Astronomy Homework # 2

Name_________________________ DUE: February 5 (by 11 PM)

Your homework grade depends not only upon your getting the correct answer but also grammar, spelling and punctuation, particularly in questions that require explanations. Numerical answers to questions do not need to be written in complete sentences and you should show your work where ever it is appropriate. Partial credit may be given for showing your work even if your result is incorrect. You will also be graded on the use of significant figures, proper units of measure and proper scientific notation. You may work with others in determining the answers to the questions, but what you write should be in your own words – any homework assignments that look too similar to that of other students will receive no credit. Unless otherwise noted, all questions are worth 1 point. Homework can be turned in at the office Latham 121 during business hours, during class, or on-line at e-Learning.

1. (6 points total) Follow the link at the course website to the In-The-Sky.org planetarium display (this uses HTML5 and is best viewed with a Chrome browser). This shows you various parts of the sky, and you can click and drag the display as well. There are controls for dates and times above the image of the sky and display options below. Follow these directions to set up the display for these questions.
   • Change the date to January 1, 2016 and the time to 12:00 (noon).
   • Change the view so that you are looking due south (“S” should be at the bottom center of your view).
   • Adjust the “Field of View” slider to the largest value, 120 degrees.
   • To simplify your view, turn off the Messier “show” and “label” options.

There are several pink dots and names for solar system objects, including the Sun, several planets and some dwarf planets (Pluto and Ceres). At times the Moon will also be visible, but ignore it.

   a. Move the “Draggable date slider” to days in the past and future. What is the general direction of apparent motion of the solar system objects relative to the stars as time moves forward?

   b. Which object appears to move the slowest?

   c. Do any of the objects move in the opposite direction from what you indicated in part “a”? If so which ones?
d. As you changed the date using the slider, you may have also noticed that the time changed. This is because the stars are not moving. Reset the date slider to 1 Jan., 2016. Now move the “Draggable Time slider”. In which direction do the solar system objects in the sky now appear to move, relative to the horizon, as time goes forward?

e. What causes the apparent motion of the solar system objects that you observed in part “a”?

f. What causes the apparent motion of the solar system objects that you observed in part “d”?

2. (2 points) You are a fearless space explorer and you’ve discovered a new planet which you’ve decided to call Morgania. This planet has a mass that is 5.71 times the mass of the Earth, and a radius that is 2.10 times the radius of the Earth. How does the gravity on Morgania compare quantitatively to that of the Earth? Make sure you indicate how many times the gravity is compared to the Earth’s.

3. Is Morgania’s gravity stronger or weaker than that of the Earth’s gravity?
4. Around the planet Morgania there are two moons (Flippo and Doopy). You were able to measure some of the characteristics of each moon, but you are not able to get all of the information. You will need to use Kepler's 3rd law to determine the missing characteristics of the Moons, the formula for that is of course

\[ P^2 = k a^3 \]

But to use this formula, you'll have to figure out what \( k \) is. Fortunately you were able to measure the motion of your spacecraft (which is still in orbit around Morgania), and you’ve determined that it takes 3.89 days to orbit at an average distance of 6.01 planet radii. Using these values determine the value for \( k \).

\[ k = \frac{P^2}{a^3} = \text{____________________} \]

5. (2 points) In the table below you have the observations that you have made of Morgania's moons. Using the value of \( k \) and Kepler’s third law, determine their average distance.

<table>
<thead>
<tr>
<th>Moon</th>
<th>Period (days)</th>
<th>Ave. Distance (planet radii)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flippo</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Doopy</td>
<td>39</td>
<td></td>
</tr>
</tbody>
</table>

6. Both moons orbit around Morgania in the ecliptic path. Which moon will be involved in more eclipses (lunar and solar) over the course of a year?

7. (3 points) Each of Morgania’s moons has a surface gravity that is a small fraction of the Earth’s. Flippo has only 5% of the Earth’s gravity, while Doopy has 27% of the Earth’s gravity. For comparison our Moon has only 16% of the Earth’s gravity. None of these moons (Flippo, Doopy, or our Moon) has an atmosphere. If you travel to each of the moon you can do a very simple experiment. You will drop a brick and a duck feather from the same height. You need only use qualitative terms in your answers (you don’t have to do any math for this).

a. When you drop the brick, on which of the moons would it fall the fastest?

b. When you drop duck feather, on which of the moons would it fall the fastest?

c. On which of the moons would the brick fall faster than the feather?
8. (4 points total) The surface of the Earth has an average temperature of about $3.30 \times 10^2$ K.

a. Use Wien’s law to determine the wavelength of the main type of light that the Earth’s surface gives off.

b. What type of light is this (IR, radio, visible, x-ray, etc.)?

c. If the temperature of the Earth were to be 25.0 times greater, what would the wavelength be for the main type of light that the Earth gives off?

d. What type of light is this?