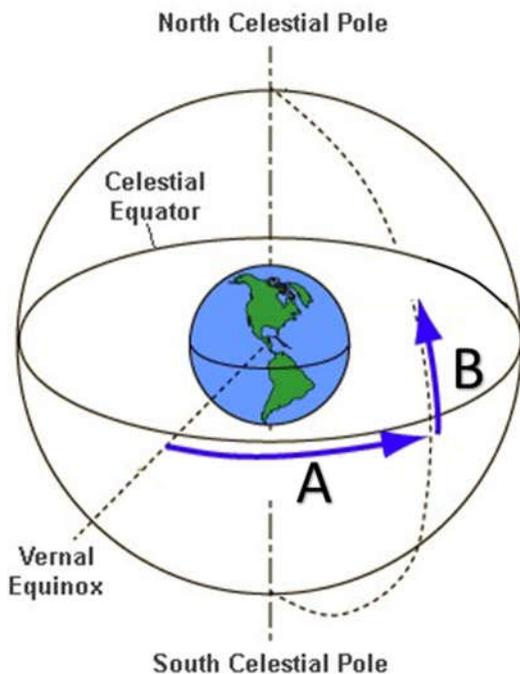


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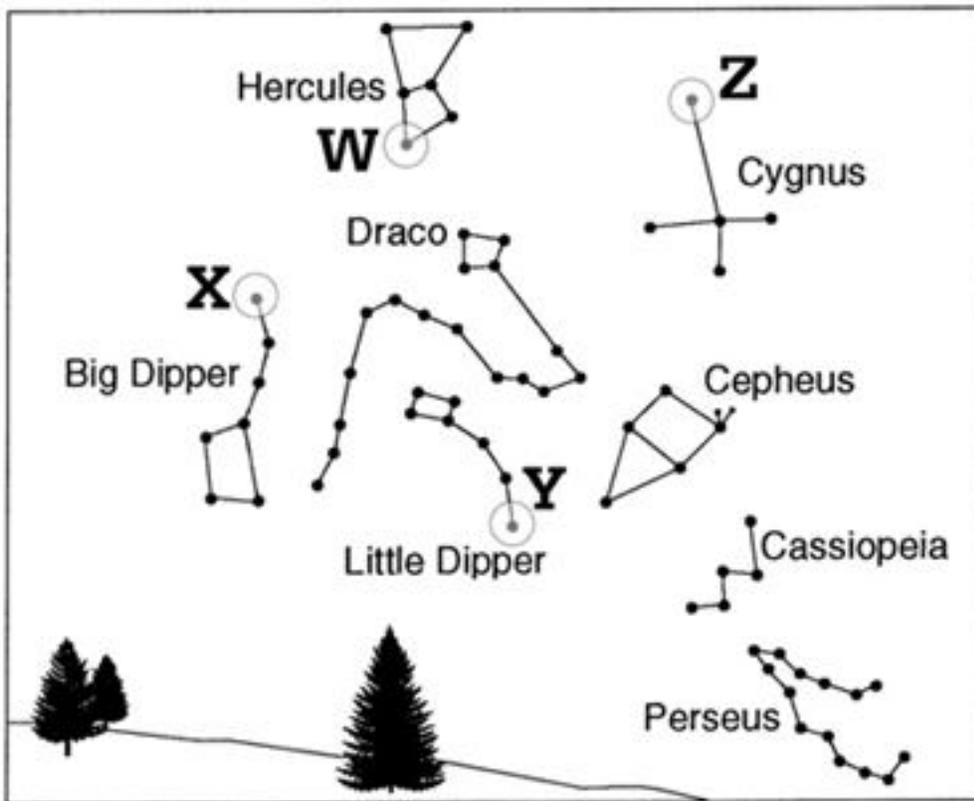
1. Why do objects you see in the sky at night change throughout the year?
 - a. As the Earth rotates on its axis, the objects change positions.
 - b. As the solar system moves, the objects in the night sky change positions.
 - c. This is due to Earth's revolution around the Sun.
 - d. This is due to the motion of our galaxy, the Milky Way
2. The Big Dipper, Orion's Belt and the Little Dipper are examples of
 - a. Constellations
 - b. Declinations
 - c. Asterisms
 - d. Astrology
3. At the start of each of earth's four seasons, the sun shines directly on
 - a. the equator
 - b. each latitude equally
 - c. the celestial equator
 - d. the equator or tropic lines

Use the following diagram for the next two questions



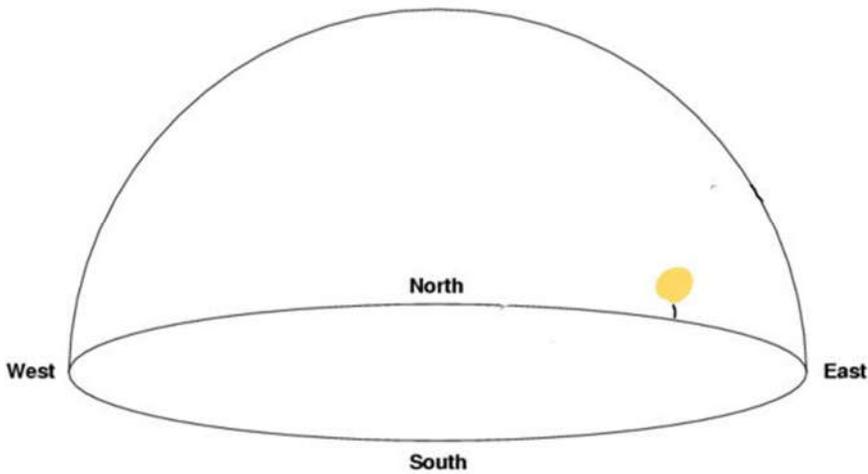
4. Examine the diagram below. What does label B represent?
 - a. The equator
 - b. Right Ascension
 - c. Left Ascension
 - d. Declination
5. Examine the diagram below. What does label A represent?
 - a. The equator

- b. Right Ascension
 - c. Left Ascension
 - d. Declination
6. When stargazing the stars appear to move from _____.
- a. east to west
 - b. west to east
 - c. north to west
 - d. south to west
7. What is a constellation?
- a. A grouping of several thousands of stars that forms a recognizable pattern.
 - b. A grouping of several stars that forms a recognizable pattern.
 - c. A collection of several galaxies.
 - d. A collection of several solar systems.
8. The diagram below shows some constellations in the night sky viewed by a group of students. The diagram shows the positions of the constellations at 9:00 PM.



