Observational Astronomy - Spring 2014
Homework 3 - Telescopes and the EM spectrum

1. Name two reasons why we put telescopes in space.

2. Name two different components of the electromagnetic spectrum that you use every day.

3. Which has a longer wavelength, blue light or red light?

4. Assume you are at a dark-sky site and can see with your naked eye stars down to magnitude +6. You pull out your trusty 7x50 binoculars, which have objective lenses 50mm in diameter. How many times more light do they gather than your naked eyes, which have pupils 7mm in diameter? What is the faintest magnitude you can see in the binoculars? Show your calculations.

5. The Hubble Space Telescope has a mirror D = 2.4m in diameter, and has diffraction-limited optics with resolution given by $\theta = 1.22\lambda/\mathrm{D}$. It orbits the Earth about 560 km high. Suppose we pointed it at the ground and looked in visible light with $\lambda = 500$nm. Could it resolve individual people, about 2m in size? Could it read street signs, with letters about 50cm high? Could it read your smart phone, with letters about 5mm high? Show your calculations.

6. There are many very exciting discoveries lately of exoplanets, which are planets orbiting stars other than the sun. We would like to build a telescope to see features on these planets. Suppose we would like to resolve continent-sized objects 1000km across in visible light with $\lambda = 500$nm on a planet orbiting a star 10 parsecs away. One parsec is 3×10^{16}m. How large would the diameter of the telescope need to be, assuming that the resolution is determined by $\theta = 1.22\lambda/\mathrm{D}$? Show your calculations.