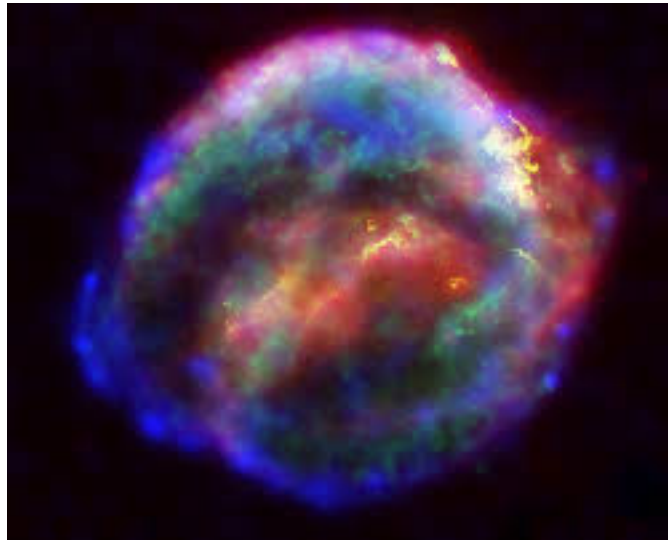


Astronomy C

Captains Tryouts

Acton-Boxborough Regional High School

Written by Antonio Frigo '19



Name: _____

Instructions:

- 1) Turn in all materials at end of testing period.
- 2) Do not forget to put your name on every page on the answer sheet.
- 3) Write all answers on answer sheets, answers written in your test may not be scored.
- 4) Please do not worry about significant figures. Use 3 or more in your answers, regardless of how many there are in the question.
- 5) You may only have a standard 3 ring binder or a computer/tablet for notes during the event.
- 6) Point values are written in the headers.

Good Luck.

Section A: Use the given image set to answer the following questions. All sub-questions are worth *one point each*.

1. (a) What object is shown in image 20?
(b) What type of object is this?
(c) What's so strange about the motion of this object?
2. (a) What object is shown in image 1?
(b) What type of variable star is this?
(c) What other image shows this object?
(d) What type of stellar structure is visible in the image from part (c)?
3. (a) What image shows S Doradus?
(b) What type of variable star is this?
(c) What is the period of this object?
(d) When this object is brightest, what color is it?
4. (a) What object is shown in image 10?
(b) What's so special about this object's discovery?
(c) Much of the luminosity of this object is provided through the radioactive decay of what isotope?
(d) What produced the rings around this object?
5. (a) What object contains the largest known yellow hypergiant?
(b) Which image shows this object?
(c) This object is in what type of binary system?
(d) What is the name of the process in which matter is accreted from one member of a binary system to the other?
6. (a) What image shows ASASSN-15lb?
(b) This object appeared to undergo a supernova explosion in 2015. What is the most likely cause of this?
(c) What type of object is this (be specific as to the type)?
(d) The spectra of this event showed no hydrogen or helium. This would lead to the conclusion of the progenitor being a Wolf-Rayet star. However, a certain isotope was not discovered that would have corroborated this. Which isotope is this?
7. (a) Which image shows Geminga?
(b) What type of nebula does this object possess?
(c) Upon discovery, what new type of object was Geminga thought to be?

- (d) However, upon further examination, this object was found to have a period of 237 milliseconds in what region of the electromagnetic spectrum?

