BROCK UNIVERSITY

Final Exam: December 2017
Course: ASTR 1P01, Section 2
Examination date: 13 December 2017
Time of Examination: 09:00 – 11:00

Number of pages: 18
Number of students: 1225
Time limit: 2 hours
Instructor: S. D'Agostino

Answer all questions on the scantron sheet provided.

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

No aids are permitted except for a non-programmable calculator. No examination aids other than those specified on the examination scripts are permitted (this regulation does not preclude special arrangements being made for students with disabilities). Translation dictionaries (e.g., English-French) or other dictionaries (thesaurus, definitions, technical) are not allowed unless specified by the instructor and indicated on the examination paper.

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Return both the exam script and your scantron sheet when you leave the exam room.

Each question is worth 1 mark. Total number of marks: 100.

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1. The radius of the Earth is
   (a) 6,400 km.
   (b) 64,000 km.
   (c) 640,000 km.
   (d) 6,400,000 km.

2. The Sun appears to rise in the _____ and set in the opposite direction because the Earth rotates from _____ .
   (a) East / East to West
   (b) East / West to East
   (c) West / East to West
   (d) West / West to East

3. The distance from the Earth to the Moon is approximately
   (a) 40,000 m.
   (b) 40,000 km.
   (c) 400,000 m.
   (d) 400,000 km.
   (e) [None of the above.]

4. The speed of light in vacuum is approximately
   (a) 300,000 km/s.
   (b) 300,000 km/min.
   (c) 300,000 km/h.
   (d) 300,000 km/year.
   (e) [much faster than any of the other alternatives listed here.]
5. The time needed for light to travel from the Earth to the Moon is about
   (a) 0.13 seconds.
   (b) 1.3 seconds.
   (c) 13.0 seconds.
   (d) 130 seconds.
6. The approximate number of stars in the Milky Way galaxy is currently thought to be
   (a) 1 trillion.
   (b) 10 trillion.
   (c) 100 trillion.
   (d) [None of the above.]
7. The Kuiper belt
   (a) had to be loosened by Mr. Kuiper towards the end of the banquet for his daughter's wedding.
   (b) contains nuclei of long-period comets.
   (c) contains nuclei of short-period comets.
   (d) is the main area of our Solar System where asteroids are found.
8. Astronomers first understood that the Earth is round
   (a) more than 2000 years ago, in the time of the ancient Greeks.
   (b) between 400 and 500 years ago, once telescopes were used to observe the heavens.
   (c) about 120 years ago, once powerful optical telescopes were developed.
   (d) about 40 years ago, once X-ray telescopes were developed.
9. Proxima Centauri
   (a) is a character in Greek mythology, with the torso of a human and the body of a horse.
   (b) played second base for the 1974 *Galactic All Stars*.
   (c) is a constellation that appears near Sagittarius in the sky.
   (d) is the star closest to the Sun.

10. The Sun's rays strike the Earth most directly on
    (a) the vernal equinox.
    (b) the summer solstice.
    (c) the autumnal equinox.
    (d) the winter solstice.
    (e) [None of the others.]
11. The Sun's rays strike the Earth least directly on
    (a) the vernal equinox.
    (b) the summer solstice.
    (c) the autumnal equinox.
    (d) the winter solstice.
    (e) [None of the others.]
12. The name of our galaxy in the English language derives from
    (a) the Arabic *halib maskub*, which means "spilled milk."
    (b) the Esperanto *teka lakto*, which means "milky tea."
    (c) the Greek *astéri thirío*, which means "starry beast."
    (d) the Latin *via lactea*, which means "milky road."
13. The Jovian planets are
    (a) Jove, Jovientum, Joviathan, and Jovanotto
    (b) Earth, Neptune, and several exoplanets.
    (c) Earth, Mars, Mercury, and Venus.
    (d) Jupiter, Neptune, Saturn, and Uranus.
14. A constellation is
    (a) a region of the Solar System that contains a large number of comets.
    (b) a region of space containing a large number of stars, such as an open cluster or a globular cluster.
    (c) a group of stars that lie in a similar direction as seen from Earth.
    (d) a group of stars that lie in the same cell of a cosmic honeycomb.
15. When the Moon rises at about sunrise, its phase is
    (a) new.
    (b) first quarter.
    (c) full.
    (d) third quarter.

