Calculus Volume 3 1st edition Strang Solutions Manual

SKU: 9781938168079-SOLUTIONS

INSTRUCTOR ANSWER AND SOLUTION GUIDE

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Calculus

Volume 3

Calculus Volume 3 1st edition Strang Solutions Manual

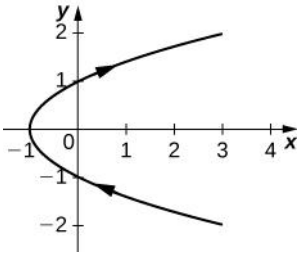
Chapter 1
Parametric Equations and Polar Coordinates
1.1 Parametric Equations

Section Exercises

For the following exercises, sketch the curves below by eliminating the parameter *t*. Give the orientation of the curve.

1. $x = t^2 + 2t, \quad y = t + 1$

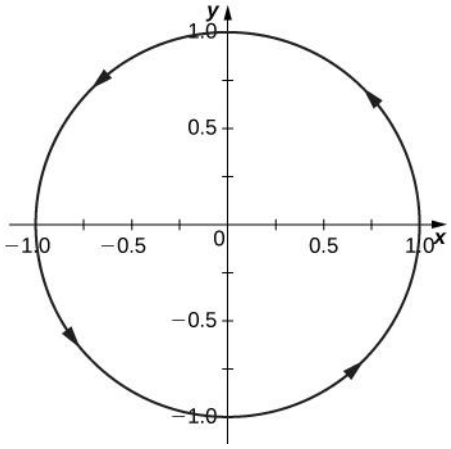
Answer:



orientation: bottom to top

2. $x = \cos(t), y = \sin(t), \left(0, 2\pi\right]$

Answer:

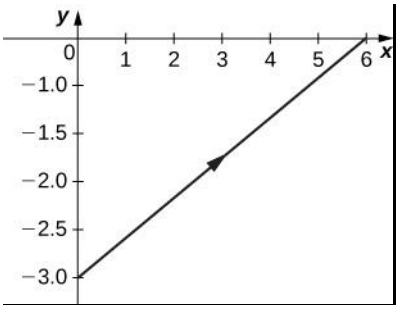


orientation: counterclockwise

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3. $x = 2t + 4,\ y = t - 1$

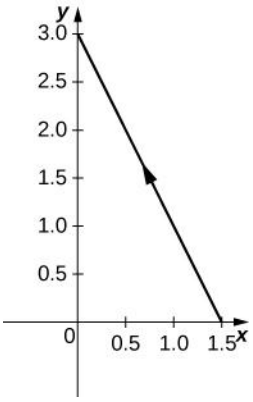
Answer:



orientation: left to right

4. $x = 3 - t,\ y = 2t - 3,\ 1.5 \le t \le 3$

Answer:

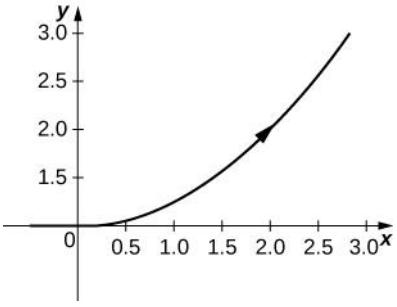


orientation: right to left

For the following exercises, eliminate the parameter and sketch the graphs.

5. $x = 2t^2,\quad y = t^4 + 1$

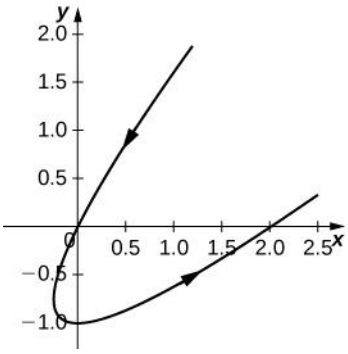
Answer: $y = \dfrac{x^2}{4} + 1$



For the following exercises, use technology (CAS or calculator) to sketch the parametric equations.

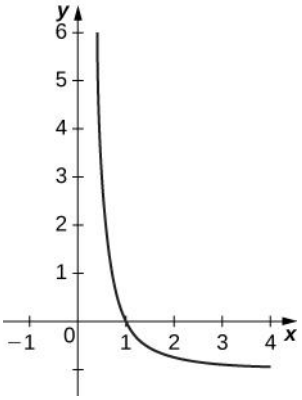
6. **[T]** $x = t^2 + t, \quad y = t^2 - 1$

Answer:



