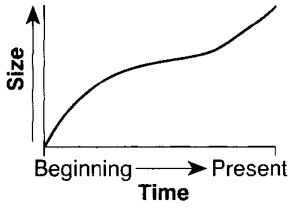
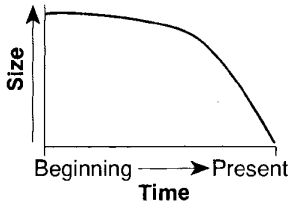
THE UNIVERSE

____ 1. According to the Big Bang theory, which graph best represents the relationship between time and the size of the universe from the beginning of the universe to the present?

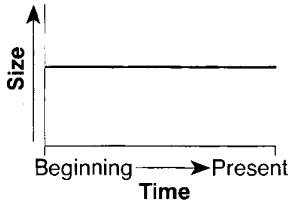
A



B



C



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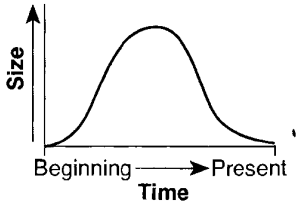
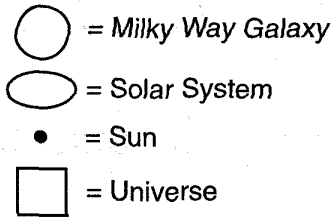


____ 2. In which list are the forms of electromagnetic energy arranged in order from longest to shortest wavelengths?

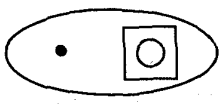
A gamma rays, x-rays, ultraviolet rays, visible light
B radio waves, infrared rays, visible light, ultraviolet rays
C x-rays, infrared rays, blue light, gamma rays
D infrared rays, radio waves, blue light, red light

____ 3. The symbols below represent the Milky Way galaxy, the solar system, the Sun, and the universe.

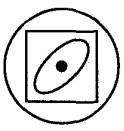


Which arrangement of symbols is most accurate?

A



B



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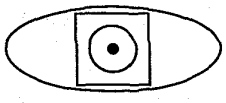

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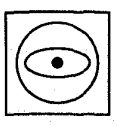
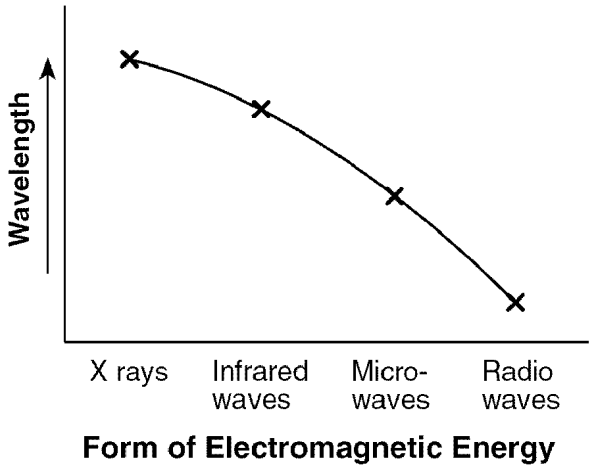
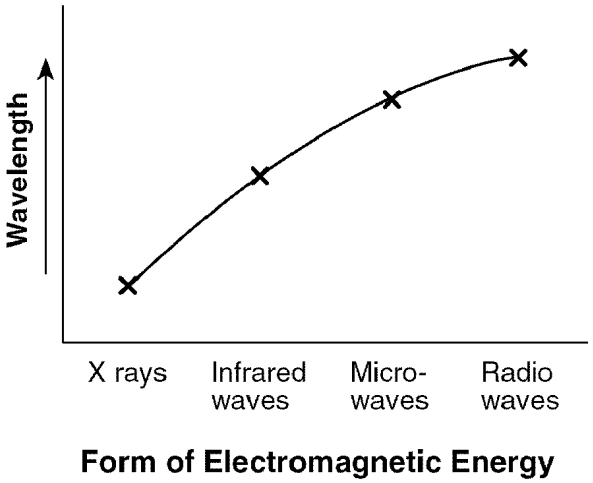


