

Name:

Answer Key

Student ID:

Blue Version

Section:

Each question has one best answer. There are 65 questions with a total of 75 points.

1. [1pt] A circular image produced by gravitational lensing is called a(n)

- A) secondary focus.
- B) Einstein ring.
- C) Hawking circle.
- D) relativistic shadow.

2. [1pt] The core of the galaxy lies in the direction of the constellation _____ ?

- A) Taurus
- B) Sagittarius
- C) Leo
- D) Cygnus
- E) Orion

3. [1pt] The cosmic background radiation, which permeates the Universe, was predicted as an outcome of the

- A) General Theory of Relativity.
- B) Big Bang theory.
- C) supermassive supernova theory.
- D) steady-state theory.

4. [1pt] Which of the four interactions of nature is most important in cosmology?

- A) strong force
- B) electromagnetic force
- C) all are of the same importance
- D) weak force
- E) gravity

5. [1pt] Theories that attempt to explain all known forces as different manifestations of a single, fundamental force are known as

- A) Inflationary theories.
- B) Grand Unified Theories.
- C) Relative theories.
- D) Supersymmetric theories.

6. [1pt] What does the Drake Equation calculate?

- A) The number of communicative civilizations in a galaxy.
- B) The age of the universe.
- C) The number of galaxies in a cluster.
- D) The probability for life to evolve on a planet.
- E) The probability that a star will have planets.

7. [1pt] The energy output of a bright quasar is typically equivalent to _____ .

- A) the Sun
- B) our Milky Way galaxy
- C) 1000 bright normal galaxies
- D) a supernova
- E) 100 stars like our Sun

8. [1pt] The length of time light from a galaxy has been traveling through space in order to reach us is the galaxy's

- A) effective age.
- B) Tully-Fisher constant.
- C) set-back time.
- D) look-back time.

9. [1pt] Which of the following has NOT commonly been used to determine extragalactic distance scales?

- A) planetary nebulae
- B) globular clusters
- C) RR Lyra variables
- D) Cepheid variables
- E) type I supernovae

10. [1pt] Stars in the galactic halo are generally

- A) very massive.
- B) accompanied by clouds of gas and dust.
- C) very old.
- D) very young.

11. [1pt] The cluster of galaxies to which the Milky Way belongs is called _____ ?

- A) the Galactic Hood
- B) the Local Group
- C) the Virgo Group
- D) the Proximate Association
- E) the Coma Group

12. [1pt] What is the 'cosmological principle'?

- A) The Universe is the same at all times, but not at all places
- B) The Universe is the same at all times
- C) The Universe is the same at all places and all times
- D) The Universe is the same at all places
- E) No part of the Universe looks like any other part

13. [1pt] The velocity of a galaxy, over and above its velocity due to the expansion of the Universe, caused by its gravitational interaction with other masses is called its

- A) tangential motion.
- B) orbital motion.
- C) peculiar motion.
- D) irregular motion.
- E) proper motion.

14. [1pt] What part of the solar system lies within the Habitable Zone?

- A) Planets from the Earth to Mars.
- B) Planets from the Earth to Jupiter.
- C) Planets from Venus to Mars.
- D) Only Earth and its Moon.
- E) Planets from Venus to the Earth.

15. [1pt] The "life as we know it" definition implies that extraterrestrial life is based on molecules containing

- A) oxygen.
- B) hydrogen.
- C) silicon.
- D) carbon.
- E) nitrogen.

16. [1pt] The discovery that some clusters of galaxies do not have enough visible mass to maintain the structure of the cluster has become known as

- A) the missing mass problem.
- B) the dark matter defect.
- C) the neutrino problem.
- D) Olbers's paradox.
- E) the cluster paradox.

17. [1pt] Many globular clusters are found in the _____ of our galaxy?

- A) spiral arms
- B) halo
- C) disk
- D) H II regions
- E) spiral arms and central bulge

18. [1pt] Which of the following statements is true of giant elliptical galaxies?

- A) Their light is dominated by Population II stars.
- B) They contain no globular clusters
- C) Their light is dominated by hot blue stars.
- D) They contain prominent dust lanes.
- E) They usually contain faint traces of spiral arms under close observation.

19. [1pt] The earliest stars that formed in the galaxy were _____ ?

