• Sign of a function

Definition: A function \( f \) is positive on an interval \((a, b)\) if \( f(x) > 0 \) for every real number \( x \) in the interval \((a, b)\). Geometrically this means that the graph of \( f \) lies above the \( x \)-axis on the interval.

A function \( f \) is negative on an interval \((a, b)\) if \( f(x) < 0 \) for every real number \( x \) in the interval \((a, b)\). Geometrically this means that the graph of \( f \) lies below the \( x \)-axis on the interval.

For example, the function \( f \) shown below is positive on the interval \((-4, 0)\) and \((3, +\infty)\), and negative on the intervals \((-\infty, -4)\) and \((0, 3)\).

• Direction of a function

Definition: A function \( f \) is increasing on an interval \((a, b)\) if, for any two numbers \( x_1 \) and \( x_2 \) in \((a, b)\) where \( x_1 < x_2 \), then \( f(x_1) < f(x_2) \). Geometrically this means that the graph of \( f \) is rising from left to right.

A function \( f \) is decreasing on an interval \((a, b)\) if, for any two numbers \( x_1 \) and \( x_2 \) in \((a, b)\) where \( x_1 < x_2 \), then \( f(x_1) > f(x_2) \). Geometrically this means that the graph of \( f \) is falling from left to right.

For example, the function shown below is increasing on the interval \((-1, 3)\) and and is decreasing on the intervals \((-\infty, -1)\) and \((3, +\infty)\).
Example. The graph below shows the graph of a function $f(x)$. Use it to answer the following questions. **Note:** In parts 4–7, your answers must be in interval notation.

1. What is $f(-2)$?

2. What is $f(5)$?

3. For what value(s) of $x$ is $f(x) = 0$?

4. Find the interval(s) on which $f(x)$ is positive.

5. Find the interval(s) on which $f(x)$ is negative.

6. Find the interval(s) on which $f(x)$ is increasing.

7. Find the interval(s) on which $f(x)$ is decreasing.