1. Find a polynomial function of degree 3 whose zeros are −3, 1, and 3.

A. $x^3 - x^2 - 9x + 9$

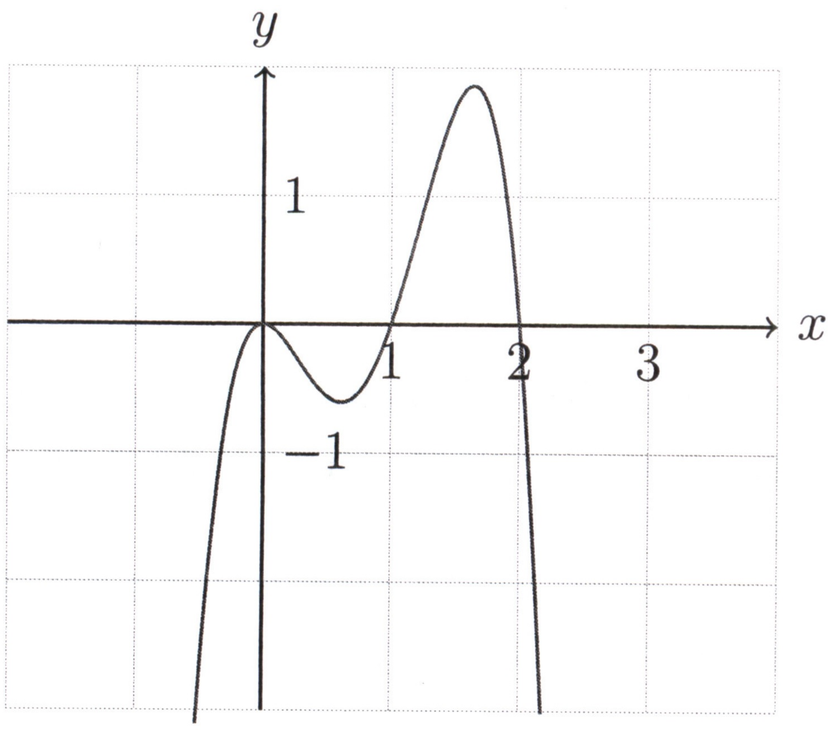
B. $x^3 + x^2 - 9x + 9$

C. $x^3 + x^2 - 9x - 9$

D. $x^3 - x^2 + 9x - 9$

E. $x^3 - x^2 + 9x + 9$

2. Select the polynomial function that represents the given graph.



A. $y = -3x^2(x+1)(x+2)$

B. $y = -3x^2(x-1)^2(x-2)^2$

C. $y = -3x^2(x-1)(x-2)$

D. $y = 3x^2(x-1)(x-2)$

E. $y = -3x(x-1)^2(x-2)$

3. Find the domain of the rational function $f(x) = \frac{7x^2 - 13x - 2}{2x(x+7)}$.

A. $\{x \mid x \neq 0, x \neq -7\}$

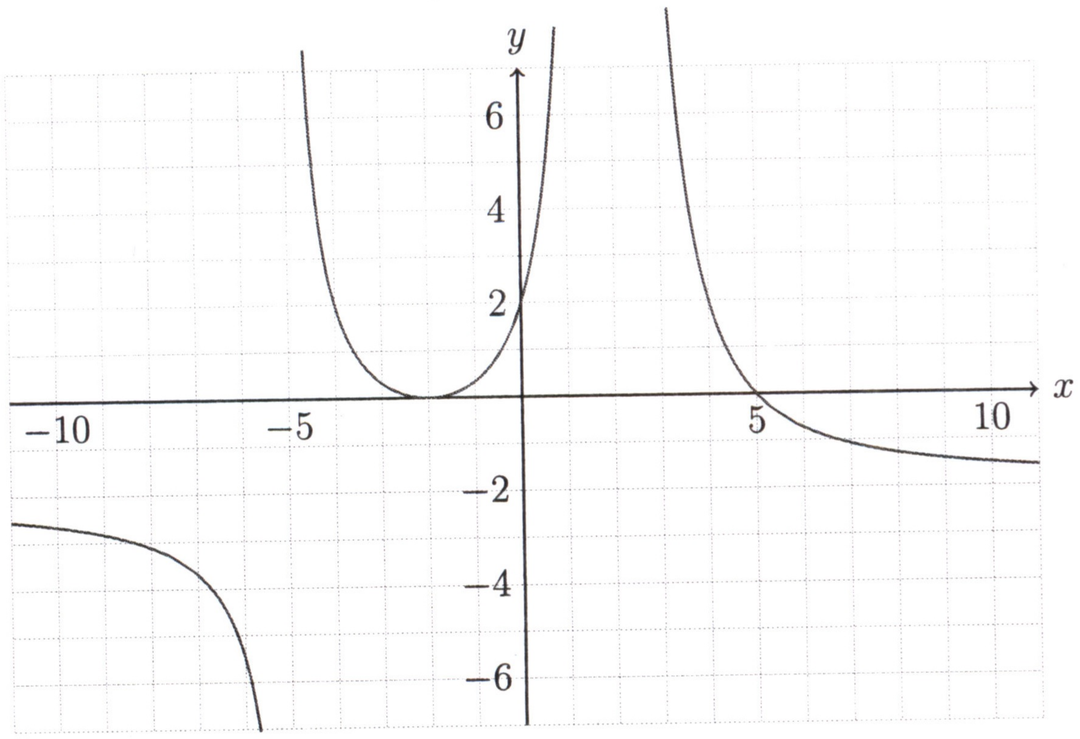
B. $\{x \mid x \neq -\frac{1}{2}, x \neq 2\}$

C. $\{x \mid x \neq 0, x \neq 7\}$

D. $\{x \mid x \neq \frac{1}{2}, x \neq -2\}$

E. all real numbers

4. Find a rational function that has the following graph.



A. $y = \dfrac{-2(x+2)^2(x-5)}{(x+5)(x-2)^2}$

B. $y = \dfrac{-3(x+2)^2(x-5)}{(x+5)(x-2)^2}$

