Name: ________________________

Don't forget to `bubble' your test version on your Parscore form.

Astronomy 10 Test #3 (Practice Version)

True/False

Indicate whether the statement is true or false.

1. In a galaxy like the Milky Way, the formation of new stars generally occurs in the spiral arms of the galaxy's disk.

2. The minimum mass of a white dwarf is about 1.4 solar masses.

3. If you watched someone fall towards a black hole, you'd see the light from them get blueshifted to ultraviolet and X-ray wavelengths.

4. When a massive star collapses, electrons and protons in its core can combine to create large numbers of neutrons.

5. During its main-sequence lifetime, a star will move slightly up and to the right, across what's really a main-sequence `band'.

Matching

For each question below, choose the item from a-e that fits best. (Items from a through e can be used more than once.)

a. Event horizon
b. Singularity
c. Gravitational redshift
d. Time dilation
e. Accretion disk

6. Stretching of wavelength of light makes an object seem to disappear as it falls toward a black hole.

7. Point where gravitationally-collapsed matter has infinite density

8. Region where matter swirling into a black hole heats up by friction and glows extremely bright and hot

9. If you're closer to a black hole than this, you can't escape, even if you're a particle of light.

Multiple Choice - General Knowledge

Choose the ONE best answer and mark it on your Parscore form.

10. The Sun is currently undergoing *mass loss*. What do we call the physical manifestation of this process?
    a. Sunspots
    b. The solar wind
    c. The Sun's photosphere
    d. The Sun's chromosphere

11. What special type of stellar remnant did Zwicky and Baade propose in the 1930s?
    a. Black holes
    b. White dwarfs
    c. Neutron stars
    d. Planetary nebulae

12. How did Hubble show that the Andromeda `nebula' is actually a separate galaxy?
    a. He recorded the emission spectrum from it.
    b. He measured the distances to all of its globular clusters.
    c. He was able to see planets orbiting stars in the Andromeda galaxy.
    d. He photographed individual stars in it, such as Cepheid variable stars.

13. What objects did Harlow Shapley use as `standard candles' when he measured the distances to the Milky Way's globular clusters?
    a. Cepheid variable stars
    b. Eclipsing binary stars
    c. Type 1a supernovae
    d. Gamma-ray bursters

14. Which of these statements best describes a black hole?
    a. A small, hot, carbon-oxygen core left over from a massive stars' death.
    b. An extremely dense mass of neutrons left behind by a collapsing star
    c. An object with a very slow escape velocity.
    d. A compact object with an escape velocity greater than the speed of light

15. Which of the following is an accurate comparison between a white dwarf star (like Sirius B) and the Sun?
    a. The white dwarf, despite the name, is a much larger star than the Sun.
    b. The white dwarf has about the same mass as the Sun, but packed into a much smaller volume.
    c. The white dwaf has the same size as the Sun, but a much smaller mass.
    d. The white dwarf, unlike the Sun, is a star that never underwent nuclear fusion in its interior.

16. Why is it unlikely that stars with masses greater than about 100 to 200 solar masses exist?
    a. A star of that mass will immediately collapse to form an object made of degenerate matter (like a white dwarf), before it can even begin nuclear fusion.
    b. The intense energy production in its core will lead to a flood of outward-flowing radiation that will drive off the star's outer layers.
    c. That much mass would make the star spin so fast that it would fling off its outer layers, thus reducing its mass.
    d. Giant molecular clouds don't exist in masses that large, so even if an entire GMC went into making a single star, the star would have a maximum mass of about 25 solar masses.

17. In what form is most of the matter in a typical galaxy (or cluster of galaxies)?
    a. Dark energy
    b. Young, bluish, high-temperature stars
    c. Dark matter
    d. Old, reddish-colored stars

18. If a star with a mass greater than 20 Suns collapses to become a black hole, what might this event look like from Earth?
    a. A gamma-ray burst
    b. It will remain invisible from Earth.
    c. A normal nova, as opposed to a supernova
    d. A region of self-sustaining star formation

Multiple Choice - Deeper Thought

As with the other multiple-choice questions, hoose the ONE best answer and mark it on your Parscore form.

19. How would an astrophysicist use velocity dispersion to measure the mass of an elliptical galaxy or a cluster of galaxies?
    a. By asking `How much mass is needed to create the gravity that holds the galaxy's stars in their orbits?'
    b. By comparing the velocity (or velocities) of the galaxy (or galaxies) in question to the velocity of the Milky Way through space.
    c. By asking `How much more luminous are the galaxy's stars than they would be if they weren't moving with such a large range of speeds?'
    d. By measuring the redshifts of other galaxies similar to the one (or the cluster) being studied.

