BROCK UNIVERSITY

Final Exam: December 2018
Course: ASTR 1P01, Section 2
Examination date: 11 December 2018
Time of Examination: 19:00 – 21:00

Number of pages: 18
Number of students: 1322
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.

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.

Use or possession of unauthorized materials or electronic devices will result in a charge of academic misconduct under the University's Academic Integrity Policy.

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

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

---

1. The smallest planet in our Solar System is
   (a) Jupiter
   (b) Mars
   (c) Mercury
   (d) Saturn
   (e) Venus

2. The Earth revolves in its orbit around the Sun once every
   (a) second.
   (b) hour.
   (c) day.
   (d) year.

3. The distance from the Earth to the nearest star is approximately
   (a) 4 AU.
   (b) 4 light years.
   (c) 400 AU.
   (d) 400 light years.
   (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 Sun to the Earth is about
   (a) 8 seconds.
   (b) 8 minutes.
   (c) 8 hours.
   (d) 8 months.
6. The first person to demonstrate the existence of matter in interstellar space (and also to measure the temperature of interstellar space) was
   (a) Albrecht Dürer.
   (b) Andrew McKellar.
   (c) Evensto Murgatroyd.
   (d) Darius Thermopylae.
7. Scientists learn more about the universe and build our understanding of how it works by
   (a) attacking each other's beliefs during drunken dinner banquets at conferences.
   (b) formulating new hypotheses and critically assessing new and existing hypotheses by gathering evidence through observations and experiments.
   (c) absorbing and accepting what the most authoritative earlier scientists believed.
   (d) consulting astrologers who cast accurate horoscopes.
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. Pluto was reclassified from a planet to a dwarf planet
   (a) at the Treaty of Westphalia in 1648.
   (b) at the Treaty of Ghent in 1814.
   (c) at the Treaty of Versailles in 1919.
   (d) at a meeting of the International Astronomical Union in Prague in 2006.

10. The diameter of the Milky Way galaxy's disk is approximately
    (a) 100,000 km.
    (b) 100,000 AU.
    (c) 100,000 light-years.
    (d) [None of the above.]
11. Most of the solar system's asteroids are located
    (a) in the Kuiper belt.
    (b) in the Oort cloud.
    (c) in Orion's belt.
    (d) between the orbits of Mars and Jupiter.
12. The Milky Way galaxy has
    (a) octopus arms.
    (b) salmon arms.
    (c) spiral arms.
    (d) jazz hands.
13. Galaxies form clusters, and clusters of galaxies form superclusters, which then form cosmic
    (a) dynamos.
    (b) honeycombs.
    (c) spider webs.
    (d) tributaries.
    (e) [None of the above.]
14. When the Moon's phase is new, it rises at about
    (a) sunrise.
    (b) mid-day.
    (c) sunset.
    (d) mid-night.
15. When the Moon's phase is first-quarter, it rises at about
    (a) sunrise.
    (b) mid-day.
    (c) sunset.
    (d) mid-night.

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

22. The Earth precesses. This means that

    (a) Earth's axis is tipped at an angle of about 23° relative to the plane of its orbit around the Earth.
    (b) the Earth orbits both the Moon and the Sun.
    (c) the Earth's rotational axis changes its direction during a 26,000 year cycle.
    (d) the Earth's orbit around the Sun changes its eccentricity during a 26,000 year cycle.

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. An asterism is

    (a) an eye ailment that many astronomers contract because of squinting into telescopes too long.
    (b) an inflammation of the star flower.
    (c) an aberration that occurs when using refracting telescopes instead of reflecting telescopes.
    (d) a recognizable grouping of stars that is not a constellation.
    (e) [None of the above.]

25. On the vernal equinox in the southern hemisphere, the Sun sets

    (a) directly west.
    (b) north of west.
    (c) south of west.
    (d) [It depends on your exact location in the southern hemisphere.]

26. In August in the northern hemisphere, the sun sets

    (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. The weather is warmer in the summer because the Earth is closer to the Sun in the summer than it is in the winter.

    (a) True.
    (b) False.

