

NAME: _____

- 1) The largest possible mass for a white dwarf is known as the Chandrasekhar limit. What is this critical mass, in solar masses? (fill in the correct numerical value below)
_____ solar masses
- 2) What is the best estimate for the largest possible mass of a neutron star, in solar masses? (fill in the correct numerical value below)
_____ solar masses
- 3) The point of infinite gravity at the center of a black hole is known as the _____.
- 4) The region of space around a black hole within which nothing can escape, not even light, is known as the _____.
- 5) If somebody snuck into the solar system during the night and replaced the Sun with a 1 solar mass black hole, how would this affect the Earth?
 - a) Earth would spiral into the Sun
 - b) Earth would spiral outward, away from the Sun
 - c) Earth's orbit would be unaffected
- 6) Which of the following types of astronomical objects do *not* provide evidence for the existence of black holes? (If they all do, circle 'd')
 - a) stars orbiting invisible companions, like Cygnus X-1
 - b) pulsars
 - c) quasars
 - d) they all provide evidence that black holes exist

For questions 7 – 9 pretend that you are falling into a black hole, while I watch you from a safe distance. (Hey, you didn't expect me to jump in, did you???)

- 7) How will *your time* appear to *me*?
 - a) slower than my time
 - b) faster than my time
 - c) the same as my time
- 8) How will *my time* appear to *you*?
 - a) slower than your time
 - b) faster than your time
 - c) the same as your time
- 9) How will *your time* appear to *you*, compared to what it was before you approached the black hole—that is, compared to your "normal time"?
 - a) slower than normal
 - b) faster than normal
 - c) the same as normal
- 10) Why do astronomers think that massive black holes lurk at the centers of most galaxies? That is, what is the evidence for these objects? (A short answer is all you need – as long as it is correct!)

Recall from class that the size of a black hole's event horizon depends simply on the mass of the black hole. The 'radius' of the event horizon is known as the Schwarzschild radius, R_s , and is equal to 3 km for each solar mass. Use this information to answer each of the questions below. (For full credit, be sure to show your calculation.)

- 11) The black hole at the center of our Milky Way Galaxy is estimated to have a mass of about 3 million solar masses. What is the Schwarzschild radius of this black hole? (Show your calculation, however simple.)
- 12) Imagine that you have just discovered a black hole, and through careful measurements you have determined that its event horizon has a diameter of 48 km. What is the mass of this black hole? (Remember – the diameter of a sphere is twice the radius; and show your calculation.)

EXTRA CREDIT: Future Earthlings have decided to turn the Moon into a black hole. They figure they will then be able to use it as a giant trash can and finally get rid of all these landfills on Earth. Given the following data, calculate the *Schwarzschild radius* that the Moon would have if it were a black hole. Express your answer in millimeters (1 kilometer = 10^6 millimeters). You must show your calculation to receive credit.

$$\text{Mass of the Moon} = 7.3 \times 10^{22} \text{ kg}$$

$$\text{Mass of the Sun} = 2.0 \times 10^{30} \text{ kg}$$