16. When the Moon rises at about sunset, its phase is
    (a) new.
    (b) first quarter.
    (c) full.
    (d) third quarter.
17. When the Moon rises at about mid-day, its phase is
    (a) new.
    (b) first quarter.
    (c) full.
    (d) third quarter.
18. When the Moon rises at about midnight, its phase is
    (a) new.
    (b) first quarter.
    (c) full.
    (d) third quarter.
19. When the Moon's phase is waxing gibbous, it sets
    (a) between sunrise and mid-day.
    (b) between mid-day and sunset.
    (c) between sunset and midnight.
    (d) between midnight and sunrise.
20. When the Moon's phase is waxing crescent, it sets
    (a) between sunrise and mid-day.
    (b) between mid-day and sunset.
    (c) between sunset and midnight.
    (d) between midnight and sunrise.
21. When the Moon's phase is waning crescent, it rises
    (a) between sunrise and mid-day.
    (b) between mid-day and sunset.
    (c) between sunset and midnight.
    (d) between midnight and sunrise.

22. When the Moon's phase is waning gibbous, it rises
    (a) between sunrise and mid-day.
    (b) between mid-day and sunset.
    (c) between sunset and midnight.
    (d) between midnight and sunrise.
23. On the summer solstice in the northern hemisphere, the Sun rises
    (a) directly east.
    (b) north of east.
    (c) south of east.
    (d) [It depends on your exact location in the northern hemisphere.]
24. On the winter solstice in the northern hemisphere, the Sun rises
    (a) directly east.
    (b) north of east.
    (c) south of east.
    (d) [It depends on your exact location in the northern hemisphere.]
25. On the vernal equinox in the southern hemisphere, the Sun rises
    (a) directly east.
    (b) north of east.
    (c) south of east.
    (d) [It depends on your exact location in the southern hemisphere.]
26. In August in the northern hemisphere, the sun rises
    (a) a little further north each day.
    (b) a little further south each day.
    (c) a little further east each day.
    (d) a little further west each day.
27. In April in the northern hemisphere, the sun rises
    (a) a little further north each day.
    (b) a little further south each day.
    (c) a little further east each day.
    (d) a little further west each day.

28. The Earth is _____ the Sun in Canada's summer than it is in our winter.
    (a) much closer to
    (b) much farther from
    (c) about the same distance from

29. One of the achievements of Aristarchus is that he was the first person to determine
    (a) that the Sun is at the centre of the Solar System, not the Earth.
    (b) the size of the Earth.
    (c) the relative sizes of the Earth, Moon, and Sun.
    (d) the mass of the Moon.

30. One of the achievements of Eratosthenes is that he was the first person to determine
    (a) that the Sun is at the centre of the Solar System, not the Earth.
    (b) the size of the Earth.
    (c) the relative sizes of the Earth, Moon, and Sun.
    (d) the mass of the Moon.

31. The star Polaris is very close to
    (a) the Celestial Equator.
    (b) the Celestial Prime Meridian.
    (c) the Celestial North Pole.
    (d) the Celestial South Pole.

32. The Oort cloud is _____ the Kuiper belt.
    (a) much smaller than
    (b) about the same size as
    (c) much larger than

33. One of the great advances of Isaac Newton was that he
    (a) was the first to observe mountains on Jupiter, which provided convincing evidence for the geocentric model of the solar system.
    (b) was the first to propose that the force exerted by the Sun on the Earth is magnetic, providing a more accurate model of planetary orbital motions.
    (c) was the first to observe the phases of Venus, which provided convincing evidence for the heliocentric model of the solar system.
    (d) was the first to propose that Pluto be reclassified as a dwarf planet instead of a planet.
    (e) was the first to propose a quantitative law of gravity, and to use it (and his laws of motion) to explain many solar-system phenomena.