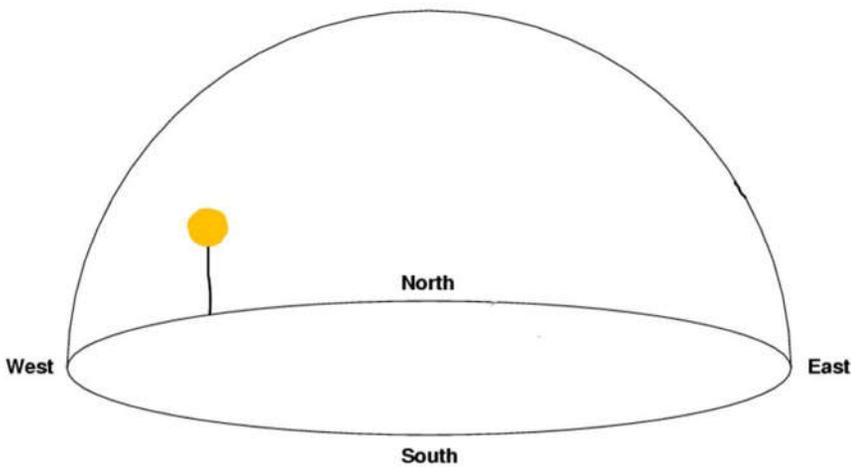
9. Which letter indicates the position of the star Polaris?
- a. letter Y
 - b. letter Z
 - c. letter X
 - d. letter W
10. Which are the correct terms for astronomical coordinates?
- a. right declination and inclination
 - b. declination and left ascension

- c. declination and right ascension
 - d. right declination and ascension
11. The astronomical coordinate declination can be likened to:
- a. longitude
 - b. latitude
 - c. altitude
 - d. Depth
12. The celestial sphere is thought to be much like latitude and longitude on Earth because it is:
- a. an imaginary transparent grid of Earth's southern hemisphere.
 - b. an imaginary transparent grid on Earth's surface.
 - c. an imaginary transparent grid in the sky at night.
 - d. an imaginary transparent grid outside the solar system.
13. What is the celestial sphere?
- a. Earth's Southern Hemisphere
 - b. an imaginary transparent grid on Earth's surface
 - c. an imaginary transparent grid in the sky at night
 - d. an imaginary transparent grid outside the solar system
14. How is the angle of declination measured? *declination is measured in degrees, minutes, and seconds
- a. Plus or minus degrees
 - b. Hours and minutes
 - c. Hours and degrees
 - d. None of the above
15. Constellations are important reference points for locating
- a. Planets
 - b. Comets
 - c. Stars
 - d. All of the above
16. Just like how the Prime Meridian divides the East from the West on Earth, which of these imaginary lines divides the Celestial Sphere into the East and West?
- a. Meridian
 - b. Celestial Equator
 - c. Ecliptic
 - d. Zenith
17. Find the altitude of the sun.



- a. 10°
- b. 40°
- c. 75°
- d. 90°

18. Find the altitude of the sun.



- a. 10°
- b. 40°
- c. 75°
- d. 90°

SC.912.E.5.11

19. A trip to Proxima Centauri at the speed of light would take 4.2 years. What is the distance from Earth to Proxima Centauri?

- a. 4.2 billion miles
- b. 4.2 million miles
- c. 4,200 kilometers
- d. 4.2 light years

20. The following table displays the average distance from Earth for four objects. Which Object is

closest to Earth?

- a. Barnard's Star
- b. Planet Neptune
- c. Andromeda Galaxy
- d. Triangulum Galaxy

Object	Average distance from Earth
Barnard's Star	6 ly
Andromeda Galaxy	2.4 million ly
Triangulum Galaxy	2.6 million ly
Planet Neptune	4.3 billion km

21. Which of the following correctly lists the units of measure from smallest to largest?

- a. Light year, meter parsec, kilometer, astronomical unit
- b. Meter, kilometer, astronomical unit, light year, parsec
- c. Parsec, meter, kilometer, astronomical unit, light year
- d. Meter, kilometer, astronomical unit, parsec, light year

22. A light year (ly) is the distance that light travels in one year. If a star is 3 ly from Earth, how long does it take light from that star to reach Earth?

- a. 3 min
- b. 3 h
- c. 3 y
- d. 3 ly

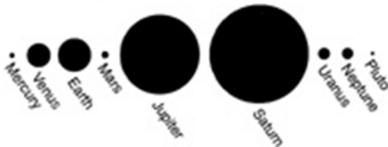
23. When measuring distances in the Universe, there are many options. Which type of unit for measuring distance is appropriate for measuring distances between stars?

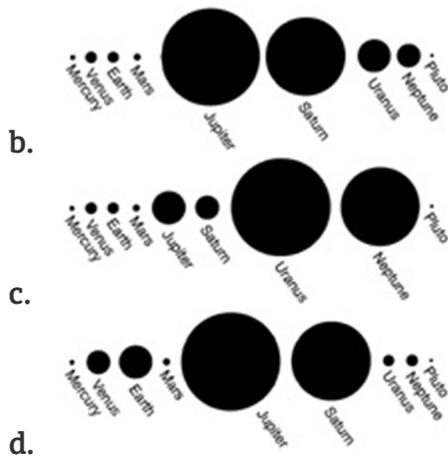
- a. Light year
- b. Astronomical Unit
- c. Kilometers
- d. Miles

24. If you are organizing planets from closest to furthest from the Sun, the sequence is as follows: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. What is the approximate distance for Mars in AU?

