1. ACME has determined that if they charge a price of \( x \) dollars per widget, then they will sell \( \frac{10000}{1+x^2} \) widgets.

   a) Find a function for the (gross) profit \( P(x) \) of the sale of widgets at price \( x \).

   b) What are the units of \( P'(x) \)? Calculate \( P'(x) \).

   c) What does it mean if \( P'(x) > 0 \)? On what interval is \( P'(x) > 0 \)?

   d) What does it mean if \( P'(x) < 0 \)? On what interval is \( P'(x) < 0 \)?

   e) What price should ACME charge in order to maximize their profit?

2. Find an equation for the tangent line to \( f(x) = x \cos x \sin x \) at the point \( \left( \frac{\pi}{4}, \frac{\pi}{8} \right) \).
3. Calculate the derivative \( \frac{d}{dx} \left[ \sin \frac{2x}{x} \right] \) (you may want to use the double angle formula \( \sin 2x = 2 \sin x \cos x \)).

4. Let \( f \) be a differentiable function.

   a) Use the product rule to find \( \frac{d}{dx} \left[ (f(x))^2 \right] \) (in terms of \( f \) and \( f' \)).

   b) Use the product rule to find \( \frac{d}{dx} \left[ (f(x))^3 \right] \) (in terms of \( f \) and \( f' \)).

   c) Use the product rule to find \( \frac{d}{dx} \left[ (f(x))^4 \right] \) (in terms of \( f \) and \( f' \)).

   d) Make a guess about the general formula for \( \frac{d}{dx} \left[ (f(x))^n \right] \).