Solutions

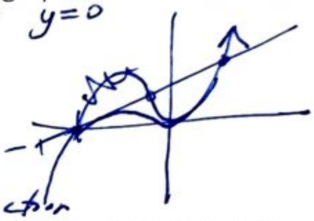
Lesson 11 Practice Problems

1. What are the points of intersection between the graphs of the functions $f(x) = x^2(x+1)$ and $g(x) = x+1$? $x=-1$ $y=0$

$(-1, 0)$

$(1, 2)$

use calculator graph solve for intersection



2. Select **all** the points of intersection between the graphs of the functions $f(x) = (x+5)(x-2)$ and $g(x) = (2x+1)(x-2)$. $x=2, y=0$

   A. (-5, 0)

   B. $(-\frac{1}{2}, 0)$

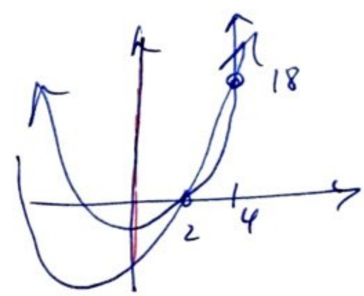
   C. (-2, -12)

   D. (2, 0)

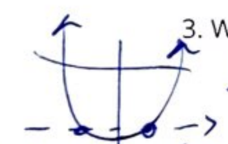
   E. (4, 18)

   F. (5, 30)

use graph solve



3. What are the solutions to the equation $(x-3)(x+5) = -15$?



g-solve

$(-2, -15)$ $(0, -15)$

$x^2+2x-15=-15$

$x^2+2x=0$

$x(x+2)=0$

$x=0$

$x=-2$

4. What are the x-intercepts of the graph of $y = (5x+7)(2x-1)(x-4)$?

$-\frac{7}{5}, \frac{1}{2}, 4$

   A. $-\frac{7}{5}, -\frac{1}{2}, 4$

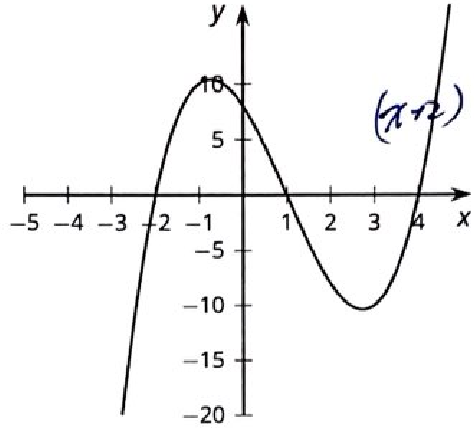
   B. $\frac{5}{7}, \frac{1}{2}, 4$

   C. $-\frac{7}{5}, \frac{1}{2}, 4$

   D. $\frac{5}{7}, 2, 4$

(From Unit 2, Lesson 5.)