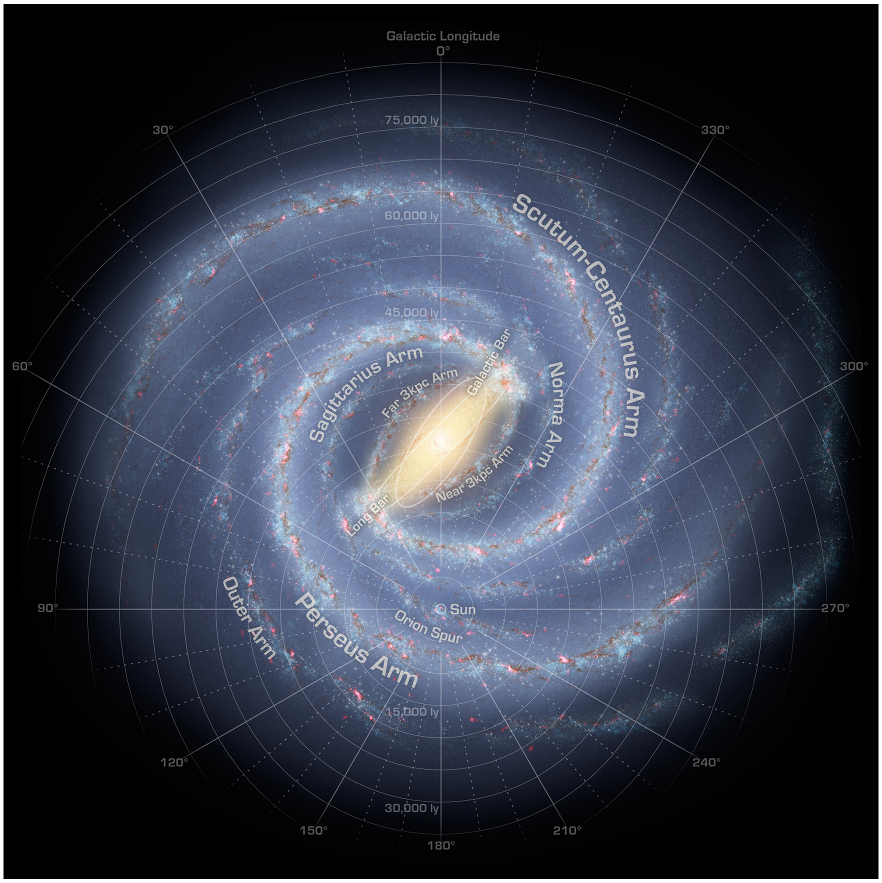
20. When a star finishes `core hydrogen burning', and transitions to `burning' hydrogen in a shell around its core, what would we observe if we could look at the star from the outside?
    a. The intense energy from the `shell hydrogen burning' would cause it to contract and cool off, moving down and to the left on the H-R diagram.
    b. This transition doesn't actually have any visible effect on the surface of the star, since all the extra energy stays deep in the interior.
    c. The star would keep the same surface temperature, but would move vertically upward on the H-R diagram, toward higher luminosity.
    d. It would get larger and cooler, moving off the main sequence toward the red giant branch of the H-R diagram.

21. If you watched someone as they fell toward the event horizon of a black hole, what strange thing would you notice about their appearance?
    a. Any light coming from them would get blueshifted until it was high-energy gamma radiation.
    b. As seen from your point of view, time (for them) would be flowing much faster than normal.
    c. They would get highly flattened, like a pancake.
    d. Their light would get redshifted until they became invisible to you.

22. Why don't we see any of the cold *black dwarfs* that white dwarfs eventually cool to become?
    a. The black dwarfs are all located in other galaxies.
    b. The universe isn't old enough for this long cooling processes to have finished yet.
    c. We don't see the black dwarfs because none of their predecessors, the white dwarfs, have formed yet.
    d. The black dwarfs are much too hot for us to see.

23. **Extra Credit:** What made Taylor and Hulse deduce that the binary pulsar system they discovered is losing energy via gravitational waves?
    a. The time between pulses is the same for both pulsars.
    b. Its orbital period is decreasing, just as general relativity predicts.
    c. The time taken for the pulsars to orbit each other is slowly increasing.
    d. They built Earth-based detectors that picked up the gravitational waves.
    e. This pair of pulsars shows a redshift similar to a distant galaxy.

