

1. Fill in the blank to correctly complete the following sentence.

A polynomial function with leading term  $4x^5$  has degree \_\_\_\_\_.

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2. Select the correct choice that completes the sentence below.

The lowest point on the graph of a parabola that opens up is the (1) \_\_\_\_\_ of the parabola.

- (1) ☐ domain  
☐ axis of symmetry  
☐ range  
☐ vertex
- 

3. Select the correct choice that completes the sentence below.

The highest point on the graph of a parabola that opens down is the (1) \_\_\_\_\_ of the parabola.

- (1) ☐ domain  
☐ axis of symmetry  
☐ range  
☐ vertex
- 

4. Fill in the blank to correctly complete the following sentence.

The axis of symmetry of the graph of  $f(x) = 4(x + 5)^2 - 8$  has equation \_\_\_\_\_.

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5. Fill in the blank to correctly complete the following sentence.

The vertex of the graph of  $f(x) = x^2 + 2x + 7$  has x-coordinate \_\_\_\_\_.  
(Type an integer or a simplified fraction.)

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6. Fill in the blanks to correctly complete the following sentence.

The graph of  $f(x) = -8x^2 - 3x + 7$  opens down with y-intercept  $(0, \text{_____})$ , so it has (1) \_\_\_\_\_ x-intercept(s).

- (1) ☐ one  
☐ no  
☐ two
-

7. Match the following equation with the description of the parabola that is its graph.

$$y = (x + 9)^2 + 8$$

Choose the correct answer below.

- ☐ A. The parabola  $y = (x + 9)^2 + 8$  has vertex  $(9, 8)$  and opens down.
- ☐ B. The parabola  $y = (x + 9)^2 + 8$  has vertex  $(-9, -8)$  and opens down.
- ☐ C. The parabola  $y = (x + 9)^2 + 8$  has vertex  $(9, 8)$  and opens up.
- ☐ D. The parabola  $y = (x + 9)^2 + 8$  has vertex  $(-9, 8)$  and opens up.
- ☐ E. The parabola  $y = (x + 9)^2 + 8$  has vertex  $(-9, -8)$  and opens up.
- ☐ F. The parabola  $y = (x + 9)^2 + 8$  has vertex  $(9, -8)$  and opens up.
- ☐ G. The parabola  $y = (x + 9)^2 + 8$  has vertex  $(9, -8)$  and opens down.
- ☐ H. The parabola  $y = (x + 9)^2 + 8$  has vertex  $(-9, 8)$  and opens down.

8. Match the following equation with the description of the parabola that is its graph.

$$y = (x + 7)^2 + 8$$

Choose the correct answer below.

- ☐ A. The parabola  $y = (x + 7)^2 + 8$  has vertex  $(-7, 8)$  and opens down.
- ☐ B. The parabola  $y = (x + 7)^2 + 8$  has vertex  $(-7, -8)$  and opens up.
- ☐ C. The parabola  $y = (x + 7)^2 + 8$  has vertex  $(7, -8)$  and opens down.
- ☐ D. The parabola  $y = (x + 7)^2 + 8$  has vertex  $(-7, -8)$  and opens down.
- ☐ E. The parabola  $y = (x + 7)^2 + 8$  has vertex  $(7, 8)$  and opens down.
- ☐ F. The parabola  $y = (x + 7)^2 + 8$  has vertex  $(7, 8)$  and opens up.
- ☐ G. The parabola  $y = (x + 7)^2 + 8$  has vertex  $(7, -8)$  and opens up.
- ☐ H. The parabola  $y = (x + 7)^2 + 8$  has vertex  $(-7, 8)$  and opens up.

9. Match the following equation with the description of the parabola that is its graph.

$$y = -(x + 7)^2 + 3$$

Choose the correct answer below.

- ☐ A. The parabola  $y = -(x + 7)^2 + 3$  has vertex  $(7, 3)$  and opens up.
- ☐ B. The parabola  $y = -(x + 7)^2 + 3$  has vertex  $(-7, -3)$  and opens up.
- ☐ C. The parabola  $y = -(x + 7)^2 + 3$  has vertex  $(7, -3)$  and opens down.
- ☐ D. The parabola  $y = -(x + 7)^2 + 3$  has vertex  $(-7, 3)$  and opens down.
- ☐ E. The parabola  $y = -(x + 7)^2 + 3$  has vertex  $(-7, -3)$  and opens down.
- ☐ F. The parabola  $y = -(x + 7)^2 + 3$  has vertex  $(7, 3)$  and opens down.
- ☐ G. The parabola  $y = -(x + 7)^2 + 3$  has vertex  $(-7, 3)$  and opens up.
- ☐ H. The parabola  $y = -(x + 7)^2 + 3$  has vertex  $(7, -3)$  and opens up.

10. Match the following equation with the description of the parabola that is its graph.

$$y = -(x + 6)^2 + 9$$

Choose the correct answer below.

- ☐ A. The parabola  $y = -(x + 6)^2 + 9$  has vertex  $(-6, 9)$  and opens up.
- ☐ B. The parabola  $y = -(x + 6)^2 + 9$  has vertex  $(-6, -9)$  and opens up.
- ☐ C. The parabola  $y = -(x + 6)^2 + 9$  has vertex  $(-6, -9)$  and opens down.
- ☐ D. The parabola  $y = -(x + 6)^2 + 9$  has vertex  $(6, 9)$  and opens down.
- ☐ E. The parabola  $y = -(x + 6)^2 + 9$  has vertex  $(6, 9)$  and opens up.
- ☐ F. The parabola  $y = -(x + 6)^2 + 9$  has vertex  $(6, -9)$  and opens up.
- ☐ G. The parabola  $y = -(x + 6)^2 + 9$  has vertex  $(-6, 9)$  and opens down.
- ☐ H. The parabola  $y = -(x + 6)^2 + 9$  has vertex  $(6, -9)$  and opens down.

11. For the given equation and graph of the quadratic function, do the following.

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

a. Give the domain and range.

The domain is \_\_\_\_\_.  
(Type your answer in interval notation.)

The range is \_\_\_\_\_.  
(Type your answer in interval notation.)

b. Give coordinates of the vertex.

The vertex is \_\_\_\_\_.  
(Type an ordered pair.)

c. Give the equation of the axis of symmetry.

