1. In the following exercise, find the coordinates of the vertex for the parabola defined by the given quadratic function.

$f(x) = 2x^2 + 16x + 9$

The vertex is ____________. (Type an ordered pair.)

2. Fill in the blank so that the resulting statement is true.

To divide $x^3 + 3x^2 - 4x + 8$ by $x - 2$ using synthetic division, the first step is to write
____| ____ ____ ____ ____.

To divide $x^3 + 3x^2 - 4x + 8$ by $x - 2$ using synthetic division, the first step is to write
____________| ____________ ____________ ____________ ____________.

3. Find the vertical asymptotes, if any, and the values of x corresponding to holes, if any, of the graph of the rational function.

$$h(x) = \frac{x+3}{x(x+1)}$$

Select the correct choice below and, if necessary, fill in the answer box to complete your choice. (Type an equation. Use a comma to separate answers as needed.)

- **A.** The vertical asymptote(s) is(are) ____________. There are no holes.
- **B.** There are no vertical asymptotes but there is(are) hole(s) corresponding to ____________.
- **C.** The vertical asymptote(s) is(are) ____________ and hole(s) corresponding to ____________.
- **D.** There are no discontinuities.

4. Divide using synthetic division.

$(x^3 + 3x^2 - 8x + 3) \div (x - 4)$

$(x^3 + 3x^2 - 8x + 3) \div (x - 4) =$ ____________ $+ \frac{\_\_\_\_\_\_}{x-4}$

(Simplify your answers. Do not factor. Use integers or fractions for any numbers in the expressions.)

5. Find the zeros for the polynomial function and give the multiplicity for each zero. State whether the graph crosses the x-axis or touches the x-axis and turns around at each zero.

$$f(x) = -2(x+8)(x-5)^2$$

Determine the zero(s).

The zero(s) is/are ______.
(Type integers or decimals. Use a comma to separate answers as needed.)

Determine the multiplicities of the zero(s). Select the correct choice below and, if necessary, fill in the answer box(es) within your choice.

- **A.** There are two zeros. The multiplicity of the smallest zero is ______. The multiplicity of the largest zero is ______.
(Simplify your answers.)
- **B.** There is one zero. The multiplicity of the zero is ______.
(Simplify your answer.)
- **C.** There are three zeros. The multiplicity of the smallest zero is ______. The multiplicity of the largest zero is ______. The multiplicity of the other zero is ______.
(Simplify your answers.)

Determine the behavior of the function at each zero. Select the correct choice below and, if necessary, fill in the answer boxes within your choice.

- **A.** The graph crosses the x-axis at x = ______ and touches the x-axis and turns around at x = ______.
(Simplify your answers. Type integers or decimals. Use a comma to separate answers as needed.)
- **B.** The graph touches the x-axis and turns around at all zeros.
- **C.** The graph crosses the x-axis at all zeros.

6. Find the domain of the following rational function.

$$h(x) = \frac{x+3}{x^2-9}$$

Select the correct choice below and, if necessary, fill in the answer box to complete your choice.

- **A.** The domain of h(x) is {x|x ≠ ______}. (Type an integer or a fraction. Use a comma to separate answers as needed.)
- **B.** There are no restrictions on the domain of h(x).

7. Find the horizontal asymptote, if any, of the graph of the rational function.

$$f(x) = \frac{10x}{3x^2 + 2}$$

Select the correct choice below and, if necessary, fill in the answer box to complete your choice.

- **A.** The horizontal asymptote is __________. (Type an equation.)
- **B.** There is no horizontal asymptote.

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8. Determine whether the following statement is true or false.

$\frac{7}{5}$ is a possible rational zero of $f(x) = 8x^3 + 14x^2 - 5x - 5$.

Choose the correct answer below.

- False
- True

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9. Fill in the blanks so that the resulting statement is true.

The graph of $f(x) = x^3$ _______ to the left and _______ to the right.

The graph of $f(x) = x^3$ (1) __________ to the left and (2) __________ to the right.

(1) falls / rises   (2) rises / falls

---

10. Use the Rational Zero Theorem to list all possible rational zeros for the given function.

$$f(x) = -5x^4 - 14x^3 - 2x^2 + 16x + 10$$

Choose the answer below that lists all possible rational zeros.

