AST 309N (Cosmic Catastrophies), Spring 2016, Exam 4, Form B

April 20, 2016

All multiple choice questions are worth 3.03 points. Mark the letter corresponding to the best answer on the scan-tron sheet and circle that letter on the exam.

1. Ionized gas must move: **A. along magnetic lines of force** B. across magnetic lines of force C. at the speed of light D. in a circle

2. A moving magnetic field will generate: A. gravity B. neutrinos **C. radiation** D. neutrons

3. Neutron stars alone in space will emit radiation from the magnetic poles if the neutron star: A. is rotating but not magnetic B. is magnetic but not rotating C. has aligned rotation and magnetic axes **D. has misaligned rotation and magnetic axes**

4. Most radio pulsars are observed to rotate about once per: **A. second** B. hour C. month D. year

5. Most of the energy of a "radio" pulsar may be emitted as gamma-ray energy. This energy is thought to come from the: A. equator of the neutron star **B. speed-of-light circle** C. north magnetic pole D. south magnetic pole

6. The radio radiation from a pulsar is received as pulses because: A. radiation comes from the axis of rotation **B. rotation beams the radiation in different directions** C. the neutron star orbits another star D. energy is generated in pulses at the magnetic poles

7. In a binary system, matter transferred from a companion star tends to land on the magnetic poles of a neutron star because: A. matter flows across magnetic lines of force **B. matter flows along magnetic lines of force** C. the axis of the magnetic field is tilted with respect to the rotation axis D. the axis of the magnetic field points at the companion star

8. Neutron stars in orbit around another star are especially important because that circumstance gives astronomers the chance to measure what property of the neutron star? A. radius **B. mass** C. magnetic field D. X-rays

9. If a neutron star accretes matter from a binary companion star and the magnetic poles of the neutron star are tilted with respect to the rotation axis, we expect to see: A. X-rays emitted at a steady rate **B. X-ray pulses** C. gamma-ray pulses D. radio pulses

10. If a neutron star accretes matter from a companion star, the radiation emitted from the surface of the neutron star is expected to be: A. radio B. optical C. ultraviolet **D. X-ray**

11. Soft gamma-ray repeaters are thought to generate huge bursts of energy when A. they accrete matter from a companion star **B. their magnetic fields are drastically rearranged** C. the magnetic pole points toward the Earth D. an iron core collapses

12. If a neutron star accretes matter from a binary companion star and the magnetic poles of the neutron star are aligned with respect to the rotation axis, we expect to see: **A. X-rays emitted at a steady rate** B. X-ray pulses C. gamma-ray radiation D. no radiation

13. The basic concept behind Einsteins theory of gravity is that: A. straight lines are curved **B. space is curved in a special way by gravitating objects** C. initially parallel lines must remain parallel D. there is a force of attraction between any two masses

14. A conceptual problem with Newtons theory of gravity is that: A. gravity seems to act as if all the matter were concentrated at the center of a star B. it means space is curved C. gravity would have to travel at the speed of light **D. gravity would be infinitely strong for the overlapping electrons in a white dwarf.**

15. The process of parallel propagation will always give: A. parallel lines that remain parallel B. triangles the sum of interior angles of which are exactly 180 C. curved space **D. the shortest distance between two points**

16. The "dimension" of a space is: **A. the number of mutually perpendicular directions in it** B. one more than the dimension of the corresponding hyperspace C. two D. three

17. An example of hyperspace with respect to the surface of a balloon is: A. a point on the surface of the balloon B. a line on the surface of the balloon C. the surface of the balloon within a class room **D. the interior volume of the balloon**

18. Flat space must have: A. two dimensions B. three dimensions **C. the property that initial parallel lines remain parallel** D. initially parallel lines that eventually cross or diverge

19. Embedding diagrams are designed to help explain: A. how 2-dimensional space is curved B. how space is 2-dimensional **C. how 3-dimensional space is curved** D. how space is 4-dimensional

20. What do we have to know about hyperspace to determine the curvature of the three-dimensional space in which we exist? **A. nothing** B. how to construct straight lines in that hyperspace C. the curvature of the hyperspace D. the dimensions of the hyperspace

21. On the surface of a sphere, I draw a point and then draw a circle of radius, r, and circumference, C, all points of which are equally distant from the first point. Which of the following describes the nature of that circle? A. the circumference is on the surface, but the radius is in hyperspace B. C is equal to $2\pi r$ **C. C is less than** $2\pi r$ D. C is greater than $2\pi r$

22. In a two-dimensional embedding diagram, the event horizon of a black hole would be represented by a: A. point **B. line** C. surface D. volume

23. According to Einstein: A. the Sun exerts a force on the Earth, causing the Earth to orbit the Sun **B. the Earth is going as straight as it can in the curved space around the Sun** C. the Sun and the Earth each have singularities at their centers D. the Earth and the Sun each have event horizons

24. Suppose scientists were to construct a circle of given circumference around the Sun and another circle of the same circumference around the Earth. What can you say about the relation of those two circles? A. the radius of both circles is the same **B. the radius of the circle around the Sun is larger** C. the radius of the circle around the Earth is larger D. the circumference is larger than 2r for both circles

25. The singularity in the center of a black hole is predicted by Einsteins theory to be the place where: **A. space and time come to an end** B. everything, even light, must move inward C. 3D space joins onto hyperspace D. objects falling in would seem to hover

26. The event horizon around a black hole is the place where: A. gravity is strongest B. tidal forces would tear apart a human body **C. light is trapped** D. space and time come to an end

27. According to Einstein, falling occurs because: A. gravitating objects exert a force on objects near them B. time is curved C. freely-falling objects have a force on them **D. empty, curved space around a gravitating object flows inward.**

28. Objects falling into a black hole become thinner because: A. time passes more slowly on the bottom than on the top **B. all points on an object tend to fall directly toward the center of the gravitating object** C. the action of gravity is to compact any object along the direction toward the center of the gravitating object D. black holes exert tidal forces whereas ordinary stars do not

29. If a strobe light emitting very bright regular flashes of light falls toward a black hole, then an astronomer watching from a distance would see: A. an increasing time between flashes of steady brightness B. a decreasing time between flashes of steady brightness **C. an increasing time between dimmer flashes** D. a constant time between dimmer flashes

30. Far from a black hole, space is A. highly curved **B. flat** C. two-dimensional D. four-dimensional

31. In her own frame of reference, a volunteer who falls into a black hole will: A. sense that she is aging more rapidly than normal B. sense that she is aging more slowly than normal **C. be noodleized and die** D. sense that her flashlight is getting dimmer

32. Compared to people on the Earths surface, an astronaut on the International Space Station is aging: A. at different rates depending on the time of the day B. at the same rate C. slower **D. faster**

33. What technology depends on Einsteins theory of gravity? A. cell phones B. Facebook C. Twitter **D. GPS**

Extra Credit Questions: Write in this space on the exam. (One Point Apiece)

1. According to a recent announcement from the Texas supernova group, what type of supernovae was observed to collide with a binary companion star?

1. **Type Ia**

2. What type of astronomical object was recently announced to be the largest ever discovered?

2. **Supermassive Black Hole**