3.4 Solutions

31. $f(x) = 2x(x-3)(x+2)$

zeros: 0   3   -2

multiplicity: 1   1   1

	-2		0		3	
$2x$	$-$		$-$		$+$	$+$
$x-3$	$-$		$-$		$-$	$+$
$x+2$	$-$		$+$		$+$	$+$
	$-$		$+$		$-$	$+$
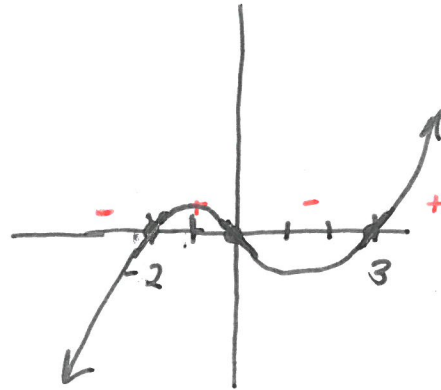
First term: $2x \cdot x \cdot x = 2x^3$
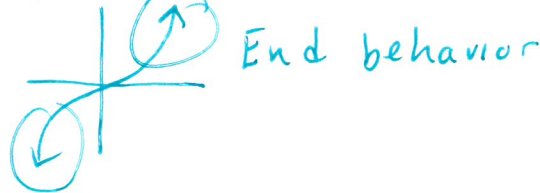
End behavior

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

zeros: 0   2   -3

mult: 2   1   2

	-3		0		2	
x^2	$+$		$+$		$+$	$+$
$x-2$	$-$		$-$		$-$	$+$
$(x+3)^2$	$+$		$+$		$+$	$+$
	$-$		$-$		$-$	$+$
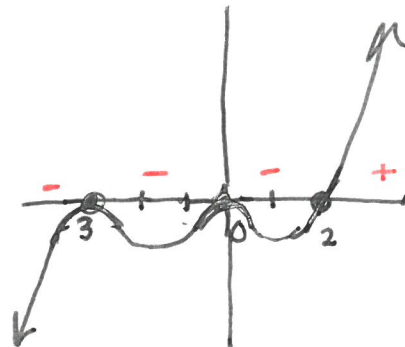
First term:

$x^2 \cdot x \cdot (x)^2 = x^5$
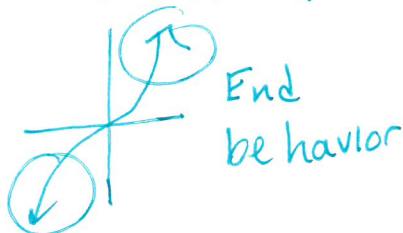
End behavior

steps
find the zeros (and multiplicity)

Put the zeros on the graph

Find the signs (use graph order of zeros when making the table).
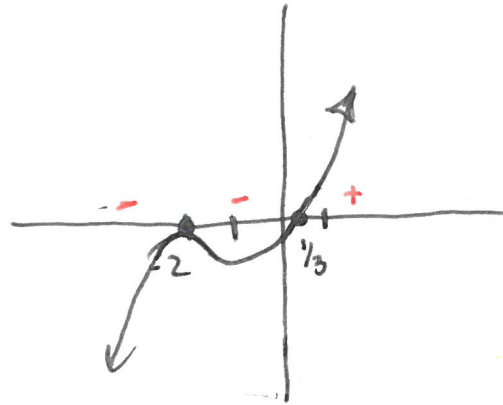
Draw behavior close to each zero

Connect to make a smooth graph

Find the first term and use it to check the end behavior
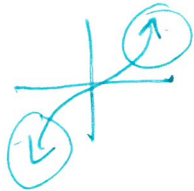
35. $f(x) = (3x-1)(x+2)^2$

zeros: 1/3   -2
mult: 1   2

	-2		1/3	
$3x-1$	−	−		+
$(x+2)^2$	+	+		+
	−	−		+

First term $(3x)(x)^2 = 3x^3$

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

factor first!

$= 2x^3(x-2)(x+2)(x-1)$
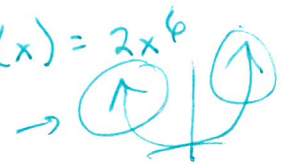
zeros: 0   2   -2   1
mult: 3   1   1   1
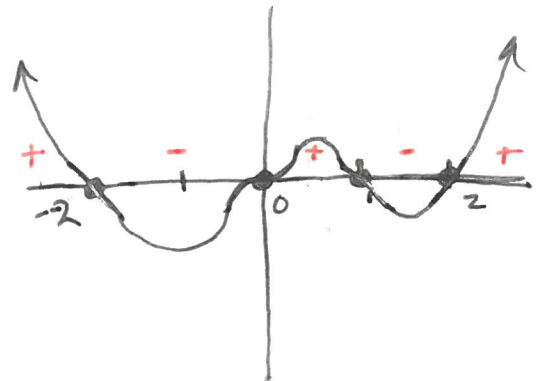
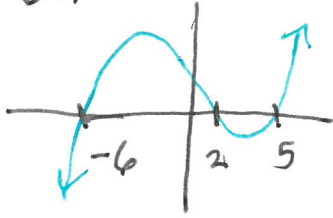|	-2		0		1		2	
$2x^3$	−	−	+	+	+
$x-2$	−	−	−	−	+
$x+2$	−	+	+	+	+
$x-1$	−	−	−	+	+
	+	−	+	−	+

First term:

$2x^3(x^2)(x) = 2x^6$

end behavior

65.

