BROCK UNIVERSITY

Test 1: February 2019
Course: ASTR 1P02, Section 2
Examination date: 2 February 2019
Time of Examination: 11:30 – 12:20

Number of pages: 10
Number of students: 1299
Time limit: 50 min
Instructor: S. D'Agostino

Answer all questions on the scantron sheet provided. No aids permitted except for a non-programmable calculator. Each question is worth 1 mark. Total number of marks: 50.

DO NOT WRITE YOUR ANSWERS ON YOUR QUESTION PAGE. DOING SO WILL RESULT IN AN ASSIGNED GRADE OF ZERO.

1. The centre of the Milky Way, from the Earth's reference point, is in the direction of the constellation
   (a) Aries.
   (b) Taurus.
   (c) Ophiuchus.
   (d) Sagittarius.
2. The number of stars in the Milky Way is approximately
   (a) 100 thousand
   (b) 100 million
   (c) 100 billion
   (d) 100 trillion
3. Population I stars are typically found in the Milky Way's
   (a) spiral arms, have approximately circular orbits, and have relatively high heavy-element content.
   (b) spiral arms, have approximately circular orbits, and have relatively low heavy-element content.
   (c) halo and bulge, have eccentric orbits, and have relatively low heavy-element content.
   (d) halo and bulge, have eccentric orbits, and have relatively high heavy-element content.

4. Main-sequence stars produce radiant energy primarily by
   (a) chemical reactions in their hot cores.
   (b) burning of combustible materials in their hot cores.
   (c) nuclear fission.
   (d) nuclear fusion.
   (e) [There is not enough information; it depends on the mass of the star.]
5. The Sun began its life as a
   (a) cold, dark cloud of gas.
   (b) white dwarf.
   (c) red giant.
   (d) neutron star.
   (e) quasar.
6. During the very early stages in the formation of a protostar, clumps of gas are
   (a) compressed and cooled.
   (b) compressed and heated.
   (c) expanded and cooled.
   (d) expanded and heated.
7. T Tauri stars are examples of
   (a) Bok globules.
   (b) Cepheid variables.
   (c) Herbig-Haro objects.
   (d) protostars.
8. The proton-proton chain is the primary means for fusing hydrogen into helium in
   (a) low-mass main-sequence stars.
   (b) high-mass main-sequence stars.
   (c) yellow giant stars.
   (d) red giant stars.
9. Main-sequence stars with masses less than 0.4 solar masses are
   (a) brown dwarfs.
   (b) red dwarfs.
   (c) yellow dwarfs.
   (d) white dwarfs.

10. Period-luminosity relationships for stars such as Cepheid variables give astronomers a powerful tool for measuring

    (a) distances to other galaxies.
    (b) the core pressure of a star.
    (c) the surface gravity of a star.
    (d) the emission spectrum of a star.
    (e) the absorption spectrum of a star.

11. A planetary nebula is a cloud of gas and dust surrounding

    (a) a Jovian planet.
    (b) a terrestrial planet.
    (c) an exoplanet.
    (d) a dwarf planet.
    (e) [None of the above.]

12. The CNO cycle is the primary means for fusing hydrogen into helium in

    (a) low-mass main-sequence stars.
    (b) high-mass main-sequence stars.
    (c) white dwarf stars.
    (d) Type II supernovae.

13. The formation of "heavy elements" (nucleosynthesis) occurs primarily during

    (a) heavy weather on white dwarf stars.
    (b) the collapse of a protostar to form a main-sequence star.
    (c) the collapse of the upper atmosphere of a medium-mass star.
    (d) the collapse of the core of a high-mass star.

14. The distances to the most distant galaxies are found using

    (a) Type Ia supernovae.
    (b) Type II supernovae.
    (c) Cepheid variables.
    (d) T Tauri stars.

15. An accretion disk is formed from

    (a) the core collapse of a red giant.
    (b) gas flowing from a companion star towards a white dwarf.
    (c) clumping in a planetary nebula.
    (d) clumping in a giant molecular cloud.