____ 4. Which graph best represents the relative wavelengths of the different forms of electromagnetic energy?

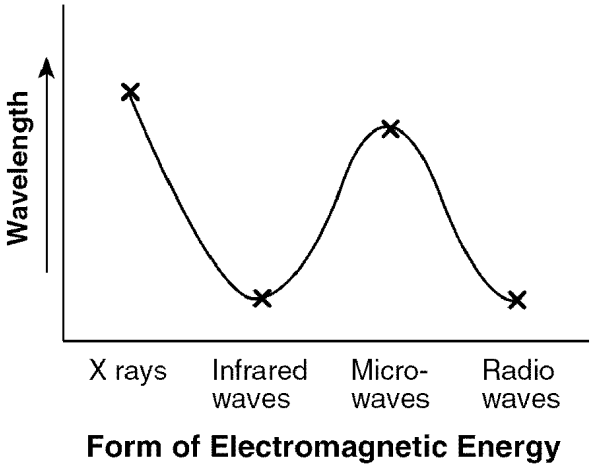
A



B



C



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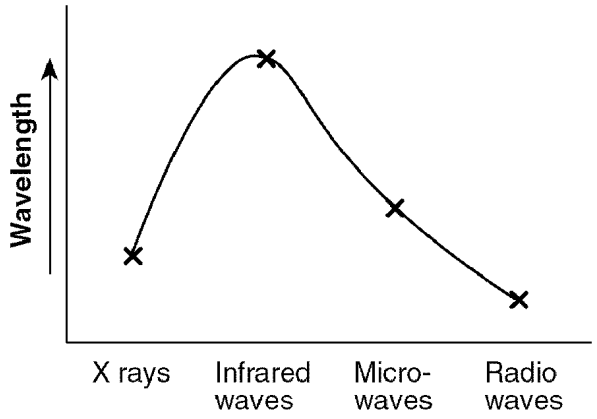


Form of Electromagnetic Energy

____ 5. In which sequence are the items listed from least total mass to greatest total mass?

A solar system, Milky Way, universe
B Milky Way, solar system, universe
C universe, Milky Way, solar system
D Milky Way, universe, solar system

____ 6. Cosmic microwave background radiation is classified as a form of electromagnetic energy because it

A travels in waves through space
B moves faster than the speed of light
C is visible to humans
D moves due to particle collisions

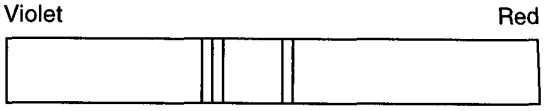
____ 7. The velocity of a star toward or away from the Earth can be determined by measuring the

A color of the star
B shift of its spectral lines
C brightness of the star
D its change in apparent size

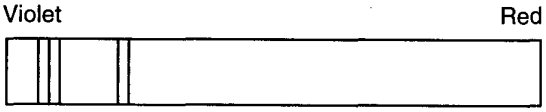
____ 8. According to the big bang theory, the universe began as an explosion and is still expanding. This theory is supported by observations that the stellar spectra of distant galaxies show a

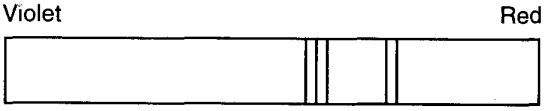
A concentration in the yellow portion of the spectrum
B concentration in the green portion of the spectrum
C shift toward the blue end of the spectrum
D shift toward the red end of the spectrum

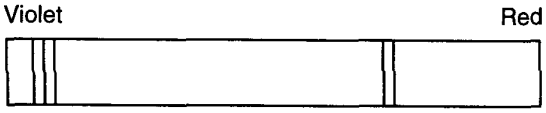
9. The diagram below represents a standard dark-line spectrum for an element.

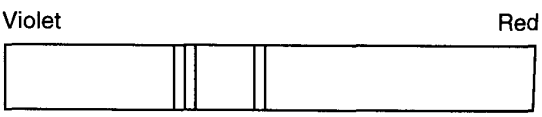


The spectral lines of this element are observed in light from a distant galaxy. Which diagram represents these spectral lines?

