

Factor completely.

1.  $2x^2 - 3x - 5$

$(2x - 5)(x + 1)$

2.  $5x^3 + 20x^2 + 15x$

$5x(x^2 + 4x + 3)$

$5x(x + 3)(x + 1)$

3.  $6x^2 - 7x - 20$

$(3x + 4)(2x - 5)$

4.  $4x^3 - 11x^2 - 3x$

$x(4x^2 - 11x - 3)$

$x(4x + 1)(x - 3)$

5.  $2x - 16x^4$

$2x(1 - 8x^3)$

$2x(1 - 2x)(1 + 2x + 4x^2)$

6.  $4x^3 + 12x^2 - x - 3$

$4x^2(x + 3) - 1(x + 3)$

$(4x^2 - 1)(x + 3)$

$(2x + 1)(2x - 1)(x + 3)$

7.  $x^4 + 3x^3 + x^2 - 3x - 2$  possible zeros:  $\pm 1, 2$

$$\begin{array}{r|rrrrr} 1 & 1 & 3 & 1 & -3 & -2 \\ & \downarrow & & & & \\ \hline & & 1 & 4 & 5 & 2 \end{array}$$

$$\begin{array}{r|rrrrr} -1 & 1 & 4 & 5 & 2 & 0 \\ & \downarrow & & & & \\ \hline & & -1 & -3 & -2 & \\ \hline & 1 & 3 & 2 & 0 & \end{array}$$

$x^3 + 4x^2 + 5x + 2$

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

$(x - 1)(x + 1)(x + 2)(x + 1)$

8.  $x^3 + 27$

$(x + 3)(x^2 - 3x + 9)$

Sketch the graph of the given function. Include the x-intercept(s), y-intercept, multiplicity of zeros, and end behavior.

9.  $f(x) = x^3 + x^2 - 4x - 4$  possible zeros:  $\pm 1, 2, 4$

$$\begin{array}{r|rrrr} -1 & 1 & 1 & -4 & -4 \\ & \downarrow & & & \\ \hline & & -1 & 0 & 4 \\ \hline & 1 & 0 & -4 & 0 \end{array}$$

$(x + 1)(x^2 - 4)$

$f(x) = (x + 1)(x + 2)(x - 2)$

x.int

$(-1, 0) (-2, 0) (2, 0)$

cross cross cross

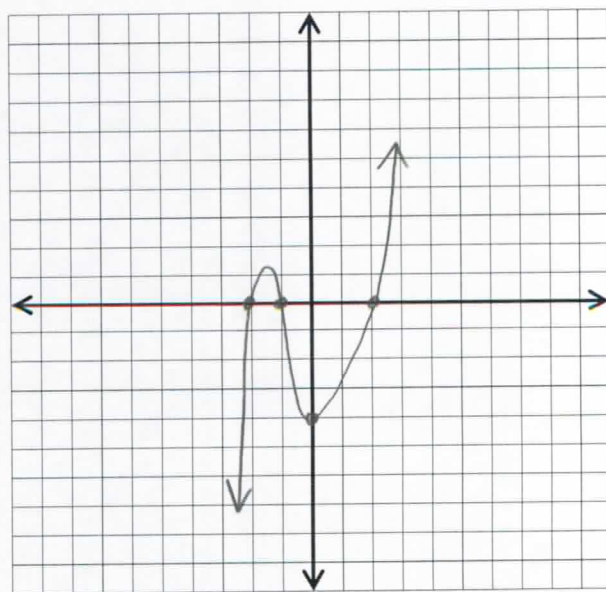
y.int

$(0, -4)$

end behavior  $\downarrow \uparrow$ 

as  $x \rightarrow -\infty$ ,  $f(x) \rightarrow -\infty$

as  $x \rightarrow \infty$ ,  $f(x) \rightarrow \infty$



10.  $f(x) = x^4 - 2x^3 - 4x^2 + 2x + 3$  possible zeros:  $\pm 1, 3$

$$\begin{array}{r|rrrrr} 1 & 1 & -2 & -4 & 2 & 3 \\ & \downarrow & & & & \\ \hline & 1 & -1 & -5 & -3 & -3 \\ -1 & & \downarrow & & & \\ \hline & 1 & -1 & -5 & -3 & 0 \\ & & \downarrow & & & \\ \hline & 1 & -2 & -3 & 0 & \end{array}$$

