1. Evaluate
   a. \( \lim_{t \to 0} \frac{-5 \tan(t)}{3t} \)
   b. \( \lim_{x \to 0} \left( \frac{2 \cos^2 x - \cos x - 1}{3x} \right) \)

2. The electric charge \( Q \) measured in coulombs, flowing through a wire satisfies the formula \( Q(t) = \frac{1}{3} t^3 + t \) where \( t \) is measured in seconds. How fast is the charge changing when \( t=3 \) seconds?

3. If \( f(x)=2x^5+3x^2-4x+1 \), evaluate \( f'''(1) \), if it exists.

4. If \( f(x) = |x-5| \), evaluate \( f'(5) \), if it exists.

5. Is \( f(x) = \begin{cases} 6x - 5 & ; x \leq 3 \\ x^2 + 4 & ; x > 3 \end{cases} \) differentiable at \( x=3 \)? If yes, state what \( f'(3) \) is. Explain your answer.

6. Is \( g(x) = \begin{cases} 8x - 5 & ; x \leq 2 \\ x^2 + 4x & ; x > 2 \end{cases} \) differentiable at \( x=2 \)? If yes, state what \( g'(2) \) is. Explain your answer.

7. Determine the point where the graph of \( f(x) = 3x^2+9x-12 \) has a horizontal tangent.

8. A rock is dropped from a tower 144 ft above the ground. Its height after \( t \) seconds is given by \( s(t) = 144 - 16t^2 \). Determine the rock’s velocity at the moment of impact?

9. After winning the her championship softball game with a no-hitter, the winning pitcher throws the game ball directly up into the air. The ball is at a height of \( s(t) = 5 + 96t - 16t^2 \) feet after \( t \) seconds. When did the ball reach its maximum height?

10. Use the definition of the derivative to differentiate the function \( f(x) = \sqrt{x + 1} \).

11. Find the derivatives of the following functions. ☺ DO NOT SIMPLIFY YOUR ANSWERS!
   a. \( y = \sqrt[5]{(3x^8 - 4x^5 + x - 1)^2} \)
   b. \( g(x) = 5^{7x^2 + x} \sec(x^3) \)
   c. \( f(x) = \frac{x^4}{3x^3 + 8x^2 + 2} \) use the quotient rule
   d. \( h(\theta) = \tan^4(e^{\theta}) \)
   e. \( y = \sin^{-1}(\ln(5x^2 - 6x + 1)) \)
   f. \( y = \tan^{-1}(2x^3 - 9x + 1) \)
   g. \( f(x) = \log(e^x) \)
12. Use the graph below to determine the x values where the function \( y = f(x) \) is not differentiable and state what is happening graphically at that point.

13. The graph of the position fn s(t) on \( 0 \leq t \leq 2 \) is given below

   a. When is the particle’s velocity zero?
   b. When does the particle move to the right?
   c. When does the particle move to the left?
   d. When is it farthest from the origin?

14. The graph below shows the velocity \( v(t) \) of a particle moving on a coordinate line.

   a. When does the particle move to the right?
   b. When does the particle reach greatest speed?
   c. When does the particle slow down?
   d. When is the particle’s acceleration zero?

15. Given the graphs to the right, identify \( f, f' \) and \( f'' \).

16. Find the second derivative of \( h(x) = \sin(x^3 + 1) \)

17. Assume that the equation \( 2x^2 - 5xy = 4y^3 - 1 \) defines a differentiable function of \( x \).
   a. Find \( \frac{dy}{dx} \) by implicit differentiation.
   b. Find the equation of the normal line to the graph of the curve in part (a) at the point \((3,1)\). You may leave your answer in point slope form.

18. Find the second derivative of the implicit function \( x^2 + y^2 = xy \)