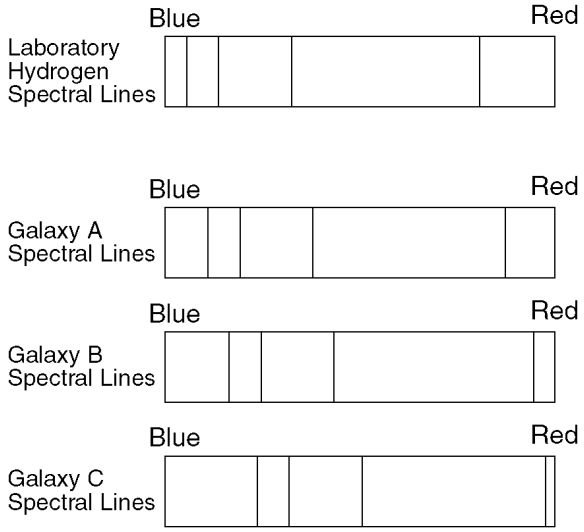
A 

B 

C 

D 

10. 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.



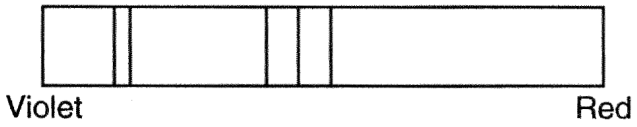
What is the best inference that can be made concerning the movement of galaxies *A, B,* and *C*?

A Galaxy *A* is moving away from Earth, but galaxies *B* and *C* are moving toward Earth.
B Galaxy *B* is moving away from Earth, but galaxies *A* and *C* are moving toward Earth.
C Galaxies *A, B,* and *C* are all moving toward Earth.
D Galaxies *A, B,* and *C* are all moving away from Earth.

11. Which evidence best supports the Big Bang theory?

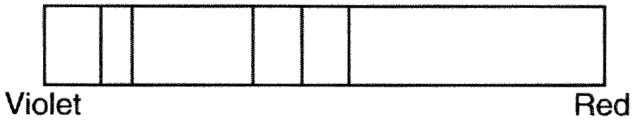
A rate of rotation of the Sun
B existence of cosmic background radiation
C uniform radioactive decay of uranium-238
D separation of Earth's interior into different layer

____ 12. The diagram below represents the spectral lines from the light of an element in a laboratory on Earth.

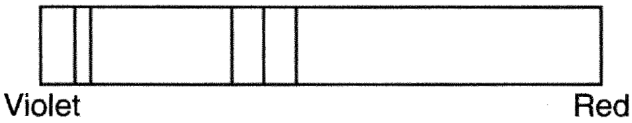


Which diagram below best represents the pattern of spectral lines from the same element when it was observed by Edwin Hubble in the light of one of the distant galaxies?

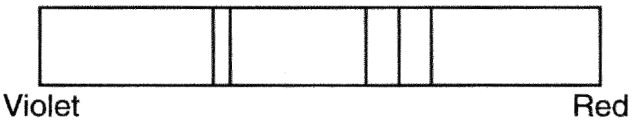
A



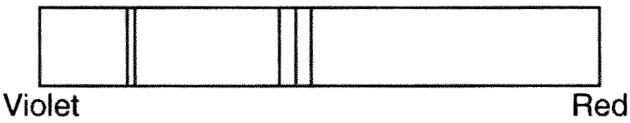
B



C



D



____ 13. If we observe a Doppler blue shift from a star, the star must be

A relatively cool in temperature
B moving away from us
C moving toward us
D a blue star

____ 14. All forms of electromagnetic energy have

A transverse wave properties
B the same temperature
C the same wavelength
D their own half-life

____ 15. A star moving away from the Earth will have a spectrum containing

A red shifted lines
B blue shifted lines
C unshifted lines
D dim lines

16. The red shift of visible light waves that is observed by astronomers on Earth is used to determine the

A sizes of nearby galaxies
B relative motions of distant galaxies
C densities of the planets
D rotation periods of the planets

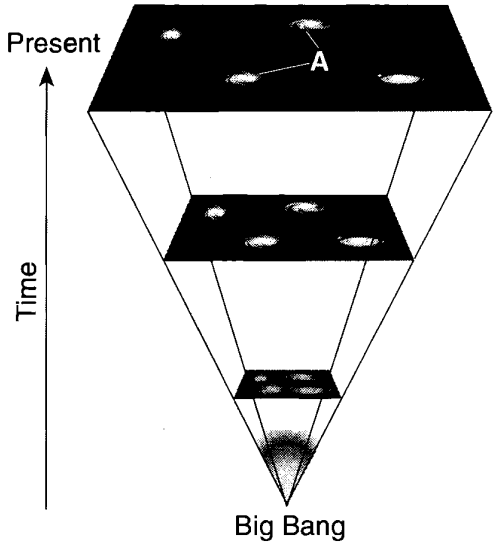
17. The redshift of light from distant galaxies provides evidence that the universe is

