

Name: \_\_\_\_\_

Section: \_\_\_\_\_

**Homework 2: Newton's Laws, Kepler's laws, Seasons, and a review of the Celestial Sphere**

**Due:** In your section the week of **February 4<sup>th</sup>**. Be neat and concise, show your work, and remember units. An answer without the correct units is wrong.

1. (2 points) **Mass and weight.** The Mars Exploration Rover Spirit has a mass of 185 kg. The SI unit of force is the Newton, written as N.  $1 \text{ N} = 1 \text{ kg m/s}^2$ . Look at Appendix E (Planetary Data) in your book for help with part b).

a) What did Spirit weigh when she was on Earth (after she was fully assembled)?

b) What does she weigh on Mars?

2. (2 points) **Newton's laws.** Given a constant force F:

a) What happens to the acceleration if you double the mass?

b) What happens to the acceleration if you halve the mass?

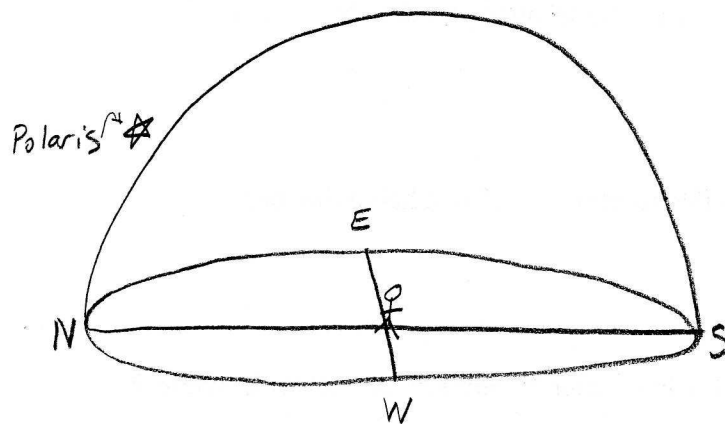
3. (1 point) **Seasons.** Why is it warmer in summer and colder in winter?

4. (3 points) **Astronomical time.**

a) What is a sidereal day? How is it different from a solar day?

b) Draw a sketch of a sidereal day. Indicate the Earth, the Sun, and far away (“fixed”) stars.

4. (6 points) **Celestial Sphere.** Label this celestial sphere, including the latitude angle (assume the person is in Ithaca), zenith, horizon, north celestial pole, Earth’s rotation axis (including the direction), and celestial equator.





- d) You now have all of the information you need to figure out Xanadu's size. By comparing the latitude (degrees) and distance (km) separation of Arcadia and Utopia to the geometry of a sphere, calculate Xanadu's circumference.
- e) **Kepler's laws.** If Xanadu's semimajor axis is 1.2 AU, how long is its year?
- f) **Gravitation.** What is the gravitational force between Xanadu and its sun? Assume that Xanadu has the same mass as the Earth, and Xanadu's sun has the same mass as the Sun.