BROCK UNIVERSITY

Test 2: July 2019
Course: ASTR 1P02, Section 1
Examination date: 6 July 2019
Time of Examination: 12:00 – 12:50

Number of pages: 9
Number of students: 343
Time limit: 50 min
Instructor: S. D'Agostino

Answer all questions on the answer 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. Currently accepted models propose that energy produced in quasars is due to
   (a) nuclear fusion.
   (b) nuclear fission.
   (c) pair production.
   (d) thermal heating of infalling gas.
   (e) [None of the above.]
2. Strong evidence that the Milky Way is not the only galaxy in the universe was first obtained
   (a) in the 1620s.
   (b) in the 1720s.
   (c) in the 1820s.
   (d) in the 1920s.
   (e) [None of the others.]
3. Spiral galaxies
   (a) lack hot, bright stars.
   (b) contain many hot, bright stars.
4. Astronomers study galaxies in the early stages of their evolution by observing
   (a) small galaxies.
   (b) large galaxies.
   (c) nearby galaxies.
   (d) distant galaxies.
   (e) [None of the above.]

5. Comparing Sa, Sb, and Sc galaxies, Sa galaxies have
   (a) relatively large nuclei.
   (b) medium-sized nuclei.
   (c) relatively small nuclei.
   (d) [The Sa, Sb, Sc classification has nothing to do with the size of a galaxy's nucleus.]

6. Galaxy A is half as far from us as Galaxy B. The recession speed of Galaxy A is _____ the recession speed of Galaxy B.
   (a) 4 times as large as
   (b) 2 times as large as
   (c) the same as
   (d) 1/2 as large as
   (e) 1/4 as large as

7. Strong evidence for the existence of galaxies outside the Milky Way was first obtained by
   (a) Vladislav Artemiev.
   (b) Albert Einstein.
   (c) Galileo Galilei.
   (d) Edwin Hubble.

8. Space between galaxies is expanding, which means that light from a galaxy that is moving away from us has its wavelength
   (a) decreased compared to what it normally would be.
   (b) increased compared to what it normally would be.
   (c) [There is no effect on the wavelength of light.]

9. A Seyfert galaxy
   (a) is an elliptical galaxy with an intensity that varies on a timescale of years.
   (b) is an elliptical galaxy with an intensity that varies on a timescale of minutes.
   (c) is a spiral galaxy with an intensity that varies on a timescale of years.
   (d) is a spiral galaxy with an intensity that varies on a timescale of minutes.

10. Interactions between galaxies
   (a) hardly ever occur.
   (b) occur only between very large spiral galaxies.
   (c) occur only between very small elliptical galaxies.
   (d) explain the shapes of irregular galaxies.
   (e) [None of the above.]

11. Sc galaxies appear
    (a) blue.
    (b) green.
    (c) red.
    (d) yellow.
12. About _____ of spiral galaxies are barred spirals.
    (a) 1%
    (b) 1/3
    (c) 2/3
    (d) 99%
13. Galactic redshifts were first observed in the early 1920s by
    (a) Galileo Galilei.
    (b) Milton Humason.
    (c) Johannes Kepler.
    (d) Vesto Slipher.
    (e) [None of the above.]
14. The COBE satellite detector has measured that the cosmic background radiation is approximately
    (a) hallowed.
    (b) isotropic.
    (c) quadratic.
    (d) unidirectional.
    (e) [None of the above.]
15. Gravitational lensing is one of the main ways to collect evidence for
    (a) cosmic filaments.
    (b) cosmic voids.
    (c) dark matter.
    (d) galaxy clusters.
16. Cosmic background radiation
    (a) provides strong evidence for the Big Bang theory.
    (b) is inconsistent with the Big Bang theory, but can be explained by fudging data.
    (c) provides strong evidence for the Steady State theory.
    (d) is still unexplained and is currently being re-evaluated by astronomers.

