1. Base your answer to the following question on the diagram below, which shows an inferred sequence in which our solar system formed from a giant interstellar cloud of gas and debris. Stage A shows the collapse of the gas cloud, stage B shows its flattening, and stage C shows the sequence that led to the formation of planets.

After the young Sun formed, the disk of gas and dust
(1) became spherical in shape
(2) became larger in diameter
(3) eventually formed into planets
(4) formed a central bulge

2. Terrestrial planets move more rapidly in their orbits than the Jovian planets because terrestrial planets are
(1) more massive
(2) rotating on a tilted axis
(3) more dense
(4) closer to the Sun

3. Which list of three planets and Earth’s Moon is arranged in order of increasing equatorial diameter?
(1) Earth’s Moon, Pluto, Mars, Mercury
(2) Mars, Mercury, Pluto, Earth’s Moon
(3) Pluto, Earth’s Moon, Mercury, Mars
(4) Mercury, Mars, Earth’s Moon, Pluto

4. Which planet would float if it could be placed in water?
(1) Saturn
(2) Pluto
(3) Earth
(4) Mercury

5. How do Jupiter’s density and period of rotation compare to Earth’s?
(1) Jupiter is less dense and has a longer period of rotation.
(2) Jupiter is more dense and has a shorter period of rotation.
(3) Jupiter is less dense and has a shorter period of rotation.
(4) Jupiter is more dense and has a longer period of rotation.

6. Scientists believe that Earth’s early atmosphere changed in composition as a result of
(1) the drifting of the continents
(2) the appearance of oxygen-producing organisms
(3) a transfer of gases from the Sun
(4) the changes in Earth’s magnetic field

7. The primary chemical constituent of the Jovian planets is
(1) iron
(2) oxygen
(3) hydrogen
(4) ammonia
8. The atmosphere of Venus is composed primarily of
   (1) ammonia
   (2) hydrogen and helium
   (3) methane
   (4) carbon dioxide

9. Most of Earth's atmosphere comes from
   (1) gas captured as Earth passed through a gas cloud
   (2) the gas surrounding Earth at the time of its formation
   (3) escaped gas from the sun
   (4) gas released from the interior of our planet

10. What was the most abundant gas present in the original planetary atmosphere?
    (1) water vapor
    (2) carbon dioxide
    (3) hydrogen
    (4) methane

11. The giant planets are composed primarily of
    (1) iron
    (2) rocky materials
    (3) hydrogen and helium
    (4) carbon dioxide

12. Most scientists believe the Milky Way Galaxy is
    (1) composed of stars revolving around Earth
    (2) spherical in shape
    (3) one of billions of galaxies in the universe
    (4) 4.6 billion years old

13. Which sequence correctly lists the relative sizes from smallest to largest?
    (1) Milky Way Galaxy, universe, our solar system
    (2) Milky Way Galaxy, our solar system, universe
    (3) our solar system, Milky Way Galaxy, universe
    (4) our solar system, universe, Milky Way Galaxy

14. Compared to Earth's solar system, the universe is inferred to be
    (1) younger and larger
    (2) older and smaller
    (3) older and larger
    (4) younger and smaller

15. The diagram below represents the shape of the Milky Way Galaxy.

![The Milky Way Galaxy is best described as]

    (1) irregular
    (2) elliptical
    (3) spiral
    (4) circular

16. Which celestial feature is largest in actual size?
    (1) the Milky Way
    (2) the Moon
    (3) Jupiter
    (4) the Sun

17. The Milky Way galaxy is best described as
    (1) a constellation visible to everyone on Earth
    (2) a type of solar system
    (3) a spiral-shaped formation composed of billions of stars
    (4) a region in space between the orbits of Mars and Jupiter

18. The Sun's position in space is best described as
    (1) the approximate center of
    (2) our solar system
    (3) the Milky Way galaxy
    (4) the universe

19. A light year is
    (1) the distance traveled by light in one year
    (2) the time it takes light to travel one year
    (3) the time it takes light to go once around the Earth's orbit
    (4) the distance the Earth moves in one year
20. What is the name usually given to the group of objects consisting of a sun and any planets, comets, and other objects that orbit it?
(1) a solar system  (3) a galaxy
(2) an ecosystem  (4) a universe

21. The unit most used by astronomers to express the distances to other galaxies is
(1) kilometers
(2) miles
(3) Lightyears (LY)
(4) astronomical unit (AU)

