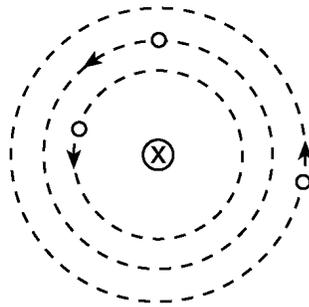


# Solar System

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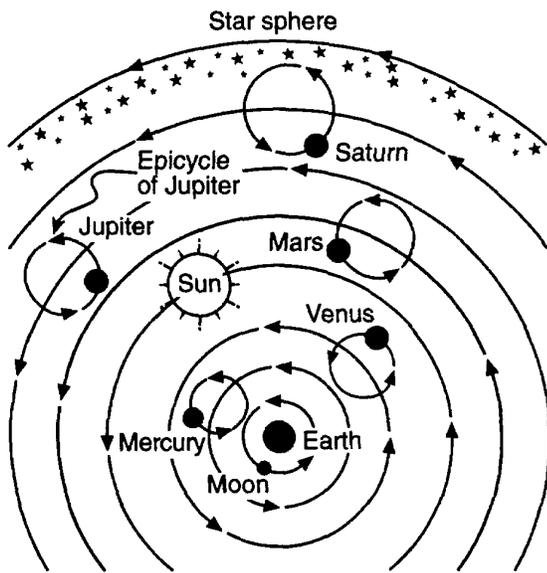
1. The diagram below represents a simple geocentric model. Which object is represented by the letter X?



( Not drawn to scale )

- A) Earth      B) Sun      C) Moon      D) Polaris
2. Which object orbits Earth in both the Earth-centered (geocentric) and Sun-centered (heliocentric) models of our solar system?
- A) the Moon      B) the Sun      C) Venus      D) *Polaris*
3. In which type of model are the Sun, other stars, and the Moon in orbit around the Earth?
- A) heliocentric model      B) tetrahedral model  
C) concentric model      D) geocentric model
-

4. The diagram below shows one model of a portion of the universe.

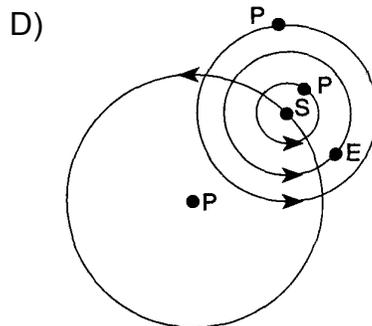
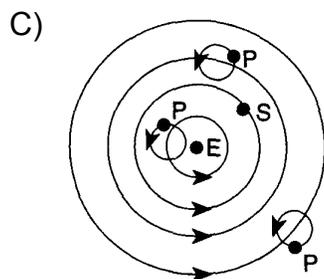
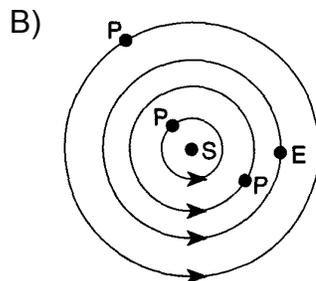
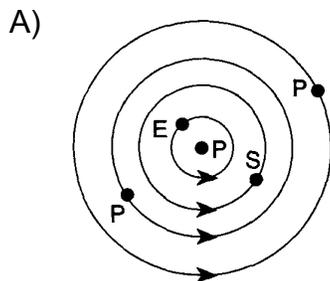


What type of model does the diagram best demonstrate?

- A) a heliocentric model, in which celestial objects orbit Earth
- B) a heliocentric model, in which celestial objects orbit the Sun
- C) a geocentric model, in which celestial objects orbit Earth
- D) a geocentric model, in which celestial objects orbit the Sun

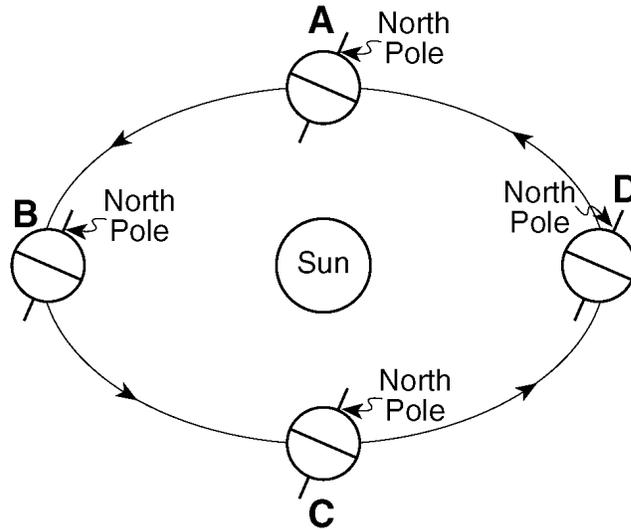
5. Which diagram represents a geocentric model?

[Key: E = Earth, P = Planet, S = Sun]



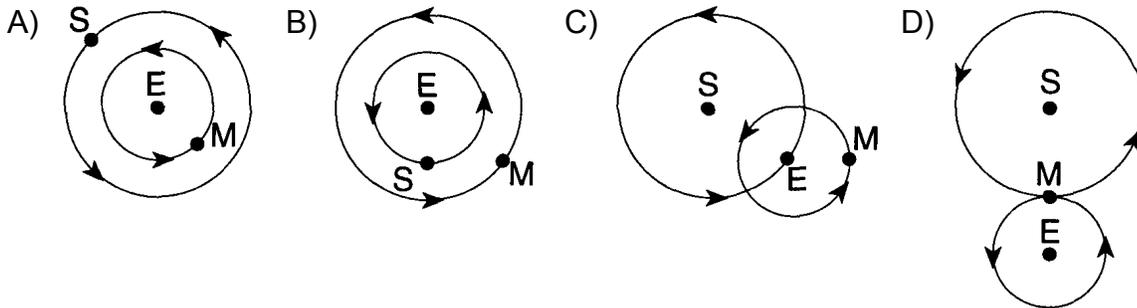
- 
6. Which statement best describes the geocentric model of our solar system?
- A) The Earth is located at the center of the model.
  - B) All planets revolve around the Sun.
  - C) The Sun is located at the center of the model.
  - D) All planets *except* the Earth revolve around the Sun.
7. Which apparent motion can be explained by a geocentric model?
- A) deflection of the wind
  - B) curved path of projectiles
  - C) motion of a Foucault pendulum
  - D) the sun's path through the sky
8. In the geocentric model (the Earth at the center of the universe), which motion would occur?
- A) The Earth would revolve around the Sun.
  - B) The Earth would rotate on its axis.
  - C) The Moon would revolve around the Sun.
  - D) The Sun would revolve around the Earth.
9. The modern heliocentric model of planetary motion states that the planets travel around
- A) the Sun in slightly elliptical orbits
  - B) the Sun in circular orbits
  - C) Earth in slightly elliptical orbits
  - D) Earth in circular orbits
-

10. Base your answer to the following question on the diagram below, which represents an exaggerated view of Earth revolving around the Sun. Letters *A*, *B*, *C*, and *D* represent Earth's location in its orbit on the first day of each of the four seasons.



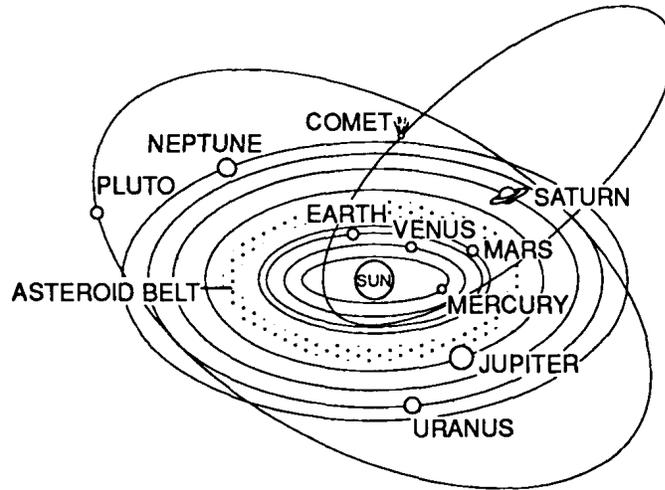
Which observation provides the best evidence that Earth revolves around the Sun?

