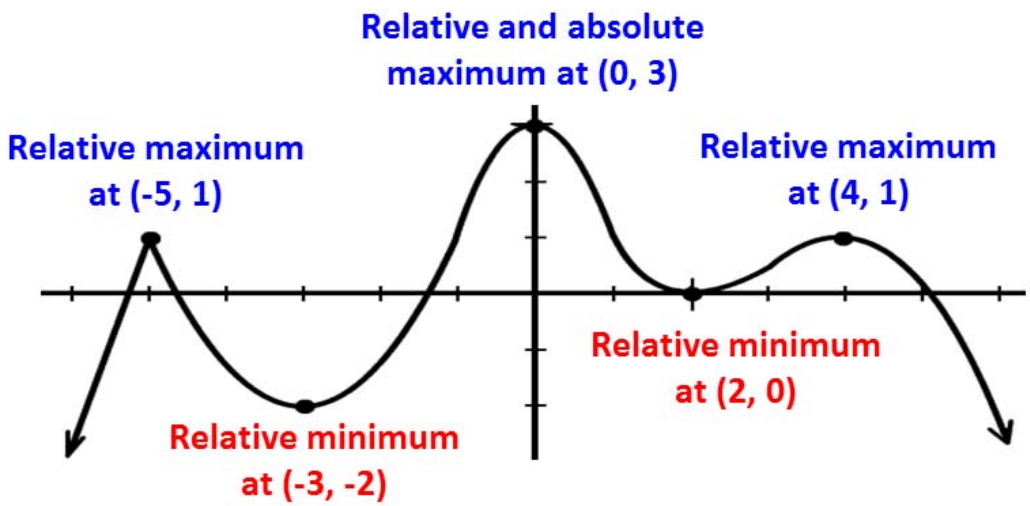
Objective: Determine key features of a polynomial function from its graph

Concept

Let f be a function defined on the interval (a, b) containing the point c.

- f has a relative *minimum* at c if $f(c) \leq f(x)$ for all x in (a, b).
- f has a relative *maximum* at c if $f(c) \geq f(x)$ for all x in (a, b).



A relative maximum is the highest point in a particular section of a graph.

A relative minimum is the lowest point in a particular section of a graph.

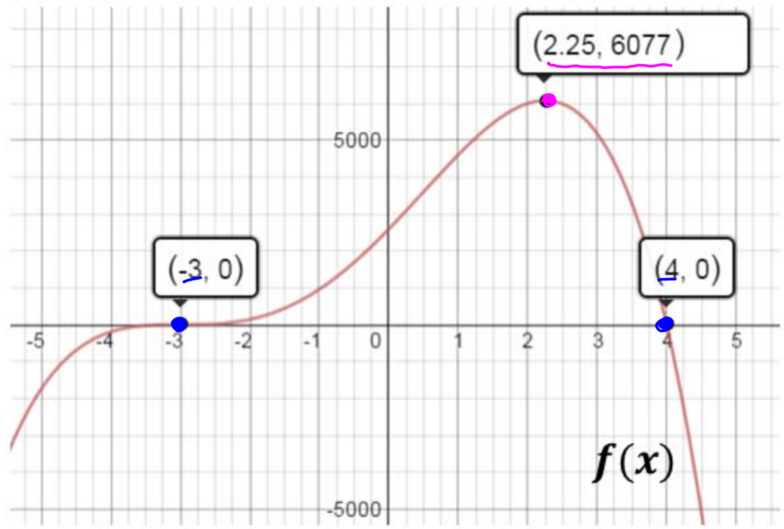
Objective: Determine key features of a polynomial function from its graph

Ex) Determine the key features for the function $f(x)$.

The zeros are at -3 and 4.

The relative maximum(s) of $f(x)$ are at (2.25, 6077).

The relative minimum(s) of $f(x)$ are at none.