Slide Section

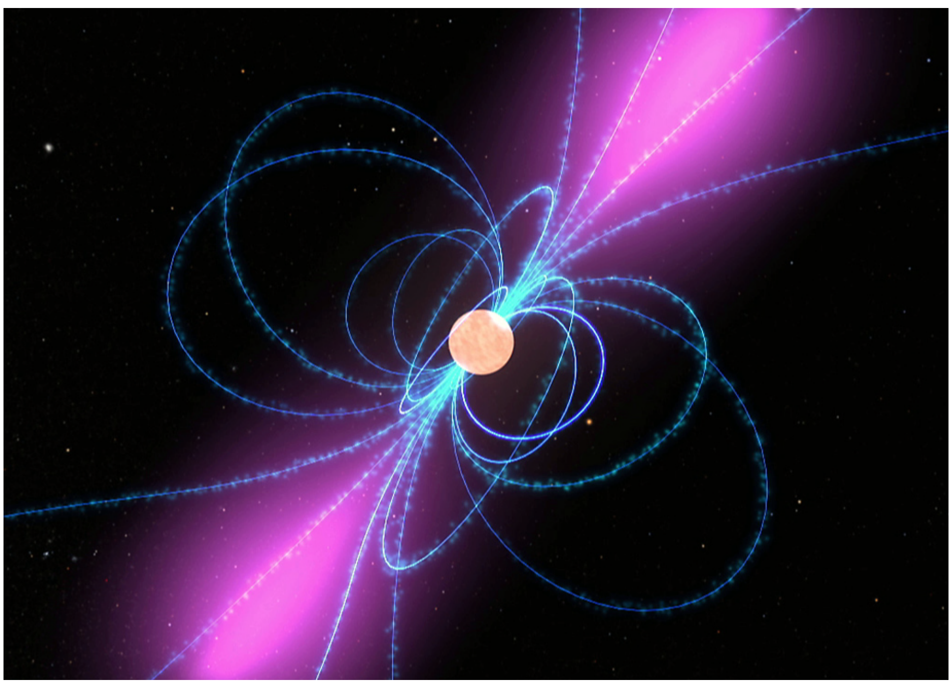


24. **(T/F)** This is a picture of the Milky Way galaxy, taken from a robotic spacecraft.

25. How have astronomers mapped the spiral structure of this galaxy?
    a. By observing light from this galaxy that has reflected off of the nearby Andromeda galaxy.
    b. By measuring accurate parallaxes of over one billion stars, so as to determine these stars' distances very accurately.
    c. By using radio telescope to measure the positions of HII regions and clouds that contain carbon monoxide (CO) gas.
    d. By mapping the positions of several hundred thousand young class O stars in the spiral arms and central bulge of this galaxy.

26. Which stellar “population” would do we find in the spiral arms of this galaxy, and of other galaxies like it?
    a. Population II, which includes the newly-formed stars in the HII regions.
    b. Population I, which includes the Sun and very old stars with low `metal' content.
    c. Population II, which includes many old red giants, as well as the stars of the globular clusters.
    d. Population I, which includes the Sun and class O and B stars.

27. Imagine that you could live on the planet Earth for several billion more years. How would this galaxy look different?
    a. It will spin much faster, which will cause it to break apart into many separate star clusters, will appear scattered around Earth’s sky.
    b. It will appear much smaller and fainter in the sky, as it moves away from the Earth.
    c. It will eventually become part of a large elliptical galaxy, after the Andromeda galaxy collides with it.
    d. Its stars will all become much hotter and bluer-looking.



Caption: Blue lines represent magnetic field lines.

28. **(T/F)** In this artist’s conception, we’re probably looking at at the powerful magnetic field and high-speed jets of a neutron star.

29. This object is the `remnant' left over after what sort of event?
    a. A type II supernova
    b. The Big Bang
    c. The formation of an active galactic nucleus
    d. The helium flash

30. What makes an object like this appear as a `pulsar' when seen from Earth?
    a. It is caught up in the accretion disk around a quasar, causing it to be eclipsed by a large black hole.
    b. Beams of radiation sweep past the Earth as the object rotates.
    c. It is moving rapidly towards the Earth, giving it a large blueshift.
    d. The object grows and shrinks many times per second, thus changing its apparent brightness.