5. Which polynomial function's graph is shown here?



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

A. $f(x) = (x + 1)(x + 2)(x + 4)$

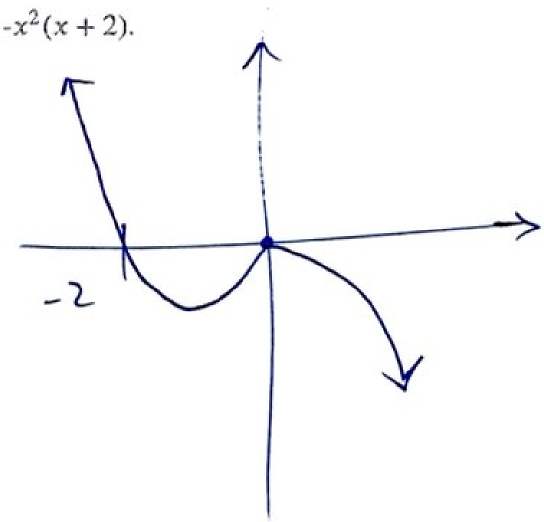
B. $f(x) = (x + 1)(x - 2)(x + 4)$

C. $f(x) = (x - 1)(x + 2)(x - 4)$

D. $f(x) = (x - 1)(x - 2)(x - 4)$

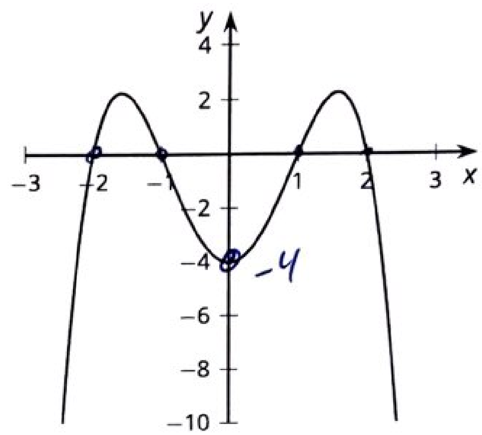
(From Unit 2, Lesson 7.)

6. Draw a rough sketch of the graph of $g(x) = -x^2(x + 2)$.



(From Unit 2, Lesson 10.)

7. The graph of a polynomial function f is shown.



a. Is the degree of the polynomial odd or even? Explain how you know.

even : in both x directions, $y \to -\infty$

b. What is the constant term of the polynomial?

-4

(From Unit 2, Lesson 9.)

Solutions

Lesson 12 Practice Problems

1. The polynomial function $p(x) = x^3 - 3x^2 - 10x + 24$ has a known factor of $(x - 4)$.

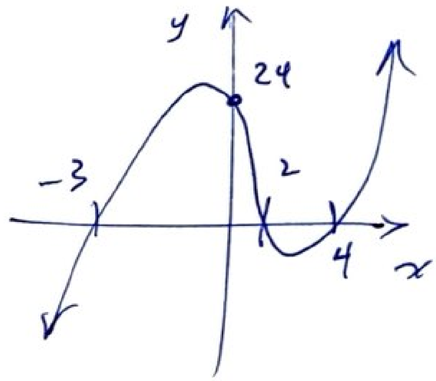
~~g~~ equation solve
4, 2, -3

   a. Rewrite $p(x)$ as the product of linear factors.

$p(x) = (x+3)(x-2)(x-4)$

   b. Draw a rough sketch of the graph of the function.

equation - g - solve



2. Tyler thinks he knows one of the linear factors of $P(x) = x^3 - 9x^2 + 23x - 15$. After finding that $P(1) = 0$, he suspects that $x - 1$ is a factor of $P(x)$. Here is the diagram he made to check if he's right, but he set it up incorrectly. What went wrong?

He left out
the negative sign
for x -1

	x^2	-8x	-15
x	x^3	-8x^2	-15x
-1	$-x^2$	+8x	+15

a= b: c= d= e=

3. The polynomial function $q(x) = 2x^4 - 9x^3 - 12x^2 + 29x + 30$ has known factors $(x - 2)$ and $(x + 1)$. Which expression represents $q(x)$ as the product of linear factors?

equation	solve	
x_1	5	$x-5$
x_2	2	$x-2$
x_3	-1	$x+1$
x_4	-1.5	$2x+3$

A. $(2x - 5)(x + 3)(x - 2)(x + 1)$

B. $(2x + 3)(x - 5)(x - 2)(x + 1)$

C. $(2x + 15)(x - 1)(x - 2)(x + 1)$

D. $(2x - 15)(x + 1)(x - 2)(x + 1)$

4. Each year a certain amount of money is deposited in an account which pays an annual interest rate of r so that at the end of each year the balance in the account is multiplied by a growth factor of $x = 1 + r$. \$1,000 is deposited at the start of the first year, an additional \$300 is deposited at the start of the next year, and \$500 at the start of the following year.

   a. Write an expression for the value of the account at the end of three years in terms of the growth factor x.

   $V(x) = \cancel{8}\ 1000x^3 + 300x^2 + 500x$

   b. Determine (to the nearest cent) the amount in the account at the end of three years if the interest rate is 4%.

   $V(1.04) = 1969.344$

   $\approx \$1969.34$

(From Unit 2, Lesson 2.)

5. State the degree and end behavior of $f(x) = 5 + 7x - 9x^2 + 4x^3$. Explain or show your reasoning.

degree 3

positive leading coefficient

$x \to +\infty,\ y \to +\infty$

$x \to -\infty,\ y \to -\infty$

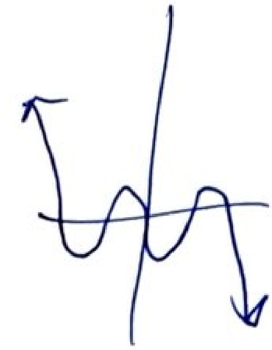
(From Unit 2, Lesson 8.)