28. In February in the northern hemisphere, the sun sets

    (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.

29. 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.

30. Stellar parallax was not observed by ancient astronomers because the light from distant stars is partly blocked by the celestial sphere, and their technology was not powerful enough to observe the remaining light that passed through the celestial sphere.

    (a) True.
    (b) False.

31. Ancient Greek astronomers believed that the Earth is

    (a) hollow, as described in Homer's *Journey to the Center of the Earth*.
    (b) flat, as described in Verne's *Odysseo*.
    (c) a barred spiral, as described in Avgolemeno's *Tractatus Logico-Spanakopitus*.
    (d) [None of the others.]

32. Pseudoscience is

    (a) a set of beliefs that appears to be scientific but fails to satisfy basic principles of science.
    (b) a branch of cosmology dealing with galactic halos.
    (c) a branch of astrophysics dealing with stellar structure.
    (d) a branch of cosmogony dealing with the origin of filamentary structures in the early universe.

33. During a lunar eclipse,

    (a) the Earth is between the Sun and the Moon.
    (b) the Sun is between the Earth and the Moon.
    (c) the Moon is between the Earth and the Sun.
    (d) [None of the others.]

34. During a solar eclipse,
    (a) the Earth is between the Sun and the Moon.
    (b) the Sun is between the Earth and the Moon.
    (c) the Moon is between the Earth and the Sun.
    (d) [None of the others.]
35. The Sun is north of the celestial equator
    (a) on the vernal equinox.
    (b) on the summer solstice.
    (c) on the autumnal equinox.
    (d) on the winter solstice.
    (e) [None of the others.]
36. One of the great advances of Tycho Brahe 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. 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.
38. Days and nights are of equal length on
    (a) the summer and winter solstices.
    (b) the vernal and autumnal equinoxes.
    (c) the day on which the Sun is farthest above the celestial equator.
    (d) the day on which the Sun is farthest below the celestial equator.
39. 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.

40. It takes light emitted from the Sun approximately _____ to reach the centre of the Milky Way galaxy.

    (a) 30 years
    (b) 30 thousand years
    (c) 30 million years.
    (d) 30 billion years.

41. One of the great advances of Galileo Galilei 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 father of modern science.
    (d) was the first to propose that Pluto be reclassified as a dwarf planet instead of a planet.
    (e) [None of the above.]

42. The Earth's rotational axis precesses, which causes the equinox points on Earth's orbit to also precess; this was first noticed by

    (a) Brahe.
    (b) Galileo.
    (c) Hipparchus.
    (d) Kepler.
    (e) Newton.

43. The Earth orbits the Sun because of the

    (a) centrifugal force that the Sun exerts on the Earth.
    (b) hydrostatic force that the Sun exerts on the Earth.
    (c) gravitational force that the Sun exerts on the Earth.
    (d) electromagnetic force that the Sun exerts on the Earth.

44. Kepler's laws

    (a) describe the gravitational forces that planets exert on each other.
    (b) explain when planets will eclipse other planets.
    (c) describe the magnetic and electric forces that the Sun exerts on planets.
    (d) describe the shapes of planetary orbits, and other relationships satisfied by planetary orbits.

45. Newton's second law of motion

    (a) describes quantitatively how forces acting on an object cause changes in the object's motion.

    (b) describes the gravitational force that the Sun exerts on a planet in terms of the masses of the two objects and the distance between them.

    (c) describes the magnetic forces that the Sun exerts on other planets.

    (d) states that planetary orbits are ellipses.

46. 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.

47. If the mass of the Earth were to suddenly increase by a factor of 2, the mass of the Moon were to suddenly increase by a factor of 2, and the distance between them increased by a factor of 2, 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.]

48. One of the great successes of Newton's laws of motion, and Newton's laws of gravity, is that he 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.

49. The orbital (sidereal) period of the Moon is about

    (a) 27.3 hours.

    (b) 27.3 days.

    (c) 27.3 years.

    (d) 27.3 centuries.

