Astronomy 301 Introduction to Astronomy

Quiz 3

Name:_____________________________

(i) **Attempt all questions in Part A and 1 of the six questions in Part B. Please write all answers to Part A on these sheets; extra paper is available if needed.**

(ii) **With few exceptions, Part B questions call for a paragraph of coherent English. Points will be deducted if sentences are incomplete and reduced to a list of items or a phrase or two. Do not, however, pad your answer by rewriting the question, by rewriting one sentence in several different ways, etc. Answers to Part B must be written on a blank sheet and not crammed into crevices on these sheets.**

Time allowed is 75 minutes. All work must be your own!

Part A

A1. The Schwarzchild radius of a black hole is
a. the radius of a star when it is on the main sequence.
b. the distance from a black hole inside of which light cannot escape.
c. the theoretical size of the smallest possible white dwarf.
d. the size of a star when it begins hydrogen burning just prior to reaching the main sequence.
e. the size of the early protosun.

A2. Which of the following objects is likely to have the greatest mass?
a. brown dwarf
b. white dwarf
c. red dwarf
d. black hole near the Sun.
e. Jupiter.

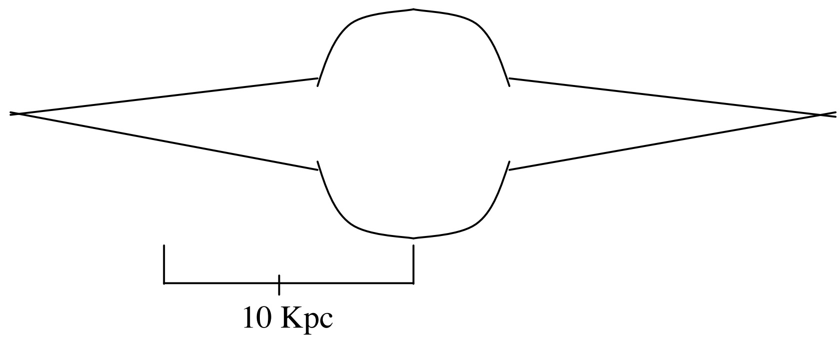
A3. Astronomers believe there are about 100 million neutron stars in our Galaxy. Radio astronomers after diligent searches have found only 1000 pulsars. Yet, we believe pulsars are neutron stars. Why are these numbers so very different?

A4. In a visible spectrum, what features distinguish a Type Ia from a Type II supernova?

A5. As a white dwarf cools, it moves toward the lower right in the H-R diagram, maintaining a constant radius. Why doesn’t it contract as it cools?

A6. Neutron stars have very hot surface temperature. Why aren’t they very luminous?

A7. On this side-on view of the Galaxy identify the location of the McDonald Observatory and the following objects:



- a globular cluster at a distance of 20 kpc from the Sun
- a young open cluster
- Mars
- a very metal-poor star
- an H II region
- the Sun

A8. Arrange the following in order of increasing mass:

hydrogen atom	a globular cluster	the Sun	yourself
the Galaxy	Betelgeuse	Local Group	

A9. How far is the Earth from the center of the Galaxy?
a. 1 AU b. 10,000 AU
c. 8 pc d. 10,000 pc
e. 8 Mpc

A10. Which of the following objects contains the most stars?
a. Globular cluster
b. The solar system
c. Galactic (open) cluster
d. Binary star

A11. Three Cepheids belong to the open cluster UT-900. These Cepheids have periods of 5, 15, and 75 days. Order the trio by increasing brightness.

A12. Match the stellar population (I or II?) with the following:

____ young	____ Type II Supernovae
____ metal poor	____ H I clouds
____ high velocity with respect to the Sun	____ globular clusters
____ H II regions	____ the Sun
____ dark clouds	

A13. What kind of object did Shapley use to find the distance to the center of the Galaxy?
a. planetary nebulae
b. O and B stars
c. globular clusters
d. open clusters
e. supernovae

A14. Arrange the following in order of increasing size (i.e. length).

centimeter	astronomical unit
light year	kilometer
white dwarf	atomic nucleus
kiloparsec	our Galaxy
hydrogen atom	neutron star

A15. The Local Group is
a. the nearest group of stars to the solar system.
b. the nearest open cluster.
c. the Andromeda galaxy and its companions.
d. the cluster of galaxies in which the Milky Way galaxy is located.