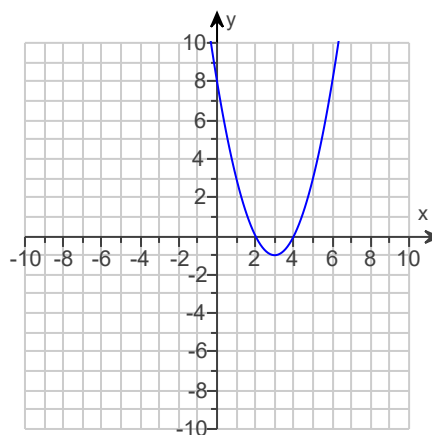
The axis of symmetry is  $x =$  \_\_\_\_\_.

d. Find the y-intercept(s).

The y-intercept(s) is/are \_\_\_\_\_.  
(Type an ordered pair. Use a comma to separate answers as needed.)

e. Find the x-intercept(s).

The x-intercept(s) is/are \_\_\_\_\_.  
(Type an ordered pair. Use a comma to separate answers as needed.)



12. For the given equation and graph of the quadratic function, do each of the following.

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

- a. Give the domain and range.

The domain is \_\_\_\_\_.  
(Type your answer in interval notation.)

The range is \_\_\_\_\_.  
(Type your answer in interval notation.)

- b. Give the coordinates of the vertex.

The vertex is \_\_\_\_\_.  
(Type an ordered pair.)

- c. Give the equation of the axis of symmetry.

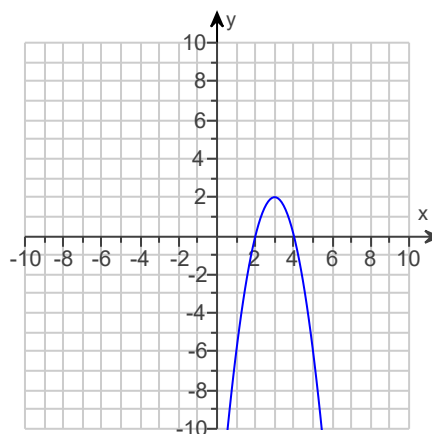
The axis of symmetry is  $x =$  \_\_\_\_\_.

- d. Find the y-intercept(s).

The y-intercept(s) is/are \_\_\_\_\_.  
(Type an ordered pair. Use a comma to separate answers as needed.)

- e. Find the x-intercept(s).

The x-intercept(s) is/are \_\_\_\_\_.  
(Type an ordered pair. Use a comma to separate answers as needed.)

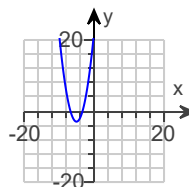


13. Choose the graph that represents the function.

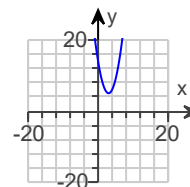
$$f(x) = (x - 3)^2 - 5$$

Choose the correct graph from the choices on the right.

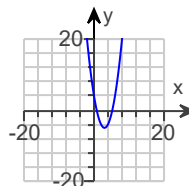
☐ A.



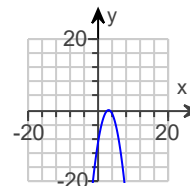
☐ B.



☐ C.



☐ D.

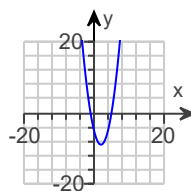


14. Choose the graph that correctly represents the function.

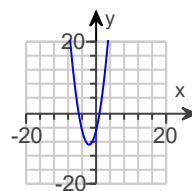
$$f(x) = (x + 2)^2 - 9$$

Choose the correct graph from the choices on the right.

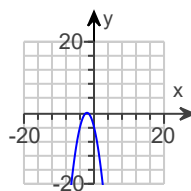
☐ A.



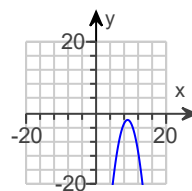
☐ B.



☐ C.



☐ D.



15. Graph the quadratic function  $f(x) = (x + 4)^2 - 2$ . Give the (a) vertex, (b) axis, (c) domain, and (d) range. Then determine (e) the largest open interval of the domain over which the function is increasing and (f) the largest open interval over which the function is decreasing.

(a) The vertex is \_\_\_\_\_.  
(Type an ordered pair.)

Use the graphing tool to graph the function.

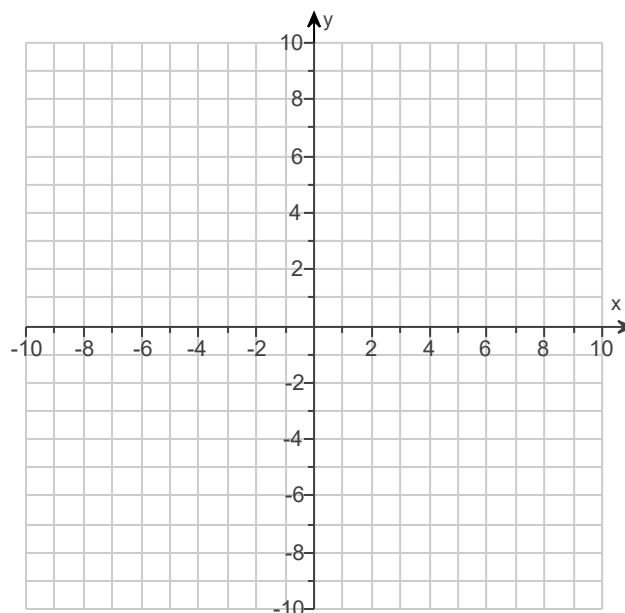
(b) The axis is \_\_\_\_\_.  
(Type an equation.)

(c) The domain is \_\_\_\_\_.  
(Type your answer in interval notation.)

(d) The range is \_\_\_\_\_.  
(Type your answer in interval notation.)

(e) The largest open interval of the domain over which the function is increasing is \_\_\_\_\_.  
(Type your answer in interval notation.)

(f) The largest open interval over which the function is decreasing is \_\_\_\_\_.  
(Type your answer in interval notation.)



16. Graph the quadratic function  $f(x) = -\frac{1}{4}(x + 2)^2 - 3$ . Give the (a) vertex, (b) axis, (c) domain, and (d) range. Then determine (e) the largest open interval of the domain over which the function is increasing and (f) the largest open interval over which the function is decreasing.

(a) The vertex is \_\_\_\_\_.  
(Type an ordered pair.)