- A) Stars seen from Earth appear to circle *Polaris*.
  - B) Earth's planetary winds are deflected by the Coriolis effect.
  - C) The change from high ocean tide to low ocean tide is a repeating pattern.
  - D) Different star constellations are seen from Earth at different times of the year.
11. Which diagram best represents a portion of the heliocentric model of the solar system?  
[S = Sun, E = Earth, and M = Moon]



12. Which statement provides the best evidence that Earth revolves around the Sun?
- A) The Sun follows an apparent daily path, rising in the east and setting in the west.
  - B) A Foucault pendulum appears to shift its direction of swing in a predictable manner.
  - C) The stars appear to follow circular paths around the North Star (*Polaris*).
  - D) The seasons of spring, summer, fall, and winter repeat in a pattern.

13. The diagram below represents our solar system.



(NOT DRAWN TO SCALE)

This system is best classified as

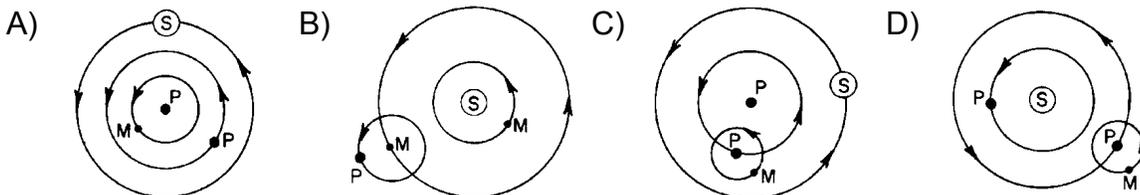
- A) geocentric, with elliptical orbits
- B) geocentric, with circular orbits
- C) heliocentric, with elliptical orbits
- D) heliocentric, with circular orbits

14. For what reason did the heliocentric model of the universe replace the geocentric model of the universe?

- A) The geocentric model no longer predicted the positions of the constellations.
- B) The geocentric model did not predict the phases of the Moon.
- C) The heliocentric model provided a simpler explanation of the motions of the planets.
- D) The heliocentric model proved that the Earth rotates.

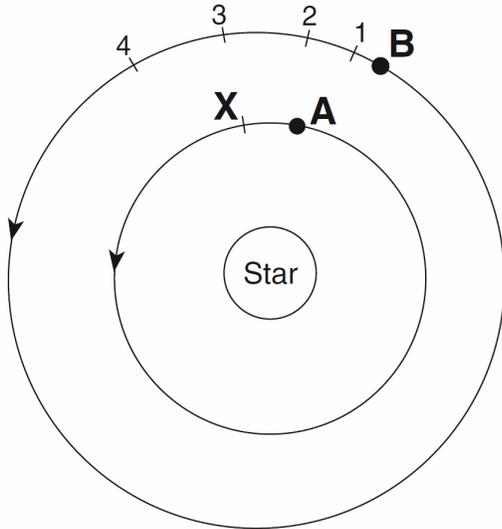
15. Which diagram best represents the motions of celestial objects in a heliocentric model?

Key:  
 P● = Planet  
 M● = Moon  
 S⊙ = Sun



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Base your answers to questions **16** and **17** on the diagram below, which represents the current locations of two planets, *A* and *B*, orbiting a star. Letter *X* indicates a position in the orbit of planet *A*. Numbers 1 through 4 indicate positions in the orbit of planet *B*.

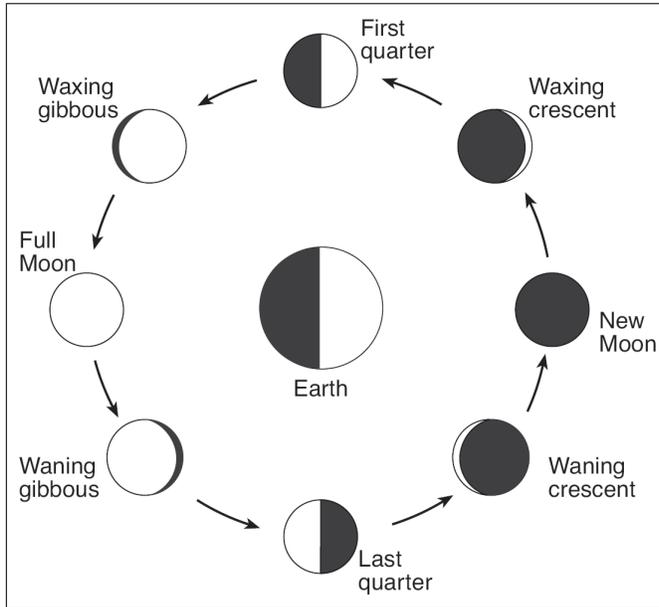


(Not drawn to scale)

16. If the diagram represents our solar system and planet *B* is Venus, which planet is represented by planet *A*?
- A) Mercury      B) Jupiter      C) Earth      D) Mars
17. As planet *A* moves in orbit from its current location to position *X*, planet *B* most likely moves in orbit from its current location to position
- A) 1      B) 2      C) 3      D) 4
-

18. Base your answer to the following question on

the diagram below, which shows positions of the Moon in its orbit and phases of the Moon as viewed from New York State.



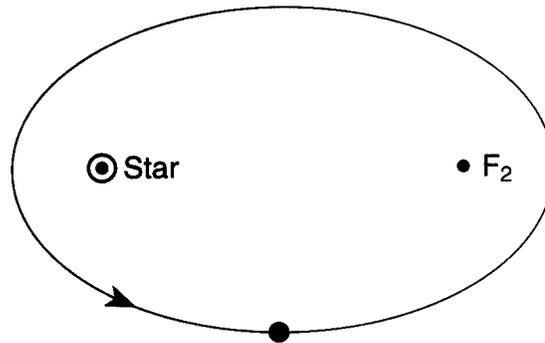
(Not drawn to scale)

What is the eccentricity of the Moon's orbit?

- A) 0.017      B) 0.055      C) 0.386      D) 0.723

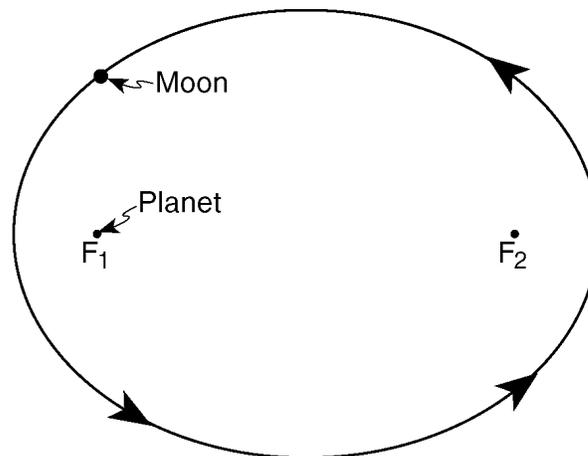


- 
22. Base your answer to the following question on The diagram below shows the elliptical orbit of a planet revolving around a star. The star and  $F_2$  are the foci of this ellipse.



What is the approximate eccentricity of this ellipse?

- A) 0.22      B) 0.47      C) 0.68      D) 1.47
23. The diagram below represents the elliptical orbit of a moon revolving around a planet. The foci of this orbit are the points labeled  $F_1$  and  $F_2$ .



