

Name(s): _____

Date: _____ Course/Section: _____
Grade: _____

Photometry of a Globular Cluster

Learning Objectives:

Students will determine the age of a globular cluster using photometry.

Checklist:

- ☐ **Complete the pre-lab quiz with your team (if required).**
- ☐ **Compile a list of resources you expect to use in the lab.**
- ☐ **Work with your team to complete the lab exercises and activities.**
- ☐ **Record your results.**
- ☐ **Share and discuss your results with the rest of the class.**
- ☐ **Determine if your team's answers are reasonable.**
- ☐ **Submit an observation request for next week (if required).**

Pre-Lab Quiz

1.

2.

3.

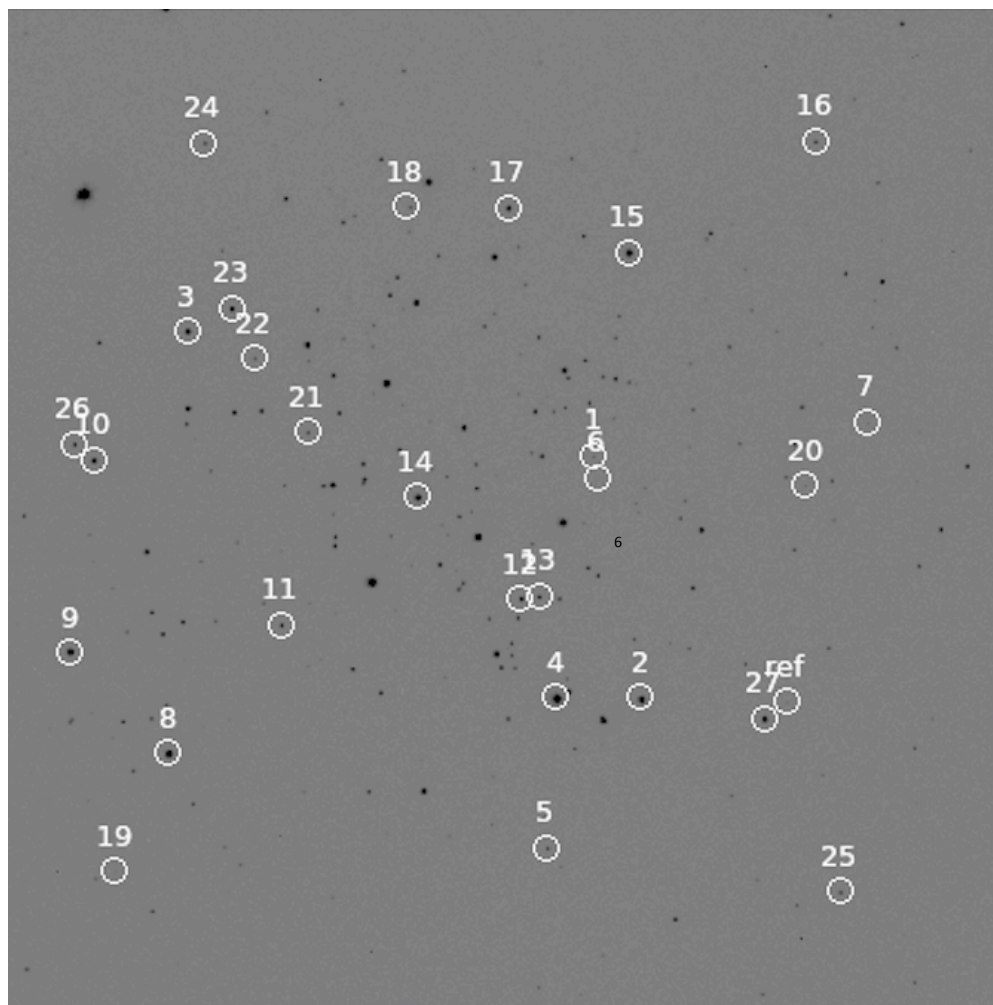
4.

5.

Part 1: Calibrating an Image for Photometry

1. Follow the instructions on the lab website on Part 1 to calibrate the image of M67.
 - ✓ Load the image into MaxIm DL and open the Information Window (ctrl+i)
 - ✓ Identify the Reference star using the finder chart and set the correct aperture size
 - ✓ Click the Calibrate button in the Information Window
 - ✓ Enter in the correct magnitude (B for blue filter image, V for V filter) into the Magnitude box
 - ✓ Click "Set from FITS" next to the Exposure box
 - ✓ Click "Extract from Image" next to the Intensity box
 - ✓ Double click on the reference star
 - ✓ Check that the magnitude in the upper portion of the Information window reads the right magnitude
 - ✓ Click to calibrate button to collapse the calibration window
2. Once calibrated, find the magnitudes of the stars and record them in the chart at the end of the packet.
3. Calculate the color index, which is B-V, and record it in the chart.

