1. Write the expression in standard form.

$(6 + 9i) - (-3 + i)$

- **A.** $9 + 8i$
- **B.** $-9 - 8i$
- **C.** $3 + 10i$
- **D.** $9 - 8i$

---

2. Divide and write the result in standard form.

$\frac{-9}{i}$

- **A.** $-9i$
- **B.** $9i$
- **C.** $81i^2$
- **D.** $-9i^2$

---

3. Solve the quadratic equation. Write complex solutions in standard form.

$x(6x + 5) = -3$

- **A.** $\frac{5}{12} \pm \frac{i\sqrt{47}}{12}$
- **B.** $-\frac{5}{12} \pm \frac{\sqrt{47}}{12}$
- **C.** $-\frac{5}{12} \pm \frac{i\sqrt{47}}{12}$
- **D.** $\frac{5}{12} \pm \frac{\sqrt{47}}{12}$

---

4. Solve the inequality.

$x^2 - 4x - 12 \le 0$

- **A.** $x \le -2$ or $x \ge 6$
- **B.** $x \ge 6$
- **C.** $-2 \le x \le 6$
- **D.** $x \le -2$

---

5. Solve the inequality.

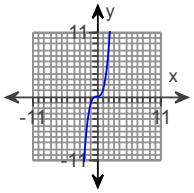
$(x - 6)(x + 2) \ge 0$

- **A.** $x \le -6$ or $x \ge 2$
- **B.** $x \le -2$ or $x \ge 6$
- **C.** $6 < x < -2$
- **D.** $x > 6$

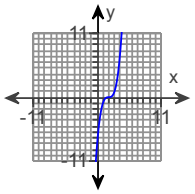
---

6. Determine which graph represents the shift in the indicated equation, where y = f(x).

y = f(x + 2)



A.



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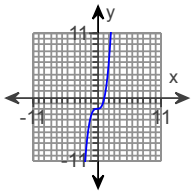

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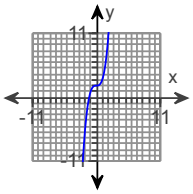
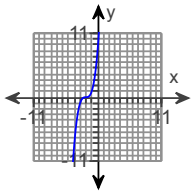


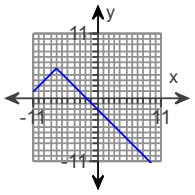
D.



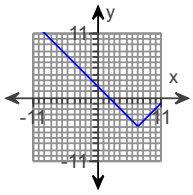
7. Use transformations of the graphs of $y = x^2$ or $y = |x|$ to sketch a graph of f by hand.

$f(x) = |x - 7| - 5$

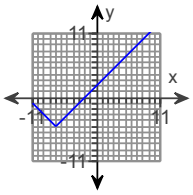
A.



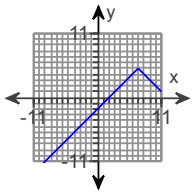
B.



C.



D.



8. How can the graph of $f(x) = -6x^2 + 4$ be obtained from the graph of $y = x^2$?

A. Stretch it vertically by a factor of 6, reflect it across the x-axis, and shift it 4 units upward.

B. Stretch it horizontally by a factor of -6, reflect it across the x-axis, and shift it 4 units downward.

C. Stretch it vertically by a factor of 6, reflect it across the y-axis, and shift it 4 units upward.

D. Stretch it horizontally by a factor of 4, reflect it across the x-axis, and shift it 6 units upward.

9. If the following is a polynomial function, then state its degree and leading coefficient. If it is not, then state this fact.

$f(x) = -5x^4 + 2x^3 + 2x^2 + 9$

A. Degree: 3; leading coefficient: -5

B. Degree: 4; leading coefficient: -5

C. Not a polynomial function.

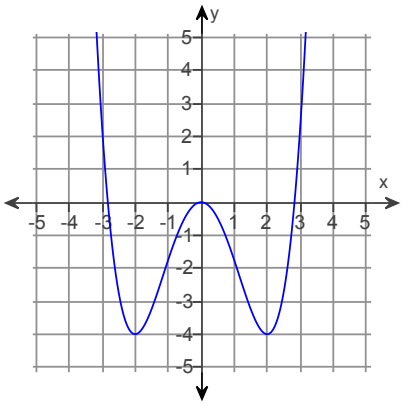
D. Degree: -5; leading coefficient: 2

10. If the following is a polynomial function, then state its degree and leading coefficient. If it is not, then state this fact.

