Astro 130, Spring 2015, Homework on Chapter 18
Name: _____ Date: _____

1. In some binary star systems, such as Algol, the less massive star is a red giant and the more massive star is on the main sequence. This is evidence that
   A) mass transfer has occurred from one star to another.
   B) the more massive star formed later, from a disk of gas surrounding the less massive star.
   C) the more massive star captured the other one into orbit some time after the two stars had formed.
   D) stars evolve differently in binary star systems, with less massive stars evolving faster than more massive stars.

2. At which phase of its evolutionary life is a white dwarf star?
   A) very late for a small mass star, the dying phase
   B) just at the main-sequence phase
   C) early phase, soon after formation
   D) post-supernova phase, the remnant of the explosion

3. One particular characteristic of a white dwarf star is its
   A) very high surface temperature.
   B) extremely low mass for a star, about 1/100 of a solar mass.
   C) very low surface temperature, because it is at the end of its life.
   D) spectrum, consisting simply of emission lines from hydrogen, helium, carbon, and oxygen.

4. Our Sun will end its life by becoming a
   A) black hole.
   B) white dwarf.
   C) molecular cloud.
   D) pulsar.

5. A Type II supernova is the
   A) explosion of a single massive star after silicon burning has produced a core of iron nuclei.
   B) explosion of a red giant star as a result of the helium flash in the core.
   C) collapse of a blue supergiant star to form a black hole.
   D) explosion of a white dwarf in a binary star system after mass has been transferred to it from its companion.

6. A pulsar is most probably formed
   A) in the core of a star as it evolves through its main sequence phase.
   B) in the center of a supernova explosion.
   C) within a huge gas cloud, by collisions between stars.
   D) just after the formation of a protostar by gravitational condensation.

7. The pulsation periods of most pulsars are in the range
   A) of 1/1000 second and a few seconds.
   B) of 10^{-6} and 10^{-3} second.
   C) from minutes to hours.
   D) from many hours to a few days.

8. A neutron star will be detected from Earth as a pulsar by its regular radio pulses *only* if the Earth lies
   A) in the plane of the neutron star's magnetic equator, halfway between its magnetic poles.
   B) almost directly in line with the magnetic axis of the neutron star at some time during the star's rotation.
   C) directly above the rotation axis of the rotating neutron star.
   D) in the neutron star's "equator," the plane perpendicular to its spin axis.

9. The very strong magnetic field of a neutron star is created by
   A) a burst of neutrinos produced by the supernova explosion, because this would be the equivalent of a very large electrical current flowing for a short time.
   B) the collapse of a star, which significantly intensifies the original weak magnetic field of the star.
   C) differential rotation of the neutron star, its equator rotating faster than the poles, similar to sunspot formation.
   D) turbulence generated in electrical plasmas during the collapse of a star, even though this star had no magnetic field originally.

10. The fastest pulsars, called millisecond pulsars, have periods of about 1/1000 second. The reason they pulse so much faster than (for example) the Crab and Vela pulsars is that they
   A) were formed from much more massive stars than were the Crab and Vela pulsars, and were spun up more as their cores collapsed to a smaller volume.
   B) are normal pulsars, whereas the Crab and Vela pulsars have been slowed down from millisecond speeds over their long lifetimes.
   C) are a totally different phenomenon, involving a black hole rather than a neutron star.
   D) were spun up by mass transferred on to them from a companion in a binary star system.

11. A nova is a sudden brightening of a star that occurs when
    A) material from a companion star is transferred onto the surface of a white dwarf in a binary system and is subsequently blasted into space by a runaway thermonuclear explosion, leaving the white dwarf intact to repeat the process.
    B) the electron-degenerate iron core of a massive star collapses after its mass becomes larger than the Chandrasekhar mass limit.
    C) material from a companion star is transferred onto a neutron star in a binary system, causing the neutron star to collapse into a black hole.
    D) material from a companion star is transferred onto the surface of a white dwarf star in a binary system, after which runaway carbon fusion reactions cause the entire white dwarf to be destroyed in an explosion.

12. Two rocket ships are traveling past Earth at 90% of the speed of light in opposite directions (i.e., they are approaching each other). One turns on a searchlight beam, which is seen by scientists aboard the second spaceship. What speed do the scientists measure for this light? (c = speed of light in a vacuum)
    A) 1.8 c
    B) 0.9 c
    C) 1.9 c
    D) c

13. If you see an object moving past you at 90% of the speed of light, you will measure the length of this object to be
    A) unchanged from when it is at rest.
    B) shorter than if it were at rest while it is traveling toward you, longer than if it were at rest when it is traveling away from you.
    C) shorter than if it were at rest.
    D) longer than if it were at rest.

14. According to Einstein's general theory of relativity, a clock that ticks at a regular rate far from a source of gravity will appear to tick
    A) at the same rate in a gravitational field if it is an atomic clock but at a slower rate if it is a mechanical clock.
    B) at the same rate wherever it is placed in a gravitational field.
    C) faster, the closer it comes to the source of gravity.
    D) slower, the closer it comes to the source of gravity.

15. According to general relativity, why does Earth orbit the Sun?
    A) Space around the Sun is curved and Earth follows this curved space.
    B) The Sun exerts a gravitational force on Earth across empty space.
    C) Matter contains quarks, and Earth and Sun attract each other with the "color force" between their quarks.
    D) Earth and the Sun are continually exchanging photons of light in a way that holds Earth in orbit.

16. What happens to the wavelength of light as it travels outward through the gravitational field of a planet, a star, or other massive object?
    A) It stays the same but the intensity of the light decreases.
    B) It stays the same but the energy of each photon decreases.
    C) It decreases.
    D) It increases.

17. Gamma ray bursters are great distances from us, yet we receive tremendous amounts of energy from them. What accounts for this?
    A) These are supermassive stars, equivalent to 100,000 ordinary supernovae.
    B) A gamma ray burster represents the explosion of an entire galaxy.
    C) The energy is released along jets rather than uniformly in all directions. If Earth is in the path of one of these jets we see a gamma ray burster.
    D) The gamma radiation from a burster is released in all directions, but then it is focussed into our direction by gravitational lensing.

18. At what location in the space around a black hole does the escape velocity become equal to the speed of light?
    A) at the point where escaping X-rays are produced
    B) at the point where clocks are observed to slow down by a factor of 2
    C) at the event horizon
    D) at the singularity