Reach for the Stars Test

2012-2013

DO NOT OPEN UNTIL INSTRUCTED

Questions? Comments? Concerns?

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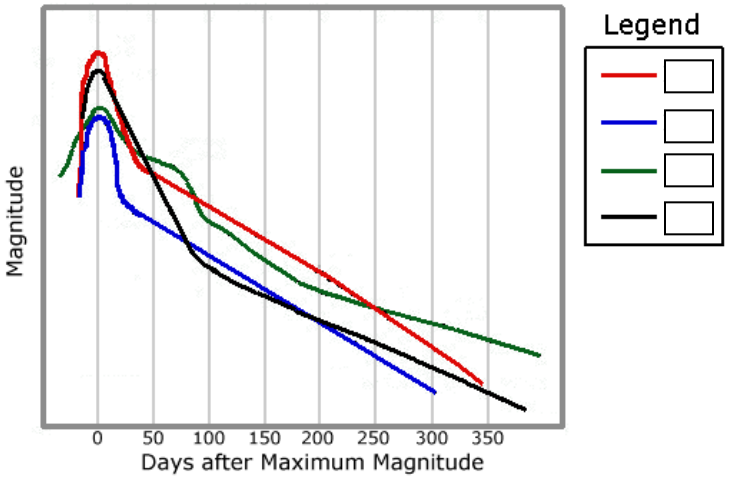
Instructions

- You are allowed two pages of notes, front and back.
- There will be no talking between separate teams.
- This test is designed to be challenging. Don't be discouraged if you can't answer a question.
- This is a **200 point** test. This means that this is a *very long, very hard* test. Use your time wisely.
- There are **four bonus points** that can be earned from this test. Two of them are marked as bonus questions, but the other two *are not told to you*. This means that you should answer questions in as much detail as time allows.
- There are **five tiebreaker questions**, denoted with an asterisk (*). These questions are (in order): Section 1 Question 4, Section 1 Question 35, Section 2 Question 10a, Section 3 Question 1, and Section 3 Question 10.

Good Luck!

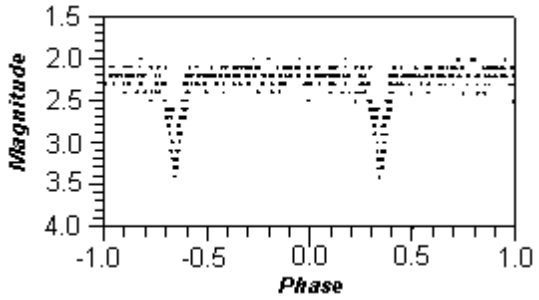
Section 1: General Knowledge (68 points)

1. Coordinates in modern astronomy are usually based on what epoch? (1 point)
2. Who made the world's first star catalogue? (Hint: He was a Chinese astronomer) (1 point)
    a. **For one bonus point, you may answer:** When did he make this star catalog?
3. What is theorized to be at the center of all spiral galaxies? (1 point)
4. Write the parallax formula (relation to distance). (2 points) *
5. What is the difference between Population I and Population II stars? (2 points)
    a. What is the population between Population I and Population II stars called? (1 point)
6. What are Kepler's Laws of Planetary Motion? (2 points)
    a. State the first law. (1 point)
    b. State the second law. (1 point)
    c. State the third law. (1 point)
7. What is an arcsecond? (1 point)
8. Briefly explain redshift relating to the Big Bang theory. (2 points)
9. What formula is used to derive spectral lines for hydrogen? (1 point)
    a. **Bonus (1 point):** Write out the formula. Define all variables.
10. How is an absorption spectra formed? (1 point)
11. What is a light curve? (2 points)
12. Label this graph (fill in the square blanks): (1 point per blank, 4 points total)



13. Name three types of pulsating variable stars. (3 points, 1 point per type named)
14. Name three classes of variable stars. (3 points, 1 point per class named)
15. If a supernova has no Balmer lines, then what kind of supernova is it? (1 point)

16. You are given the following light curve:



What kind of object does it represent? (1 point)

17. How many globular clusters are currently known in the Milky Way? (1 point)
18. What is the theoretical naked singularity? (1 point)
19. Black holes have something called the event horizon, which is the point of no return. What is the name of the radius of this event horizon? (1 point)
20. At a certain point in a young star's life, it reaches a state of stability and stays in this state for the rest of its career as a main sequence star. What is the name of this state of stability? (1 point)
21. When a massive star explodes and a neutron star forms, its mass cannot go above a certain limit, or else it will collapse into a black hole. What is the name of this limit? (1 point)
22. When information gets sucked into a black hole, it is thought to be completely lost. What is this phenomenon known as? (1 point)
23. What is the theoretical center of the Milky Way Galaxy? (1 point)
24. What is a "failed" star known as? (a star that never got big enough/hot enough to begin the process of hydrogen fusion) (1 point)
25. What are Bok globules? (2 points)
26. What is "quasar" a shortened version of? (1 point)
27. What is a quasar? (1 point)
28. Explain the Bayer designation system. (1 point)
29. To what distance is trigonometric parallax accurate? (1 point)
30. What is the pulsation period of an RR Lyrae star? (1 point)
31. Who is usually credited for developing the heliocentric system? (1 point)
32. What does SETI stand for? (1 point)
33. When did Julian time start? (1 point)
34. What kind of hydrogen emission occurs in the infrared region of the EM spectrum? (1 point)
35. Name the 17 stars closest to the Solar System. (17 points, 1 point per star)*

