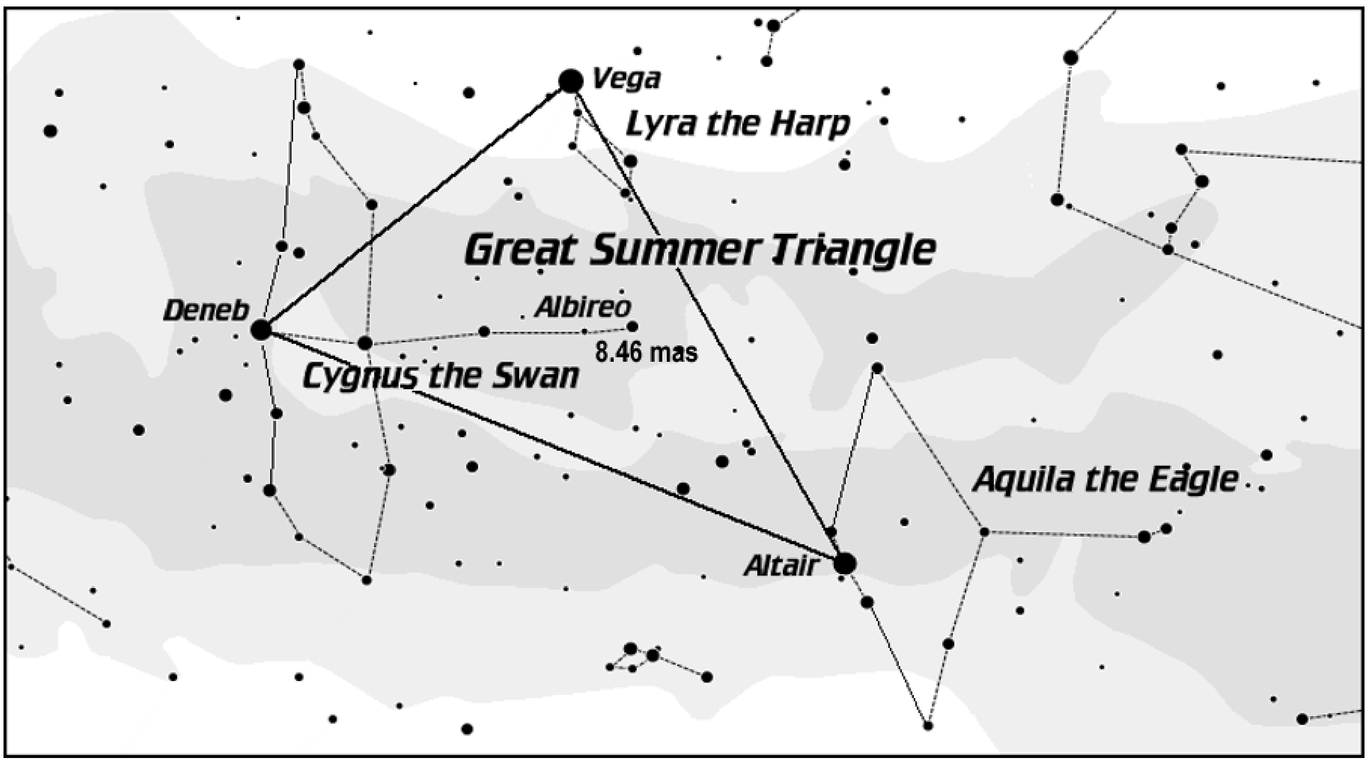
Name ________________________________ Date __________________ Moravian University

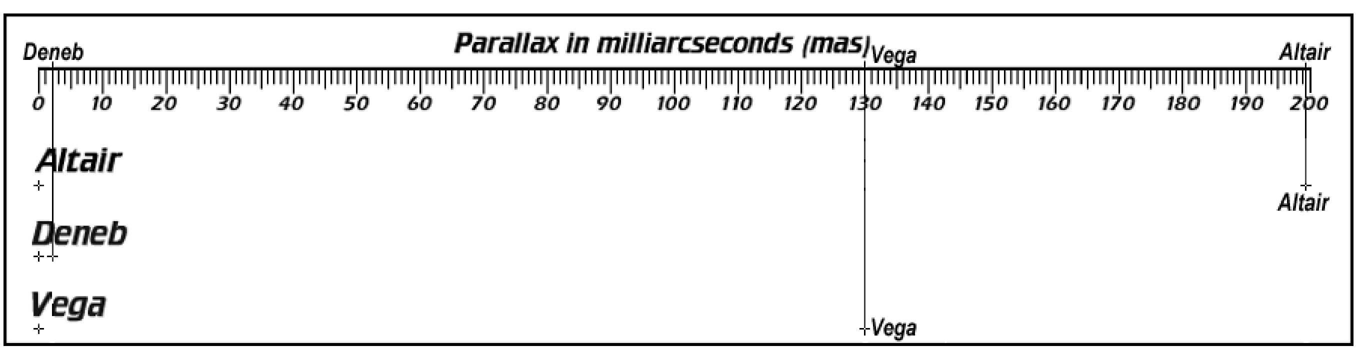
FINDING THE MOST LUMINOUS STAR IN THE GREAT SUMMER TRIANGLE

(10 points)

__Instructions__: The Great Summer Triangle is one of the hallmark asterisms of the summer and fall sky. It is not really a constellation, but composed of the first magnitude stars of three constellations, Altair of Aquila the Eagle, Deneb of Cygnus the Swan, and Vega of Lyra the Lyre (harp). In the table on the next page, the apparent magnitudes (m) of these three stars are given. Using the scale below, find the parallaxes of the stars of the Great Summer Triangle in milliarcseconds and calculate their distances. Afterwards, use the Distance Modulus to find the absolute magnitudes (M) of these stars and compare M with the sun's absolute magnitude to discover which star is really the most luminous. Finally, discover how much brighter or dimmer the stars of the Great Summer Triangle are to our sun. The sun has an absolute magnitude of **+4.83**.



