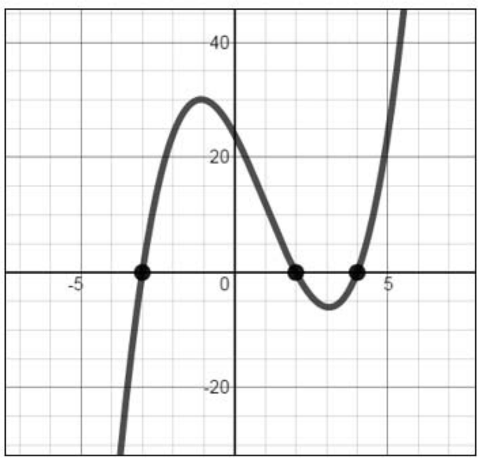
Objective: Graph polynomial functions using multiplicity.

## Concept

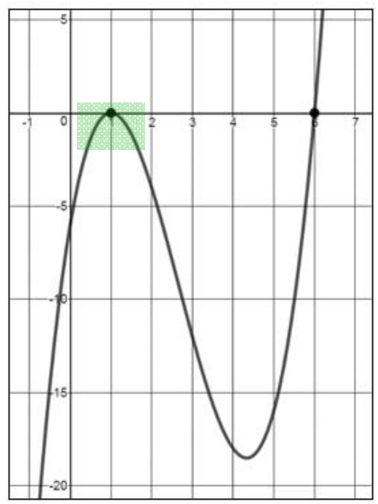
When a function has more than one of the same zero, this is called **multiplicity.**

An **even multiplicity creates a relative maximum or minimum** at that zero.
An odd multiplicity greater than 1 creates a point of inflection at that zero (a curving through the zero that creates a change in concavity.

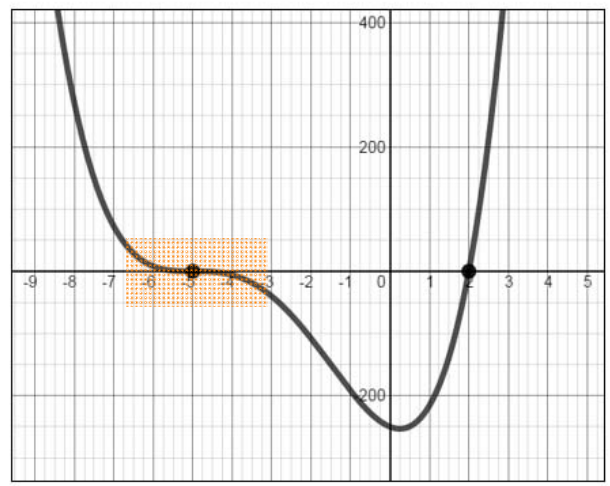
**real zeros: , −3, 2, 4**
**(no multiplicity)**




**real zeros: , 1, 1, 6**
**1 (multiplicity x2), 6**




**real zeros: −5, −5, −5, 2**
**−5 (multiplicity x3), 2**



Objective: Graph polynomial functions using multiplicity.

## Concept

To graph a polynomial function given the real zeros and end behavior, follow these steps:

1. Graph the zeros. Make note of any zero where there is multiplicity.
2. Mark the quadrants where the function's end behavior occurs. (QI or QIV and QII or QIII)
3. Draw a smooth curve that includes the zeros and estimates the relative maximums and relative minimums.