A shrinking, only
B expanding, only
C shrinking and expanding in a cyclic pattern
D remaining the same size

18. The unit most used by astronomers to express the distances to other galaxies is

A miles
B kilometers
C astronomical unit (AU)
D Lightyears (LY)

19. The diagram below represents the development of our universe from the time of the Big Bang until the present. Letter *A* indicates two celestial objects.



The present-day celestial objects labeled *A are best identified as*

A asteroid belts
B terrestrial planets
C spiral galaxies
D eccentric comets

20. In which list are celestial features correctly shown in order of increasing size?

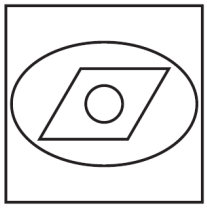
A galaxy → solar system → universe → planet
B solar system → galaxy → planet → universe
C planet → solar system → galaxy → universe
D universe → galaxy → solar system → planet

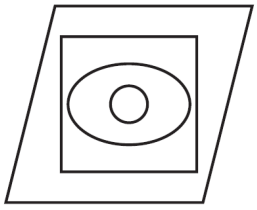
21. The symbols below are used to represent different regions of space.

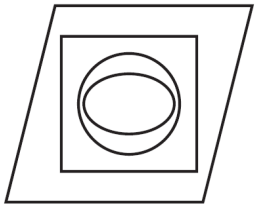
Universe =  Earth =  Galaxy =  Solar system = 

Which diagram shows the correct relationship between these four regions? [If one symbol is within another symbol, that means it is part of, or included in, that symbol.]

A 

B 

C 

D 

22. Which sequence correctly lists the relative sizes from smallest to largest?

A our solar system, universe, Milky Way Galaxy
B our solar system, Milky Way Galaxy, universe
C Milky Way Galaxy, our solar system, universe
D Milky Way Galaxy, universe, our solar system

Base your answers to questions **23** through **25** on the table below, which shows eight inferred stages describing the formation of the universe from its beginning to the present time.

Data Table

Stage	Description of the Universe	Average Temperature of the Universe (°C)	Time From the Beginning of Universe
1	the size of an atom	?	0 second
2	the size of a grapefruit	?	10^{-43} second
3	"hot soup" of electrons	10^{27}	10^{-32} second
4	Cooling allows protons and neutrons to form.	10^{13}	10^{-6} second
5	still too hot to allow the forming of atoms	10^{8}	3 minutes
6	Electrons combine with protons and neutrons, forming hydrogen and helium atoms. Light emission begins.	10,000	300,000 years
7	Hydrogen and helium form giant clouds (nebulae) that will become galaxies. First stars form.	–200	1 billion years
8	Galaxy clusters form and first stars die. Heavy elements are thrown into space, forming new stars and planets.	–270	13.7 billion years

____ 23. How soon did protons and neutrons form after the beginning of the universe?

A 10^{-43} second
B 10^{-32} second
C 10^{-6} second
D 13.7 billion years

____ 24. What is the most appropriate title for this table?

A The Big Bang Theory
B The Theory of Plate Tectonics
C The Law of Superposition
D The Laws of Planetary Motion

____ 25. According to this table, the average temperature of the universe since stage 3 has

A decreased, only
B increased, only
C remained the same
D increased, then decreased

____ 26. Which statement best describes the age of our solar system and the universe?

A The universe is at least twice as old as our solar system.
B Our solar system is at least twice as old as the universe.
C Our solar system and the universe are estimated to be 5 billion years old.
D Our solar system and the universe are estimated to be 10 billion years old.

____ 27. The Doppler effect predicts that light from a source moving away from Earth will be

A shifted to shorter wavelengths.
B shifted to longer wavelengths.
C appear blue.
D appear red.