$f(x) = 3x^{-3} + 9$

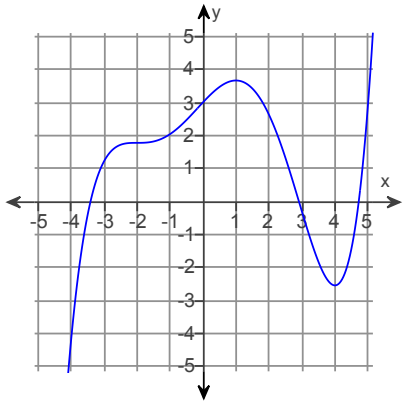
- **A.** Degree: 3; leading coefficient: -3
- **B.** Not a polynomial function
- **C.** Degree: -3; leading coefficient: 3
- **D.** Degree: 3; leading coefficient: 3

11. Use the graph of f to estimate the absolute extrema.



- **A.** Absolute maximum: ∞
  Absolute minima: -2 and 2
- **B.** Absolute maximum: 0
  Absolute minima: -2 and 2
- **C.** No absolute maximum
  Absolute minimum: -4
- **D.** Absolute maximum: ∞
  Absolute minimum: -4

12. Use the graph of f to estimate the absolute extrema.



- **A.** Absolute maximum: 1
  Absolute minimum: 4
- **B.** Absolute maximum: approx. 3.66
  Absolute minimum: approx. -2.55
- **C.** Absolute maximum: ∞
  Absolute minimum: $-\infty$
- **D.** No absolute maximum
  No absolute minimum

13. Determine whether the function is odd, even, or neither.

$f(x) = 4x - 2$

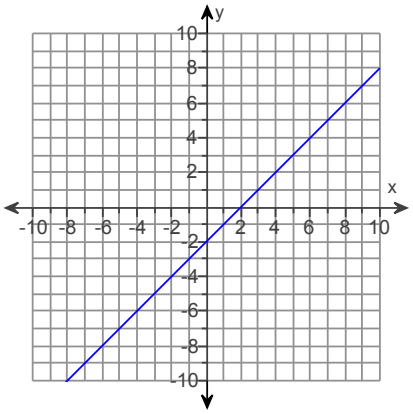
- **A.** Odd
- **B.** Even
- **C.** Neither

14. Determine whether the function is odd, even, or neither.

$f(x) = 6x^5 + 4x^3$

- **A.** Odd
- **B.** Neither
- **C.** Even

15. Use the graph of the polynomial function f to estimate the x-intercept and to determine whether the leading coefficient is positive or negative.

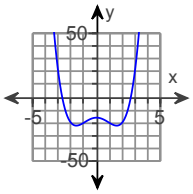


- **A.** 2, positive
- **B.** -2, negative
- **C.** 2, negative
- **D.** -2, positive

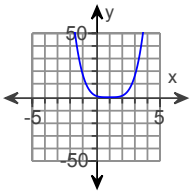
16. Pick which graph satisfies the given conditions.

Quartic polynomial with one real zero and a positive leading coefficient.

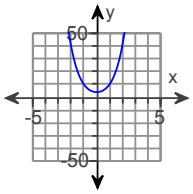
- **A.**



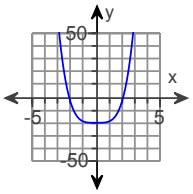
- **B.**



- **C.**



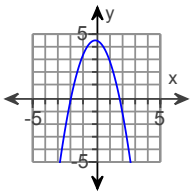
- **D.**



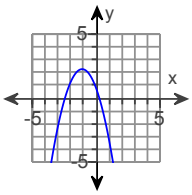
17. Pick which graph satisfies the given conditions.

Degree 2 passing through $(-1,0)$, $(2,3)$, and $(3,-1)$.

