

Midterm Exam #1: Astronomy 160b, spring 2006, January 31, 2006

NAME:

This test consists of problems relating to a fake newspaper report (see testarticle) on a potential future discovery. The test consists of 30 points: the four problems on the back of this sheet total 14 points, and problem five on the next sheet is worth 16 points. The test will last for 50 minutes — please plan your time accordingly. Please answer the problems on the test paper. **Please put your name on both pages!!** The following quantities and equations may prove useful:

$$1 \text{ year} = 3 \times 10^7 \text{ seconds}$$

$$1 \text{ A.U.} = 1.5 \times 10^{11} \text{ m}$$

$$1M_{\odot} = 2 \times 10^{30} \text{ kg}$$

$$1M_J = 10^{-3}M_{\odot}$$

$$1M_E = 3 \times 10^{-6}M_{\odot}$$

$$P_J \approx 11 \text{ years}$$

$$a_J \approx 5 \text{ A.U.}$$

$$c = 3 \times 10^8 \text{ m/s}$$

$$G = 7 \times 10^{-11} \text{ in mks units}$$

$$1 \text{ parsec} = 3 \times 10^{16} \text{ m}$$

$$1 \text{ radian} = 2 \times 10^5 \text{ arcseconds}$$

$$a^3 = P^2 GM / (4\pi^2)$$

$$\alpha = D_2 / D_1$$

$$V = 2\pi a / P$$

$$V_* M_* = V_p M_p$$

$$\Delta\lambda / \lambda = V / c$$

1. (6 points): Dr. Budweiser notes that the relatively low mass of the star and the small orbit of the planet make New Earth easier to detect using the radial velocity method. Why is this? This question can be answered in two statements of 1-2 sentences each, so to help organize your thoughts, we provide the start of each of those statements:

Planets are easier to detect around low mass stars because

Planets with small orbits are easier to detect because

2. (4 points): In order to determine the density of the planet, the Heineken team needs to know both its mass and its radius. The mass of the planet can be determined from the radial velocity curve. How do they know its radius?

3. (4 points). Finish the incomplete sentence at the end of the article:

“The composition of the atmosphere was determined by

NAME:

5 (16 points): The plot above is the radial velocity curve observed by the Anheuser-Busch team (note to 2007 students — the plot was simply a sine curve with some points on it — I xeroxed it out of a journal article so I don't have an on-line copy, but you can see it on the answers). You'll notice that the axes are not labelled. Please label them. In particular, put in the quantities that are being plotted. Be specific — don't just say "distance", but "distance between the planet and the star" etc (that's *not* the right answer for either axis, by the way). Then put in numerical values with appropriate units for the tick marks. To do this you'll need to do some calculations based on information presented in the fake news article. Please carry out the calculations in the space below, and continue on the other side of the paper if necessary.