1. Using the differentiation rules, compute the derivatives of the following functions:

   (a) $f(x) = 3x^4 - 2x^3 + 2x - 5$

   (b) $f(x) = ax^3 + bx^2 + cx + d$ where a, b, c and d are constants

   (c) $f(x) = \dfrac{x-2}{x+2}$

   (d) $f(t) = \dfrac{3t+1}{t^2+t-2}$

   (e) $f(x) = 2x^3 e^x$

2. Compute the derivatives of the following functions using each time two different methods, once using the quotient rule and once without using the quotient rule. In each case, which method is easier?

   (a) $f(t) = \dfrac{t^3 + 5t^2 - 2t}{t}$ and $g(t) = \dfrac{t}{t^3 + 5t^2 - 2t}$

   (b) $f(x) = \dfrac{3}{x^4}$ and $g(x) = \dfrac{x^2 + x + 1}{\sqrt{x}}$

   (c) Based on the calculation you have done, when is it easier *not* to use the quotient rule?

3. The goal of this exercise is to see why $(f(x)g(x))' \neq f'(x)g'(x)$.

   (a) A friend of yours claims (contrary to what the textbook says) that the product rule *is* $(f(x)g(x))' = f'(x)g'(x)$. You want to show him that his claim is wrong. If you compute the derivative of $f(x) = x^2$ using your friend's differentiation rule, what do you get?

   (b) Why is this answer incorrect? Give a graphical argument.

   (c) Find as many other arguments you could give to your friend to show him his claim is wrong (e.g. by computing the derivative of x^2 using other differentiation rules and see that the answers don't match with the answer obtained above).

(d) Let $p(x)$ be $p(x) = f(x)g(x)$ with $f(x)$ and $g(x)$ differentiable.
Write down the limit definition of $p'(x)$. Explain in words what this limit represent.

(e) Let us consider a graphical representation of the situation. Let $f(x)$ be the width of a rectangle and $g(x)$ its height. Let us suppose that both $f(x)$ and $g(x)$ are positive and growing with time. How is this picture you have drawn connected to the limit you have written above? (You can also compare to what you would get using $f'(x)g'(x)$).