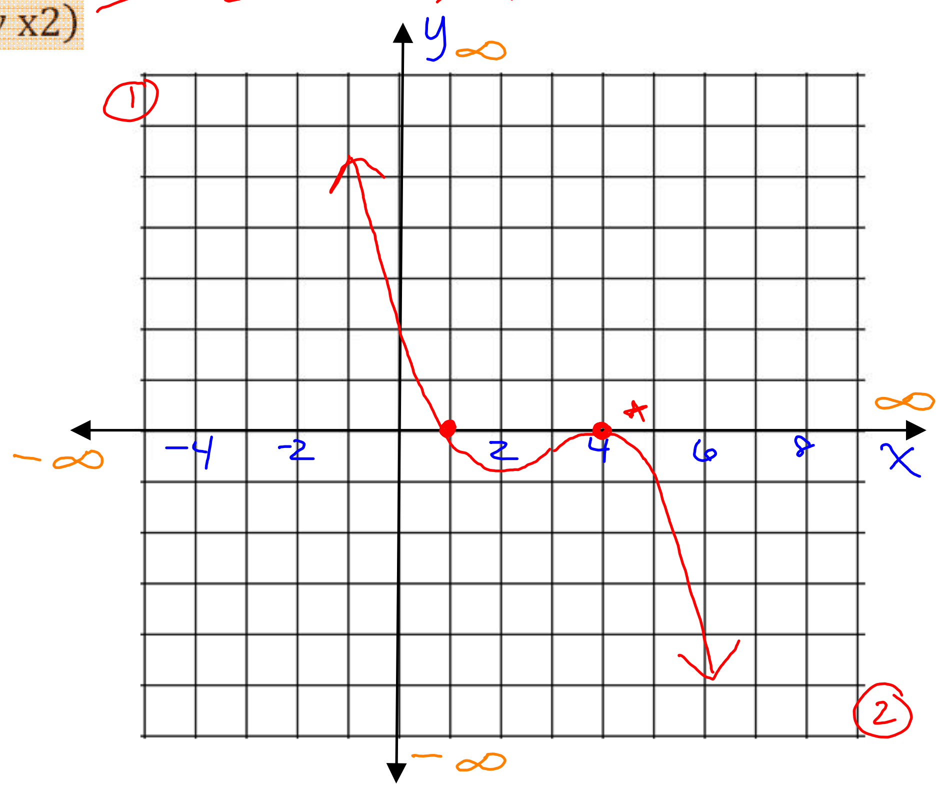
Objective: Graph polynomial functions using multiplicity.

Ex) Sketch the graph of each polynomial function given the real zeros and end behavior.

$real\ zeros: 1, 4\ (multiplicity\ x2)$ → zeros: 1, 4, 4

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

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



**Objective**: Graph polynomial functions using multiplicity.

Ex) Sketch the graph of each polynomial function given the real zeros and end behavior.

*real zeros*: $-\sqrt{39}$, $-4$ (*multiplicity* x2), $0$ → zeros: $-\sqrt{39}, -4, -4, 0$

