

1.) Shu, problem 2.3

2.) Superman is supposed to have had X-ray eyes. Although the media played up his ability to see through solid matter, it seems to me that his increased visual acuity is at least as interesting. About how small an object could Superman resolve at a distance of 1 km, if he used his X-ray vision? (Use a pupil size of 2 mm, and choose a typical X-ray wavelength from Fig. 2.3 in your text.) You should assume the Superman's super-eyes are resolving at the theoretical diffraction limit. He must, after all, obey the laws of physics.

2b.) You, alas, are stuck with crummy old optical vision. Nature knows this, and has designed the receptor spacings on your retina accordingly. (You can only resolve at about twice the diffraction limit, remember.) TV makers also know this of course. If a typical viewer watches a television from a distance of 2 meters and has a pupil opening of 2 mm, approximately what is the minimum separation distance between individual picture elements one should design for? If your TV is 25×25 inches, how many picture elements is that?

3.) Two stars, each with the mass of the sun, are in orbit about each other with a 10 year period. The system is 15 pc, or about 4.6×10^{19} cm, distant. At a wavelength of 500 nm (green light), how large a telescope is needed to resolve the separation of the stars? You may assume that you are viewing the system face-on, so that the plane of the orbit is the plane of the sky.

4.) Daytona Beach, FL has a latitude of 28.7° N. A full moon is directly overhead. What holiday is approaching? Explain your reasoning clearly.

5.) Radio station WHOM in the city of Weston broadcasts at 99.5 MHz on your FM dial. Radio station WHAT in the city of Easton broadcasts at 100.5 MHz. Evil Cardassians, traveling in their space vehicle (near the ground) in a straight line connecting Easton and Weston, pick up both stations at exactly the same spot on their radio receiver! Toward which city are they traveling, how fast are they going, and at what frequency do they hear both stations?