- **A.** $-1, 1, -2, 2, -5, 5, -10, 10, -\frac{1}{5}, \frac{1}{5}, -\frac{2}{5}, \frac{2}{5}$
- **B.** $-1, 1, -2, 2, -5, 5, -10, 10, -\frac{1}{2}, \frac{1}{2}, -\frac{1}{5}, \frac{1}{5}, -\frac{1}{10}, \frac{1}{10}$
- **C.** $-1, 1, -5, 5, -\frac{1}{2}, \frac{1}{2}, -\frac{1}{10}, \frac{1}{10}, -\frac{1}{5}, \frac{1}{5}, -\frac{5}{2}, \frac{5}{2}$
- **D.** $-1, 1, -2, 2, -5, 5, -10, 10, -\frac{1}{2}, \frac{1}{2}, -\frac{1}{10}, \frac{1}{10}, -\frac{1}{5}, \frac{1}{5}, -\frac{2}{5}, \frac{2}{5}, -\frac{5}{2}, \frac{5}{2}$

11. Decide whether the following statement is true or false.

If the degree of the numerator of a rational function equals the degree of the denominator, then the ratio of the leading coefficients gives rise to the horizontal asymptote.

Choose the correct answer below.

- ◯ True
- ◯ False

---

12. In the following exercise, find the coordinates of the vertex for the parabola defined by the given quadratic function.

$$f(x) = -2(x+6)^2 + 8$$

The vertex is ________. (Type an ordered pair.)

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13. Find the horizontal asymptote, if any, of the graph of the rational function.

$$g(x) = \frac{14x^2}{7x^2 + 2}$$

Select the correct choice below and, if necessary, fill in the answer box to complete your choice.

- ◯ **A.** The horizontal asymptote is ________. (Type an equation.)
- ◯ **B.** There is no horizontal asymptote.

---

14. Fill in each blank so that the resulting statement is true.

To divide $x^3 + 5x^2 - 2x + 6$ by $x - 6$ using synthetic division, the first step is to write __ | __ __ __ __.

To divide $x^3 + 5x^2 - 2x + 6$ by $x - 6$ using synthetic division, the first step is to write
________ | ________ ________ ________ ________.

---

15. Fill in the blanks so that the resulting statement is true.

Consider the polynomial function with integer coefficients $f(x) = a_n x^n + a_{n-1} x^{n-1} + \cdots + a_1 x + a_0$, $a_n \neq 0$. The Rational Zero Theorem states that if $\frac{p}{q}$ is a rational zero of f (where $\frac{p}{q}$ is reduced to lowest terms), then p is a factor of

(1) ________ and q is a factor of (2) ________

(1) ◯ a_0 ◯ a_n

(2) ◯ a_n. ◯ a_0.

---

16. Fill in each blank so that the resulting statement is true.

Consider the quadratic function $f(x) = ax^2 + bx + c$, $a \neq 0$. If $a > 0$, then f has a minimum that occurs at x = ________. This minimum value is ________. If $a < 0$, then f has a maximum that occurs at x = ________. This maximum value is ________.

Consider the quadratic function $f(x) = ax^2 + bx + c$, $a \neq 0$. If $a > 0$, then f has a minimum that occurs at

x = (1) ____________ This minimum value is (2) ____________ If $a < 0$, then f has a maximum that occurs at

x = (3) ____________ This maximum value is (4) ____________

(1)
- ○ $f\left(-\frac{b}{2a}\right)$.
- ○ $\frac{2a}{b}$.
- ○ $f\left(\frac{2a}{b}\right)$.
- ○ $-\frac{b}{2a}$.

(2)
- ○ $-\frac{b}{2a}$.
- ○ $f\left(\frac{2a}{b}\right)$.
- ○ $f\left(-\frac{b}{2a}\right)$.
- ○ $\frac{2a}{b}$.

(3)
- ○ $f\left(\frac{2a}{b}\right)$.
- ○ $\frac{2a}{b}$.
- ○ $f\left(-\frac{b}{2a}\right)$.
- ○ $-\frac{b}{2a}$.

(4)
- ○ $f\left(\frac{2a}{b}\right)$.
- ○ $f\left(-\frac{b}{2a}\right)$.
- ○ $\frac{2a}{b}$.
- ○ $-\frac{b}{2a}$.

17. Use the given function to complete parts (a) through (e) below.

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

---

a) Use the Leading Coefficient Test to determine the graph's end behavior.

- ◯ **A.** The graph of f(x) falls left and rises right.
- ◯ **B.** The graph of f(x) falls left and falls right.
- ◯ **C.** The graph of f(x) rises left and rises right.
- ◯ **D.** The graph of f(x) rises left and falls right.

b) Find the x-intercepts.

x = ____________

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

At which zeros does the graph of the function cross the x-axis? Select the correct choice below and, if necessary, fill in the answer box to complete your choice.

- ◯ **A.** x = ____________ (Type an integer or a decimal. Use a comma to separate answers as needed.)
- ◯ **B.** There are no x-intercepts at which the graph crosses the x-axis.