C. $y = \dfrac{(x+2)^2(x-5)}{(x+5)(x-2)^2}$

D. $y = \dfrac{-2(x+2)(x-5)^2}{(x+5)(x-2)^2}$

E. $y = \dfrac{2(x+2)^2(x-5)^2}{(x+5)(x-2)^2}$

5. Let $R(x) = \dfrac{2x^2+2x+1}{x^2+1}$. Find all horizontal or oblique asymptotes if any.

A. $y = -1$

B. $y = 1$

C. $y = 0$

D. $y = 2$

E. no horizontal or oblique asymptotes

6. Let $R(x) = \dfrac{6x^5+4x^4+2}{2x^4+2x^3}$. Find all horizontal or oblique asymptotes if any.

A. $y = 3x - 1$

B. $y = 3x - 2$

C. $y = 3x + 2$

D. $y = 3x + 1$

E. no horizontal or oblique asymptotes

7. **Find all vertical asymptotes of the rational function $R(x) = \frac{x^2 + 4x + 4}{x(x+2)(x-2)}$.**

A. $x = 0,\ x = 2$
B. $x = 0,\ x = -2$
C. $x = 0,\ x = 2,\ x = -2$
D. $x = 0$
E. $x = 2,\ x = -2$

8. **Solve the inequality $(x+1)(x+2)(x+3) \leq 0$.**

A. $(-\infty, -3] \cup [-2, -1]$
B. $(-\infty, -3) \cup (-2, -1)$
C. $[-3, -1]$
D. $(-3, -2) \cup (-1, \infty)$
E. $[-3, -2] \cup [-1, \infty)$