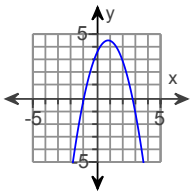
- **A.**



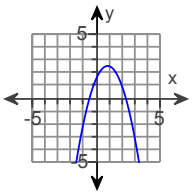
- **B.**



- **C.**



- **D.**



18. Evaluate the function f at the indicated value.

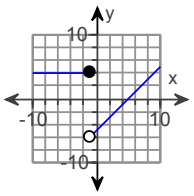
$f(0)$ for $f(x) = \begin{cases} x-5, \text{ if } x < 6 \\ 8-x, \text{ if } x \geq 6 \end{cases}$

- **A.** 2
- **B.** 8
- **C.** 1
- **D.** -5

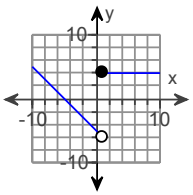
19. Graph the function.

$$f(x) = \begin{cases} 4, & \text{if } x \geq 1 \\ -5 - x, & \text{if } x < 1 \end{cases}$$

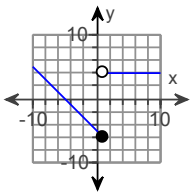
A.



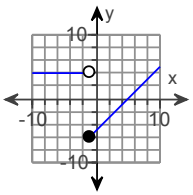
B.



C.



D.



20. Divide. Write with positive exponents.

$$\frac{15x^{10} + 25x^9 + 30x^8 + 35x^6 + 2x^4}{5x^8}$$

A. $3x^2 + 5x + 6 + \frac{7}{x^2} + \frac{2}{5x^4}$

B. $15x^{10} + 5x^2 + 6 + \frac{7}{x^2} + \frac{2}{5x^3}$

C. $3x^3 + 25x^9 + 30x^8 + 35x^6 + 2x^4$

D. $3x^3 + 5x^2 + 6$

21. Divide the first polynomial by the second and state the quotient and the remainder.

$4x^3 + 27x^2 + 13x - 30,\ x + 6$

A. Quotient: $4x^2 + 3x - 5$; remainder: 0

B. Quotient: $2x^2 + 9x + 13$; remainder: 0

C. Quotient: $-4x^2 - 6x - 5$; remainder: 0

D. Quotient: $4x + 3$; remainder: 0

22. Divide.

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

A. $x^2 - 5x - 4 + \frac{10x - 8}{x^2 + 1}$

B. $x^2 + 5x - 4$

C. $x^2 - 5x - 4$

D. $x^2 + 5x - 4 + \frac{10x - 8}{x^2 + 1}$

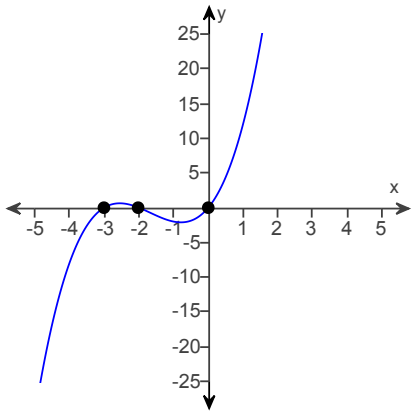
23. Use division to express the (Dividend) as (Divisor)(Quotient) + (Remainder).

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

- **A.** $(x + 2)(2x^2 + x + 3) + 10$
- **B.** $(x - 2)(2x^2 + x - 3) - 2$
- **C.** $(x - 2)(2x^2 + 7x + 9) + 22$
- **D.** $(x - 2)(2x^2 - 7x + 11) + 18$

24. Use the graph and the factor theorem to list the factors of f(x).

$y = f(x)$



- **A.** x, (x + 2), (x + 3)
- **B.** x, (x − 2), (x − 3)
- **C.** (x + 2), (x + 3)
- **D.** (x − 2), (x − 3)