- A) metal rich
- B) metal poor
- C) devoid of helium
- D) composed almost entirely of helium
- E) part of present Population I

20. [1pt] The primary source of 'metals' in Population I stars is probably _____ that have enriched the galaxy in heavy elements.

- A) supernovae
- B) T-Tauri winds
- C) novae
- D) planetary nebulae
- E) pulsars

21. [1pt] Galaxies that radiate strongly at radio and x-ray wavelengths are called

- A) elliptical galaxies.
- B) active galaxies.
- C) transition galaxies.
- D) spiral galaxies.
- E) irregular galaxies.

22. [1pt] In 1929, Hubble announced that a galaxy's distance from us is directly proportional to its

- A) size.
- B) proper motion.
- C) mass.
- D) type.
- E) redshift.

23. [1pt] One success of the inflationary theory of the Universe is that it can explain why the Universe appears to be

- A) closed.
- B) oscillating.
- C) open.
- D) undergoing a phase transition.
- E) flat.

24. [1pt] While studying the distribution of globular clusters, Harlow Shapley discovered that we are not in the

- A) galactic disk.
- B) galactic corona.
- C) galactic halo.
- D) center of the Galaxy.

25. [1pt] The basic building blocks of proteins have been found in meteorites. What are these building blocks called?

- A) esters
- B) nucleic bases
- C) glycols
- D) complex carbohydrates
- E) amino acids

26. [1pt] The force holding the nuclei of atoms together is the

- A) gravitational force.
- B) weak force.
- C) electromagnetic force.
- D) strong force.

27. [1pt] The nearest galaxy to us in the Local Group that isn't a dwarf elliptical is _____ ?

- A) M33
- B) M81
- C) NGC 205
- D) Andromedae
- E) The Large Magellanic Cloud

28. [1pt] Classification of spiral galaxies into subtypes is based on

- A) grouping of stars into globular clusters.
- B) the number of stars contained in the galaxy.
- C) how tightly wound the spiral arms are.
- D) the size of the dust lane.
- E) the presence of a nuclear bulge.

29. [1pt] The strongest non-thermal radio source in the Milky Way galaxy is _____ ?

- A) Orion B
- B) Taurus M1
- C) RR-Lyra
- D) Sagittarius A
- E) Cygnus X-1

30. [1pt] To determine if gravitational effects can be strong enough to stop the expansion of the Universe it is necessary to know the Universe's

- A) average mass density.
- B) matter/photon ratio.
- C) overall size.
- D) average redshift factor.
- E) material composition.

31. [1pt] In the northern hemisphere the 'winter Milky Way' is less prominent in our sky than the 'summer Milky Way' because _____ ?

- A) the summer Milky Way is composed of Population II stars, which are brighter
- B) it is made of variable stars that are brighter in the summer
- C) the stars in the summer Milky Way are closer to us than those in the winter Milky Way
- D) the dust clouds in the disk of the galaxy cause more obscuration in the winter than the summer
- E) the Sun is closer to the outer edge of the galaxy than the center

32. [1pt] The oldest objects we can reliably date are

- A) globular clusters.
- B) H II regions.
- C) iron meteorites.
- D) pulsars.
- E) Cepheid variables.

33. [1pt] To trace out the spiral structure of our Galaxy we should look at

- A) dark nebulae.
- B) very old objects.
- C) very young objects.
- D) neutron stars.

34. [1pt] A Universe in which composition and density are the same everywhere at a given time is

- A) homogenous.
- B) open.
- C) isotropic.
- D) closed.
- E) perfectly cosmological.

35. [1pt] 'Fuzz' and the spectra of stars have been observed around quasars. This is important because it suggests strongly that _____ ?

- A) quasars really are stars, though of a very strange sort
- B) quasars are really Seyfert Galaxies
- C) quasars appear to be embedded in galaxies of some kind
- D) the redshift is being caused by a large gravitational field
- E) quasars are really much closer than originally thought

36. [1pt] The most distant quasar yet observed is moving away from us at about _____ percent of the speed of light?

- A) 15
- B) 94
- C) 120
- D) 7
- E) 41

37. [1pt] Quasars appear to be

- A) long-lived objects, unchanged since the beginning of the Universe.
- B) all at about the same distance.
- C) a particularly active phase in the history of a galaxy.
- D) extremely rare in galaxy clusters.