$$x^3 - x^2 - 5x - 3$$

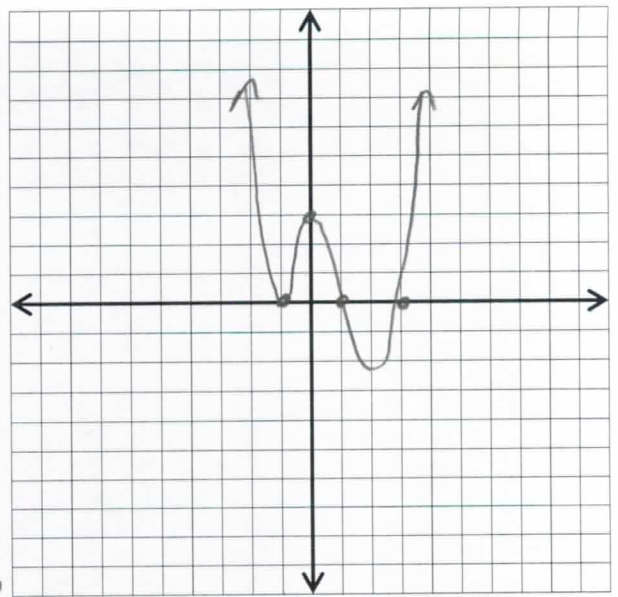
x.int  
 $(1,0) (-1,0) (3,0)$   
 cross bounce cross

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

$$(x-1)(x+1)(x-3)(x+1)$$

y.int  
 $(0,3)$

end beh.  $\uparrow\uparrow$   
 as  $x \rightarrow -\infty, f(x) \rightarrow \infty$   
 as  $x \rightarrow \infty, f(x) \rightarrow \infty$



11.  $f(x) = -x^3 + 7x + 6$  possible zeros:  $\pm 1, 2, 3, 6$

$$\begin{array}{r|rrrr} -1 & -1 & 0 & 7 & 6 \\ & \downarrow & & & \\ \hline & -1 & 1 & -6 & -6 \\ & & \downarrow & & \\ \hline & -1 & 1 & 6 & 0 \end{array}$$

x.int  
 $(-1,0) (3,0) (-2,0)$   
 cross cross cross

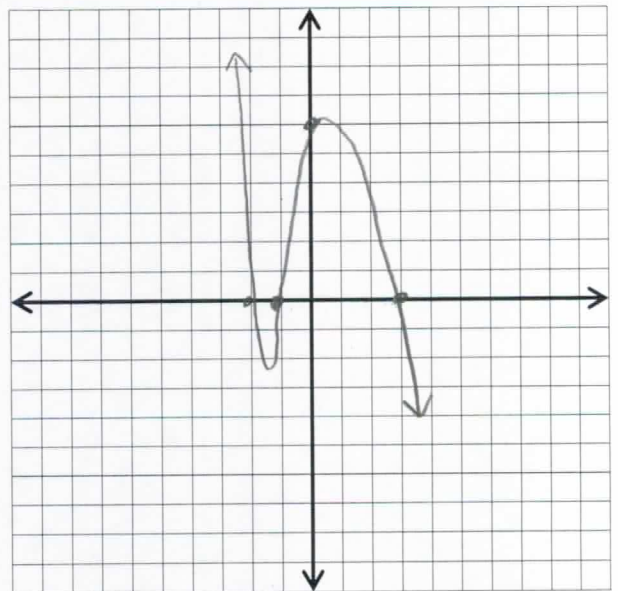
$$(x+1)(-x^2+x+6)$$

$$-(x+1)(x^2-x-6)$$

$$-(x+1)(x-3)(x+2)$$

y.int  
 $(0,6)$

end behavior  
 as  $x \rightarrow -\infty, f(x) \rightarrow \infty$   
 as  $x \rightarrow \infty, f(x) \rightarrow -\infty$



12.  $f(x) = 2x^3 - 3x^2 + 1$  possible zeros:  $\pm 1, \frac{1}{2}$

$$\begin{array}{r|rrrr} 1 & 2 & -3 & 0 & 1 \\ & \downarrow & & & \\ \hline & 2 & -1 & -1 & -1 \\ & & \downarrow & & \\ \hline & 2 & -1 & -1 & 0 \end{array}$$

x.int  
 $(-\frac{1}{2}, 0) (1, 0)$   
 cross bounce

$$(x-1)(2x^2-x-1)$$

$$(x-1)(2x+1)(x-1)$$

$$(2x+1)(x-1)^2$$

y.int  
 $(0,1)$

end behavior  
 as  $x \rightarrow -\infty, f(x) \rightarrow -\infty$   
 as  $x \rightarrow \infty, f(x) \rightarrow \infty$

