

### Challenge Problem!

Use the numbers 0 through 9 to fill in the boxes below

$$\begin{array}{ccccccc}
 \boxed{9} & + & \boxed{1} & + & \boxed{0} & + & \boxed{7} & = & 17 \\
 + & & & & & + & & & \\
 \boxed{3} & & & & & & \boxed{6} & & \\
 + & & & & & + & & & \\
 \boxed{5} & + & \boxed{2} & + & \boxed{8} & + & \boxed{4} & = & 17 \\
 \parallel & & & & & \parallel & & & \\
 17 & & & & & 17 & & & 
 \end{array}$$

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#### 1.2 Representations of Polynomial Functions

In small groups, investigate using graphing calculators.



##### 1. LINEAR

Function	a) $f(x) = 2x$	b) $f(x) = -4x$	c) $f(x) = 5$
Sketch			

Function	Degree	# of Zeros	Sign of Leading Coefficient	End Behaviour as $x \rightarrow \infty$	End Behaviour as $x \rightarrow -\infty$
a	1	1	+	$f(x) \rightarrow \infty$	$f(x) \rightarrow -\infty$
b	1	1	-	$f(x) \rightarrow -\infty$	$f(x) \rightarrow \infty$
c	0	0	+	$f(x) \rightarrow 5$	$f(x) \rightarrow 5$

Maximum # of zeros for a linear function: 1

##### 2. QUADRATIC

Function	a) $f(x) = 3x^2 - 5x + 1$	b) $f(x) = -2x^2 + x - 4$	c) $f(x) = 4x^2 + 16x + 16$
Sketch			

Function	Degree	# of Zeros	Sign of Leading Coefficient	End Behaviour as $x \rightarrow \infty$	End Behaviour as $x \rightarrow -\infty$
a	2	2	+	$f(x) \rightarrow \infty$	$f(x) \rightarrow \infty$
b	2	0	-	$f(x) \rightarrow -\infty$	$f(x) \rightarrow -\infty$
c	2	1	+	$f(x) \rightarrow \infty$	$f(x) \rightarrow \infty$

Maximum # of zeros for a quadratic function: 2

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**3. CUBIC**

Function	a) $f(x) = -6x^3 + 11x^2 - 73x + 20$	b) $f(x) = -x^3 + 9x^2 - 27x + 27$	c) $f(x) = 2x^3 - 11x^2 - 8x + 80$
Sketch			

Function	Degree	# of Zeros	Sign of Leading Coefficient	End Behaviour as $x \rightarrow \infty$	End Behaviour as $x \rightarrow -\infty$
a	3	3	-	$f(x) \rightarrow -\infty$	$f(x) \rightarrow \infty$
b	3	1	-	$f(x) \rightarrow -\infty$	$f(x) \rightarrow \infty$
c	3	1	+	$f(x) \rightarrow \infty$	$f(x) \rightarrow -\infty$

Maximum # of zeros for a cubic function: 3 (2,1)

**4. QUARTIC**

Function	a) $f(x) = 8x^4 - 34x^3 - 53x^2 + 109x + 30$	b) $f(x) = -x^4 + 8x^3 - 24x^2 + 32x - 16$	c) $f(x) = x^4 - 7x^3 + 11x^2 - 7x + 10$
Sketch			

Function	Degree	# of Zeros	Sign of Leading Coefficient	End Behaviour as $x \rightarrow \infty$	End Behaviour as $x \rightarrow -\infty$
a	4	4	+	$f(x) \rightarrow \infty$	$f(x) \rightarrow \infty$
b	4	1	-	$f(x) \rightarrow -\infty$	$f(x) \rightarrow -\infty$
c	4	2	+	$f(x) \rightarrow \infty$	$f(x) \rightarrow \infty$

Maximum # of zeros for a quartic function: 4

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**SUMMARY**

**Cubic Functions : degree 3**

**\* Positive Leading Coefficient**  
 End Behaviour: as  $x \rightarrow \infty, y \rightarrow \infty$   
 as  $x \rightarrow -\infty, y \rightarrow -\infty$

**Double root**

**\* Negative Leading Coefficient**  
 End Behaviour: as  $x \rightarrow \infty, y \rightarrow -\infty$   
 as  $x \rightarrow -\infty, y \rightarrow \infty$

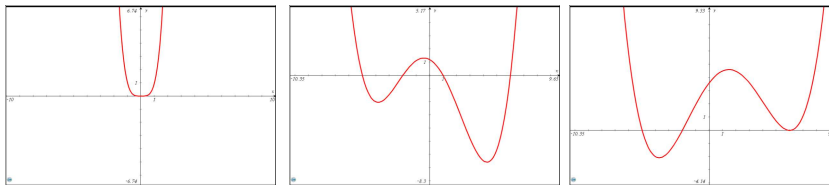
**\* Can have 1,2 or 3 zeros.**

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Quartic Functions : degree 4

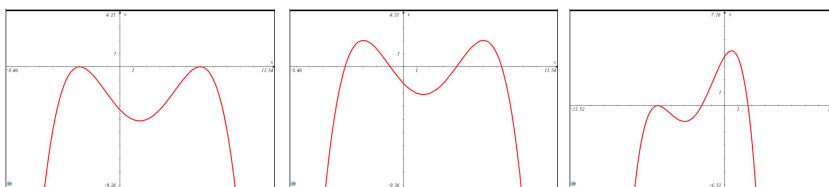
\* Positive Leading Coefficient

End Behaviour: as  $x \rightarrow \infty, y \rightarrow \infty$   
 as  $x \rightarrow -\infty, y \rightarrow \infty$



\* Negative Leading Coefficient

End Behaviour: as  $x \rightarrow \infty, y \rightarrow -\infty$   
 as  $x \rightarrow -\infty, y \rightarrow -\infty$



\* Can have 0, 1, 2, 3 or 4 zeros.

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*Summary of Zeros*

Degree	Min #	Max #
Even	0	Degree #
Odd	1	Degree #

**Turning Point:** a maximum or minimum point on a curve.  
 --> A quadratic always has one turning point.

	Turning Points	
	Minimum	Maximum
Cubic	0	2
Quartic	1	3

Homework  
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