1. Find the derivative of \( f(x) = \frac{4}{7x^3} + 5\sqrt[3]{x^2} \) using the power rule.

2. Find the equation of the tangent line to \( y = \sqrt{x} \) at the point (9,3).

3. Match the graphs of the functions with the graphs of the derivatives.

4. Find the following limits, if they exist.
   a) \( \lim_{x \to -2} f(x) \)
   b) \( \lim_{x \to 0^+} f(x) \)
   c) \( \lim_{x \to -\infty} f(x) \)

5. Find the derivative:
   a) \( y = 2.4 \sqrt{x} \)
   b) \( y = e^{3x} + \pi x^2 \)
   c) \( y = 4x^2 - \frac{3}{x} + \pi \)
   d) \( y = \frac{15x^3 - 40x^2 + 5x - 12}{5\sqrt{x}} \)

6. A population of bacteria is growing according to \( N(t) = .1t^2 + 5t + 500 \) where \( t \) is measured in hours. What is the rate of change of the population when \( t = 10 \)?

7. If an object is dropped from a building 185 feet tall, its height above the ground after \( t \) seconds is given by \( s(t) = 185 - 16t^2 \) where \( s(t) \) is measured in feet.
   a) Find \( v(t) \), the velocity function.
   b) Find \( s(1) \) and \( s(3) \) and interpret.
   c) Find the average velocity from \( t = 1 \) to \( t = 3 \).
   d) When does the object hit the ground?

8. Use the product rule to find the derivative of \( f(x) = (3\sqrt{x} + 5)(4x^2 - 8) \)

9. If \( t \) is the number of weeks after the introduction of a new debugging program for computers, the percentage of the firms in an industry not using the new technology is given by \( p(t) = \frac{80 + 5\sqrt{t}}{1 + t^2} + 20 \).
   a) What is the initial value?
   b) What is the rate of change of \( p \) with respect to \( t \)?
   c) What percentage is not using the program after 10 weeks?

10. Given \( y = (4x^2 - 5)(7x + 3)(5x - 2) \); find \( \frac{dy}{dx} \).

11. Find the derivative of \( f(x) = \frac{(2x - x^3)\sqrt{x}}{3x + 2} \)

12. Find the derivative of \( g(x) = (5x - 2)\sqrt{4x^2 + 16} \)

13. Where is the function pictured below discontinuous, and state why it is not continuous at that point.

14. Find the points of discontinuity for the function:

\[
f(x) = \begin{cases} 
-3x + 4, & x < 2 \\
\frac{x^2}{x^2 - 3x - 4}, & x \geq 2 
\end{cases}
\]
15. For what value(s) of $k$ is the function $f(x)$ continuous over the interval $(-\infty, \infty)$?

$$f(x) = \begin{cases} \sqrt{6 - 2x}, & x < 1 \\ 3k - 10x, & x \geq 1 \end{cases}$$

Find the derivative of each of the following functions.

16. $f(x) = (3x^2 - 10)^4$

17. $g(x) = (x^2 + 3x)^2(2x + 1)^3$

18. $h(x) = \frac{x^2 + x + 5}{6x^2 + 30}$

Given $f(5) = -3$, $f'(5) = 2$, $g(5) = 1$, $g'(5) = 4$:

19. Find $p'(5)$ given that $p(x) = f(x) \cdot g(x)$.

20. Find $h'(5)$ given that $h(x) = \frac{f(x)}{g(x)}$

ANSWERS:

1. $f'(x) = \frac{-12}{7x^4} + \frac{10}{3x^7}$

2. $y - 3 = \frac{1}{6}(x - 9)$

3. A) iv, B) v, C) i, D) iii, E) ii, F) vi

4. a) 3, b) $\infty$, c) 0

5. a) $y' = \frac{6}{5\sqrt{x}}$

5. b) $y' = 2\pi x$

5. c) $y' = 8x + \frac{3}{x^2}$

5. d) $y' = \frac{15}{2}x^\frac{3}{2} - 12x^\frac{1}{2} + \frac{1}{2}x^{-\frac{1}{2}} + \frac{6}{5}x^{-\frac{3}{2}}$

6. Bacteria are growing at a rate of 7/hr.

7. a) $v(t) = -32t$

7. b) After 1 second the object is 169 ft above ground, and after 3 seconds the object is 41 ft above ground.

7. c) $-32$ ft/sec

7. d) $t \approx 3.4$ seconds

8. $f'(x) = 24x + 30x^{\frac{1}{2}} - 12x^{-\frac{1}{2}}$

9. a) 100%

9. b) $p'(t) = \frac{5t^{\frac{5}{2}} - 320t - 15t^2}{2(1 + t^2)^2}$

9. c) 20.9%

10. $\frac{dy}{dx} = 560x^3 + 12x^2 - 398x - 5$