

Name:

Answer Key

Student ID:

White Version

Section:

Each question has one best answer. There are 60 questions with a total of 75 points.

1. [1pt] The imaginary boundary around a rotating black hole at which no particles can remain at rest is the

- A) singularity.
- B) Schwarzschild radius.
- C) stationary limit.
- D) event horizon.
- E) ergosphere.

2. [1pt] 'Double quasars', where two quasars close together are observed to have exactly the same characteristics are caused by _____ ?

- A) binary quasar systems similar to binary star systems
- B) the collision of active galactic nuclei
- C) a parallax effect
- D) gravitational lenses
- E) the Doppler effect

3. [5pt] Match each statement with the appropriate object, and enter the associated letter.

- | | |
|---|-------------------------|
| <u>D</u> a star whose double nature is indicated by its wobbling motion. | A. spectroscopic binary |
| <u>A</u> a star whose double nature is indicated by variations in its doppler shift. | B. eclipsing binary |
| <u>E</u> two stars at different distances which happen to be along the same line of sight. | C. visual binary |
| <u>B</u> a star whose double nature is indicated by the varying intensity of its light curve. | D. astrometric binary |
| <u>C</u> a star which appears double by sight and is held to another gravitationally. | E. optical double |

4. [1pt] The spectra of quasars were not interpreted properly at first because they have _____ ?

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

5. [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.

6. [1pt] The primary source of 'metals' in Population I stars is probably _____ that have enriched the galaxy in heavy elements.

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

7. [1pt] About 94 percent of the nuclei in the outer parts of the Sun are

- A) gas.
- B) helium.
- C) hydrogen.
- D) heavy elements.

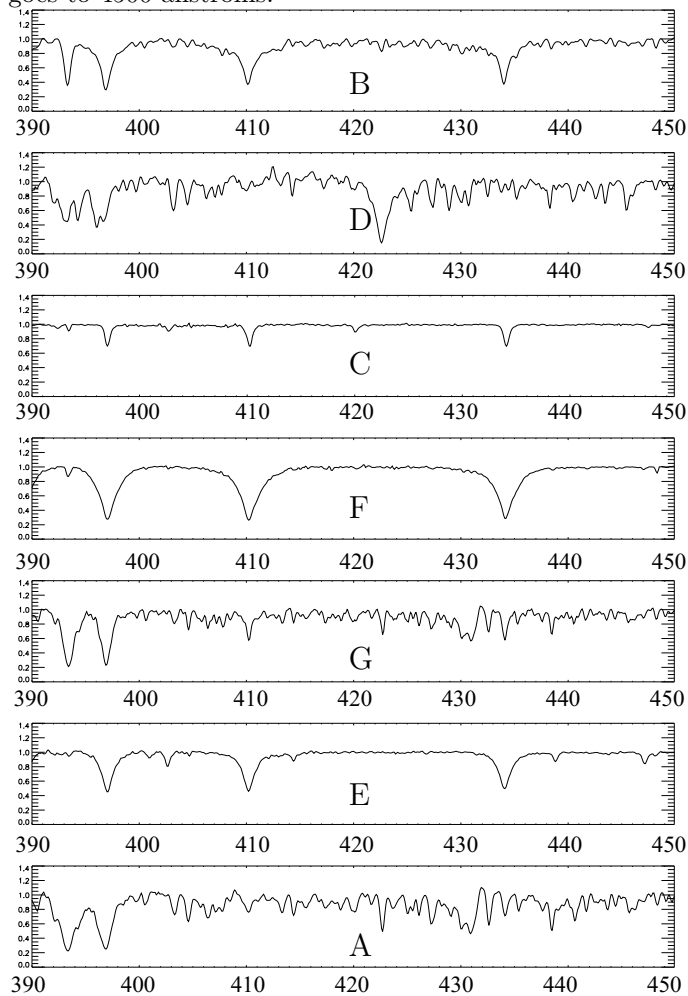
8. [1pt] A heavily-studied giant molecular cloud is in

- A) Orion.
- B) our solar system.
- C) Ursa Major.
- D) a distant quasar.

9. [1pt] The notion that the Universe had an instant when it began is implied by its

- A) homogeneity.
- B) uniform optical brightness.
- C) expansion.
- D) infiniteness.
- E) iron abundance.