6. Describe the end behavior of $f(x) = 1 + 7x + 9x^3 + 6x^4 - 2x^5$

degree 5 (odd)
negative leading coefficient

$x \to +\infty, y \to -\infty$

$x \to -\infty, y \to +\infty$

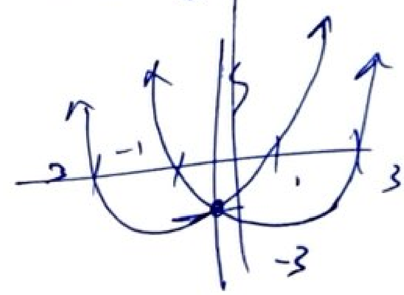


(From Unit 2, Lesson 10.)

7. What are the points of intersection between the graphs of the functions $f(x) = (x+3)(x-1)$ and $g(x) = (x+1)(x-3)$?

use g-solve

$(0, -3)$



(From Unit 2, Lesson 11.)

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

$4x = 0$

$x = 0,$

$y = -3$

Solutions

Lesson 13 Practice Problems

$a =$ $c =$ $d =$

1. The polynomial function $B(x) = x^3 - 21x + 20$ has a known factor of $(x - 4)$. Rewrite $B(x)$ as a product of linear factors.

$B(x) = (x-4)(x-1)(x+5)$

$x_1 = 4$ $(x-4)$
$x_2 = 1$ $(x-1)$
$x_3 = -5$ $(x+5)$

2. Let the function P be defined by $P(x) = x^3 + 7x^2 - 26x - 72$ where $(x + 9)$ is a factor. To rewrite the function as the product of two factors, long division was used but an error was made:

$$\begin{array}{r}
x^2 + 16x + 118 \\
x + 9 \overline{)\, x^3 + 7x^2 - 26x - 72} \\
\underline{-x^3 + 9x^2 \qquad\qquad\qquad} \\
16x^2 - 26x \qquad \\
\underline{-16x^2 + 144x \qquad} \\
118x - 72 \\
\underline{-118x + 1062} \\
990
\end{array}$$

How can we tell by looking at the remainder that an error was made somewhere?

x+9 is a factor, so the remainder should be zero

$a=$ $b=$ $c=$ $d=$ $e=$

3. For the polynomial function $A(x) = x^4 - 2x^3 - 21x^2 + 22x + 40$ we know $(x-5)$ is a factor. Select **all** the other linear factors of $A(x)$.

A. $(x+1)$

B. $(x-1)$

C. $(x+2)$

D. $(x-2)$

E. $(x+4)$

F. $(x-4)$

G. $(x+8)$

$x_1 = 5$ $x-5$
$x_2 = 2$ $x-2$
$x_3 = -1$ $x+1$
$x_4 = -4$ $x+4$

4. Match the polynomial function with its constant term.

A. $P(x) = (x-2)(x-3)(x+7)$ $+42$ (4) — 1. -210

B. $P(x) = (x+2)(x-3)(x+7)$ -42 (2) — 2. -42

C. $P(x) = \frac{1}{2}(x-2)(x-3)(x+7)$ $+21$ (3) — 3. 21

D. $P(x) = 5(x-2)(x-3)(x+7)$ $+210$ (5) — 4. 42

E. $P(x) = -5(x-2)(x-3)(x+7)$ -210 (1) — 5. 210

(From Unit 2, Lesson 6.)

