Due Thursday 5/15

Exercises

Communicate

1. Describe the information you can obtain from the standard equation of a translated ellipse, such as $\frac{x^2}{16} + \frac{(y-2)^2}{25} = 1$.

2. Describe the procedure used to write the standard equation of the ellipse defined by $9x^2 + 4y^2 + 18x - 40y + 73 = 0$.

3. Explain how to graph $\frac{(x-4)^2}{3^2} + \frac{(y-5)^2}{2^2} = 1$.

4. Describe the graph of $\frac{x^2}{25} + \frac{y^2}{25} = 1$.

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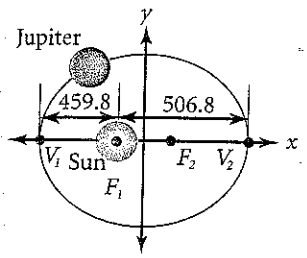
Guided Skills Practice

5. Write the standard equation for an ellipse centered at the origin with foci at (5, 0) and (−5, 0) and with a minor axis of 8. Sketch the graph. ***(EXAMPLE 1)***

APPLICATION

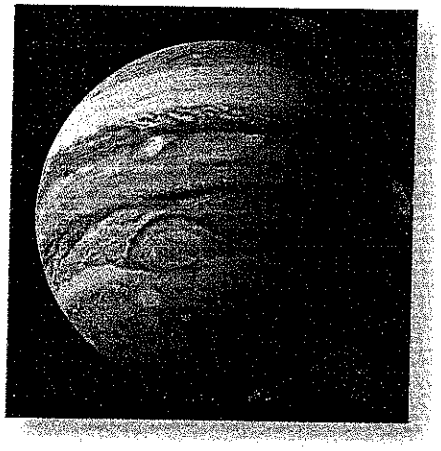


[*Not to scale*]

6. **ASTRONOMY** The diagram at left gives the minimum and maximum distances (in millions of miles) from Jupiter to the Sun. Write the standard equation for Jupiter's elliptical orbit around the Sun. ***(EXAMPLE 2)***

7. Write the standard equation for an ellipse centered at (1, −2) with a vertical major axis of 6 and a minor axis of 4. Sketch the graph. ***(EXAMPLE 3)***

8. An ellipse is defined by the equation $25x^2 + 4y^2 + 50x - 8y - 71 = 0$. Write the standard equation, and identify the coordinates of the center, vertices, co-vertices, and foci. Sketch the graph. ***(EXAMPLE 4)***



Jupiter as seen by Voyager 1

Practice and Apply

Find the vertices and co-vertices of each ellipse.

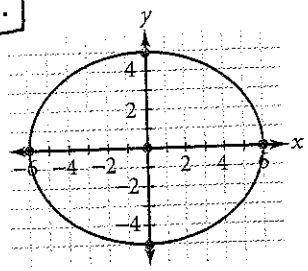
9. $\frac{x^2}{25} + \frac{y^2}{9} = 1$
10. $\frac{x^2}{16} + \frac{y^2}{49} = 1$
11. $\frac{x^2}{81} + \frac{y^2}{4} = 1$
12. $\frac{x^2}{9} + \frac{y^2}{36} = 1$
13. $\frac{x^2}{1} + \frac{y^2}{64} = 1$
14. $\frac{x^2}{1} + \frac{y^2}{4} = 1$

Write the standard equation of each ellipse. Find the coordinates of the center, vertices, co-vertices, and foci.

15. $3x^2 + 12y^2 = 12$
16. $50x^2 + 2y^2 = 50$
17. $3x^2 + 7y^2 = 28$
18. $5x^2 + 20y^2 = 80$
19. $\frac{x^2}{8} + \frac{y^2}{18} = 2$
20. $\frac{x^2}{3} + \frac{y^2}{12} = 3$

Write the standard equation for each ellipse.

21.



