1. Show that \( \arctan \frac{1}{x} = \frac{\pi}{2} - \arctan x \) for all \( x > 0 \). Try to do this in two ways, by using derivatives (i.e., that a function with zero derivative must be constant), and by using the definition of arctan. What is the analogous formula for \( x < 0 \)?

2. Find all critical points of \( y = f(x) \) given by
   \[ f(x) = x + 5 \arctan \frac{1}{x} \]
on the interval \( (0, \infty) \). Then find the global maximum and minimum of \( y = f(x) \) on the interval \([1, 5]\).

3. Find domain and range of the function \( f \) given by \( f(x) = \sqrt{x^2 - x^4} \).

4. A particle is moving on a coordinate line. Its position at time \( t \geq 0 \) is given by \( s = f(t) \), where \( f(t) = 4t - \cos(2t) \). How many times does the particle visit the origin (i.e., its position is \( s = 0 \))? 

5. Let \( f(x) = x^2(x - 4)^{2/3} \). Find the global maximum and the global minimum of \( y = f(x) \) on \([0, 5]\) and on \([-4, 4]\). (Note, Nov. 5, 6pm: I changed the function as the previous one was done in the lecture.)