BROCK UNIVERSITY

Test 1: February 2018
Course: ASTR 1P02, Section 2
Examination date: 3 February 2018
Time of Examination: 13:00 – 13:50

Number of pages: 9
Number of students: 1200
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. Main-sequence stars convert matter to energy primarily by
   (a) * nuclear fusion.
   (b) nuclear fission.
   (c) radioactivity.
   (d) nuclear magnetic resonance.
   (e) [There is not enough information; it depends on the mass of the star.]

2. The rate at which a main-sequence star evolves depends primarily on
   (a) Darwin's descent of stellar species.
   (b) the number of the star's sunspots.
   (c) * the mass of the star.
   (d) the rate of neutrino convection in the star's core.

3. Main-sequence stars are in hydrostatic equilibrium, which means a balance between a star's
   (a) hydrogen and helium isotopes.
   (b) hydraulic and static forces.
   (c) rotational hydrodynamical forces and radial magnetostatic forces.
   (d) * inward gravitational forces and outward forces due to core pressure.

4. If the mass of Star A is greater than the mass of Star B, then the main-sequence lifetime of Star A is ___________ the main-sequence lifetime of Star B.
   (a) * less than
   (b) about the same as
   (c) greater than
   (d) [There is not enough information given; the lifetime of a star also depends on its spectral topology.]

5. The youngest main-sequence stars are found in this part of the H-R diagram.
    (a) * the upper-left corner
    (b) the upper-right corner
    (c) the lower-left corner
    (d) the lower-right corner
    (e) near the centre
6. A cloud of gas and dust that can be observed at visible wavelengths is called
    (a) a visible molecular cloud.
    (b) an Oort cloud.
    (c) * a nebula.
    (d) an accretion disk.
7. A young star is typically
    (a) at risk of appearing in a *TMZ* headline.
    (b) surrounded by an entourage.
    (c) * surrounded by a cloud of gas and dust.
    (d) surrounded by white dwarfs.
    (e) surrounded by neutron stars.
8. Protostars begin to form in interstellar clouds of gas and dust that are
    (a) much hotter than the surface of a main-sequence star.
    (b) about as hot as the surface of a main-sequence star.
    (c) about as hot as the Earth's surface.
    (d) * much colder than the Earth's surface.
9. Dark nebulae emit primarily
    (a) visible light.
    (b) X-rays.
    (c) * infrared light.
    (d) dark matter.
10. Emission nebulae appear
    (a) blue.
    (b) green.
    (c) yellow.
    (d) * red.
    (e) [None of the above.]

11. Reflection nebulae appear
    (a) * blue.
    (b) green.
    (c) yellow.
    (d) red.
    (e) [None of the above.]
12. The least massive main-sequence stars are
    (a) * red.
    (b) yellow.
    (c) white.
    (d) blue.
13. The diameter of a giant molecular cloud is typically between about
    (a) 15 km and 600 km.
    (b) 15 thousand km and 600 thousand km.
    (c) 15 million km and 600 million km.
    (d) * 15 light years and 600 light years.
14. 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.
15. The average distance between stars in the Milky Way is
    (a) about the same as the average diameter of a star.
    (b) about 10 times greater than the average diameter of a star.
    (c) about 10 thousand times greater than the average diameter of a star.
    (d) * about 10 million times greater than the average diameter of a star.
16. The proton-proton chain is the primary way that
    (a) energy is transmitted by supernovae into space.
    (b) energy is transported from the core of a high-mass star to its surface.
    (c) * low-mass stars fuse hydrogen into helium.
    (d) high-mass stars fuse hydrogen into helium.

17. The CNO cycle is the primary way that
    (a) energy is transmitted by supernovae into space.
    (b) energy is transported from the core of a high-mass star to its surface.
    (c) low-mass stars fuse hydrogen into helium.
    (d) * high-mass stars fuse hydrogen into helium.
18. The triple-alpha process is the primary way that
    (a) energy is transmitted by white dwarfs into space.
    (b) energy is transported from the core of a low-mass star to its surface.
    (c) stars like the Sun fuse hydrogen into helium.
    (d) * stars like the Sun fuse helium into carbon.
19. The pressure in the core of a star is ________ than the pressure near the surface of a star.
    (a) much less than
    (b) about the same as
    (c) * much greater than
    (d) [It depends on the mass of the star.]
20. The temperature in the core of a star is ________ than the temperature near the surface of a star.
    (a) much less than
    (b) about the same as
    (c) * much greater than
    (d) [It depends on the mass of the star.]
21. A planetary nebula surrounds
    (a) a planet such as Saturn, which has rings.
    (b) a supernova.
    (c) a neutron star.
    (d) * a white dwarf.
22. The maximum mass for a white dwarf is about ________ solar masses.
    (a) * 1.4
    (b) 14
    (c) 140
    (d) 1400
    (e) [There is apparently no maximum mass for a white dwarf.]

23. Electron degeneracy pressure is the primary way that
    (a) main-sequence stars maintain hydrostatic equilibrium.
    (b) supernovae produce the enormous amount of energy needed for them to explode.
    (c) black holes are produced.
    (d) * white dwarfs are supported against gravitational collapse.

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. Degenerate matter has unusual properties different from normal matter. For example, in a degenerate star,
    (a) the greater the mass, the smaller the radius.
    (b) the pressure does not depend on temperature, but only on density.
    (c) the density is enormous compared to ordinary stars.
    (d) * [All of the above.]
    (e) [None of the above.]

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 binary star system consisting of a normal star and an invisible companion having a mass of at least $3M_\odot$ that is a strong source of X-rays is good indirect evidence for
    (a) dark matter.
    (b) a neutron star.
    (c) a pulsar.
    (d) * a black hole.

