

Name: \_\_\_\_\_

Date: \_\_\_\_\_

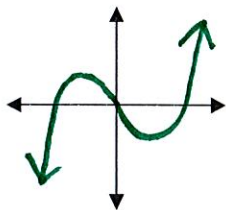
**End Behavior:**

Look left and Right, to figure out what's happening up and down.

(x goes right)  $x \rightarrow +\infty$   $f(x) \rightarrow$  \_\_\_\_\_  $\leftarrow$  y goes up or down  
 (x goes left)  $x \rightarrow -\infty$   $f(x) \rightarrow$  \_\_\_\_\_  $\leftarrow$  y goes up or down

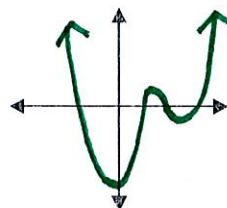
**Graphically:**

1.



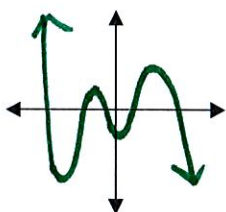
Right  $\rightarrow x \rightarrow +\infty$   $f(x) \rightarrow \infty$   
 left  $\rightarrow x \rightarrow -\infty$   $f(x) \rightarrow -\infty$

2.



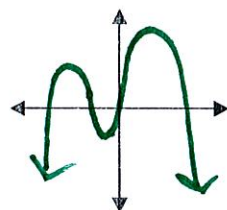
$x \rightarrow +\infty$   $f(x) \rightarrow \infty$   
 $x \rightarrow -\infty$   $f(x) \rightarrow \infty$

3.



Right  $\rightarrow x \rightarrow +\infty$   $f(x) \rightarrow -\infty$   
 left  $\rightarrow x \rightarrow -\infty$   $f(x) \rightarrow \infty$

4.



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

**Algebraically:** Determine the left & Right behavior based on equation

5.  $f(x) = |x^4 + 2x^2 - 3x$

deg: 4 (even)  $\nearrow \nearrow$   
 sign L.C.: +1

sign of leading coeff

	Pos	Neg
even	$\nearrow \nearrow$	$\searrow \searrow$
odd	$\searrow \nearrow$	$\nearrow \searrow$

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

6.  $f(x) = -x^5 + 3x^4 - x$

degree: 5 (odd)  
 sign of leading: (-1) neg

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

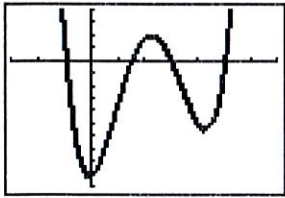
7.  $f(x) = 2x^3 - 3x^2 + 5$

degree: 3 (odd)  
 sign of leading: 2 pos

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

**Extrema:** are turns in the graph.

- If you are given a graph, take the turns and add 1 to get the least possible degree of the polynomial.



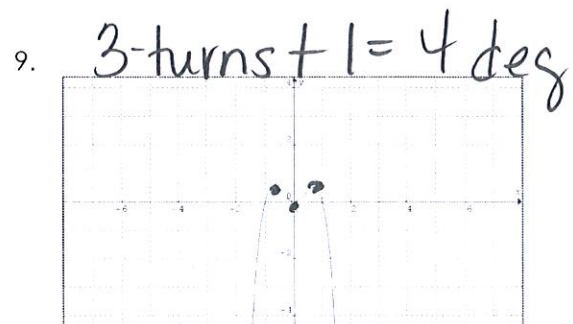
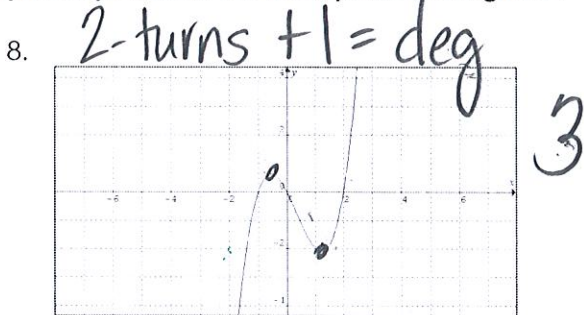
Least Possible Degree: 4  
 (extrema) turns + 1 = deg  
 3 + 1

- If you are given the function, take the degree and subtract 1 to get the number of extrema.

$$f(x) = 2x^3 - 3x^2 + 5$$

deg - 1 = # extrema  
 Number of Extrema:  
 $3 - 1 = 2$

**Graphically, what is the least possible degree?**



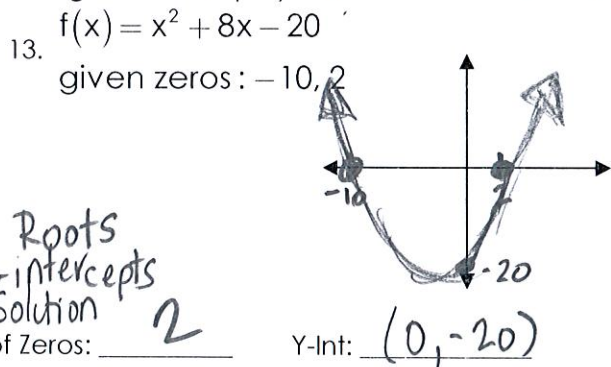
**Algebraically, what is the number of extrema?**

10.  $f(x) = x^4 + 2x^3 - 3x$   
 deg - 1  
 $4 - 1 = 3$  extrema

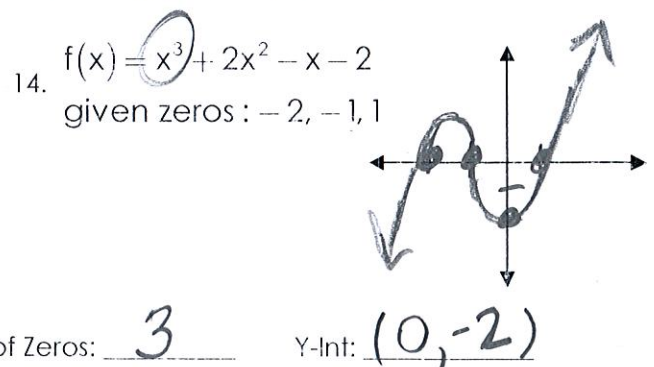
11.  $f(x) = -x^5 + 3x^4 - x$   
 deg - 1  
 $5 - 1 = 4$  extrema

12.  $f(x) = 2x^3 - 3x^2 + 5$   
 2 extrema

**Sketching:** Given the polynomial and zeros, sketch a graph and determine the characteristics



$x \rightarrow +\infty f(x) \rightarrow \infty$   
 $x \rightarrow -\infty f(x) \rightarrow \infty$  # of extrema 1  
 $\nearrow x^2 \nearrow$  even & pos exponent leading coef



$x \rightarrow +\infty f(x) \rightarrow \infty$   
 $x \rightarrow -\infty f(x) \rightarrow -\infty$  # of extrema (turns) 2  
 $\nwarrow x^3 \nearrow$  exp odd LC +