A16. Name two members of the Local Group.

A17. How did Hubble first measure the actual distance to the Andromeda galaxy, M31?
a. direct trigonometric parallax.
b. the moving cluster method applied to its open clusters
c. spectroscopic distance of its O star
d. the period-luminosity relation applied to its Cepheids
e. main sequence fitting applied to its globular clusters

A18. Why must astronomers use infrared and radio telescopes to observe the supermassive black hole at the center of our Galaxy?

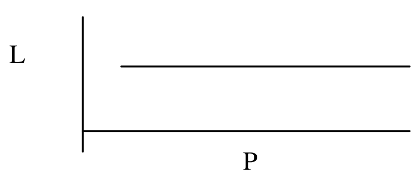
A19. Rank these objects from oldest to youngest: the Solar System, the Universe, Milky Way Galaxy.

A20. What is the Zone of Avoidance?

Part B

B1. a. What is a neutron star? Your description should include remarks on the mass, size, composition, temperature, and any other pertinent properties.
Do **not** describe how a neutron star is formed.
b. What is a black hole? Your description should include remarks on the mass, size, composition, temperature, and any other pertinent properties.
Do **not** describe how a black hole is formed.
c. Describe how black holes are detected in our Galaxy. Be sure that your description is consistent with the fact that light cannot escape from a black hole. Also explain why the observations you describe point to a black hole rather than a neutron star or a white dwarf.

B2. a. Explain why the *Hubble Space Telescope* is able to use Cepheid variables to measure distances to galaxies much more distant than those measurable from Cepheids using much larger telescopes on the ground.
b. Explain clearly what is meant by 'the period-luminosity relation' of Cepheid variables, and show why it is so useful as a tool for measuring distances to spiral galaxies.
c. The following is a period-luminosity relation (it is **not** the relation for Cepheids):



Discuss whether this relation would permit the variable stars obeying it to be used for distance measurements?

B3. a. Describe the difference between Population I and Population II stars in terms of the following properties:

i) metal content (relative to solar value)
ii) age
iii) mass of the most luminous stars
iv) motion in the Galaxy

Be as specific as possible: i.e., 'about 500 billion years' not simply 'very, very old'!

b. Discuss how **two** of the above differences are to be understood in terms of a model for the formation of the Galaxy.

B4. a. What is the zone of avoidance? If we lived in an elliptical galaxy, would we see a zone of avoidance?
b. If a star appears red, what observations would you make to decide if it is
- a cool star, or
- a hot star reddened by interstellar dust?
c. Why does the setting sun appear redder than the noonday sun?
d. Why is the sky white on a cloudy day?

B5. a. Why have no visual binaries been observed in the Andromeda Galaxy?
b. What observations would you make at the telescope to confirm a report that the star UT 301 in our Galaxy is a spectroscopic binary?
c. Why are the periods of all visual binaries measured in years, but the periods of many spectroscopic binaries are only a few days?

B6. a. How is the 21 cm line of hydrogen produced by interstellar clouds of cold hydrogen gas?
b. Suppose you had access to a radio telescope with high resolving power. Describe how you would determine the direction and speed of rotation of a nearby and well-resolved spiral galaxy observed edge-on.
c. Spiral galaxies contain large amounts of dark matter. Suppose you observed a spiral galaxy that had no dark matter. How would you distinguish it through observations of its speed of rotation?

B7. a. Describe two key observed differences between Supernova of Type I and II.
b. In a spiral galaxy, supernovae occur at the rate of about 1 every 100 years. If you were given access to a small telescope, describe how you would check this estimate.
c. Our Galaxy is a typical spiral galaxy. The last recorded supernovae occurred about 300 years ago. We would expect several supernovae to have exploded in the last 300 years. How is it possible to miss so many so close (the Galaxy is a mere 40 kpc in diameter!) supernovae?

When the heavens were a little blue arch, stuck with stars, methought the universe was too straight and close: I was almost stifled for want of air: but now it is enlarged in height and breadth, and a thousand vortices taken in. I begin to breathe with more freedom, and I think the universe to be incomparably more magnificent that it was before.

Bernard Le Bovier
(1657-1717)

It is the great beauty of our science that advancement in it, whether in a degree great or small, instead of exhausting the subject of research, opens the doors to further and more abundant knowledge, overflowing with beauty and utility.

Michael Faraday
(1791-1867)