

Name: .....

## ASTRONOMY 1102 - Section 1

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Spring 1999

Homework # 1 due Fri. Jan. 22

### Waves & Electromagnetic Radiation

1) The following are examples of waves of different types. Indicate which are material waves (oscillations in a material medium) and which are electromagnetic waves like visible light, but differing in the wavelength.

- |                                  |          |
|----------------------------------|----------|
| a) light                         | EMW      |
| b) seismic waves                 | material |
| c) sound                         | material |
| d) X-rays                        | EMW      |
| e) radio waves                   | EMW      |
| f) ocean waves                   | material |
| g) Infrared light                | EMW      |
| h) UV                            | EMW      |
| i) $\gamma$ -rays (gamma rays)   | EMW      |
| j) vibrations in a guitar string | material |

2) The speed of any electromagnetic wave in vacuum is the speed of light. Therefore the frequency and the wavelength are always inversely proportional to one another. Knowing that the wavelength of 10 kHz radio waves is 30 km, and using only proportions, answer the following questions:

- a) What is the wavelength of 1 kHz radio waves?  $\lambda(1\text{kHz}) = \lambda(10\text{kHz}) \times 10 = 300$   
LOWER  $f \Rightarrow$  LONGER  $\lambda$
- b) What is the wavelength of 100 kHz radio waves?  $\lambda(100\text{kHz}) = \lambda(10\text{kHz})/10 = 3$   
HIGHER  $f \Rightarrow$  SHORTER  $\lambda$

3) Calculate using powers of ten (without calculators) the length of a light-year, a unit of length commonly used for stellar distances, which equals the distance travelled by electromagnetic waves (take speed =  $3 \times 10^5$  km/s) in one year (take  $1 \text{ yr} = 3.15 \times 10^7 \text{ s}$ ).

$$1 \text{ LY} = 3.15 \times 10^7 \cancel{\text{s}} \times 3 \times 10^5 \cancel{\text{km/s}} = \underbrace{(3.15 \times 3)}_{\approx 9.5} \times 10^{7+5} \text{ km}$$
$$\approx 9.5 \times 10^{12} \text{ km}$$

(OR  $\approx 10^{13} \text{ km}$   
 $\approx 10^{16} \text{ m}$   
 $\approx 10^{18} \text{ cm}$ )