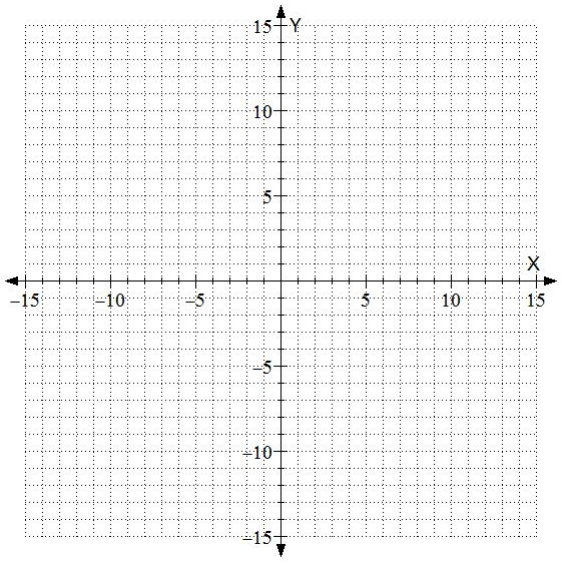
1. *(10 points)* Using the *first derivative test*, find any local minima/maxima of the function $f(x)$ given below.

$$f(x) = \frac{5x^3 - x}{x^2 + 1}$$

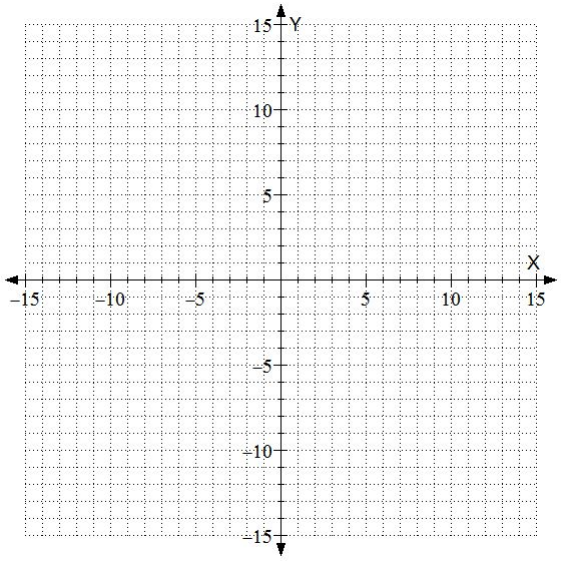
All work must be shown, and answers must be clearly labelled to receive credit. (!)

2. *(20 points)* Consider the following.

   (a) Sketch the graph of a function $f(x)$ such that $f(x)$ has a critical point and a global minimum at $x = 5$.



   (b) Sketch the graph of a function $f(x)$ such that $f'(x) < 0$.

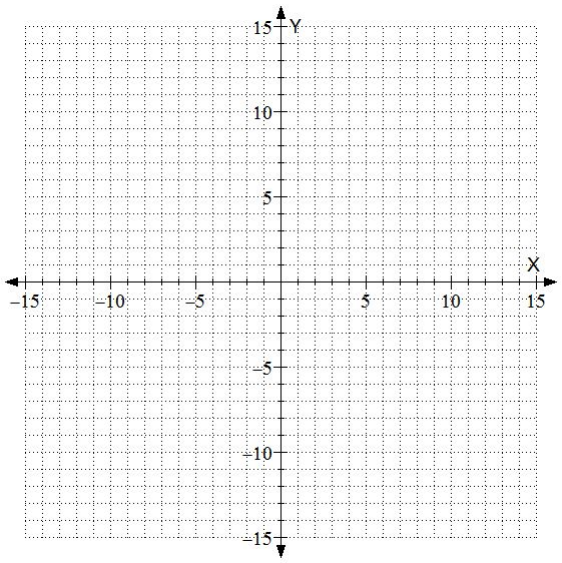


(c) Sketch the graph of a function $f(x)$ that satisfies the following:

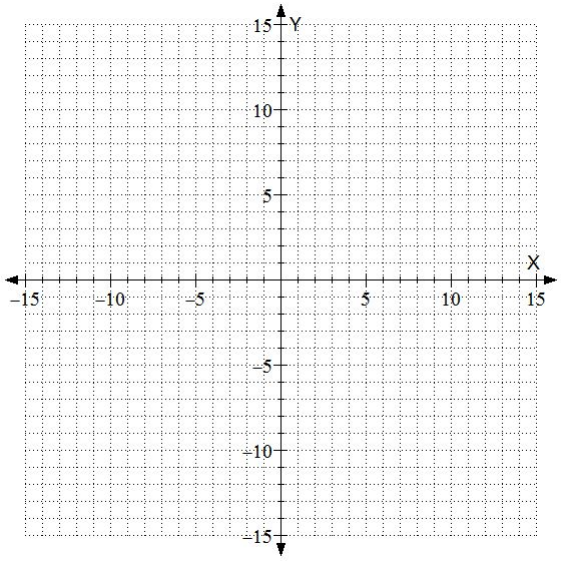
i. $f'(x) > 0$ from $x = -15$ to $x = 1$

ii. $f'(1) = 0$

iii. $f'(10) = -1$



(d) Sketch the graph of a function $f(x)$ such that $f(x)$ has inflection points at $x = -10$, $x = 0$, and $x = 10$.



3. *(20 points)* Let $f(x) = 2\ln\left(x^2 + x + 1\right) 3x^7$. Consider the following.

   (a) Momo, owner and founder of *Momo & Co*, donated $f'(2)$ dollars to various Columbia-area pet rescue organizations. Evaluate $f'(2)$ to determine how much money Momo donated.
   All work must be shown to receive credit. Circle your final answer.

   (b) In 2016 Alicia spent $f''(1)$ dollars on dry-erase markers and chalk. Evaluate $f''(1)$ to determine how much money Alicia spent.
   All work must be shown to receive credit. Circle your final answer.