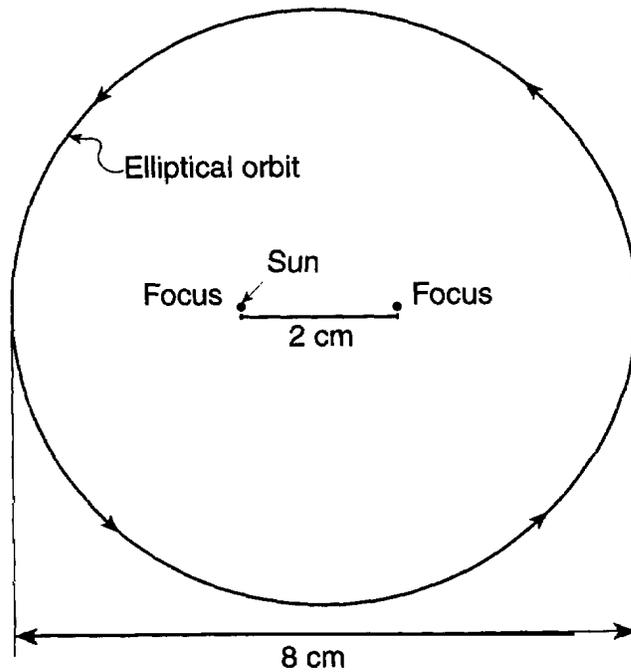
(Drawn to scale)

What is the approximate eccentricity of this elliptical orbit?

- A) 0.3      B) 0.5      C) 0.7      D) 1.4
24. Which planet's orbit around the Sun is most nearly circular?  
A) Mercury      B) Neptune      C) Pluto      D) Venus
25. Which planet has an orbital eccentricity most like the orbital eccentricity of the Moon?  
A) Pluto      B) Saturn      C) Mars      D) Mercury
-

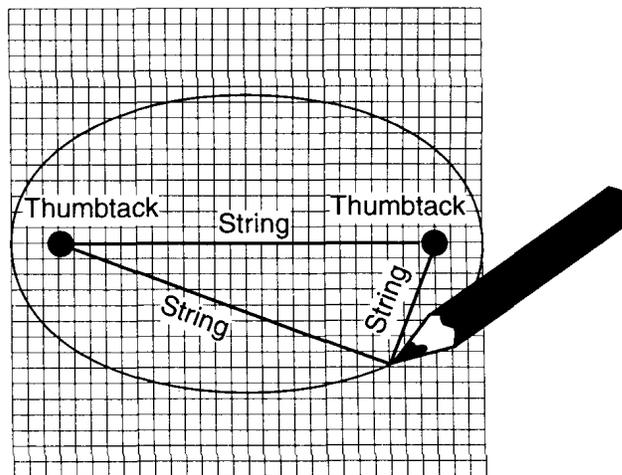
- 
26. Which planet has an orbit with an eccentricity most similar to the eccentricity of the Moon's orbit around Earth?
- A) Earth      B) Jupiter      C) Pluto      D) Saturn
27. Which object is located at one foci of the elliptical orbit of Mars?
- A) the Sun      B) *Betelgeuse*      C) Earth      D) Jupiter
28. An observer on Earth determines that the apparent diameter of the Moon as viewed from Earth varies in a cyclic manner. The best explanation for this observation is that the
- A) Moon is rotating  
B) Moon's orbit is elliptical  
C) atmospheric transparency of the Moon changes  
D) distance between the Moon and the Sun changes
29. The shape of the orbits of most of the planets in the solar system would best be described as
- A) elliptical and very elongated      B) parabolic  
C) nearly circular      D) perfectly circular
30. Which observation is a direct result of changes in distance between Earth and the Sun?
- A) A Foucault pendulum shows predictable changes in its direction of swing.  
B) The apparent diameter of the Sun shows predictable changes in size.  
C) The length of daylight at the poles changes from 0 to 24 hours during the year.  
D) Summer occurs in the Northern Hemisphere at the same time that winter occurs in the Southern Hemisphere.
-

31. The constructed ellipse below is a true scale model of the orbit of a planet in our solar system. This ellipse best represents the orbit of the planet



- A) Neptune    B) Jupiter    C) Pluto    D) Mars

32. The diagram below represents a student's constructed laboratory drawing.



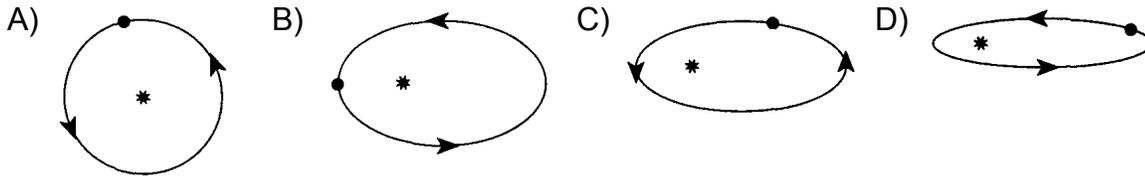
( Not drawn to scale )

The student's drawing best represents the

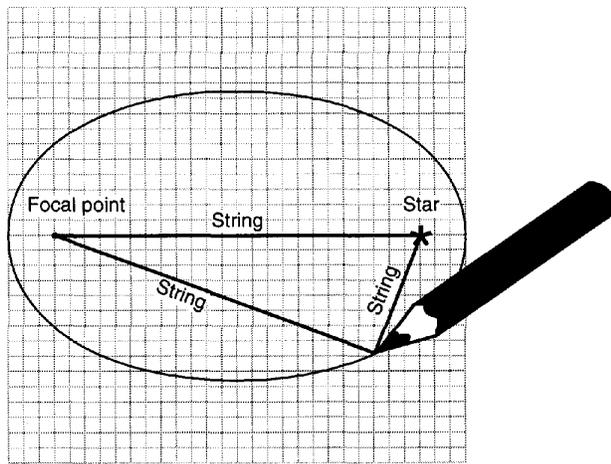
- A) shape of Earth's Moon  
B) shape of an elliptical orbit  
C) path of an earthquake wave  
D) path of a projectile deflected by Earth's rotation

33. Which diagram shows a planet with the *least* eccentric orbit?

( Key: • = planet \* = star )



34. The diagram below represents the construction of a model of an elliptical orbit of a planet traveling around a star.  
The focal point and the center of the star represent the foci of the orbit.

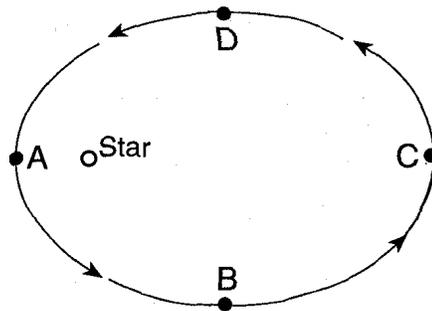


( Drawn to scale )

The eccentricity of this orbit is approximately

- A) 1.3      B) 0.8      C) 0.5      D) 0.3

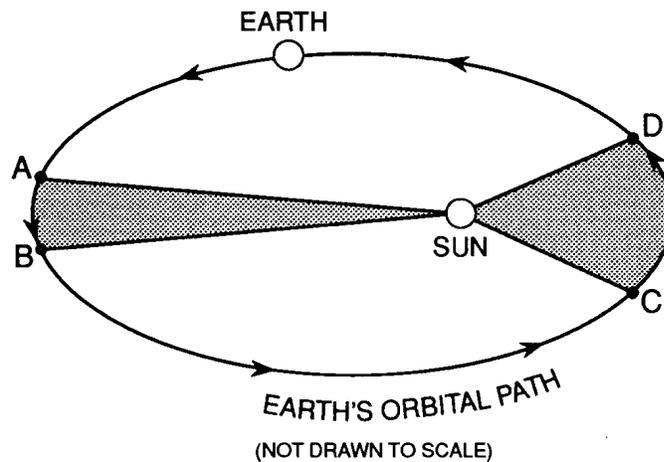
- 
35. Base your answer to the following question on Base your answer to the question below on the diagram below. The diagram represents the path of a planet orbiting a star. Points *A*, *B*, *C*, and *D* indicate four orbital positions of the planet.