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

    (a) gamma rays, X-rays, ultraviolet rays, visible light
    (b) gamma rays, ultraviolet rays, X-rays, visible light
    (c) ultraviolet rays, X-rays, visible light, gamma rays
    (d) visible light, ultraviolet light, X-rays, gamma rays

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

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

52. Gamma 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 gamma rays reach the Earth from outer space.]

53. Photon A has a longer 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.]

54. The wavelength of yellow light is about

    (a) 600 millimetres.
    (b) 600 micrometres.
    (c) 600 nanometres.
    (d) 600 picometres.

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

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

56. 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

57. Consider two glowing objects, A and B, where the temperature of A is less than the temperature of B, but otherwise A and B are identical. The peak wavelength of electromagnetic radiation emitted from A is _____ than the peak wavelength of electromagnetic radiation emitted from B.

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

58. When an electron "jumps" from a higher energy level to a lower one in an atom,

    (a) a photon of electromagnetic radiation is emitted.
    (b) the atom moves about with greater speed.
    (c) the atom moves about with greater temperature.
    (d) [It depends on whether it's a "high jump" or a "long jump."]

59. Wave-particle duality means that

    (a) sometimes electromagnetic radiation behaves like a wave and sometimes like a particle.
    (b) waves and particles can interact with each other.
    (c) dialectical materialism has been confirmed as a theory of atomic structure.
    (d) [All of the above.]
    (e) [None of the above.]

60. Analyzing a star's discrete spectrum can provide information about the star's

    (a) core density.
    (b) core pressure.
    (c) dark energy content.
    (d) dark matter content.
    (e) chemical composition.

61. The surface temperature of a star can be determined by analyzing the star's

    (a) twitter feed.
    (b) discrete spectrum.
    (c) continuous spectrum.
    (d) harmonic spectrum.

62. If a star's spectral lines are shifted towards shorter wavelengths, then the star's radial component of its motion is

    (a) away from us.
    (b) towards us.
    (c) slowing down.
    (d) speeding up.

63. Telescope A and Telescope B have objective mirrors of the same diameter, but the length of the light-gathering tube of A is twice as large as that 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

64. Telescope A and Telescope B have light-gathering tubes of the same length, but the diameter of the objective mirror of A is half 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

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) ultraviolet light.
    (c) X-rays.
    (d) gamma rays.
    (e) [None of the above.]

67. Refraction is

    (a) a process by which metal is fracted in a furnace and then fracted again to strengthen it in preparation for building a telescope.
    (b) the bending of light when it crosses the interface between two different media.
    (c) the process of focussing of light reflected from a telescope mirror or microscope mirror.
    (d) the detection of light in a charge-coupled device.

68. A technique used to dramatically increase the resolving power in astronomical observations is to

    (a) use telescopes that are much longer.
    (b) place telescopes at the tops of tall mountains.
    (c) place telescopes at the bottoms of deep valleys.
    (d) use two or more widely-spaced telescopes working together.

69. The power output of the Sun is equivalent to the power output of _____ hydrogen bomb explosions per second.

    (a) about 1
    (b) between 1 and 100
    (c) between 100 and 10,000
    (d) between 10,000 and 1 million
    (e) more than 1 million

70. One can calculate the distance to a nearby star based on its measured parallax. Stars with larger parallaxes are

    (a) farther away from us.
    (b) nearer to us.
    (c) the same distance to us as other stars.
    (d) [There is no relation between stellar parallax and distance.]

71. An average star is composed mainly of

    (a) fire and substances that are burning with fire.
    (b) hydrogen and helium, with traces of other elements.
    (c) gaseous carbon, nitrogen, and oxygen.
    (d) a core of molten metals, with mainly gaseous nitrogen and oxygen elsewhere.

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

    (a) 100
    (b) 10,000
    (c) 1,000,000
    (d) [None of the above.]

73. Two stars have the same size. Star A has greater luminosity than Star B. Which star has the greater surface temperature?

    (a) Star A.
    (b) Star B.
    (c) The two stars have the same surface temperature.
    (d) [There is not enough information.]

