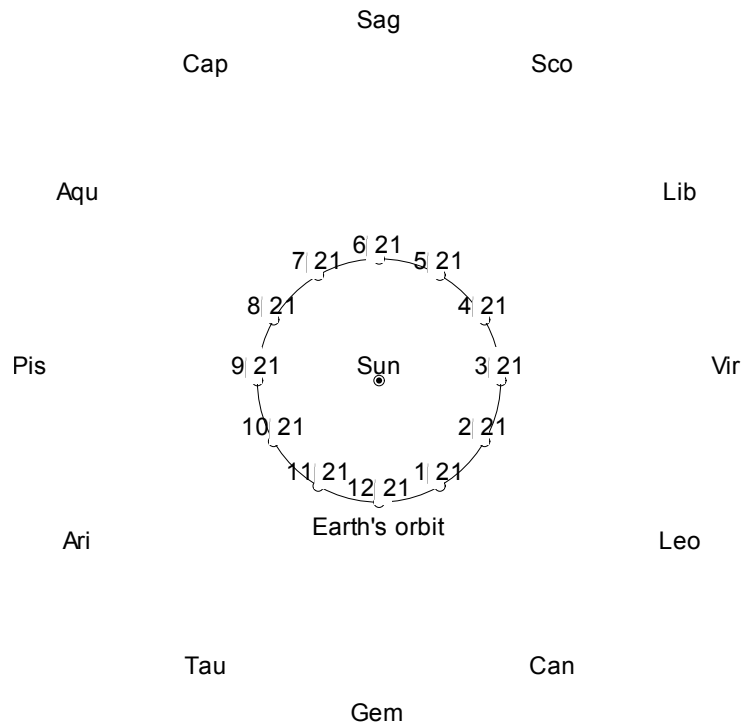You may use one sheet of notes. You may not use books or additional notes.

Do the easy questions first. Then go back to the harder ones.

Name	
PID	
1	/ 5
2	/ 4
3	/ 8
4	/ 6
Total	/ 23

Planet	Period (yr)	Semi-major axis (AU)	Eccentricity
Mercury	0.241	0.387	0.206
Venus	0.615	0.723	0.007
Earth	1.000	1.000	0.017
Mars	1.881	1.523	0.093
Jupiter	11.86	5.202	0.049
Saturn	29.46	9.539	0.056

Sag

Cap   Sco

Aqu   Lib

7 21   6 21   5 21

8 21   4 21

Pis   9 21   Sun   3 21   Vir

10 21   2 21

11 21   12 21   1 21

Ari   Earth's orbit   Leo

Tau   Can

Gem

1. Galileo disproved Ptolemy's geocentric model by observing the phases of Venus. He wrote, "(1) Know therefore that about 3 months ago I began to observe Venus with the instrument, and I saw her in a round shape and very small. Day by day she increased in size and maintained that round shape until finally, attaining a great distance from the Sun, the roundness of her eastern part began to diminish, and (2) in a few days she was reduced to a semicircle. She maintained this shape for many days, all the while, however, growing in size. (3) At present, she is becoming sickle-shaped."

    a. (2 pt.) What did Galileo observe that contradicted Ptolemy's model?

        Galileo observed that Venus was in the full phase.

    b. (1 pt.) Why did Ptolemy not disprove his own model in the same way?

        Ptolemy did not have a telescope, which is needed to see phases.

    c. (2 pt.) Draw a diagram that shows Venus at the time (2) of his observations. You must include the sun and earth. For simplicity, you may let earth be stationary. Explain your placement of Venus in your diagram.

        Put Venus so that the boundary between the sunlit and dark halves is along the line between earth & Venus. It is below because it is getting closer to earth.
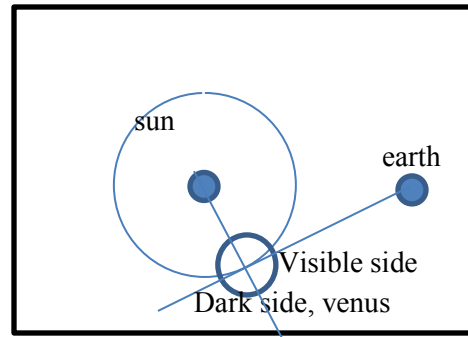
2. Copernicus wrote *On the Revolutions of the Heavenly Spheres*.

    a. (2 pt.) What did he propose in this book?

        Copernicus proposed that the planets, including earth moved around the sun.

    b. (2 pt.) What did he mean by "revolutions"? What did he mean by "heavenly spheres"?

        Revolutions refer to the orbits, and heavenly spheres are planets.

3. The drawing on the front page shows the constellations of the Zodiac. Suppose the date is 3/21 and sunrise and sunset occur at 6am and 6pm.

    a. (2 pt.) Which constellation is rising at sunset? You must explain how you found the answer, either in words or with a drawing, to receive any credit.

        At sunset, the horizon is in the line from Pisces to Virgo. Since the earth turns counterclockwise, more of Virgo will be seen later: Virgo is rising.

    b. (3 pt.) Which constellation(s) can you not see at any time during the night? Explain how you found your answer.

        You cannot see Pisces, the constellation in the direction of the sun. You can see Aries, because its center rises 2 hours after sunset. You can also see Aquarius, because its center rises 2 hours before sunrise.

    c. (2 pt.) Explain why the earth spins more than 360° from noon on one day to noon on the next day. Hint: Consider how much earth must spin in 90 days, and show that it is more than 90×360°. (1 pt.) How many degrees does the earth spin between successive noons?

Consider noon on 3/21 and noon on 6/21, approximately 90 days later. On the diagram you are standing on the left side of earth at noon on 3/21 and on the bottom at noon on 6/21. Earth turned 90 full turns and an extra 90°. Therefore earth turns 360° in a day; more precisely, it is 360+360/365.25=360.99°.

4. Astronomers discovered a new comet, and they found that it passes closest to the sun at a distance of 0.5AU and the second focus of its orbit is 20AU from the sun.

     a. (3 pts.) Find the length of the major axis.

        The major axis is 20+2×0.5=21AU. The semi major axis is 10.5AU. The relationship is from the drawing.

     b. (3 pts.) Is it likely to return in your lifetime? (You are 20 years old.) Explain how you found your answer.

        The period can be found from Kepler's 3rd Law. The period is 34years. Quicker way is to look at the table on the front page. Saturn has a slightly shorter semi major axis. Therefore the comet's period is slightly longer than 29years, which is within my lifetime.