- When viewed by an observer on the planet, the star has the largest apparent diameter at position
- A) *A*                      B) *B*                      C) *C*                      D) *D*
36. In what way are the planets Mars, Mercury, and Earth similar?
- A) They have the same period of revolution.  
B) They are perfect spheres.  
C) They exert the same gravitational force on each other.  
D) They have elliptical orbits with the Sun at one focus.
37. The actual shape of the Earth's orbit around the Sun is best described as
- A) a very eccentric ellipse                      B) a slightly eccentric ellipse  
C) an oblate spheroid                              D) a perfect circle
38. In our solar system, the orbits of the planets are best described as
- A) circular, with the planet at the center  
B) circular, with the Sun at the center  
C) elliptical, with the planet at one of the foci  
D) elliptical, with the Sun at one of the foci
39. The period of time a planet takes to make one revolution around the Sun is most dependent on the planet's average
- A) rotation rate                                      B) mass  
C) insolation from the Sun                      D) distance from the Sun
-



- 
42. The diagram below represents the Earth's orbital path around the Sun. The Earth takes the same amount of time to move from *A* to *B* as from *C* to *D*.

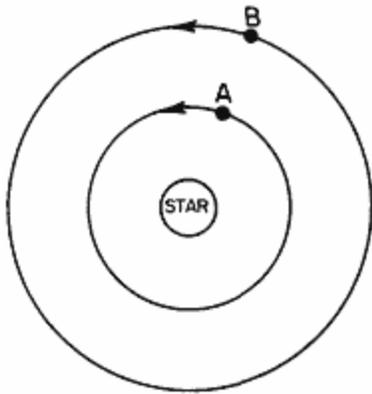


Which values are equal within the system?

- A) The shaded sections of the diagram are equal in area.
  - B) The distance from the Sun to the Earth is the same at point *A* and at point *D*.
  - C) The orbital velocity of the Earth at point *A* equals its orbital velocity at point *C*.
  - D) The gravitational force between the Earth and the Sun at point *B* is the same as the gravitational force at point *D*.
43. The elliptical shape of the Earth's orbit results in
- A) changes in the orbital velocity of the Earth
  - B) tilting of the Earth's axis
  - C) the oblate spheroid shape of the Earth
  - D) the phases of the Moon
-

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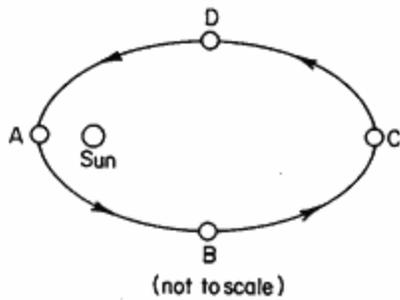
44. The diagram below shows the orbits of planets *A* and *B* in a star-planet system.



The period of revolution for planet *B* is 40 days. The period of revolution for planet *A* most likely is

- A) less than 40 days                      B) greater than 40 days  
C) 40 days

45. The diagram below shows a planet's orbit around the Sun.



At which location is the planet's orbital velocity greatest?

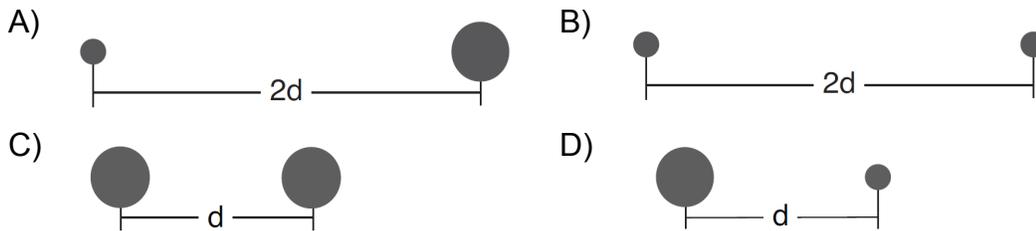
- A) *A*                      B) *B*                      C) *C*                      D) *D*
-

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46. The symbols below represent star masses and distances.

- represents a star with a mass the same as the Sun's mass
- represents a star with a mass greater than the Sun's mass
- d represents a certain distance between star centers
- 2d represents twice the distance between star centers

Which diagram shows two stars that have the greatest gravitational force between them?



47. If the average distance between Earth and the Sun were doubled, what changes would occur in the Sun's gravitational pull on Earth and Earth's period of revolution?

- A) Gravitational pull would decrease and period of revolution would increase.
- B) Gravitational pull would decrease and period of revolution would decrease.
- C) Gravitational pull would increase and period of revolution would increase.
- D) Gravitational pull would increase and period of revolution would decrease.

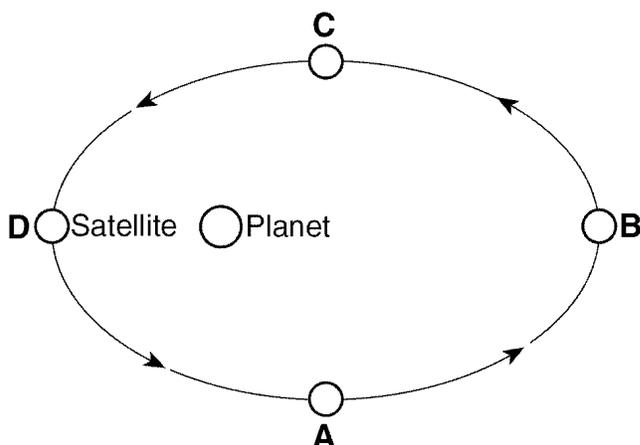
48. One factor responsible for the strength of gravitational attraction between a planet and the Sun is the

- A) degree of tilt of the planet's axis
- B) distance between the planet and the Sun
- C) planet's period of rotation
- D) amount of insolation given off by the Sun

49. What is the main reason that the gravitational attraction between Earth and the Moon changes each day?

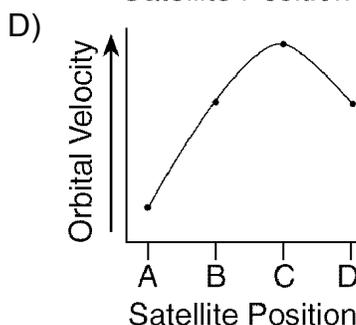
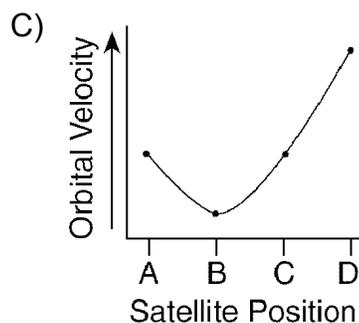
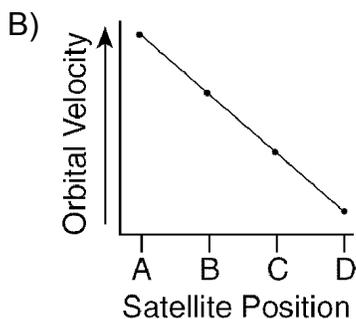
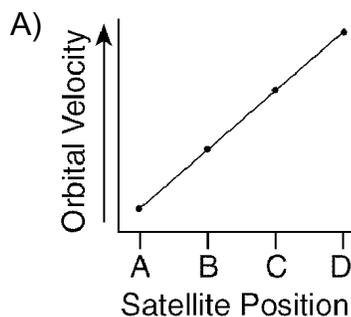
- A) Earth's axis is tilted at  $23.5^\circ$ .
  - B) Earth's rotational speed varies with the seasons.
  - C) The Moon has an elliptical orbit.
  - D) The Moon has a spherical shape.
-

50. The diagram below shows a satellite in four different positions as it revolves around a planet.



(Not drawn to scale)

Which graph best represents the changes in this satellite's orbital velocity as it revolves around the planet?

