1. Find the equation of the line which goes through the point (1,2) and is parallel to the line given by the equation $3x + y = 1$.

**Answer.** If we write the equation as $y = 1 - 3x$, we see that the slope is $-3$. $(1,2)$ is on the line, so we use the point-slope form:

$$\frac{y - 2}{x - 1} = -3$$

Simplifying, we get $y - 2 = -3(x - 1) = -3x + 3$ or $y = -3x + 5$.

2. Find the derivatives of the following functions:

   a) $f(x) = x^2 + 1$
   
   **Answer.** $f'(x) = 2x$.

   b) $f(x) = x + \frac{1}{x}$
   
   **Answer.** Rewrite this as $f(x) = x + x^{-1}$. Then $f'(x) = 1 - x^{-2}$.

   c) $f(x) = (x + x^{-1})(x^2 + 1)$
   
   **Answer.** We use the product rule
   
   $$f'(x) = (x + x^{-1})(2x) + (x^2 + 1)(1 - x^{-2})$$
   
   and then simplify:
   
   $$f'(x) = 2x^2 + 2 + x^2 - 1 + 1 - x^{-2}, \text{ or } f'(x) = 3x^2 + 2 - x^{-2}$$

3. Find the derivatives of the following functions:

   a) $f(x) = \frac{x}{x^2 + 1}$
   
   **Answer.** Use the quotient rule:
   
   $$f'(x) = \frac{(x^2 + 1)(1) - x(2x)}{(x^2 + 1)^2} = \frac{1 - x^2}{(x^2 + 1)^2}$$

   b) $f(x) = \frac{1 + \tan x}{1 - \tan x}$
   
   **Answer.** Use the addition formula for the tangent: $f(x) = \tan(x + \pi/4)$. Then differentiate: $f'(x) = \sec^2(x + \pi/4)$. If you used the quotient rule, you probably ended up with
   
   $$f'(x) = \frac{(1 - \tan x)(\sec^2 x) - (1 + \tan x)(-\sec^2 x)}{(1 - \tan x)^2} = \frac{2\sec^2 x}{(1 - \tan x)^2}$$
   
   which is also correct.
4. At what points \((x, y)\) does the graph of the function \(y = x^2 - x^3\) have horizontal tangent line (a line with slope 0)?

**Answer.** Taking the derivative we have \(dy/dx = 2x - 3x^2\). This gives the slope of the tangent line at the general point, so we are looking for the values of \(x\) where this is zero. Solve \(2x - 3x^2 = 0\) to get \(x = 0\) and \(x = 2/3\). Now solve for the corresponding values of \(y\), finding the points \((0,0)\) and \((3/2, 4/27)\).

5. Let \(C\) be the curve given by the equation \(y = (2x+1)^3 - 12x^3\). Find the equation of the tangent line to \(C\) at the point \((2, 29)\).

**Answer.** To get the slope of the tangent line, differentiate: \(dy/dx = 3(2x+1)^2(2) - 36x^2\). Now, at \(x = 2\), we have the slope \(m = 3(5)^2(2) - 36(2^2) = 6\). Thus, in point-slope form, the equation is

\[
\frac{y - 29}{x - 2} = 6,
\]

which simplifies to \(y = 6x + 17\).