- a. 1 ly
- b. 1 AU
- c. 1.5 ly
- d. 1.5 AU

25. Which of the following best describes an Astronomical Unit?
- The distance from the core of the Earth to the core of the Moon.
 - The distance from the core of the Earth to the core of the Sun.
 - The distance across the Solar System.
 - The distance from the core of the Sun the core of the nearest planet.
26. Scientists use the light-year to describe the relationships between objects in space. What does a light-year measure?
- the distance that light can travel in one year
 - the brightness of light that travels through space
 - the number of years it takes light to travel to Earth
 - the time it takes light to travel 1 million km
27. Which celestial feature is largest in actual size?
- the Milky Way
 - the moon
 - Jupiter
 - The sun
28. A special unit called a light-year is used to describe the relationship between objects in space. How long is a light-year?
- 365 days
 - 950,000 km
 - 9.5 trillion days
 - 9.5 trillion km
29. Astronomers use the light-year to describe the relationship between objects in space. For example, the Andromeda galaxy is 2.5 million ly from Earth. Which of the following units is most similar to the light-year?
- Gram
 - Second
 - Kilometer
 - degrees Celsius
30. Two Stars are 2 ly apart. How many kilometers apart are these two stars?
- 19 billion km
 - 90 billion km
 - 19 trillion km
 - 90 trillion km
31. Which sequence in the diagram below correctly represents the relative size of the nine planets of our solar system?





32. Asteroids

Most known asteroids are found orbiting the Sun approximately halfway between the orbits of Mars and Jupiter, in a vast ring known as the Asteroid Belt. Occasionally, though, an asteroid leaves this orbit belt and moves into a more eccentric orbit that brings it into the inner solar system. This sudden change may be caused by an impact with another asteroid or by the gravitational pull of Jupiter or Mars. The closest known near-Earth collision was in 1994, when asteroid 1994 XL1 came within the Moon's orbit at a distance of 100,000 kilometers from Earth. Earth had missed hitting this asteroid by a mere 52 minutes. This asteroid was only about 15 hours away from Earth when it was first noticed. Only 30 feet in diameter, 1994 XL1 was 100,000 times fainter than an object that could be seen with the naked eye. Each year other asteroids are spotted coming close to Earth.

Evidence on Earth indicates that some asteroids have come close enough to be drawn into Earth by gravitational attraction. A 110-mile-wide crater discovered by oil geologists under the Yucatan Peninsula and the Gulf of Mexico is one such piece of evidence. This crater is closely linked to the extinction of the dinosaurs. Some scientists estimate that a 10-mile-wide asteroid caused this crater.

Approximately how many million kilometers from the Sun is the Asteroid Belt?

- 40 - 60 km
- 400 - 600 km
- 4,000 - 6,000 km
- 40,000 - 60,000 km

33. Which distance is greatest?

- 1 parsec
- 1 light year
- 2 light years
- 5 AU's

34. What unit of measurement would you use to give distances between close (neighbor) stars?

- Kilometer (km)

- b. Astronomical Unit (AU)
 - c. Parsecs (pc)
 - d. Light years (lys)
35. The average distance from the Earth to the Sun is:
- a. 100,00,000 meters
 - b. 10,000,000 meters
 - c. 1 Astronomical Unit
 - d. 10 Parsecs
36. you are asked to make a scale model of two objects that are 50,000,000 km apart. If you used a scale of 1 m = 10,000,000 km, how far apart will the two objects be on the model?
- a. 50,000,000 m
 - b. 50,000,000 km
 - c. 5 m
 - d. 5 km
37. Which term describes the apparent shift in the position of an object when a person views it from different locations?
- a. Ellipses
 - b. Parallax
 - c. axis of rotation
 - d. Parsec
38. Which of the following distances could be measured with several astronomical units (AU)?
- a. The distance from Earth to the Moon.
 - b. The distance Earth to Proxima Centauri (Nearest star to our Sun)
 - c. The distance from Earth to Jupiter.
 - d. The distance from Earth to the Sun

SC.912.N.3.1

39. Scientific theories are the culmination of many different observations and tested hypotheses. Which of the following statements best describes the characteristics of a scientific theory?
- a. Galileo's experiment where he dropped balls from the leaning tower of Pisa was the benchmark for scientific work on gravity. (Incorrect; students will recall Galileo's experiment as the first proof of gravity)
 - b. Newton's findings expanded Galileo's ideas, eventually Newton's work was accepted then and now as the most complete work on gravity. (Incorrect; students associate Newton with gravity without realizing that his work has been expanded upon)
 - c. Einstein's work on equivalence and gravitational forces represented the foremost work and remain the most current data regarding the theory of gravitation. (Incorrect; students associate Einstein with scientific innovation)
 - d. The current research on the theory of gravitation is always evolving based on new observations that were not available to previous scientists, allowing theories to be modified.

40. The Big Bang Theory offers an explanation about the formation of the universe as we know it. Discoveries and the dialogue that follow continue to add more evidence supporting the theory. New evidence leads to logical reasoning about the details of the universe's beginning and adds more credibility to the theory. How does scientific theory relate to the scientific method of inquiry?
- Theory cannot be tested. (incorrect: hypothesis is tested)
 - Theory determines observations. (incorrect: observations support theory)
 - Theory cannot be shared with others. (incorrect: theories can be shared and supported by evidence collected by others)
 - Theory changes as new data is collected.
41. The Kinetic Molecular Theory states several postulates about the behavior of gases. One of these is that collisions are perfectly elastic. How do scientists make such an assumption when gas molecules are invisible?
- through experimental observations and models
 - through data collection from outer space (incorrect; this theory is irrelevant to data from space)
 - through mutual agreement (incorrect; scientist rarely mutually agree, everything must be back with experimental results)
 - through theoretical logic (incorrect; logic is important but must be back by experimentation)
42. Which of the following scenarios most accurately depicts the process of scientific theory formation?
- Roger has been working on an experiment for over two years. He keeps getting the same results and has come up with the best explanation he can for what he has observed. (Incorrect - theories are based upon multiple investigations by several scientists.)
 - Zachary was working in a laboratory late one night and observed something he had never seen before. He has tried and tried to recreate the same conditions so he could observe the phenomenon again, but has not been successful. He has developed the best explanation for what he observed. (Incorrect - theories are based upon multiple investigations by several scientists of observed phenomena.)
 - Heloise, Stanley, and Dolores are colleagues in different countries. They have been working on an experiment for several years and have together developed an explanation for what they have observed. This theory may be altered with the findings of new investigations. (correct answer - theories are explanations that may change over time based upon results from multiple investigations by several scientists.)
 - Several years ago, Pedro developed an explanation based on results from an experiment. He shared those results with colleagues at a scientific meeting, but no one agreed with him. Earlier this year, Michaela conducted the same experiments and came up with a slightly different explanation based upon her results. Her theory will stay the same whether or not new evidence is presented. (Incorrect - theories typically

change over time due to new evidence/discoveries.)

