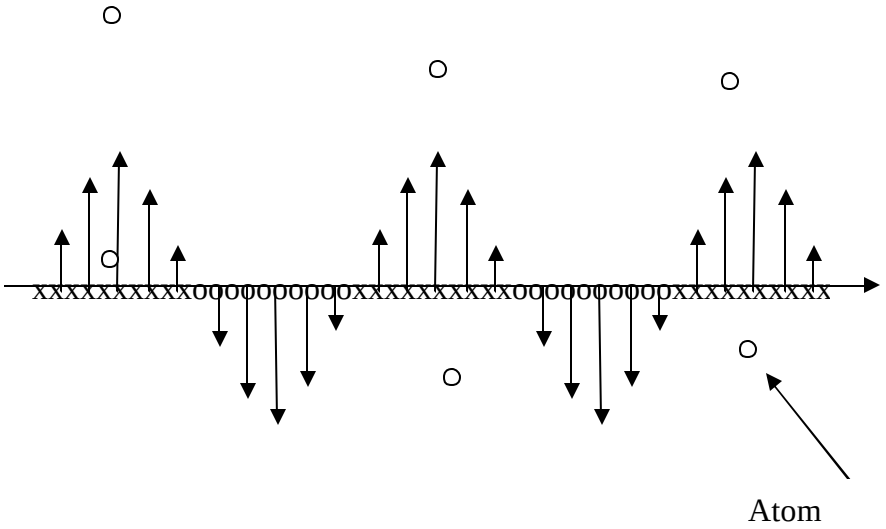
Physics 322 Homework
Due Monday February 13

1) Consider the diagram below that shows electromagnetic radiation traveling to the right. The x's and o's indicate fields are either in or out of the page respectively. The diagram represents light of between 500 and 700 nm wavelength. What sort of material would you think this was (gas, liquid or solid)?



A) Determine which are the electric and magnetic fields. Explain.

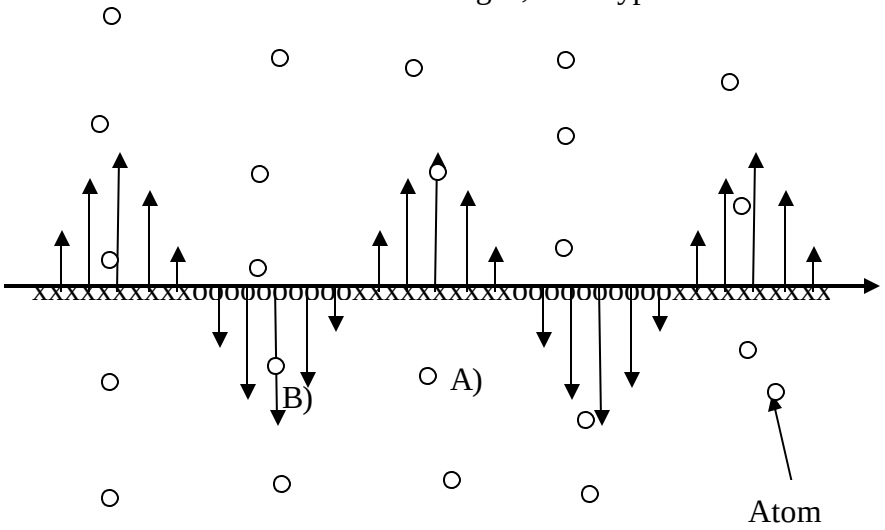
B) Several Atoms are indicated on the diagram. What are the possible directions of radiation of these atoms? Explain.

C) What is the approximate separation of the atoms?

D) If the observer is located some large distance, ~10 cm, what is the path difference for the emission from each of the atoms? What does this mean about the emission to the side?

E) If an observer was either on the right or on the left (looking at where the wave is going or coming from, what is the path difference for the emission from each of the atoms? What does this mean about emission in the forward and backward direction?

2. The substance has now been changed, what type of material would you say this was?



A) Consider the atoms near A) and B). What is the phase of their emission?

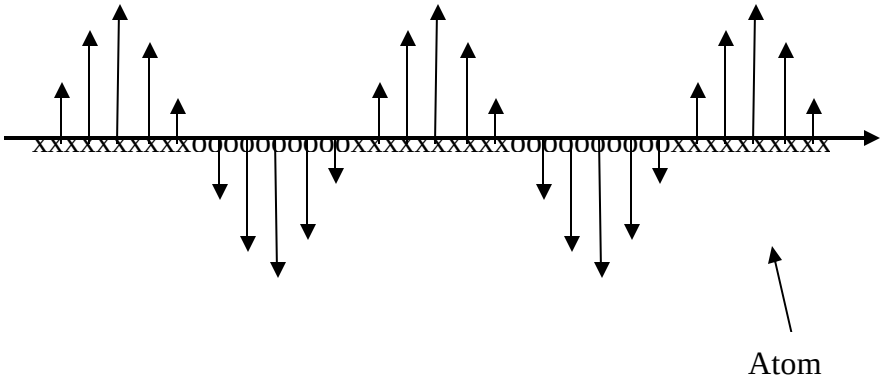
B) What are the path lengths for someone further down the page? What does the phase difference and path length do to the emission perpendicular to the direction the wave is traveling?

C) In the forward direction, does it matter that some of the radiators are separated by ½ of a wavelength?

D) Do the path difference and relative phases have any impact on forward or backward scattering? Explain.

E) What impact would slight variations in position have on the side scattering? Explain.

3) Imagine the wave is now traveling through a material with a regular structure of closely spaced atoms.



A) What would this regular structure do to side scattering? Explain.

B) What impact would the closely spaced atoms have on forward or backward scattering?

4. Using Fermat's principle, derive an expression relating the angle of incidence to the angle of refraction.

5. Consider a coin placed at the bottom of a fish tank with a water depth 30 cm. Looking straight down on the coin, how far does the coin appear to be from the surface?