Use the graphing tool to graph the function.

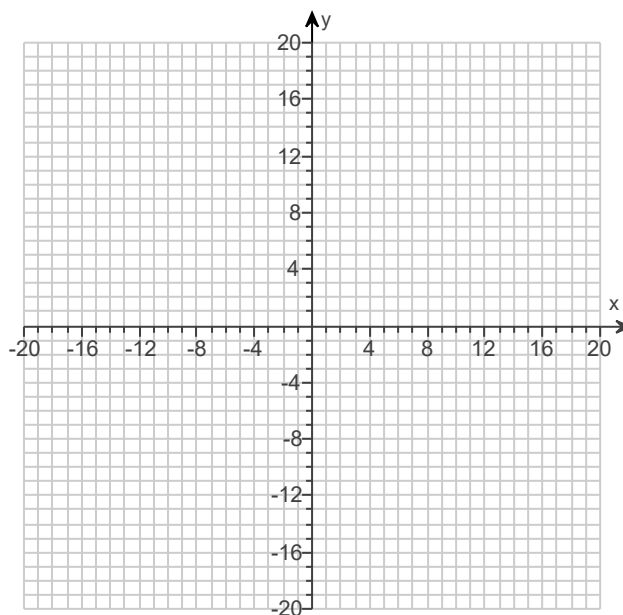
(b) The axis is \_\_\_\_\_.  
(Type an equation.)

(c) The domain is \_\_\_\_\_.  
(Type your answer in interval notation.)

(d) The range is \_\_\_\_\_.  
(Type your answer in interval notation.)

(e) The largest open interval of the domain over which the function is increasing is \_\_\_\_\_.  
(Type your answer in interval notation.)

(f) The largest open interval over which the function is decreasing is \_\_\_\_\_.  
(Type your answer in interval notation.)



17. Graph the quadratic function  $f(x) = x^2 - 10x + 24$ . Give the (a) vertex, (b) axis, (c) domain, and (d) range. Then determine (e) the largest open interval of the domain over which the function is increasing and (f) the largest open interval over which the function is decreasing.

(a) The vertex is \_\_\_\_\_.  
(Type an ordered pair.)

Use the graphing tool to graph the function.

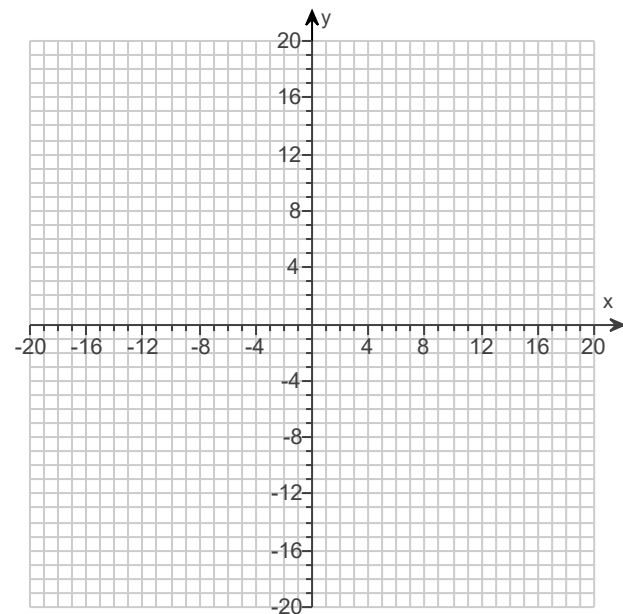
(b) The axis is \_\_\_\_\_.  
(Type an equation.)

(c) The domain is \_\_\_\_\_.  
(Type your answer in interval notation.)

(d) The range is \_\_\_\_\_.  
(Type your answer in interval notation.)

(e) The largest open interval of the domain over which the function is increasing is \_\_\_\_\_.  
(Type your answer in interval notation.)

(f) The largest open interval over which the function is decreasing is \_\_\_\_\_.  
(Type your answer in interval notation.)



18. Graph the quadratic function  $f(x) = -2x^2 - 16x - 30$ . Give the (a) vertex, (b) axis, (c) domain, and (d) range. Then determine (e) the largest open interval of the domain over which the function is increasing and (f) the largest open interval over which the function is decreasing.

(a) The vertex is \_\_\_\_\_.  
(Type an ordered pair.)

Use the graphing tool to graph the function.

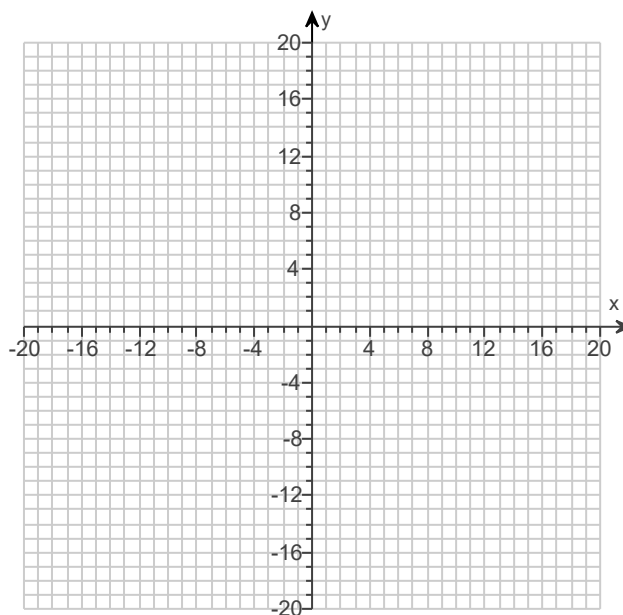
(b) The axis is \_\_\_\_\_.  
(Type an equation.)

(c) The domain is \_\_\_\_\_.  
(Type your answer in interval notation.)

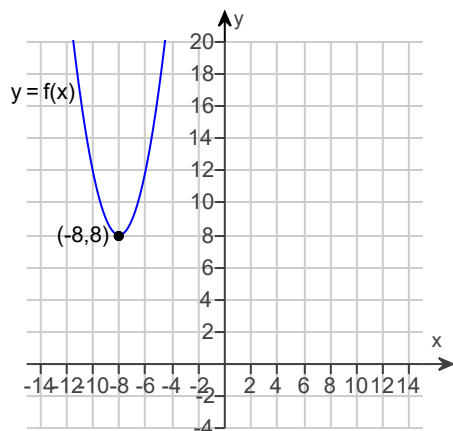
(d) The range is \_\_\_\_\_.  
(Type your answer in interval notation.)