43. Jose asked a question, which led to a hypothesis. Through experimentation he proved his hypothesis was correct. Victoria then expounded on this information and proposed another hypothesis. Again through experimentation, she substantiated both of their hypotheses.

What can Jose and Victoria propose to the scientific community?

- a. A law (incorrect; a law is derived from naturally observed phenomena, nothing in the scenario eludes to this)
- b. A purpose (incorrect; a purpose is not part of a scientific process)
- c. A reason (incorrect; a reason is not a scientific term reflecting on the process)
- d. A theory (correct answer - a theory is proposed for other scientist to validate or falsify)

SC.912.P.10.11

44. Which of the following is true about nuclear fission?

- a. it takes place in stars.
- b. it is the splitting apart of a nucleus into two or more nuclei.
- c. it does not produce radioactive waste
- d. it is not yet usable at an industrial level

45. Which of the following statements best describes Nuclear Fusion?

- a. When two small nuclei form one large heavy nucleus and releases energy
- b. When two small nuclei combine to form a single nucleus and releases neutrons along with energy
- c. When one heavy nucleus splits in half and releases neutrons along with energy
- d. When one heavy nucleus splits and creates 3 smaller particles and releases energy

46. If the sun stopped shining right now, the soonest it could be noticed on Earth would be:

- a. in a few seconds
- b. in a few minutes
- c. in a few hours
- d. in a few days

47. Why do sunspots look darker than the rest of the Sun's photosphere?

- a. Sunspots are somewhat cooler than the rest of the sun's surface.
- b. Sunspots are somewhat warmer than the rest of the sun's surface.
- c. Sunspots are not going through nuclear fusion all the time.
- d. Sunspots are not as bright than the rest of the sun's surface.

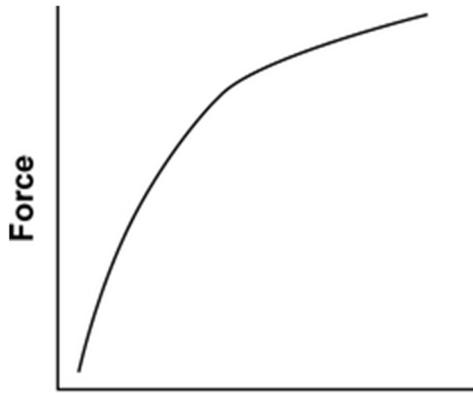
SC.912.P.12.4

48. The distance between two point masses is D . The gravitational force of attraction between them can be quadrupled by changing the distance to which of the following?

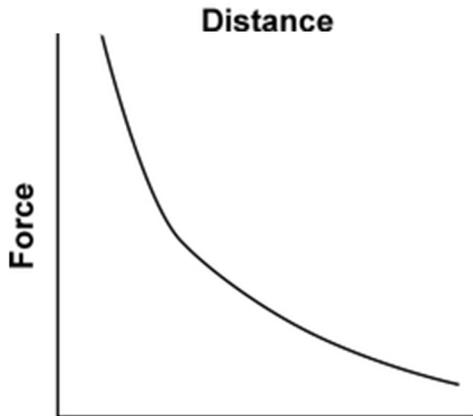
- a. $\frac{1}{4} D$
- b. $\frac{1}{2} D$
- c. $2 D$
- d. $4 D$

49. Which of the following graphs best represents the gravitational force between two point

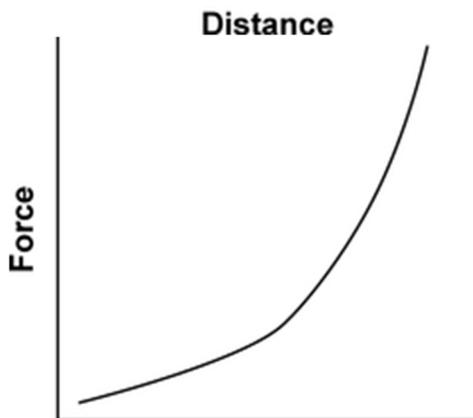
masses as a function of the distance between the masses?



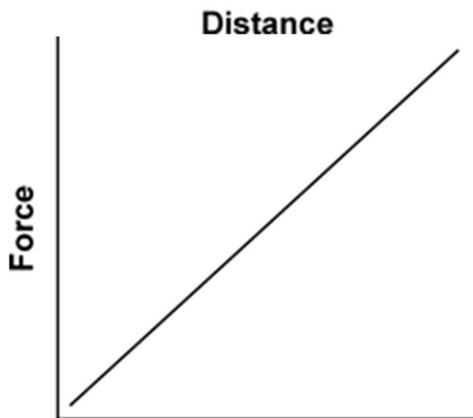
a.



b.



c.

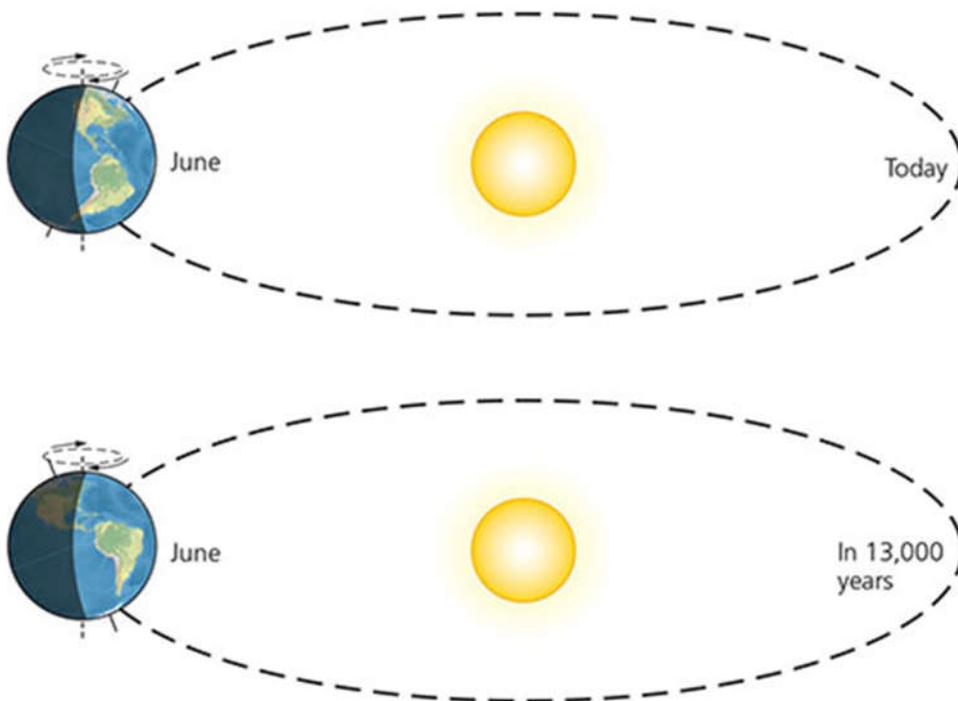


d.