Use this Scale to measure the parallax angles of the three stars of the Great Summer Triangle.



Procedure for comparing the stars of the Great Summer Triangle with each other and the sun.

Find the distance to the star by converting the parallactic angle given in milliarcseconds **(MAS)** into seconds of arc. Take the inverse of the parallax in seconds of arc to find the distance to the star in parsecs (**$D_{pc} = 1/p$”**). Finally, multiply the distance in parsecs by the number of light years in one parsec (**3.2616 ly/pc**) to find the star’s distance in light years. Enter the calculated values into the table below.

Find the absolute magnitude (M) of the star by using the Distance Modulus, **M = m + 5 – 5log r,** where **M** = the absolute magnitude of the star at 10 parsecs, **m** = the apparent magnitude of the star as seen from the Earth, and **r** = the distance to the star in parsecs. Enter these values into the table below.

Examine how much brighter or dimmer these stars are to the sun by finding the difference in magnitude compared to the sun and converting this number into an intensity. Enter these values into the table below.
Difference in magnitude between the sun and star = **$\Delta M = M_{sun} - M_{star}$**
$I = 2.51^x$, where **I** is the light intensity of the star and the exponent **“x”** represents the difference in magnitudes between the star and the sun. **The absolute magnitude of the sun (M_{sun}) is +4.83.**

PRACTICE WITH THE DOUBLE STAR ALBIREO: Significant numbers are a requirement.

First, find the Distance to Albireo. Parallax of Albireo = 8.46 mas (three significant figures)

$8.46 \text{ mas} \times \frac{1''}{1000 \text{ mas}} = 0.00846''$; $D = \frac{1}{p''}$; $\frac{1}{0.00846''}$ = **118 pc** $\times$ $3.2616 \frac{\text{ly}}{\text{pc}}$ = **386 ly**

Then, find the absolute magnitude of Albireo. Apparent magnitude of Albireo = +2.90 (given)
M = m + 5 – 5log r; M = +2.90 + 5 – 5log 118; M = +2.90 + 5 – 5(2.072); M = +7.90 – 10.36

M = -2.46

Finally, find the intensity difference between the sun and Albireo. Which star is brighter, the sun or Albireo?
Difference in magnitude = $\Delta M = M_{sun} - M_{star}$; $\Delta M = +4.83 - (-2.46)$ = **7.29 magnitudes**.
Since Albireo has the brighter (more negative) absolute magnitude, it is the more luminous star.
What is the actual intensity difference?
$I = 2.51^{\Delta M}$; $I = 2.51^{7.29}$; **I = 820**, taking into account significant figures Albireo is brighter than the sun by an intensity difference of 820 times.

Data Table for the Great Summer Triangle Lab

(Correct Significant Figures Required)

Name of Star	**Parallax (mas)** (Number of Significant Figures to be used is in parentheses)	**Apparent Magnitude (given) (m)**	**Distance in Parsecs/ Light Years $D_{pc} = 1/p$” pc / ly**	**Absolute Magnitude** M = m + 5 – 5log r Distance Modulus **(M)**	**Change in Magnitude $M_{sun} - M_{star}$ (ΔM)**	**Intensity in Comparison to the Sun $I = 2.51^{\Delta M}$ (I)**	**Which Star is Brighter, the Sun or the Other Star? (Star’s Name)**
Albireo	(3) 8.46	+2.90	118 / 386	-2.46	7.29	820	Albireo
Altair	**(3)**	**+0.77**	/				
Deneb	**(1)**	**+1.24**	/				
Vega	**(2)**	**+0.03**	/				

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Show all work, i.e., steps in the problem's solution, including the correct usage of significant figures.

Altair

Distance to Altair in parsecs/light years:

D_{pc} = 1/p"; 3.2616 ly/pc

Absolute magnitude of Altair:

M = m + 5 – 5log r

Difference in intensity compared to the sun:

Difference in M: $\Delta M = M_{sun} - M_{Altair}$; $M_{sun} = +4.83$ Intensity = I = $2.51^{\Delta M}$

Deneb

Distance to Deneb in parsecs/light years:

D_{pc} = 1/p"; 3.2616 ly/pc

Absolute magnitude of Deneb:

M = m + 5 – 5log r

Difference in intensity compared to the sun:

Difference in M: $\Delta M = M_{sun} - M_{Deneb}$; $M_{sun} = +4.83$ Intensity = I = $2.51^{\Delta M}$

Vega

Distance to Vega in parsecs/light years:
$D_{pc} = 1/p''$; 3.2616 ly/pc

Absolute magnitude of Vega:
$M = m + 5 - 5\log r$

Difference in intensity to the sun:
Difference in M: $\Delta M = M_{sun} - M_{Vega}$; $M_{sun} = +4.83$ Intensity = $I = 2.51^{\Delta M}$

The most luminous star of the Great Summer Triangle is ______________.