22. In which list are celestial features correctly shown in order of increasing size?
(1) solar system → galaxy → planet → universe
(2) galaxy → solar system → universe → planet
(3) planet → solar system → galaxy → universe
(4) universe → galaxy → solar system → planet

23. The diagram below represents a side view of the Milky Way Galaxy.

At approximately which position is Earth’s solar system located?
(1) A  (3) C
(2) B  (4) D

24. Billions of stars in the same region of the universe are called
(1) solar systems  (3) constellations
(2) galaxies  (4) asteroid belts

25. The redshift of light from distant galaxies provides evidence that the universe is
(1) shrinking, only
(2) expanding, only
(3) remaining the same size
(4) shrinking and expanding in a cyclic pattern

26. Starlight from distant galaxies provides evidence that the universe is expanding because this starlight shows a shift in wavelength toward the
(1) blue-light end of the visible spectrum
(2) red-light end of the visible spectrum
(3) ultraviolet-ray end of the electromagnetic spectrum
(4) gamma-ray end of the electromagnetic spectrum

27. The diagram below shows a standard spectrum compared to a spectrum produced from a distant star.

Which conclusion can be made by comparing the standard spectrum to the spectrum produced from this distant star?
(1) The star’s spectral lines have shifted toward the ultraviolet end of the spectrum and the star is moving toward Earth.
(2) The star’s spectral lines have shifted toward the infrared end of the spectrum and the star is moving toward Earth.
(3) The star’s spectral lines have shifted toward the infrared end of the spectrum and the star is moving away from Earth.
(4) The star’s spectral lines have shifted toward the ultraviolet end of the spectrum and the star is moving away from Earth.

28. The more that the spectral lines of a star are shifted to the red end of the spectrum
(1) the larger it is.
(2) the hotter it is
(3) the faster it is rotating
(4) the faster it is moving away from us
29. In the diagram below, the spectral lines of hydrogen gas from three galaxies, A, B, and C, are compared to the spectral lines of hydrogen gas observed in a laboratory.

![Spectral lines diagram]

What is the best inference that can be made concerning the movement of galaxies A, B, and C?

1. Galaxies A, B, and C are all moving away from Earth.
2. Galaxy B is moving away from Earth, but galaxies A and C are moving toward Earth.
3. Galaxies A, B, and C are all moving toward Earth.
4. Galaxy A is moving away from Earth, but galaxies B and C are moving toward Earth.

30. The velocity of a star toward or away from the Earth can be determined by measuring the

1. color of the star
2. shift of its spectral lines
3. brightness of the star
4. its change in apparent size

31. During a total solar eclipse one might view

1. sun spots
2. the sun's corona
3. the sun's solar winds
4. nothing of the sun, since it is totally blocked by the moon

32. The most abundant element on the sun is

1. hydrogen
2. helium
3. oxygen
4. carbon

33. The diagram below represents a standard dark-line spectrum for an element.

![Spectrum diagram]

The spectral lines of this element are observed in light from a distant galaxy. Which diagram represents these spectral lines?

1. ![Spectrum 1]
2. ![Spectrum 2]
3. ![Spectrum 3]
4. ![Spectrum 4]

34. The most observable phenomena in the "Solar Cycle" is the appearance of

1. solar storms
2. solar eclipses
3. black holes
4. sun spots

35. Sun spots are believed to be most closely related to the sun's

1. period of rotation
2. magnetic field
3. corona
4. changing size

36. Approximately how many times larger is the diameter of the sun compared to the earth?

1. 10 times
2. 100 times
3. 1000 times
4. 10,000 times
37. Which star’s surface temperature is closest to the temperature at the boundary between Earth’s mantle and core?
   (1) Rigel  (3) Sirius
   (2) Betelgeuse  (4) the Sun

38. Which two stars have the most similar luminosity and temperature?
   (1) Alpha Centauri and the Sun
   (2) Betelgeuse and Barnard’s Star
   (3) Rigel and Betelgeuse
   (4) Sirius and Procyon B

39. Which star color indicates the hottest star surface temperature?
   (1) yellow  (3) blue
   (2) red  (4) white

40. Stars are believed to undergo evolutionary changes over millions of years. The flowchart below shows stages of predicted changes in the Sun.

