BROCK UNIVERSITY

Final Exam: December 2016	Number of pages: 18
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Examination date: 15 December 2016	Time limit: 2 hours
Time of Examination: 12:00 – 14:00	Instructor: S. D'Agostino

Answer all questions on the scantron sheet provided.

No aids are permitted except for a non-programmable calculator. Use or possession of unauthorized materials will automatically result in the award of a zero grade for this examination.

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 planet closest to the Sun is
   (a) Mars
   (b) * Mercury
   (c) Venus
   (d) Vulcan

2. The radius of the Moon's orbit around the Earth is _____ the radius of Earth's orbit around the Sun.
   (a) much larger than
   (b) approximately the same as
   (c) * much smaller than
   (d) [The Moon does not orbit around the Earth.]

3. The mass of the Sun is about _____ times the mass of the Earth.
   (a) 30
   (b) 300
   (c) 3,000
   (d) 30,000
   (e) * 300,000

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. One astronomical unit (1 AU) is approximately equal to
   (a) 150 thousand km.
   (b) * 150 million km.
   (c) 150 billion km.
   (d) 150 trillion km.

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) absorbing and accepting what the most authoritative earlier scientists believed.
   (b) attacking each other's beliefs during drunken dinner banquets at conferences.
   (c) * formulating new hypotheses and critically assessing new and existing hypotheses by gathering evidence through observations and experiments.
   (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 approximate number of stars in the Milky Way galaxy is
   (a) 100 trillion.
   (b) * 100 billion.
   (c) 100 million.
   (d) 100 thousand.

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 terrestrial planets are
   (a) Earth, Jupiter, Mars, and Saturn.
   (b) Earth, Neptune, and several exoplanets.
   (c) * Earth, Mars, Mercury, and Venus.
   (d) Jupiter, Neptune, Saturn, and Uranus.

13. When the Moon sets at about sunset, its phase is
   (a) * new.
   (b) first quarter.
   (c) full.
   (d) third quarter.

14. When the Moon sets at about mid-day, its phase is
   (a) new.
   (b) first quarter.
   (c) full.
   (d) * third quarter.

15. When the Moon sets at about sunrise, its phase is

    (a) new.
    (b) first quarter.
    (c) * full.
    (d) third quarter.

16. When the Moon sets at about midnight, its phase is

    (a) new.
    (b) * first quarter.
    (c) full.
    (d) third quarter.

17. 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.

18. 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.

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. 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.
22. 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.]
23. 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.]
24. On an 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.]
25. In the northern hemisphere, in the two months from January to February, 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.
26. In the northern hemisphere, in the two months from October to November, 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. 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. The first reasonably accurate calculation of the size of the Earth was performed by

    (a) Aristarchus.
    (b) Aristotle.
    (c) * Eratosthenes.
    (d) Ptolemy.

29. The first reasonably accurate calculation of the relative sizes of the Earth, Moon, and Sun was performed by

    (a) * Aristarchus.
    (b) Aristotle.
    (c) Eratosthenes.
    (d) Ptolemy.

30. The strongest ancient argument in favour of an Earth-centred solar system was that

    (a) the Earth is much too massive to move.
    (b) it would be much more windy on Earth if it moved.
    (c) the Sun was the ruler of the Earth in ancient mythology.
    (d) * [None of the others.]

31. 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.

32. 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.]

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. The distance from the Sun to the nearest star is approximately

    (a) * 4 light years
    (b) 4 thousand light years
    (c) 4 million light years
    (d) 4 billion light years

35. 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.]

36. 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.

37. 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.

38. It takes light emitted from the Sun approximately _____ to reach the Earth.

    (a) 8 seconds
    (b) * 8 minutes
    (c) 8 hours
    (d) 8 days

39. 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 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.

40. Earth's seasons (spring, summer, autumn, and winter) are caused by

    (a) the precession of the Earth's orbit.
    (b) the eccentricity of the Earth's orbit.
    (c) * the tilt in the Earth's rotation axis relative to it's orbital plane.
    (d) the distance of the Earth's rotation axis from the celestial sphere.

41. 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.

42. 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.

43. 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.]

44. 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.

45. 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.

46. If the mass of the Earth were to suddenly increase by a factor of 2, the mass of the Moon were to suddenly decrease by a factor of 2, while 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) increase by a factor of 6.
    (d) increase by a factor of 9.
    (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 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.

48. If two beams of visible light have different wavelengths, they also have different

    (a) * colours.
    (b) masses.
    (c) speeds.
    (d) weights.