5. What are the solutions to the equation $(x-2)(x-4) = 8$?

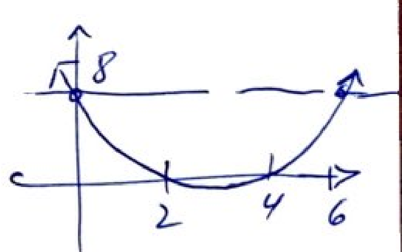
algebraically: $x^2 - 6x + 8 = 8$

$x^2 - 6x = 0$

$x(x-6) = 0$

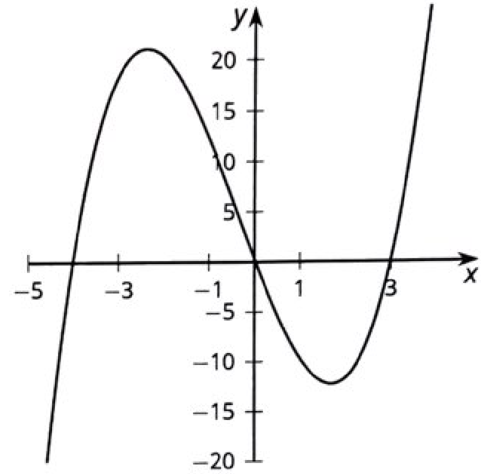
$x = 0, 6$

graphically:



(From Unit 2, Lesson 11.)

6. The graph of a polynomial function f is shown. Which statement is true about the end behavior of the polynomial function?



A. As x gets larger and larger in the either the positive or the negative direction, $f(x)$ gets larger and larger in the positive direction.

B. As x gets larger and larger in the positive direction, $f(x)$ gets larger and larger in the positive direction. As x gets larger and larger in the negative direction, $f(x)$ gets larger and larger in the negative direction.

C. As x gets larger and larger in the positive direction, $f(x)$ gets larger and larger in the negative direction. As x gets larger and larger in the negative direction, $f(x)$ gets larger and larger in the positive direction.

D. As x gets larger and larger in the either the positive or negative direction, $f(x)$ gets larger and larger in the negative direction.

(From Unit 2, Lesson 8.)

$a=1$ $b=$ $c=$ $d=$

7. The polynomial function $p(x) = x^3 + 3x^2 - 6x - 8$ has a known factor of $(x + 4)$.

a. Rewrite $p(x)$ as the product of linear factors.

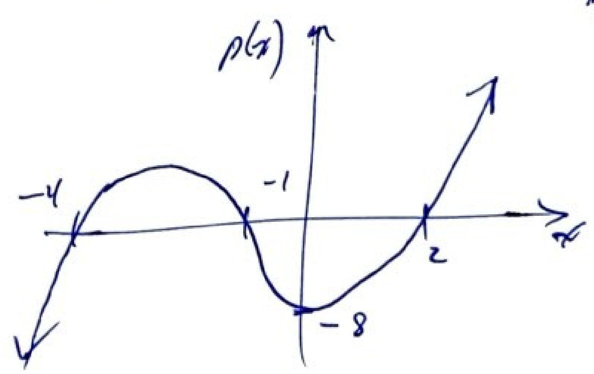
$p(x) = (x-2)(x+1)(x+4)$

$x_1 = 2$ $x-2$

$x_2 = -1$ $x+1$

$x_3 = -4$ $x+4$

b. Draw a rough sketch of the graph of the function.

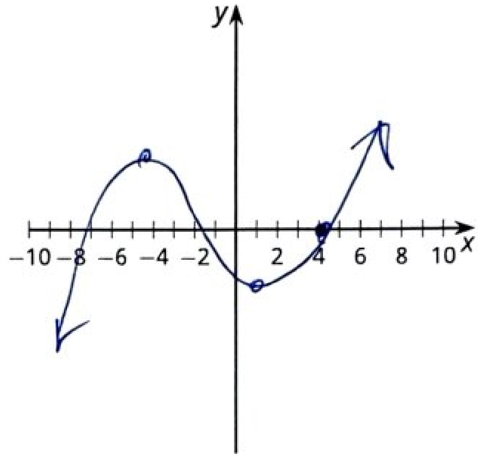


(From Unit 2, Lesson 12.)

Solutions

Lesson 14 Practice Problems

1. We know these things about a polynomial function, $f(x)$: it has exactly one relative maximum and one relative minimum, it has exactly three zeros, and it has a known factor of $(x-4)$. Sketch a graph of $f(x)$ given this information.