Section 2: DSO/Constellation Questions (66 points)

1. What is so special about SN1993J? (2 points)
2. What is 30 Doradus known for (2 things)? (2 points)
3. What kind of radiation is Geminga known for radiating? (1 point)
4. Cygnus X-1 is an eclipsing binary system around 6,000 light years away in the constellation Cygnus. What type of radiation does it emit? (1 point)
5. In the middle of the Crab Nebula is a pulsar. How many times per second does this pulsar spin? (1 point)
    a. The Crab Nebula is a SNR. What is the designation of the supernova that created the Crab Nebula? (1 point)
6. Identify image 1. (1 point)
    a. What wavelength is it taken in? (1 point)
    b. How far away is it? (1 point)
7. Identify image 2. (1 point)
    a. What is notable about this DSO? (1 point)
    b. What is the companion of this DSO called? (1 point)
8. Identify image 3. (1 point)
    a. What is the most notable feature of this DSO? (1 point)
    b. What kind of system is it? (1 point)
9. Identify image 4. (1 point)
    a. When did this object *first* appear? (1 point)
    b. Give another designation for this object. (1 point)
10. Identify image 5. (1 point)
    a. Name four of the major stars in this cluster (i.e. stars that are actually named). (4 points, 1 point per star)*
    b. How old is this cluster? (1 point)
11. Identify image 6. (1 point)
    a. What constellation is it located in? (1 point)
    b. About how old is this DSO? (1 point)

Numbers 9-14 deals with image 7.

12. Was this picture taken the northern or southern hemisphere? (1 point)
13. Identify star a. (1 point)
    a. What constellation is it in? (1 point)
    b. What is this star most famously known for? (1 point)
14. Identify star b. (1 point)
    a. What is the name of its "partner" star? (1 point)
    b. What does the name of this constellation mean? (1 point)
15. Identify star c. (1 point)
    a. What is the Bayer designation of this star? (1 point)
    b. What does the name of this star mean? (1 point)
16. Identify star d. (1 point)
    a. What kind of star is it? (1 point)

b. What is its absolute magnitude? (1 point)

17. Name one constellation that can be seen in image 6. (1 point)
18. Name two nebulae from this year's rules. (2 points, one point per nebula)
19. Name the nine constellations from this year's rules that fall along the ecliptic. (9 points, 1 point per constellation)
20. What kind of star system is Mizar? (1 point)
    a. Alcor? Be specific! (1 point)
21. What kind of supernova gave us Tycho's SNR? (1 point)
22. What star is the most studied star after the Sun? (1 point)
23. Why is Gliese 581 the subject of so many studies? (1 point)
    a. What is the name of this object that makes us study Gliese 581? (1 point)
24. Name six stars from this year's rules with a spectral type of A. (6 points, 1 point per star)

Section 3: Stellar Evolution and the HR Diagram (66 points)

1. What is the triple alpha process? (2 points)*
2. What is the ultimate, *ultimate* end of a sun-sized star? (note the use of ultimate) (1 point)
3. After the protostar stage, a young star becomes this kind of star briefly before becoming a main sequence star. It does not yet have the temperature to ignite fusion of hydrogen. What is this kind of star called? (1 point)
4. At what temperature does helium fusion begin? (1 point)
5. What does AGB stand for? (1 point)
6. What is the size limit of a white dwarf called? (1 point)
    a. What is this size limit, in $M_{\odot}$? (1 point)
7. What element cannot be fused (or absorbs energy when fused), and therefore stops the shell burning stages? (1 point)
8. What is a pulsar? (1 point)
9. About how many $M_{\odot}$ does a star need to be in order to become a black hole? (1 point)
10. What is a thermal pulse? (2 points)*
11. What is a stellar nursery? (1 point)
12. What is the life sequence of a Sun-sized star? There are six steps. (6 points, 1 point per step)
13. What is the life sequence of a much more massive star? There are five steps. (5 points, I point per step)
14. Fill in the following chart on your answer sheet. (20 points)

Star	Ab Mag	Spect Type	Temp (K)	Right Asc	Dec δ
	-0.48		4,940±50	05h16m41.359s	+45d59'52.77"
	1.42(A)		9,940(A)	06h45m08.917s	16d42'58.017"
	15.49		3,042±117	14h29m42.9487	62d40'46.141"
	-0.52		10,300-15,400	10h08m22.3s	+11d58'02"
	1.33		10,300	07h34m36s	+31d53'18"
	0.58		9,602±180	18h36m56.336s	+38d47'01.29"
	-6.05		3,500	05h55m10.305s	+07d24'25.43"
	-6.7		11,000	05h14m32.272s	-08d12'05.91"
	-0.63		4,010	04h35m55.239s	+16d30'33.49"
	-3.63±0.14		7,200	02h31m49.09s	+89d15'50.8"

15. Plot the stars in the chart above on the HR Diagram on your answer sheet. Label each star. (20 points)

Congratulations! You are done! (finally)

If you have time, draw a pretty picture in the space below.