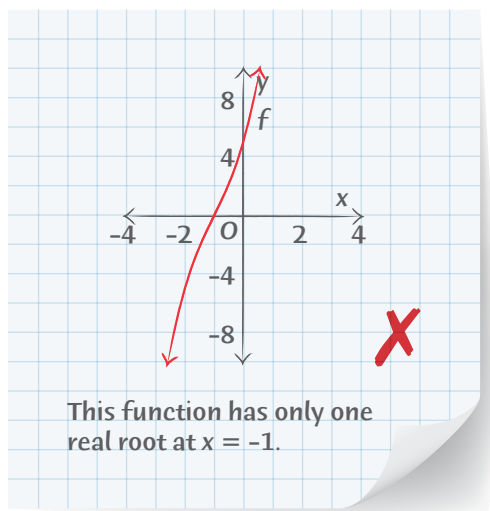


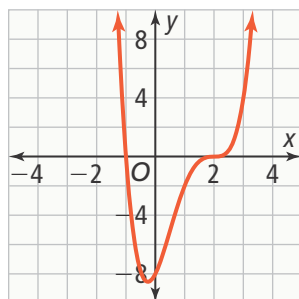


**UNDERSTAND**

6. **Reason** If you use zeros to sketch the graph of a polynomial function, how can you verify that your graph is correct?
7. **Error Analysis** Describe and resolve two errors that Tonya may have made in finding all the roots of the polynomial function,  $f(x) = x^3 + 3x^2 + 7x + 5$ .



8. **Higher Order Thinking** How could you use your graphing calculator to determine that  $f(x) = (x + 2)(x + 6)(x - 1)$  is not the correct factorization of  $f(x) = x^3 + 7x^2 + 16x + 12$ ? Explain.
9. **Generalize** How can you determine that the polynomial function shown does not have any zeros with even multiplicity? Explain.



10. **Look for Relationships** Factor the polynomial  $x^4 - 16$ . How many real zeros does the function  $g(x) = x^4 - 16$  have?
11. At what points do the graphs of  $f(x) = x^3 - 2x^2 - 16x + 20$  and  $g(x) = -12$  intersect?

**PRACTICE**

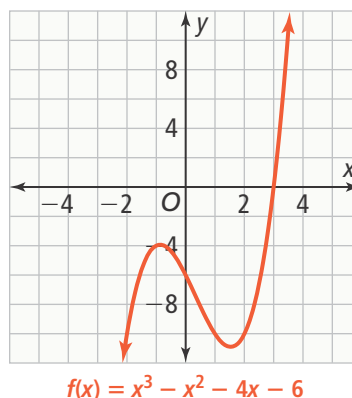
Sketch the graph of the function by finding the zeros. SEE EXAMPLE 1

12.  $f(x) = 3x^3 - 9x^2 - 12x$
13.  $g(x) = x^3 - 2x^2 - 11x + 12$

Find the zeros of the function, and describe the behavior of the graph at each zero. SEE EXAMPLE 2

14.  $f(x) = x^3 - 8x^2 + 16x$
15.  $g(x) = x^3 - x^2 - 25x + 25$
16.  $f(x) = 9x^4 - 40x^2 + 16$

17. What are all the real and complex zeros of the polynomial function shown in the graph? SEE EXAMPLE 3



18. Waterworks is a company that manufactures and sells paddleboards. Their profit  $P$ , in hundreds of dollars earned, is a function of the number of paddleboards sold  $x$ , measured in thousands. Profit is modeled by the function  $P(x) = -3x^3 + 48x^2 - 144x$ . What do the zeros of the function tell you about the number of paddleboards that Waterworks should produce? SEE EXAMPLE 4

What are the solution(s) of the equation?

SEE EXAMPLE 5

19.  $-3x^3 - x^2 + 54x - 40 = 2x^2 + 6x + 20$
20.  $2x^3 + 3x^2 - 36 = x^3 - x^2 + 9x$
21.  $-5x^4 + 4x^2 - 12x = -6x^4 + 3x^3$

What are the solutions of the inequality?

