

**UPPER & LOWER BOUNDS**

Directions: Use synthetic division to determine if each given  $x$ -value is an upper bound, lower bound, or neither.

1.)  $f(x) = x^4 - x^3 + x^2 - 3x - 6$

- a.)  $x = -2$     b.)  $x = 1$     c.)  $x = 3$

2.)  $f(x) = 2x^4 - 9x^3 - 18x^2 + 71x - 30$

- a.)  $x = -1$     b.)  $x = -5$     c.)  $x = 6$

Directions: Use your knowledge of properties of polynomial functions to determine all zeros WITHOUT a calculator.

3.)  $f(x) = x^3 - 9x^2 + 20x - 12$

- a.) Determine the end behavior of  $f(x)$ .

$x \rightarrow -\infty$   $f(x) \rightarrow$  \_\_\_\_\_                           $x \rightarrow \infty$   $f(x) \rightarrow$  \_\_\_\_\_

- b.) Determine the possible number of turning points of  $f(x)$ .

# of possible turning points: \_\_\_\_\_

- c.) Use the Rational Root Test to determine the possible rational roots.

Possible Rational Roots: \_\_\_\_\_

- d.) Use Descartes' Rule of Signs to determine the possible number of positive and negative zeros of  $f(x)$ .

# of possible positive zeros: \_\_\_\_\_

# of possible negative zeros: \_\_\_\_\_

- e.) Use synthetic division to test for rational zeros. Remember you can use Upper and Lower Bound Rules.

FACTORS: \_\_\_\_\_

ZEROS: \_\_\_\_\_

$x$ -intercept(s): \_\_\_\_\_

4.)  $f(x) = 2x^4 - 15x^3 + 23x^2 + 15x - 25$

a.) Determine the end behavior of  $f(x)$ .

$x \rightarrow -\infty$   $f(x) \rightarrow$  \_\_\_\_\_       $x \rightarrow \infty$   $f(x) \rightarrow$  \_\_\_\_\_

b.) Determine the possible number of turning points of  $f(x)$ .

# of possible turning points: \_\_\_\_\_

c.) Use the Rational Root Test to determine the possible rational roots.

Possible Rational Roots: \_\_\_\_\_

d.) Use Descartes' Rule of Signs to determine the possible number of positive and negative zeros of  $f(x)$ .

# of possible positive zeros: \_\_\_\_\_

# of possible negative zeros: \_\_\_\_\_

e.) Use synthetic division to test for rational zeros. Remember you can use Upper and Lower Bound Rules.

FACTORS: \_\_\_\_\_

ZEROS: \_\_\_\_\_

$x$ -intercept(s): \_\_\_\_\_

5.)  $f(x) = x^4 + 6x^3 + 10x^2 + 6x + 9$

a.) Determine the end behavior of  $f(x)$ .

$x \rightarrow -\infty$   $f(x) \rightarrow$  \_\_\_\_\_       $x \rightarrow \infty$   $f(x) \rightarrow$  \_\_\_\_\_

b.) Determine the possible number of turning points of  $f(x)$ .

# of possible turning points: \_\_\_\_\_

c.) Use the Rational Root Test to determine the possible rational roots.

Possible Rational Roots: \_\_\_\_\_

d.) Use Descartes' Rule of Signs to determine the possible number of positive and negative zeros of  $f(x)$ .

# of possible positive zeros: \_\_\_\_\_

# of possible negative zeros: \_\_\_\_\_

e.) Use synthetic division to test for rational zeros. Remember you can use Upper and Lower Bound Rules.

FACTORS: \_\_\_\_\_

ZEROS: \_\_\_\_\_

$x$ -intercept(s): \_\_\_\_\_