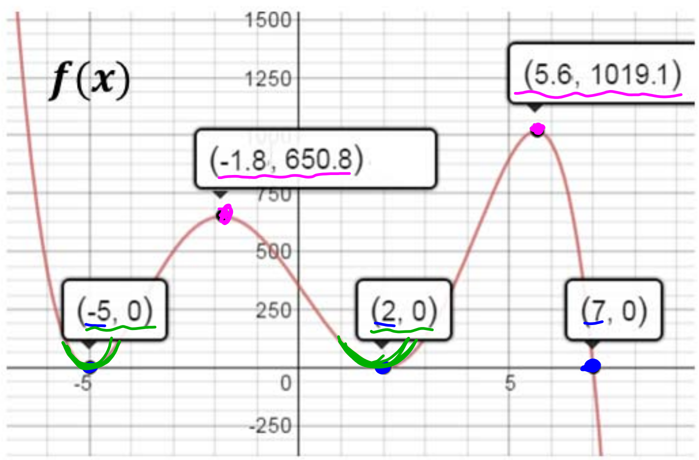
Objective: Determine key features of a polynomial function from its graph

Ex) Determine the key features for the function $f(x)$.

The zeros are at −5, 2, and 7.

The relative maximum(s) of $f(x)$ are at (−1.8, 650.8) and (5.6, 1019.1).

The relative minimum(s) of $f(x)$ are at (−5, 0) and (2, 0).

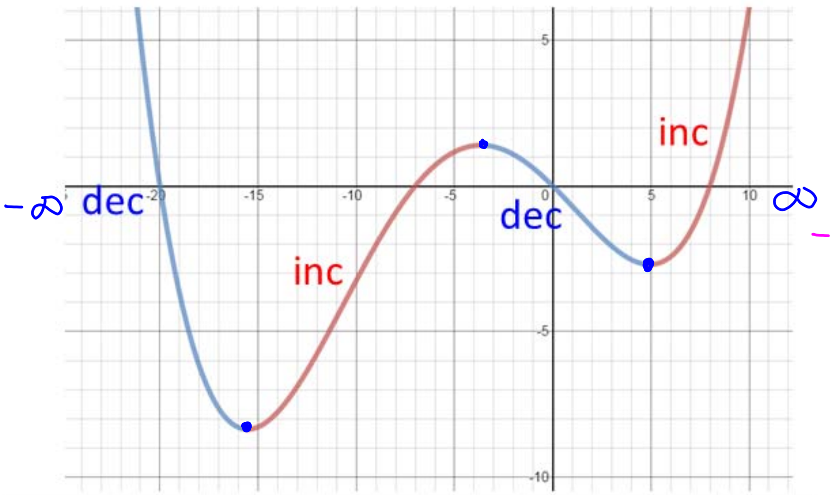


Objective: Determine key features of a polynomial function from its graph

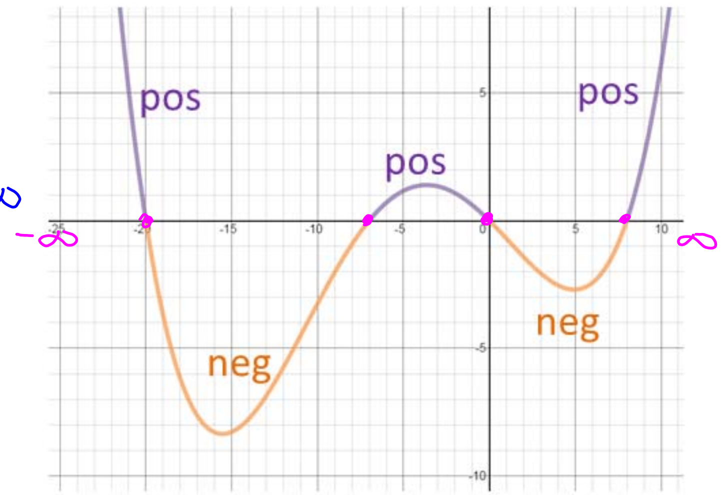
Concept

A function changes from increasing to decreasing or decreasing to increasing at the x values of relative maximums and minimums.