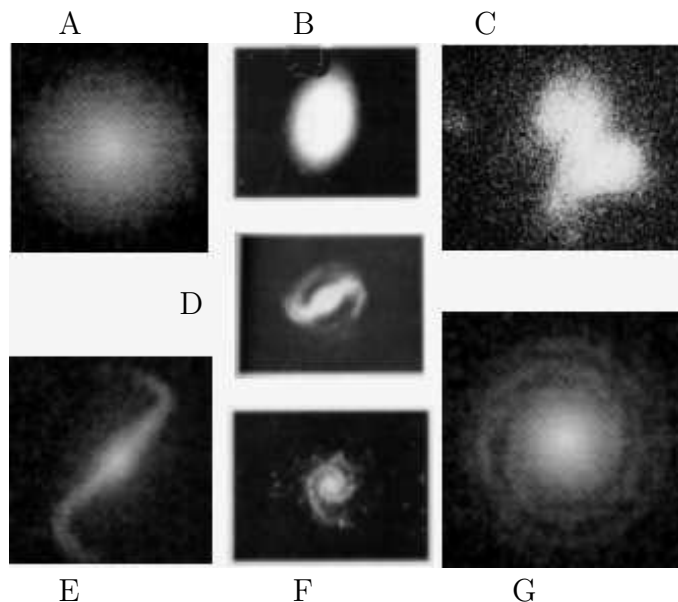
38. [1pt] Which of the following are primary distance indicators?

- A) Type Ia supernovae
- B) Cepheid variables
- C) neutron stars
- D) gamma ray bursts

39. [1pt] Quasars and the cosmic background radiation are the strongest evidence against the

- A) steady-state theory.
- B) supermassive supernova theory.
- C) Big Bang theory.
- D) General Theory of Relativity.

40. [7pt] Match the Hubble classification of the galaxy with the picture. (For each type below, enter the letter for the corresponding picture.)



- B E3
- C Irregular
- A E0
- F Sc
- E SBc
- D SBa
- G Sa

41. [1pt] Which spacecraft currently leaving the Solar System carry a selection of music from around the world in the event they are ever found by an extraterrestrial civilization?

- A) the Challengers
- B) the Pioneers
- C) the Mariners
- D) the Rangers
- E) the Voyagers

42. [1pt] The spectra of quasars were not interpreted properly at first because they have _____ ?

- A) images that look very different from stars
- B) only absorption and no emission lines
- C) no lines in the visible spectrum
- D) blue shifts larger than any known star
- E) very large redshifts

43. [1pt] Most of the mass of the Milky Way Galaxy is detectable

- A) in the infrared.
- B) in visible light.
- C) in no part of the electromagnetic spectrum.
- D) in x-rays.
- E) at radio wavelengths.

44. [1pt] The _____ Catalog of objects in the sky grew from a compilation of 'fuzzy' objects designed to keep comet watchers from mistaking these objects for comets.

- A) New Galactic
- B) Messier
- C) Halley
- D) New General
- E) Hubble

45. [1pt] The largest, brightest stars are unexpected to have planets harboring life because

- A) they burn out too fast for life to have time to evolve.
- B) they have very small habitable zones.
- C) it is improbable life evolved anywhere but Earth.
- D) their planets tend to be in unstable orbits.
- E) they produce too much high energy radiation.

46. [1pt] The critical density of the Universe is defined as _____ ?

- A) the density just sufficient to cause galaxies to begin to form
- B) the density that is just sufficient to cause the Universe to collapse back on itself
- C) the density that is just enough to stop the expansion after infinite time
- D) the initial density necessary to trigger the Big Bang
- E) the density at which superclusters of galaxies begin to form

47. [1pt] The volume around a star in which conditions may be suitable for life is called the

- A) habitable zone.
- B) biosphere.
- C) photon sphere.
- D) living space.

48. [1pt] A well-known effort to find intelligent life elsewhere in the Universe is or was called

- A) DS9.
- B) Project Contact.
- C) ETU6.
- D) SETI.

49. [1pt] The cosmological red shift of the light from very distant galaxies is caused by _____ .