____ 28. Cosmic background radiation provides direct evidence for the origin of

A the universe
B our solar system
C Earth's ozone layer
D Earth's earliest atmosphere

____ 29. Compared to Earth's solar system, the universe is inferred to be

A younger and larger
B younger and smaller
C older and larger
D older and smaller

____ 30. The more that the spectral lines of a star are shifted to the red end of the spectrum

A the larger it is.
B the faster it is rotating
C the hotter it is
D the faster it is moving away from us

____ 31. Which statement about electromagnetic energy is correct?

A Violet light has a longer wavelength than red light.
B X-rays have a longer wavelength than infrared waves.
C Radar waves have a shorter wavelength than ultraviolet rays.
D Gamma rays have a shorter wavelength than visible light.

32. The current temperature indicated by the cosmic microwave background radiation is

A higher than the temperature at which water boils
B between the temperature at which water boils and room temperature
C between room temperature and the temperature at which water freezes
D lower than the temperature at which water freezes

33. Astronomers viewing light from distant galaxies observe a shift of spectral lines toward the red end of the visible spectrum. This shift provides evidence that

A orbital velocities of stars are decreasing
B Earth's atmosphere is warming
C the Sun is cooling
D the universe is expanding

Base your answers to questions **34** and **35** on the passage below and on your knowledge of Earth Science.

Cosmic Microwave Background Radiation

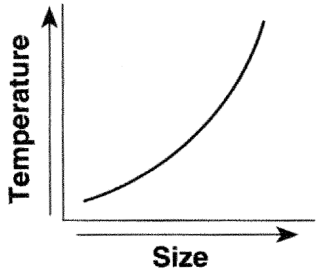
In the 1920s, Edwin Hubble's discovery of a pattern in the red shift of light from galaxies moving away from Earth led to the theory of an expanding universe. This expansion implies that the universe was smaller, denser, and hotter in the past. In the 1940s, scientists predicted that heat (identified as cosmic microwave background radiation) left over from the Big Bang would fill the universe. In the 1960s, satellite probes found that cosmic microwave background radiation fills the universe uniformly in every direction, and indicated a temperature of about 3 kelvins (K). This radiation has been cooling as the universe has been expanding.

34. Scientists infer that the universe began approximately

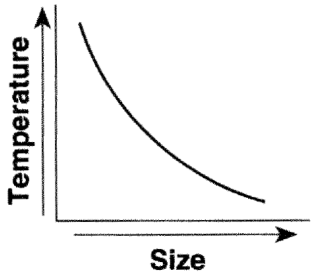
A 1.0 billion years ago
B 3.3 billion years ago
C 8.2 billion years ago
D 13.7 billion years ago

35. Which graph best shows the relationship of the size of the universe to the temperature indicated by the cosmic microwave background radiation?

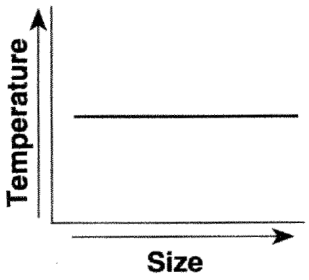
A



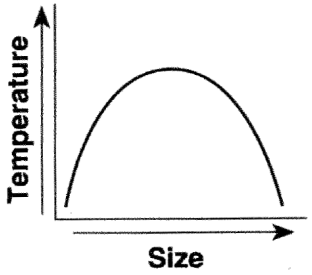
B



C



D



36. The major evidence supporting the "Big Bang" theory is

A observations of supernova explosions.
B the discovery of black holes.
C observations that the Doppler red shift becomes greater as we look at more distant galaxies.
D observations that most galaxies are rotating

37. Compared to light from from a stationary source at the same point, light from an object moving toward you is

A brighter
B bluer
C redder
D unchanged in both color and brightness

38. Infrared, ultraviolet, and visible light are all part of the solar spectrum. The basic difference between them is their