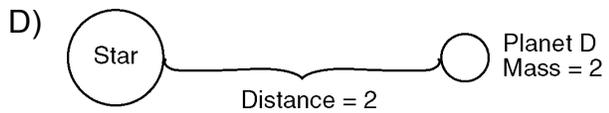
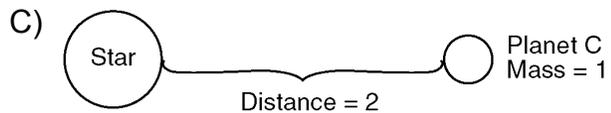
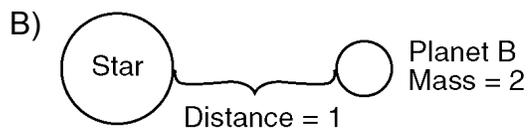
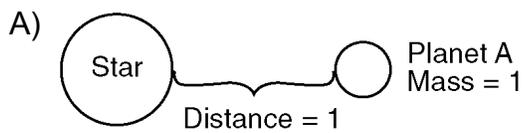


51. Earth is farthest from the Sun during the Northern Hemisphere's summer, and Earth is closest to the Sun during the Northern Hemisphere's winter. During which season in the Northern Hemisphere is Earth's orbital velocity greatest?

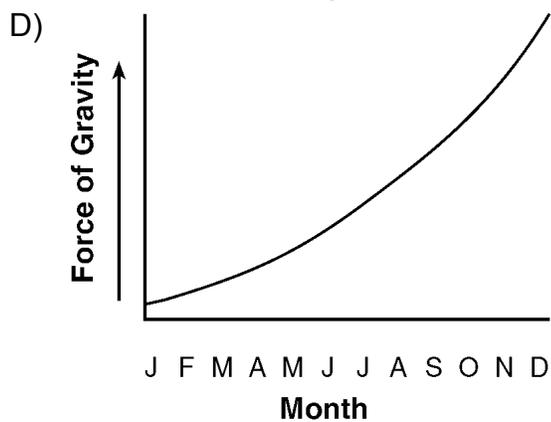
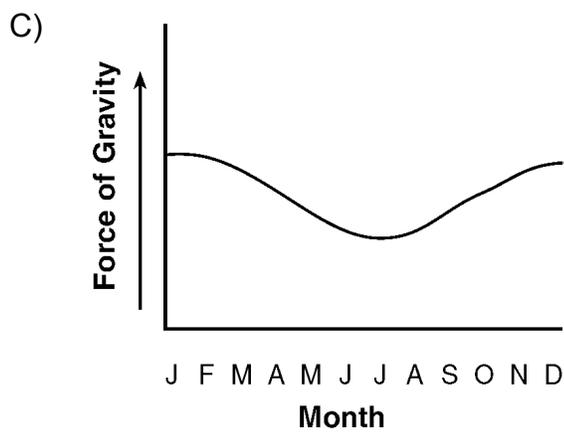
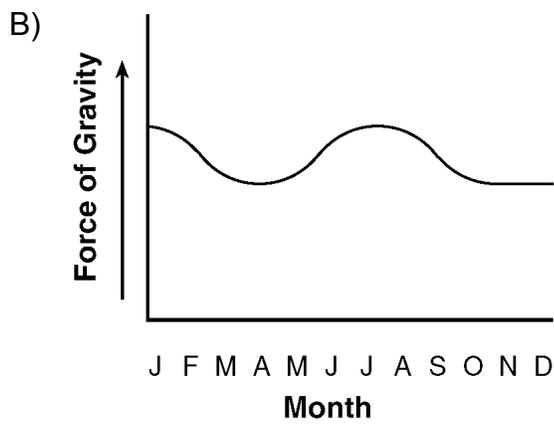
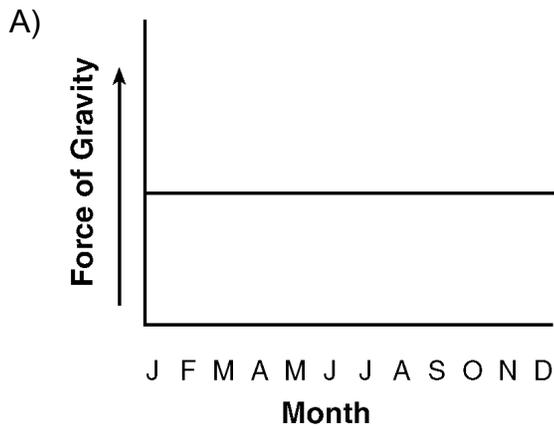
A) winter      B) spring      C) summer      D) fall

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52. In each diagram below, the mass of the star is the same. In which diagram is the force of gravity greatest between the star and the planet shown?



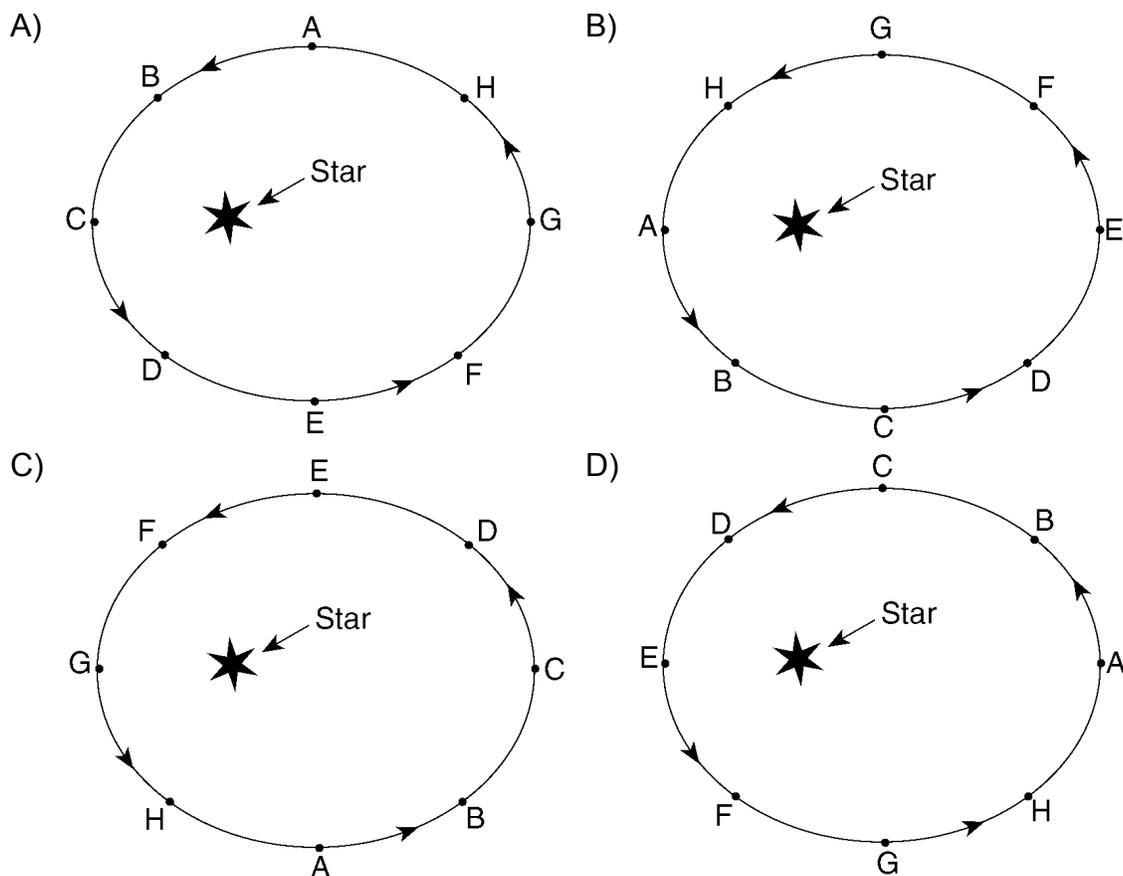
53. Which graph best represents the force of gravity between Earth and the Sun during one revolution of Earth around the Sun?



