

BROCK UNIVERSITY

Test 2: June 2017

Course: ASTR 1P02, Section 1

Examination date: 24 June 2017

Time of Examination: 13:00 – 13:50

Number of pages: 9

Number of students: 366

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.

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

1. It was first confirmed that separate galaxies existed outside our own Milky Way galaxy
 - (a) by ancient Greek astronomers.
 - (b) by medieval European astronomers.
 - (c) in the eighteenth century.
 - (d) * in the twentieth century.

2. Some galaxies have no disk, no spiral arms, and almost no gas, dust, or new stars forming. These galaxies are called
 - (a) active galaxies.
 - (b) * elliptical galaxies.
 - (c) irregular galaxies.
 - (d) spiral galaxies.
 - (e) [None of the above.]

3. 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.

4. Elliptical galaxies contain mostly
 - (a) younger stars.
 - (b) * older stars.
 - (c) rich stars.
 - (d) poor stars.

5. Spiral galaxies contain a significant number of
 - (a) * younger stars.
 - (b) older stars.
 - (c) rich stars.
 - (d) poor stars.
6. The distance ladder is used by astronomers to
 - (a) reach the very top of telescopes in their observatories.
 - (b) rearrange items on the top shelf of the celestial sphere.
 - (c) * build a distance scale that extends from nearby stars to distant galaxies.
 - (d) construct density and pressure profiles of galactic nuclei.
7. 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.
8. The method of Cepheid variables is used to
 - (a) determine gravitational redshifts.
 - (b) determine the sizes of globular clusters.
 - (c) * measure the distances to nearby galaxies.
 - (d) classify the intensities of quasars.
 - (e) [None of the others.]
9. The method of globular clusters is used to
 - (a) measure stellar parallax for nearby galaxies.
 - (b) determine the direction of supernova explosions.
 - (c) measure the power output of Type III supernovae.
 - (d) * measure the distances to galaxies that are more than 100 million light years away.
10. Astronomers deduce that the universe is expanding by analyzing evidence from
 - (a) * the cosmic microwave background radiation.
 - (b) Hubble's law.
 - (c) Olbers's paradox.
 - (d) radio emissions from quasars.

11. Galaxy A is 2 times 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
12. The largest elliptical galaxies appear to be the result of
- (a) enormous quasar explosions.
 - (b) supernova-supernova scattering.
 - (c) * galaxy collisions.
 - (d) intergalactic declusterization.
13. Cosmological redshift is a result of
- (a) * space between galaxies expanding.
 - (b) light moving away from massive stars.
 - (c) the source of light moving rapidly towards us.
 - (d) the gravitational lensing effect.
14. Astronomers must be careful to avoid selection effects, which
- (a) are jealous feelings when rivals are selected for prestigious awards.
 - (b) * result from studying un-representative samples.
 - (c) result from making incorrect redshift measurements.
 - (d) result from over-estimating the masses of spiral galaxies.
15. A galaxy is 2 million light-years away. The light from the galaxy that you observe now was emitted
- (a) less than 2 million years ago.
 - (b) * 2 million years ago.
 - (c) more than 2 million years ago.
 - (d) [There is not enough information.]
16. Rich galaxy clusters contain
- (a) a high concentration of swimming pools, sports cars, and affected accents.
 - (b) more than one million galaxies.
 - (c) * more than one thousand galaxies.
 - (d) more than one hundred galaxies.

17. A standard candle is
- (a) used to light up control panels in observatories during power blackouts.
 - (b) an astronomical object with known density.
 - (c) * an astronomical object with known luminosity.
 - (d) an astronomical object with known mass.
 - (e) [None of the others.]
18. In the 1930s, Fritz Zwicky observed that galaxies in the Coma cluster move too fast to be explained by the visible matter in the galaxy cluster. This was the first evidence for
- (a) cosmic filaments.
 - (b) cosmic voids.
 - (c) cosmological redshifts.
 - (d) * dark matter.
 - (e) galactic clustering.
19. The super-massive black hole at the centre of the Milky Way galaxy contains _____ of the galaxy's mass.
- (a) * a tiny fraction of 1%
 - (b) about 10%
 - (c) about 50%
 - (d) about 90%
20. The first discovery of a black hole was made by
- (a) * Tom Bolton.
 - (b) Tom Brady.
 - (c) Tom Dikkenherry.
 - (d) Tom Petty.
 - (e) Tom Thomson.
21. Gravitational lensing is the
- (a) aberration of star light in spherical lenses of telescopes on Earth.
 - (b) appearance of elliptical galaxies as lens-shaped.
 - (c) appearance of spiral galaxies as lens-shaped.
 - (d) * bending of light from very distant galaxies by more nearby galaxies.
 - (e) [None of the above.]