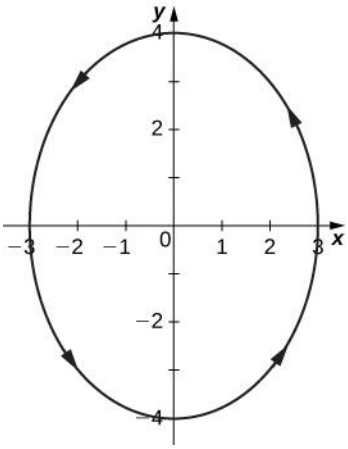
7. **[T]** $x = e^{-t}, \quad y = e^{2t} - 1$

Answer:



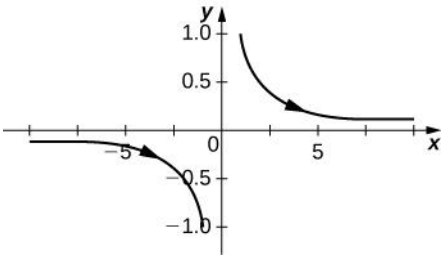
8. **[T]** $x = 3\cos t, \quad y = 4\sin t$

Answer:



9. **[T]** $x = \sec t, \quad y = \cos t$

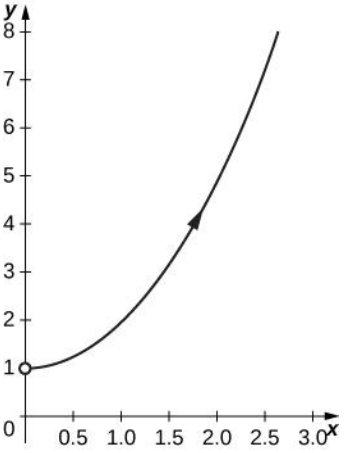
Answer:



For the following exercises, sketch the parametric equations by eliminating the parameter. Indicate any asymptotes of the graph.

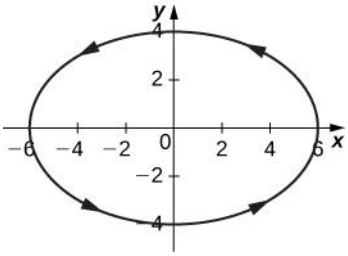
10. $x = e^t, \quad y = e^{2t} + 1$

Answer:



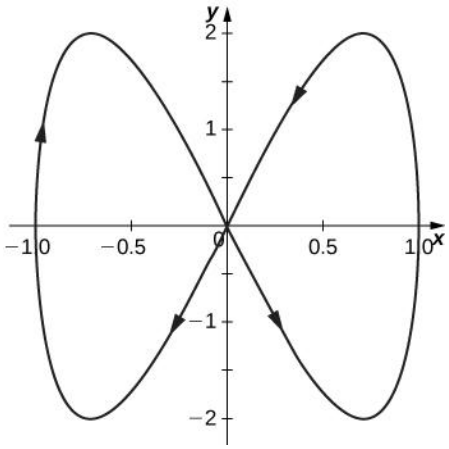
11. $x = 6\sin(2\theta), \quad y = 4\cos(2\theta)$

Answer:



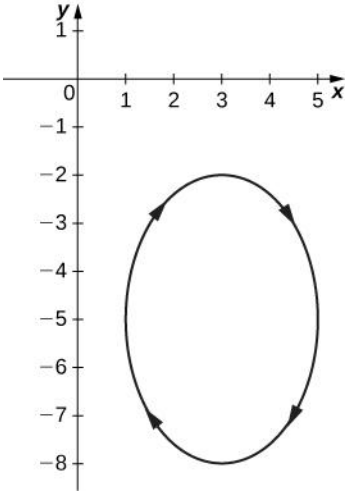
12. $x = \cos\theta, \quad y = 2\sin(2\theta)$

Answer:



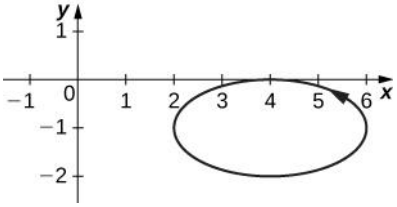
13. $x = 3 - 2\cos\theta, \quad y = -5 + 3\sin\theta$

Answer:



14. $x = 4 + 2\cos\theta, \quad y = -1 + \sin\theta$

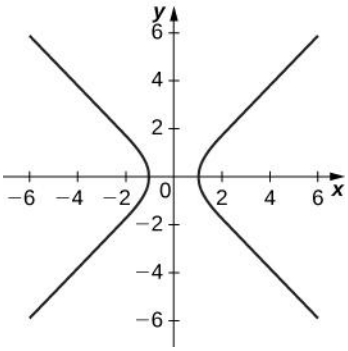
Answer:



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15. $x = \sec t, \quad y = \tan t$

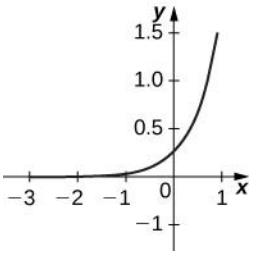
Answer:



Asymptotes are $y = x$ and $y = -x$

16. $x = \ln(2t), \quad y = t^2$

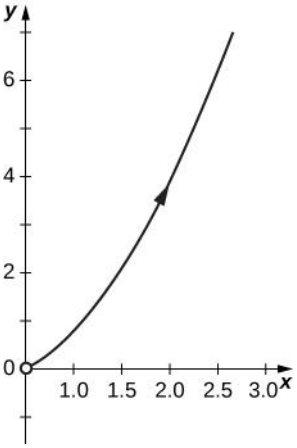
Answer:



$y = 0$ is a horizontal asymptote.

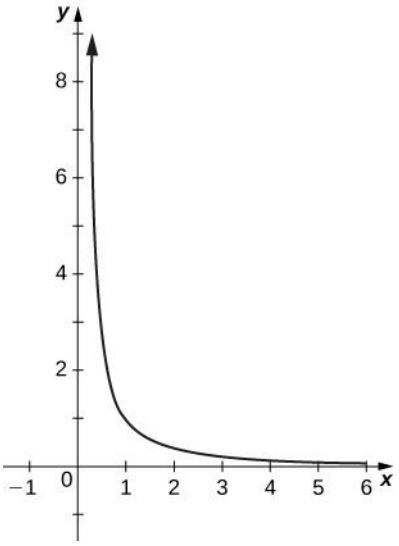
17. $x = e^t, \quad y = e^{2t}$

Answer:



18. $x = e^{-2t}, \quad y = e^{3t}$

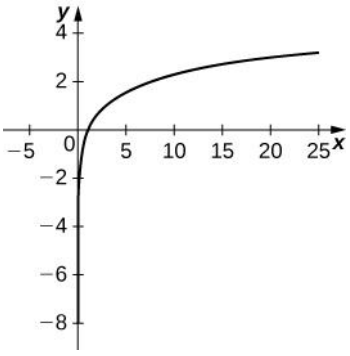
Answer:



Horizontal asymptote: $y = 0.$ Vertical asymptote: $x = 0.$

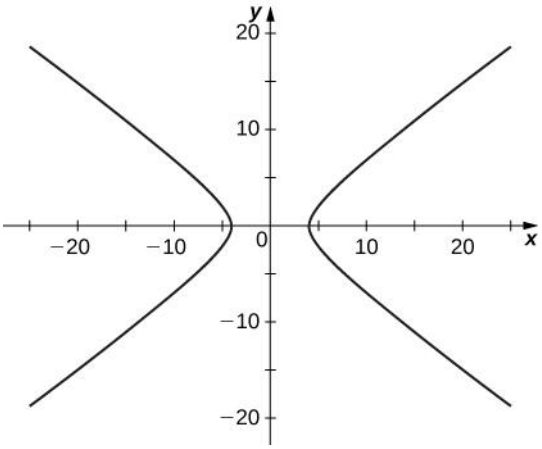
19. $x = t^3, \quad y = 3\ln t$

Answer:



20. $x = 4\sec\theta, \quad y = 3\tan\theta$

Answer:



For the following exercises, convert the parametric equations of a curve into rectangular form. No sketch is necessary. State the domain of the rectangular form.

21. $x = t^2 - 1, \quad y = \dfrac{t}{2}$

Answer: $y = \dfrac{\sqrt{x+1}}{2}$; domain: $x \in [-1, \infty)$

22. $x = \dfrac{1}{\sqrt{t+1}}, \quad y = \dfrac{t}{1+t}, \ t > -1$

Answer: $y = 1 - x^2$; domain: $x \in (0, \infty)$.

23. $x = 4\cos\theta, \ y = 3\sin\theta, \ \theta \in (0, 2\pi]$

Answer: $\dfrac{x^2}{16} + \dfrac{y^2}{9} = 1$; domain $x \in [-4, 4]$.

24. $x = \cosh t, \quad y = \sinh t$

Answer: $x^2 - y^2 = 1$; domain $x \in [1, \infty) \cup (-\infty, -1]$.

25. $x = 2t - 3, \quad y = 6t - 7$

Answer: $y = 3x + 2$; domain: all real numbers.

26. $x = t^2, \quad y = t^3$

Answer: $y = \pm x^{3/2}$; domain: $x \in [0, \infty)$.

27. $x = 1 + \cos t, \quad y = 3 - \sin t$

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Answer: $(x-1)^2+(y-3)^2=1$; domain: $x\in\left[0,2\right]$.

28. $x=\sqrt{t},\quad y=2t+4$

Answer: $y=2x^2+4,\ x\geq 0;$; domain: $x\in\left[0,\infty\right)$.

