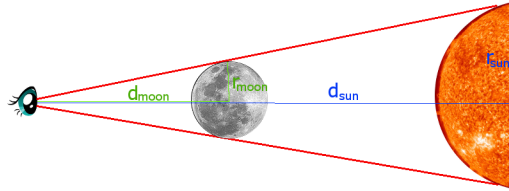**Arvind Borde**
AST 9: Homework 6

1] Here's a diagram that illustrates (not to scale, obviously) how a solar eclipse can be total:


For the moon to more-or-less cover the sun, the moon and the sun need to have more-or-less the same *apparent size* (i.e, look as if they have close to the same size). The condition for that is

$$\frac{d_{\text{sun}}}{r_{\text{sun}}} \approx \frac{d_{\text{moon}}}{r_{\text{moon}}}.$$

The radius of the sun is $\sim 7 \times 10^5$ km and its distance from us is $\sim 1.5 \times 10^8$ km. The radius of the moon is $\sim 1.74 \times 10^3$ km and its distance from us is $\sim 3.84 \times 10^5$ km.
Does the condition for equal apparent sizes hold for the sun and moon?

2] Keeping in mind that it's possible to faintly see the moon even in daylight, answer the questions below using this diagram as a guide
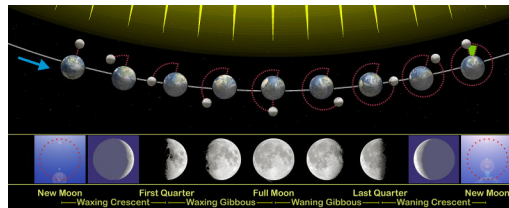
(a) Is it possible to see a full moon at noon? (b) Is it possible to see a new (crescent) moon at midnight? (c) Can you deduce from the photograph below where the sun might be hidden, and very roughly what time it might be?

3] Newton's Law tells us that the gravitational force on you "caused" by an object of mass M a distance d from you can be expressed as $F_{\text{grav}} \propto M/d^2$. The mass of the sun is $\sim 2 \times 10^{30}$ kg and that of the moon is $\sim 7.4 \times 10^{22}$ kg. Using the distances from question 1, calculate M/d^2 for the sun and the moon. Which is greater and by how much? The tidal force, on the other hand is $F_{\text{tidal}} \propto M/d^3$. Do the same sun/moon calculation here, and note which is greater.

4] Does the moon exert appreciable tidal forces on *your* bodily fluids? One of the units of force is a Newton. It's roughly the weight of a small apple in your hand on earth. A 60 kg person will have roughly 40 kg of water in her/him. To get the tidal force of the moon on this person's fluids, take the answer for M/d^3 for the moon from above and multiply it by 40. To covert to Newtons, however, you must *divide* by 10^{20}. How's them apples?