$\approx -6.2$

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

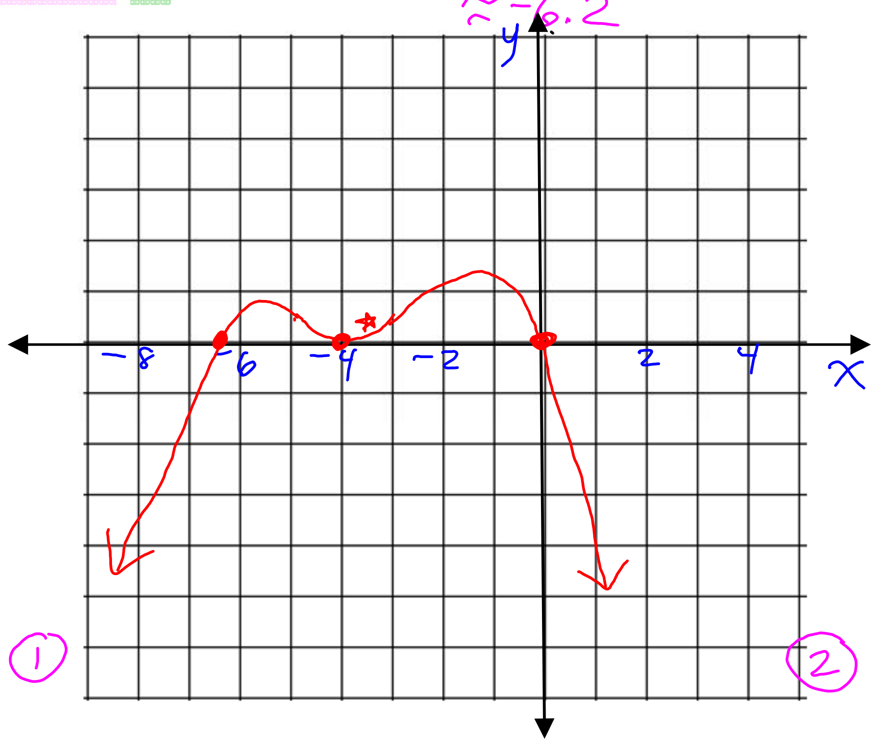
② as $x \to \infty, f(x) \to -\infty$

$-\sqrt{39}$

$-\sqrt{36}$ $\underbrace{\quad}_{3}$ $-\sqrt{39}$ $\underbrace{\quad}_{10}$ $-\sqrt{49}$

$-6$ $\quad \approx -6.2$ $\quad -7$

$\approx -6.3$



**Objective**: Graph polynomial functions using multiplicity.

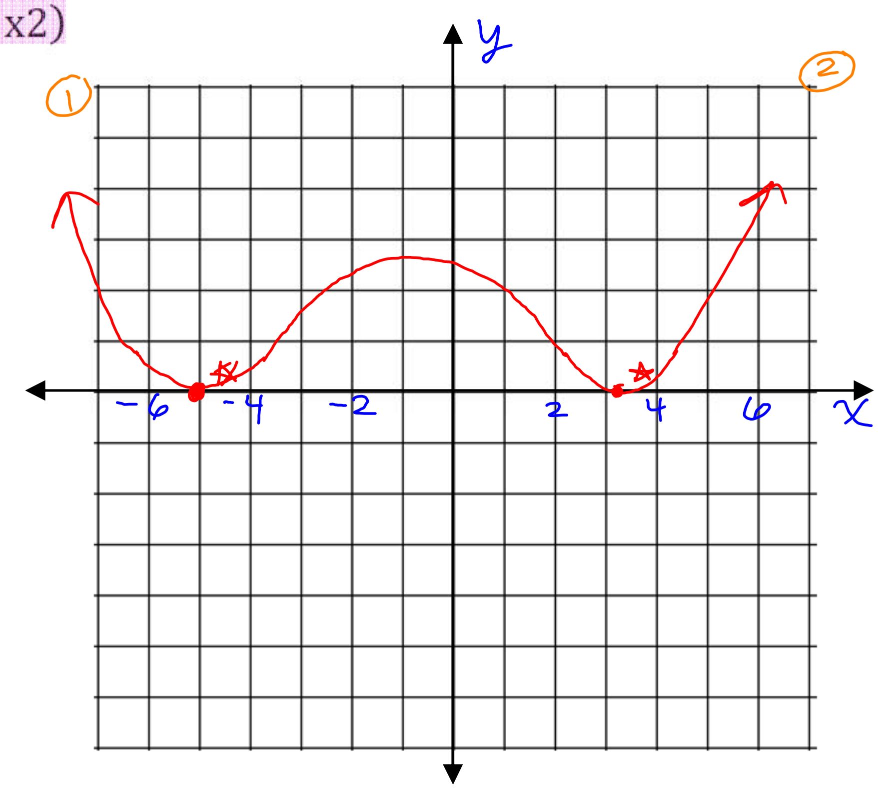
Ex) Sketch the graph of each polynomial function given the real zeros and end behavior.

$real\ zeros: -5(multiplicity\ x2),$
$\sqrt{11}\ (multiplicity\ x2)$

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

$\sqrt{9}$ 2 $\sqrt{11}$ 5 $\sqrt{16}$

3 $\approx 3.2$ $\approx 3.3$ 4



Objective: Graph polynomial functions using multiplicity.

Ex) Sketch the graph of each polynomial function given the real zeros and end behavior.

$real\ zeros: -3, 1, 6$

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

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