Astronomy 102
Solutions to Review Problems for Examination 3

1. Answer: (d)

2. Answer: (a). This was on the last homework assignment.

3. Answer: (b). Red giants are huge, and thus have low surface gravity. It's hard for them to hold on to their outer layers. This is even more true as the star throws off its planetary nebula. Note that (a) is wrong: there is hydrogen fusion in a shell around a helium nucleus.

4. Answer: (e)

5. Answer: (a)

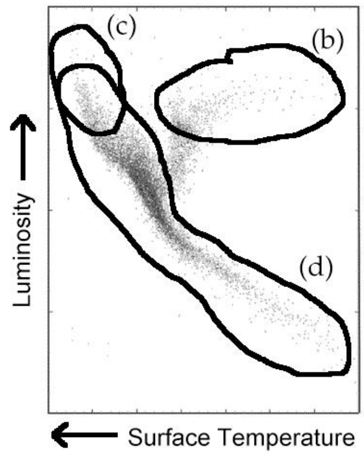
6. Answer: (a)

7. Answer: (c)

8. Answer: (a)

9.
(a) blueshifted (we're catching up with it, thus distance is getting smaller, thus the relative velocity has it moving towards us.)
(b) redshifted (it's pulling away from us, this distance is getting larger, thus the relative velocity has it moving away from us.)
(c) unshifted/redshifted (it's moving parallel to us, at the same velocity, this there is no relative velocity and thus no redshift nor blueshift. Note, however, that it's unshifted because it's transitioning from blueshifted (it has just caught up) to redshifted (it will start pulling away). (In this case, I would have accepted either answer.)
(d) blueshifted (it's catching up)
(e) redshifted (we're pulling away)
(f) unshifted (we're staying the same distance from it at all times

10. (a): the Galaxy. It's not the nearest stars, because of the oversupply of high luminosity stars. The nearest stars (or any group of random stars in the Galaxy's disk) will have many more low mass main sequence stars than high mass luminous main sequence stars. It's not a globular cluster or an open cluster because there's no well defined main sequence turnoff: this is a group of stars all at a different age.



11. (a) A white dwarf. The Sun's main sequence lifetime is about 10 billion years, and we're about halfway through that. All of it's post-main sequence life as a red giant (then as a horizontal branch star then as an AGB star) is less than 10% of it's main sequence life. It will be past all of that in 10 billion years, and thus there will just be a white dwarf left behind.

(b) This is a bit more interesting. There are two basic possibilities. (1) A binary star, one of which is a white dwarf, and the other of which is maybe a white dwarf, maybe a main sequence or a red giant star. (You don't have enough information to know where the second star's age is, so any guess like that would be fine.) (2) Only one star, the second star, which might be still "alive" or might itself be a white dwarf. In this case, the primary star would have turned into a white dwarf, and then pulled matter from the companion star (maybe once it was a red giant). If it pulled enough matter off the red giant companion (which might be difficult given the mass of the stars, but brush that under the rug for a moment), the first white dwarf might have gotten massive enough to destroy itself in a Type Ia supernova. The other star would then be left behind by itself.

(Note, though, that if you really want to get into details (which I wouldn't have required on the test, as we're getting pretty advanced here), it might go winging off into space. Why? Well, it has some velocity because of orbiting the first star. But if you spread out all that first star's mass in a supernova, that first star isn't there to provide gravity to hold the second star in place, so that second star would go winging off in whatever direction its velocity was pointing when the first star went supernova.)

12. (1) A post-AGB star (or, less jargonly, an exposed hot core of a low mass star) at the center of the cloud. In this case, the cloud is a planetary nebula; the hot core is ionizing the nebula with its UV radiation. (2) Hot young massive stars. In this case, the cloud is an HII region, or a star forming region. The hot young massive stars put out enough UV to ionize the cloud. (Other possibilities include a supernova; supernovae put out a lot of UV, and the shocks have enough energy to ionize the gas. We haven't talked much about this, but if you had listed a supernova as one of your options and said something intelligent about why, that would have been good enough. If you listed an active galactic nucleus, then you're way ahead of the rest of us; we'll talk about that sort of thing probably the Friday after the test.)

13. (a) The halo. If it's moving that fast relative to the Sun, it's not part of the disk (whose stars are all moving around the center of the galaxy at about the same speed as the Sun). If it's near the Sun, it's not part of the bulge, as we're far from the Bulge.

(b) Much lower. Stars in the halo have low heavy element abundances.

(c) It is more likely to be less massive than the Sun. Less massive stars form in greater numbers than more massive stars anyway (see homework set 4). Also, all halo stars in the disk are very old, so any stars more massive than the Sun will have died; the most massive ones will have gone supernova long ago.

(d) It must be a white dwarf. See above: all stars more massive than the sun will have already died, since halo stars are so old. Dead stars which aren't too massive do leave behind a white dwarf. (A neutron star would also be an acceptable answer, if this was a leftover from a very massive star.)

14. What we're looking at that is emitting the light must be expanding. Since it's cooling off, the only way for it to get more luminous if it's emitting thermally (which is implied since we assign a temperature to it) is for it to be getting bigger. This is no surprise... a supernova is the result of an exploding star, complete with shock wave travelling outward and sweeping up the gas. It would be surprising if it *weren't* expanding.