1. Find $f''(x)$ for $f(x) = \frac{2x^2}{x^3 + 3}$.

2. Find $f^{(54)}(x)$ for $f(x) = \cos \left( \frac{x}{7} \right)$

3. Find a formula for $f^{(n)}(x)$ where $f(x) = \frac{1}{(ax - 1)^2}$ and $a$ is some nonzero constant.
4. If the position of an object in linear motion is given by $s(t) = \sqrt{t^3 - 3t^2 + 8}$ where $t \geq 0$, find the acceleration at the points where the velocity is 0.

5. Given the position function $r(t) = \langle -4 \cos 2t, \cos^2 t \rangle$, find the acceleration when $t = \frac{\pi}{2}$. 
6. Consider the curve \( x = t^2 - 10t - 3, \ y = 5t^2 + t. \)

(a) Find the equation of the tangent line at the point \((8, 4)\).

(b) At what point(s) is the tangent line to the graph parallel to the line \(7x + 2y = 19\).

7. Find an equation of the tangent line to the curve \( x = 8 \sin^2 t, \ y = 4 \cos 2t \) when \( t = \frac{\pi}{3} \).
8. Find the values of \( t \) for which the curve \( x = t^3 - 9t^2, y = 2t^3 + 3t^2 - 12t \) has a horizontal or vertical tangent.

9. The curve \( x = t^3 - 9t, y = t^2 - 5 \) crosses itself at the point \((0, 4)\). Find the equations of both tangent lines at this point.

10. A spherical balloon is being inflated so that its diameter is increasing at a rate of 3 in./s. How fast is the volume of the ballon increasing when the diameter is 10 inches?
11. A man watches a rocket launch from a distance of 150 m. The rocket is rising vertically with a speed of 300 m/s.

(a) At what rate is the distance from the man to the rocket changing when the rocket is at a height of 200 m?

(b) At what rate is the angle of elevation from the man to the rocket changing when the rocket is at a height of 200 m?
(c) Suppose at the instant the rocket takes off, the man begins running toward the launch pad with a speed of 2 m/s. How fast is the distance between them changing 5 seconds later?

12. An inverted circular cone with radius 20 ft and height 30 ft is being filled with water at a constant rate. If the water level is rising at a rate of 3 ft/s when the height of the water is 4 ft, at what rate is the water being poured in?
13. A trapezoid has a base with length 10 inches. The length of the top of the trapezoid is decreasing at a rate of 1 in/min while the height of the trapezoid is increasing at a rate of 2 in/min. At what rate is the area of the trapezoid changing when the height is 3 inches and the area of the trapezoid is 24 in².

14. A trough has ends which are equilateral triangles with side length 6 cm. The length of the trough is 30 cm. If water is being poured into the trough at a rate of 50 cm³/hr, at what rate is the water level rising when the height of the water is 2 cm?