(e) The largest open interval of the domain over which the function is increasing is \_\_\_\_\_.  
(Type your answer in interval notation.)

(f) The largest open interval over which the function is decreasing is \_\_\_\_\_.  
(Type your answer in interval notation.)

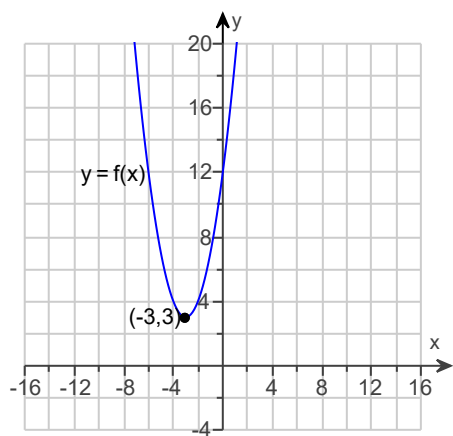


19. The figure shows the graph of a quadratic function  $y = f(x)$ . Use it to find the minimum value of  $f(x)$ .



The minimum value of  $f(x)$  is \_\_\_\_\_.  
(Type an integer or a fraction.)

20. The figure shows the graph of a quadratic function  $y = f(x)$ .



How many real solutions are there of the equation  $f(x) = 2$ ?

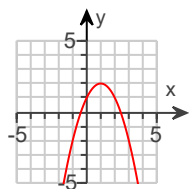
Choose the correct answer below.

- ☐ A. One  
☐ B. Two  
☐ C. None

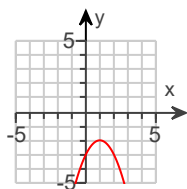
21. If  $a < 0$  and  $b^2 - 4ac < 0$ , determine the possible corresponding graph of  $f(x) = ax^2 + bx + c$ .

Choose the possible corresponding graph of  $f(x) = ax^2 + bx + c$ , where  $a < 0$  and  $b^2 - 4ac < 0$ .

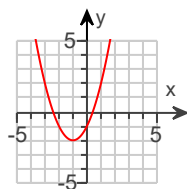
☐ A.



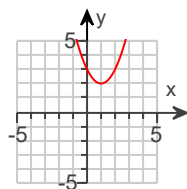
☐ B.



☐ C.



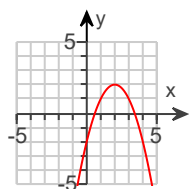
☐ D.



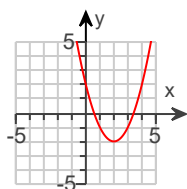
22. If  $a > 0$  and  $b^2 - 4ac > 0$ , determine the possible corresponding graph of  $f(x) = ax^2 + bx + c$ .

Choose the possible corresponding graph of  $f(x) = ax^2 + bx + c$ , where  $a > 0$  and  $b^2 - 4ac > 0$ .

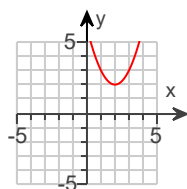
☐ A.



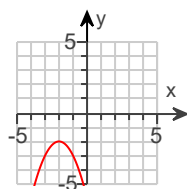
☐ B.



☐ C.



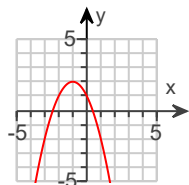
☐ D.



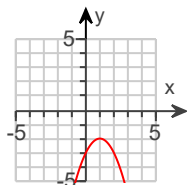
23. If  $a > 0$  and  $b^2 - 4ac < 0$ , determine the possible corresponding graph of  $f(x) = ax^2 + bx + c$ .

Choose the possible corresponding graph of  $f(x) = ax^2 + bx + c$ , where  $a > 0$  and  $b^2 - 4ac < 0$ .

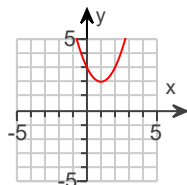
☐ A.



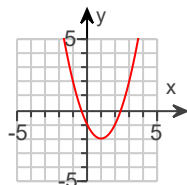
☐ B.



☐ C.

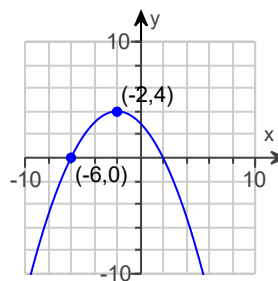


☐ D.



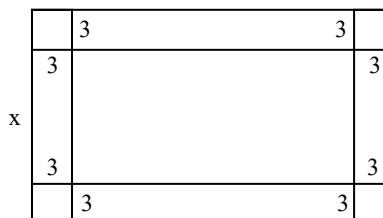


24. Find a quadratic function  $f$  whose graph matches the one in the figure.



$f(x) = \underline{\hspace{2cm}} (x + \underline{\hspace{2cm}})^2 + \underline{\hspace{2cm}}$   
(Simplify your answer. Use integers or fractions for any numbers in the expression.)

25. A piece of cardboard is 2.6 times as long as it is wide. It is to be made into a box with an open top by cutting 3-inch squares from each corner and folding up the sides. Let  $x$  represent the width (in inches) of the original piece of cardboard. Answer the following questions.



- a) Represent the length of the original piece of cardboard in terms of  $x$ .

Length =  $\underline{\hspace{2cm}}$  in.  
(Use integers or decimals for any numbers in the expression.)

- b) Give the restrictions on  $x$ . What will be the dimensions of the bottom rectangular base of the box?

The restriction on  $x$  will be  $\underline{\hspace{2cm}}$ . (Type an inequality.)

The length will be  $(\underline{\hspace{2cm}})$  in. and the width will be  $(\underline{\hspace{2cm}})$  in.  
(Type expressions using  $x$  as the variable. Use integers or decimals for any numbers in the expressions.)

- c) Determine a function  $V$  that represents the volume of the box in terms of  $x$ .

$V = (\underline{\hspace{2cm}})$  in.<sup>3</sup>  
(Simplify your answer. Use integers or decimals for any numbers in the expression.)

- d) For what dimensions of the bottom of the box will the volume be 520 in.<sup>3</sup>?