10. [1pt] Digital spectra of each spectral class are shown. Select the correct order of the digital spectra from hottest to coldest. DATA: blue hydrogen lines are at 3970, 4101 and 4471 *angstroms*; calcium II (an ionized heavy metal lines are at 3933 and 3968 *angstroms*. The scale starts at 3900 *angstroms* and goes to 4500 *angstroms*.



- A) AGECDDBF
- B) CEGBFAD
- C) CEFBGAD
- D) GFEDBAC
- E) BEAFGDC
- F) EACDFBG

11. [4pt] Identify the spectral type (OBAFGKM) of the given spectra shown above.

- M Spectrum D
- O Spectrum C
- B Spectrum E
- A Spectrum F

12. [1pt] Quasars and the cosmic background radiation are the strongest evidence against the

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

13. [1pt] The energy output of a bright quasar is typically equivalent to _____ .

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

14. [1pt] The cosmic background radiation, which permeates the Universe, was predicted as an outcome of the

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

15. [1pt] The cosmological red shift of the light from very distant galaxies is caused by _____ .

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

16. [5pt] Match each statement with the appropriate object, and enter the associated letter.

- B the light we receive from the Sun comes from this layer. A. chromosphere
- E a layer of the solar atmosphere so hot it emits mostly X-rays B. photosphere
- C this extension of the solar atmosphere extends at least to Neptune. C. solar wind
- D the sun produces all of its energy in this layer. D. core
- A the spiky atmospheric layer just above the visible layer. E. corona

17. [1pt] Astronomers discovered quasars while trying to correlate optical objects in the sky with

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

18. [1pt] The multiple images seen in a gravitationally lensed quasar have all but which of the following?

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

19. [1pt] In 1929, Hubble announced that a galaxy's distance from us is directly proportional to its

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

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

21. [1pt] Because molecular hydrogen is difficult to detect, astronomers map the distribution of molecular material in our Galaxy with observations of the more easily detectable molecule

- A) CO.
- B) H₃⁺.
- C) NH₃.
- D) H₂CO.

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

23. [1pt] Star clusters with irregular shapes and containing stars with relatively large amounts of heavier elements are called

- A) globular clusters.
- B) star clusters.
- C) Population I areas.
- D) Population II areas.
- E) open clusters.

24. [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) hydrogen spin flip
- D) molecular rotation

25. [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.

26. [1pt] A graph of temperature versus magnitude for stars is sometimes known as a(n)

- A) color-temperature diagram.
- B) star chart.
- C) Hertzsprung-Russell diagram.
- D) astrometric chart.
- E) periodic table.

27. [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.

28. [1pt] Stars in the galactic halo are generally

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

29. [1pt] Which of the four interactions of nature is most important in cosmology?

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

30. [1pt] In the northern hemisphere the 'winter Milky Way' is less prominent in our sky than the 'summer Milky Way' because _____ ?

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

31. [1pt] If, after a supernova, the stellar core is less than two solar masses, the result will probably be a

- A) black hole.
- B) supermassive star.
- C) black dwarf.
- D) white dwarf.
- E) neutron star.

32. [1pt] Mini black holes may be left over from

- A) supernovae.
- B) novae.
- C) the beginning of the Universe.
- D) stellar collisions.

33. [1pt] The length of time light from a galaxy has been traveling through space in order to reach us is the galaxy's

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

34. [1pt] The oldest objects we can reliably date are

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

35. [1pt] Oscillating stars were ruled out as an explanation for pulsars because they would not have the correct

- A) period.
- B) magnitude.
- C) wavelength.
- D) intensity.
- E) energy.

36. [1pt] Which of the following statements is true of giant elliptical galaxies?

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

37. [1pt] Pulsars with very short, very stable periods of rotation are called

- A) early pulsars.
- B) quick pulsars.
- C) millisecond pulsars.
- D) microsecond pulsars.
- E) fast pulsars.

38. [1pt] When the core of a massive star collapses, rebounds, and explodes into a supernova, it picks up much of its energy from the outflow of

- A) photons.
- B) neutrinos.
- C) positrons.
- D) ions.
- E) neutral atoms.

