

1. The density of a neutron star is closest to:
 - a. 10 kg / teaspoon
 - b. 1 atom / cubic centimeter
 - c. 5 tons / teaspoon
 - d. 1 billion tons / teaspoon

2. A pulsar is a
 - a. oscillating white dwarf
 - b. oscillating neutron star
 - c. rotating white dwarf
 - d. rotating neutron star
 - e. none of the above

3. Cygnus X-1 is almost certainly a black hole. Which of these is an important piece of evidence for this?
 - a. Measurements of its mass and radius show that it is much denser than a neutron star.
 - b. Its measured mass is larger than the maximum mass of a neutron star.
 - c. It is the remnant of a massive star which we observed exploding in a gamma ray burst.
 - d. It is observed to be perfectly black.

4. A black hole is likely to be the end of stellar evolution for what type of main-sequence star?
 - a. O
 - b. M
 - c. G
 - d. A

5. What can escape from within a black hole?
 - a. Neither light nor matter
 - b. Light only
 - c. Both light and matter
 - d. Matter only

6. The mass of a black hole candidate can be found by
 - a. measuring its luminosity and distance
 - b. measuring the speed of an orbiting companion and the radius of its orbit
 - c. measuring the radius of its event horizon only
 - d. measuring its luminosity and the radius of its event horizon

7. The fastest-spinning neutron star known rotates about
 - a. once a day
 - b. once an hour
 - c. once a second
 - d. 30 times a second
 - e. 700 times a second

8. Why do neutron stars in x-ray binaries rotate faster than most other observed neutron stars?
 - a. They are spun up by the gravitational tidal force of their companion.
 - b. They are spun up by matter that spirals onto them from their companion star.
 - c. Like other stars in binary systems, they spin faster than isolated stars.

9. Which of the following is not a terrestrial planet?
 - a. Mars
 - b. Earth
 - c. Neptune
 - d. Mercury
 - e. Venus

10. Which of the following is not a Jovian planet?
 - a. Venus
 - b. Jupiter
 - c. Neptune
 - d. Saturn
 - e. Uranus

11. Compared to terrestrial planets, Jovian planets are
 - a. larger and denser
 - b. smaller and denser
 - c. larger and less dense
 - d. smaller and less dense

12. Most of the solar system's mass is in
 - a. the Sun
 - b. comets
 - c. asteroids
 - d. meteoroids
 - e. planets

13. When a rotating cloud contracts, it
 - a. spins slower and flattens
 - b. spins faster and flattens
 - c. spins slower and heats up
 - d. spins faster and heats up

14. Why do all of the planets have orbits that lie in nearly the same plane and that are in the same direction -- counterclockwise looking down on the solar system from far above the Earth's North Pole?
 - a. When they were captured by the Sun, the Sun was moving past a cluster of planets, and all of those planets were on one side of its path.
 - b. Shortly after they formed, the planets were moving in random directions. In the 4 1/2 billion years since then, the Sun's gravity has pulled them into the same plane.
 - c. The planets and Sun all formed from a cloud of gas and dust that contracted as it cooled. As the cloud contracted, its spin increased and it flattened. By the time the planets formed, the cloud was a flat spinning disk.

For questions 15 to 18, choose one of the three following answers:

- a. comets
- b. meteoroids
- c. asteroids

- 15. Their orbits usually lie between Mars and Jupiter.
- 16. They often pass the Sun once and then leave the solar system.
- 17. They have the lowest average density of the three kinds of objects.
- 18. They are typically small pebbles.

19. What is the reason for the difference between typical meteors and typical meteorites?

- a. The only meteors that do not burn up in the atmosphere are the large ones. These are all asteroid fragments.
- b. The only meteors that do not burn up in the atmosphere are the rocky ones. These all come from comets.
- c. Meteorites are the meteors that burn up in the atmosphere.
- d. Meteors are ice balls, while meteorites are great balls of fire.

20. Comet tails extend from the comet in what direction?

- a. away from the Sun
- b. away from the Sun when the comet is approaching the Sun and toward the Sun when the comet is moving away
- c. toward the Sun

For questions 21 to 24, choose one of the following answers:

- a. Jupiter
- b. Mercury
- c. Mars
- d. Venus
- e. Uranus

21. The greenhouse effect makes this the planet with the hottest average temperature in the solar system.

22. This planet is about 20 AU from the Sun.

23. This planet is the only one of those listed that was not known to the ancient Greeks.

24. This planet has no liquid water on its surface, but does have channels which are probably the streambeds of ancient rivers.

