Problem Set #1 *A little E&M practice*

Problems 1-2 refer to: The electric field in a laser beam is given by

$$\mathcal{E}(x,t) = (1000\text{V/m})\sin\left[(\pi \text{x} 10^{7}\text{rad/m})x + (3\pi \text{x} 10^{15}\text{rad/s})t\right].$$

1. Answer these questions by referring to the general form for a plane wave found on Fn1, p3. (a) What is the wavelength of the beam? Is the laser beam visible light, IR, or UV? Why? (b) What is the (ordinary) frequency of the beam? (c) Using the results of (a) and (b) verify that the expression given above describes a light wave. (d) How long does it take the beam to travel 1 nm? (e) In which direction is the beam propagating? Explain.

2. Given that the magnitude of the electric and magnetic fields in the laser beam are related by $\mathcal{E} = cB$, find the maximum value of the energy density *u*.

3. A double slit interference pattern appears on a whiteboard 1 m from the plate with holes. The wavelength of the light is 550 nm. The distance from the central maximum to the first adjacent maximum is 5 cm. What is the slit separation in the plate? In principle, how many maxima might be observed? Explain all steps.