16. Most of the energy produced in Type II supernovae explosions is carried away by
    (a) neutrinos.
    (b) protons.
    (c) radio waves.
    (d) visible light.
    (e) X-rays.
17. The surface temperature of a white dwarf is typically
    (a) less than the Sun's surface temperature.
    (b) about the same as the Sun's surface temperature.
    (c) greater than the Sun's surface temperature.
18. The density of a white dwarf is typically
    (a) about the same as the Sun's density.
    (b) about the same as the Earth's density.
    (c) about the same as Jupiter's density.
    (d) about the density of solid rock.
    (e) [None of the above.]
19. In a white dwarf, equilibrium is maintained by a balance of
    (a) core temperature and core mass.
    (b) core temperature and core pressure.
    (c) electronegativity pressure and electron degeneracy pressure.
    (d) electronegativity pressure and gravity.
    (e) electron degeneracy pressure and gravity.
20. If the mass of a neutron star were to suddenly increase to greater than about 3 solar masses, then it would
    (a) explode into a Type II supernova.
    (b) explode into a Type Ib supernova.
    (c) collapse into a black hole.
    (d) become a T Tauri or Mira variable star.

21. The period-luminosity relationship for Cepheid variable stars was first observed by

    (a) Nicholas Copernicus in 1538.
    (b) Isaac Newton in 1794.
    (c) Henrietta Swan Leavitt in 1912.
    (d) Edwin Hubble in 1987.

22. The first reasonably good approximation for the size of the Milky Way was determined by

    (a) Svetožar Gligorić.
    (b) Stephen Hawking.
    (c) Theodore Roosevelt.
    (d) Vera Rubin.
    (e) Harlow Shapley.

23. The first reasonably good approximation for the size of the Milky Way was determined by measuring the distances to

    (a) giant molecular clouds.
    (b) globular star clusters.
    (c) pulsars.
    (d) comets.

24. The age of the Milky Way is approximately

    (a) 9 million to 13 million years old.
    (b) 9 billion to 13 billion years old.
    (c) 9 trillion to 13 trillion years old.
    (d) 9 zillion to 13 zillion years old.

25. One way astronomers deduce that the Milky Way has a disk-like shape is that they observe

    (a) stars moving in a circle about the North Celestial Pole.
    (b) large spinning clouds of dust and gas that must be flat.
    (c) about the same number of stars in all directions.
    (d) the great majority of stars in a band that encircles us.

26. The diameter of a neutron star is typically about

    (a) half the diameter of the Sun.
    (b) the diameter of Jupiter.
    (c) the diameter of the Earth.
    (d) the diameter of the Moon.
    (e) [None of the above.]

27. The Crab Nebula is a

    (a) good place for fishing.
    (b) planetary nebula.
    (c) supernova remnant.
    (d) globular star cluster.

28. We detect regularly-spaced pulses of electromagnetic radiation from pulsars due to their

    (a) rhythmic increases and decreases in size.
    (b) nearly constant rotation rates.
    (c) regular volcanic eruptions.
    (d) regular prominences.

29. Binary pulsars emit _____ that can be used to test _____ .

    (a) electromagnetic waves / Planck's theory of blackbody radiation
    (b) gravitational waves / Einstein's theory of general relativity
    (c) magnetohydrodynamic waves / Alfven's theory of plasma oscillations
    (d) shock waves / Mach's theory of ultrasonic oscillations

30. A binary system that includes _____ that has a mass of at least 3 solar masses provides strong evidence for the existence of a black hole.

    (a) a spiral galaxy and an invisible neutron emitter
    (b) a Seyfert galaxy and an invisible gamma-ray emitter
    (c) an elliptical galaxy and an invisible positron emitter
    (d) an ordinary star and an invisible X-ray emitter

31. That the Milky Way is made up of an enormous number of individual stars was confirmed by Galileo in 1609, but was first suggested by

    (a) Anaxagoras and Democritus in 400 BCE.
    (b) Manfredo the Elder in 1260.
    (c) Tycho Brahe in 1583.
    (d) William and Caroline Herschel in 1785.

32. The electromagnetic radiation emitted by a pulsar is due to charged particles spiralling about

    (a) gravitational field lines.
    (b) electric field lines.
    (c) magnetic field lines.
    (d) [None of the above.]

