ASTRONOMY 020

Problem Set #2

Due: September 26, 2003

1. Answer each of the following questions, (a) to (d), for observers at **each** of the following locations on the Earth's surface: (i) the North Pole, (ii) the equator, and (iii) latitude 43°N. Summarize all of your answers in a table.

   (a) What are the azimuth and altitude of the North Celestial Pole?

   (b) What is the maximum altitude of the celestial equator?

   (c) What are the maximum and minimum declinations for stars which always remain above the observer's horizon? Such stars are called circumpolar stars. What are the equivalent declination limits for stars that are never visible, i.e., always below the horizon?

   (d) When you look directly east, what is the angle, $\leq 90°$, between the diurnal path of a rising star on the celestial sphere and the horizon?

2. Make a sketch of the horizon coordinate system at each of three locations: (i) the North Pole, (ii) the equator, and (iii) latitude 43°N. Label the N, S, E, and W directions in each diagram. Within **each** diagram, plot the path of the Sun at three different times: summer solstice, winter solstice, and the equinoxes. Clearly label the angular separation between paths and the angle each path makes with the horizon.

   Hints: (1) The Sun's path is identical at the two equinoxes. (2) The Sun is not visible at the North Pole during winter solstice.

3. What are the maximum and minimum altitudes of the Sun at noon for the entire year if your latitude is 50°N?

4. Visit a night sky web site such as www.heavens-above.com, or use planetarium software to do the following:
   (a) Find the latitude and longitude of London, Ontario.
   (b) Write down the RA and declination δ for the Sun on any day this week. Additionally, write down the sunrise and sunset times for that day. Mention which date you pick.
   (c) The autumnal equinox occurs this year at 06:46 am, Sep. 23. Find a picture of the sky as viewed from London, Ontario at about this time. Write down which objects among the Moon and planets are in the sky and the nearest associated constellation for each one.

Practice problem:

1. The Greek astronomer Eratosthenes noted that, at summer solstice, the noon altitude of the Sun in the city of Syene differed by $7°12'$ from its altitude in Alexandria. Use this information, together with the fact that Alexandria is located 800 km (in modern units!) due north of Syene, to reproduce Eratosthenes' determination of the Earth's radius. What is the percentage difference with the currently accepted value? (Hint: see Fig. 4-1 in textbook).
   Answer: 6,366 km, which differs by only 0.188% from the official value $R_\oplus = 6,378$ km.