34. In their daily motions, stars appear to move by about

    (a) 1° per hour.
    (b) 15° per hour.
    (c) 23.5° per hour.
    (d) 90° per hour.

35. The first astronomer to catalogue stars by their apparent brightness was

    (a) Aristarchus.
    (b) Galileo.
    (c) Hipparchus.
    (d) Kepler.
    (e) Ptolemy.

36. One of the great advances of Nicolaus Copernicus was that he

    (a) discovered the asteroid belt.
    (b) made careful observations of comets.
    (c) was the first to explain the relationship between supernovas and nebulae.
    (d) revived the ancient heliocentric model of the solar system.
    (e) [None of the above.]

37. The Earth's rotational axis precesses

    (a) once every day.
    (b) once every month.
    (c) once every year.
    (d) once every 26,000 years.
    (e) [The Earth's rotational axis does not precess.]

38. Scientific theories that are very similar are typically discriminated by

    (a) which one can be expressed in more stylistically attractive prose.
    (b) which one can be expressed in fewer words.
    (c) which one can be expressed using fewer equations.
    (d) which one is logically simpler.

39. It takes light emitted from the Sun approximately _____ to reach the nearest star.

    (a) 4 hours
    (b) 4 months
    (c) 4 years
    (d) 4 centuries

40. One of the great advances of Johannes Kepler was that he

    (a) was the greatest naked-eye astronomer in history.
    (b) determined that planetary orbits are ellipses, and determined other properties of planetary orbits.
    (c) was the first to observe mountains and other features on the Moon.
    (d) was the first to observe the gaps in the rings of Saturn.
    (e) was the first to explain the Earth's precession.

41. _____ proposed a theory of periodic Earth climate change based on periodic changes in the eccentricity of Earth's orbit, periodic changes in the tilt of Earth's rotational axis, and precession of Earth's rotational axis.

    (a) Svetožar Gligorić
    (b) Ljubomir Ljubojević
    (c) Milutin Milanković
    (d) Dragoljub Velimirović

42. The shapes of planetary orbits, and other relationships satisfied by planetary orbits, are described by

    (a) Copernicus's laws.
    (b) Galileo's laws.
    (c) Kepler's laws.
    (d) Wien's laws.

43. The quantitative description of how forces acting on an object cause changes in the object's motion is

    (a) Galileo's law of inertia.
    (b) Kepler's second law.
    (c) Newton's second law.
    (d) Newton's law of gravity.

44. Newton's third law states that

    (a) if you are a giant, Newton will stand on your shoulders.
    (b) when two objects interact, the more massive one exerts a greater force on the less massive one, in the same ratio as the masses.
    (c) when two objects interact, each exerts a force on the other, and the two forces have the same magnitude and opposite directions.
    (d) when two objects interact, the forces each exerts on the other are directly proportional to the masses of the objects and the square of the distance separating the objects.

45. If the net force acting on a moving object is not zero, then

    (a) the speed of the object will certainly change.
    (b) the direction of the object's motion will certainly change.
    (c) either the speed of the object or its direction of motion, or both, will change.
    (d) [There is not enough information given to give a definitive answer.]

46. If the mass of the Earth were to suddenly increase by a factor of 2, the mass of the Moon were to remain the same, and the distance between them remained the same, then the gravitational force on each of them exerted by the other would

    (a) increase by a factor of 2.
    (b) increase by a factor of 4.
    (c) decrease by a factor of 2.
    (d) decrease by a factor of 4.
    (e) [There would be no change in the gravitational force.]

47. One of the great successes of Newton's laws of motion, and Newton's laws of gravity, is that Newton was able to use them to successfully explain

    (a) how to pick a winner in this Saturday's lottery.
    (b) solar and lunar eclipses.
    (c) tides on Earth.
    (d) supernova explosions.

48. The cycle of the Moon's phases repeats with a period (the synodic period) of about

    (a) 29.5 hours.
    (b) 29.5 days.
    (c) 29.5 years.
    (d) 29.5 centuries.