17. Once formed, galaxies
    (a) maintain a stable structure.
    (b) can evolve significantly.
18. Matter began to be created
    (a) within the first second after the Big Bang.
    (b) a few years after the Big Bang.
    (c) a few thousand years after the Big Bang.
    (d) a few million years after the Big Bang.
    (e) [None of the above.]
19. The parameter Ω indicates the fate of the universe. If $\Omega = 1$, then the universe will
    (a) expand for a while, but slow down, reverse, and eventually collapse in a "Big Crunch."
    (b) continue to expand indefinitely, but the expansion rate approaches zero more and more closely as time passes.
    (c) continue to expand indefinitely, but the expansion rate is approximately constant.
20. The parameter Ω indicates the fate of the universe. If $\Omega > 1$, then the universe will
    (a) expand for a while, but slow down, reverse, and eventually collapse in a "Big Crunch."
    (b) continue to expand indefinitely, but the expansion rate approaches zero more and more closely as time passes.
    (c) continue to expand indefinitely, but the expansion rate is approximately constant.
21. The parameter Ω indicates the fate of the universe. If $\Omega < 1$, then the universe will
    (a) expand for a while, but slow down, reverse, and eventually collapse in a "Big Crunch."
    (b) continue to expand indefinitely, but the expansion rate approaches zero more and more closely as time passes.
    (c) continue to expand indefinitely, but the expansion rate is approximately constant.
22. The best current measurements of the parameter Ω are that its value is
    (a) greater than 1.
    (b) approximately equal to 1.
    (c) less than 1.
    (d) [It is currently impossible to estimate its value.]

23. Ordinary stars typically emit

    (a) over 99% of their energy as radio waves.
    (b) about 50% of their energy as radio waves.
    (c) about 30% of their energy as radio waves.
    (d) very little of their energy as radio waves.

24. Quasars are

    (a) quasi-stellar radio sources.
    (b) qualitative galactic radioactive zones.
    (c) quantified cosmic onanic emitters.
    (d) quantum superconducting degenerate stars.

25. A typical quasar emits

    (a) about the same amount of power as a typical main-sequence star.
    (b) about the same amount of power as the brightest star in our galaxy.
    (c) about the same amount of power as an entire galaxy.
    (d) much more power than an entire galaxy.

26. Right after the Big Bang, the universe was

    (a) very hot and dense, and it contracted and gradually warmed up.
    (b) very hot and dense, and it expanded and gradually cooled.
    (c) very cool and not very dense, and it expanded and gradually warmed up.
    (d) very cool and not very dense, and it contracted and gradually cooled.

27. During the evolution of the early universe, when protons combined with free electrons, the universe

    (a) exploded in the Big Bang.
    (b) imploded in the Big Crunch.
    (c) experienced the first period of peace and harmony.
    (d) experienced *Zitterbewegung* (the "jitterbug" period).
    (e) became transparent to light.

28. The cosmic background radiation currently has its peak in the _____ part of the electromagnetic spectrum.

    (a) ultraviolet
    (b) infrared
    (c) microwave
    (d) radio wave

29. Virtually all of the helium that exists in the universe today was produced by nuclear fusion inside stars.

    (a) True.
    (b) False.

30. The age of the universe is currently thought to be about

    (a) 14,000 years old.
    (b) 14,000,000 years old.
    (c) 14,000,000,000 years old.
    (d) 14,000,000,000,000 years old.
    (e) 14,000,000,000,000,000 years old.

31. The currently accepted resolution of Olbers's paradox is that

    (a) the density of galaxies is greater than the critical value.
    (b) stellar nucleosynthesis took place in the first few minutes after the Big Bang.
    (c) the acceleration of cosmic expansion is decreasing.
    (d) the orthodox interpretation was predicted by a pair of docs.
    (e) [None of the others.]

32. The idea that the universe is expanding was first proposed by _____ based on his or her observations.

    (a) Halton Arp
    (b) Johannes Garp
    (c) Felicia Harp
    (d) Wolfgang Warp
    (e) [None of the others.]

33. The Higgs boson was first detected

    (a) by the WMAP satellite in 2005.
    (b) by the Planck satellite in 2007.
    (c) by the COBE satellite in 2009.
    (d) by the LHC in 2012.

