

Name \_\_\_\_\_

Astronomy 161 – Solar System Astronomy  
Autumn Quarter 2009 – Prof. Gaudi  
Homework #3

**Due Monday, October 26 in class**

Instructions

Answer the following five multiple-choice questions by circling the correct answer. Each question is worth the number of points given in parentheses (out of a total of 100). In addition, there is one extra credit question.

**No late homework will be accepted.**

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Astronomers surveying the outer solar system discover a new planet that they name Fred. Astronomers estimate that Fred has an orbital period around the Sun of one million years and is on a circular orbit. They also estimate that Fred is only 100 times less massive than the Sun.

Question 1 (20 points)

What is Fred's semi-major axis?

- a) 1000 AU
- b) 10,000 AU
- c) 100 AU
- d) One million AU
- e) One billion AU

Question 2 (20 points)

What is the apparent brightness of the Sun on Fred relative to the apparent brightness on the Earth?

- a) One trillion times fainter
- b) 100 million times fainter
- c) 10,000 times fainter
- d) 100 times fainter
- e) One million times fainter

Question 3 (20 points)

How much weaker is the gravitational force between the Earth and Fred than the gravitational force between the Earth and the Sun?

- a) the Fred-Earth force is 100 million times weaker
- b) the Fred-Earth force is 100 billion times weaker
- c) the Fred-Earth force is a million times weaker
- d) the Fred-Earth force is a trillion times weaker
- e) the Fred-Earth force is 10 billion times weaker

Question 4 (20 points)

How much weaker are the tides raised by Fred on the Earth than the tides raised by the Sun on the Earth?

- a) the tides raised by Fred are 10 billion times weaker
- b) the tides raised by Fred are a million times weaker
- c) the tides raised by Fred are 100 million times weaker
- d) the tides raised by Fred are 10 trillion times weaker
- e) the tides raised by Fred are 100 trillion times weaker

Question 5 (20 points)

The velocity of an object in a circular orbit about the Sun is,

$$v_c = \sqrt{\frac{GM_{\text{Sun}}}{d}}$$

Where  $G$  is the gravitational constant,  $M_{\text{Sun}}$  is the mass of the Sun, and  $d$  is the radius of the orbit. Approximating the Earth's orbit as circular with a velocity of 30 km/s, what is the velocity of Fred?

- a) about 30 m/s
- b) about 3 km/s
- c) about 300 km/s
- d) about 3 m/s
- e) about 300 m/s

Extra Credit Question:

Question 6 (20 points)

What is the escape velocity from the Sun at the distance of Fred's orbit?

- a) about 4.24 m/s
- b) about 42.4 m/s
- c) about 30 m/s
- d) about 424 m/s
- e) about 300 m/s