54. The table below shows gravitational data for a planet traveling in an elliptical orbit around a star. The table shows the relative gravitational force between the star and this planet at eight positions in the orbit (letters *A* through *H*). Higher numbers indicate stronger gravitational attraction.

Planet's Position in the Orbit	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>	<i>G</i>	<i>H</i>
Relative Gravitational Force Between Star and Planet	52	42	25	12	10	12	25	42

Which diagram best represents the positions of the planet in its orbit that would produce the gravitational forces shown in the data table?

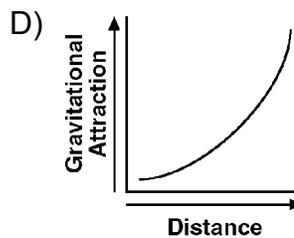
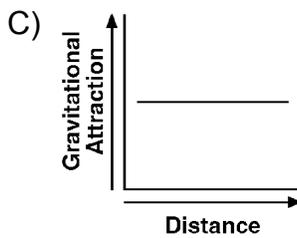
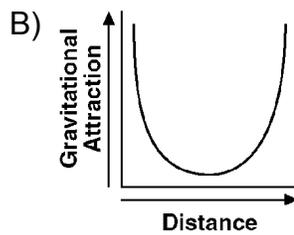
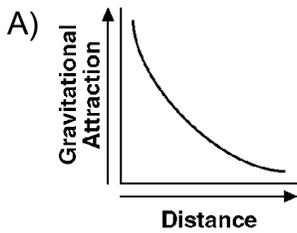


55. Earth's orbital velocity is slowest on July 5 because

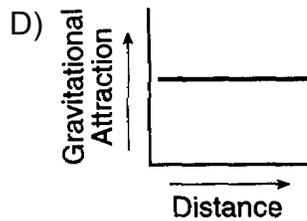
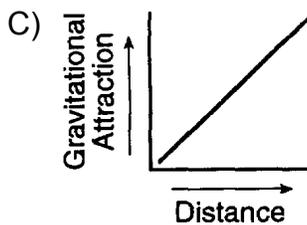
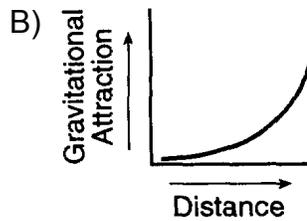
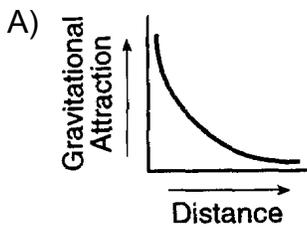
- A) the Moon is closest to Earth
- B) Earth's distance from the Sun is greatest
- C) Earth, the Moon, and the Sun are located along a straight line in space
- D) the highest maximum temperatures occur in the Northern Hemisphere

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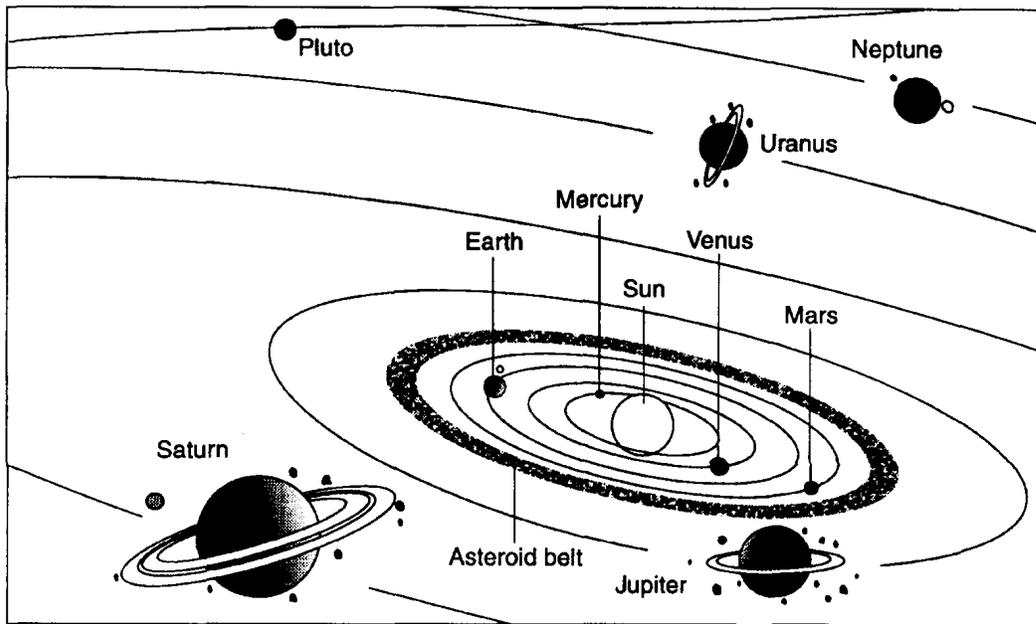
56. Which graph best represents the change in gravitational attraction between the Sun and a comet as the distance between them increases?



57. Which graph best represents the relationship between the gravitational attraction of two objects and their distance from each other?



Base your answers to questions 58 through 61 on the diagram of the solar system below.

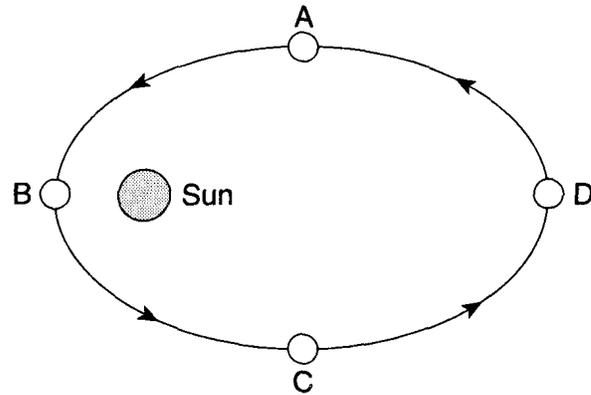


( Not drawn to scale )

58. Which kind of model of the solar system is represented by the diagram?
- A) heliocentric model                      B) geocentric model  
C) sidereal model                          D) lunar model
59. According to Kepler's Harmonic Law of Planetary Motion, the farther a planet is located from the Sun, the
- A) shorter its period of rotation              B) shorter its period of revolution  
C) longer its period of rotation              D) longer its period of revolution
60. Which planet has the most eccentric orbit?
- A) Venus              B) Mars              C) Saturn              D) Pluto
61. If the Earth's distance from the Sun were doubled, the gravitational attraction between the Sun and Earth would be
- A) one-ninth as great                      B) nine times as great  
C) one-fourth as great                      D) four times as great

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62. The diagram below shows four positions of a planet in its orbit around the Sun.



(Not drawn to scale)

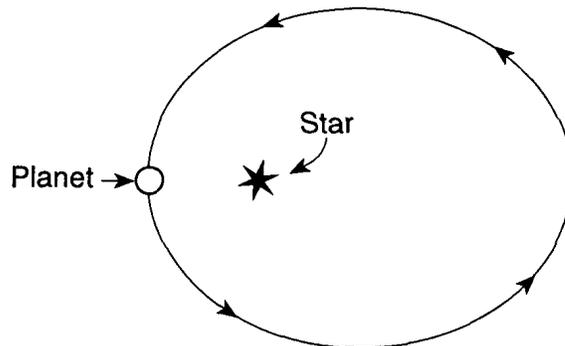
At which position is the planet's orbital speed greatest?

