

For Problems 1 and 2, you will need to use a celestial sphere. There is one in the lobby of the planetarium and one in 1219 BMPS. The planetarium is open 8:30–12:00 and 13:00–16:30.

1. **Motion of the Brightest Stars.** (6 pts.) The 16 brightest stars that are visible from the northern hemisphere are Sirius, Arcturus, Vega, Capella, Procyon, Rigel, Betelgeuse, Altair, Aldebaran, Spica, Antares, Pollux, Fomalhaut, Deneb, Regulus, and Castor. Choose one of them, and find (1) the coordinates of the star, (2) the date on which it is visible on the meridian at sunset, and (3) the date on which it is rising at sunset. The meridian is the great circle line that passes through the celestial pole and the zenith. Give the declination in degrees and the right ascension in hours and minutes. Explain how you found the dates. For simplicity, assume that you are on the equator.
2. The coordinates of the center of the Milky Way galaxy are  $17^{\text{hr}}39^{\text{min}}$  right ascension and  $-29^{\circ}$  declination.
  - a. (5 pts.) When is the best time of year to observe it? Explain how you can figure this out from knowing that the right ascension of the sun is  $0^{\text{hr}}0^{\text{min}}$  on the vernal equinox.
  - b. (2 pts.) Is it better to observe it from Michigan or from Chile in South America? Explain your reasoning.
3. **Observing the Moon** You are on a desert island without any books. You observed that the moon is full. In one week, when should you observe it, and in what direction should you look?
  - a. (5 pts.) Describe a model that enables you to answer. The model must have the earth, sun, and moon.
  - b. (5 pts.) Explain how you figured out the answer from your model.
4. **Ptolemy versus Copernicus**
  - a. (3 pts.) Draw a model of the Sun, Earth, and Venus according to Copernicus. Show the motion over a 12-hour period.
  - b. (3 pts.) Draw a model of the Sun, Earth, and Venus according to Ptolemy. Show the motion over a 12-hour period.
  - c. (3 pts.) On your picture, show how Ptolemy explained the observation that Venus is never seen late at night.