1. Find derivatives of the following functions. You may need to use chain rule.

   (a) $f(x) = (x^2 + 1)^2$

   (b) $f(x) = (x^2 + 1)^{100}$

   (c) $f(x) = \sin 4x \cos 5x$

   (d) $f(x) = \sqrt[3]{1 + \sec x}$

   (e) $f(x) = \dfrac{1}{(x^2 - x)^4}$

   (f) $f(x) = \dfrac{\sin \pi x}{\cos \pi x + \sin \pi x}$

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

   (h) $f(x) = x \sin \sqrt[3]{x}$

   (i) $f(x) = (x^2 + 1)(\sqrt[4]{x^3 + 5})$

   (j) $f(x) = (x^4 - 1)^3 (x^5 + 1)^6$

   (k) $f(x) = \dfrac{x}{\sqrt{3 - 2x}}$

   (l) $f(x) = \sin(\sin(\sin(x^2)))$

   (m) $f(x) = \sqrt[3]{x + \sqrt{x}}$

2. The derivatives of the exponential and logarithmic functions are as follows:

$$(\ln x)' = \frac{1}{x} \qquad (e^x)' = e^x$$

   Find derivatives of the following functions.

   (a) e^{3x}

   (b) $\ln x^3$

   (c) $(x^4 + 2x)2^x$

   (d) $\log_2 x$

   (e) 3^x

   (f) $\ln \sqrt{x^2 + 6}$

   (g) $e^{(\sin x + x^4)}$

   (h) $\log(10x\sqrt{x - 3})$

   (i) $\dfrac{4}{e^{-x} + e^x}$

   (j) $\log \dfrac{\sqrt[3]{x + 2}}{\cos 5x}$

   (k) $\ln \dfrac{x^2 \sin^3 x}{\sqrt{x^2 + 1}}$

   (l) $\ln \sqrt{\dfrac{1}{x^3 + 5}}$

3. Find derivatives. (Hint: It may be useful to take logarithm firstly, (for example, $5^{\sqrt{x}} = e^{\ln 5^{\sqrt{x}}} = e^{\sqrt{x}\cdot\ln 5}$) and then derivate.)

(a) $5^{\sqrt{x}}$

(b) x^x

(c) $(\ln x)^{\cos x}$

(d) $x^{\tan x}$

4.
- Find y' by implicit differentiation.
- Solve the equation explicitly for y and differentiate to get y' in terms of x.
- Check that your solutions are consistent.

(a) $9x^2 - y^2 = 1$

(b) $1/x + 1/y = 1$

5. Find $\frac{dy}{dx}$ by implicit differentiation.

(a) $x^3 + y^3 = 1$

(b) $x^4(x + y) = y^2(3x - y)$

(c) $4 \cos x \sin y = 1$

(d) $\tan(x/y) = x + y$

(e) $\sqrt{xy} = 1 + x^2 y$

(f) $y \cos x = 1 + \sin(xy)$