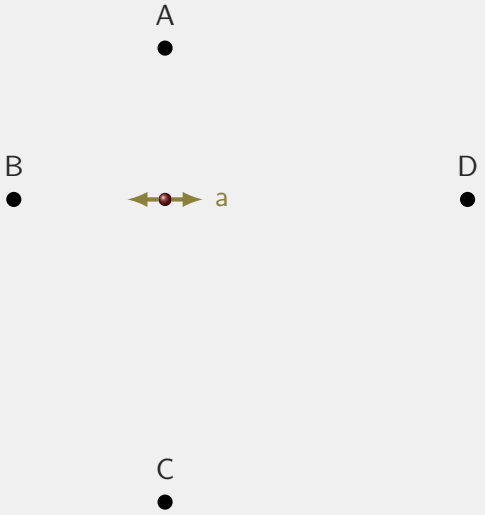
- Know that
  - Accelerating charges create radiation
  - What matters is the perpendicular direction of acceleration
- Turns out that

$$\vec{\mathbf{E}}_{radiative} = \frac{1}{4\pi\epsilon_0}\frac{-q\vec{\mathbf{a}}_\perp}{c^2 r}$$

- Note the $\frac{1}{r}$ dependence. The strength drops off with distance!



Understanding Check



The charge to the left is accelerating back and forth. Rank the indicated points from strongest radiation observed to weakest.

A) $A = B > C = D$

B) $B > A > C > D$

C) $A > C > B = D$

D) $A = C > B = D$

Solution: $A > C > B = D$

Sinusoidal Radiation

- Imagine we have a charge that is oscillating back and forth
  - As if it were on the end of a spring:

$$y = y_{max} \sin(\omega t)$$

  where ω is the angular frequency.
- In the xz plane, creates an electromagnetic wave with

$$E_y = \frac{1}{4\pi\epsilon_0} \frac{q\omega^2 y_{max}}{c^2 r} \sin(\omega t)$$

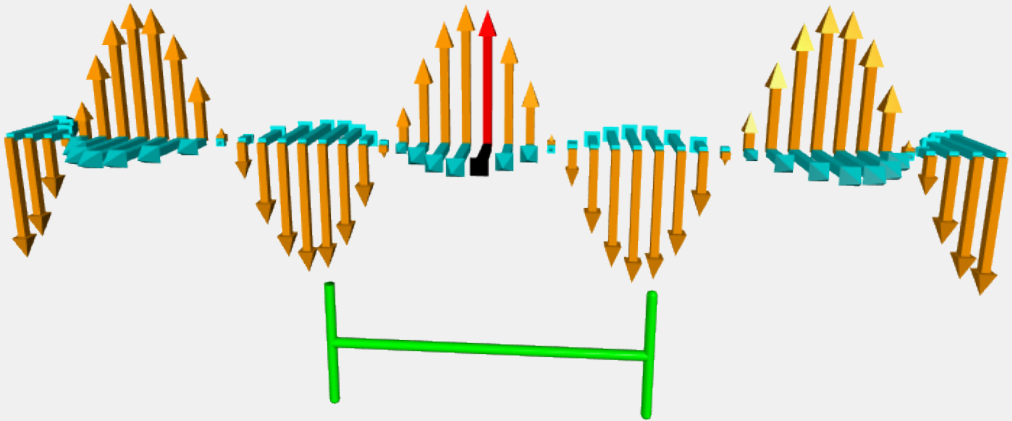
- Remember that our rules for how the magnetic field relates still apply
- This is such a common radiative situation that it is worth breaking down in more detail

Sine Wave Basics

- Amplitude is the peak height of the wave, measured from the center line
- Period is the time between crests passing by
- Frequency is $\frac{1}{T}$ or $\frac{\omega}{2\pi}$
- Wavelength is the distance between successive peaks (or troughs)
  - Recall that wavelength is related to the "type" or color of light
- A peak travels one wavelength every period
- For light, this directly relates the wavelength and frequency:

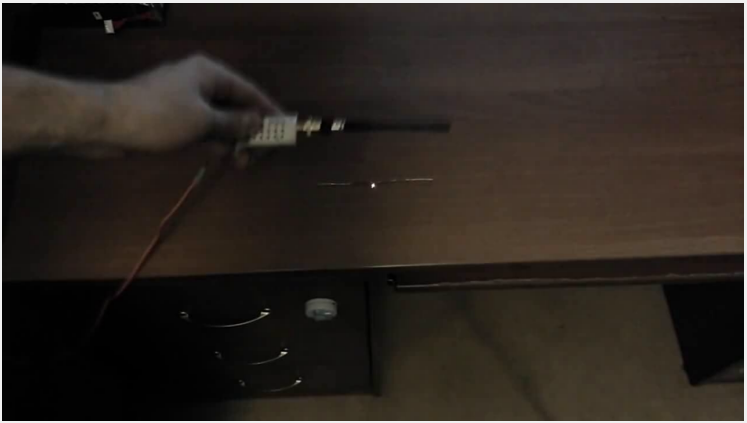
$$v = c = \frac{\lambda}{T} = \lambda f$$

A Visual



Radiation Interacting with Matter

- Just like normal, electric and magnetic fields exert forces on charges!



Full link: here

End of Testable Material

STOP

Here ends the testable material from Chapter 23 that could show up on Test 3. Nothing else from Chapter 23 will be showing up on THIS test.