49. Of the following types of electromagnetic radiation, which has the longest wavelength?

    (a) Microwaves.
    (b) * Radio waves.
    (c) Visible light.
    (d) X-rays.

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51. The brightness (also known as intensity) of light is a measure of

    (a) its intelligence.
    (b) * its energy.
    (c) its force.
    (d) its wavelength.

52. 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.]

53. The wavelength of green light is about

    (a) 500 millimetres.
    (b) 500 micrometres.
    (c) * 500 nanomotres.
    (d) 500 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. 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. As the temperature of a glowing object increases, the object radiates electromagnetic waves more strongly at all wavelengths, and the peak wavelength

    (a) increases.
    (b) * decreases.

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

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

58. Electromagnetic waves are emitted by

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

59. The surface temperature 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.

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. If a star is moving away us, then its spectral lines are shifted towards
    (a) * longer wavelengths.
    (b) shorter wavelengths.
    (c) brighter colours.
    (d) dimmer colours.

62. Most of the ultraviolet light that is directed at the Earth from space is blocked by
    (a) that tall fellow sitting directly in front of you at the theatre.
    (b) sunblock.
    (c) * the atmosphere's ozone layer.
    (d) the atmosphere's Van Allen belt.

63. The light-gathering power 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.]

64. The resolving power 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.]

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. Radio telescopes use _____ to detect radio waves emitted by various astronomical objects.

    (a) glass refractors
    (b) glass reflectors
    (c) fibre-optic cables
    (d) * metallic antennas

67. Optical observatories are placed in space

    (a) because it's a good excuse for astronomers to vacation at interplanetary hot spots.
    (b) because they are much less expensive than ground-based observatories.
    (c) because they can thereby last forever.
    (d) * to avoid atmospheric blurring.

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. 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.

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 Earth's diameter.

    (a) * 100
    (b) 10,000
    (c) 1,000,000
    (d) [The average star has about the same diameter as the Earth.]

73. The surface temperature of a star is greatest for stars that are

    (a) red.
    (b) yellow.
    (c) * blue.
    (d) [The surface temperature of a star depends on other factors.]

74. The luminosity of a star is greatest for stars that are

    (a) red.
    (b) yellow.
    (c) blue.
    (d) * [The luminosity of a star depends on other factors.]

75. It follows from the Stefan-Boltzmann law that

    (a) the Stephen Curry factor increases when combined with the Kevin Durant factor.
    (b) if two stars have the same luminosity, the hotter one has greater size.
    (c) * if two stars have the same size, the hotter one has greater luminosity.
    (d) if two stars have the same density, the larger one has greater luminosity.

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. 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.

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) masses that vary widely.

79. 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.]

80. 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.]

81. 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.]

82. 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.]

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. 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

85. 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

86. The diameter of a typical white dwarf is

    (a) much larger than the Sun's diameter.
    (b) about the same as the Sun's diameter.
    (c) between the Sun's diameter and the Earth's diameter.
    (d) * about the same as the Earth's diameter.
    (e) much smaller than the Earth's diameter.

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. 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.

89. As you move from the outer layers of the Sun towards its core, its density

    (a) remains approximately constant.
    (b) decreases.
    (c) * increases.

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. The chemical composition of the Sun was first determined by

    (a) * Cecilia Payne-Gaposchkin.
    (b) Vera Rubin.
    (c) Carol Shields.
    (d) Margaret Atwood.

93. The outermost layer of the Sun's atmosphere is called the

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

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

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

95. Sunspots increase and decrease in number in a cycle that has peaks approximately every
    (a) 11 centuries.
    (b) * 11 years.
    (c) 11 months.
    (d) 11 days.

96. The Sun's upper atmosphere is extremely hot because
    (a) it absorbs neutrinos flowing from the Sun's core.
    (b) of nuclear fusion in the upper atmosphere.
    (c) of nuclear fission in the upper atmosphere.
    (d) * [This is currently a mystery.]

97. Solar activity is associated with the Sun's
    (a) sunny personality.
    (b) * magnetic field.
    (c) nuclear field.
    (d) photovoltaic field.
    (e) spectrophotometric field.

98. The Sun's equator rotates
    (a) * faster than near the poles.
    (b) at the same rate as near the poles.
    (c) slower 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. A solar flare
    (a) is a safety device used by people when they are caught in a severe solar storm.
    (b) * releases a large swarm of highly energetic particles that can disrupt electrical power grids on Earth.
    (c) is a result of nuclear fission in a convective layer of the Sun.
    (d) is a result of nuclear fission in a radiative layer of the Sun.