A function is **positive when it is above the x-axis**. A function is **negative when it is below the x-axis**. A function changes from positive to negative or negative to positive at the zeros of a function.



Increasing and Decreasing intervals change at the x-coordinates of maximums and minimums.



Positive and Negative intervals change at the zeros.

Objective: Determine key features of a polynomial function from its graph

Ex) Determine the key features for the function $f(x)$.

The zeros are at -3 *and* 4.

The relative maximum(s) of $f(x)$ are at $(2.25, 6077)$.

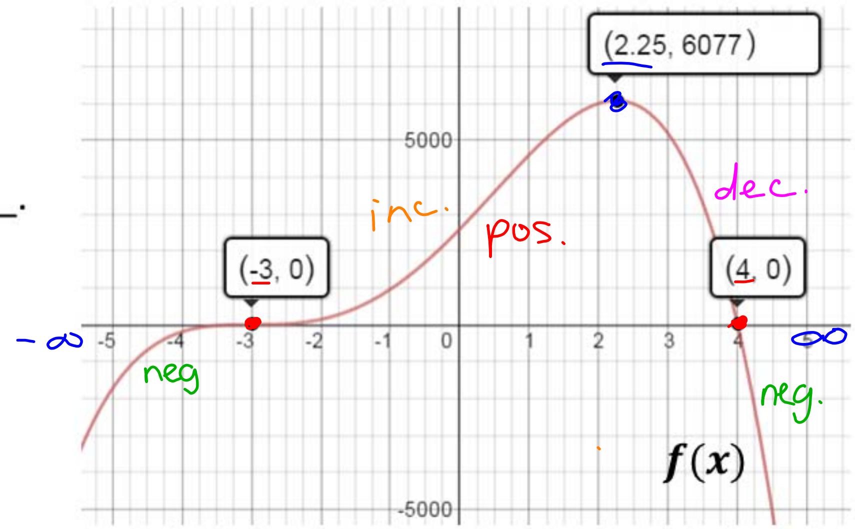
The relative minimum(s) of $f(x)$ are at *none*.

$f(x)$ is decreasing on the interval(s) $(2.25, \infty)$ and

increasing on the interval(s) $(-\infty, 2.25)$.

$f(x)$ is positive on the interval(s) $(-3, 4)$

and negative on the interval(s) $(-\infty, -3) \cup (4, \infty)$.



Objective: Determine key features of a polynomial function from its graph

Ex) Determine the key features for the function $f(x)$.

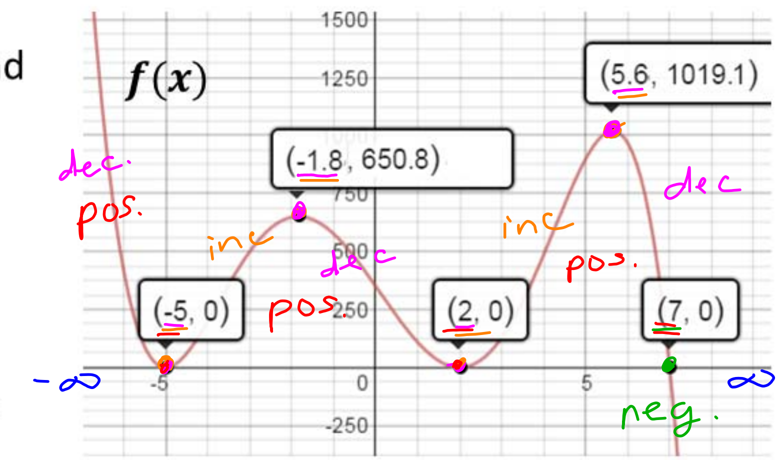
The zeros are at $-5, 2$ *and* 7.

The relative maximum(s) of $f(x)$ are at $(-1.8, 650.8)$ and $(5.6, 1019.1)$.

