Spring 2015 Name and class meeting time:______________________________

This is your sixth assignment using the *Starry Night* software.

This is due <u>in class</u> by Tuesday May 5th.

<u>You may turn this in any time prior to the due date.</u> Homework is due at the start of class. **Late homework is not accepted!** If you will be unable to make it to class to turn this in, you must give it to me before the end of class on the day it is due. **It will not be accepted if turned in at the mailboxes in the administration building!**

Remember, although you may discuss these exercises with other students, the work you hand in should be your own. Students who turn in answers which are substantially the same as those of other students will receive between 0 and 50% of the points they would otherwise score.

Exercise E2: The Magnitude Scale

Open the **SkyGuide** pane, and navigate to
Student Exercises > E: Star Finding and Constellations
> E2: The Magnitude Scale

Question 1a: (Go to 1: Apparent magnitude) A magnitude 2 star is ____ times **brighter** than a magnitude 4 star. Remember, each magnitude bigger is 2.512 times fainter. You have to multiply!
☐ **a.** 2.512
☐ **b.** 6.31
☐ **c.** 15.85
☐ **d.** 100

Question 1b: How many time brighter is a magnitude 2 star than a magnitude 6 star? Make sure you round off your answer to only two digits past the decimal.

Question 2a: What are the magnitudes of the following 4 stars in Orion?
a. Bellatrix

b. Mintaka

c. Alnitak

d. Saiph

Question 2b: Of the above 4, which is the brightest? Which is the faintest?

Question 3: (Go to 2: Magnitudes of solar system objects) The Sun is the brightest object in the sky visible from Earth. What is the apparent magnitude of the Sun? Negative magnitudes are brighter than positive magnitudes.

Question 4: What is the second brightest object visible from Earth?

☐ **a.** Full Moon
☐ **b.** First Quarter Moon
☐ **c.** Venus
☐ **d.** Sirius

Go to 3: Comparing brightness of objects.

To find the brightness ratio of objects whose magnitudes are not whole numbers (1, 2, …) you must use the following formula:

$$B1/B2 = 2.512^{(m2-m1)}$$

where B1/B2 = brightness ratio and m1, m2 are apparent magnitudes. To make sure you are using this formula correctly, try m1 = 1 and m2 = 6. Then object 1 should be 100 times brighter than object 2. On the computer's scientific calculator, enter as follows:

2.512 **x^y (**6 **-** 1**) =**

where **x^y** is a single key for raising a number to a power. Try it. Does B1/B2 = 100 (remember to round off)? If not, you are not entering the numbers correctly.

Question 5a: What is the magnitude of Mars on January 24, 2015?

Question 5b: What is the magnitude of Venus on January 24, 2015?

Question 5c: How much brighter is the planet Venus than the planet Mars on January 24, 2015? Since Venus has a negative magnitude, you are subtracting a negative number, which is like adding a positive number.

Exercise F4: Inverse-Square Law
Apparent Brightness and Luminosity

Open the **SkyGuide** pane, and navigate to
Student Exercises > F: The Stars
> F4: Inverse-Square Law

Question 1a: (Go to 1: Luminosity and apparent brightness) What is the distance and apparent magnitude of Spica? Place your cursor over the star and note the information in the pop-up display.

Question 1b: What is the distance and apparent magnitude of Antares? Place your cursor over the star and note the information in the pop-up display.

Question 1c: The two stars have almost the same apparent magnitude, meaning that they appear to be the same brightness. But Antares is quite a bit farther away than Spica. How can it appear the same brightness if it is much farther away?

Go to 2: Calculating luminosity

The luminosity tells us the true total power output of the star, rather than how bright it looks. You calculate luminosity in terms of solar luminosities using the following formula

$$L_{star} = (0.0813) \times (R_{star})^2 \times 10^{(-0.4)(\text{mag. star})}$$

Here, R_{star} is the distance of the star in light years. and mag. star is the apparent magnitude of the star. On the scientific calculator on the computer, you would enter this as :

magnitude *** 0.4 = ± 10^X *** R_{star} **x^2** * 0.0813 **=**

± is the change sign key**,** **x^2** takes the square of **R_{star}**, and **10^X** takes 10 to a power. As a check, an object of mag=4.83 located 32.6 light years away should have L_{star}=1.01. Try it.

Question 2a What is the distance and apparent magnitude of Polaris? Place your cursor over the star and note the information in the pop-up display.

Question 2b Calculate the luminosity of Polaris. It should match one of the given answers. **Note: in this and subsequent exercises, you must use the numbers you get from the program and calculate the answers, rather than looking them up in some outside reference!**

Question 2c: Calculate the luminosity of Spica (in terms of the Sun's luminosity) using the numbers you found in question 1a of "Luminosity and apparent brightness" in Student Exercise F4 and the formula above**.**

Question 2d: Calculate the luminosity of Antares (in terms of the Sun's luminosity) using the numbers you found in question 1b "Luminosity and apparent brightness" in Student Exercise F4 and the formula above**:**

Question 2e: Do the relative luminosities of Spica and Antares found in 2c and 2d agree with your answer to question 1c of "Luminosity and apparent brightness" in Student Exercise F4?

Go back to Exercise E2: The Magnitude Scale

Open the **SkyGuide** pane, and navigate to
Student Exercises > E: Star Finding and Constellations
> E2: The Magnitude Scale

Question 6a: (Go to 4: Absolute magnitude) What is the apparent magnitude and distance in parsecs of the star Deneb? (To get the distance in parsecs, divide the distance in light years by 3.26)

Question 6b What is the apparent magnitude and distance in parsecs of the star Vega (the brightest star in the constellation *Lyra* just to the right and a bit above Deneb)? If you cannot find it, hit "k" one or two times until the constellation names appear.

The absolute magnitude is an old fashioned way of describing luminosity. It tells you how luminous a star really is, rather than how bright it looks, as does apparent magnitude. But it has the backwards magnitude scale, unlike the luminosities we just calculated, so a smaller (or negative) absolute magnitude is a larger luminosity than a greater absolute magnitude. The absolute magnitude is calculated using the formula

$$M = m - 5 \times \log(d/10)$$

where M is the absolute magnitude, m is the apparent magnitude, and d is the distance in parsecs. On the computer's scientific calculator, enter the calculation as follows:

d**/10 = log * 5 ± +** m **=**

where **log** is the logarithm key and **±** is the change sign key. As an example, a star of apparent magnitude 3 located 100 parsecs away should have an absolute magnitude of -2 (negative 2). Try it!

Question 6c: Calculate the absolute magnitude of Deneb.

Question 6d: Calculate the absolute magnitude of Vega.

Question 6e: Which star appears brighter, Vega or Deneb (see questions 6a and 6b)?

Question 6f: Which star is more luminous, Vega or Deneb? How do you know?