29. $x=\sec t,\quad y=\tan t,\ \pi\leq t<\dfrac{3\pi}{2}$

Answer: $y=\sqrt{x^2-1};$ domain: $x\in(-\infty,1]$

30. $x=2\cosh t,\quad y=4\sinh t$

Answer: $\dfrac{x^2}{4}-\dfrac{y^2}{16}=1$

31. $x=\cos(2t),\quad y=\sin t$

Answer: $y^2=\dfrac{1-x}{2};$ domain: $x\in\left[2,\infty\right)\cup\left(-\infty,-2\right]$.

32. $x=4t+3,\qquad y=16\,t^2-9$

Answer: $y=(x-3)^2-9;$ domain: all real numbers.

33. $x=t^2,\quad y=2\ln t,\ t\geq 1$

Answer: $y=\ln x;$ domain: $x\in[1,\infty)$.

34. $x=t^3,\quad y=3\ln t,\ t\geq 1$

Answer: $y=\ln x;$ domain: $x\in(0,\infty)$.

35. $x=t^n,\quad y=n\ln t,\ t\geq 1,$ where n is a natural number

Answer: $y=\ln x;$ domain: $x\in(0,\infty)$.

36. $\begin{aligned}x&=\ln(5t)\\y&=\ln(t^2)\end{aligned}$ where $1\leq t\leq e$

Answer: $y=2x-\ln 25,$ a linear function; domain: $x\in\left[\ln(5),\ln(5)+1\right]$.

37. $\begin{aligned}x&=2\sin(8t)\\y&=2\cos(8t)\end{aligned}$

Answer: $x^2+y^2=4;$ domain: $x\in[-2,2]$.

38. $\begin{aligned}x&=\tan t\\y&=\sec^2 t-1\end{aligned}$

Answer: $y=x^2;$ domain: all real numbers.

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For the following exercises, the pairs of parametric equations represent lines, parabolas, circles, ellipses, or hyperbolas. Name the type of basic curve that each pair of equations represents.

39.
$$x = 3t + 4$$
$$y = 5t - 2$$
Answer: line

40.
$$x - 4 = 5t$$
$$y + 2 = t$$
Answer: line

41.
$$x = 2t + 1$$
$$y = t^2 - 3$$
Answer: parabola

42.
$$x = 3\cos t$$
$$y = 3\sin t$$
Answer: circle

43.
$$x = 2\cos(3t)$$
$$y = 2\sin(3t)$$
Answer: circle

44.
$$x = \cosh t$$
$$y = \sinh t$$
Answer: hyperbola

45.
$$x = 3\cos t$$
$$y = 4\sin t$$
Answer: ellipse

46.
$$x = 2\cos(3t)$$
$$y = 5\sin(3t)$$
Answer: ellipse

47.
$$x = 3\cosh(4t)$$
$$y = 4\sinh(4t)$$
Answer: hyperbola

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48. $\begin{aligned} x &= 2\cosh t \\ y &= 2\sinh t \end{aligned}$

Answer: hyperbola

49. Show that $\begin{aligned} x &= h + r\cos\theta \\ y &= k + r\sin\theta \end{aligned}$ represents the equation of a circle.

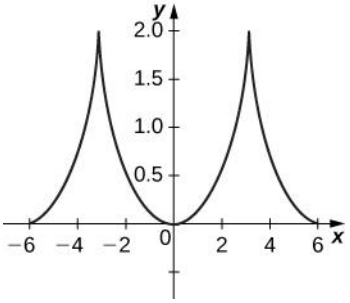
50. Use the equations in the preceding problem to find a set of parametric equations for a circle whose radius is 5 and whose center is $(-2,\ 3)$.

Answer: $\begin{aligned} x &= -2 + 5\cos\theta \\ y &= 3 + 5\sin\theta \end{aligned}$

For the following exercises, use a graphing utility to graph the curve represented by the parametric equations and identify the curve from its equation.

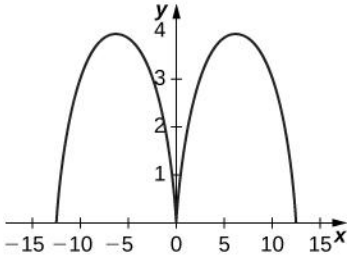
51. **[T]** $\begin{aligned} x &= \theta + \sin\theta \\ y &= 1 - \cos\theta \end{aligned}$

Answer: The equations represent a cycloid.



52. **[T]** $\begin{aligned} x &= 2t - 2\sin t \\ y &= 2 - 2\cos t \end{aligned}$

Answer: The equations represent the mirror image of a cycloid, the graph of which is symmetric with the *y*-axis.



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