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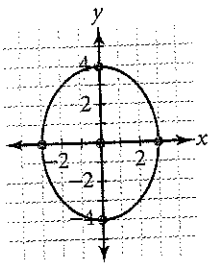

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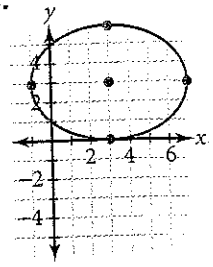

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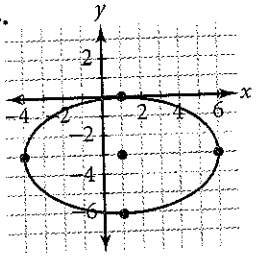

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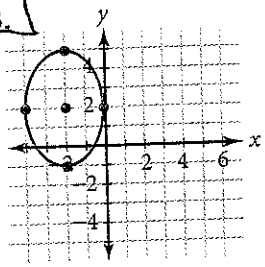

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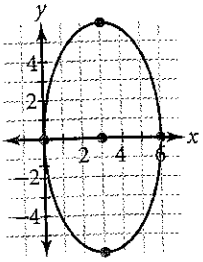


Sketch the graph of each ellipse. Label the center, foci, vertices, and co-vertices.

27. $\frac{x^2}{25} + \frac{y^2}{4} = 1$

28. $\frac{x^2}{1} + \frac{y^2}{9} = 1$

29. $\frac{x^2}{4} + \frac{y^2}{9} = 1$

30. $\frac{x^2}{16} + \frac{y^2}{1} = 1$

31. $\frac{(x+2)^2}{4} + \frac{(y+1)^2}{9} = 1$

32. $\frac{(x-2)^2}{9} + \frac{(y-2)^2}{4} = 1$

33. $\frac{x^2}{1} + \frac{(y+2)^2}{9} = 1$

34. $\frac{(x+1)^2}{4} + \frac{y^2}{1} = 1$

35. $\frac{(x-1)^2}{4} + \frac{(y-1)^2}{4} = 1$

36. $16(x+1)^2 + 9(y-1)^2 = 144$

37. $9(x-1)^2 + 25(y+2)^2 = 225$

38. $4x^2 + 25y^2 = 100$

39. $25x^2 + 9y^2 = 225$

Write the standard equation for the ellipse with the given characteristics.

40. foci: (5, 0), (−5, 0)
vertices: (9, 0), (−9, 0)

41. foci: (0, 4), (0, −4)
vertices: (0, 8), (0, −8)

42. foci: (7, 0), (−7, 0)
co-vertices: (0, 3), (0, −3)

43. foci: (0, 3), (0, −3)
co-vertices: (1, 0), (−1, 0)

44. co-vertices: (0, 2), (0, −2)
vertices: (3, 0), (−3, 0)

45. vertices: (5, 0), (−5, 0)
co-vertices: (0, 4), (0, −4)

State whether each equation represents a parabola, a circle, or an ellipse.

46. $\frac{x}{2} = \frac{(y-3)^2}{4}$

47. $\frac{y}{4} = \frac{(x+2)^2}{2}$

48. $\frac{(x-1)^2}{12} = 6 - \frac{(y+5)^2}{9}$

49. $\frac{(y+4)^2}{6} = 8 - \frac{(x-1)^2}{4}$

Write the standard equation for each ellipse. Identify the coordinates of the center, vertices, co-vertices, and foci.

50. $x^2 + 4y^2 + 6x - 8y = 3$

51. $16x^2 + 4y^2 + 32x - 8y = 44$

52. $x^2 + 16y^2 - 64y = 0$

53. $25x^2 + y^2 - 50x = 0$

54. $4x^2 + 9y^2 - 16x + 18y = 11$

55. $25x^2 + 9y^2 + 100x + 18y = 116$

56. $9x^2 + 16y^2 - 36x - 64y - 44 = 0$

57. $36x^2 + 25y^2 - 72x + 100y = 764$

CONNECTIONS

58. TRANSFORMATIONS If the ellipse defined by the equation $\frac{(x+5)^2}{36} + \frac{(y-1)^2}{64} = 1$ is translated 1 unit up and 5 units to the right, write the standard equation of the resulting ellipse.

59. TRANSFORMATIONS If the ellipse defined by the equation $16x^2 + 4y^2 + 96x + 8y + 84 = 0$ is translated 4 units down and 7 units to the left, write the standard equation of the resulting ellipse.

