AY1 Homework for Quiz 3: Spring 2017

1. **Which of the following are part of the scenario for SNI?**

__X__ Mass transfer from a close companion onto a white dwarf

__X__ The collapse of a white dwarf whose mass exceeds $1.4M_{Sun}$

___ The iron core of a massive star reaches the Chandrasekar limit

___ Core collapse, "neutronization", neutrino production and shock waves

2. **In a SNI outburst, the initial burst of light is due to the energy released in fusion reactions. What keeps the SNI glowing after the first 15 days?**

___ neutrino heating

___ photo-disintegration of iron nuclei

___ radioactive decay of Hydrogen and Helium

_X__ radioactive decay of Nickel and Cobalt formed during the explosion

3. **Which of the following are true (T) and which false (F) regarding the formation of elements with atomic number larger than iron?**

__X__ most are made by the addition of neutrons to existing nuclei

___ most are made by the fusing of light elements to iron (Fe)

__X__ most are made by the S-process and the R-process

___ most are made by fission reactions involving Uranium and other rare-earth elements

4. **What is the evidence for black holes of the 3 -- 10 M_{Sun} variety?**

Binary system emitting hard x-rays where an unseen companion with mass > $3M_{Sun}$ is inferred, but a main-sequence star or giant would be visible. Cygnus X-1 is a good example

5. **If the Earth could be compressed to a small enough radius, it would become a black hole. What is that critical radius?**

$R_{critical}=R_{Sch}=(2M_{Earth} \times G)/(c^2)=(2 \times 6 \times 10^{27} gr \times 6.67 \times 10^{-8} cm^3 gr^{-1} s^{-2})/(9 \times 10^{20} cm^2 s^{-2})$

$= 8.9 \times 10^{-1}$ cm (about a cm)

6. **Which of the following are True (T) and which False (F) in describing an event horizon?**

_X__ It is the distance from a singularity where the escape velocity is the speed of light

___ It is the extent of the gravitational influence of a black hole

___ Only black holes that are $3M_{Sun}$ or larger have an event horizon

_X__ The size of the event horizon of a black hole increases as mass is added to the black hole

7. **Which of the following are predictions of Special or General Relativity?**

_X__ The clock in a spaceship traveling at a high velocity with respect to the Earth will run more slowly than a clock on Earth

___ If you are in a spaceship moving at 0.9 the speed of light and shine a flashlight in the direction of travel, you will measure the speed of the light beam to be 0.1c

_X__ Time moves more slowly as you approach the event horizon of a Black Hole

_X__ Mass creates "warps" in the space-time fabric of the universe

8. **Compare the escape velocity from the surface of the Earth for a hydrogen atom (mass = 3×10^{-24} grams) and for the Space Shuttle (mass = 10^7 grams).**

Escape velocity does not depend on the mass of the escaping object so it is the same for all objects independent of mass

9. **To the best of our knowledge, neutron degeneracy can only support a mass up to $3M_{Sun}$. If mass is added to a neutron star and this limit is exceeded, what prevents the star from collapsing?**

Nothing – it will collapse into a singularity

10. **Which of the following are components of the Milky Way Galaxy?**

_X__ Rotating disk containing stars, gas and dust

_X__ 4×10^6 M_{Sun} Black Hole at the center

_X__ Extended, low-density spherical halo with stars and globular clusters

_X__ Bulge of gas and young stars

11. What is the evidence for a dark matter component of the Galaxy?

The rotation curve. Objects at large galactocentric radius have orbital speed much larger than would be expected from the mass of the galaxy inferred from luminous material interior to their orbits

12. What was the subject of the 1920 "Great Debate" between Herber Curtis and Harlow Shapley?

Where the Milky Way Galaxy was the extent of the Universe or if there were other galaxy-sized objects in a much larger Universe

13. What is believed to be the source of energy for QSOs and Active Galactic Nuclei radiation (check all that are true)?

__X_ material being heated as it is falling into a supermassive black hole

___ intense bursts of star formation

___ series of supernova II explosions

___ runaway thermo-nuclear reactions in the center of the galaxies

14. Which of the following are observations that have led us to believe there is a supermassive black hole at the center of the Galaxy?

___ gas clouds being ejected from the center of the Galaxy at escape velocity

__X_ orbits of stars near the center of the Galaxy

___ the regular disappearance of stars near the center of the Galaxy

___ extremely energetic photons streaming from the center of the Galaxy

15. The Local Group of Galaxies contains (label true or false)

____ several thousand galaxies

__X__ several galaxies of comparable size to the Milky Way Galaxy and a few hundred dwarf galaxies

____ a few hundred galaxies including some much larger than the Milky Way Galaxy

____ a mix of large and smaller galaxies along with several energetic QSOs

16. The discovery that our Milky Way Galaxy is one of billions of galaxies in a very large Universe was made by:

___ Astronomers in ancient times an many different cultures

___ Galileo when he used the first telescope to view the sky

_X_ Astronomers from the early 1900s who first used photographic plates to make images of the sky to much fainter levels than was previously possible

___ Astronomers in the last decade using the Hubble Space Telescope

17. Vesto Slipher obtained spectra of galaxies during the period 1912 – 1917 and made what remarkable discovery?

The vast majority of galaxies are moving away from the Milky Way Galaxy

18. The vast majority of galaxies are moving away from the Galaxy. There is a linear relation between the recession velocity and the distance to a galaxy. The interpretation of this observation is which of the following?

____ The Galaxy is at the center of the Universe

__X__ Space-time is uniformly expanding

____ Galaxies were ejected by the Big Bang

____ Cepheid variable stars have been ejected from their host galaxies