BROCK UNIVERSITY

Test 1: February 2016
Course: ASTR 1P02, Section 2
Examination date: 6 February 2016
Time of Examination: 16:30 – 17:20

Number of pages: 10
Number of students: 993
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.

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1. Main-sequence stars convert matter to energy primarily by
   (a) fusing jazzium and rockium.
   (b) * fusing hydrogen to produce helium.
   (c) fusing helium to produce hydrogen.
   (d) fusing uranium to produce solarium.
   (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. Heat flows from the core of a main-sequence star to its surface because
   (a) * the star's core temperature is greater than its surface temperature.
   (b) the vacuum outside the star's atmosphere draws the heat out from the core.
   (c) the star's core is opaque and its surface is transparent.
   (d) of neutrino oscillations in the star's core.

5. If the mass of Star A is less 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 cohomology.]
6. The Sun is expected to remain a main-sequence star for a total of about
   (a) 10 thousand years.
   (b) 10 million years.
   (c) * 10 billion years.
   (d) 10 trillion years.
7. Once about 90% of the hydrogen in the Sun's core has been consumed, the next stage in the Sun's evolution is that it will become
   (a) a supernova.
   (b) a neutron star.
   (c) a white dwarf.
   (d) * a red giant.
8. Most medium-mass stars begin their lifetimes as ______ and end their lifetimes as ______.
   (a) led zeppelins, green giants
   (b) * protostars, white dwarfs
   (c) protostars, red dwarfs
   (d) protostars, supernova remnants
9. Most high-mass stars begin their lifetimes as ______ and end their lifetimes as ______.
   (a) Shaquille O'Neal, Charles Barkley
   (b) protostars, white dwarfs
   (c) protostars, red dwarfs
   (d) * protostars, supernova remnants
10. 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.

11. During the very early stages in the formation of a protostar, clumps of gas are compressed together by
    (a) * gravitational attraction.
    (b) attraction from powerful magnetic fields.
    (c) electrostatic attraction.
    (d) gas pressure.
12. The most massive main-sequence stars are
    (a) red.
    (b) yellow.
    (c) white.
    (d) * blue.
13. In a variable star, it is variations in the star's ________ that we observe directly.
    (a) neutron emission spectrum
    (b) * brightness
    (c) core pressure
    (d) core metallicity
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. A planetary nebula is
    (a) the initial "clumping" in a giant molecular cloud, resulting in further collapse which forms a protostar.
    (b) the material falling into a dwarf star from a neighbouring star in a binary system.
    (c) * the stellar material ejected when the core of a medium-sized star collapses into a white dwarf.
    (d) the interstellar medium accreted around a large planet, eventually becoming the planet's rings.

16. Low-mass main-sequence stars fuse hydrogen into helium primarily through the
    (a) * proton-proton chain.
    (b) CNO cycle.
    (c) Krebs cycle.
    (d) thorium fusion reaction.

17. High-mass main-sequence stars fuse hydrogen into helium primarily through the
    (a) proton-proton chain.
    (b) * CNO cycle.
    (c) Krebs cycle.
    (d) thorium fusion reaction.

18. The formation of "heavy elements" (nucleosynthesis) occurs primarily during
    (a) the collapse of a tin-pot dictator dwarf.
    (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.

19. A type Ia supernova occurs because of
    (a) the core collapse of a medium-mass star.
    (b) the core collapse of a high-mass star.
    (c) * matter from a nearby star falling onto the surface of a white dwarf, becoming compressed and heated, and eventually resulting in an explosion.
    (d) matter from a nearby star falling onto the surface of a neutron star, becoming compressed and heated, and eventually resulting in an explosion.

20. A type II supernova occurs because of
    (a) the core collapse of a medium-mass star.
    (b) * the core collapse of a high-mass star.
    (c) matter from a nearby star falling onto the surface of a white dwarf, becoming compressed and heated, and eventually resulting in an explosion.
    (d) matter from a nearby star falling onto the surface of a neutron star, becoming compressed and heated, and eventually resulting in an explosion.

21. The density of a white dwarf is
    (a) much less than a main-sequence star.
    (b) about the same as the density of a main-sequence star.
    (c) * much greater than a main-sequence star.
    (d) [It depends on the white dwarf; their densities vary over a very wide range.]

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. The main factor counteracting gravity to maintain equilibrium in a white dwarf is
   (a) extremely high core temperature.
   (b) extremely high core mass.
   (c) chemical double-bond electronegativity pressure.
   (d) * electron degeneracy pressure.