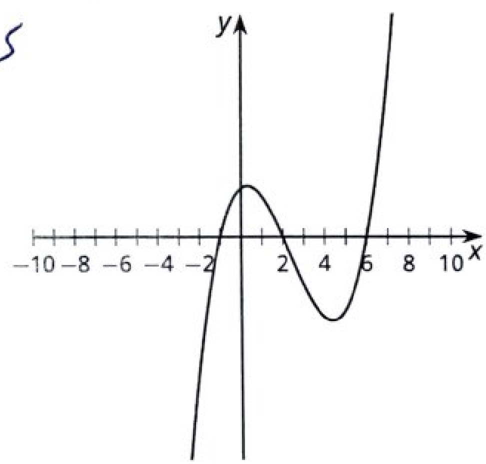


2. Mai graphs a polynomial function, $f(x)$, that has three linear factors $(x+6)$, $(x+2)$, and $(x-1)$. But she makes a mistake. What is her mistake?

$x = -6, -2$

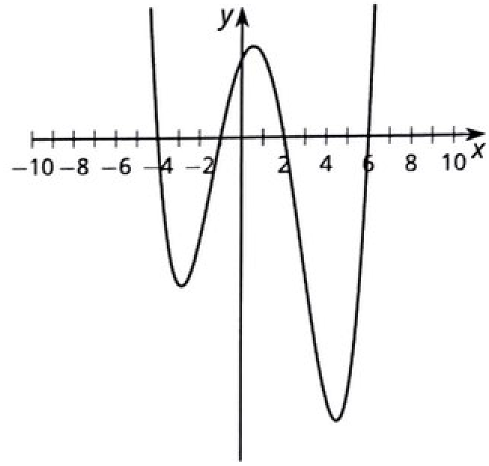
$x = +1$

Wrong signs



3. Here is the graph of a polynomial function with degree 4.

   Select **all** of the statements that are true about the function.



   A. The leading coefficient is positive.

   B. The constant term is negative. ✗

   C. It has 2 relative maximums. ✗

   D. It has 4 linear factors.

   E. One of the factors is $(x-1)$. ✗

   F. One of the zeros is $x=2$.

   G. There is a relative minimum between $x=1$ and $x=3$. ✗

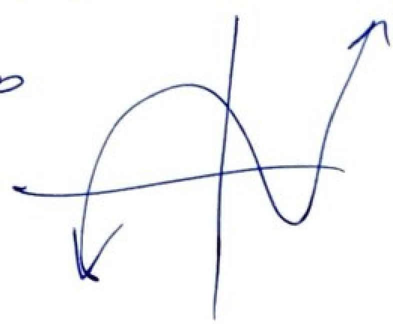
4. State the degree and end behavior of $f(x)=2x^3-3x^5-x^2+1$. Explain or show your reasoning.

   degree 3
   positive leading coefficient

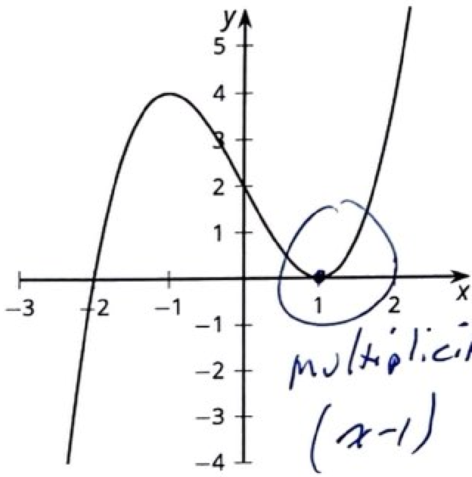
   (From Unit 2, Lesson 9.)

   $x \to +\infty,\ y \to +\infty$

   $x \to -\infty,\ y \to -\infty$



5. Is this the graph of $g(x) = (x - 1)^2(x + 2)$ or $h(x) = (x - 1)(x + 2)^2$? Explain how you know.



$g(x)$

$x-1$ is squared

multiplicity of 2 $(x-1)$

(From Unit 2, Lesson 10.)

6. Kiran thinks he knows one of the linear factors of $P(x) = x^3 + x^2 - 17x + 15$. After finding that $P(3) = 0$, Kiran suspects that $x - 3$ is a factor of $P(x)$, so he sets up a diagram to check. Here is the diagram he made to check his reasoning, but he set it up incorrectly. What went wrong?

minus 3, not +3

	x^2	$4x$	-5
x	x^3	$4x^2$	$-5x$
-3	$3x^2$	$12x$	15

(From Unit 2, Lesson 12.)

