

ASTR 1404 Stars, Galaxies, and Cosmology

Problem Set 1

June 5, 2016

Recall the **Law of Skinny Triangles**

$$a = \theta \cdot D$$

where θ is in radians, a and D are in same units.

An alternative way to write this is in AU, arcsecs, and parsecs (pc):

$$a(\text{AU}) = \theta(\text{arcsec}) \cdot D(\text{pc})$$

where $1 \text{ AU} = 1.5 \times 10^{13}$ and $1 \text{ pc} = 3.09 \times 10^{18}$

Problem 1.

Compute the number of

- degrees in a radian
- arcminutes in a radian
- arcseconds in a radian
- radians in a degree
- radians in a arcminute
- radians in an arcsecond

Problem 2.

Compute the angular separation of the Earth-Moon system as seen from the Sun. The Earth-Moon distance is $D_M = 384,000$ km. $1 \text{ AU} = 1.5 \times 10^{13}$

Problem 3.

The diameter of Jupiter is 143,000 km. the closest the Earth and Jupiter ever get is about 4 AU or 6×10^{13} .

3 (a).

What is the angular diameter of Jupiter as seen from the Earth?

3 (b).

Can you see this with your unaided eye? How about with a small telescope?

Problem 4.

The angular diameter of Saturn's ring system is 39 arcsec. The distance to Saturn is 1.3×10^{14} cm. What is the physical diameter of Saturn's rings?

Problem 5.

Venus is 0.28 AU from the Earth during a transit of the sun. Two observers separated by a North-South distance of $R_E = 6.37 \times 10^8$ cm will see the path of Venus across the solar disk displaced by a parallax of 31.3 arcsec. How big is 1 AU?

Problem 6.

Pluto is $40 \text{ AU} = 6 \times 10^{14}$ cm from the Earth. The Pluto-Charon separation is $a = 19,600$ km. What is the Pluto-Charon angular separation as seen from the Earth? Is the Pluto-Charon system resolvable with a ground based telescope?

Problem 7.

The distance from Earth to Jupiter is $4 \text{ AU} = 6 \times 10^{13} \text{ cm}$. The radii of the orbits of the 4 large moons of Jupiter (Galilean Satellites) are given below. Compute the angular sizes of the orbits as seen from Earth.

Moon	Distance to Jupiter (Moon to Jupiter)
Io	422,000 km
Europa	671,000 km
Ganymede	1,070,000 km
Callisto	1,880,000 km

Table 1: Distances to Jupiter from Jupiter's moons

Problem 8.

The parallax of the star Sirius is 0.37 arcsec. What is the distance to Sirius in (a) parsecs, (b) meters, and (c) light years. Note that the speed of light, c , is $c = 3 \times 10^{10} \text{ cm/s}$

Problem 9.

The parallax of the closest star, αCen , is 0.75 arcsec.

9 (a).

What is the distance to αCen ?

9 (b).

What is the angular separation between the Sun and Jupiter as seen from αCen ? The Sun-Jupiter distance is 5.2 AU.