Project 1

Please type your responses into a word document, and submit that on UNM Learn. Be sure to number your responses 1, 2(a), etc. so I know which question you're answering, and **show your work** for all questions.

This project consists of four questions. Be careful not to give away answers in the forums. As discussed in the video, *the lower grade of the homework average for module 1 and this project will be replaced by the average of the two*. That means if your homework grade so far is low, it'll be raised by however well you do on this project.

1. *(40 points) Draw the Earth and the Sun from a top-down view (not to scale, you'll need a large Earth).*

   (a) *(8 points) On the Earth, label the following local times: 12:00 am, 3:00 am, 6:00 am, 9:00 am, 12:00 pm, 3:00 pm, 6:00 pm, 9:00 pm.*

   (b) *(10 points) Outside of each time, draw the phase of a Moon at that position. About how long is the Moon in each phase?*

   (c) *(5 points) Label the point on Earth where you'd be when you observe the full Moon set. What time do you observe the full Moon setting?*

   (d) *(4 points) Label A for where sunrise is experienced on Earth, B for where sunset is experienced, C for where the Sun is at the Zenith, and D for the middle of the night.*

   (e) *(5 points) In reality, we notice that sunrise and sunset times change throughout the year. Putting all atmospheric effects aside, why is this?*

   (f) *(3 points) For an observer in the Southern hemisphere, are the days longer in their Winter or Summer?*

   (g) *(5 points) You and your Australian friend measure the day with stopwatches to find that you've both experienced exactly the same amount of daytime. At what latitude is the Sun at the zenith?*

2. *(20 points) The Sun has a luminosity of $382.8 \times 10^{24} \ \frac{J}{s}$. What is the flux (power per unit area) where Earth is? What if Earth was twice as far from the Sun? Extra Credit: How much energy does the Earth receive from the sun from this luminosity?*

3. *(20 points) List all of the wavelengths that can be emitted from electron transitions in the first five energy levels of hydrogen (see Homework 2 for help). You'll have to calculate the energy levels first, and you should find 10 wavelengths.*

4. *(30 points) (To answer this question, you have to understand Question 2 of Assignment I. If you didn't understand that question (or if you get stuck on this one), now is the time to ask in the forums. Asking questions in the discussion forums is a necessary step to do some homework problems, and projects.) It's March 18th and you're stranded on a raft in the water, with no idea how you got here. Not feeling great, you decide you need to figure out where you are so you can use your paper map of the Earth.*

Energies (J)	-2.2×10^{-18}	-5.4×10^{-19}	-2.4×10^{-19}	-1.4×10^{-19}	-8.7×10^{-20}
Resonances (J)	1.6×10^{-18}	1.9×10^{-18}	3×10^{-19}	2×10^{-18}	4.1×10^{-19}
	1.1×10^{-19}	2.1×10^{-18}	4.6×10^{-19}	1.6×10^{-19}	4.9×10^{-20}
Wavelengths (nm)	95	97	103	122	434
	486	657	1282	1876	4053

You check your phone, it says the local time is 9:00 pm, a reasonable hour. You give Maziar, who has retired to Greenwich, a call to see if he can help you identify your position based on the stars. He picks up, you explain your situation and start naming constellations you see. As you explain that you observe Polaris at 49 degrees from your zenith, he replies, "Are you crazy? It's 4 in the morning! I told you this information would come in handy and you didn't listen! Besides, just use your GPS!" You realize he's right, you could have just pulled up Google maps, and hang up on him as he rants on about how easy the class would have been if you'd just use the discussion forums. You pull up Google maps and your phone shuts off, out of battery.

(a) *(5 points) With a geometrical picture, show how you can find your latitude.*

(b) *(5 points) What is your latitude?*

(c) *(5 points) Timezones are generally divided into one-hour increments—with this assumption, how many timezones are there, and how many degrees do they span on average? (Do not look this up, just calculate it.)*

(d) *(2 points) Is your longitude in the East or West hemisphere? Support your answer with the direction of the rotation of the Earth. (Double check with your picture for Problem 1).*

(e) *(5 points) How many degrees away from 0 are you longitudinally?*

(f) *(3 points) Considering (b), how accurate is your answer? Express as, e.g., [answer to (c)]±[error]° [E/W].*

(g) *(5 points) Identify your timezone and check that your answer is reasonable.*

(h) *(5 points, extra credit) You are thirsty. Where are you, and why shouldn't you drink the water? (Try searching the coordinates in a map, find the nearest body of water and check that it's within your error in (e)).*