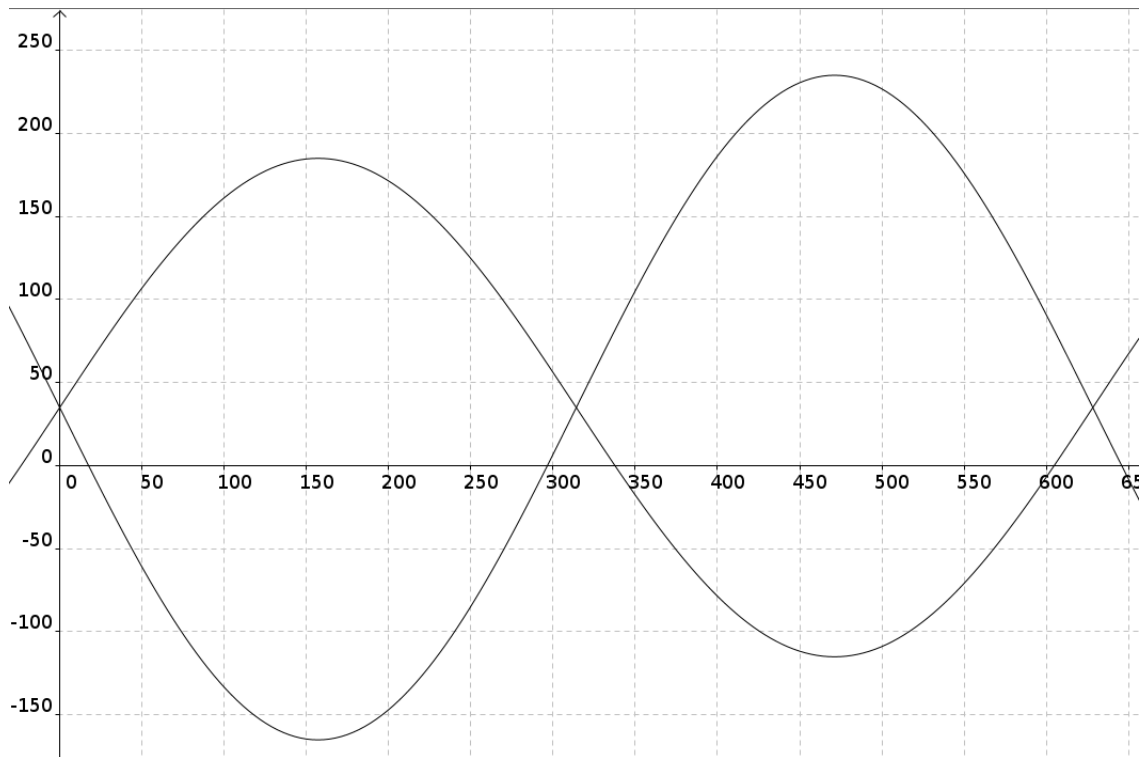
Section B: All subquestions are worth *two points each*.

8. (a) What type of mechanism drives Cepheid variable pulsation?
(b) What population of stars are Classical Cepheids?
(c) What population of stars are Type II Cepheids?
(d) For a given period, what is the expected magnitude difference between Classical and Type II Cepheids? Are Classical Cepheids brighter or dimmer than Type II Cepheids?
9. (a) In what type of galaxy would you not expect to find an HII region? Why?
(b) In a starburst galaxy, what type of evolved star would you expect to see?
(c) What sort of profile do the stars in part (b) have?
(d) What elements are notably lacking from the spectra of these stars?
10. Consider a star of 15 solar masses.
(a) What process does this star primarily use to fuse hydrogen into helium?
(b) What type of supernova will this star most likely explode as?
(c) What type of galaxy is this star least likely to reside?
(d) Which element will be the last fused? Explain why no element more massive than this can be fused.
(e) The supernova is observed to have a plateau in its light curve from 30 to 80 days after maximum light. What subcategory of supernova is this?
11. (a) What is the name of the maximum mass of a neutron star?
(b) What is a neutron star with an extremely strong magnetic field?
(c) What is the name of a neutron star emitting a beam of electromagnetic radiation?
12. Stars of the spectral class A have the strongest hydrogen lines. Why do both hotter and cooler stars have weaker lines? Explain.

Section C: Each subquestion is worth 2 points each.

13. A given binary system has period of 100 days and separation of 0.5 AU. What is the combined mass of the system?
14. A given Classical Cepheid has period of 12 days.
(a) What is its absolute magnitude?
(b) If this star had an apparent magnitude of 7, what's its distance in megaparsecs?

15. The Large Magellanic Cloud is 160,000 Ly away from Earth. How many seconds does it take light to travel this far?
16. A particular star has a redshift of 0.0001803 and has shown 3.00 arcseconds of proper motion in 15 years. The star is 20 pc away, has 160 solar luminosities, and has a surface temperature of 4000K.
- What is the wavelength (in Angstroms) at which this star radiates the most energy?
 - What is the star's recessional velocity, in km/s?
 - What is the star's transverse velocity, in km/s?
 - What is the star's true space motion, in km/s?
 - What is the star's absolute magnitude?
 - What is the star's apparent magnitude?
 - What is the star's radius, in solar radii?
 - What is the star's parallax in arcseconds?
 - What is the star's spectral class?
17. Consider the following radial velocity light curve of a binary star system with the vertical axis in km/s and the horizontal in minutes



- What is the recessional velocity in km/s

- (b) What is the period in days?
- (c) What is the radial velocity of the smallest component of this system?
- (d) What is the radial velocity of the largest?
- (e) What is the combined mass of the system?
- (f) What is the mass of the most massive object?