Distance

50. Two bodies attract each other with a gravitational force of 10.0 newtons. What would be the force of attraction, in N, if the mass of each body were doubled? 40

51. An object weighs 100. newtons on Earth's surface. When it is moved to a point one Earth radius above Earth's surface, how much will it weigh, to the nearest tenth of a N?
- 50.0 N.
 - 25.0 N.
 400. N.
 100. N.
52. Point objects A and B are separated by distance R. Object A exerts a gravitational force of F on object B. If the mass of A is doubled and distance R is tripled, what is the new gravitational force that A exerts on B?
- $\frac{2}{9} F$
 - $\frac{2}{3} F$
 - $\frac{3}{2} F$
 - $\frac{9}{2} F$
53. Which of the following would increase the gravitational force of attraction between two objects?
- doubling the mass of one object and doubling the distance between the objects
 - doubling the distance between the objects, only
 - doubling the mass of both objects and doubling the distance between the objects
 - doubling the mass of both objects, only
54. The diagram represents:



- Tilt
 - Obliquity
 - Axial Precession
 - Orbital Precession
55. The tilt of the Earth's rotation axis:

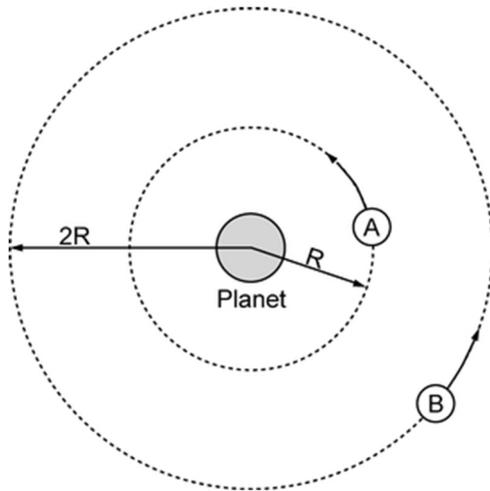
- a. varies on an annual cycle.
 - b. varies between a 200 and 300 year cycle.
 - c. varies between a 10 and 100 year cycle.
 - d. varies on a 41,000 year cycle.
56. If the tilt of the Earth's rotation axis were less than it is today, today's winter would be:
- a. Warmer
 - b. Cooler
 - c. Drier
 - d. The same temperature
57. Of the following bodies that orbit the sun, which body has the fastest orbital speed?
- a. a dwarf planet between Mars and Jupiter
 - b. a comet as it nears the sun
 - c. an asteroid in the Kuiper belt
 - d. Jupiter
58. Which of these choices states Kepler's first law of planetary motion?
- a. As a planet moves around its orbit, the planet sweeps out equal areas in equal amounts of time.
 - b. The orbit of a planet or other body around the sun is an ellipse, and the sun is one focus of the ellipse.
 - c. The square of a planet's orbital period is proportional to the cube of the planet's mean distance from the sun.
 - d. Gravitational force increases as the mass of an object increases or as the distance between two objects decreases.
59. The distance between objects, along with the masses of the objects, affect the gravitational force between the objects. Which statement is true according to Newton's law of universal gravitation?
- a. When the masses of objects increase, gravitational force decreases.
 - b. When distance between objects increases, gravitational force decreases.
 - c. When distance between objects decreases, gravitational force decreases.
 - d. When the masses of objects decrease, the distance between objects decreases.
60. At a distance of 5,000 m, the gravitational force between two objects is 58 N. What would the force be if the distance between them increased 5 times?
- a. 290 N
 - b. 2.32 N
 - c. 1,000 N
 - d. 53 N
61. Gravity is defined as the attraction between two bodies based on their _____
- a. Shape
 - b. kinetic energy
 - c. Masses
 - d. potential energy

62. Two objects, each with a mass of 21 kg, have a gravitational force of 55 N. What would the force between them be if the mass of one of the objects was decreased 3 times?
- 495 N
 - 18.3 N
 - 165 N
 - 6.1 N
63. If the distance between two objects of the same mass is doubled, what will be the new value of the gravitational force, F , between the objects?
- $\frac{1}{4} F$
 - $\frac{1}{2} F$ (incorrect - there is an inverse relationship between gravitational force and the square of the distance)
 - $2 F$
 - $4 F$
64. Jose and Aly conducted an experiment to determine the relationship between the force of gravity between two objects. Using their calculated data below, what is the relationship Jose and Aly determined and does this relationship support the Universal Law of Gravitation?

Force of Gravity (N)	Distance (m)
1.8 E -10	3
1.0 E -10	4
6.7 E -11	5

- The relationship is directly proportional. It does agree with the law. (incorrect; the first part is inverse, the second part is right)
 - The relationship is inversely proportional. It does agree with the law.
 - The relationship is directly proportional. It does not agree with the law. (incorrect; the first part is inverse, it DOES agree with the law)
 - The relationship is inversely proportional. It does not agree with the law. (incorrect; the first part is right, it DOES agree with the law)
65. A satellite weighs 200 newtons on the surface of Earth. What is its weight, in N, at a distance of one Earth radius above the surface of Earth? 50.0 N
66. An astronaut weighs 600 newtons at Earth's surface. If he were to double his distance from Earth's center, what would be his new weight, to the nearest newton? 150 N
67. The distance between a spaceship and the center of Earth is increased from one Earth radius to 4 Earth radii. How is the gravitational force acting on the spaceship affected?
- It becomes $\frac{1}{16}$ the amount.
 - It becomes $\frac{1}{4}$ the amount.

