BROCK UNIVERSITY

Test 1: June 2019
Course: ASTR 1P02, Section 1
Examination date: 22 June 2019
Time of Examination: 12:00 – 12:50

Number of pages: 9
Number of students: 347
Time limit: 50 min
Instructor: S. D'Agostino

Answer all questions on the answer 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 interstellar medium is

   (a) 99% dust.
   (b) * 99% gas.
   (c) composed of about equal parts gas and dust.
   (d) [None of the above.]

2. Astronomers estimate that a supernova explodes in our galaxy about once every

   (a) year.
   (b) * hundred years.
   (c) million years.
   (d) billion years.

3. About 90% of cosmic rays are

   (a) electrons.
   (b) gamma rays.
   (c) neutrons.
   (d) * protons.

4. The next stage in the Sun's evolution is that it will become a red giant. This will happen once about _____ of the hydrogen in the Sun's core has been consumed.

   (a) 20%
   (b) 50%
   (c) * 90%
   (d) 100%

5. Type Ia supernovae

   (a) have hydrogen spectral lines in their spectra.
   (b) * do not have hydrogen spectral lines in their spectra.

6. Type II supernovae

   (a) * have hydrogen spectral lines in their spectra.

   (b) do not have hydrogen spectral lines in their spectra.

7. Protostars begin to form in interstellar clouds of gas and dust that are

   (a) * much colder than the Earth's surface.

   (b) about as hot as the Earth's surface.

   (c) about as hot as the surface of a main-sequence star.

   (d) much hotter than the surface of a main-sequence star.

8. It is likely that cosmic rays originate

   (a) outside of our galaxy.

   (b) * within our galaxy, but outside of our solar system.

   (c) within our solar system, but outside the Earth.

   (d) within the Earth.

9. 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.

10. The coolest main-sequence stars are

    (a) * red.

    (b) yellow.

    (c) white.

    (d) blue.

11. A plausible explanation for dark matter in our galaxy is that it consists of concentrations of ionized hydrogen atoms.

    (a) True.

    (b) * False.

12. 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.

13. 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.

14. Comparing high-mass stars to medium-mass stars, the high-mass stars have _____ core density, and their cores are_____ .

    (a) greater / cooler

    (b) * greater / hotter

    (c) lesser / cooler

    (d) lesser / hotter

15. The typical spacing between stars in the neighbourhood of our Sun is about

    (a) a few AU.

    (b) a few hundred AU.

    (c) * a few light years.

    (d) a few hundred light years.

16. 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.

17. 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.

18. 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.

19. 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.

20. A mass of about 1.4 solar masses is the maximum mass for a

    (a) giant molecular cloud.
    (b) neutron star.
    (c) protostar.
    (d) red giant star.
    (e) * white dwarf star.

21. The more massive a protostar is _____ is needed for the protostar to become a main-sequence star.

    (a) * the less time
    (b) the more time
    (c) [There is no relation between the mass of a protostar and how much time is needed to reach the main sequence.]

22. 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.

23. The typical lifetime of a star is

    (a) shorter than a typical human lifetime.
    (b) about the same as a typical human lifetime.
    (c) * longer than a typical human lifetime.

24. The radius of a neutron star is typically about

    (a) 0.1 km.
    (b) * 10 km.
    (c) 1000 km.
    (d) 100,000 km.

25. 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.

26. 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.

27. A red giant has _____ than the Sun.

    (a) higher core temperature and higher average density

    (b) * higher core temperature and lower average density

    (c) lower core temperature and higher average density

    (d) lower core temperature and lower average density

28. 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.

29. The emission of X-rays by an invisible component (having a mass of at least $3M_{\odot}$) of a binary system that also includes a normal star is strong evidence for the existence of

    (a) * a black hole.

    (b) a neutron star.

    (c) a quasar.

    (d) a white dwarf.

30. Planetary nebulae are formed

    (a) from bombardment by meteorites.

    (b) in a way similar to the way planetary ring systems form.