A wavelength B speed C source D temperature

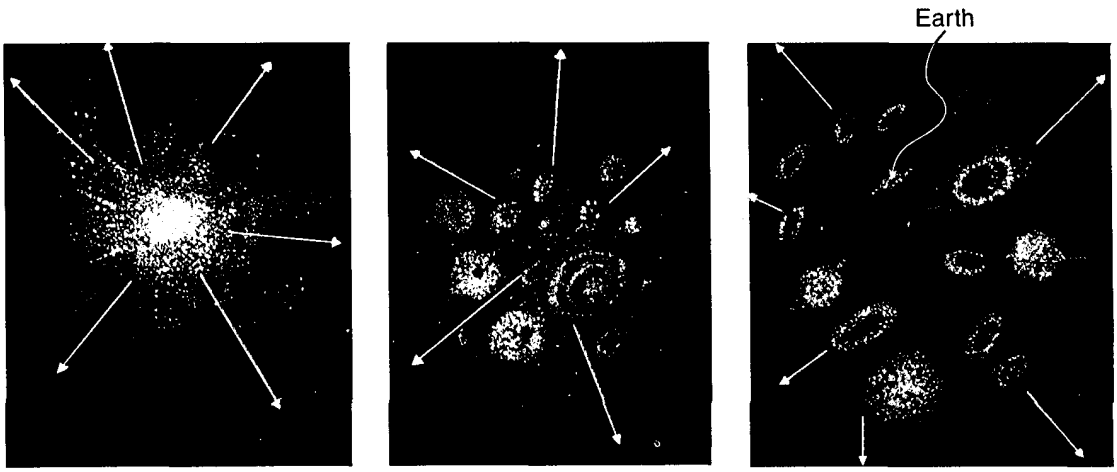
____ 39. Starlight from distant galaxies provides evidence that the universe is expanding because this starlight shows a shift in wavelength toward the

A red-light end of the visible spectrum
B blue-light end of the visible spectrum
C ultraviolet-ray end of the electromagnetic spectrum
D gamma-ray end of the electromagnetic spectrum

____ 40. When viewed from Earth, the light from very distant galaxies shows a red shift. This is evidence that these distant galaxies are

A revolving around the Sun
B revolving around the Milky Way
C moving away from Earth
D moving toward Earth

____ 41. The diagram below illustrates three stages of a current theory of the formation of the universe.



A major piece of scientific evidence supporting this theory is the fact that wavelengths of light from galaxies moving away from Earth in stage 3 are observed to be

A shorter than normal (a red shift)
B shorter than normal (a blue shift)
C longer than normal (a red shift)
D longer than normal (a blue shift)

42. What is the basic difference between ultraviolet, visible, and infrared radiation?

A half-life B temperature C wavelength D wave velocity

43. The Big Bang Theory, describing the creation of the universe, is most directly supported by the

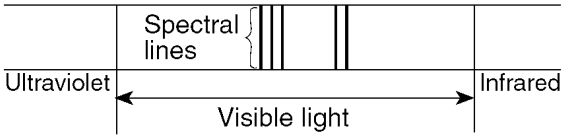
A redshift of light from distant galaxies B presence of volcanoes on Earth
C apparent shape of star constellations D presence of craters on Earth's Moon

44. Which form of electromagnetic energy has the longest wavelength?

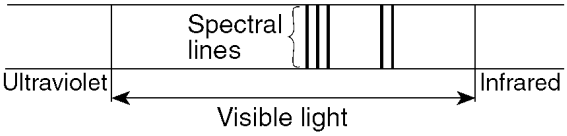
A ultraviolet rays B visible light
C gamma rays D radio waves

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

Standard Spectrum



Spectrum from Distant Star



Which conclusion can be made by comparing the standard spectrum to the spectrum produced from this distant star?

A The star's spectral lines have shifted toward the ultraviolet end of the spectrum and the star is moving toward Earth.
B The star's spectral lines have shifted toward the ultraviolet end of the spectrum and the star is moving away from Earth.
C The star's spectral lines have shifted toward the infrared end of the spectrum and the star is moving toward Earth.
D The star's spectral lines have shifted toward the infrared end of the spectrum and the star is moving away from Earth.

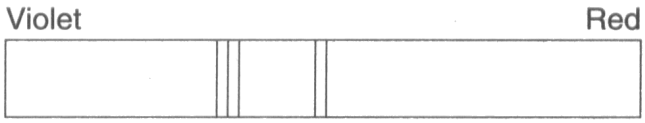
____ 46. According to Hubbell's law more rapidly moving galaxies are now

A further away from us
B closer to us
C accelerating rapidly
D already contracting toward another big bang