25. The average density of the Earth is about

- a. the density of water
- b. the density of iron
- c. the density of black volcanic rock
- d. the density of ice

26. The Earth's atmosphere is primarily

- a. carbon dioxide and oxygen
- b. water vapor and carbon dioxide
- c. nitrogen and oxygen
- d. methane and ammonia
- e. nitrogen and water vapor

27. Mars is larger than the Earth.

- a. TRUE
- b. FALSE

28. What are the main constituents of Mars?
- a. hydrogen and rock
 - b. rock and ice
 - c. water, methane and ammonia
 - d. hydrogen and helium
 - e. rock and iron

For questions 29 to 31, choose one of the following answers:

- a. Mars
 - b. Mercury
 - c. Earth
 - d. Venus
 - e. Jupiter
29. The crater-covered surface of this terrestrial planet resembles the surface of the Moon.
30. Olympus Mons is a volcano on this planet.
31. Dry ice (frozen carbon dioxide) vastly enlarges this planet's polar caps in the winter for each cap.
32. Voyager discovered active volcanoes on what moon?
- a. Phobos
 - b. Ganymede
 - c. Titan
 - d. Europa
 - e. Io
33. The Great Red Spot is
- a. a desert on Mars
 - b. a crater on the moon
 - c. a persistent storm on Jupiter
34. Jupiter emits more energy than it receives from the Sun.
- a. TRUE
 - b. FALSE

35. Pluto is now classified as
- a cold terrestrial planet
 - a large Kuiper belt object
 - a comet in a bound orbit
36. Pluto is the largest of the known plutoids.
- TRUE
 - FALSE
37. Plutoids are
- comets in the Oort cloud
 - balls of ice and rock in the Kuiper belt
 - carbonaceous chondrites between Mars and Jupiter
 - the moons of the Jovian planets that are primarily ices of water, ammonia, carbon dioxide, and methane
38. Compared to Population I stars, Population II stars are
- older, with a smaller fraction of heavy elements
 - younger, with a larger fraction of heavy elements
 - older, with a larger fraction of heavy elements
 - younger, with a smaller fraction of heavy elements
39. What population of stars are found in globular clusters?
- Population I only
 - Population II only
 - both Population I and Population II
 - neither

40. Each method of finding distances (or distance indicator) listed below is used to find the distance to a set of objects. Match the indicators to the objects.

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| A. radar bouncing | 1. distances to planets |
| B. parallax | 2. distances to the nearest stars |
| C. main-sequence matching
("spectroscopic parallax") | 3. distances to nearby galaxies |
| D. Cepheid variables | 4. distances to stars in the Milky Way
more than 2,000 ly away |

- a. A and 2, B and 3, C and 1, D and 4
- b. A and 3, B and 1, C and 4, D and 2
- c. A and 1, B and 2, C and 4, D and 3
- d. A and 4, B and 3, C and 1, D and 2

41. The Milky Way is

- a. a spiral galaxy
- b. an elliptical galaxy
- c. a globular cluster
- d. an irregular galaxy

42. In which part of the Milky Way galaxy is the Sun?

- a. halo
- b. disk
- c. central bulge
- d. none of these

43. Most of the mass of the Milky Way galaxy is

- a. in the spiral arms
- b. in the disk, but not in the spiral arms
- c. in the nuclear bulge
- d. invisible and in the halo
- e. in the brightest, most massive stars of halo

44. The strongest evidence for a black hole in the center of the Milky Way is
- a. Observed orbits of stars show nearly 4 million times the mass of the Sun is in a region less than 6 light-hours across.
 - b. Doppler shifts of 21-cm radiation from the galactic center imply that roughly 50 million times the mass of the Sun lies within a region 3 light-years across,
 - c. Observed orbits of stars show nearly 30 million times the mass of the Sun is in a region less than 8 light-seconds across.
 - d. Doppler shifts of 21-cm radiation from the galactic center imply that over one billion times the mass of the Sun lies within a region 3 light-years across.
 - e. None of these is thought to be evidence for a central black hole.
45. What is the approximate diameter of the disk of the Milky Way?
- a. 100,000 ly
 - b. 300,000 ly
 - c. 3 million ly
 - d. 100 million ly