The length will be  $\underline{\hspace{2cm}}$  in. and the width will be  $\underline{\hspace{2cm}}$  in.  
(Round to the nearest tenth as needed.)

- e) Find the values of  $x$  if such a box is to have a volume between 600 and 800 in.<sup>3</sup>.

Between which two values must  $x$  be in order to produce this range of volumes?

$\underline{\hspace{2cm}}$   
(Use a comma to separate answers as needed. Round to the nearest tenth as needed.)

26. Find two numbers whose sum is 22 and whose product is the maximum possible value.

What two numbers yield this product?

$\underline{\hspace{2cm}}$   
(Use a comma to separate answers.)

27. Fill in the blanks to correctly complete the sentence.

In arithmetic, the result of the division shown below can be written  $11 = 5 \cdot \underline{\hspace{2cm}} + \underline{\hspace{2cm}}$ .

$$\begin{array}{r} 2 \\ 5 \overline{)11} \\ \underline{10} \\ 1 \end{array}$$

28. Fill in the blanks to correctly complete the sentence.

In algebra, the result of the division shown below can be written  $x^2 + 2x + 2 = (x - 3) \cdot (\underline{\hspace{2cm}}) + \underline{\hspace{2cm}}$ .

$$\begin{array}{r} x + 5 \\ x - 3 \overline{)x^2 + 2x + 2} \\ \underline{x^2 - 3x} \phantom{+ 2} \\ 5x + 2 \\ \underline{5x - 15} \\ 17 \end{array}$$

29. Fill in the blanks to correctly complete the sentence.

To perform the division  $x - 3 \overline{)x^2 + 2x + 1}$ , begin by writing the synthetic division problem shown below.

$$\underline{\hspace{2cm}} \overline{) \hspace{1cm} \hspace{1cm} \hspace{1cm} 2 \hspace{1cm} 1}$$

30. Fill in the blanks to correctly complete the sentence.

To perform the division  $x + 5 \overline{)x^3 + 3x + 3}$ , begin by writing the synthetic division problem shown below.

$$\underline{\hspace{2cm}} \overline{) 1 \hspace{1cm} \hspace{1cm} \hspace{1cm} 3 \hspace{1cm} 3}$$

31. Fill in the blanks to correctly complete the sentence.

To perform the division  $x - 1 \overline{)x^3 + 3x^2 + 5x}$ , begin by writing the synthetic division problem shown below.

$$\underline{\hspace{2cm}} \overline{) 1 \hspace{1cm} \hspace{1cm} \hspace{1cm} 5 \hspace{1cm} \hspace{1cm}}$$

32. Use synthetic division to perform the division.

$$\frac{x^3 + 4x^2 + 8x + 5}{x + 1}$$

$$\frac{x^3 + 4x^2 + 8x + 5}{x + 1} = \underline{\hspace{2cm}}$$

(Simplify your answer.)

33. Use synthetic division to perform the division.

$$\begin{array}{r} -6x^3 + 8x^2 - 9x + 4 \\ x - 2 \end{array}$$

$$\frac{-6x^3 + 8x^2 - 9x + 4}{x - 2} = \underline{\hspace{2cm}} \text{ (Simplify your answer.)}$$

34. Use synthetic division to decide whether the given number  $k$  is a zero of the polynomial function. If it is not, give the value of  $f(k)$ .

$$f(x) = x^2 - 7x + 10; k = 5$$

Is 5 a zero of the function? Select the correct choice below and, if necessary, fill in the answer box to complete your choice.

- ☐ A. The given  $k$  is not a zero of the polynomial function.  $f(5) = \underline{\hspace{2cm}}$ .
- ☐ B. The given  $k$  is a zero of the polynomial function.

35. Use synthetic division to decide whether the given number  $k$  is a zero of the polynomial function. If it is not, give the value of  $f(k)$ .

$$f(x) = 5x^3 - 7x^2 - 16x + 15; k = 1$$

Is 1 a zero of the function? Select the correct choice below and, if necessary, fill in the answer box to complete your choice.

- ☐ A. The given  $k$  is not a zero of the polynomial function.  $f(1) = \underline{\hspace{2cm}}$ .
- ☐ B. The given  $k$  is a zero of the polynomial function.

36. Decide whether the following statement is true or false. If false, tell why.

Since  $x - 1$  is a factor of  $f(x) = x^6 - x^4 + 2x^2 - 2$ , we can conclude that  $f(1) = 0$ .

Is the statement true or false?

- ☐ A. The statement is true.
- ☐ B. The statement is false because since  $x - 1$  is a factor of  $f(x) = x^6 - x^4 + 2x^2 - 2$ , we can conclude that  $f(0) = 1$ .
- ☐ C. The statement is false because since  $x - 1$  is a factor of  $f(x) = x^6 - x^4 + 2x^2 - 2$ , we can conclude that  $f(-1) = 0$ .

37. Determine whether the following statement is true or false. If false, explain why.

Because  $f(1) = 0$  for  $f(x) = x^6 - x^4 + 11x^2 - 11$ , we can conclude that  $x - 1$  is a factor of  $f(x)$ .

Is the statement true or false?

- ☐ A. The statement is true.
- ☐ B. The statement is false. Because  $f(1) = 0$  for  $f(x) = x^6 - x^4 + 11x^2 - 11$ , we can conclude that  $x$  is a factor of  $f(x)$ , not  $x - 1$ .
- ☐ C. The statement is false. Because  $f(1) = 0$  for  $f(x) = x^6 - x^4 + 11x^2 - 11$ , we can conclude that  $1$  is a factor of  $f(x)$ , not  $x - 1$ .
- ☐ D. The statement is false. Because  $f(1) = 0$  for  $f(x) = x^6 - x^4 + 11x^2 - 11$ , we can conclude that  $x + 1$  is a factor of  $f(x)$ , not  $x - 1$ .

38. Decide whether the following statement is true or false. If false, tell why.

For  $f(x) = (x + 7)^5(x - 8)$ ,  $-7$  is a zero of multiplicity 5.

Choose the correct answer below.

- ☐ A. The statement is false because  $-7$  is a zero of multiplicity \_\_\_\_\_.
- ☐ B. The statement is false because  $-7$  is not a zero of  $f(x)$ .
- ☐ C. The statement is true.

39. Determine whether the following statement is true or false. If false, explain why.

Because  $2 + 3i$  is a zero of  $f(x) = x^2 - 4x + 13$ , we can conclude that  $2 - 3i$  is also a zero.