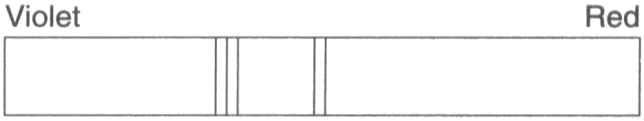
____ 47. A light year is

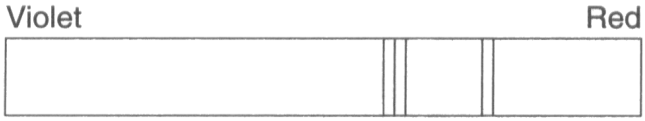
A the distance traveled by light in one year
B the distance the Earth moves in one year
C the time it takes light to go once around the Earth's orbit
D the time it takes light to travel one year

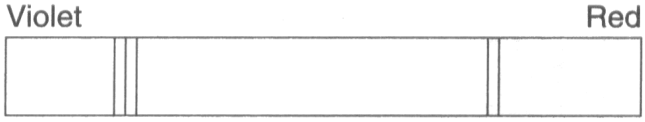
____ 48. The diagram below shows the spectral lines for an element.

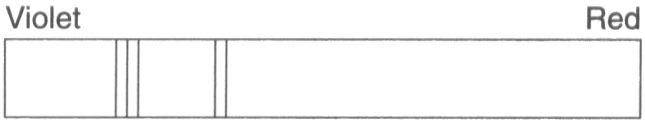


Which diagram best represents the spectral lines of this element when its light is observed coming from a star that is moving away from Earth?

A 

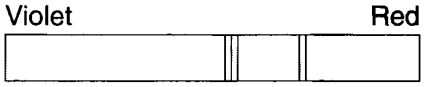
B 

C 

D 

____ 49. The diagram below represents the bright-line spectrum for an element.

The spectrum of the same element observed in the light from a distant star is shown below.



The shift in the spectral lines indicates that the star is moving

A toward Earth
B away from Earth
C in an elliptical orbit around the Sun
D in a circular orbit around the Sun

____ 50. Most astronomers agree that at the present time universe is

A contracting
B expanding
C staying the same size
D expanding and contracting regularly

____ 51. A blue shift of the light from a star indicates that the star

A will soon become a main sequence star
B will soon become a giant star
C is moving closer to Earth
D is moving away from Earth

____ 52. Which type of electromagnetic energy has the longest wavelength?

A infrared radiation
B radio wave radiation
C ultraviolet radiation
D x-ray radiation

____ 53. Which color of the visible spectrum has the *shortest* wavelength?

A violet B blue C yellow D red

____ 54. Which information best supports the inference that the universe began with an explosion?

A measurements of rates of decay using carbon-14
B measurements of cosmic background radiation
C calculations of the distance from the Sun to each asteroid in the asteroid belt
D calculations of the temperature and luminosity of stars

____ 55. In a Doppler red shift, the observed wavelengths of light from distant celestial objects appear closer to the red end of the spectrum than light from similar nearby celestial objects. The explanation for the red shift is that the universe is presently

A contracting, only
B expanding, only
C remaining constant in size
D alternating between contracting and expanding

____ 56. A red shift in the light from very distant galaxies suggests that the universe is

A fixed and stationary
B moving randomly
C contracting
D expanding

____ 57. Evidence that the universe is expanding is best provided by the

A red shift in the light from distant galaxies
B change in the swing direction of a Foucault pendulum on Earth
C parallelism of Earth's axis in orbit
D spiral shape of the Milky Way Galaxy

____ 58. What does a red shift in light from distant celestial objects indicate to a scientist on Earth?

A The gravitational force on Earth changes.
B The universe appears to be expanding.
C The Jovian planets are aligned with the Sun.
D Galaxies are becoming more numerous.

____ 59. Compared to the wavelength of ultraviolet radiation, the wavelength of infrared radiation is

A shorter B longer C the same

____ 60. Compared to the wavelength of ultraviolet radiation, the wavelength of infrared radiation is

A shorter B longer C the same

____ 61. The red shift of light from most galaxies is evidence that

A most galaxies are moving away from Earth
B a majority of stars in most galaxies are red giants
C the light slows down as it nears Earth
D red light travels faster than other colors of light

____ 62. The theory that the universe is expanding is supported by the

A blue shift of light from distant galaxies
B red shift of light from distant galaxies
C nuclear fusion occurring in the Sun
D radioactive decay occurring in the Sun

____ 63. The explosion associated with the theory and the formation of the universe inferred to have occurred how many billion ago?

A less than 1 B 2.5 C 4.6 D over 10