- A) a gravitational red shift due to the galaxy's mass
- B) the rotational motion within the Universe
- C) absorption of blue light by interstellar dust
- D) the expansion of space and the stretching of a photon's wavelength in that expanding space
- E) a Doppler shift and the motion of a galaxy away from a stationary observer

50. [1pt] The cosmic background radiation is left over from the instant when the Universe became

- A) opaque.
- B) hot.
- C) transparent.
- D) solid.
- E) cold.

51. [1pt] Astronomers discovered quasars while trying to correlate optical objects in the sky with

- A) infrared sources.
- B) cosmic ray sources.
- C) x-ray sources.
- D) radio sources.

52. [1pt] Searches for signals from intelligent extraterrestrial life have been conducted mainly at

- A) ultraviolet wavelengths.
- B) radio wavelengths.
- C) optical wavelengths.
- D) infrared wavelengths.

53. [1pt] The multiple images seen in a gravitationally lensed quasar have all but which of the following?

- A) the same spectra
- B) the same redshift
- C) the same distance
- D) the same light path through space

54. [1pt] One surprising result of Hubble Space Telescope observations of quasars is that

- A) most quasars are in binary or multiple quasar systems.
- B) quasars typically have luminosities lower than those typical of AGNs.
- C) quasars are local objects with measurable parallax.
- D) quasars can be found in both spiral and elliptical galaxies.

55. [1pt] Which of the following is a major source of radio continuum radiation from celestial sources outside the solar system?

- A) inversion
- B) synchrotron radiation
- C) molecular rotation
- D) hydrogen spin flip

56. [1pt] The notion that the Universe had an instant when it began is implied by its

- A) uniform optical brightness.
 - B) expansion.
 - C) iron abundance.
 - D) homogeneity.
 - E) infiniteness.
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57. [1pt] In the several spacecraft leaving the Solar System that carry information intended for any extraterrestrial civilization that should find the spacecraft, how is the time of the spacecraft launch included in the information?

- A) by showing a series of solar eclipses with the time in between recorded
 - B) by recording the times of several recent supernova events
 - C) by including a long-running atomic clock
 - D) by including a long half-life decaying radioactive source
 - E) by showing the directions and periods of nearby pulsars
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58. [1pt] A universe that has not expanded uniformly, but for some very short period in its history expanded rapidly, is called

- A) flat.
 - B) inflationary.
 - C) oscillating.
 - D) open.
 - E) closed.
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59. [1pt] The large (60,000 ly radius) sphere of older stars and globular clusters around the central region of the Galaxy is the

- A) nuclear bulge.
 - B) halo.
 - C) disk.
 - D) galactic nucleus.
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60. [1pt] 'Double quasars', where two quasars close together are observed to have exactly the same characteristics are caused by _____ ?

- A) gravitational lenses
 - B) the Doppler effect
 - C) binary quasar systems similar to binary star systems
 - D) a parallax effect
 - E) the collision of active galactic nuclei
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61. [1pt] We describe galaxies primarily by their

- A) M-class.
- B) Hubble type.
- C) NGC-class.
- D) UBV magnitude.
- E) brightness coefficient.

62. [1pt] The observation that some quasars vary their light output on timescales as short as days is important because it implies that _____ ?

- A) they must contain variable stars
 - B) they must be very close to us
 - C) they must have a very compact energy source
 - D) they cannot be stars
 - E) their redshifts cannot be a gravitational effect
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63. [1pt] An explanation for the quasars found nearby is that they are being fueled by

- A) collapsing galaxies.
 - B) gas from another, interacting galaxy.
 - C) clusters interacting.
 - D) black holes.
 - E) nucleosynthesis.
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64. [5pt] Match each statement with the appropriate object, and enter the associated letter.

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|--|--------------------------|
| <u>B</u> Spiral galaxies with bright nuclei and regions of gas in turbulent motion. | A. radio galaxies |
| <u>D</u> Luminous galaxies that have non-thermal spectra. | B. Seyfert galaxies |
| <u>C</u> Polarized radiation produced when electrons spiral around magnetic field lines. | C. synchrotron radiation |
| <u>A</u> Galaxies that emit much of their energy in radiowave photons. | D. active galaxies |
| <u>E</u> Distant objects that show very red shifted spectral lines. | E. quasars |
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65. [1pt] Nebulae with hot central stars that ionize the nebula with their UV radiation are called _____ nebulae?

- A) ultraviolet
- B) dark
- C) emission
- D) reflecting
- E) absorption