At which zeros does the graph of the function touch the x-axis and turn around? Select the correct choice below and, if necessary, fill in the answer box to complete your choice.

- ◯ **A.** x = ____________ (Type an integer or a decimal. Use a comma to separate answers as needed.)
- ◯ **B.** There are no x-intercepts at which the graph touches the x-axis and turns around.

c) Find the y-intercept by computing f(0).

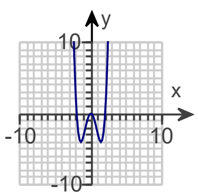
f(0) = ____________

d) Determine the symmetry of the graph.

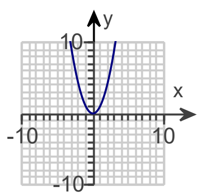
- ◯ Odd; origin symmetry
- ◯ Even; y-axis symmetry
- ◯ Neither

e) Determine the graph of the function.

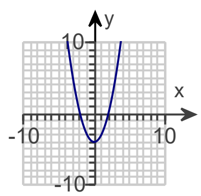
◯ **A.**



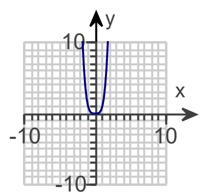
◯ **B.**



◯ **C.**



◯ **D.**



18. Consider the function $f(x) = -2x^2 + 16x - 5$.

a. Determine, without graphing, whether the function has a minimum value or a maximum value.
b. Find the minimum or maximum value and determine where it occurs.
c. Identify the function's domain and its range.

a. The function has a (1) ____________ value.

b. The minimum/maximum value is ____________. It occurs at x = ____________.

c. The domain of f is ____________. (Type your answer in interval notation.)

The range of f is ____________. (Type your answer in interval notation.)

(1) ○ maximum
○ minimum

19. Use the Leading Coefficient Test to determine the end behavior of the graph of the given polynomial function.

$f(x) = -8x^4 + 5x^2 - x + 9$

Choose the correct answer below.

○ **A.** The graph of f(x) falls to the left and falls to the right.
○ **B.** The graph of f(x) rises to the left and rises to the right.
○ **C.** The graph of f(x) rises to the left and falls to the right.
○ **D.** The graph of f(x) falls to the left and rises to the right.

20. Use synthetic division and the remainder theorem to find the indicated function value.

$f(x) = 5x^3 - 11x^2 + 4x - 6$; f(2)

f(2) = ____________

1. $(-4, -23)$

---

2. 2

   1

   3

   -4

   8

---

3. A. The vertical asymptote(s) is(are) **$x = -1, x = 0$**. There are no holes.

---

4. $x^2 + 7x + 20$

   83

---

5. $-8, 5$

   A.
   There are two zeros. The multiplicity of the smallest zero is **1**. The multiplicity of the largest zero is **2**.
   (Simplify your answers.)

   A. The graph crosses the x-axis at x = **-8** and touches the x-axis and turns around at x = **5**.
   (Simplify your answers. Type integers or decimals. Use a comma to separate answers as needed.)

---

6. A.
   The domain of h(x) is $\{x | x \neq$ **$3, -3$** $\}$. (Type an integer or a fraction. Use a comma to separate answers as needed.)

---

7. A. The horizontal asymptote is **$y = 0$**. (Type an equation.)

---

8. False

---

9. (1) falls

   (2) rises

---

10. A. $-1, 1, -2, 2, -5, 5, -10, 10, -\frac{1}{5}, \frac{1}{5}, -\frac{2}{5}, \frac{2}{5}$

---

11. True

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12. $(-6,8)$

---

13. A. The horizontal asymptote is **$y=2$**. (Type an equation.)

---

14. 1

5

-2

6

6

---

15. (1) a_0

(2) a_n.

---

16. (1) $-\frac{b}{2a}$.

(2) $f\left(-\frac{b}{2a}\right)$.

(3) $-\frac{b}{2a}$.

(4) $f\left(-\frac{b}{2a}\right)$.

---

17. C. The graph of f(x) rises left and rises right.

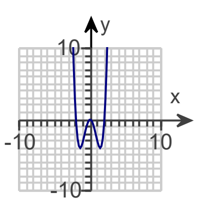
$-2,2,0$

A. x = **$-2,2$** (Type an integer or a decimal. Use a comma to separate answers as needed.)

A. x = **0** (Type an integer or a decimal. Use a comma to separate answers as needed.)

0

Even; y-axis symmetry



A.

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18. (1) maximum

27

4

$(-\infty,\infty)$

$(-\infty,27]$

---

19. A. The graph of f(x) falls to the left and falls to the right.

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20. -2