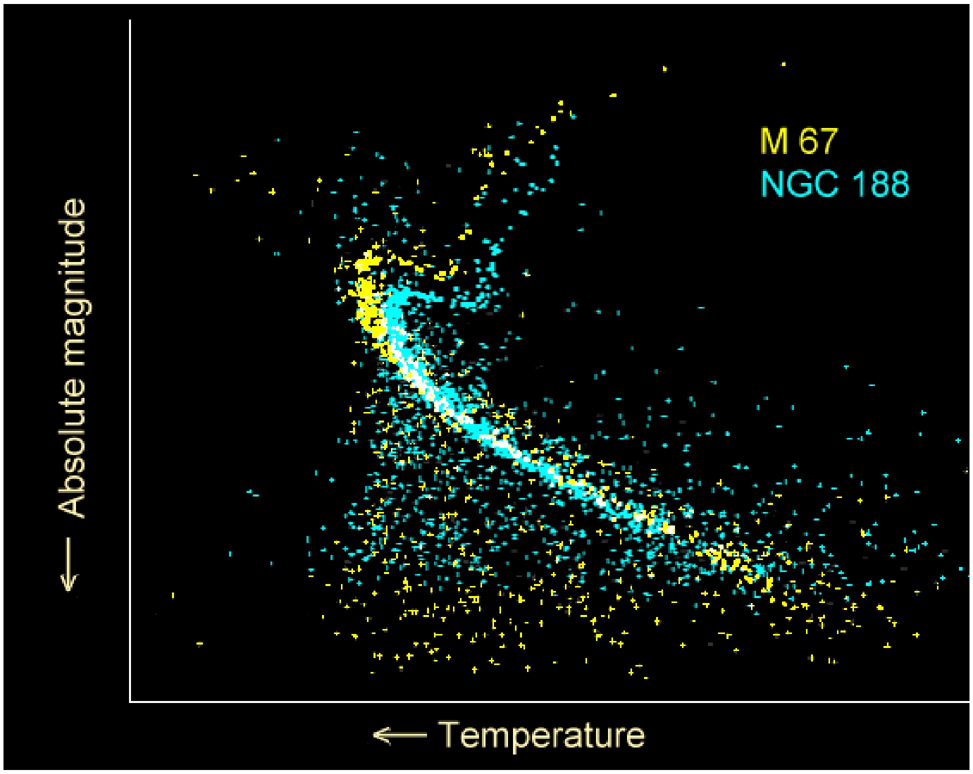
31. If the original object (of which this is a leftover) had been much more massive, so that this remnant weighed several times the Sun's mass, what would have happened here?
    a. A new star would have begun hydrogen fusion.
    b. The object would have slowed its rotation, nearly ceasing to rotate.
    c. A black hole would have formed.
    d. The host galaxy would have developed a new spiral arm.

32. **(T/F)** This is most likely a planetary nebula, formed from the cast-off outer layers of an aging star.

33. What type of object is found at the center of this type of nebula?
    a. A black hole
    b. A red dwarf
    c. A neutron star
    d. A white dwarf

34. The fact that this nebula is glowing with emission-line light tells us what about the object at its center?
    a. The object emits a lot of red and blue light, which reflects off the nebula.
    b. The object must be moving away from us very rapidly, which explains why this nebula looks so heavily redshifted.
    c. The object is hot enough to emit significant amounts of ultraviolet radiation.
    d. The object is very cool, emitting most of its energy in the infrared.

35. Imagine you could somehow add a great deal of hydrogen gas to the object at this nebula's center. If you added enough hydrogen to suddenly increase its mass well above 1.4 solar masses, what would happen?
    a. The nebula would contract back onto the object, forming a main-sequence star.
    b. A globular star cluster would form.
    c. The expansion of the universe in the host galaxy would suddenly reverse.
    d. It would explode as a type Ia supernova.



Caption: M67 and NGC 188 are two star clusters.

36. **(T/F)** These H-R diagrams show that all of the stars in these clusters have the same luminosities and temperatures.

37. Which of these two clusters is older?
    a. They are the same age.
    b. H-R diagrams like this can't be used to estimate the ages of star clusters.
    c. NGC 188
    d. M67

38. In each of these clusters, what has happened to the most massive stars?
    a. They have evolved into emission nebulae and HII regions.
    b. The helium in their cores has all been used up, which means they've started buring hydrogen for the first time.
    c. They have been ejected from the cluster by gravitational encounters with other stars.
    d. They've run out of hydrogen to burn in their cores, and have evolved into red giants.

39. If you could travel several hundred million years back in time and observe these clusters, what would be different about their H-R diagrams?

   a. The `turn-off points' would be higher up on the main sequence.
   b. The white dwarf stars would be much less luminous than they are now.
   c. The red dwarf stars in these clusters would have burned through all their hydrogen and moved off the main sequence.
   d. The main sequence lines on the diagrams would be horizontal lines near the bottom edge of the graph.

Astronomy 10

Answer key for Test #3 PRACTICE VERSION

1	T		21	D	
2	F		22	B	
3	F		23	B	
4	T		24	F	
5	T		25	C	
6	C		26	D	
7	B		27	C	
8	E		28	T	
9	A		29	A	
10	B		30	B	
11	C		31	C	
12	D		32	T	
13	A		33	D	
14	D		34	C	
15	B		35	D	
16	B		36	F	
17	C		37	C	
18	A		38	D	
19	A		39	A	
20	D				