

Name:

Answer Key

Student ID:

Pink Version

Section:

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

1. [1pt] Lacertids, or BL Lac objects, are probably
- A) stars with no or very few emission and absorption lines.
 - B) spiral galaxies at very high redshifts.
 - C) galaxies with strong radio emission.
 - D) quasars with their jets pointed straight at us.

2. [1pt] The Sun is located in the _____ of the galaxy.
- A) nucleus
 - B) halo
 - C) far outer edge
 - D) spheroidal component
 - E) disk

3. [1pt] The assumption that the Universe is homogeneous, isotropic, and unchanging in time is called
- A) Olbers's paradox.
 - B) the energy problem.
 - C) the perfect cosmological principle.
 - D) the cosmological principle.
 - E) the equivalence principle.

4. [1pt] The center of the Universe is located _____ .
- A) the Universe has no center
 - B) at the Earth
 - C) at the center of the Andromeda galaxy
 - D) at the Sun
 - E) at the center of the Milky Way galaxy

5. [1pt] The Hubble Time places an upper limit on the age of the Universe, but its actual age may be less, even if there were no uncertainty in the value of the Hubble Constant. Why?
- A) According to relativity, our clocks may be running too fast
 - B) According to relativity, our clocks may be running slowly.
 - C) the Universe may have a negative acceleration.
 - D) The rate of expansion may be constant with time.
 - E) The rate of expansion may be increasing with time.

6. [1pt] What does the Drake Equation calculate?
- A) The number of galaxies in a cluster.
 - B) The number of communicative civilizations in a galaxy.
 - C) The probability that a star will have planets.
 - D) The age of the universe.
 - E) The probability for life to evolve on a planet.

7. [1pt] The fact that we do not see blue shifted quasars _____ .
- A) proves that the Universe will never collapse
 - B) proves that the Universe is almost all hydrogen
 - C) is a result of gravitational lensing
 - D) is evidence against the hypothesis that quasars are locally ejected objects
 - E) disproves Hubble's law

8. [1pt] Galaxies are known with look-back times out to about _____ .
- A) 4.5 billion years.
 - B) 65 million years.
 - C) 3.26 years.
 - D) 13 billion years.

9. [1pt] In comparing elliptical galaxies to our own, the part of our own that most resembles the elliptical galaxies is _____?
- A) the disk
 - B) the spiral arms
 - C) the prominent dust lanes
 - D) the halo and central bulge
 - E) the open cluster distribution

10. [1pt] Most of the mass of the Milky Way Galaxy is detectable _____ .
- A) in no part of the electromagnetic spectrum.
 - B) in x-rays.
 - C) in visible light.
 - D) in the infrared.
 - E) at radio wavelengths.

11. [1pt] The fact that the Universe is expanding is stated in quantitative form by the _____ ?
- A) Maxwell-Boltzmann Law
 - B) Inverse Square Law
 - C) Hubble Law
 - D) Third Law of Kepler
 - E) Slipher Law

12. [1pt] The relative abundances of protons and neutrons was set when the age of the Universe was about _____ .
- A) 10^{-10} s.
 - B) 1 s.
 - C) 100 s.
 - D) 10^{-35} s.
 - E) 10^{-6} s.

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

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

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

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

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

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

17. [1pt] The location of clouds of neutral hydrogen in the galaxy can be mapped using the 21 centimeter line of hydrogen which comes in the _____ region of the spectrum?

- A) gamma-ray
- B) ultraviolet
- C) radio frequency
- D) x-ray
- E) infra-red

18. [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) Hubble
- B) New Galactic
- C) New General
- D) Halley
- E) Messier

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 core of the galaxy lies in the direction of the constellation _____ ?

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

21. [1pt] If enough mass is present in a small enough volume at the center of a galaxy, it implies the presence of

- A) dust and gas.
- B) a white dwarf.
- C) star formation.
- D) a black hole.
- E) a star cloud.

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

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

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

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

- A) galactic corona.
- B) galactic halo.
- C) galactic disk.
- 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) complex carbohydrates
- B) esters
- C) nucleic bases
- D) amino acids
- E) glycols

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

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

27. [1pt] The Andromedae Galaxy (M31) is approaching us and does not obey the Hubble Law. Why?

- A) The reddening of light by interstellar absorption invalidates the Hubble Law in this case
- B) M31 is too far away for the Hubble Law to be applicable.
- C) The Hubble Law is valid only for elliptical galaxies.
- D) The Hubble Law does not apply to irregular galaxies like Andromedae
- E) M31 is too close for the Hubble Law to be applicable.

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 presence of a nuclear bulge.
- E) the size of the dust lane.

29. [1pt] The youngest stars in the galaxy are found in the _____?

- A) spiral arms
- B) halo
- C) core
- D) central bulge
- E) globular clusters

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

31. [1pt] The Milky Way Galaxy rotates once about every _____ years?

- A) 225 million
- B) 11 million
- C) 100 billion
- D) 45 billion
- E) 100,000

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

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

33. [1pt] In which of the following parts of the electromagnetic spectrum are we learning the least about the very center of our Galaxy?

- A) infrared
- B) visible light
- C) radio waves
- D) gamma

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

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

35. [1pt] Presently the most plausible explanation for the energy sources in the centers of active galaxies is _____ ?