The relative minimum(s) of $f(x)$ are at $(-5, 0)$ *and* $(2, 0)$.

$f(x)$ is decreasing on the interval(s) $(-\infty, -5) \cup (-1.8, 2) \cup (5.6, \infty)$ and increasing on the interval(s) $(-5, -1.8) \cup (2, 5.6)$.

$f(x)$ is positive on the interval(s) $(-\infty, -5) \cup (-5, 2) \cup (2, 7)$ and negative on the interval(s) $(7, \infty)$.



Objective: Determine key features of a polynomial function from its graph

Concept

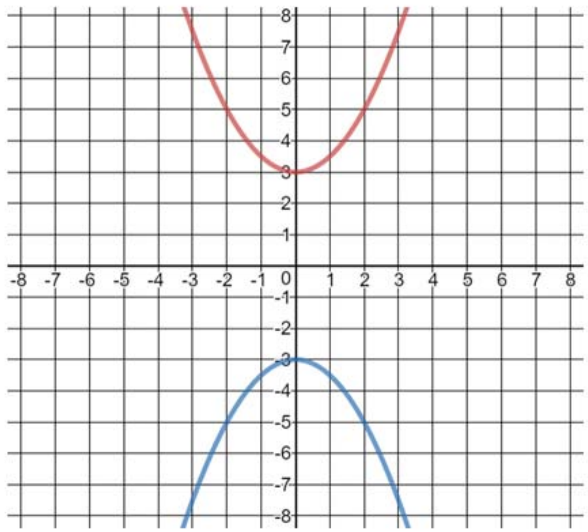
The **End Behavior** of a function $f(x)$ is determined based on how each end is behaving (the direction the values are going) for both x and y.

For a left end that is heading above the x-axis

$as\ x \to -\infty, f(x) \to +\infty$

For a right end that is heading above the x-axis

$as\ x \to +\infty, f(x) \to +\infty$



For a left end that is heading below the x-axis

$as\ x \to -\infty, f(x) \to -\infty$

For a right end that is heading below the x-axis

$as\ x \to +\infty, f(x) \to -\infty$

Objective: Determine key features of a polynomial function from its graph

Ex) Determine the key features for the function $f(x)$.

The zeros are at -3 *and* 4.

The relative maximum(s) of $f(x)$ are at $(2.25, 6077)$.

The relative minimum(s) of $f(x)$ are at *none*.

$f(x)$ is decreasing on the interval(s) $(2.25, +\infty)$ and

increasing on the interval(s) $(-\infty, 2.25)$.

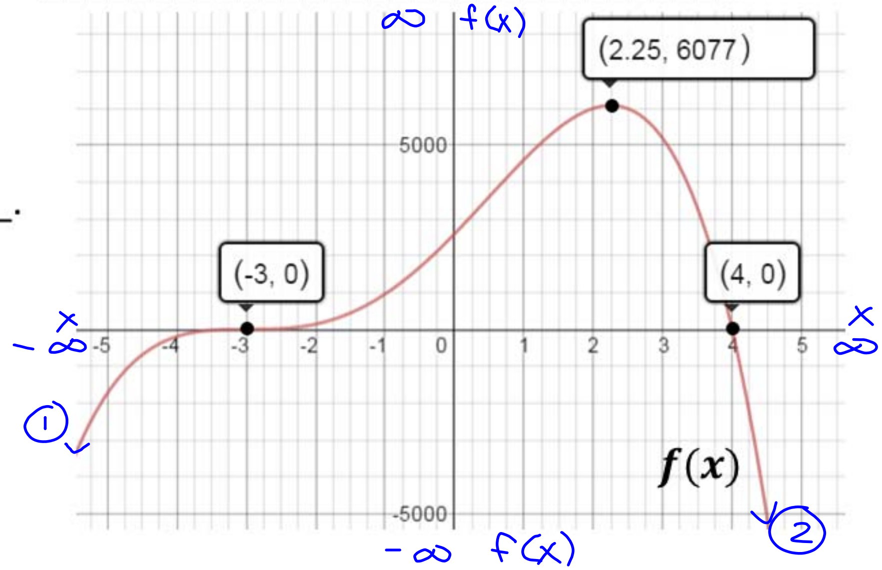
$f(x)$ is positive on the interval(s) $(-3, 4)$

and negative on the interval(s) $(-\infty, -3) \cup (4, +\infty)$.

