1. **Erathosthenes in a parallel universe**. Suppose Erathosthenes lived on an earth that is half as big as the real one. Keep the distance between Alexandria and Syene the same.
    a. (3 pts.) Draw a diagram that shows the well, the stick, the shadow with the actual angle, Syene, and Alexandria.
    b. (5 pts.) Draw the same diagram showing the case with a smaller earth. You must show what is different in this diagram.
2. The **autumnal equinox** will occur at 6:23 pm EDT on September 22.
    a. (5 pts.) Does the autumnal equinox occur at a different time for people in Hawaii, which is 6 hours behind us? Make certain that you know the definition of the equinox. Explain your reasoning.
    b. (5 pts.) Draw a picture of the earth as viewed from the sun on the autumnal equinox. On your drawing, show the north and south poles, the equator, and the constellation directly behind the earth. You may want to use the celestial sphere in the planetarium.
3. **Hipparchus** measures the distance to the moon. At the Hellespont, the solar eclipse of 189BC was total. In Alexandria, the moon covered ¼ of the sun. The distance between Alexandria and Hellespont is 1000 km.
    a. (5 pts.) Draw a picture that shows the Hellespont, Alexandria, the moon, and the sun. The picture must show that the eclipse is total at the Hellespont and partial in Alexandria.
    b. (5 pts.) Find the distance to the moon using Hipparchus' measurements.