49. Which list of types of electromagnetic waves is in correct order from longest wavelength to shortest wavelength?

    (a) ultraviolet rays, infrared rays, radio waves, microwaves
    (b) ultraviolet rays, infrared rays, microwaves, radio waves
    (c) microwaves, radio waves, infrared rays, ultraviolet rays
    (d) radio waves, microwaves, infrared rays, ultraviolet rays

50. X-rays from outer space

    (a) can mostly pass through the atmosphere and reach the ground.
    (b) are mostly blocked by the atmosphere, and so little of them reach the ground.
    (c) [No X-rays reach the Earth from outer space.]

51. Which list of colours of visible light waves is in correct order from longest wavelength to shortest wavelength?

    (a) blue, green, yellow, red
    (b) red, yellow, green, blue
    (c) yellow, green, red, blue
    (d) green, blue, yellow, red

52. Photon A has a shorter wavelength than photon B, which means that the energy of photon A is _____ the energy of photon B.

    (a) greater than
    (b) less than
    (c) [The energy of Photon A might be greater than or less than Photon B.]
    (d) [The energy of a photon is not related to its wavelength.]

53. The wavelength of red light is about

    (a) 650 millimetres.
    (b) 650 micrometres.
    (c) 650 nanomotres.
    (d) 650 picometres.

54. William Herschel discovered _____ in 1800 when he projected a spectrum of sunlight onto a table top and placed a thermometer next to the red end of the visible spectrum.

    (a) infrared light
    (b) microwaves
    (c) X-rays
    (d) ultraviolet light

55. Analyzing a star's continuous spectrum can provide information about the star's

    (a) love life.
    (b) surface temperature.
    (c) core density.
    (d) dark matter content.

56. The temperature of Star A is greater than the temperature of Star B. The peak wavelength of electromagnetic radiation emitted from Star A is _____ than the peak wavelength of electromagnetic radiation emitted from Star B.

    (a) greater than
    (b) less than
    (c) [It could be either, depending on other factors not mentioned.]

57. Jacob Ritter discovered _____ in 1801, while he was experimenting with light-sensitive chemicals. He found that silver chloride blackened most strongly when illuminated by electromagnetic radiation just beyond the violet end of the spectrum.

    (a) infrared light
    (b) microwaves
    (c) X-rays
    (d) ultraviolet light

58. When two atoms collide, an electron in one of the atoms experiences an increase in its energy, and therefore

    (a) the electron moves about with greater speed.
    (b) the electron moves about with greater temperature.
    (c) the entire atom, including the electron, moves about with greater speed and temperature.
    (d) the electron "jumps" to a higher energy level.
    (e) [All of the above.]

59. Electromagnetic waves are emitted by

    (a) the Sun.
    (b) stars.
    (c) brightly glowing nebulae.
    (d) [All of the above.]
    (e) [None of the above.]

60. The chemical composition of a star can be determined by analyzing the star's

    (a) discrete spectrum.
    (b) continuous spectrum.
    (c) dark energy spectrum.
    (d) dark matter spectrum.

61. Star A and Star B have equal luminosities, and Star A is twice as far from us as Star B. The apparent brightness of Star A (as measured by us) is _____ the apparent brightness of Star B.

    (a) 4 times as large as
    (b) 2 times as large as
    (c) equal to
    (d) 1/2 as large as
    (e) 1/4 as large as

62. If a star is moving towards us, then its spectral lines are shifted towards

    (a) longer wavelengths.
    (b) shorter wavelengths.
    (c) lighter colours.
    (d) darker colours.

63. Telescope A and Telescope B have light-gathering tubes of the same length, but the diameter of the objective mirror of A is twice as large as the diameter of the objective mirror of B. The light-gathering power of A is _____ the light-gathering power of B.

    (a) 4 times
    (b) 2 times
    (c) equal to
    (d) 1/2 of
    (e) 1/4 of

64. Telescope A and Telescope B have light-gathering tubes of the same length, but the diameter of the objective mirror of A is twice as large as the diameter of the objective mirror of B. The resolving power of A is _____ the resolving power of B.