The end behavior of $f(x)$ is

① as $x \to -\infty$, $f(x) \to -\infty$

② as $x \to \infty$, $f(x) \to -\infty$.



Objective: Determine key features of a polynomial function from its graph

Ex) Determine the key features for the function $f(x)$.

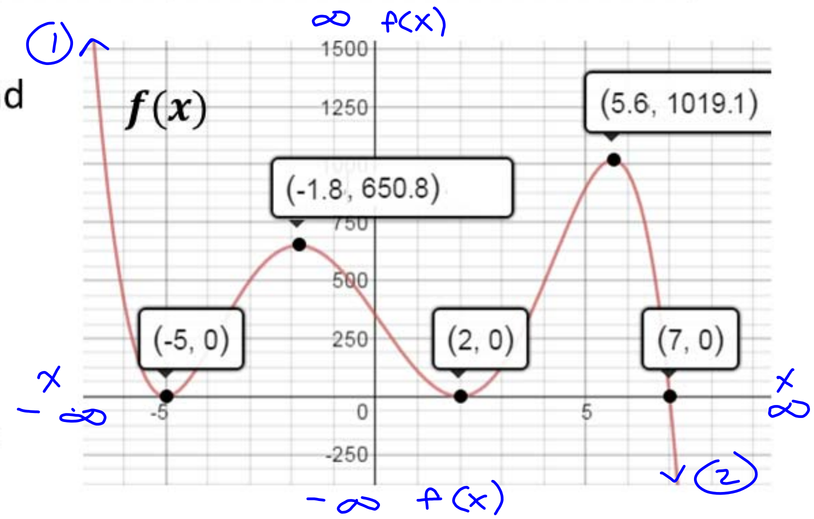
The zeros are at $\mathbf{-5, 2}$ ***and*** $\mathbf{7}$.

The relative maximum(s) of $f(x)$ are at $(\mathbf{-1.8, 650.8})$ **and** $(\mathbf{5.6, 1019.1})$.

The relative minimum(s) of $f(x)$ are at $(\mathbf{-5, 0})$ ***and*** $(\mathbf{2, 0})$.

$f(x)$ is decreasing on the interval(s) $(-\infty, \mathbf{-5}) \cup (\mathbf{-1.8, 2}) \cup (\mathbf{5.6}, +\infty)$ and

increasing on the interval(s) $(\mathbf{-5, -1.8}) \cup (\mathbf{2, 5.6})$.



$f(x)$ is positive on the interval(s) $(-\infty, \mathbf{-5}) \cup (\mathbf{-5, 2}) \cup (\mathbf{2, 7})$

and negative on the interval(s) $(\mathbf{2}, +\infty)$.

The end behavior of $f(x)$ is

1. as $x \to -\infty$, $f(x) \to \infty$
2. as $x \to \infty$, $f(x) \to -\infty$.

Objective: Determine key features of a polynomial function from its graph

Ex) Determine the key features for the function $f(x)$.

The zeros are at -7, -3 and 3.

The relative maximum(s) of $f(x)$ are at (0, 8).