   According to this flowchart, the Sun will become
   (1) hotter and brighter in stage 2, then cooler and dimmer in stage 3
   (2) hotter and dimmer in stage 2, then cooler and brighter in stage 3
   (3) cooler and dimmer in stage 2, then hotter and brighter in stage 3
   (4) cooler and brighter in stage 2, then hotter and dimmer in stage 3
Base your answers to questions 41 through 43 on the diagram below, which shows two possible sequences in the life cycle of stars, beginning with their formation from nebular gas clouds in space.

41. According to the diagram, a star like Earth’s Sun will eventually
   (1) become a black hole  (3) explode in a supernova
   (2) become a neutron star  (4) change into a white dwarf

42. Stars like Earth’s Sun most likely formed directly from a
   (1) black dwarf  (2) supernova  (3) nebula  (4) red giant

43. According to the diagram, the life-cycle path followed by a star is determined by the star’s initial
   (1) temperature and origin  (3) mass and size
   (2) luminosity and structure  (4) luminosity and color

44. Which of the following stars is least bright?
   (1) a red giant  (3) a blue supergiant
   (2) the sun  (4) a white dwarf

45. Compared to the sun a white dwarf star is
   (1) hotter and larger  (3) cooler and larger
   (2) hotter and smaller  (4) cooler and smaller

46. Barnard's Star has a surface temperature of
   about
   (1) 300 °C  (3) 5000 °C
   (2) 3000 °C  (4) 10,000 °C
47. What is Jupiter’s distance from the Sun, in astronomical units? Express your answer to the nearest tenth.

__________________ AU

48. State the relationship between a planet’s distance from the Sun and the temperature at which that planet formed.

49. Saturn is located 9.5 AU from the Sun. State the approximate temperature at which Saturn formed.

__________________ K

50. According to the graph, Neptune was mainly composed of which material at the time of its formation?

51. Compared to the sun, stars near the top of the H-R diagram are always
   (1) about the same brightness
   (2) much hotter
   (3) over 10,000 times brighter
   (4) much redder
52. The graph below represents the brightness and temperature of stars visible from Earth.

Which location on the graph best represents a star with average brightness and temperature?

(1) A  (3) C
(2) B  (4) D

53. In the H-R diagram, 90 percent of all stars fall
(1) in the Red Dwarf region.
(2) on the Main Sequence.
(3) in the Supergiant region.
(4) among the White Dwarfs.

54. What factor below usually determines whether a star will be on the main sequence?

(1) age
(2) size
(3) distance from our sun.
(4) mass

55. Compared to the surface temperature and luminosity of massive stars in the Main Sequence, the smaller stars in the Main Sequence are

(1) cooler and more luminous
(2) cooler and less luminous
(3) hotter and more luminous
(4) hotter and less luminous

56. Which stars are the youngest?

(1) Red Dwarfs  (3) Blue star
(2) White dwarf  (4) Supergiant

57. The explosion of a massive star near the end of its life is known as a

(1) pulsar  (3) nebula
(2) nova  (4) supernova

58. By using a spectroscopy an astronomer can

(1) identify elements in the atmosphere of a star
(2) measure the size of a star
(3) measure the altitude of a star
(4) measure the diameter of a star
The diagram above shows a view of the ground from directly above a flagpole in New York State at solar noon on a particular day of the year. The flagpole’s shadow at solar noon is shown. Draw the position and relative length of the shadow that would be cast by this flagpole three hours later.
1. 3  
2. 4  
3. 3  
4. 1  
5. 3  
6. 2  
7. 3  
8. 4  
9. 4  
10. 4  
11. 3  
12. 3  
13. 3  
14. 3  
15. 3  
16. 1  
17. 3  
18. 4  
19. 1  
20. 1  
21. 3  
22. 3  
23. 2  
24. 2  
25. 2  
26. 2  
27. 3  
28. 4  
29. 1  
30. 2  
31. 2  
32. 1  
33. 4  
34. 4  
35. 2  
36. 2  
37. 4  
38. 1  
39. 3  
40. 4  
41. 4  
42. 3  
43. 3  
44. 4  
45. 4  
46. 2  
47. 5.2 AU  
48. Examples: — As distance from the Sun increases, temperature decreases. — 
49. Any value from 150 K to 200 K. 
50. Frozen gases 
51. 3  
52. 2  
53. 2  
54. 1  
55. 2  
56. 3  
57. 4  
58. 1  
59. Essay