CHALLENGES

60. Use equations to explain why the eccentricity of an ellipse cannot equal 1.

61. Describe the graph of the equation $\frac{(x+2)^2}{3} + \frac{(y-1)^2}{6} = 0$.

APPLICATIONS

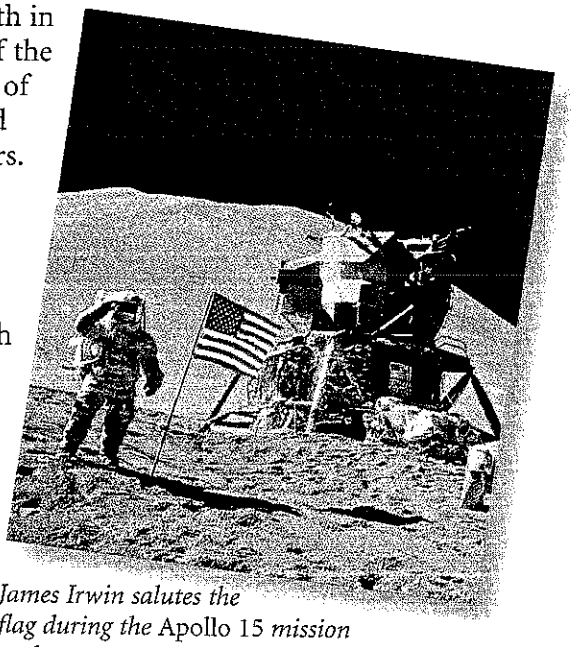
62. ASTRONOMY The Moon orbits Earth in an elliptical path with the center of the Earth at one focus. The major axis of the orbit is 774,000 kilometers, and the minor axis is 773,000 kilometers.

a. Using (0, 0) as the center of the ellipse, write the standard equation for the orbit of the Moon around Earth.

b. How far from the center of Earth is the Moon at its closest point?

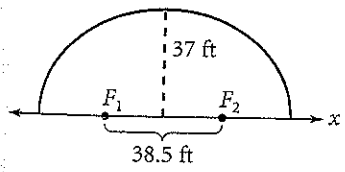
c. How far from the center of Earth is the Moon at its farthest point?

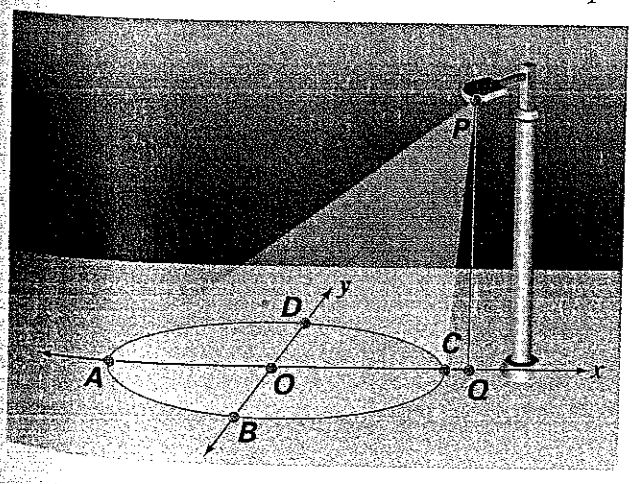
d. Find the eccentricity of the Moon's orbit around Earth.



James Irwin salutes the flag during the Apollo 15 *mission to the Moon.*

63. ARCHITECTURE The ceiling of the "whispering gallery" of the Statuary Hall in the United States Capitol Building can be approximated by a *semi-ellipse.* Because of the properties of reflection, the whispering of someone standing at one focus can be clearly heard by a person standing at the other focus. It is said that John Quincy Adams used this attribute of the Statuary Hall to eavesdrop on his adversaries. Suppose that the distance between the foci is 38.5 feet and the maximum height of the ceiling above ear level is 37 feet. Find the equation of an elliptical cross section of this gallery, assuming that the center is placed at the origin.





64. LIGHTING A light atop the pole represented by $\overline{PQ}$ illuminates an elliptical region at the base of the pole as shown in the illustration at left, where $PQ = 18$ feet, $CQ = 2$ feet, $AQ = 26$ feet, and $BD = 18$ feet.

a. Using the x- and y-axes shown, write an equation for the boundary of the elliptical region illuminated by the light.

b. Write an inequality in terms of x and y that represents the points in the illuminated area.

c. Describe the region that would be illuminated if the pole stood straight up at point O and the light were directed straight down.