33. The diameter of a white dwarf is typically about

    (a) half the diameter of the Sun.
    (b) the diameter of Jupiter.
    (c) the diameter of the Earth.
    (d) the diameter of the Moon.
    (e) [None of the above.]

34. When a type Ia supernova explodes, it leaves behind

    (a) a white dwarf as a central remnant.
    (b) a neutron star as a central remnant.
    (c) a black hole as a central remnant.
    (d) no central remnant.
    (e) [Either (b) or (c) could occur.]

35. When a type II supernova explodes, it leaves behind

    (a) a white dwarf as a central remnant.
    (b) a neutron star as a central remnant.
    (c) a black hole as a central remnant.
    (d) no central remnant.
    (e) [Either (b) or (c) could occur.]

36. The Schwarzschild radius is

    (a) the smallest possible radius of a white dwarf.
    (b) the smallest possible radius of a neutron star.
    (c) the radius of the region around a neutron star within which X-ray bursts occur.
    (d) the radius of the region around a black hole within which not even light can escape.

37. The youngest stars are plotted in this part of the H-R diagram.
    (a) upper-left corner
    (b) upper-right corner
    (c) lower-left corner
    (d) upper-right corner
    (e) near the centre

38. For a star in hydrostatic equilibrium, energy is transported in the star primarily by
    (a) conduction and convection.
    (b) conduction and radiation.
    (c) convection and radiation.
    (d) conduction, convection, and radiation.
    (e) [None of the above.]

39. In the Sun, the convective zone is
    (a) near the surface of the Sun.
    (b) near the core of the Sun.
    (c) about mid-way between the core and the surface of the Sun.
    (d) throughout the entire Sun.
    (e) [The Sun has no convective zone.]

40. Emission nebulae appear
    (a) transparent.
    (b) red.
    (c) blue.
    (d) green.

41. High temperatures and pressures are required to produce nuclear reactions because this helps
    (a) convince atomic nuclei to get to know each other.
    (b) atomic nuclei attract each other.
    (c) to overcome the electrical repulsion between atomic nuclei.
    (d) to overcome the gravitational attraction between atomic nuclei.

42. Giant molecular clouds have a diameter of about

    (a) 15 km to 600 km.
    (b) 15 AU to 600 AU.
    (c) 15 light years to 600 light years.
    (d) [None of the others; it is the molecules that are giant, not the clouds.]

43. As a main-sequence star evolves, steadily converting hydrogen to helium in its core, the core of the star gradually

    (a) becomes cooler and contracts.
    (b) becomes cooler and expands.
    (c) becomes hotter and expands.
    (d) becomes hotter and contracts.
    (e) [There is no change in the core temperature and size.]

44. As a main-sequence star evolves, steadily converting hydrogen to helium in its core, the outer layers of the star gradually

    (a) become cooler and contract.
    (b) become cooler and expand.
    (c) become hotter and expand.
    (d) become hotter and contract.
    (e) [There is no change in the temperature and size of the outer layers.]

45. Stars are formed in

    (a) giant molecular clouds.
    (b) black holes.
    (c) protostars.
    (d) intergalactic nurseries.
    (e) white holes.

46. Most of the Milky Way's younger stars are found in its
    (a) cone.
    (b) cylinder.
    (c) disk.
    (d) halo and bulge.
    (e) helix.

47. Most of the Milky Way's stars that have a relatively high concentration of heavy elements are found in its
    (a) cone.
    (b) cylinder.
    (c) disk.
    (d) halo and bulge.
    (e) helix.

48. Most of the Milky Way's stars that have a relatively low concentration of heavy elements are found in its
    (a) cone.
    (b) cylinder.
    (c) disk.
    (d) halo and bulge.
    (e) helix.

49. Population II stars are typically found in the Milky Way's
    (a) spiral arms, have approximately circular orbits, and have relatively high heavy-element content.
    (b) spiral arms, have approximately circular orbits, and have relatively low heavy-element content.
    (c) halo and bulge, have eccentric orbits, and have relatively low heavy-element content.
    (d) halo and bulge, have eccentric orbits, and have relatively high heavy-element content.

50. Most of the Milky Way's older stars are found in its
    (a) cone.
    (b) cylinder.
    (c) disk.
    (d) halo and bulge.
    (e) helix.