9. **Solve the inequality $x^4 + x^2 < 2x^2$.**

A. $(-1,0) \cup (1, \infty)$
B. $(-1,0) \cup (0,1)$
C. $(-1,1)$
D. $(-\infty, 0)$
E. $(-\infty, -1) \cup (1, \infty)$

10. **Solve the inequality $\frac{(3+x)(2-x)}{x+3} > 0$.**

A. $(-\infty, -2) \cup (2,3)$
B. $(-\infty, -3) \cup (2, \infty)$
C. $(-\infty, -3) \cup (2,3)$
D. $(-3,2) \cup (3, \infty)$
E. $(-3,2) \cup (2,3)$
F. $(-\infty, -3) \cup (3, \infty)$

11. **Solve the inequality $\frac{2x-5}{x+2} \leq 1$.**

A. $[-2,3]$
B. $(-\infty, -2) \cup [3, \infty)$
C. $[-2,7]$
D. $(-\infty, -2) \cup [7, \infty)$
E. $(-2,7]$
F. $(-2,3]$

12. Let $f(x)$ be a polynomial so that $f(1) = -1, f(2) = 1, f(3) = 5, f(4) = -1$, and $f(5) = 1$. Then the intermediate value theorem promises that there must be how many zeros for $f(x)$, for x between 1 and 4?

A. one
B. two
C. three
D. four
E. none

13. Use the factor theorem to determine if $x - 2, x + 2$ and $x - 1$ are factors of $x^{20} - 4x^{18} - x^3 + 8$. Choose the correct response.

A. Both $x - 1$ and $x - 2$ are not factors and $x + 2$ is a factor.
B. Both $x + 2$ and $x - 2$ are factors and $x - 1$ is not a factor.
C. Both $x + 2$ and $x - 2$ are not factors and $x - 1$ is a factor.
D. Both $x + 2$ and $x - 1$ are not factors and $x - 2$ is a factor.
E. Both $x - 1$ and $x - 2$ are factors and $x + 2$ is not a factor.
F. Both $x + 2$ and $x - 1$ are factors and $x - 2$ is not a factor.

14. If $x^{25} - 25x^{23} + x - 3$ is divided by $x - 5$, then the remainder is

A. 3.
B. -1.
C. 0.
D. 2.
E. 1.

15. Find k so the $x^4 - kx^3 + kx^2 + x - 2$ has the factor $x - 2$.

A. $k = 3$
B. $k = -3$
C. $k = -2$
D. $k = 2$
E. $k = 4$
F. $k = -4$

16. The polynomial $4x^4 + 8x^3 + 3x^2 - 2x - 1$ has four rational zeros. Find the zero that has multiplicity two.

A. 1/2
B. 2
C. $-1/2$
D. -1
E. -2
F. 1

17. Form a polynomial of degree 4 whose zeros are 1, −1, 1 + *i*, and 1 − *i*.

A. $x^4 - 2x^2 - 1$

B. $x^4 + 2x^2 - 1$

C. $x^4 - x^3 + x^2 - x + 1$

D. $x^4 - 1$

E. $x^4 - 2x^3 + x^2 + 2x - 2$

18. Find a quadratic polynomial with real coefficients so that 1 + *i* is a zero.

A. $x^2 - 2x + 2$

B. $x^2 + 2x + 2$

C. $x^2 + 2x - 2$

D. $x^2 - 2x - 2$

E. $x^2 - 4x + 2$

19. Find all solutions to $x^4 - 2x^3 + 6x^2 - 2x + 5 = 0$, given that $x = i$ is a solution.

A. $\pm i, 2 \pm i$

B. $\pm i, \pm 2i$

C. $\pm i, 2 \pm 3i$

D. $\pm i, 1 \pm 2i$

E. $\pm i, -1 \pm 2i$

20. Find all solutions to $2x^3 - 9x^2 + 14x - 5 = 0$.

A. $1, \frac{1}{2} + i, \frac{1}{2} - i$

B. $\frac{5}{2}, 2 + i, 2 - i$

C. $-\frac{5}{2}, -2 + i, -2 - i$

D. $-\frac{1}{2}, -2 + i, -2 - i$

E. $\frac{1}{2}, 2 + i, 2 - i$