- c. It becomes 4 times the amount.
 - d. It becomes 16 times the amount.
68. An object weighs 200. newtons at a distance of 100. kilometers above the center of a small planet. How much will the object weigh 200. kilometers above the planet's center?
- a. 25.0 N
 - b. 50.0 N
 - c. 100. N
 - d. 400. N
69. An object weighs 100. newtons on Earth's surface. When it is moved to a point one Earth radius above Earth's surface, how much will it weigh?
- a. 25.0 N
 - b. 50.0 N
 - c. 100. N
 - d. 400. N
70. Two objects are moved apart so that they are separated by three times their original distance of separation. Compared to the magnitude of the original gravitational force between them, the magnitude of the new gravitational force is which of the following?
- a. one-ninth the amount
 - b. one-third the amount
 - c. three times the amount
 - d. nine times the amount
71. If Earth had twice the mass it has now, then the magnitude of the gravitational force between it and the Sun would be which of the following?
- a. twice as much as it is now
 - b. four times as much as it is now
 - c. half as much as it is now
 - d. the same as it is now
72. As a meteor moves from a distance of 16 Earth radii to a distance of 2 Earth radii from the center of Earth, what happens to the magnitude of the gravitational force between the meteor and Earth?
- a. It becomes $\frac{1}{8}$ the amount.
 - b. It becomes 4 times the amount.
 - c. It becomes 8 times the amount.
 - d. It becomes 64 times the amount.
73. The diagram represents two satellites, A and B, moving in circular orbits around a planet. The satellites have equal masses.



Compared to the magnitude of the gravitational force of attraction between satellite A and the planet, the magnitude of the gravitational force of attraction between satellite B and the planet is which of the following?

- a. one-fourth as much
- b. half as much
- c. two times as much
- d. four times as much

74. When Earth and the Moon are separated by a distance of 3.84×10^8 meters, the magnitude of the gravitational force of attraction between them is 2.0×10^{20} newtons. What would be the magnitude of this gravitational force of attraction if Earth and the Moon were separated by a distance of 1.92×10^8 meters?

- a. 5.0×10^{19} N
- b. 2.0×10^{20} N
- c. 4.0×10^{20} N
- d. 8.0×10^{20} N

75. True or False: The Earth has a gravitational pull on you and you have a gravitational pull on the Earth.

- a. True
- b. False

76. What variable causes the Moon's gravitational pull to be less than Earth's?

- a. The Moon's mass
- b. The Moon's orbital speed
- c. The Moon's orbital path
- d. The Moon's distance from Earth

SG.912.E.5.7

77. Different types of telescopes, such as gamma-ray detectors and radio telescopes, are used in space science. What is the reason for this?

- a. Different types of telescopes are needed to detect visible light.
- b. Different types of telescopes are needed to measure different colors of waves.
- c. Different types of telescopes are needed to collect data from different ranges of

radiation.

- d. Different types of telescopes are needed to observe the same part of the electromagnetic spectrum.

78. Some places in the universe are too distant for humans to observe directly. Which of these technologies is used to observe these distant places?

- a. Rocket
- b. Probe
- c. Space shuttle
- d. Space station

79. The "Space Race" refers to the competition for the first spacecraft launched successfully:

- a. Between USA and Japan
- b. Between USA and Germany
- c. Between USA and USSR
- d. Between USA and Canada

80. The largest human made object in space is the international space station

81. The United States government's organization designed to explore space is called NASA

SC.912.P.10.18

82. Visible light occupies the range of wavelengths from 380 to 790 nanometers in the electromagnetic spectrum. Which of the following kinds of electromagnetic radiation has shorter wavelength than visible light?

- a. radio waves
- b. X-rays
- c. infrared radiation
- d. Microwaves

83. An aurora is a natural light show caused by charged particles from solar winds that flow through the magnetosphere and are then guided by Earth's magnetic field into the atmosphere. Energy is transformed into visible light as the charged particles collide with the atmosphere. The color of the aurora is determined by two primary atmospheric gases. What are the two primary gases and the corresponding visible light wavelength produced?

- a. Oxygen and nitrogen atoms collide producing visible light at 557 nm and 475 nm respectively.
- b. Oxygen and nitrogen atoms collide producing visible light at 750 nm and 400 nm respectively. (Incorrect: wavelength does not correspond to oxygen and nitrogen gases)
- c. Oxygen and carbon dioxide atoms collide producing visible light at 557 nm and 630 nm respectively. (Incorrect; carbon dioxide is not one of the primary gases)
- d. Nitrogen and carbon dioxide atoms collide producing visible light at 475 nm and 630 nm respectively. (incorrect: carbon dioxide is not one of the primary gases)

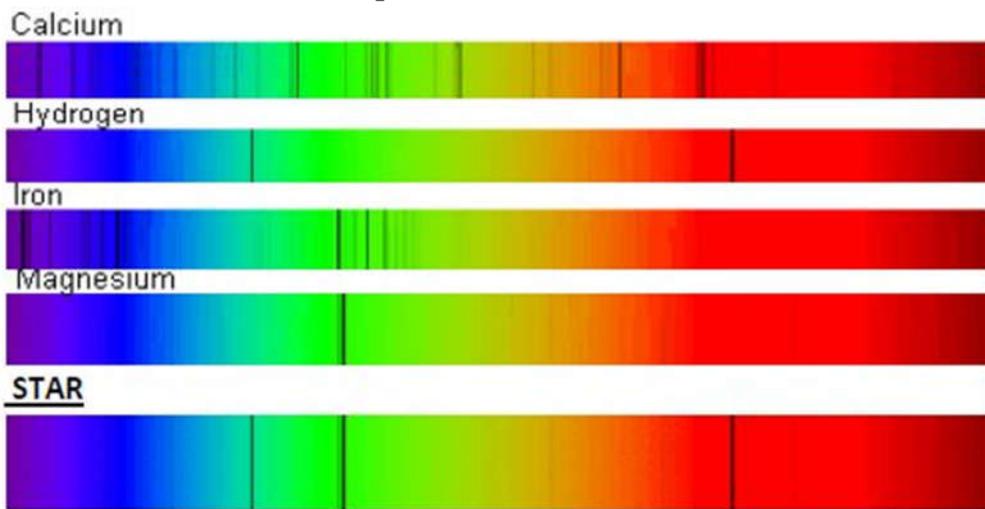
84. Which statements correctly compare infrared waves to ultraviolet waves?

- l. Infrared have a higher frequency than ultraviolet waves.

