AST 201 MIDTERM ASSIGNMENT

Due: Fri. March 5, 2021 at 11:00 am

Please submit electronically via Crowdmark

Student name: *Student number:*

Instructions

The AST 201 MIDTERM ASSIGNMENT has two separate parts. Part 1 of the assignment is the timed on-line quiz (see Quercus for details if you have not completed Part 1 already). Part 2, featured below, is a series of short answer questions to be answered using the form provided on Quercus and uploaded to Quercus by March 5, 2021 at 11:00 am EST.).

Honour Statement:

I _____ acknowledge that this assignment was completed by me and me alone, with only the aid of AST 201 Course Materials (lecture and tutorial slides, the textbook, my personal notes). I am aware that obtaining or providing assistance on this assignment from another source, including my fellow students, is considered an academic offence according to the University of Toronto's Code of Behaviour on Academic Matters (see https://www.artsci.utoronto.ca/current/academic-advising-and-support/student-academic-integrity)
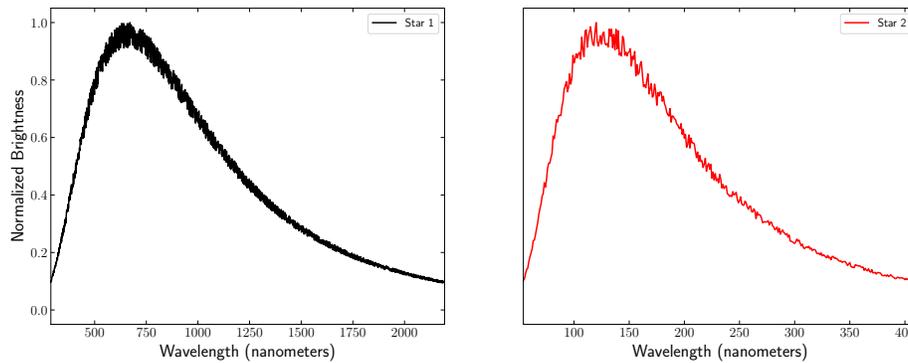
Signed: _____

Figure 1: Blackbody radiation curve for Star 1 (left panel) and Star 2 (right panel).

Part 2: Short Answer Questions

Fill out the answers to these questions using the form available on Quercus.

Question 1:

Astronomers are always turning to citizen scientists to help process the abundance of data that large telescope surveys generate. Imagine an example where astronomers have measured the blackbody radiation curves of every star in our Milky Way and now need the help of citizen scientists like you to interpret the data. Figure 1 illustrates the blackbody radiation curve of two different stars from the survey. Note that the y-axis has been normalized by the star's maximum brightness, so the curve peaks at 1. From this Figure, answer the following questions and help your fellow astronomers out:

a) Qualitatively discuss all of the relative differences between four properties of Star 1 and Star 2 that are known based on the information provided so far, assuming both stars are main-sequence stars. Explain your reasoning. [4 marks - approx 200-400 words]

b) Using Wein's Displacement Law, we can determine that the surface temperatures of the stars are 4405 K and 23454 K. Describe what you would expect the spectrum of each star to look like in terms of the strength of key absorption lines. Explain why the spectrum looks as you describe in terms of each star's properties. [4 marks - approx 200-400 words]
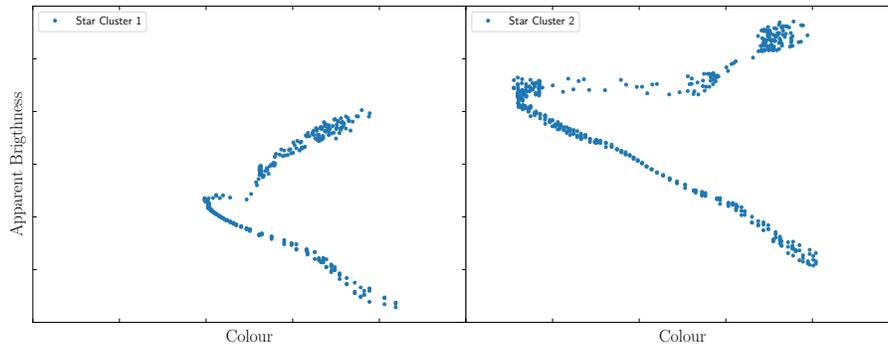
Figure 2: Apparent Brightness and colour of individual stars that are members of Star Cluster 1 (left panel) and Star Cluster 2 (right panel). The axes in both panels are identical.

Question 2:

Due to your amazing performance in AST 201, a brand new telescope has been named after you. It is therefore only fitting that you get to make the very first set of observations. During your first night observing with the Vishala Maharaj Telescope, you observe two separate groups of stars in the night sky. After measuring the properties of each star, you plot their apparent brightness versus their colour (see Figure 2). Recall from class that colour is determined by measuring a stars apparent brightness in two different wavelengths. It allows you to determine which stars are redder or bluer, relative to one another, but not their actual temperature. From Figure 2, you conclude that the groups are both previously undiscovered star clusters! Use Figure 2 to answer the following questions:

a) What features in Figure 2 help you conclude that the groups of stars are indeed star clusters? Explain your reasoning. [2 marks - approx 100-200 words].

b) From Figure 2 alone, which star cluster is younger? Explain your reasoning. [2 marks - approx 100-200 words]

c) From Figure 2 alone, which star cluster is closest? Explain your reasoning. [2 marks - approx 100-200 words]

d) Approximately six months after your observations of Cluster 1 were taken, the positions of each star in Cluster 1 were measured again. With this additional data, what additional cluster properties can be determined? What additional properties of individual stars in each cluster can be determined? Explain your reasoning. [4 marks - approx 200-400 words]

Question 3:

a) You are travelling in a spaceship at 0.8 c, heading to a distant galaxy that is 98 million light years away, as measured from Earth. What do you notice about the distance you measure to the galaxy? Explain your reasoning. [1 mark - approx 100-200 words]

b) You are sitting in a spaceship moving at speed 0.8 c. A friend is in a different spaceship moving toward you at speed 0.72 c. They are holding a mirror. You shine a white light toward the, and the light beam bounces back at you. What is the speed of the reflected beam and why? [1 mark - approx 100-200 words]