    (c) when planets collide.

    (d) when planets form too close together.

    (e) * [None of the above.]

31. The evolution of a star with mass of 100 times the Sun's mass will eventually include

    (a) frequent stops at galactic pizza joints.
    (b) becoming a green dwarf.
    (c) becoming a red dwarf.
    (d) * becoming a supernova.
    (e) [None of the above.]

32. The idea of a black hole was first suggested by

    (a) Arno Penzias and Robert Wilson in the 1960s.
    (b) Fritz Zwicky and Edwin Hubble in the early 1900s.
    (c) * John Michell and Pierre Simon Laplace in the late 1700s.
    (d) Johannes Kepler and Galileo Galilei in the early 1600s.
    (e) Aristarchus and Aristotle in the 300s BC.

33. In low-mass stars, significant helium fusion takes place

    (a) before significant hydrogen fusion begins.
    (b) * after significant hydrogen fusion ends.

34. The Crab Nebula is a

    (a) good place for fishing.
    (b) planetary nebula.
    (c) * supernova remnant.
    (d) giant molecular cloud.

35. In medium-mass stars, significant fusion of uranium occurs while the star is

    (a) ending its protostar phase and reaching the main sequence.
    (b) in its stable main-sequence phase.
    (c) during the star's helium flash.
    (d) during the star's red giant phase.
    (e) * [None of the above.]

36. The first astronomer to observe that the Milky Way consists of a very large number of faint stars was

    (a) Tycho Brahe.
    (b) Nicolas Copernicus
    (c) * Galileo Galilei.
    (d) Johannes Kepler.
    (e) Isaac Newton.

37. In the triple-alpha process,

    (a) * helium nuclei are fused to produce carbon nuclei.
    (b) hydrogen nuclei are fused to produce lithium nuclei.
    (c) oxygen nuclei are fused to produce silicon nuclei.
    (d) wicca nuclei are fused to produce alchemy nuclei.
    (e) [None of the above.]

38. 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.

39. _____ determined our location in the Milky Way by measuring the distances to _____ .

    (a) Fritz Zwicky / globular clusters
    (b) * Harlow Shapley / globular clusters
    (c) Edwin Hubble / open clusters
    (d) Jacobus Kapteyn / open clusters

40. Objects that have smaller diameters than brown dwarfs include

    (a) Cepheid variables.
    (b) quasars.
    (c) red dwarfs.
    (d) T-Tauri stars.
    (e) * [None of the above.]

41. At maximum brightness, the most luminous supernovae have luminosities that are about _____ the luminosity of the Sun.

    (a) 10
    (b) 10 thousand
    (c) 10 million
    (d) * 10 billion
    (e) [None of the above.]

42. Interstellar extinction refers to

    (a) * the attenuation or absorption of light by dust in the interstellar medium.

    (b) the deaths of certain very rare pink or purple stars.

    (c) the elimination of certain zones of the interstellar medium by comets sweeping it up with their tails.

    (d) Earth satellites losing contact once they reach the outer edges of the solar system.

    (e) [None of the above.]

43. 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.

44. 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.

45. The idea that the Milky Way is approximately disk-like was first proposed by

    (a) Jocelyn Bell in the 1900s

    (b) Jacobus Kapteyn in the 1900s

    (c) Sir William Herschel in the 1800s

    (d) * Thomas Wright and Immanuel Kant in the 1700s

46. 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.

47. 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.

48. Molecules such as water, ammonia, and ethanol are found in cold interstellar gas clouds.

    (a) * True
    (b) False

49. Radio waves with a wavelength of 21 cm are very important for observational astronomy, and are emitted by

    (a) hot clouds of hydrogen gas.
    (b) * cold clouds of hydrogen gas.
    (c) quasars.
    (d) pulsars.

50. The centre of the Milky Way

    (a) can be seen clearly from the Earth.
    (b) * is obscured by clouds of dust.
    (c) can be seen clearly from Earth only during certain seasons.