Is the statement true or false?

- ☐ A. The statement is false. Because  $2 + 3i$  is a zero of  $f(x) = x^2 - 4x + 13$ , we can conclude that  $-2 - 3i$  is a zero, not  $2 - 3i$ .
- ☐ B. The statement is true.
- ☐ C. The statement is false. Because  $2 + 3i$  is a zero of  $f(x) = x^2 - 4x + 13$ , we can conclude that  $-2 + 3i$  is a zero, not  $2 - 3i$ .
- ☐ D. The statement is false. Because  $2 + 3i$  is a zero of  $f(x) = x^2 - 4x + 13$ , we can conclude that  $-3 + 2i$  is a zero, not  $2 - 3i$ .

40. Determine whether the following statement is true or false. If false, explain why.

A polynomial function having degree 2 and only real coefficients may have no real zeros.

Is the statement true or false?

- ☐ A. The statement is false. A polynomial function having a degree of 2 and only real coefficients must have at least two real zeros.
- ☐ B. The statement is true.
- ☐ C. The statement is false. A polynomial function having a degree of 2 and only real coefficients must have at least one real zero.
- ☐ D. The statement is false. A polynomial function having a degree of 2 and only real coefficients must have at least three real zeros.

41. Use the factor theorem and synthetic division to decide whether the second polynomial is a factor of the first.

$$x^3 + 10x^2 + 19x - 30; x + 6$$

Is  $x + 6$  a factor of  $x^3 + 10x^2 + 19x - 30$ ?

- ☐ Yes  
☐ No

42. Use the factor theorem and synthetic division to decide whether the second polynomial is a factor of the first.

$$-x^3 + 3x - 2; x + 2$$

Is  $x + 2$  a factor of  $-x^3 + 3x - 2$ ?

- ☐ Yes  
☐ No

43. Factor  $f(x)$  into linear factors given that  $k$  is a zero of  $f(x)$ .

$$f(x) = 3x^3 + 10x^2 - 43x + 30; k = 1$$

$f(x) =$  \_\_\_\_\_ (Factor completely.)

44. Factor  $f(x) = 3x^3 + x^2 - 20x + 12$  into linear factors given that  $-3$  is a zero of  $f(x)$ .

$$f(x) = 3x^3 + x^2 - 20x + 12 = \text{_____}$$

(Factor completely.)

45. Factor  $f(x)$  into linear factors given that  $k$  is a zero of  $f(x)$ .

$$f(x) = x^4 + 3x^3 - 20x^2 - 84x - 80; k = -2 \text{ (multiplicity 2)}$$

In completely factored form,  $f(x) =$  \_\_\_\_\_. (Factor completely.)

46. Given that 5 is a zero of the polynomial function  $f(x)$ , find the remaining zeros.

$$f(x) = x^3 - 11x^2 + 43x - 65$$

List the remaining zeros (other than 5).

\_\_\_\_\_  
(Simplify your answer. Type an exact answer, using radicals and  $i$  as needed. Use a comma to separate answers as needed.)

47. For the following function, one zero is given. Find all the others.

$$f(x) = x^3 - 11x^2 + 41x - 51; 4 - i$$

The zeros of  $f(x)$  are  $4 - i$ , \_\_\_\_\_, and \_\_\_\_\_.

(Simplify your answers. Type any nonreal complex zeros first. Type exact answers, using radicals and  $i$  as needed.)

48. For the polynomial function, **(a)** list all possible rational zeros, **(b)** find all rational zeros, and **(c)** factor  $f(x)$ .

$$f(x) = x^3 + 7x^2 + 7x - 15$$

**(a)** Determine the possible rational zeros for  $f(x)$ . Choose the correct answer below.

- ☐ A. 1, 3, 5, 15                      ☐ B.  $\pm 1, \pm 3, \pm 5, \pm 15$   
☐ C. 1, -3, -5                      ☐ D.  $\pm 1, \pm 3, \pm 5$

**(b)** Determine the rational zeros for  $f(x)$ . Choose the correct answer below.

- ☐ A. 1, -3, -5                      ☐ B. 1  
☐ C.  $\pm 1, \pm 3, \pm 5, \pm 15$                       ☐ D. -1, 3, 5

**(c)** The factored form of  $f(x) = x^3 + 7x^2 + 7x - 15$  is  $f(x) = \underline{\hspace{2cm}}$ .  
(Simplify your answer. Factor completely. Use integers or fractions for any numbers in the expression.)

49. For the polynomial function, **(a)** list all possible rational zeros, **(b)** find all rational zeros, and **(c)** factor  $f(x)$ .

$$f(x) = 10x^3 + 241x^2 - 223x + 50$$

**(a)** Determine the possible rational zeros for  $f(x)$ . Choose the correct answer below.

- ☐ A.  $1, 5, 2, 25, 10, 50, \frac{1}{5}, \frac{1}{2}, \frac{1}{10}, \frac{5}{2}, \frac{25}{2}, \frac{2}{5}$   
☐ B.  $\pm 1, \pm 5, \pm 2, \pm 25, \pm 10, \pm \frac{1}{5}, \pm \frac{1}{2}, \pm \frac{1}{10}, \pm \frac{5}{2}, \pm \frac{25}{2}, \pm \frac{2}{5}$   
☐ C.  $-25, \frac{1}{2}, \frac{2}{5}$   
☐ D.  $\pm 1, \pm 5, \pm 2, \pm 25, \pm 10, \pm 50, \pm \frac{1}{5}, \pm \frac{1}{2}, \pm \frac{1}{10}, \pm \frac{5}{2}, \pm \frac{25}{2}, \pm \frac{2}{5}$

**(b)** Determine the rational zeros for  $f(x)$ . Choose the correct answer below.

- ☐ A. -25  
☐ B.  $25, \frac{1}{2}, \frac{2}{5}$   
☐ C.  $\pm 1, \pm 5, \pm 2, \pm 25, \pm 10, \pm 50, \pm \frac{1}{5}, \pm \frac{1}{2}, \pm \frac{1}{10}, \pm \frac{5}{2}, \pm \frac{25}{2}, \pm \frac{2}{5}$   
☐ D.  $-25, \frac{1}{2}, \frac{2}{5}$

**(c)** The factored form of  $f(x) = 10x^3 + 241x^2 - 223x + 50$  is  $f(x) = \underline{\hspace{2cm}}$ .  
(Simplify your answer. Factor completely. Use integers or fractions for any numbers in the expression.)