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 range of observed sizes for white dwarfs is approximately
   (a) between the size of a hippopotamus and the size of Donald Trump's ego.
   (b) between the sizes of Grumpy and Bashful.
   (c) * between the radius of the Earth and twice the radius of the Earth.
   (d) between the radius of the Sun and twice the radius of the Sun.

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. Neutron stars with masses greater than about 3 solar masses do not exist because neutron degeneracy pressure is not strong enough to balance gravity, and so such a neutron star 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.

28. One type of indirect observational evidence for black holes is a binary system consisting of a normal star and

    (a) an overdribbling ball-stopper who is a weak source of assists.
    (b) * an invisible companion having a mass of at least $3M_\odot$ that is a strong source of X-rays.
    (c) an invisible companion having a mass of at least $3M_\odot$ that is a strong source of radio waves.
    (d) an invisible companion having a mass of at least $3M_\odot$ that is a strong source of microwaves.

29. A pulsar is a

    (a) pulsating variable star, such as a Cepheid variable.
    (b) a yellow giant.
    (c) * a rapidly rotating neutron star.
    (d) an oscillating galactic halo.

30. When pulsars were first observed by ________ they were jokingly referred to as signals from ________ .

    (a) Donaldus Trumpinus, bombast bursting in air
    (b) * Jocelyn Bell, little green men
    (c) Aristarchus, after-meal emissions from the Delphic oracle
    (d) Galileo, angels tap-dancing on the head of a pin

31. Black holes are called "black" because

    (a) dementors live there, so people who venture into them end up in dark moods.
    (b) they are always surrounded by thick clouds of black dust.
    (c) the event horizon of a black hole is covered with blackbodies.
    (d) * not even light can escape from the region within the black hole's event horizon.

32. The Schwarzschild radius for a 10-solar-mass black hole is about

    (a) * 30 km.
    (b) 30 thousand km.
    (c) 30 million km.
    (d) 30 billion km.

33. Although it was originally thought that black holes should emit no radiation whatsoever, applying quantum mechanics to black holes has led to the hypothesis that black holes emit minute amounts of electromagnetic radiation, called
    (a) blocking radiation.
    (b) clocking radiation.
    (c) docking radiation.
    (d) * Hawking radiation.

34. Spectral lines emitted by material close to the event horizon of a black hole appear redshifted to us because
    (a) blue light cannot escape from the region near the event horizon.
    (b) * of gravitational redshift due to the strong gravitational field near the event horizon.
    (c) of cosmological redshift due to microscopic tears in the fabric of spacetime near the event horizon.
    (d) of the Doppler effect, due to the high recession speed of the black hole.

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. The general shape of the Milky Way is
    (a) * a disk with a central bulge and a spherical halo.
    (b) a cone with a central bulge and an ellipsoidal halo.
    (c) a cylinder with a central bulge and a conical halo.
    (d) a helix with a central bulge and a spiral halo.

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) Type Ia supernovae

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. 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.

41. 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.

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
    (e) 1,000,000 light years

43. Most of the Milky Way's gas and dust is found in its
    (a) cone.
    (b) cylinder.
    (c) * disk.
    (d) halo.
    (e) helix.

44. The Sun orbits around the centre of the Milky Way about once every
    (a) 230,000 years.
    (b) 2.3 million years.
    (c) 23 million years.
    (d) * 230 million years.

45. Astronomers determine the masses of various parts of the Milky Way by
    (a) looking them up in *Wikipedia Galactica*.
    (b) carefully measuring the motions of stars and then using Newton's formulation of Kepler's first law.
    (c) carefully measuring the motions of stars and then using Newton's formulation of Kepler's second law.
    (d) * carefully measuring the motions of stars and then using Newton's formulation of Kepler's third law.

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. The average distance between stars in the Milky Way is about
    (a) * a few light years.
    (b) a few hundred light years.
    (c) a few thousand light years.
    (d) a few million light years.

48. The number of stars in the Milky Way is approximately

    (a) 100 thousand
    (b) 100 million
    (c) * 100 billion
    (d) 100 trillion

49. When light from a distant object passes through clouds of interstellar dust, the resulting light that reaches us

    (a) * is dimmer and redder.
    (b) is dimmer and bluer.
    (c) is brighter and redder.
    (d) is brighter and bluer.

50. The centre of the Milky Way appears to contain, among other things, a giant

    (a) billboard promoting Las Vegas.
    (b) * black hole.
    (c) white dwarf.
    (d) neutron star.