EXERCISES FOR SECTION 9.3

Exercises 1–4, find dy/dx.

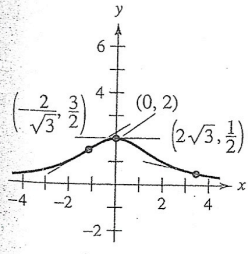
1. $x = t^2,\ y = 5 - 4t$
2. $x = \sqrt[3]{t},\ y = 4 - t$
3. $x = \sin^2\theta,\ y = \cos^2\theta$
4. $x = 2e^{\theta},\ y = e^{-\theta/2}$

In Exercises 5–14, find dy/dx and d^2y/dx^2, and find the slope and concavity (if possible) at the indicated value of the parameter.

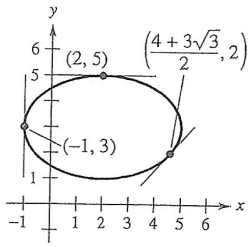
Parametric Equations	*Point*
5. $x = 2t,\ y = 3t - 1$	$t = 3$
6. $x = \sqrt{t},\ y = 3t - 1$	$t = 1$
7. $x = t + 1,\ y = t^2 + 3t$	$t = -1$
8. $x = t^2 + 3t + 2,\ y = 2t$	$t = 0$
9. $x = 2\cos\theta,\ y = 2\sin\theta$	$\theta = \frac{\pi}{4}$
10. $x = \cos\theta,\ y = 3\sin\theta$	$\theta = 0$
11. $x = 2 + \sec\theta,\ y = 1 + 2\tan\theta$	$\theta = \frac{\pi}{6}$
12. $x = \sqrt{t},\ y = \sqrt{t-1}$	$t = 2$
13. $x = \cos^3\theta,\ y = \sin^3\theta$	$\theta = \frac{\pi}{4}$
14. $x = \theta - \sin\theta,\ y = 1 - \cos\theta$	$\theta = \pi$

In Exercises 15 and 16, find an equation of the tangent line at the indicated points on the curve.

15. $x = 2\cot\theta$
$y = 2\sin^2\theta$



16. $x = 2 - 3\cos\theta$
$y = 3 + 2\sin\theta$



In Exercises 17–20, (a) use a graphing utility to graph the curve represented by the parametric equations, (b) use a graphing utility to find dx/dt, dy/dt, and dy/dx at the indicated value of the parameter, (c) find an equation of the tangent line to the curve at the indicated value of the parameter, and (d) confirm the result in part (c) by using a graphing utility to graph the tangent line.

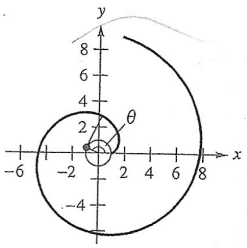
Parametric Equations	*Parameter*
17. $x = 2t,\ y = t^2 - 1$	$t = 2$
18. $x = t - 1,\ y = \frac{1}{t} + 1$	$t = 1$
19. $x = t^2 - t + 2,\ y = t^3 - 3t$	$t = -1$
20. $x = 4\cos\theta,\ y = 3\sin\theta$	$\theta = \frac{3\pi}{4}$

In Exercises 21 and 22, find the equations of the tangent lines at the point where the curve crosses itself.

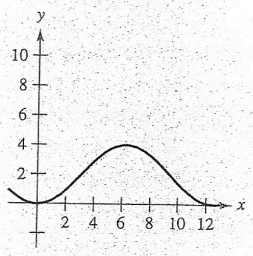
21. $x = 2\sin 2t,\ y = 3\sin t$
22. $x = t^2 - t,\ y = t^3 - 3t - 1$

In Exercises 23 and 24, find all points (if any) of horizontal and vertical tangency to the portion of the curve shown.

23. Involute of a circle:
$x = \cos\theta + \theta\sin\theta$
$y = \sin\theta - \theta\cos\theta$



24. $x = 2\theta$
$y = 2(1 - \cos\theta)$



In Exercises 25–34, find all points (if any) of horizontal and vertical tangency to the curve. Use a graphing utility to confirm your results.

25. $x = 1 - t,\ y = t^2$
26. $x = t + 1,\ y = t^2 + 3t$
27. $x = 1 - t,\ y = t^3 - 3t$
28. $x = t^2 - t + 2,\ y = t^3 - 3t$
29. $x = 3\cos\theta,\ y = 3\sin\theta$
30. $x = \cos\theta,\ y = 2\sin 2\theta$
31. $x = 4 + 2\cos\theta,\ y = -1 + \sin\theta$
32. $x = 4\cos^2\theta,\ y = 2\sin\theta$
33. $x = \sec\theta,\ y = \tan\theta$
34. $x = \cos^2\theta,\ y = \cos\theta$

Arc Length **In Exercises 35–40, find the arc length of the given curve on the indicated interval.**

Parametric Equations	*Interval*
35. $x = t^2,\ y = 2t$	$0 \le t \le 2$
36. $x = t^2 + 1,\ y = 4t^3 + 3$	$-1 \le t \le 0$
37. $x = e^{-t}\cos t,\ y = e^{-t}\sin t$	$0 \le t \le \frac{\pi}{2}$
38. $x = \arcsin t,\ y = \ln\sqrt{1 - t^2}$	$0 \le t \le \frac{1}{2}$
39. $x = \sqrt{t},\ y = 3t - 1$	$0 \le t \le 1$
40. $x = t,\ y = \frac{t^5}{10} + \frac{1}{6t^3}$	$1 \le t \le 2$