Astronomy 102: Stars and Galaxies
Examination 3 Review Problems

Multiple Choice Questions: The first eight questions are multiple choice. Except where explicitly noted, only one answer is correct for each question. Circle the letter of the correct answer. Each multiple choice question is worth **4 points**

1. Given the presence of dust throughout the plane of the disk of the Milky Way Galaxy, what is the best technique for learning about more distant regions of our galaxy's disk?
 (a) Look for red light from stars and nebulae.
 (b) Look for blue radiation (light) from stars and nebulae, since the light is reddened by dust
 (c) Look for ionized hydrogen regions, whose high-energy radiation penetrates dust
 (d) Look for radiation at long wavelengths, for example in the infrared region of the spectrum.

2. Most of the light emitted by the galaxy in the visible wavelengths comes from:
 (a) The most luminous stars.
 (b) The much more numerous low-mass main sequence stars.
 (c) Glowing gas and dust.
 (d) The supermassive black hole at the center.
 (e) Dark matter.

3. Which of the following statements about the life of a star with a mass like the Sun is correct?
 (a) After the main sequence stage, there is no further fusion of hydrogen anywhere in the star.
 (b) As the star is dying, a considerable part of its mass will be lost into space.
 (c) The core of this star will be too massive to form a white dwarf.
 (d) Before the star dies, it will fuse dozens of different elements in its core.
 (e) At the end of its life, the star will explode as a supernova

4. Once a black hole forms, the *size* of the event horizon is determined only by:
 (a) The size of the star that collapsed into the black hole
 (b) The time since the black hole formed
 (c) The composition of the material that formed the black hole
 (d) All black holes have the same size for their event horizon
 (e) The mass inside the event horizon

5. Observations of what two properties of an object will allow for a determination of the Milky Way's mass (or at least the mass interior to an object's orbit about the center of the Galaxy)?

(a) The object's orbital velocity and distance from the galactic center.

(b) The object's mass and orbital velocity.

(c) The object's age and distance from the galactic center.

(d) The object's mass and luminosity.

(e) The object's composition and luminosity.

6. The planetary nebula phase in the evolution of a star lasts only a very short 20,000 years or so, yet we know of many of them. This is principally because:

(a) They tend to be very large and luminous and are therefore visible for great distances.

(b) The wavelengths of light they emit can easily pass through the interstellar dust.

(c) The region of space we are living in is very old.

(d) They are the final stages of evolution of low mass stars, which are common.

7. What technique did astronomers use to make the first confirmed discovery of a planet around another star similar to the Sun?

(a) Block out the light of the star and take a photograph of the fainter planet

(b) Measure the position of the star in the sky very carefully over many years and search for small wiggles in its position due to the gravitational pull of the planet.

(c) Measure the Doppler shift of the lines in the star's spectrum and look for periodic changes in this shift due to the pull of the planet as it orbits the star.

(d) Search for the presence of metallic and rocky elements in the spectrum of the star.

8. Which statement about Globular Clusters and Open Clusters is correct?

(a) Globular Clusters have a main sequence turnoff which is down and to the right of that of Open Clusters, indicating that Globular Clusters have an older stellar population.

(b) Globular Clusters have a main sequence turnoff which is down and to the right of that of Open Clusters, indicating that Globular Clusters have a younger stellar population.

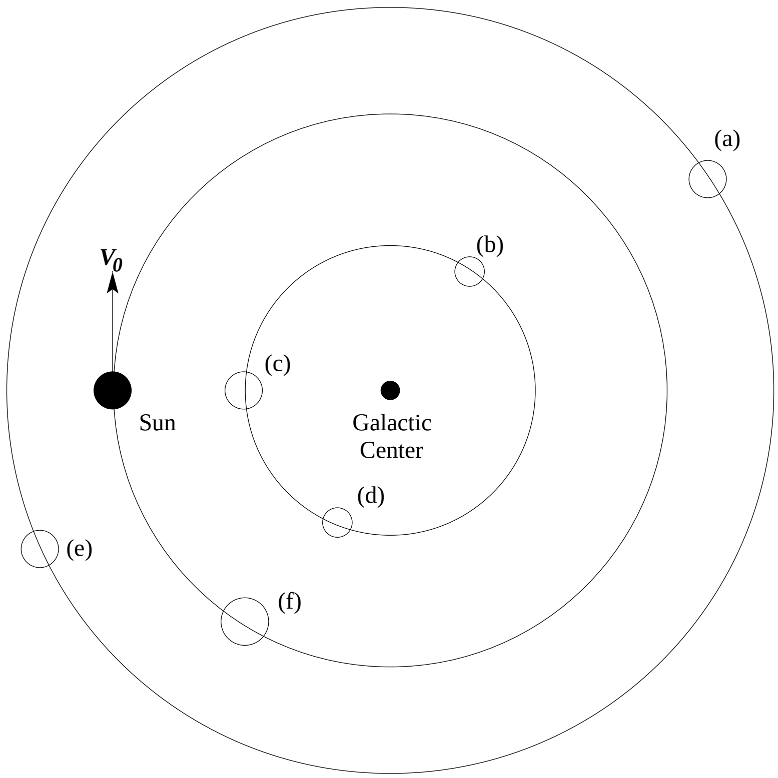
(c) While Globular Clusters show a well-defined main sequence turnoff, Open Clusters do not. This means Globular Clusters are all stars of the same age, but Open Clusters have stars at a range of ages.

