The derivative can be defined in terms of a limit. For a function \( f(t) \) that depends on the variable \( t \), the derivative is \( f'(t) = \frac{df}{dt} = \lim_{\Delta t \to 0} \frac{f(t + \Delta t) - f(t)}{\Delta t} \). This corresponds to finding the tangent to the curve at the point \( t \). In practice, for a polynomial, the derivative can be found using the following formula: if \( f(t) = a_2t^2 + a_1t + a_0 \), then \( \frac{df}{dt} = 2a_2t + a_1 \).

The “chain rule” says that if a function \( f \) depends on \( g \) which itself depends on the variable \( x \), i.e. \( f(g(x)) \), then the derivative of \( f \) with respect to \( x \) is \( \frac{df}{dx} = \left( \frac{df}{dg} \right) \left( \frac{dg}{dx} \right) \). For example, if \( f = 2g^2 \) and \( g = x + 3x^2 \), then \( \frac{df}{dx} = (4g) \frac{dg}{dx} = (4(x + 3x^2))(1 + 6x) \).

1. Find the derivative of \( y = 5 + 6x \)
2. Find the derivative of \( f(t) = 10t^{10} \)
3. Find the derivative of \( f(x) = 3x^3 - 9x + 1 \)
4. Find the derivative of \( y = 3t^3 - 12t^2 + 23t \)
5. Find the derivative of \( f(t) = 2t^9 - 5t - 9 + 9t \)
6. Find the derivative of \( z = 2y^6 - 4y^4 + 6y^{-2} + 8 \)
7. Find the derivative of \( y = 2\sqrt{x} + 3\sqrt[3]{x} - 4\sqrt[4]{x} \)
8. Find the derivative of \( f(x) = 2x^{3/5} - 4x^{7/4} + 3x^{8/3} - 8 \)
9. Find the derivative of \( f(t) = \frac{1}{t} - \frac{1}{t^3} + \frac{1}{t^5} \)
10. Find the derivative of \( g(z) = \frac{2}{z^3} \left( 1 + \frac{1}{2z^2} - \frac{3}{z^4} \right) \)
11. Find the derivative of \( y = x^2(5x^2 - 2) \)
12. Find the derivative of \( y = (2t - 3)(3t + 2t^2) \)
13. Find the derivative of \( f(x) = \frac{4 - 7x + 8x^3}{x} \)
14. Find the derivative of \( r(t) = \frac{5t^5 - t^3 + 4t}{t^3} \)
15. Find where (if anywhere) the function \( v(t) = \frac{1}{3}t^3 + t^2 - 15t + 2200 \) isn’t instantaneously changing
16. Find where (if anywhere) the function \( a(t) = t^5 - 2t^4 - 5t^3 \) isn’t instantaneously changing
17. Determine where the function \( f(x) = 600 - 40x^3 - 5x^4 + 4x^5 \) is increasing and decreasing.
18. Determine where the function \( f(x) = (x + 3)(x - 1)^2 \) is increasing and decreasing.
19. Determine where, if anywhere, the tangent line to \( f(x) = \frac{1}{3}x^3 - x^2 + 3x \) is parallel to the line \( y = 2x + \frac{1}{2} \).
20. Determine where, if anywhere, the tangent line to \( v(t) = 3t^3 - t^3 \) is parallel to the line \( \omega(t) = 9t - t/9 \).