34. The Large Magellanic Cloud and the Small Magellanic Cloud

    (a) both have a significant amount of gas and dust.
    (b) both have very little gas and dust.
    (c) both have nearly no stars.
    (d) both have a significant number of axions.

35. Elliptical galaxies contain mostly
    (a) Population I stars and tend to be green.
    (b) Population I stars and tend to be blue.
    (c) Population II stars and tend to be red.
    (d) Population II stars and tend to be yellow.

36. Spiral galaxies contain a significant number of
    (a) younger stars.
    (b) older stars.
    (c) rich stars.
    (d) poor stars.

37. For elliptical galaxies, the E0, E1, ..., E7 classification scheme indicates the galaxy's
    (a) mass.
    (b) colour.
    (c) average density.
    (d) deviation from apparent spherical shape.

38. Spiral galaxies typically contain
    (a) a lot of gas and dust.
    (b) a lot of dust, but very little gas.
    (c) an unusually large amount of gas, but very little dust.
    (d) very little gas and dust.

39. In 1918 Heber Curtis observed jets in the galaxy M87, which are
    (a) airplane-shaped objects flying through a galaxy at high speed.
    (b) comets moving through a galaxy at high speed.
    (c) streams of material flowing away from some astronomical object.
    (d) streams of material flowing towards some astronomical object.
    (e) [None of the above.]

40. The masses of elliptical galaxies vary from about _____ to about _____ the Milky Way's mass.
    (a) 1% / 1 to 10 times
    (b) 10% / 10 to 100 times
    (c) 50% / 100 to 1000 times
    (d) 99% / 1000 to 10,000 times

41. The method of globular clusters is used to measure the distances of galaxies that are more than about _____ away from us.

    (a) 100 million m
    (b) 100 million km
    (c) 100 million AU
    (d) 100 million light years

42. Helium was first produced in the universe

    (a) in the first few minutes after the Big Bang.
    (b) about 400 thousand years after the Big Bang.
    (c) about 100 million years after the Big Bang.
    (d) [No helium was produced until stars formed.]

43. The youngest galaxies that we can see appear

    (a) blue.
    (b) green.
    (c) red.
    (d) yellow.
    (e) [None of the above.]

44. The universe has approximately the same average properties in all directions; to describe this fact, we say that the universe is

    (a) adiabatic.
    (b) heliocentric.
    (c) homogeneous.
    (d) isotropic.
    (e) [None of the above.]

45. Light from distant stars has its path bent by the gravitational effect of matter between us and the source of the light. This is a prediction of

    (a) both the BCS theory and the Λ-CDM theory.
    (b) Einstein's theory of general relativity.
    (c) Hegel's theory of hegemony.
    (d) Zeldovich's theory of dialectical imperialism.
    (e) [None of the others.]

46. Data from the WMAP and Planck satellite observatories suggest that the the universe

    (a) is flat (overall).
    (b) has accelerating expansion.
    (c) will probably expand forever.
    (d) [All of the above.]
    (e) [None of the above.]

47. In the first minute or so after the Big Bang, atomic nuclei could not exist because

    (a) it was too hot.
    (b) stars had not yet formed.
    (c) galaxies had not yet formed.
    (d) the density of quasars was too high.
    (e) [None of the above.]

48. It is currently estimated that the content of the universe is approximately

    (a) 95% ordinary matter, 5% dark matter, and a trace of dark energy.
    (b) 75% ordinary matter, 10% dark matter, and 15% dark energy.
    (c) 50% ordinary matter, 20% dark matter, and 30% dark energy.
    (d) 5% ordinary matter, 25% dark matter, and 70% dark energy.
    (e) [None of the others.]

49. Spectroscopic studies of galaxies indicates that the first stars formed

    (a) a few thousand years after the Big Bang.
    (b) a few hundred thousand years after the Big Bang.
    (c) a few hundred million years after the Big Bang.
    (d) a few billion years after the Big Bang.
    (e) [None of the above.]

50. The youngest galaxies that we have been able to observe

    (a) look remarkably similar, on average, to older galaxies.
    (b) look quite different from older galaxies.