AST 309N (Cosmic Catastrophies), Spring 2016, Exam 2, Form A

March 1, 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. Which portion of a star with the mass of the Sun would be supported by quantum pressure? A. the center, when on the main sequence B. in the red giant envelope that forms after the main sequence **C. the center, when a core of carbon and oxygen forms** D. the center, when an iron core forms

2. Isaac Newton invented a modern form of calculus to show that gravity on the surface of a star depends on the mass of the star and the distance: A. between electrons **B. from the center of the star** C. to the next star D. from the surface of the star

3. The fact that no two electrons can occupy the same place with the same energy is related to: A. thermal pressure B. the uncertainty principal **C. the exclusion principal** D. gravity

4. When particles like electrons are squeezed tightly together they acquire more energy that is related to: **A. the uncertainty principal** B. the exclusion principal C. gravity D. thermal pressure

5. A critical difference between a star supported by thermal pressure and a star supported by quantum pressure is that: A. a star supported by quantum pressure can undergo nuclear burning and one supported by thermal pressure cannot B. a star supported by thermal pressure can undergo nuclear burning and one supported by quantum pressure cannot C. a star supported by quantum pressure can regulate its temperature and one supported by thermal pressure cannot **D. a star supported by thermal pressure can regulate its temperature and one supported by quantum pressure cannot**

6. A critical difference between thermal pressure and quantum pressure is that: **A. thermal pressure depends on temperature and quantum pressure does not** B. quantum pressure depends on temperature and thermal pressure does not C. thermal pressure can support a star and quantum pressure cannot D. quantum pressure can support a star and thermal pressure cannot

7. Which star will get cooler with time? A. the Sun while it is on the main sequence B. a star with 10 times the mass of the Sun while it is on the main sequence C. Betelgeuse **D. the white dwarf orbiting Sirius**

8. Students running rapidly around the front of the lecture hall represent: **A. thermal pressure** B. quantum pressure C. gravity D. neutrinos

9. The force that tends to prevent atomic nuclei from colliding in the gas of a star is: A. gravity **B. charge repulsion** C. the exclusion force D. quantum pressure

10. The force that holds neutrons and protons together in the nucleus of an atom is: **A. the strong nuclear force** B. the weak nuclear force C. thermal pressure D. charge repulsion

11. If a star supported by the thermal pressure is not undergoing any nuclear burning it will: A. contract and cool off **B. contract and heat up** C. expand and cool off D. expand and heat up

12. To overcome the effects of charge repulsion and initiate nuclear burning, stars must become: A. supported by the quantum pressure B. iron C. more massive **D. hotter**

13. Which element has the most tightly bound arrangement of protons and neutrons in its nucleus? A. helium B. carbon **C. iron** D. uranium

14. Carbon must be hotter than helium in order to undergo thermonuclear burning in stars because: A. carbon has more neutrons then helium B. carbon has less protons than helium **C. carbon has more protons than helium** D. carbon has more electrons than helium

15. A massive star will collapse inward when it forms a central core: A. supported by thermal pressure B. supported by quantum pressure C. of carbon and oxygen **D. of iron**

16. Massive stars, those with more then 12 solar masses on the main sequence, develop layers of ever heavier elements because they are always supported by: **A. thermal pressure** B. quantum pressure C. the strong nuclear force D. charge repulsion

17. Neutrinos interact with matter by means of: A. charge repulsion B. quantum pressure C. the strong nuclear force **D. the weak nuclear force**

18. What particles are created when an iron core collapses? A. electrons **B. neutrinos** C. protons D. carbon atoms

19. Type II, Type Ib and Type Ic supernovae undergo explosions by the same basic mechanism because they all arise in stars: **A. supported by the thermal pressure until they collapse** B. supported by the quantum pressure until they collapse C. with red giant envelopes D. without red giant envelopes

20. What is the importance of neutrinos in massive stars? A. they cause the collapse of the iron core **B. they carry off most of the energy of iron core collapse** C. they provide quantum pressure D. they convert protons into electrons

21. The collapse of an imploding iron core is stopped because: A. neutrinos are emitted B. electrons combine with protons C. at short distance protons repel one another **D. at short distance neutrons repel one another**

22. A neutron star is about the same distance across as: A. the Earth B. Texas **C. Austin** D. the UT campus

23. A neutron star would establish a special direction in space along which energy could flow if the neutron star: **A. rotates** B. is magnetic C. traps neutrinos D. emits neutrinos

24. A newly-formed neutron star is dense enough to temporarily trap neutrinos. This means that: A. a standing shock will form at some distance from the neutron star B. a black hole will form **C. the trapped neutrinos can leak out later and enhance the explosion** D. energy will be focused into a jet

25. Magnetic lines of force have the property that they: A. produce thermal pressure B. produce quantum pressure **C. can wrap around in a rotating star** D. cause stars to rotate

26. In the "bagel and breadstick" picture predicted for a jet-induced supernova, the bagel represents the: A. direction that neutrons flow B. direction of the jets C. effect of shock waves colliding along the rotation axis **D. effect of shock waves colliding along the equator**

27. Both core-collapse supernovae and Type Ia supernovae involve iron in important ways. The difference is that: A. iron triggers the explosion in white dwarfs B. iron is endothermic in core-collapse but exothermic in exploding white dwarfs C. iron is formed before the explosion in the Type Ia **D. iron is formed during the explosion in the Type Ia**

28. Which type of supernova is not powered by falling inward? A. Type II **B. Type Ia** C. Type Ib D. Type Ic

29. Type Ia supernovae show silicon early and iron later. This means: A. the explosion makes silicon before it makes iron B. the iron was in the star before it exploded **C. the silicon is on the outside** D. the silicon is on the inside

30. Temperature is important in the explosion of white dwarfs because it: A. provides the pressure to support the star **B. helps to overcome charge repulsion and start carbon burning** C. causes the iron core to collapse D. allows them to shine before they explode

31. Why does a subsonic thermonuclear deflagration alone fail to account for the observations of a Type Ia supernova? **A. the ejected matter would contain too much carbon** B. a neutron star would be left behind C. all the ejected matter would be iron D. the ejected matter would have silicon and magnesium on the outside

32. Exploding stars expand at about the speed of: A. a deflagration B. a detonation C. light **D. sound in the exploding material**

33. Why does a supersonic thermonuclear detonation alone fail to account for the observations of a Type Ia supernova? A. a neutron star would be left behind B. the ejected matter would have silicon and magnesium on the outside C. the ejected matter would contain too much carbon **D. all the ejected matter would be iron**

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

1. What telescope was used to detect the biggest black hole ever?

1. **Hubble**

2. What was the HUGE NEWS announced on Thursday, February 11?

2. **Gravitonal waves**