

# PHYS 452 Homework

## Chapter 3

Name: \_\_\_\_\_

Problem 1 \_\_\_\_\_

Problem 2 \_\_\_\_\_

Problem 3 \_\_\_\_\_

Problem 4 \_\_\_\_\_

Problem 5 \_\_\_\_\_

Problem 6 \_\_\_\_\_

Total \_\_\_\_\_

**Directions:** Work as many of the problems as you can and return the problem set when you are finished. Remember, you are to work *independently* on these problems.

You are encouraged to either type your work directly into this form, or to print the form, write your answers on the printed copy, scan and attach to a return email. Either way works for me.

If, however, you are a luddite or (some other form of technophobe) you may just drop it by my office in Pocatello, hand it to me in class, or snail mail it. Any method of delivery that gets it in my hands by the due date is fine.

Best of luck!

**Problem 1.** Imagine an electromagnetic wave with its E field in the +y direction. Show that

$$\frac{\partial \vec{E}}{\partial x} = -\frac{\partial \vec{B}}{\partial t}$$

applied to the harmonic wave **B**

$$\mathbf{E} = E_0 \cos(kx - \omega t) \text{ and } \mathbf{B} = B_0 \cos(kx - \omega t)$$

yields the fact that

$$E_0 = cB_0$$

**Problem 2.** A 550 nm harmonic EM wave whose E field is in the +z direction is traveling in the +y direction in a vacuum.

- What is the frequency of the wave?
- If  $E = 600$  V/m what is the amplitude of  $B$ ?
- Write expressions for  $E(t)$  and  $B(t)$  given that each is zero at  $t = 0$ .

**Problem 3.** The energy flow to the earth associated with sunlight is about  $1.4 \text{ kW/m}^2$ . Find the maximum values of  $E$  and  $B$  for a wave of this power density.

**Problem 4.** A light wave is traveling in glass of index 1.50. If the electric field amplitude of the wave is 100 V/m find the amplitude of the magnetic field and the average magnitude of the Poynting vector.

**Problem 5.**

- Derive an expression for the radiation pressure when a normally incident beam of light is totally reflected.
- A completely absorbing screen receives 300W of light for 100 seconds. Compute the total linear momentum transferred to the screen.

**Problem 6.**

- What is the speed of light when the index of refraction is 2.42?
- A 500 nm light wave enters a glass plate of refractive index 1.60 and propagates perpendicularly across it. How many waves span the glass if it is 1.0 cm thick?