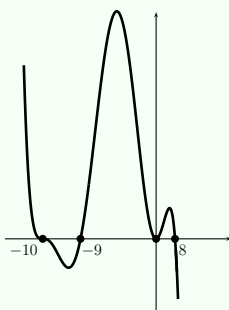our work. Here is the final sketch.


What can be understood from this sketch? Questions like "when is $p(x) > 0$?" can be answered by looking at the sketch. Further, the general shape of the curve is correct so that other properties can be concluded. For example, p has a local minimum between $x = -10$ and $x = -9$ and a local maximum between $x = -9$ and $x = 0$, and between $x = 0$ and $x = 8$. The exact point where the function reaches its maximum or minimum cannot be decided by looking at this sketch. But it will help to decide on an appropriate window so that the minimum or maximum finder on the calculator can be used.   □
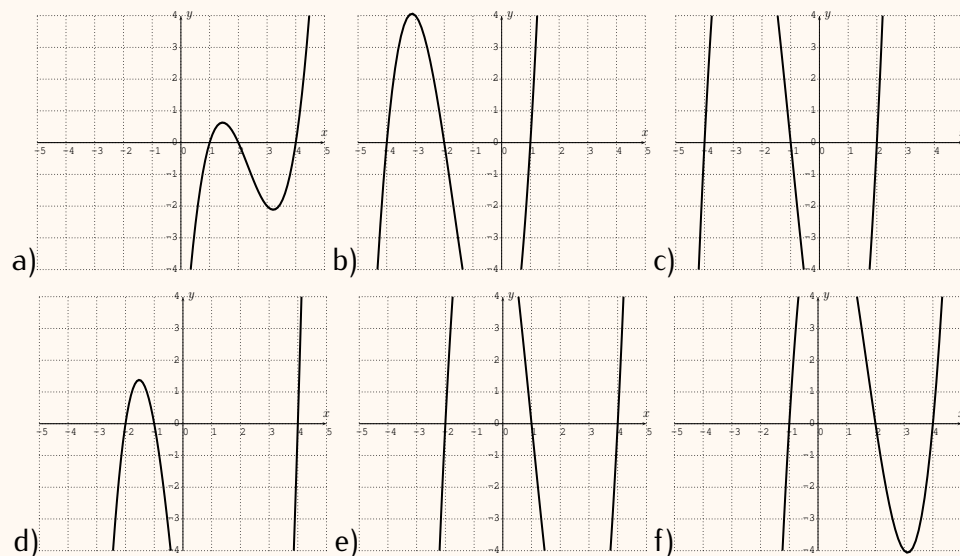
8.4   Exercises

Exercise 8.1

Assuming the graphs below are complete graphs, which of the graphs could be the graphs of a polynomial?
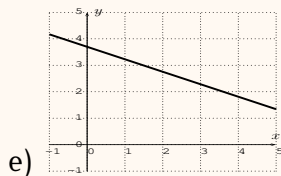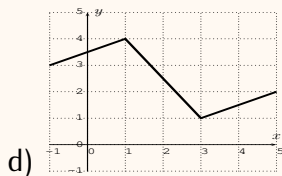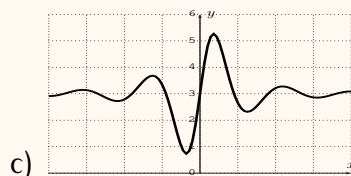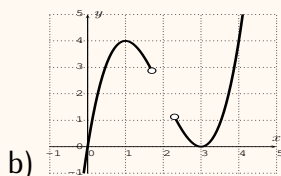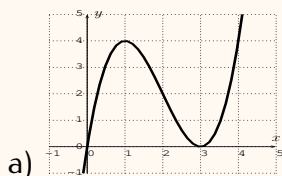
Exercise 8.2