- II. Infrared have longer wavelengths than ultraviolet waves.
- III. Infrared and ultraviolet waves cannot be seen with human eyes.
 - a. I only (incorrect: uv waves have higher frequency)
 - b. III only (incorrect: infrared waves also have longer wavelengths)
 - c. II and III
 - d. I and III (incorrect: uv waves have higher frequency)

85. Which of the following best describes the behavior of light?
- a. light acts only as a wave
 - b. light acts only as a particle
 - c. light acts as both a wave and a particle
 - d. light acts as neither a wave nor a particle

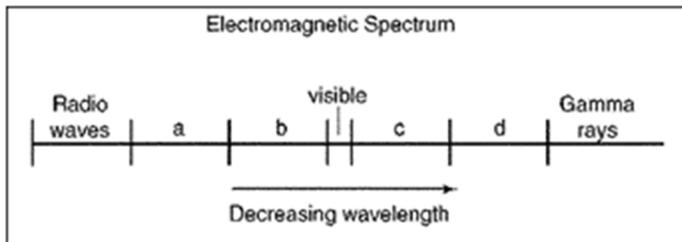
86. Which elements are present in this star?



- a. Calcium and Hydrogen
 - b. Hydrogen and Iron
 - c. Iron and Magnesium
 - d. Hydrogen and Magnesium
87. Which of the following colors in the Visible Light Spectrum has the highest frequency?
- a. Red
 - b. Orange
 - c. Green
 - d. Violet
88. How are the frequency and wavelength of light related?
- a. They are inversely proportional to each other.
 - b. Frequency equals wavelength divided by the speed of light.
 - c. Wavelength is determined by dividing frequency by the speed of light.
 - d. They are directly proportional to each other.
89. How does the speed of visible light compare with the speed of gamma rays?
- a. The speed of visible light is greater.
 - b. The speed of gamma rays is greater.

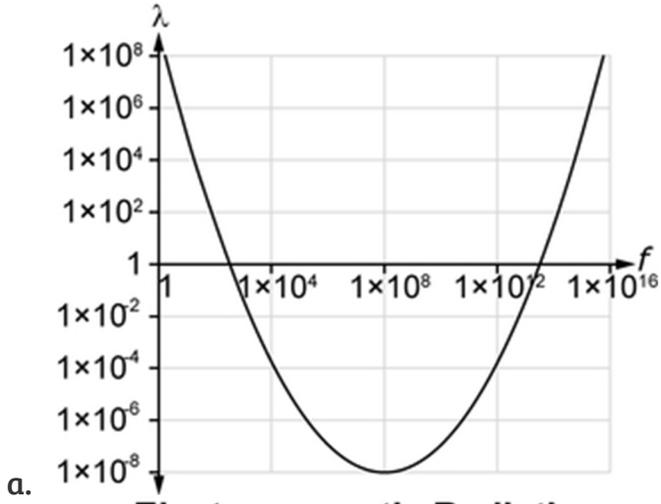
- c. The speeds are the same.
- d. No answer can be determined from the information given.

90. In the diagram below, which part of the spectrum has greatest energy?

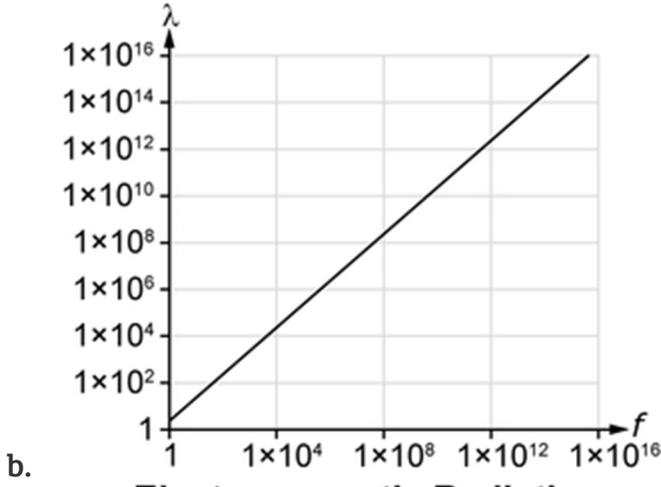


- a. Radio
 - b. Visible
 - c. Gamma
 - d. each part has equal energy
91. Which of the following best explains why Very High Frequency (VHF) and Ultra High Frequency (UHF) radio waves are used for communications between space vehicles and ground stations?
- a. These waves travel slowly.
 - b. These waves travel along a curved path.
 - c. These waves are not refracted by the ionosphere.
 - d. These waves require a large antenna.
92. Which of the following electromagnetic waves has the lowest frequency?
- a. red light
 - b. yellow light
 - c. green light
 - d. violet light
93. Due to the Doppler Effect, waves from a receding source (moving away from the observer) are observed as having a longer wavelength than when they were emitted. Which of the following pairs could represent the kind of radiation emitted from a source moving away from Earth and the kind of radiation it is detected as on Earth?
- a. emitted as red light, observed as a microwave
 - b. emitted as yellow light, observed as ultraviolet light
 - c. emitted as an X-ray, observed as a gamma ray
 - d. emitted as a radio wave, observed as infrared radiation
94. A photon of which of these types of electromagnetic radiation has the most energy?
- a. Ultraviolet
 - b. Infrared
 - c. Microwave
 - d. X-ray
95. Which graph correctly displays the relationship between wavelength, in meters, and frequency, in hertz, in the electromagnetic spectrum?