28. Towards the end of its life, a mature super-giant star has an inner core consisting of
    (a) carbon.
    (b) helium.
    (c) hydrogen.
    (d) * iron.

29. When pulsars were first observed by ________ the radiation they emitted was jokingly referred to as signals from ________ .
    (a) Aristarchus, after-meal emissions from the Delphic oracle
    (b) Tycho Brahe, the fifth Beatle
    (c) Fritz Zwicky, the dearly departed astronomers in the heavens
    (d) * Jocelyn Bell, little green men

30. Most of the energy in a Type II supernova explosion is carried away by
    (a) * neutrinos.
    (b) neutrons.
    (c) photons.
    (d) protons.

31. The first observational evidence for black holes was obtained by
    (a) * Tom Bolton in 1971, using the David Dunlop observatory in Richmond Hill, Ontario.
    (b) Tycho Brahe in 1702, using his mural quadrant in Hven, Denmark.
    (c) Magnus Carlsen in 1987, using the Simen Agdestein observatory in Moose Jaw, Saskatchewan.
    (d) Kevin Spraggett in 1942, using the Phil Haley observatory near Montreal, Quebec.

32. To mathematically describe the vicinity of black holes, one needs
    (a) Anand's theory of curved spacetime.
    (b) * Einstein's theory of general relativity.
    (c) Hawking's theory of black holes.
    (d) Planck's theory of blackbody radiation.

33. The design and proper functioning of GPS (global positioning system) depends on the theories of
    (a) alchemy and astrology.
    (b) quantum mechanics and magnetohydrodynamics.
    (c) * special relativity and general relativity.
    (d) thermodynamics and statistical physics.

34. Most of the Milky Way's gas and dust is found in its
    (a) bulge.
    (b) halo.
    (c) * spiral arms.
    (d) transverse axis.

35. 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.

36. That the Milky Way is generally disk-shaped was first proposed by
    (a) Patti Smith in the 17th century.
    (b) * Thomas Wright and Immanuel Kant in the 18th century.
    (c) Bob and Doug Mackenzie in the 19th century.
    (d) Guido Sarducci and Taupo Gigio in the 20th century.

37. Harlow Shapley determined our location in the Milky Way by measuring the distances to
    (a) fudge clusters.
    (b) * globular clusters.
    (c) open clusters.
    (d) closed clusters.

38. Harlow Shapley determined our location in the Milky Way by measuring certain distances using the method of ________________ pioneered by Henrietta Swan Leavitt.
    (a) * Cepheid variables
    (b) RR Lyrae variables
    (c) Mira variables
    (d) T Tauri variables

39. Leavitt's method is based on her observation that there is a relationship between ________________ for the variable stars that she studied.
    (a) * period and luminosity
    (b) luminosity and mass
    (c) mass and temperature
    (d) temperature and radius

40. The work of Harlow Shapley and Henrietta Swan Leavitt described in the previous few questions was done in the
    (a) 17th century.
    (b) 18th century.
    (c) 19th century.
    (d) * 20th century.

41. More than half of all ________ in the Milky Way are found in the direction of the constellation Sagittarius.
    (a) black holes.
    (b) * globular star clusters.
    (c) neutron stars.
    (d) pulsars.
    (e) dark matter.

42. The diameter of the Milky Way is approximately
    (a) 100 light years
    (b) 1,000 light years
    (c) 10,000 light years
    (d) * 100,000 light years

43. The material in the Milky Way's disk is
    (a) uniformly distributed.
    (b) concentrated in radial spikes.
    (c) * concentrated in spiral arms.
    (d) concentrated in exponential domains.

44. The Milky Way's halo contains
    (a) almost no gas and dust and stars that are mostly relatively hot.
    (b) * almost no gas and dust and stars that are mostly relatively cool.
    (c) a lot of gas and dust and stars that are mostly relatively hot.
    (d) a lot of gas and dust and stars that are mostly relatively cool.

45. The Milky Way's spiral arms contain
    (a) * a lot of gas and dust and many relatively hot stars.
    (b) a lot of gas and dust and very few relatively hot stars.
    (c) not very much gas and dust and many relatively hot stars.
    (d) not very much gas and dust and very few relatively hot stars.

46. "Rotation curves" for stars at various positions in the Milky Way, first measured by Vera Rubin, do not match observed luminous matter in the galaxy. This is strong evidence for the presence of

    (a) the LMC gyre, which contains an enormous number of discarded toasters and TV sets.
    (b) * dark matter in the Milky Way.
    (c) a giant black hole at the centre of the Milky Way.
    (d) an enormous number of neutrinos streaming through the Milky Way.

47. Stars in the Milky Way's halo move along

    (a) circles that lie in the disk.
    (b) circles that lie in the ecliptic plane.
    (c) highly eccentric ellipses that lie in the disk.
    (d) * highly eccentric ellipses that are randomly oriented.

48. Stars in the Milky Way that have a relatively high concentration of heavier elements are generally found in its

    (a) bulge
    (b) * disk.
    (c) halo.
    (d) bulge and halo.
    (e) bulge and disk.

49. Stars in the Milky Way that have a relatively low concentration of heavier elements are generally found in its

    (a) bulge
    (b) disk.
    (c) halo.
    (d) * bulge and halo.
    (e) bulge and disk.

50. The centre of the Milky Way is not visible because light from there is blocked by gas and dust. However, we can detect ________ emitted by the centre of the Milky Way.

    (a) gravitinos
    (b) protons
    (c) * radio waves
    (d) Z-waves