1. Work out the solid angle corresponding to the entire sphere, and to the ‘celestial dome’ - the entire sky above the horizon.

**Problem 2.11:** Consider a cloud that, when viewed from a point on the surface, occupies the portion of the sky defined by $\pi/4 < \theta < \pi/2$ and $0 < \phi < \pi/8$.

(a) What is the solid angle subtended by the cloud?
(b) What percentage of the sky is covered by this cloud?

**Problem 2.12:** The moon is at a mean distance $D_m = 3.84 \times 10^5$ km from the earth; the Sun is at a mean distance $D_S = 1.496 \times 10^8$ km. The radius of the moon is $R_m = 1.74 \times 10^3$ km; the radius of the sun is $R_s = 6.96 \times 10^5$ km.

(a) Compute the angular diameter (in degrees) subtended by the sun and the moon. Refer to Fig. 2.5 for help visualizing the geometry of this problem. (b) Compute the solid angle subtended by the sun and the moon. (c) Which appears larger from Earth, and by what percentage do the two solid angles differ? (d) If the above values were constant, would it be possible to explain the occurrence of total solar eclipses?

(recall flux density = $W \text{ m}^{-2}$ while intensity = $W \text{ m}^{-2} \text{ sr}^{-1}$)

**Problem 2.14:** A typical laser pointer used in lectures puts out 5 mW of power into a nearly parallel beam with a diameter of 5 mm. (a) What is the flux density normal to the beam, and how does it compare with the typical clear-sky solar flux (at ground level) on a surface normal to the beam of 1000 W m$^{-2}$? (b) If beam can be assumed to be confined to a cone of angular diameter 1 milliradian, what is the intensity of the beam in watts per steradian, and how does this compare with the intensity of sunlight computed from the above solar flux and an angular diameter of 0.5° for the sun’s disk?)