25. Write the complete factored form of the polynomial f(x), given the indicated zero.

$f(x) = 2x^3 - 15x^2 + 22x + 15$; 5 is a zero

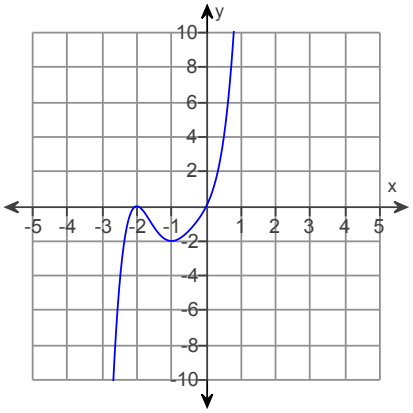
- **A.** $f(x) = \left(x + \frac{1}{2}\right)(x - 3)(x - 5)$
- **B.** $f(x) = \left(x - \frac{1}{2}\right)(x - 3)(x - 5)$
- **C.** $f(x) = 2\left(x - \frac{1}{2}\right)(x + 3)(x - 5)$
- **D.** $f(x) = 2\left(x + \frac{1}{2}\right)(x - 3)(x - 5)$

26. Use the given information about the polynomial function f(x) to write its complete factored form.

Degree 4; zeros: $-4, -3, 3, -2$; leading coefficient = 1

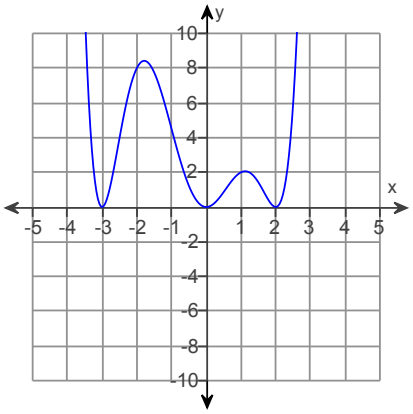
- **A.** $f(x) = (x + 4)(x + 3)(x - 3)(x + 2)$
- **B.** $f(x) = (x - 4)(x - 3)(x + 3)(x - 2)$
- **C.** $f(x) = (x - 4)(x + 3)(x + 3)(x - 2)$
- **D.** $f(x) = (x + 4)(x - 3)(x - 3)(x + 2)$

27. The graph of the polynomial f(x) is shown in the figure. Estimate the zeros and state whether their multiplicities are odd or even.



- **A.** − 2 (even), 0 (odd)
- **B.** − 2 (odd), 0 (even)
- **C.** − 2 (even), 0 (even)
- **D.** − 2 (odd), 0 (odd)

28. The graph of the polynomial f(x) is shown in the figure. Estimate the zeros and state whether their multiplicities are odd or even.



- **A.** − 3 (odd), 0 (even), 2 (odd)
- **B.** − 3 (even), 0 (odd), 2 (even)
- **C.** − 3 (odd), 0 (odd), 2 (odd)
- **D.** − 3 (even), 0 (even), 2 (even)

29. Use the rational zero test to find all the rational zeros of f(x).

$f(x) = 4x^5 + 4x^4 - 37x^3 - 37x^2 + 9x + 9$

- **A.** Zeros: $-1, 3, -3, 2, -2$
- **B.** Zeros: $1, 3, -3, 2, -1$
- **C.** Zeros: $1, 3, -3, -\frac{1}{2}, \frac{1}{2}$
- **D.** Zeros: $-1, -3, 3, -\frac{1}{2}, \frac{1}{2}$

30. Use the rational zero test to find all the rational zeros of f(x).

$f(x) = 3x^4 + 2x^3 - 76x^2 - 50x + 25$

- **A.** Zeros: $5, -5, 1, -1$
- **B.** Zeros: $-5, 3, -1, \frac{1}{3}$
- **C.** Zeros: $-5, 5, -1, \frac{1}{3}$
- **D.** Zeros: $5, -5, 1, -\frac{1}{3}$

31. Solve the polynomial equation symbolically.

$x^2 - 64 = 0$

- **A.** 32, − 32
- **B.** 8, − 8
- **C.** 24, − 24
- **D.** 16, − 16

32. Solve the polynomial equation graphically or numerically.

$x^3 - 27x - 54 = 0$

- **A.** 3, 6, − 6
- **B.** − 6, − 3, 3
- **C.** − 3, 3, 6
- **D.** − 3, − 3, 6

33. Find the complete factored form of the polynomial f(x) that satisfies the given conditions.

Degree 2, leading coefficient − 3, zeros at $-5i$ and $5i$

- **A.** $f(x) = -3x^2 + 25$
- **B.** $f(x) = -3(x - 5i)(x + 5i)$
- **C.** $f(x) = (-3x - 5i)(-3x + 5i)$
- **D.** $f(x) = -3\left(x^2 + 25\right)$

