

AY2 Homework for Quiz 3: Fall 2019

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

- Mass transfer from a close companion onto a white dwarf
- The collapse of a white dwarf whose mass exceeds $1.4M_{\text{Sun}}$
- 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
- 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?

- most are made by the addition of neutrons to existing nuclei
- most are made by the fusing of light elements to iron (Fe)
- 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?

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

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

- 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 $3M_{\text{Sun}}$ or larger have an event horizon
- 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?

- 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 $0.1c$
- Time moves more slowly as you approach the event horizon of a Black Hole
- 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).

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

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

- Rotating disk containing stars, gas and dust
- $4 \times 10^6 M_{\text{Sun}}$ Black Hole at the center
- Extended, low-density spherical halo with stars and globular clusters
- Bulge of gas and young stars

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

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

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

- 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
- 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
- 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

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?

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

Space-time is uniformly expanding

Galaxies were ejected by the Big Bang

Cepheid variable stars have been ejected from their host galaxies