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

    (a) Star A.
    (b) Star B.
    (c) The two stars have the same luminosity.
    (d) [The luminosity depends on other factors not mentioned.]

75. One way to increase the light-gathering power of a reflecting telescope is to

    (a) replace its mirror with one that has larger diameter.
    (b) make its tube longer.
    (c) increase the magnification of its eyepiece.
    (d) change the focus from Cassegrain or prime to Newtonian.

76. 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.

77. As you move from the core of the Sun towards its outer layers, its density
    (a) remains approximately constant.
    (b) decreases.
    (c) increases.

78. 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.

79. Hotter, more luminous main sequence stars have
    (a) relatively high masses.
    (b) relatively low masses.
    (c) similar masses to hotter main-sequence stars.
    (d) masses that vary widely.

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

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

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

83. Stars represented by positions in the upper-right part of the H-R diagram

    (a) are mainly white dwarfs.
    (b) are bright and hot.
    (c) are dim and cool.
    (d) are mainly red giants.
    (e) [None of the above.]

84. 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.

85. Using Eddington's mass-luminosity relation, measuring a star's _____ allows us to determine the star's _____ .

    (a) luminosity, mass
    (b) mass, luminosity
    (c) spectral heliosity, temperature
    (d) temperature, spectral heliosity

86. Stellar masses typically lie in the range from _____ solar masses to _____ solar masses.

    (a) 0.1 / 3
    (b) 0.1 / 30
    (c) 0.1 / 300
    (d) 0.1 / 3,000

87. According to Eddington's mass-luminosity relationship, the more massive a main-sequence star is,

    (a) the more luminous it is.
    (b) the less luminous it is.
    (c) [There is no relationship between a star's mass and its luminosity.]

88. The average density of a typical red giant 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.

89. Gravitational forces due to the Sun's enormous mass serve to

    (a) drive the solar wind.
    (b) counter gas pressure to keep the Sun relatively stable.
    (c) cool the Sun so that it doesn't overheat.
    (d) regulate the temperature of the Sun's upper atmosphere.

90. Most stars are born with approximately the following composition.

    (a) About 90% hydrogen, about 10% helium, and less than 2% heavier elements.
    (b) About 75% hydrogen, about 25% helium, and less than 2% heavier elements.
    (c) About 60% hydrogen, about 40% helium, and less than 2% heavier elements.
    (d) About 50% hydrogen, about 50% helium, and less than 2% heavier elements.

91. The layer of the Sun's atmosphere that is the source of most of the light received by the Earth is called the

    (a) lumosphere.
    (b) luciferous zone.
    (c) chromosphere.
    (d) corona.
    (e) 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 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.

94. Near the Sun's core, the net outward energy flow occurs primarily by

    (a) cavitation.
    (b) conduction.
    (c) convection.
    (d) radiation.

95. The primary way that the Sun converts matter into energy in its core is

    (a) the CNO cycle.
    (b) the proton-proton chain.
    (c) the triple-alpha process.
    (d) the Krebs cycle.

96. If the Sun's core were to suddenly get a bit hotter, then it would maintain hydrostatic equilibrium by

    (a) contracting a little bit.
    (b) expanding a little bit.
    (c) slightly increasing its electric field.
    (d) slightly decreasing its electric field.

97. Aurorae on Earth are caused by

    (a) refraction of light in the Earth's upper atmosphere.
    (b) lightning in the Earth's upper atmosphere.
    (c) charged particles from the Sun hitting air molecules in the Earth's atmosphere.
    (d) cosmic rays.

98. The Sun's photosphere rotates

    (a) faster near the equator than near the poles.
    (b) at the same rate near the equator as near the poles.
    (c) slower near the equator than near the poles.

99. Hydrostatic equilibrium is present in

    (a) only the Sun, as far as we know.
    (b) only rapidly pulsating red giants, as far as we know.
    (c) all main sequence stars.
    (d) [None of the above.]

100. As nuclear fusion reduces the particle number density in the Sun's core, the core temperature of the Sun

    (a) remains constant
    (b) gradually increases.
    (c) gradually decreases.