(d) Globular Clusters and Open Clusters are both found primarily in the disk of the galaxy.

(e) Open Clusters are much more massive than Globular Clusters.

Short Answer Questions: Answer questions in the space provided. Indicate clearly if you must continue on the back of the page. Include any calculations or diagrams necessary. Some questions require only a word or a few words, others will require a sentence or two of explanation, and others will require a calculation. **Be brief and to the point.**

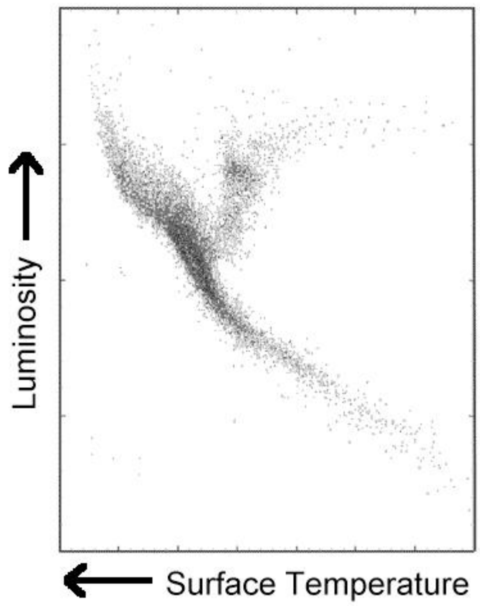
9. Consider the following drawing of our Galaxy, indicating the orbits about the center of the Galaxy for the Sun and for several blobs of gas in the disk of the Galaxy:



The position and velocity of the Sun is indicated. Assuming that the galaxy has a flat rotation curve with every object moving at velocity $v = v_0$ (i.e. the same velocity as the Sun), indicate if each blob of gas (a) through (f) will show a *redshift*, *blueshifted*, or *unshifted* spectrum.

(a) redshfited blueshifted unshifted
(b) redshfited blueshifted unshifted
(c) redshfited blueshifted unshifted
(d) redshfited blueshifted unshifted
(e) redshfited blueshifted unshifted
(f) redshfited blueshifted unshifted

10. Consider the following H-R diagram:



(a) The stars in this H-R diagram were selected from (circle one):

the nearest stars   the Galaxy   a globular cluster   an open clusters

(b) Circle and indicate with "(b)" the major group of stars on the diagram which have the largest physical sizes (i.e. radius).

(c) Circle and indicate with "(c)" a group of stars on the diagram for which you are sure that all the stars you circled are young (i.e. less than a few tens of millions of years old).

(d) Circle and indicate with "(d)" the stars which undergoing burning Hydrogen fusion at their core.

11. (a) Ten billion years from now, and astronomer and a historian decide to look for the Sun (the original birthplace of humanity). Assuming they locate the right place to look, will they find anything there? If so, what will they find? If not, why not?

(b) Emboldened by their discovery (or lack thereof), the astronomer and the historian next go looking for α Centauri. That star is very much like the Sun, except that it has a companion, a K star of slightly lower mass. Are the two explorers sure to find anything there? If they were to find something, what would it be? If not, why not?

12. An astronomer discovers a glowing cloud of ionized gas. What might she expect to find near or inside this cloud? List two possibilities, and explain in a few words or a couple of sentences why she might expect to find that and what that would tell her about the glowing gas cloud.

13. An astronomer observes a star near the Sun which is moving relative to the Sun with a velocity of 250 km/s.

(a) To which component of the galaxy is this star likely to belong?

(b) If the astronomer determines the fraction of heavy elements in this star, how is that fraction likely to compare to the fraction of heavy elements in the Sun?

(c) Is this star more likely to be *more massive* than the Sun, or *less massive* than the Sun?

(d) If the star is more massive than the Sun, what else is probably true about its nature?

14. For the first week or so after the explosion of a Type II supernova, we observe the supernova to continuously get a lot brighter. We also observe its temperature to drop from about 60,000 K to 10,000 K during the same time period. From just these two facts, what can we conclude about the part of the supernova emitting the light that we can see?