

17. $f(x) = -6x^7 + 5x^3 + \pi^2$ 18. $y = 13x^4 - 6x^3 - 3(x - 8)$
 19. $y = \frac{1}{3}x^3 + \frac{1}{2}x^2$ 20. $f(z) = -\frac{1}{4}z^8 + \frac{1}{2}z^4 - 2^3$

In Exercises 21–24, evaluate the derivative of each of the given functions at the given point. In Exercises 23 and 24, check your result using the derivative evaluation feature of a calculator.

21. $y = 6x^2 - 8x + 1$ (2, 9) 22. $s = 2t^3 - 5t^2$ (-1, -7)
 23. $y = 2x^3 + 9x - 7$ (-2, -41)
 24. $y = x^4 - 9x^2 - 5x$ (3, -15)

In Exercises 25–28, find the slope of a line tangent to the curve of each of the given functions for the given values of x . Use the tangent feature of a calculator to display the curve and the tangent line to see if the slope is reasonable for the given value of x .

25. $y = 2x^6 - 4x^2$ ($x = -1$) 26. $y = 3x^3 - 9x$ ($x = 1$)
 27. $y = 35x - 2x^4$ ($x = 2$)
 28. $y = x^4 - \frac{1}{2}x^2 + 2$ ($x = -2$)

In Exercises 29–32, determine an expression for the instantaneous velocity of objects moving with rectilinear motion according to the functions given, if s represents displacement in terms of time t .

29. $s = 6t^5 - 5t + 2$ 30. $s = 20 + 60t - 4.9t^2$
 31. $s = 2 - (6t - 2t^3)$ 32. $s = s_0 + v_0t + \frac{1}{2}at^2$

In Exercises 33–36, s represents the displacement, and t represents the time for objects moving with rectilinear motion, according to the given functions. Find the instantaneous velocity for the given times.

33. $s = 2t^3 - 4t^2$; $t = 4$ 34. $s = 8t^2 - 2(10t + 6)$; $t = 5$
 35. $s = 120 + 80t - 16t^2$; $t = 2.5$
 36. $s = 0.5t^4 - 1.5t^2 + 2.5$; $t = 3$

In Exercises 37–56, solve the given problems by finding the appropriate derivative.

37. For what value(s) of x is the tangent to the curve of $y = 3x^2 - 6x$ parallel to the x -axis? (That is, where is the slope zero?)
 38. Find the value of a if the tangent to the curve of $y = ax^2 + 2x$ has a slope of -4 for $x = 2$.
 39. For what point(s) on the curve of $y = 3x^2 - 4x$ is the slope of a tangent line equal to 8?
 (W) 40. Explain why the curve $y = 5x^3 + 4x - 3$ does not have a tangent line with a slope less than 4.
 41. Find the point at which a tangent line to the parabola $y = 2x^2 - 7x$ is perpendicular to the line $x - 3y = 16$.
 (W) 42. Display the graphs of $y = x^2$ and its derivative on a calculator. State any conclusions you can draw from the relationship of the two graphs.
 43. For what value(s) of x is the slope of a line tangent to the curve of $y = 4x^2 + 3x$ equal to the slope of a line tangent to the curve of $y = 5 - 2x^2$?
 44. For what value(s) of t is the instantaneous velocity of an object moving according to $s = 5t - 2t^2$ equal to the instantaneous velocity of an object moving according to $s = 3t^2 + 4$?
 45. The length of a certain metal tube is always 20 times the radius r . The tube is heated and the radius and volume V increase. Find dV/dr for $r = 3.0$ mm.

46. A rectangular solid block of ice is melting such that the height is always twice the edge of the square base. Find the expression for the instantaneous rate of change of surface area A with respect to the edge of the base e .
 47. The electric power P (in W) as a function of the current i (in A) in a certain circuit is given by $P = 16i^2 + 60i$. Find the instantaneous rate of change of P with respect to i for $i = 0.75$ A.
 48. The torque T on the arm of a robotic control mechanism varies directly as the cube of the diameter d of the arm. If $T = 850$ lb · in. for $d = 0.925$ in., find the expression for the instantaneous rate of change of T with respect to d .
 49. The resistance R (in Ω) of a certain wire as a function of the temperature T (in $^\circ\text{C}$) is given by $R = 16.0 + 0.450T + 0.0125T^2$. Find the instantaneous rate of change of R with respect to T when $T = 115^\circ\text{C}$.
 50. The deflection d of a diving board x m from the fixed end at the pool side is given by $d = kx^2(3L - x)$, where L is the length of the diving board and k is a positive constant. Find the expression for the instantaneous rate of change of d with respect to x .
 51. The tensile strength S (in N) of a certain material as a function of the temperature T (in $^\circ\text{C}$) is $S = 1600 - 0.000022T^2$. Find the instantaneous rate of change of S with respect to T for $T = 65^\circ\text{C}$.
 52. A tank containing 6000 L of water drains out in 30 min. The volume V of water in the tank after t min of draining is $V = 6000(1 - t/30)^2$. Find the instantaneous time rate of change of V after 15 min of draining.
 53. The altitude h (in m) of a jet as a function of the horizontal distance x (in km) it has traveled is given by $h = 0.000104x^4 - 0.0417x^3 + 4.21x^2 - 8.33x$. Find the instantaneous rate of change of h with respect to x for $x = 120$ km.
 54. The force F (in N) exerted by a cam on a lever is given by $F = x^4 - 12x^3 + 46x^2 - 60x + 25$, where x ($1 \leq x \leq 5$) is the distance (in cm) from the center of rotation of the cam to the edge of the cam in contact with the lever (see Fig. 31). Find the instantaneous rate of change of F with respect to x when $x = 4.0$ cm.

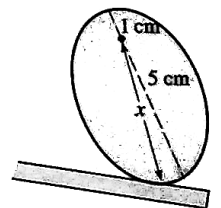


Fig. 31

55. Two ball bearings wear down such that the radius r of one is constantly 1.20 mm less than the radius of the other. Find the instantaneous rate of change of the total volume V_T of the two ball bearings with respect to r for $r = 3.30$ mm.
 56. Equal squares of side x are to be cut from the corners of a 6.00 in. by 8.00 in. rectangular piece of cardboard. The sides are to be bent up and taped together to make an open top container. Find the instantaneous rate of change of the volume V of the container with respect to x for $x = 1.75$ in. See Fig. 32.

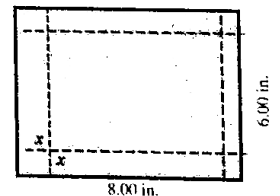


Fig. 32

Answers to Practice Exercises

1. $dy/dx = 18x^2$ 2. $v = 28t^3 - 4$