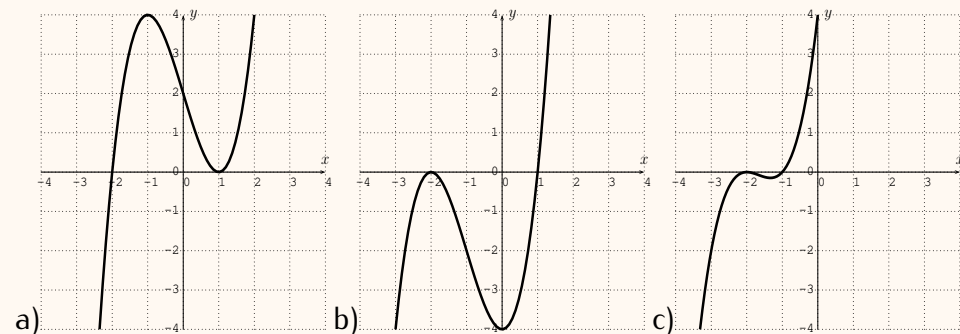For each of the polynomials f, g, h, and k, find the corresponding graph from (a)–(f) below.

$$f(x) = (x - 1) \cdot (x + 2) \cdot (x - 4) \qquad g(x) = (x + 1) \cdot (x - 2) \cdot (x + 4)$$
$$h(x) = (x - 1) \cdot (x - 2) \cdot (x - 4) \qquad k(x) = (x + 1) \cdot (x - 2) \cdot (x - 4)$$

a)

b)

c)

d)

e)

f)

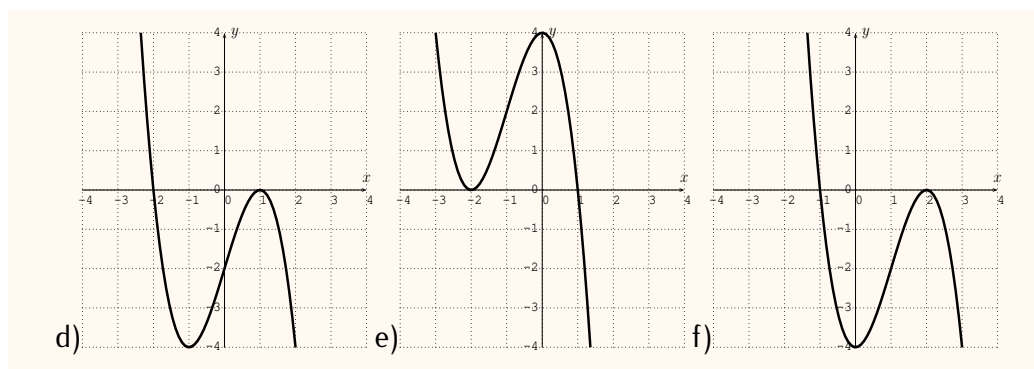## Exercise 8.3

For each of the polynomials f, g, h, and k, find the corresponding graph from (a)–(f) below.

$$f(x) = (x + 1) \cdot (x + 2)^2 \qquad g(x) = -(x + 1) \cdot (x - 2)^2$$
$$h(x) = -(x - 1)^2 \cdot (x + 2) \qquad k(x) = (x - 1) \cdot (x + 2)^2$$

a)

b)

c)

d)

e)

f)

