QUIZ 3 – ASTR-1 Spring 2017 YOUR NAME:_____

1. **Which of the following are predictions of Special or General Relativity? (select any that are true)**

   _F__ 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 ($3x10^7$ m/sec).

   _T__ Mass warps the space-time fabric of the universe

   _F__ Time reverses as an object approaches the speed of light

   _T__ Light traveling near a mass will appear to bend as it follows a straight line through curved space

2. **Which of the following best describes the calculation of the Schwarzchild radius for an object with mass M? (select one)**

   _X__ Set velocity equal to the speed of light in the equation for escape velocity and solve for radius at a given M

   ___ Calculate the maximum radius for a neutron star and adjust by the maximum mass for a neutron star $3M_{Sun}$ divided by M (a factor of $3M_{Sun}/M$)

   ___ Calculate the equivalent energy for an object using $E=Mc^2$ and use this to determine the closest orbit of a photon before it is captured by the object

   ___ Determine the radius from a mass M where time slows to zero based on the time dilation formula from Special and General Relativity

3. **Which of the following are observations that have led us to believe there is a supermassive black hole at the center of the Galaxy? (check any that are true)**

   ___ the complete lack of electromagnetic radiation in the central parsec of the Galaxy

   _X__ orbits of stars near the center of the Galaxy

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

   _X__ the existence of "hyper-velocity" stars that are traveling near escape velocity from the Galaxy and whose orbits indicate they were accelerated near the central black hole

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

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

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

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

   _F__ The size of the event horizon of a black hole decreases as mass is added to the black hole

5. **Which of the following are components of the Milky Way Galaxy? (select any that are)**

   _X__ Rotating, flattened 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__ A dark matter halo

6. **What is the evidence for a dominant dark matter component of the Galaxy? (select as many as are correct)**

___ Planets in the outer solar system orbit the Sun at larger and larger speeds

___ gravitational lens experiments have demonstrated a population of black holes in the Galactic bulge

__X__ the "rotation curve" of the Galaxy is flat: stars in the outer parts of the Galactic disk orbit faster than expected based on the stars and gas seen inside their orbits

___ Galaxies at increasing distances have larger recessional velocities

7. **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? (select one)**

___ The Galaxy is at the center of the Universe

__X__ Space-time is uniformly expanding

___ Galaxies were ejected by the Big Bang

___ Space-time is warped by the accumulated mass of all the galaxies in the Universe

8. **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

9. **Which of the following are part of the reasoning chain that leads us to believe that binary system Cygnus X1 contains a stellar-mass black hole? (select any that are true)**

___ There is an unseen companion in the system that is emitting degenerate electrons

__X__ There is an unseen companion that is at least $5M_{Sun}$ but is not visible at optical wavelengths and is therefore not a red giant or main-sequence star

__X__ There is an unseen companion that is at least $5M_{Sun}$ which excludes the possibility that it could be a white dwarf or neutron star

__X__ The system emits "hard" (short-wavelength) X-rays from material heated to high temperature near the black hole

10. **Which of the following are used to make the case that the Universe is uniformly expanding? (select any that are true)**

___ Slipher measured the radial velocity of the Andromeda Galaxy and showed it was approaching the Milky Way Galaxy at ~300km/sec

_X__ The vast majority of galaxies show red-shifted spectra indicating they are moving away from the Milky Way Galaxy

____The light curves of Cepheid variables are used to measure the rotation curve of the Milky Way Galaxy

_X__ The light curves of Cepheid variables are used to estimate the distances to galaxies