3.5 Exercises

In Exercises 1–20, find the first and second derivatives of the function.

1. $f(x) = 4x^2 - 2x + 1$

2. $f(x) = -0.2x^2 + 0.3x + 4$

3. $f(x) = 2x^3 - 3x^2 + 1$

4. $g(x) = -3x^3 + 24x^2 + 6x - 64$

5. $h(t) = t^4 - 2t^3 + 6t^2 - 3t + 10$

6. $f(x) = x^5 - x^4 + x^3 - x^2 + x - 1$

7. $f(x) = (x^2 + 2)^5$ 8. $g(t) = t^2(3t + 1)^4$

9. $g(t) = (2t^2 - 1)^2(3t^2)$

10. $h(x) = (x^2 + 1)^2(x - 1)$

11. $f(x) = (2x^2 + 2)^{7/2}$

12. $h(w) = (w^2 + 2w + 4)^{5/2}$

13. $f(x) = x(x^2 + 1)^2$ 14. $g(u) = u(2u - 1)^3$

15. $f(x) = \dfrac{x}{2x + 1}$ 16. $g(t) = \dfrac{t^2}{t - 1}$

17. $f(s) = \dfrac{s - 1}{s + 1}$ 18. $f(u) = \dfrac{u}{u^2 + 1}$

19. $f(u) = \sqrt{4 - 3u}$ 20. $f(x) = \sqrt{2x - 1}$

In Exercises 21–28, find the third derivative of the given function.

21. $f(x) = 3x^4 - 4x^3$

22. $f(x) = 3x^5 - 6x^4 + 2x^2 - 8x + 12$

23. $f(x) = \dfrac{1}{x}$ 24. $f(x) = \dfrac{2}{x^2}$

25. $g(s) = \sqrt{3s - 2}$ 26. $g(t) = \sqrt{2t + 3}$

27. $f(x) = (2x - 3)^4$ 28. $g(t) = \left(\dfrac{1}{2}t^2 - 1\right)^5$

29. **ACCELERATION OF A FALLING OBJECT** During the construction of an office building, a hammer is accidentally dropped from a height of 256 ft. The distance (in feet) the hammer falls in t sec is $s = 16t^2$. What is the hammer's velocity when it strikes the ground? What is its acceleration?

30. **ACCELERATION OF A CAR** The distance s (in feet) covered by

31. **AUTO TRANSMISSIONS AND FUEL ECONOMY** In trying to extract maximum efficiency out of every subsystem of a vehicle, auto transmission engineers are developing transmissions with up to ten gears. This is one of the ways in which manufacturers are trying to meet stricter federal fuel economy and pollution standards. The projected percentage of new cars equipped with transmissions that have seven speeds or more is given by the function

$$P(t) = 0.38t^2 + 1.3t + 3 \qquad (0 \le t \le 20)$$

where t is measured in years, with $t = 0$ corresponding to 2010.

a. What will the percentage of vehicles equipped with transmissions that have seven speeds or more be in 2015 according to the projection?

b. How fast will the percentage of vehicles equipped with transmissions that have seven speeds or more be changing in 2015?

c. What is $P''(5)$? Interpret your result.

Source: IHS Automotive.

32. **ALZHEIMER'S DISEASE** As baby boomers enter their golden years, the number of people afflicted with Alzheimer's disease is expected to rise dramatically. In a study published in the *Journal of Neurology*, the number of people with Alzheimer's disease in the United States age 65 years and over is projected to be

$$N(t) = 0.00525t^2 + 0.075t + 4.7 \qquad (0 \le t \le 4)$$

million in decade t, where $t = 0$ corresponds to 2010.

a. What is the projected number of people with Alzheimer's disease in the United States age 65 years and over in 2030?

b. How fast is the number of people with Alzheimer's disease in the United States age 65 years and over projected to grow in 2030?

c. How fast is the rate of growth of people with Alzheimer's disease in the United States age 65 years and over projected to change in the period covered by the study?

Source: American Academy of Neurology.

33. **CRIME RATES** The number of major crimes committed in Bronxville between 2006 and 2013 is approximated by the function

$$N(t) = -0.1t^3 + 1.5t^2 + 100 \qquad (0 \le t \le 8)$$

where $N(t)$ denotes the number of crimes committed in year t, with $t = 0$ corresponding to 2006. Enraged by the dramatic increase in the crime rate, Bronxville's citizens,