50. For the following polynomial function, find all zeros and their multiplicities.

$$f(x) = (x - 5)^4 (x^2 - 2)$$

Choose the correct answer below.

- ☐ A. 5 (multiplicity 4),  $\sqrt{2}$ ,  $-\sqrt{2}$   
☐ B. -5 (multiplicity 4),  $\sqrt{2}$ ,  $-\sqrt{2}$   
☐ C. -2 (multiplicity 2),  $\sqrt{5}$ ,  $-\sqrt{5}$   
☐ D. 2 (multiplicity 2),  $\sqrt{5}$ ,  $-\sqrt{5}$

51. Find all zeros of the function  $f(x) = 5(x - 3)^2(2x + 1)(x^2 - 1)$  and their multiplicities.

Choose the zeros of  $f(x)$  and their multiplicities.

- ☐ A. 3(multiplicity 2),  $-\frac{1}{2}$ , 1(multiplicity 2)  
☐ B. 3,  $\frac{1}{2}$ , 1, -1  
☐ C. 3(multiplicity 2),  $-\frac{1}{2}$ , 1, -1  
☐ D. -5, 3(multiplicity 2),  $-\frac{1}{2}$ , 1, -1

52. Find a polynomial of degree 3 with real coefficients and zeros of -3, -1, and 4, for which  $f(-2) = 12$ .

$f(x) =$  \_\_\_\_\_  
(Simplify your answer. Do not factor.)

53. Find a polynomial equation with real coefficients that has the given zeros.

$$1 - 5i \text{ and } 1 + 5i$$

The equation is  $x^2 -$  \_\_\_\_\_  $x +$  \_\_\_\_\_  $= 0$ .

54. Find a polynomial function  $f(x)$  of least degree having only real coefficients with zeros of 0,  $3i$ , and  $4 + i$ .

The polynomial function is  $f(x) =$  \_\_\_\_\_.

55. Find a polynomial function of least degree having only real coefficients, a leading coefficient of 1, and zeros of 3 and  $5 + i$ .

The polynomial function is  $f(x) =$  \_\_\_\_\_.  
(Simplify your answer.)

56. Find all complex zeros of the polynomial function. Give exact values. List multiple zeros as necessary.

$$f(x) = x^4 - 8x^3 - 30x^2 + 400x - 875$$

All complex zeros are \_\_\_\_\_.

(Simplify your answer. Type an exact answer, using radicals and  $i$  as needed. Use a comma to separate answers as needed.)

57. Find all complex zeros of the polynomial function. Give exact values. List multiple zeros as necessary.

$$f(x) = 2x^5 + 15x^4 + 29x^3 + 24x^2 + 80x$$

All complex zeros are \_\_\_\_\_.

(Type an exact answer, using radicals and  $i$  as needed. Use a comma to separate answers as needed.)

58. Find all complex zeros of the polynomial function. Give exact values. List multiple zeros as necessary.

$$f(x) = 7x^4 - 6x^3 + 174x^2 - 150x - 25$$

What are the complex zeros of  $f(x)$ ?

\_\_\_\_\_  
(Type an exact answer, using radicals and  $i$  as needed. Use integers or fractions for any numbers in the expression. Use a comma to separate answers as needed.)

59. Find all complex zeros of the polynomial function. Give exact values. List multiple zeros as necessary.

$$f(x) = x^4 + 25x^2 + 144$$

All complex zeros are \_\_\_\_\_.

(Type an exact answer, using radicals and  $i$  as needed. Use a comma to separate answers as needed.)

60. Find all complex zeros of the polynomial function. Give exact values. List multiple zeros as necessary.

$$f(x) = x^4 + 53x^2 + 196$$

All complex zeros are \_\_\_\_\_.

(Type an exact answer, using radicals and  $i$  as needed. Use a comma to separate answers as needed.)

61. Find all complex zeros of the polynomial function. Give exact values. List multiple zeros as necessary.

$$f(x) = x^4 - 14x^3 + 47x^2$$

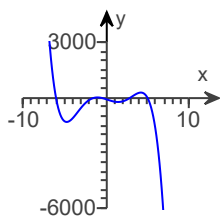
All complex zeros are \_\_\_\_\_.

(Simplify your answer. Type an exact answer, using radicals and  $i$  as needed. Use a comma to separate answers as needed.)

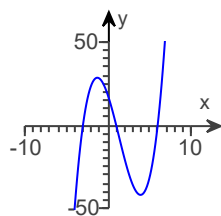
62. Which one of the graphs is that of  $x^3 - 4x^2 - 15x + 18$ ?

Choose the correct answer below.

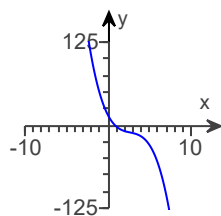
☐ A.



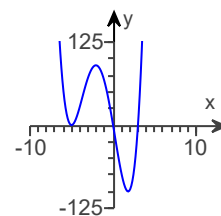
☐ B.



☐ C.



☐ D.

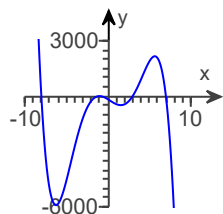




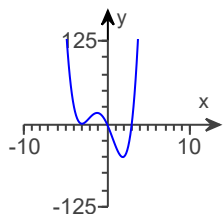
63. Which one of the graphs is that of  $x^4 + 3x^3 - 9x^2 - 27x$ ?

Choose the correct answer below.

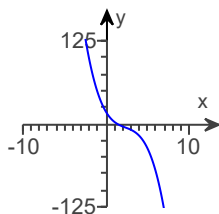
☐ A.



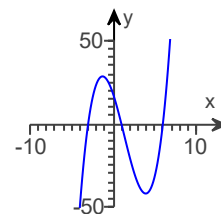
☐ B.



☐ C.

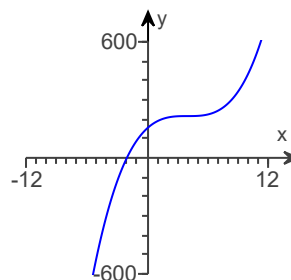


☐ D.



64. The comprehensive graph of a polynomial function  $y = f(x)$  is shown.

How many real zeros does the function  $f$  have?

