

Name ANSWER KEY

ASTR 1010 - Exam 2 - Spring 2009 - Prof. Magnani

March 4, 2009

There are 8 questions on this exam and you must attempt them all (the numerical value of each question is denoted in parentheses). A formula and constants sheet is included at the end of this exam. Please write right on the exam pages and use the back of the sheets if you need more room. You may use a calculator. Be sure to include the units associated with the numerical result that you get for your quantitative answers. Good luck!

- 1. (13 points) A stick moves rapidly across your line of sight at 2/3 the speed of light. As it is moving by, you measure its length to be 6.40 m. What would its length be if the stick was stationary?

$$v = \frac{2}{3}c$$

$$L = L_0 \sqrt{1 - \frac{v^2}{c^2}}$$

$$v^2 = \frac{4}{9}c^2 \quad L = L_0 \sqrt{1 - \frac{4}{9} \frac{c^2}{c^2}} = L_0 \sqrt{1 - \frac{4}{9}}$$

$$6.40 \text{ m} = L_0 \sqrt{\frac{5}{9}}$$

$$L_0 = 8.59 \text{ m}$$

- 2. (13 points) My weight on Earth is 980 Nt. If a planet has a mass of 2.71M_{Earth} and a radius of 1.17R_{Earth}, what would be my weight on that planet? What would be my mass on that planet?

Weight $\rightarrow F = ma$ a on Earth is $9.8 \frac{m}{s^2}$

On Earth: $980 = m \cdot 9.8 \Rightarrow m = 100 \text{ kg}$

$F = \frac{GMm}{d^2} = ma \Rightarrow a = \frac{GM}{d^2}$

On other planet: $a = \frac{G \cdot 2.71 M_{\text{EARTH}}}{(1.17 R_{\text{EARTH}})^2} = \frac{2.71}{1.37} \left(\frac{GM_{\text{EARTH}}}{R_{\text{EARTH}}^2} \right) = \frac{2.71}{1.37} \cdot 9.8 = 19.4 \frac{m}{s^2}$

Weight on other planet: ~~980 Nt~~ 1940 Nt

Mass on other planet: 100 kg