Finder Chart for M67



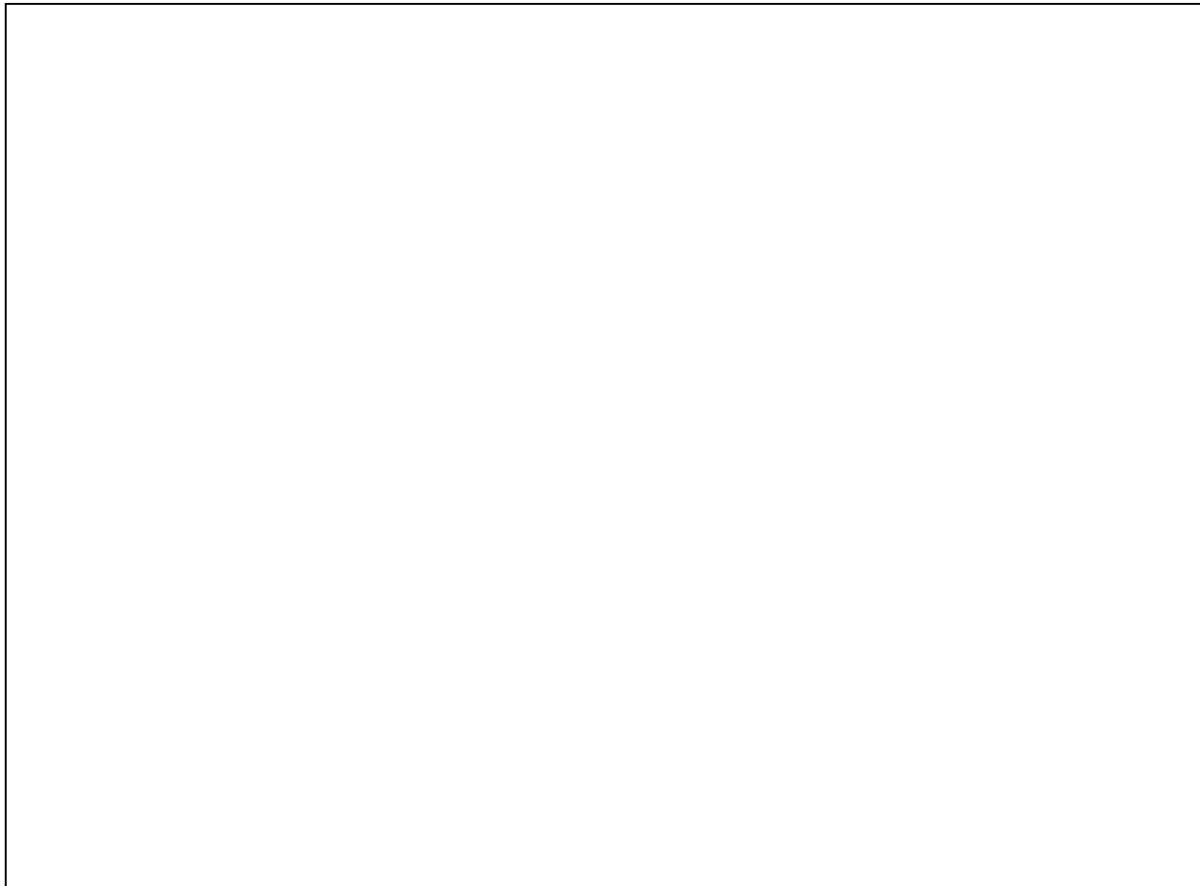
Part 2: Finding the Temperature and Spectral Type

1. Using the B-V values, find the temperature of each star either using the equation on the lab website, or the plot that relates color index to temperature.
2. Using the HR Diagram on the lab website, record the spectral class of each star in the chart at the end of the packet.

Part 3: Determining the Age of M67

Make an HR Diagram for M67 using the temperatures and apparent magnitudes you recorded in Parts 1 and 2.

- Label the axes (apparent magnitude, luminosity, temperature, and spectral class)
- Draw and label the main sequence and the giant branch.
- Plot the stars from your analysis and indicate the main sequence turn off point



Discussion Questions

1. What is the Main Sequence turn off age of M67? Explain how you found this.
2. What assumptions did you make to determine the age of M67?
3. If the reference star has an absolute magnitude of $M_V=5.01$, find the distance to the cluster in parsecs.

Distance to M67 (parcsecs)	
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4. Using the distance you found in question 3, find the absolute magnitudes of the three hottest stars in M67.

Star ID #	Spectral Class	Apparent Magnitude (V)	Absolute Magnitude

5. Use the HR Diagram Explorer to determine the luminosities and radii of the three hottest stars. You will need the absolute magnitudes from Question 4.

Star ID #	Spectral Class	Temperature (K)	Luminosity (L_{sun})	Radius (R_{sun})

6. What are the luminosity classes of the three hottest stars from question 5?

Part 4: Comparing Ages of Globular Clusters

1. Follow the links provided on the lab website. Rank the clusters by age from oldest to youngest. Include your results for M67.

Table 1: Properties of Stars in M67

Following the instructions on the lab manual, determine the apparent magnitudes of the stars in M67. Your group will be responsible for 9 stars in either the B or V magnitude. Once you have found the apparent magnitude in B or V, collaborate with the group that did the opposite magnitude for your stars. Then, determine the rest of the properties for all 9 stars.

[illegible]