22. Gravitational lensing is one of the main ways to collect evidence for
- (a) cosmic filaments.
 - (b) cosmic voids.
 - (c) * dark matter.
 - (d) galaxy clusters.
23. Gravitational lensing was first proposed by _____ and first confirmed by the observations of _____ .
- (a) * Einstein / Eddington
 - (b) Justin / Denikotype
 - (c) Shapley / Rubin
 - (d) Zwicky / Hubble
24. Cosmic background radiation was first observed in ____ by _____
- (a) 1283 / Penzias Pendragon.
 - (b) 1731 / Edwin Hubble and Jocelyn Bell.
 - (c) 1824 / Johannes Kepler and Tycho Brahe.
 - (d) 1911 / Galileo Galilei and Isaac Newton.
 - (e) * [None of the above.]
25. 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.
26. The reciprocal of the Hubble constant gives an approximate value for the age of
- (a) the solar system.
 - (b) the Milky Way galaxy.
 - (c) * the universe.
 - (d) white dwarf stars.
 - (e) [None of the above.]
27. 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.

28. 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.
29. 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.”
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30. Dark energy tends to
- (a) draw matter in to itself, much like a black hole, and therefore tends to cause the universe to contract.
 - (b) be chaotic, and scatters matter in all directions, and therefore tends to increase the negentropy of the universe.
 - (c) concentrate in the darkest regions of space, the “voids” between filaments connecting super clusters of galaxies.
 - (d) * oppose gravity, and therefore tends to cause the universe to expand.
31. Which type of galaxy deviates more from an apparent spherical shape?
- (a) E0
 - (b) * E5
32. Rich galaxy clusters consist mostly of
- (a) spiral Sc galaxies.
 - (b) barred spiral galaxies.
 - (c) irregular galaxies.
 - (d) active galaxies.
 - (e) * [None of the above.]
33. Observations of elliptical galaxies with multiple nuclei is evidence for
- (a) the density wave theory.
 - (b) * galaxy mergers.
 - (c) the general theory of relativity.
 - (d) [There are no known elliptical galaxies with multiple nuclei.]

34. Radio galaxies are typically certain elliptical galaxies that emit large amounts of
- (a) bosons.
 - (b) fermions.
 - (c) quasars.
 - (d) X-rays.
 - (e) * [None of the above.]
35. The universe is
- (a) finite
 - (b) infinite
 - (c) * [This is not currently known.]
36. 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.
37. 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.
38. The universe became transparent to light
- (a) in the Anthropocene epoch.
 - (b) in the Pleistocene epoch.
 - (c) * when free electrons and free protons combined.
 - (d) when photons combined with anti-photons to form gamma rays.
 - (e) when stellar nucleosynthesis began.
39. The cosmic background radiation currently has its peak in the _____ part of the electromagnetic spectrum.
- (a) ultraviolet
 - (b) infrared
 - (c) * microwave
 - (d) radio wave

40. The observed distribution of chemical elements in the early universe (about 75% hydrogen, about 25% helium, and a trace of lithium) is strong evidence for
- (a) Kepler's laws.
 - (b) the steady state theory.
 - (c) * the Big Bang theory.
 - (d) Einstein's theory of gravity (general relativity).
41. 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 universe is not infinitely old.
42. The idea that the universe is expanding was first proposed by _____ based on his or her observations.
- (a) Halton Arp
 - (b) Nicholas Copernicus
 - (c) * Edwin Hubble
 - (d) Vera Menchik
43. 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.
44. 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.]
45. The universe is approximately isotropic, which means that
- (a) it has approximately the same density in all galaxy clusters.
 - (b) it has approximately the same temperature in all galaxy super-clusters.
 - (c) it has approximately the same mass in all galaxy super-clusters.
 - (d) * it has approximately the same properties in all directions.
 - (e) [None of the above.]

46. One of the predictions of Einstein's theory of general relativity is that light from distant stars should have its path bent by
- (a) refraction through interstellar glasses, ices, and crystals.
 - (b) scattering from interstellar gas and dust.
 - (c) destructive interference due to the Doppler effect from giant black holes.
 - (d) * the gravitational effect of matter between us and the source of the light.
47. 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.]
48. 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.]
49. Currently, the universe appears to be
- (a) * expanding.
 - (b) contracting.
 - (c) maintaining approximately the same size.
 - (d) [This is currently an open question.]
50. It is estimated that the first stars and galaxies formed about _____ after the Big Bang.
- (a) 100 years
 - (b) 100 thousand years
 - (c) * 100 million years
 - (d) 100 billion years