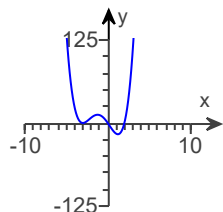


The function  $f$  has \_\_\_\_\_ real zero(s).

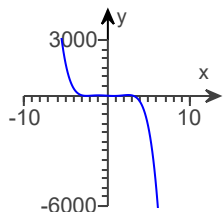
65. Which one of the graphs is that of  $-x^3 + 10x^2 - 30x + 19$ ?

Choose the correct answer below.

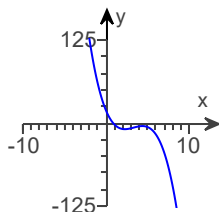
☐ A.



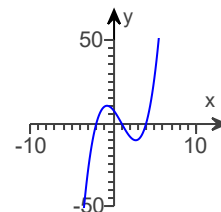
☐ B.



☐ C.

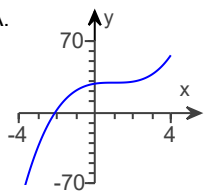


☐ D.

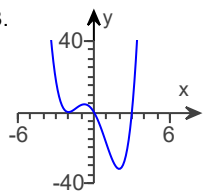


66. The comprehensive graphs of four polynomial functions are shown in A-D.

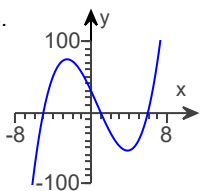
A.



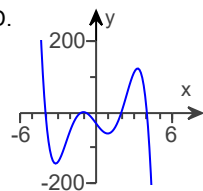
B.



C.



D.



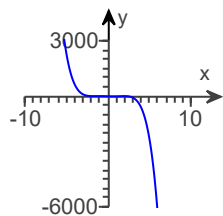
Which of the graphs cannot be that of a cubic polynomial function?

The graph(s) in \_\_\_\_\_ cannot be the graph of a cubic polynomial function.  
(Type A, B, C, or D. Use commas to separate answers as needed.)

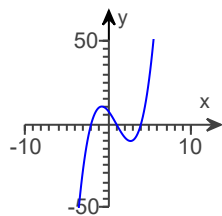
67. Which one of the graphs is that of a function whose range is not  $(-\infty, \infty)$ ?

Choose the correct answer below.

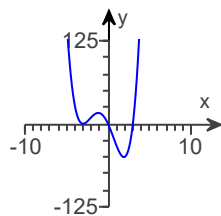
☐ A.



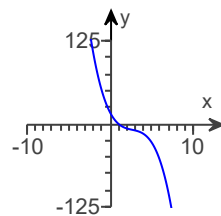
☐ B.



☐ C.



☐ D.



68. Describe the end behavior of the graph of the polynomial function.

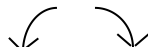
$$f(x) = 7x^5 + 3x^3 - 2x + 4$$

Choose the correct answer below.

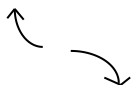
☐ A.



☐ B.



☐ C.



☐ D.

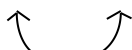


69. Describe the end behavior of the graph of the polynomial function.

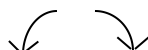
$$f(x) = -4x^3 + 5x^2 - 3$$

Choose the correct answer below.

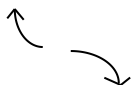
☐ A.



☐ B.



☐ C.



☐ D.



70. Describe the end behavior of the graph of the polynomial function.

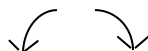
$$f(x) = 9x^6 - 3x^4 + x^2 - 2$$

Choose the correct answer below.

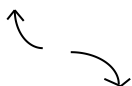
☐ A.



☐ B.



☐ C.



☐ D.



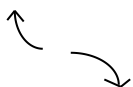
71. Describe the end behavior of the graph of the polynomial function.

$$f(x) = 4 + 5x - 2x^2 - 3x^{10}$$

Choose the correct answer below.

☐ A. 

☐ B. 

☐ C. 

☐ D. 

72. Use the intermediate value theorem to show that the polynomial function has a real zero between the numbers given.

$$f(x) = 4x^2 - 2x - 3; 1 \text{ and } 2$$

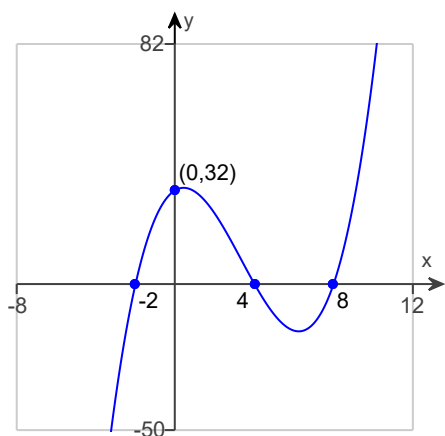
What is  $f(1)$ ? \_\_\_\_\_  
(Simplify your answer. Type an integer or a fraction.)

What is  $f(2)$ ? \_\_\_\_\_  
(Simplify your answer. Type an integer or a fraction.)

Choose the correct statement below that explains why the given polynomial has a zero between 1 and 2, according to the intermediate value theorem.

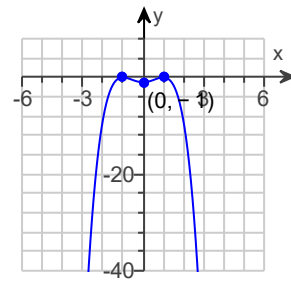
- ☐ A. Since  $f(1)$  and  $f(2)$  are opposite in sign, there exists at least one zero between 1 and 2.
- ☐ B. Since  $f(2)$  is greater than  $f(1)$ , the function is increasing and so there must be one real zero between 1 and 2.

73. Find a polynomial of least possible degree having the graph shown.



$f(x) =$  \_\_\_\_\_  
(Type your answer in factored form.)

74. Find a polynomial of least possible degree having the graph shown. Use a leading coefficient of 1 or  $-1$ .



$f(x) =$  \_\_\_\_\_ (Simplify your answer.)

75. For the given polynomial function, approximate each zero as a decimal to the nearest tenth.

$$f(x) = -5x^4 - x^2 + x + 2$$

$x =$  \_\_\_\_\_

(Type an integer or decimal rounded to the nearest tenth as needed. Use a comma to separate answers as needed.)