34. Find the complete factored form of the polynomial f(x) that satisfies the given conditions.

Degree 3, leading coefficient 2, zeros at 5, $8i$, and $-8i$

- **A.** $f(x) = 2(x - 5)\left(x^2 + 64\right)$
- **B.** $f(x) = 2(x + 5)(x + 8i)(x - 8i)$
- **C.** $f(x) = 2(x - 5)(x + 8i)(x - 8i)$
- **D.** $f(x) = 2(x + 5)\left(x^2 + 64\right)$

35. Find the complete factored form of the polynomial f(x) that satisfies the given conditions.

Degree 4, leading coefficient 5, zeros at 6, − 4, $3i$, and $-3i$

- **A.** $f(x) = 5(x + 6)(x - 4)\left(x^2 + 9\right)$
- **B.** $f(x) = 5(x - 6)(x + 4)\left(x^2 + 9\right)$
- **C.** $f(x) = 5(x - 6)(x + 4)(x + 3i)(x - 3i)$
- **D.** $f(x) = 5(x + 6)(x - 4)(x + 3i)(x - 3i)$

36. Find the zeros of f(x), given that one zero is k.

$f(x) = x^3 + 6x^2 - 3x - 18,\ k = -6$

- **A.** $-6,\ \pm 3$
- **B.** $-6,\ \pm\sqrt{3}$
- **C.** $-\sqrt{6},\ \pm 3$
- **D.** $-\sqrt{6},\ \pm\sqrt{3}$

37. Find the zeros of f(x), given that one zero is k.

$f(x) = x^3 - 6x^2 + x - 6,\ k = 6$

- **A.** $-6,\ \pm i$
- **B.** $\pm 6,\ i$
- **C.** $6,\ \pm i$
- **D.** $\pm 1,\ 6$

38. Find the zeros of f(x), given that one zero is k.

$f(x) = x^3 - 11x^2 + 48x - 90,\ k = 5$

- **A.** $5,\ 3 \pm 3i$
- **B.** $5,\ -3 \pm 3i$
- **C.** $5,\ 3 \pm i$
- **D.** $5,\ 3 \pm i\sqrt{5}$

39. Find the zeros of f(x), given that one zero is k.

$f(x) = x^4 - 21x^2 - 100,\ k = -2i$

- **A.** $\pm 2i,\ \pm 5$
- **B.** $\pm 2i,\ \pm 5i$
- **C.** $\pm 2i,\ \pm 10i$
- **D.** $\pm 2i,\ \pm 10$

40. Express f(x) in complete factored form.

$f(x) = 9x^3 + 9x$

- **A.** $f(x) = 9x(x + 1)^2$
- **B.** $f(x) = 9x(x + i)^2$
- **C.** $f(x) = 9x(x + i)(x - i)$
- **D.** $f(x) = x(x + 9i)(x - i)$

41. Express f(x) in complete factored form.

$f(x) = 4x^3 + 20x$

- **A.** $f(x) = 4x\left(x + i\sqrt{5}\right)\left(x - i\sqrt{5}\right)$
- **B.** $f(x) = 4x\left(x + i\sqrt{5}\right)^2$
- **C.** $f(x) = x\left(x + \sqrt{20}\right)\left(x + i\sqrt{20}\right)$
- **D.** $f(x) = 4x\left(x + \sqrt{5}\right)^2$

---

42. Express f(x) in complete factored form.

$f(x) = x^4 + 16x^2$

- **A.** $f(x) = x^2(4x + i)^2$
- **B.** $f(x) = x^2(4x + i)(4x - i)$
- **C.** $f(x) = x^2(x + 4i)^2$
- **D.** $f(x) = x^2(x + 4i)(x - 4i)$

---

43. Express f(x) in complete factored form.

$f(x) = x^3 + 7x^2 + 4x + 28$

- **A.** $f(x) = (x + 7i)(x + 2i)(x - 2i)$
- **B.** $f(x) = (x + 7)(x + 2i)(x - 2i)$
- **C.** $f(x) = (x + 2)(x + 7i)(x - 7i)$
- **D.** $f(x) = (x + 2i)(x + 7i)(x - 7i)$