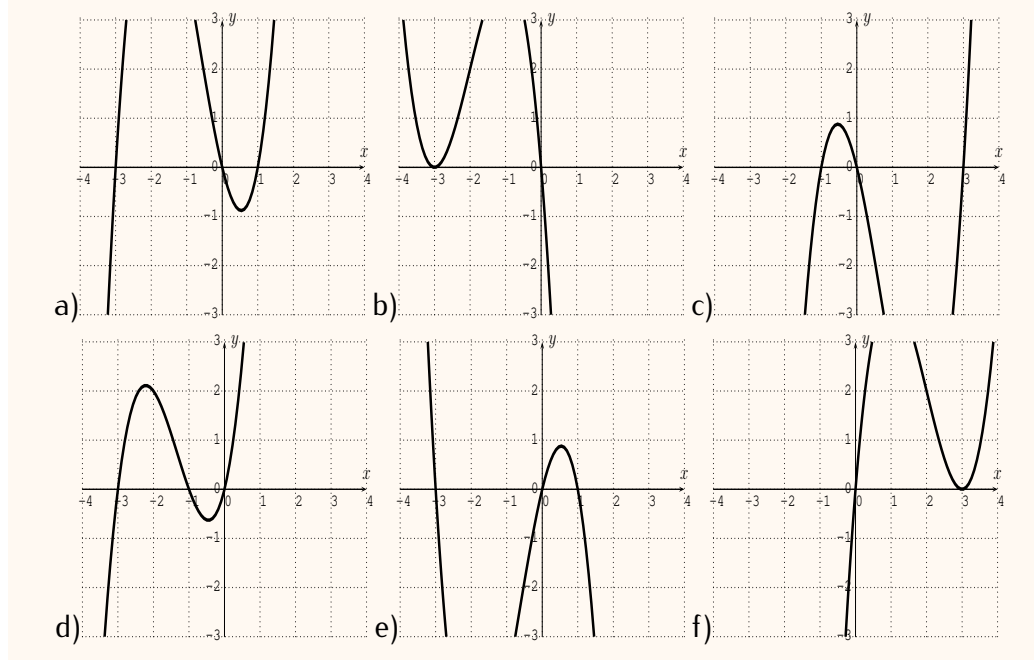## Exercise 8.4

For each of the polynomials f, g, h, and k, find the corresponding graph from (a)–(f) below.

$$f(x) = x^3 + 4x^2 + 3x \qquad g(x) = -x^3 - 2x^2 + 3x$$
$$h(x) = x^2 - 2x^2 - 3x \qquad k(x) = -x^3 - 6x^2 - 9x$$

a)

b)

c)

d)

e)

f)

Exercise 8.5

Sketch a complete the graph of the function. Label all intercepts of the graph.

a) $f(x) = x^3 + 4x^2 + x - 6$
b) $f(x) = 2x^3 - 15x^2 + 34x - 24$
c) $f(x) = x^3 - 16x - 21$
d) $f(x) = -2x^3 - 5x^2 - 2x + 1$
e) $f(x) = x^4 - 7x^3 + 15x^2 - 7x - 6$
f) $f(x) = 3x^4 + 11x^3 - x^2 - 19x + 6$

Exercise 8.6

Find the exact value of at least one root of the given polynomial.

a) $f(x) = x^3 - 10x^2 + 31x - 30$
b) $f(x) = -x^3 - x^2 + 8x + 8$
c) $f(x) = x^3 - 11x^2 - 3x + 33$
d) $f(x) = x^4 + 9x^3 - 6x^2 - 136x - 192$
e) $f(x) = x^2 + 6x + 3$
f) $f(x) = x^4 - 6x^3 + 3x^2 + 5x$

Exercise 8.7

Find all roots and factor the polynomial completely.

a) $f(x) = x^3 - 5x^2 + 2x + 8$
b) $f(x) = x^3 + 7x^2 + 7x - 15$
c) $f(x) = x^3 + 9x^2 + 26x + 24$
d) $f(x) = x^3 + 4x^2 - 11x + 6$
e) $f(x) = 3x^3 + 13x^2 - 52x + 28$
f) $f(x) = 6x^3 - 5x^2 - 13x - 2$
g) $f(x) = 6x^3 - x^2 - 31x - 10$
h) $f(x) = x^3 - 7x^2 + 13x - 3$
i) $f(x) = x^3 + 2x^2 - 11x + 8$
j) $f(x) = 2x^3 + 7x^2 + 5x - 2$
k) $f(x) = 3x^3 - 10x^2 - 4x + 21$

Exercise 8.8

Graph the following polynomials without using the calculator.

  a) $f(x) = (x+4)^2(x-5)$
  b) $f(x) = -3(x+2)^3 x^2(x-4)^5$
  c) $f(x) = 2(x-3)^2(x-5)^3(x-7)$
  d) $f(x) = -(x+4)(x+3)(x+2)^2(x+1)(x-2)^2$