- A) *A*                      B) *B*                      C) *C*                      D) *D*

63. The force of gravity between two objects is greatest when

- A) masses are small and the objects are close together
- B) masses are small and the objects are far apart
- C) masses are large and the objects are close together
- D) masses are large and the objects are far apart

64. The diagram below represents a planet revolving in an elliptical orbit around a star.

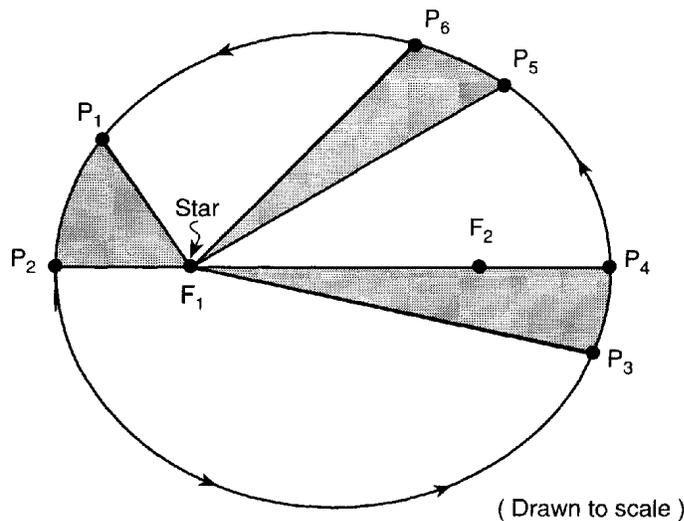


As the planet makes one complete revolution around the star, starting at the position shown, the gravitational attraction between the star and the planet will

- A) decrease, then increase
- B) increase, then decrease
- C) continually decrease
- D) remain the same

65. Differences in Earth's orbital velocity around the Sun are caused primarily by changes in the
- A) inclination of Earth's axis
  - B) rate of rotation of Earth
  - C) distance between Earth and the Sun
  - D) oblate spheroid shapes of Earth and the Sun

Base your answers to questions 66 through 70 on the diagram below which represents a planet,  $P$ , in an elliptical orbit around a star located at  $F_1$ . The foci of the elliptical orbit are  $F_1$  and  $F_2$ . Orbital locations are represented by  $P_1$  through  $P_6$ .



66. If the mass of planet  $P$  were tripled, the gravitational force between the star and planet  $P$  would
- A) remain the same
  - B) be two times greater
  - C) be three times greater
  - D) be nine times greater
67. If the shaded portions of the orbital plane are equal in area, the time period between  $P_1$  and  $P_2$  will be equal to the time period between
- A)  $P_2$  and  $P_3$
  - B)  $P_4$  and  $P_5$
  - C)  $P_3$  and  $P_4$
  - D)  $P_6$  and  $P_1$
68. What is the approximate eccentricity of planet  $P$ 's orbit?
- A) 0.52
  - B) 0.83
  - C) 2.11
  - D) 4.47
69. When observed from the planet, the star would have its greatest apparent angular diameter when the planet is located at position
- A)  $P_1$
  - B)  $P_2$
  - C)  $P_3$
  - D)  $P_4$

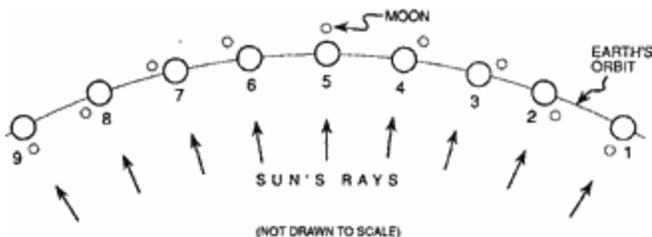
- 
70. The gravitational attraction between planet  $P$  and the star is greatest when the planet is located at position
- A)  $P_1$                       B)  $P_2$                       C)  $P_3$                       D)  $P_4$
- 

71. The speed of a planet in its orbit around the Sun depends primarily on the planet's
- A) direction of revolution                      B) distance from the Sun  
C) polar circumference                      D) axial tilt

72. Which change always occurs as the distance between the Earth and the Sun decreases?
- A) The gravitational force between the Earth and the Sun decreases.  
B) The Sun's apparent diameter decreases.  
C) The Sun's rate of rotation increases.  
D) The Earth's orbital speed increases.

73. The force of gravity between two objects will be greatest if their masses are
- A) small and they are far apart                      B) small and they are close together  
C) large and they are far apart                      D) large and they are close together

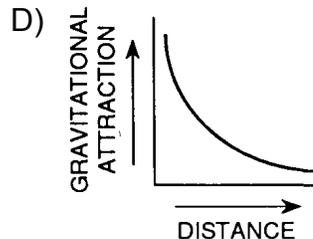
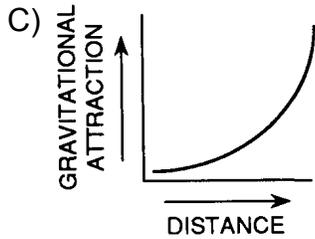
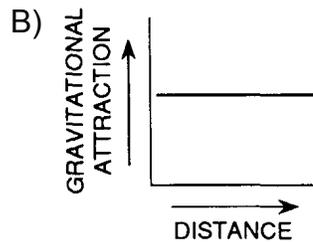
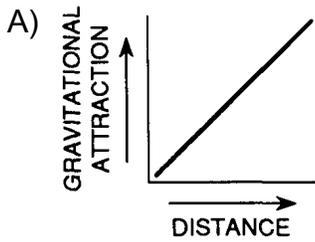
74. Base your answer to the following question on the diagram below which represents nine positions of the Earth in orbit around the Sun during one complete orbit of the Moon around the Earth.



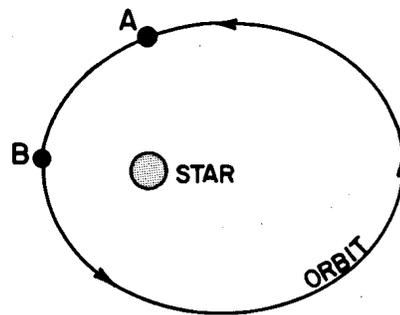
The elliptical shape of the Moon's orbit around the Earth causes

- A) changes in the gravitational attraction between the Moon and the Earth  
B) the Earth to have an equatorial bulge  
C) the Moon's period of rotation to equal its period of revolution  
D) the  $23\frac{1}{2}^\circ$  tilt of the Earth's axis of rotation
-

75. Which graph best represents the relationship between the gravitational attraction of two objects and their distance from each other?



76. The diagram below represents a planet in orbit around a star.



NOT DRAWN TO SCALE

Which statement best describes how the planet's energy is changing as it moves from point A to point B?

- A) Kinetic energy is increasing and potential energy is decreasing.
- B) Kinetic energy is decreasing and potential energy is increasing.
- C) Both kinetic and potential energy are decreasing.
- D) Both kinetic and potential energy are increasing.

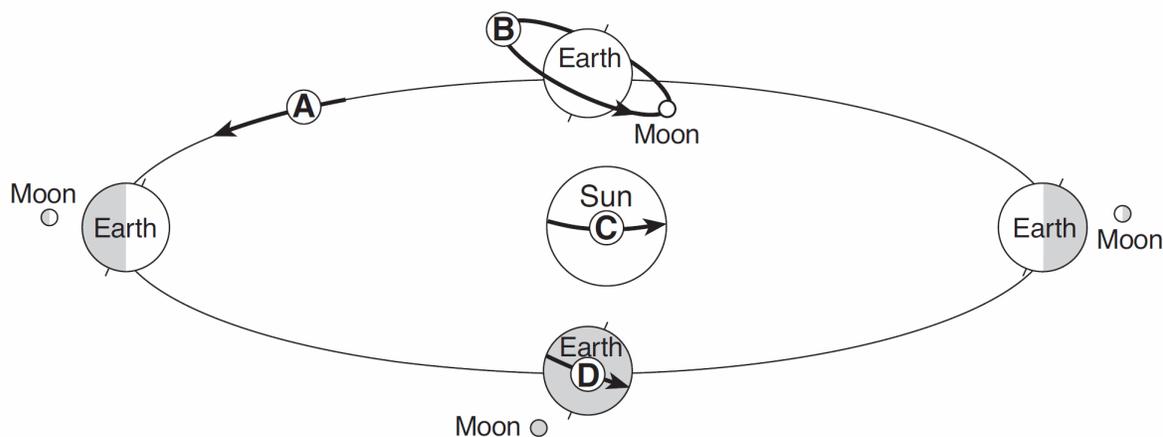
77. Which event is cyclic and predictable?