39. [1pt] One success of the inflationary theory of the Universe is that it can explain why the Universe appears to be

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

40. [1pt] After about 10 billion years on the main sequence a one-solar-mass star will have in its core no remaining

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

41. [1pt] As the solar atmosphere expands outward into interplanetary space it becomes the

- A) solar wind.
- B) corona.
- C) chromosphere.
- D) photosphere.
- E) core.

42. [1pt] The cluster of galaxies to which the Milky Way belongs is called _____ ?

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

43. [1pt] The wavelength peak of the Sun's radiation is in the middle of the

- A) infrared region.
- B) ultraviolet region.
- C) visible spectrum.
- D) x-ray region.
- E) radio spectrum.

44. [1pt] A nova involves material from a companion star falling on a

- A) white dwarf.
- B) protostar.
- C) red giant.
- D) main-sequence star.
- E) dust cloud.

45. [1pt] Magnetic storms on the Earth are caused by

- A) solar flares.
- B) the solar corona.
- C) the solar photosphere.
- D) the solar chromosphere.

46. [1pt] An explanation for the quasars found nearby is that they are being fueled by

- A) gas from another, interacting galaxy.
- B) clusters interacting.
- C) collapsing galaxies.
- D) black holes.
- E) nucleosynthesis.

47. [1pt] What happens to most of the extra mass of a star that becomes a white dwarf?

- A) It remains in a shell close by the white dwarf.
- B) There is no extra mass - it all goes into the white dwarf.
- C) It disperses into interstellar space, mixing with other interstellar matter.
- D) The gravity of the white dwarf pulls it into a ring like Saturn's.

48. [1pt] The rule describing the relationship between the total radiant energy emitted by a blackbody to its temperature is

- A) Planck's law.
- B) the quantum theory.
- C) the Wien displacement law.
- D) the Stefan-Boltzmann law.
- E) the blackbody rule.

49. [1pt] A stellar sized hot body that derives its energy from free-falling gravitational collapse is a

- A) protostar.
- B) main-sequence star.
- C) circumstellar disk.
- D) brown dwarf.
- E) white dwarf.

50. [1pt] We describe galaxies primarily by their

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

51. [1pt] A star that is 100 times fainter than another star at the same distance will be

- A) 2.5 magnitudes dimmer.
- B) 5 magnitudes dimmer.
- C) 10 magnitudes dimmer.
- D) 3 magnitudes dimmer.
- E) 1 magnitude dimmer.

52. [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

53. [1pt] The angle at which a star appears to move when observed from the ends of a baseline of 1 A.U. is the star's

- A) speckle.
- B) proper motion.
- C) parallax.
- D) space velocity.
- E) radial velocity.

54. [1pt] If electrons are added to or removed from a neutral atom the atom is said to be

- A) ionized.
- B) electronic.
- C) a proto-atom.
- D) nuclear.
- E) doubly neutral.

55. [1pt] The nearest galaxy to us in the Local Group that isn't a dwarf elliptical is _____ ?

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

56. [1pt] Solar surface granulation is caused by

- A) thermal flux.
- B) conduction.
- C) convection.
- D) radioactivity.
- E) radiation.

57. [1pt] What are 'top down' theories of galaxy formation?

- A) Theories in which superclusters of galaxies form and then fragment to make galaxies
- B) Theories in which galaxies form and then conglomerate to form clusters and superclusters of galaxies
- C) Theories in which all galaxies first form as clusters of giant elliptical galaxies
- D) Theories in which all galaxies first form as clusters of spiral galaxies and some of these evolve into elliptical galaxies
- E) Theories in which clusters of giant elliptical galaxies are torn apart by supernova explosions to form smaller galaxies

58. [1pt] The main value in the study of binary stars is the ability it gives us to determine stellar

- A) masses.
- B) sizes.
- C) periods.
- D) colors.
- E) spectra.

59. [1pt] Many globular clusters are found in the _____ of our galaxy?

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

60. [5pt] Match each statement with the appropriate object, and enter the associated letter.

A Very intense quasars with rapidly varying brightness. A. BL Lac objects

B Spiral galaxies with bright nuclei and regions of gas in turbulent motion. B. Seyfert galaxies

E Distant objects that show very red shifted spectral lines. C. active galaxies

D Galaxies that emit much of their energy in radiowave photons. D. radio galaxies

C Luminous galaxies that have non-thermal spectra. E. quasars