

## SUNSPOT LAB HOMEWORK

On a separate piece of paper, please answer the following questions:

1. The Sun has a radius of  $6.96 \times 10^8$  m, a mass of  $1.988 \times 10^{30}$  kg, and, as we calculated in class, a rotational velocity of about  $1.875 \times 10^3$  m/s. Using this information, please calculate the Sun's angular momentum. (3 points)
2. One day, many years from now, the Sun will inflate into a state known as a red giant. It will be so big that the orbits of Mercury and Venus will be completely engulfed. When this happens, what will happen to its angular momentum? Why? (2 points)
3. Suppose the red giant version of our Sun has a radius that is a factor of 200 times greater than its current value. What will its new rotational velocity be? (3 points)
4. How does the Sun's red giant rotational velocity compare with its current rotational velocity? (2 points)
5. The Sun currently has a temperature of about 6000 K. What is its luminosity? (3 points)
6. When the Sun turns into a red giant, it will cool as it gets larger and eventually settle to a new temperature of about 4000 K. What will its new luminosity be? (2 points)
7. How does the Sun's red giant luminosity compare with its current luminosity? (2 points)
8. If a star exactly like the Sun and a star exactly like the red giant version of the Sun were placed at equal distances from Earth, which would look brighter? (1 point)
9. In your own words, please give a description that characterizes the nature of a red giant based on what you've just calculated (1 point)

Hints: The units of angular momentum are  $\frac{\text{kg m}^2}{\text{s}}$  and those of luminosity are watts (W). To calculate luminosity, you will need to use the Stefan-Boltzmann constant, which has a value of  $\sigma = 5.67 \times 10^{-8} \frac{\text{W}}{\text{m}^2 \text{K}^4}$ . To successfully complete this lab, you simply need to refer to the equations presented in your notes for the quantities that you have been asked to calculate. After writing down the equation, just plug in the applicable values and use your calculator (and your brain) to get the answer. This portion of the lab is worth 19 points and the in-class work is worth 28 for a total of 47 points.