    (a) 4 times
    (b) 2 times
    (c) equal to
    (d) 1/2 of
    (e) 1/4 of

65. The magnifying power (magnification) of an optical telescope depends on

    (a) the diameter of its objective lens or mirror.
    (b) the length of its light-gathering tube.
    (c) the magnification of its eye-piece lens.
    (d) the focal lengths of its objective lens and eye-piece.
    (e) [None of the above.]

66. Metal mesh antennas are used to detect _____ emitted by various astronomical objects.

    (a) infrared light.
    (b) radio waves.
    (c) X-rays.
    (d) gamma rays.

67. The focal length of a telescope mirror is

    (a) the length of the light-gathering tube.
    (b) the diameter of the objective lens.
    (c) the thickness of the mirror.
    (d) the thickness of the eye-piece.
    (e) the distance from the mirror to the point at which parallel incoming light beams are focussed.

68. An interferometer

    (a) allows two widely-spaced telescopes to act like one giant telescope with increased resolving power.
    (b) decreases atmospheric interference in a telescope.
    (c) measures, but does not decrease, the atmospheric interference in a telescope.
    (d) measures the interference in a source of light, such as a star.

69. To understand the inner workings of atoms, scientists developed the theory of

    (a) Newtonian mechanics.
    (b) automotive mechanics.
    (c) relativistic mechanics.
    (d) quantum mechanics.

70. Measuring a star's parallax allows one to determine the star's

    (a) surface temperature.
    (b) apparent brightness.
    (c) distance from us.
    (d) Doppler shift.

71. A white dwarf star is relatively

    (a) hot and luminous.
    (b) cool and luminous.
    (c) hot and not very luminous.
    (d) cool and not very luminous.

72. The diameter of a typical star is about _____ times the Sun's diameter.

    (a) 1
    (b) 100
    (c) 10,000
    (d) 1,000,000

73. Two stars, a red one and a blue one, have the same luminosity. Which one has the greater size?

    (a) The red star.
    (b) The blue star.
    (c) The two stars have the same size.
    (d) [There is not enough information.]

74. Star A and Star B have the same luminosity, but Star A has the greater apparent brightness. Which star is closer to us?

    (a) Star A.
    (b) Star B.
    (c) The two stars are equally distant from us.
    (d) [The distance depends on other factors not mentioned.]

75. In a reflecting telescope, replacing its mirror with a mirror that has a larger diameter will increase the telescope's

    (a) coefficient of reflectivity.
    (b) focussing power.
    (c) refraction power.
    (d) light-gathering power.
    (e) [None of the above.]

76. White stars certainly have a greater _____ than red stars.

    (a) surface temperature
    (b) diameter
    (c) mass
    (d) [All of the above.]

77. A red giant star is relatively

    (a) hot and luminous.
    (b) cool and luminous.
    (c) hot and not very luminous.
    (d) cool and not very luminous.

78. Hotter, more luminous main sequence stars have

    (a) relatively high masses.
    (b) relatively low masses.
    (c) similar masses to hotter main-sequence stars.
    (d) [Main-sequence stars that are hot are not luminous.]

79. Stars represented by positions in the upper-left part of the H-R diagram
    (a) are bright and hot.
    (b) are dim and cool.
    (c) are mainly red giants.
    (d) are mainly white dwarfs.
    (e) [None of the above.]

80. Stars represented by positions in the upper-right part of the H-R diagram
    (a) are bright and hot.
    (b) are dim and cool.
    (c) are mainly red giants.
    (d) are mainly white dwarfs.
    (e) [None of the above.]

81. Stars represented by positions in the lower-left part of the H-R diagram
    (a) are bright and hot.
    (b) are dim and cool.
    (c) are mainly red giants.
    (d) are mainly white dwarfs.
    (e) [None of the above.]

