

# Chapter J - Problems

Blinn College - Physics 2426 - Terry Honan

## Problem J.1

Verify that  $u(x, t) = f(x - vt) + g(x + vt)$  is a solution of the one dimensional wave equation:

$$\frac{\partial^2}{\partial x^2} u = \frac{1}{v^2} \frac{\partial^2}{\partial t^2} u .$$

## Problem J.2

If the peak electric field for a plane electromagnetic wave is  $1800 \text{ V/m}$  then what is the peak magnetic field?

## Problem J.3

The electric field for a plane wave is given by

$$E(x, t) = \left(100 \frac{\text{V}}{\text{m}}\right) \sin\left[\left(10^7 \text{ m}^{-1}\right)x - \omega t\right].$$

- (a) What is the magnetic field amplitude?
- (b) What is the wavelength?
- (c) What value must  $\omega$  have?
- (d) What is the frequency?

## Problem J.4

At what distance from a  $50 \text{ W}$  isotropic source (a point source) is the peak electric field  $15 \text{ V/m}$ ?

## Problem J.5

A helium-neon laser produces a polarized beam of  $632.8 \text{ nm}$  light at a power of  $5 \text{ mW}$ .

- (a) What is the peak electric field at a point where the beam has a cross-sectional area of  $4 \text{ mm}^2$ ?
- (b) What is the total electromagnetic energy in a  $1 \text{ m}$  length of the beam?

### Problem J.6

A 5 MWatt radio station emits radio waves isotropically.

- (a) What is the intensity of radio waves 5 m from the source?
- (b) What is the force on a  $2\text{ cm} \times 2\text{ cm}$  square sheet that is a perfect conductor oriented normally to the radiation?

### Problem J.7

A 100 mW laser reflects normally off a perfect mirror. What is the force on the mirror?

### Problem J.8

An electromagnetic plane wave of intensity  $750\text{ W/m}^2$  is normally incident on a  $0.5\text{ m} \times 1\text{ m}$  rectangular surface that reflects half the energy.

- (a) What is the total energy absorbed by the surface in 1 min?
- (b) What is the total momentum given to the surface in 1 min?

### Problem J.9

The AM radio band is from 540 kHz to 1600 kHz and the FM band is between 88 MHz and 108 MHz. What are the range of wavelengths in each band?