Astr 1020

Problem Set #2

[Hand in! Due 2/11/03.]

1. A set of wireless headphones receives a signal of frequency of 914 MHz. (Such radio waves will pass through walls; this is not true for infra-red radiation, which is used by some wireless speaker units.) Find the wavelength of these EM waves. (Note, the "M" here stands for Mega, that is, 10^6.)

2. Find the frequency of EM waves which have a wavelength of 5.0×10^{-2} cm. Using Fig. 6-2 in the text, what kind of radiation is this?

3. Find the angular size of a crater on the moon which has a (linear) diameter of 1.5 km. Use $380,000$ km as the distance to the Moon's surface.

4. Will it ever be possible for astronomers to *directly* observe the disk of a star?

To get a rough idea of their angular sizes, consider the star Alpha Centauri, which is close to the sun; its distance is only about 4.2 ly. Its diameter is about the same as that of the sun, namely 1.4×10^9 m. Find the angular diameter of Alpha Centauri as seen from the earth. (Express the answer in arcseconds.)

5. The Helix Nebula in Aquarius is a cosmic "smoke ring" with a diameter of about 1.75 light years. Its *angular* width is about 15 arcminutes.

Find the distance to the Helix Nebula.

6. One of the department's reflecting telescopes has a mirror diameter of 4.0 inches. If it didn't have to cope with the earth's atmosphere, what would its resolving power be? (Express the answer in seconds.)

Important formulae:

$$1 \text{ km} = 10^3 \text{ m} \qquad 1 \text{ cm} = 10^{-2} \text{ m} \qquad 1 \text{ in} = 2.54 \text{ cm} \qquad 1 \text{ AU} = 1.5 \times 10^{11} \text{ m}$$

$$\lambda f = v \qquad c = v_{\text{light}} = 2.998 \times 10^8 \tfrac{\text{m}}{\text{s}} \qquad 1 \text{ ly} = 9.46 \times 10^{15} \text{ m}$$

$$\theta = \frac{d}{D} \qquad (\theta \text{ is in radians; units of } d \text{ and } D \text{ are the same!})$$

$$\pi \text{ rad} = 180 \text{ deg} \qquad 1 \text{ deg} = 60 \text{ min} \qquad 1 \text{ min} = 60 \text{ sec}$$

$$\alpha = \frac{11.6}{D} \qquad \text{For optical telescopes; } D \text{ in cm, } \alpha \text{ in seconds}$$