- A) a volcano erupting above a subducting tectonic plate
- B) an earthquake occurring at the San Andreas Fault
- C) Jupiter's apparent movement across the night sky
- D) an asteroid striking Earth's surface

78. Which planet's day (period of rotation) is longer than its year (period of revolution)?

- A) Mercury
- B) Venus
- C) Jupiter
- D) Saturn

79. The diagram below shows Earth and the Moon in four locations during their orbits. Arrows *A* through *D* represent different motions of Earth, the Moon, and the Sun.



(Not drawn to scale)

Which arrow represents a rate of movement of approximately  $1^\circ$  per day?

- A) *A*                      B) *B*                      C) *C*                      D) *D*
80. Base your answer to the following question on the passage below.

### A Newly Discovered Planet

Scientists studying a Sun-like star named Ogle-Tr-3 discovered a planet that is, on the average, 3.5 million kilometers away from the star's surface. The planet was discovered as a result of observing a cyclic decrease in the brightness of Ogle-Tr-3 every 28.5 hours. The changing brightness is the result of the planet blocking some of the starlight when it is between Ogle-Tr-3 and Earth. This observation allowed scientists to find not only the planet, but also to determine the planet's mass and density. The mass has been calculated to be approximately 159 times the mass of Earth. The planet is only 20% as dense as Jupiter. Scientists think that this low density is the result of being very close to Ogle-Tr-3.

Compared to the period of revolution of Mercury and Venus, this newly discovered planet's period of revolution is

- A) shorter than both Mercury's and Venus'  
B) longer than both Mercury's and Venus'  
C) shorter than Mercury's but longer than Venus'  
D) longer than Mercury's but shorter than Venus'

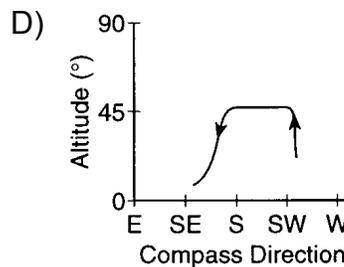
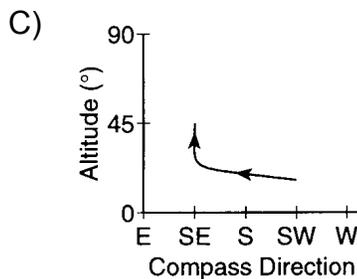
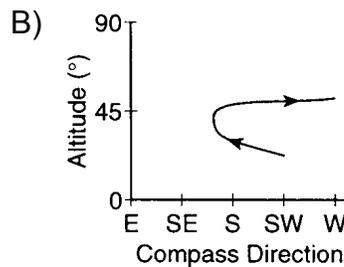
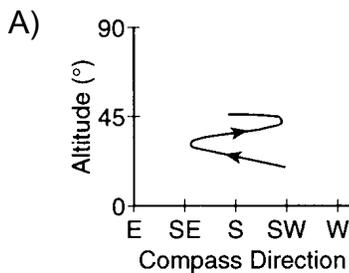
81. Which event takes the most time?

- A) one revolution of Earth around the Sun
- B) one revolution of Venus around the Sun
- C) one rotation of the Moon on its axis
- D) one rotation of Venus on its axis

82. The table below shows the altitude and compass direction of one planet, as viewed by an observer in New York State at 10 p.m. on the first day of each month from April through November.

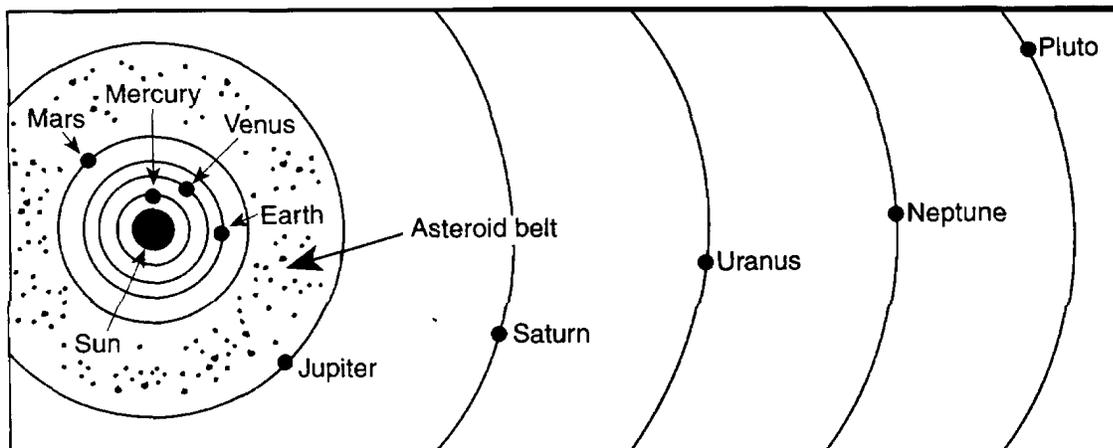
Month	Altitude	Compass Direction
April	20°	SW
May	23°	SSW
June	25°	S
July	29°	SSE
August	33°	SE
September	38°	S
October	42°	SW
November	45°	S

Which graph best represents a plot of this planet's apparent path, as viewed by the observer over the 7-month period?



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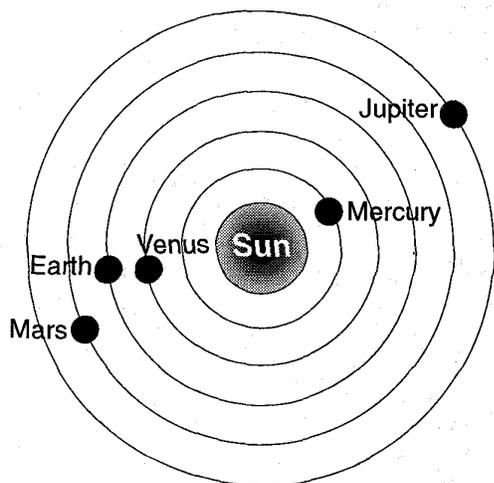
Base your answers to questions **83** and **84** on the diagram below, which shows a portion of the solar system.



( Not drawn to scale )

83. The actual orbits of the planets are
- A) elliptical, with Earth at one of the foci
  - B) elliptical, with the Sun at one of the foci
  - C) circular, with Earth at the center
  - D) circular, with the Sun at the center
84. Mercury and Venus are the only planets that show phases when viewed from Earth because both Mercury and Venus
- A) revolve around the Sun inside Earth's orbit
  - B) rotate more slowly than Earth does
  - C) are eclipsed by Earth's shadow
  - D) pass behind the Sun in their orbit
-

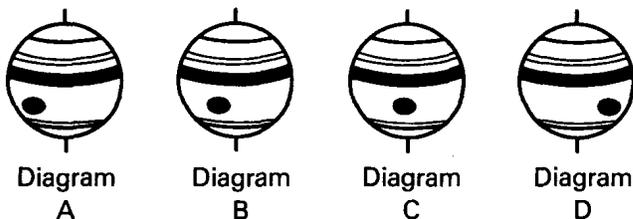
85. The diagram below shows several planets at various positions in their orbits at a particular time.



(Not drawn to scale)

Which planet would be visible from the Earth at night for the longest period of time when the planets are in these positions?

- A) Mercury      B) Venus      C) Mars      D) Jupiter
86. If viewed from the Earth over a period of several years, the apparent diameter of Mars will
- A) decrease constantly      B) increase constantly  
C) remain unchanged      D) vary in a cyclic manner
87. A planet was viewed from Earth for several hours. The diagrams below represent the appearance of the planet at four different times.



The best inference that can be made based on the diagrams is that this planet is

- A) tilted on its axis      B) changing seasons  
C) revolving      D) rotating