$a=1$ $b=$ $c=$ $d=-14$

7. The polynomial function $B(x) = x^3 + 8x^2 + 5x - 14$ has a known factor of $(x + 2)$. Rewrite $B(x)$ as a product of linear factors.

$B(x) = (x-1)(x+2)(x+7)$

$x_1 = 1$ $x-1$

$x_2 = -2$ $x+2$

$x_3 = -7$ $x+7$

(From Unit 2, Lesson 13.)

Solutions

Lesson 15 Practice Problems

1. For the polynomial function $f(x) = x^3 - 2x^2 - 5x + 6$, we have $f(0) = 6$, $f(2) = -4$, $f(-2) = 0$, $f(3) = 0$, $f(-1) = 8$, $f(1) = 0$. Rewrite $f(x)$ as a product of linear factors.

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

2. Select **all** the polynomials that have $(x - 4)$ as a factor. $f(4) = 0$

A. $x^3 - 13x - 12$ $4^3 - 13(4) - 12 = 0$

B. $x^3 + 8x^2 + 19x + 12$ $= 268$ ×

C. $x^3 + 6x + 5x - 12$ > 0 ×

D. $x^3 - x^2 - 10x - 8$ $= 0$

E. $x^2 - 4$ ×

3. Write a polynomial function, $p(x)$, with degree 3 that has $p(7) = 0$.

$p(x) = x^2(x-7)$

$= x^3 - 7x^2$

4. Long division was used here to divide the polynomial function $p(x) = x^3 + 7x^2 - 20x - 110$ by $(x - 5)$ and to divide it by $(x + 5)$.

$$\begin{array}{r} x^2 + 12x + 40 \\ x - 5 \overline{) x^3 + 7x^2 - 20x - 110} \\ \underline{-x^3 + 5x^2} \qquad\qquad\quad \\ 12x^2 - 20x \qquad\quad \\ \underline{-12x^2 + 60x} \qquad\quad \\ 40x - 110 \\ \underline{-40x + 200} \\ 90 \end{array} \qquad \begin{array}{r} x^2 + 2x - 30 \\ x + 5 \overline{) x^3 + 7x^2 - 20x - 110} \\ \underline{-x^3 - 5x^2} \qquad\qquad\quad \\ 2x^2 - 20x \qquad\quad \\ \underline{-2x^2 - 10x} \qquad\quad \\ -30x - 110 \\ \underline{30x + 150} \\ 40 \end{array}$$

a. What is $p(-5)$? 40

b. What is $p(5)$? 90

5. Which polynomial function has zeros when $x = 5, \frac{2}{3}, -7$?

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

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

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

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

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

(From Unit 2, Lesson 5.)

$a=3$ $b=$ $c=$ $d=$ $e=24$

6. The polynomial function $q(x) = 3x^4 + 8x^3 - 13x^2 - 22x + 24$ has known factors $(x + 3)$ and $(x + 2)$. Rewrite $q(x)$ as the product of linear factors.

$q(x) = (x+3)(x+2)(x-1)(3x-4)$

$x_1 = \frac{4}{3}$ $x - \frac{4}{3}$

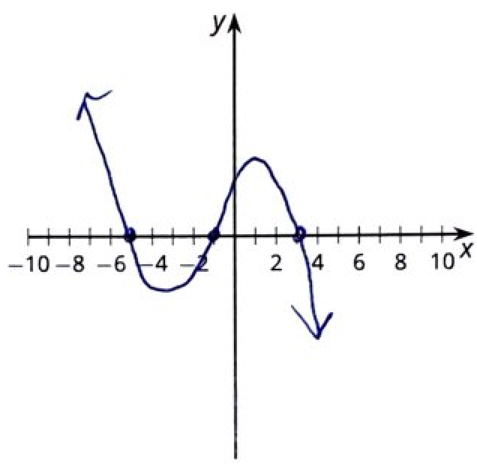
$x_2 = 1$ $x-1$

$x_3 = -2$ $x+2$

$x_4 = -3$ $x+3$

(From Unit 2, Lesson 12.)

7. We know these things about a polynomial function $f(x)$: it has degree 3, the leading coefficient is negative, and it has zeros at $x = -5, -1, 3$. Sketch a graph of $f(x)$ given this information.



(From Unit 2, Lesson 14.)