- A) chain reaction supernova explosions
- B) large clusters of rapidly spinning neutron stars
- C) very dense clusters of O and B stars
- D) rapid and sequential nova explosions
- E) a supermassive black hole

36. [1pt] A Seyfert Galaxy is an example of _____ ?

- A) a giant elliptical galaxy
- B) an active galaxy
- C) a quasar
- D) an irregular galaxy with radio emission
- E) a normal galaxy

37. [1pt] Quasars appear to be

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

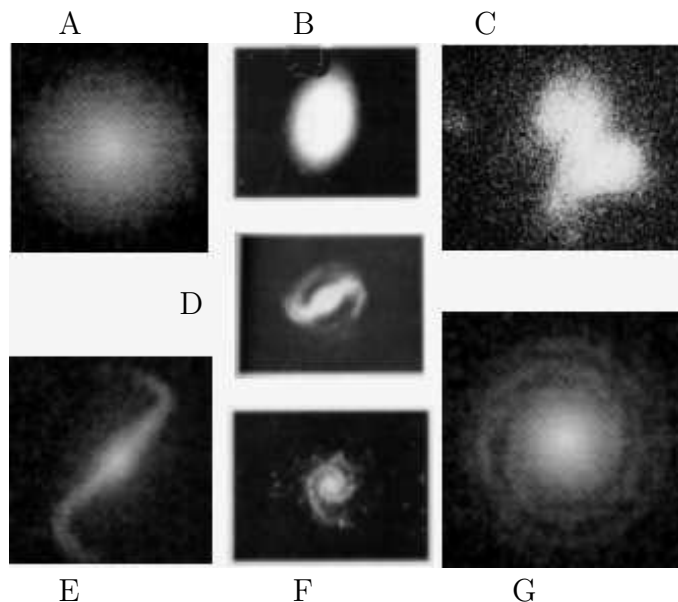
38. [1pt] Which of the following are primary distance indicators?

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

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

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

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



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

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

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

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

43. [1pt] The hypothesis that we are not in the center of our Galaxy

- A) cannot be determined from visible-light photographs.
- B) was first shown to be true in the 1920s.
- C) has proved to be untrue.
- D) was finally proven by the Hubble Space Telescope.

44. [1pt] The primary means of determining the mass of a spiral galaxy uses _____ ?

- A) the cepheid period-luminosity relation
- B) Kepler's third law
- C) Einsteins theory of special relativity
- D) Newton's first law
- E) the Wien displacement law

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) their planets tend to be in unstable orbits.
- D) it is improbable life evolved anywhere but Earth.
- E) they produce too much high energy radiation.

46. [1pt] If the geometry of spacetime in our Universe is 'open', the Universe _____ ?

- A) will go through oscillations, first expanding, then contracting
- B) will stop expanding in a finite amount of time but not collapse
- C) will stop expanding after infinite time
- D) will collapse back on itself in a cosmic fireball
- E) will never stop expanding

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

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

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

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

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

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

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

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

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

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

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

- A) optical wavelengths.
- B) infrared wavelengths.
- C) ultraviolet wavelengths.
- D) radio 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) quasars typically have luminosities lower than those typical of AGNs.
- B) quasars are local objects with measurable parallax.
- C) most quasars are in binary or multiple quasar systems.
- 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) hydrogen spin flip
- B) inversion
- C) molecular rotation
- D) synchrotron radiation

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

- A) uniform optical brightness.
 - B) homogeneity.
 - C) infiniteness.
 - D) iron abundance.
 - E) expansion.
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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 including a long half-life decaying radioactive source
 - B) by including a long-running atomic clock
 - C) by showing a series of solar eclipses with the time in between recorded
 - D) by recording the times of several recent supernova events
 - 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) closed.
 - B) inflationary.
 - C) flat.
 - D) open.
 - E) oscillating.
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59. [1pt] The mechanism that may have created the spiral arms of our Galaxy by piling up material to create new stars is called the

- A) differential-rotation effect.
 - B) supernova chain reaction.
 - C) mass-rotation relation.
 - D) density wave.
 - E) T Tauri association.
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60. [1pt] The fact that the Universe is expanding is stated in quantitative form by the _____ ?

- A) Slipher Law
 - B) Inverse Square Law
 - C) Hubble Law
 - D) Third Law of Kepler
 - E) Maxwell-Boltzmann Law
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61. [1pt] The jets seen in some active galaxies are thought to consist of

- A) ejected black holes.
- B) molecular clouds.
- C) charged particles moving at close to the speed of light.
- D) stellar coronas.
- E) gravitationally lensed arcs.

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

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

- | | |
|---|---------------------|
| <u>C</u> Spiral galaxies with bright nuclei and regions of gas in turbulent motion. | A. radio galaxies |
| <u>A</u> Galaxies that emit much of their energy in radiowave photons. | B. active galaxies |
| <u>B</u> Luminous galaxies that have non-thermal spectra. | C. Seyfert galaxies |
| <u>D</u> Distant objects that show very red shifted spectral lines. | D. quasars |
| <u>E</u> Very intense quasars with rapidly varying brightness. | E. BL Lac objects |
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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