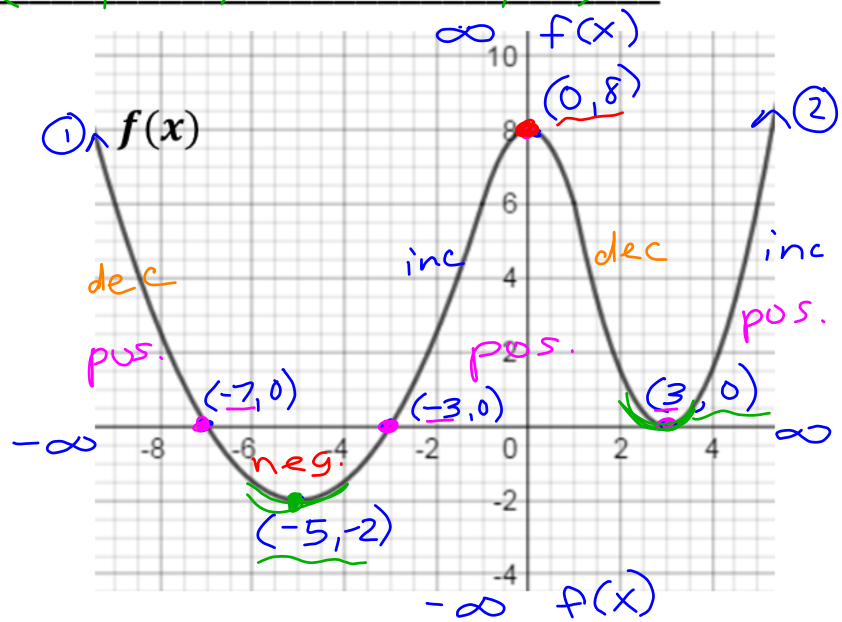
The relative minimum(s) of $f(x)$ are at (-5, -2) and (3, 0).

$f(x)$ is decreasing on the interval(s) $(-\infty, -5) \cup (0, 3)$ and

increasing on the interval(s) $(-5, 0) \cup (3, \infty)$.

$f(x)$ is positive on the interval(s) $(-\infty, -7) \cup (-3, 3) \cup (3, \infty)$

and negative on the interval(s) $(-7, -3)$.



The end behavior of $f(x)$ is

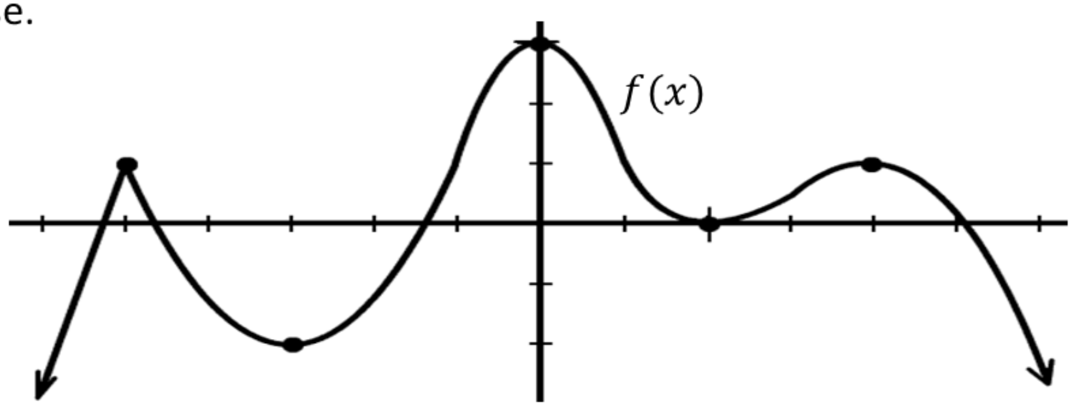
① as $x \to -\infty$, $f(x) \to \infty$

② as $x \to \infty$, $f(x) \to \infty$.

Objective: Determine key features of a polynomial function from its graph

Closure

Jose says the minimum of the graph of $f(x)$ is $(-3,-2)$. Is Jose correct or incorrect? If he is incorrect, explain why he is wrong and how to correct his response.



Jose is incorrect. The end behavior of the graph of $f(x)$ is to negative infinity. This means $(-3,-2)$ is a relative minimum, not the minimum.