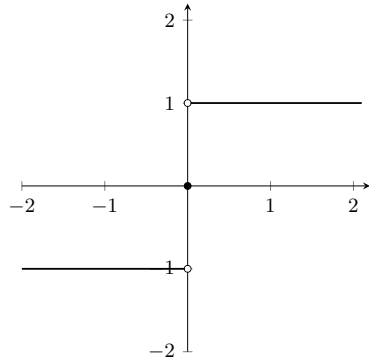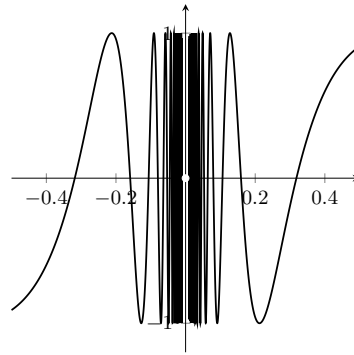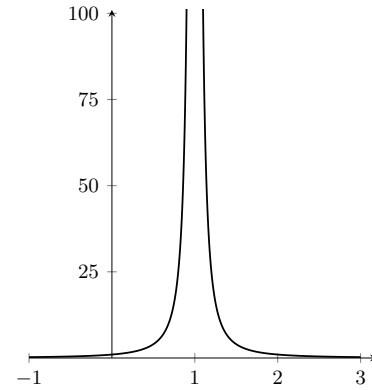**1. Limits.**

$$f(x) = \begin{cases} 0 & \text{if } x = 0 \\ \frac{x}{|x|} & \text{if } x \neq 0 \end{cases}$$

$$g(x) = \sin(1/x)$$

$$h(x) = \frac{1}{(x-1)^2}$$

(a) For each function, describe its domain and range.

(b) For each function, identify the x values where the limit does not exist. Explain why they do not exist.

2. Intermediate Value Theorem.

(a) Given $f(1) = 4$ and $f(2) = -3$ which of the following is true by the Intermediate Value Theorem?

    i) there exists a constant c such that $-4 < c < 3$ and $f(0) = c$.

    ii) $f(x)$ has a root between $[1, 2]$.

    iii) $f(2) \leq f(x) \leq f(1)$ for any $1 < x < 2$.

    iv) for any value $-3 \leq y \leq 4$, there is some x-value $1 \leq x \leq 2$ so that $f(x) = y$.

    v) for any value $1 \leq x \leq 2$, there is some y-value $-3 \leq y \leq 4$ so that $f(x) = y$.

(b) Do the graphs of $y = x^3$ and $y = 1 + x - 2x^2$ intersect at a positive value of x?