---

44. Solve the polynomial equation.

$x^3 + 4x^2 + 49x + 196 = 0$

- **A.** $x = -4, -7i, 7i$
- **B.** $x = -4, -\sqrt{7}, -\sqrt{7}$
- **C.** $x = -\sqrt{4}, -\sqrt{4}, 7i$
- **D.** $x = -4, 196i, 49i$

---

45. Solve the polynomial equation.

$3x^5 + 6x^4 + -9x^3 + -18x^2 - 12x - 24 = 0$

- **A.** $x = -2, -2, i$
- **B.** $x = 2, -2, -2, \pm i$
- **C.** $x = -2, 2, 2, \pm i$
- **D.** $x = 2, -2$

1. A. $9 + 8i$

---

2. B. $9i$

---

3. C. $-\frac{5}{12} \pm \frac{i\sqrt{47}}{12}$

---

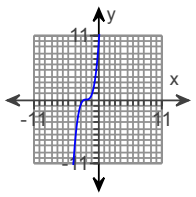
4. C. $-2 \le x \le 6$

---

5. B. $x \le -2$ or $x \ge 6$

---

6. D.



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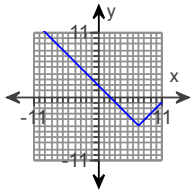
7. B.



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8. A. Stretch it vertically by a factor of 6, reflect it across the x-axis, and shift it 4 units upward.

---

9. B. Degree: 4; leading coefficient: -5

---

10. B. Not a polynomial function

---

11. C. No absolute maximumAbsolute minimum: -4

---

12. D. No absolute maximumNo absolute minimum

---

13. C. Neither

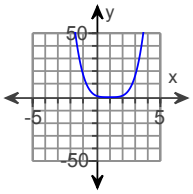
---

14. A. Odd

---

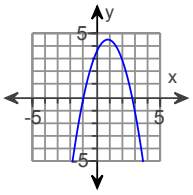
15. A. 2, positive

16.



B.

17.

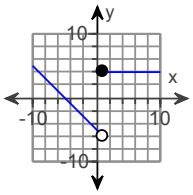


C.

---

18. D. -5

19.



B.

---

20. A. $3x^2 + 5x + 6 + \frac{7}{x^2} + \frac{2}{5x^4}$

---

21. A. Quotient: $4x^2 + 3x - 5$; remainder: 0

---

22. C. $x^2 - 5x - 4$

---

23. B. $(x - 2)(2x^2 + x - 3) - 2$

---

24. A. x, $(x + 2)$, $(x + 3)$

---

25. D. $f(x) = 2\left(x + \frac{1}{2}\right)(x - 3)(x - 5)$

---

26. A. $f(x) = (x + 4)(x + 3)(x - 3)(x + 2)$

---

27. A. -2 (even), 0 (odd)

---

28. D. -3 (even), 0 (even), 2 (even)

---

29. D. Zeros: $-1,\ -3,\ 3,\ -\frac{1}{2},\ \frac{1}{2}$

30. C. Zeros: $-5,\ 5,\ -1,\ \frac{1}{3}$

31. B. $8,\ -8$

32. D. $-3,\ -3,\ 6$

33. B. $f(x) = -3(x-5i)(x+5i)$

34. C. $f(x) = 2(x-5)(x+8i)(x-8i)$

35. C. $f(x) = 5(x-6)(x+4)(x+3i)(x-3i)$

36. B. $-6,\ \pm\sqrt{3}$

37. C. $6,\ \pm i$

38. A. $5,\ 3\pm 3i$

39. A. $\pm 2i,\ \pm 5$

40. C. $f(x) = 9x(x+i)(x-i)$

41. A. $f(x) = 4x\left(x+i\sqrt{5}\right)\left(x-i\sqrt{5}\right)$

42. D. $f(x) = x^2(x+4i)(x-4i)$

43. B. $f(x) = (x+7)(x+2i)(x-2i)$

44. A. $x = -4,\ -7i,\ 7i$

45. B. $x = 2,\ -2,\ -2,\ \pm i$