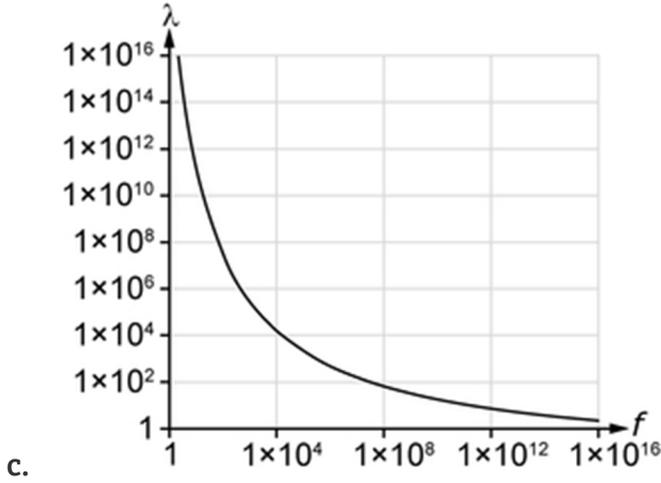
Electromagnetic Radiation



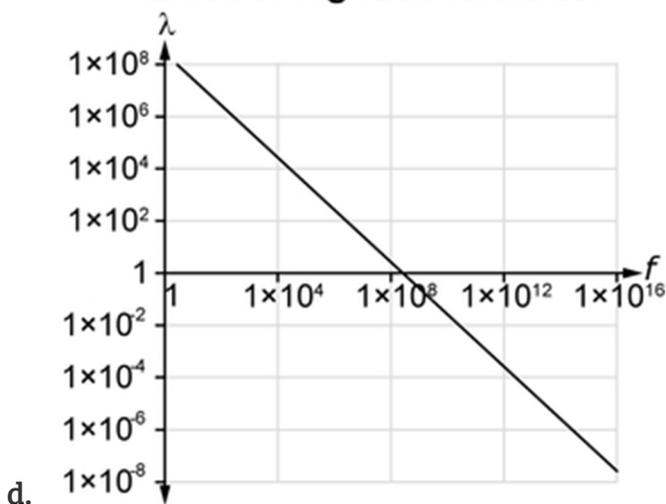
Electromagnetic Radiation



Electromagnetic Radiation



Electromagnetic Radiation



- d.
96. Compared to visible light, ultraviolet radiation is more harmful to human skin and eyes because ultraviolet radiation has which of the following characteristics?
- higher frequency
 - longer wavelength
 - higher speed
 - longer period
97. Which of the following best describes the role of two wave behaviors in weather forecasting?
- The Doppler effect helps meteorologists determine the size of a weather system, while reflection helps meteorologists determine the speed at which it is approaching or moving away from an area.
 - Resonance helps meteorologists pinpoint the exact location of a weather system, while diffraction helps meteorologists determine the types of precipitation it contains.
 - Reflection helps meteorologists determine the size of a weather system, while the Doppler effect helps meteorologists determine the speed at which it is approaching or moving away from an area.
 - Diffraction helps meteorologists pinpoint the exact location of a weather system, while resonance helps meteorologists determine the types of precipitation it contains.
98. Which of the following electromagnetic waves has the shortest wavelength?
- Microwave
 - Ultraviolet
 - X-ray
 - Light
99. Due to the Doppler Effect, waves from an approaching source (moving toward the observer) are observed as having a shorter wavelength than when they were emitted. Which of the following pairs could represent the kind of radiation emitted from a source rapidly approaching Earth and the kind of radiation it is detected as on Earth?
- emitted as a gamma ray, observed as ultraviolet light
 - emitted as a microwave, observed as a radio wave
 - emitted as yellow light, observed as blue light

- d. emitted as ultraviolet light, observed as infrared radiation
100. A telescope is a tool that helps people observe distant objects. In the simplest telescope design, incoming light hits a lens and is focused to a single point. This focused image is then magnified by a second lens so that it is roughly the same size as an observer's pupil. Which of the following wave behaviors plays the most important role in the functioning of this type of telescope?
- Refraction
 - Interference
 - Resonance
 - Reflection
101. Two photons of electromagnetic radiation, A and B, are propagating in a vacuum. If photon A is less energetic than photon B, which of the following is true?
- A has lower frequency and longer wavelength than B.
 - A has higher frequency and longer wavelength than B.
 - A has higher frequency and shorter wavelength than B.
 - A has lower frequency and shorter wavelength than B.
102. What occurs when light passes from water into flint glass?
- Its speed increases, its wavelength becomes longer, and its frequency decreases.
 - Its speed increases, its wavelength becomes longer, and its frequency remains the same.
 - Its speed decreases, its wavelength becomes shorter, and its frequency remains the same.
 - Its speed decreases, its wavelength becomes shorter, and its frequency increases.
103. Gamma rays are emanations that have
- mass but no charge.
 - neither mass nor charge.
 - charge but no mass.
 - both mass and charge
104. Which of the following is the same for radio waves and gamma rays traveling in space?
- Period
 - Wavelength
 - Speed
 - Frequency
105. Which of the following waves has a wavelength shorter than that of visible light?
- Infrared
 - Ultraviolet
 - Microwave
 - Radio
106. Visible light occupies the range of wavelengths from 380 to 790 nanometers in the electromagnetic spectrum. Which of the following kinds of electromagnetic radiation has shorter wavelength than visible light?

- a. radio waves
 - b. X-rays
 - c. infrared radiation
 - d. Microwaves
107. Which characteristic is the same for every color of light in a vacuum?
- a. Energy
 - b. Period
 - c. Speed
 - d. Frequency
108. Which of these is the least energetic form of electromagnetic radiation?
- a. Microwaves
 - b. gamma rays
 - c. visible light
 - d. radio waves
109. Which of the following types of electromagnetic radiation has the shortest wavelength?
- a. Radio
 - b. Infrared
 - c. Gamma
 - d. Ultraviolet
110. Radar involves the use of radio waves. Radar can be used not only to detect objects, but also to determine how far away they are and how fast they are moving. Which of the following wave behaviors is used to detect the presence of objects?
- a. doppler effect
 - b. Diffraction
 - c. Reflection
 - d. Refraction
111. Which of the following statements about electromagnetic radiation is true?
- a. Electromagnetic waves with long wavelength are more energetic than electromagnetic waves with short wavelength.
 - b. All electromagnetic radiation carries the same amount of energy.
 - c. Electromagnetic radiation in a vacuum can change frequency to become more or less energetic.
 - d. Electromagnetic waves with high frequency are more energetic than electromagnetic waves with low frequency.
112. Light of which color has the greatest period?
- a. Violet
 - b. Orange
 - c. Red
 - d. Green
113. Which form of electromagnetic radiation is more energetic than ultraviolet rays?

- a. X-rays
- b. infrared radiation
- c. Microwaves
- d. violet light

114. At any given time, there are many radio waves traveling through the air. A radio's antenna picks up these radio waves, and then a tuner allows people to zero in on one radio wave frequency and listen to their favorite station. Which wave behavior can best explain how a radio tuner works?

- a. Diffraction
- b. Interference
- c. Reflection
- d. Resonance

115. Which of the following types of electromagnetic radiation has the shortest wavelength?

- a. Visible
- b. Infrared
- c. Ultraviolet
- d. Radio