SEE EXAMPLE 6

22.  $x^3 - 9x > 0$
23.  $0 > 4x^3 + 8x^2 - x - 2$
24.  $64x^2 > -4x^3 - x - 16$

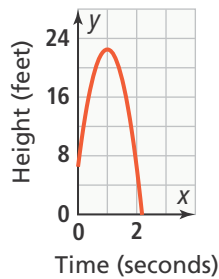
**APPLY**

**25. Make Sense and Persevere** A firework is launched vertically into the air. Its height in meters is given by the function shown, where  $t$  is measured in seconds.

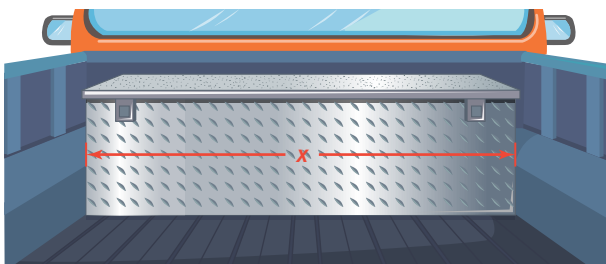


- What is a reasonable domain of the function?
- What are the zeros of the function? Explain what they represent in this situation.
- Use technology to find the vertex. What does it represent in this situation?

**26.** The height of a baseball thrown in the air can be modeled by the function  $h(t) = -16t^2 + 32t + 6.5$ , where  $h(t)$  represents the height in feet of the baseball after  $t$  seconds. Explain why the graph of this function only shows one zero.



**27. Model With Mathematics** The height of a rectangular storage box is less than both its length and width. The function  $f(x) = x^3 + 2x^2 - 8x$  represents the volume of the rectangular box, where  $x$  represents the width of the box, in inches.

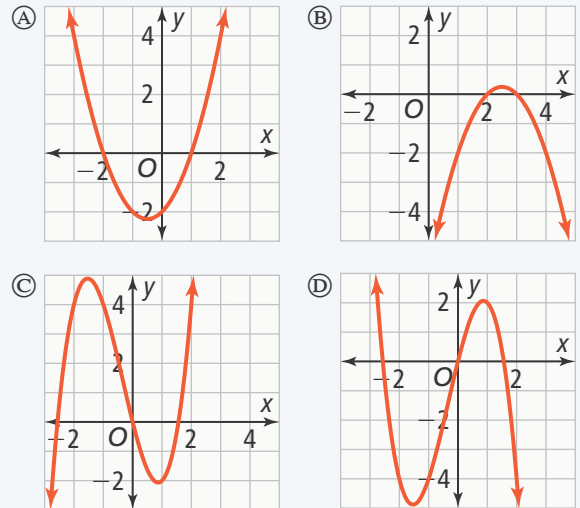


- Find the factored form of  $f(x)$ .
- Find the zeros of the function.
- You know  $x$  represents the width of the box. What do the other two factors represent?
- Find the dimensions of the box when the volume is  $240 \text{ in.}^3$ .

**ASSESSMENT PRACTICE**

**28.** Complete each statement so it means the same as 4 is a zero of the function.  
The function's graph crosses the \_\_\_\_\_ at 4.  
\_\_\_\_\_ is a factor of the polynomial.

**29. SAT/ACT** Without the use of a graphing calculator, determine which of the following functions is the graph of  $f(x) = x^3 + x^2 - 4x$ .



**30. Performance Task** Venetta opened several deli sandwich franchises in 2000. The profit  $P$  (in hundreds of dollars) of the franchises in  $t$  years (since the franchises opened) can be modeled by the function  $P(t) = t^3 + t^2 - 6t$ .

**Part A** Sketch a graph of the function.

**Part B** Based on the model, during what years did Venetta not make a profit?

**Part C** If the model is appropriate, predict the amount of profit Venetta will receive from her franchises in 2020.