ASTRO 81 - Assignment #1

due Friday of Week #1 before 5pm

To get full credit for these problems you need to show all your work. Longer problems with more sub-parts are worth more points.

1. The supermassive black hole at the center of the galaxy is four mega solar masses ($M_\odot$) and is 8 kpc away.
   (a) How massive is this black hole in units of grams?
   (b) How far away is this black hole in meters? In light years?
   (c) How long ago did the light that we see today from stars near the black hole originate? What was happening here on earth at that time?
2. Calculate the angular diameter of the moon and the sun (you may look up their sizes and distances) in units of degrees and units of arcseconds.
3. Order of magnitude calculation: Estimate how many cups of coffee will you consume in your lifetime. Explain your reasoning based on your own current and expected habits.
4. What is the latitude and longitude of your current location?
5. What will the right ascension of the sun be on inauguration day?
6. London has a latitude of 51 degrees N and a longitude of 0 degrees. Sydney has a latitude of 40 degrees South and a longitude of 151 degrees East. What is the mean solar time difference between London and Sydney? Show your work.
7. The hour angle of the star Rigel is 20 hours. How much longer will it take for Rigel to transit the meridian?
8. If you discover a new object and observe it to have a certain altitude and azimuth, what other piece or pieces of information do you need to record to communicate the location of the object you discovered to someone else?
9. If the object you discovered has a minimum altitude of 20^o on the Northern Meridian and a maximum altitude of 70^o on the Southern meridian, what is the latitude of the observer and the declination of your object?
10. The Galactic center is has a right ascension of 18 hours and a declination of -29 degrees.
    (a) What is the maximum and minimum altitude of the Galactic center as observed from Keck Observatory, which has a latitude of 20 degrees North?

(b) Draw a picture of the celestial sphere as observed from Keck Observatory, showing the zenith, horizon, the celestial north and south poles, the celestial equator, and the path that the Galactic center takes through the course of 24 hours.

(c) At what latitude(s) would the Galactic center be circumpolar?

(d) What time of year does the Galactic center transit at midnight in Hawaii?

11. How many times per year does the sun rise at the North Pole?

12. Is a solar day longer or shorter than a sidereal day? Let Δt be the time difference between a solar and sidereal day. In units of Δt, what is the time difference between the solar and sidereal day if the earth rotated in the opposite direction and its rotational speed was twice as fast? Explain your answer.