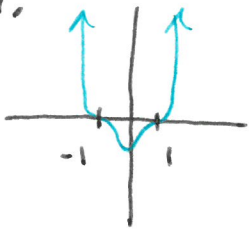zeros: -6 2 5

multiplicity: 1 1 1

factors: $(x+6)$ $(x-2)$ $(x-5)$

$$f(x) = (x+6)(x-2)(x-5)$$
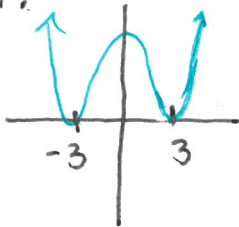
67.

zeros: -1 1

multiplicities: 3 3

factors: $(x+1)^3$ $(x-1)^3$

$$f(x) = (x+1)^3 (x-1)^3$$

69.
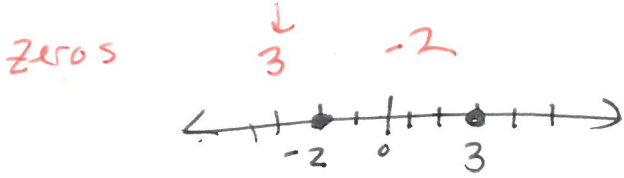

zeros: -3 3

multiplicities: 2 2

factors: $(x+3)^2$ $(x-3)^2$

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

1.7 solutions

39. $x^2 - x - 6 > 0$

$(x-3)(x+2) > 0$

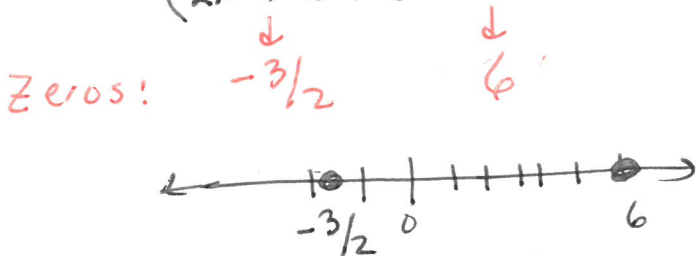zeros   3   -2

	-2	3	
$x-3$	$-$	$-$	$+$
$x+2$	$-$	$+$	$+$

... > 0 $\oplus$ $-$ $\oplus$

$$(-\infty, -2) \cup (3, \infty)$$

41. $2x^2 - 9x \leq 18$

$2x^2 - 9x - 18 \leq 0$

$(2x+3)(x-6) \leq 0$

zeros! $-3/2$ 6

	$-3/2$	6	
$2x+3$	$-$	$+$	$+$
$x-6$	$-$	$-$	$+$
	$+$	$\ominus$	$+$

... ≤ 0

$$[-3/2, 6]$$

Steps

- All terms on one side of inequality

- Factor

○ Find zeros

○ Put zeros on a number line (put in order)

- Find $+, -$ signs

○ Figure out if you want $+$ or $-$, and whether to include endpoints (include for $\leq, \geq$ use [ ])

○ Write solution as an interval or several intervals

43. $-x^2 - 4x - 6 \leq -3$

$-x^2 - 4x - 3 \leq 0$

$(x-1)$ $x^2 + 4x + 3 \geq 0$

$(x+3)(x+1) \geq 0$

zeros: -3 -1

	-3	-1	
$x+3$	$-$	$+$	$+$
$x+1$	$-$	$-$	$+$
	$+$	$-$	$+$

$\ldots \geq 0$

$(-\infty, -3] \cup [-1, \infty)$

or

$-x^2 - 4x - 3 \leq 0$

$(-x - 3)(x+1) \leq 0$

-3 -1
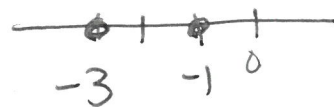
	-3	-1	
$-x-3$	$+$	$-$	$-$
$x+1$	$-$	$-$	$+$
	$-$	$+$	$-$

$\ldots \leq 0$

$(-\infty, -3] \cup [-1, \infty)$

45. $x(x-1) \leq 6$

$x^2 - x - 6 \leq 0$

$(x-3)(x+2) \leq 0$

zeros 3 -2

	-2	3	
$x-3$	$-$	$-$	$+$
$x+2$	$-$	$+$	$+$
≤ 0	$+$	$-$	$+$

$[-2, 3]$