82. Stars represented by positions in the lower-right part of the H-R diagram
    (a) are bright and hot.
    (b) are dim and cool.
    (c) are mainly red giants.
    (d) are mainly white dwarfs.
    (e) [None of the above.]

83. The Sun's placement in the H-R diagram is
    (a) in the upper-left part of the H-R diagram.
    (b) in the upper-right part of the H-R diagram.
    (c) in the lower-left part of the H-R diagram.
    (d) in the lower-right part of the H-R diagram.
    (e) along the main sequence of the H-R diagram.

84. The core of a star is generally _____ its surface.

    (a) hotter and denser than
    (b) hotter but not as dense as
    (c) cooler and denser than
    (d) cooler but not as dense as

85. The total mass of a binary star system can be determined from its orbital data and

    (a) Wien's law.
    (b) the Stefan-Boltzmann law.
    (c) Newton's law of levity.
    (d) Kepler's third law.

86. The Sun's surface looks granular as a result of

    (a) convection currents in the Sun's outer layers.
    (b) solar prominences.
    (c) sunspots organized into honeycomb-like cells.
    (d) molecular clumping due to gravitational instabilities.
    (e) molecular clumping due to magnetic instabilities.

87. Spectroscopic binary stars can be resolved

    (a) using optical telescopes.
    (b) using hybrid infrared-ultraviolet incendoscopes.
    (c) by measuring periodic shifts in their spectral lines.
    (d) by making spectro-theliometric measurements.

88. Stars that have denser atmospheres (with higher pressure) have spectral lines that are

    (a) narrower.
    (b) broader.
    (c) redder.
    (d) bluer.

89. The average density of the Sun is _____ the average density of the Earth.

    (a) greater than.
    (b) equal to.
    (c) less than.

90. The surface temperature of the Sun is approximately

    (a) 6,000 K.
    (b) 600,000 K.
    (c) 60,000,000 K.
    (d) 6,000,000,000 K.

91. The layer of the Sun's atmosphere that is its apparent surface is called the

    (a) chromosphere.
    (b) corona.
    (c) lumosphere.
    (d) photosphere.

92. This person's research in molecular spectroscopy helped us to learn about the chemical composition of planetary atmospheres and comets.

    (a) Jorge Garbajosa
    (b) Gerhard Herzberg
    (c) Cecilia Payne-Gaposchkin
    (d) Maxime Vachier-Lagrave

93. The average amount of time needed for a photon to make it through the Sun's radiative zone is about a few

    (a) seconds.
    (b) minutes.
    (c) months.
    (d) years.
    (e) [None of the above.]

94. This part of the Sun is surprisingly hot, and we don't yet understand why.

    (a) chromosphere
    (b) corona
    (c) photosphere
    (d) sunspots

95. The average density of a typical white dwarf is

    (a) much greater than the Sun's average density.
    (b) about the same as the Sun's average density.
    (c) much less than the Sun's average density.

96. In this part of the Sun, the net outward energy flow occurs primarily by convection.

    (a) chromosphere
    (b) core
    (c) corona
    (d) photosphere
    (e) [None of the above.]

97. Sunspots have temperatures that are typically _____ cooler than the temperature of the nearby solar surface.

    (a) 10 degrees to 15 degrees
    (b) 1000 degrees to 1500 degrees
    (c) 100,000 degrees to 150,000 degrees
    (d) 10 million degrees to 15 million degrees

98. The SNO detector in Sudbury, Ontario played a crucial role in solving the solar

    (a) electron problem.
    (b) neutrino problem.
    (c) photon problem.
    (d) proton problem.
    (e) Vulcan problem.

99. The solar wind

    (a) results from the Sun eating too much guacamole.
    (b) is a flow of magnetic fields emitted by the Sun.
    (c) is a flow of charged particles emitted by the Sun.
    (d) is a flow of photons emitted by the Sun.

100. Within about _____ the Sun will become so hot that all water on Earth will evaporate.

    (a) 1,000 years
    (b) 100,000 years
    (c) 10,000,000 years
    (d) 1,000,000,000 years