1. Write the expression in standard form.

   $(9 - 4i) + (5 + 8i)$

   - **A.** $14 + 4i$
   - **B.** $4 + 12i$
   - **C.** $-14 - 4i$
   - **D.** $14 - 4i$

2. Write the expression in standard form.

   $8i + (-8 - i)$

   - **A.** $-8 + 7i$
   - **B.** $8 - 9i$
   - **C.** $-8 + 9i$
   - **D.** $8 - 7i$

3. Multiply and write the result in standard form.

   $4i(2 + 7i)^2$

   - **A.** $-112 - 180i$
   - **B.** $-180i$
   - **C.** $-112i + 112i^2 + 196i^3$
   - **D.** $-180 + 112i$

4. Divide and write the result in standard form.

   $\frac{-6}{i}$

   - **A.** $-6i$
   - **B.** $-6i^2$
   - **C.** $6i$
   - **D.** $36i^2$

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

   $x(x - 8) = -52$

   - **A.** $4 + 6i, 0$
   - **B.** $8 \pm 12i$
   - **C.** $4 \pm 6i$
   - **D.** $10, -2$

6. Solve the inequality.

$x^2 - 11x + 28 > 0$

- **A.** $4 < x > 7$
- **B.** $x < 4$ or $x > 7$
- **C.** $x > 7$
- **D.** $x < 4$

---

7. Solve the inequality.

$16 - x^2 \leq 0$

- **A.** $x \leq -4$ or $x \geq 4$
- **B.** $x \geq 4$
- **C.** $x \leq -4$
- **D.** $-4 < x < 4$

---

8. Find an equation that shifts the graph of f by the indicated amounts.

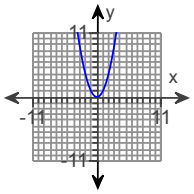
$f(x) = x^4$; right 8 units, up 3 units

- **A.** $y = -(x-8)^4 + 3$
- **B.** $y = -(x-8)^4 + 24$
- **C.** $y = (x-8)^4 + 3$
- **D.** $y = (x+8)^4 - 3$

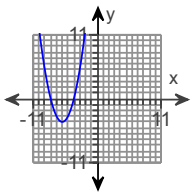
---

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

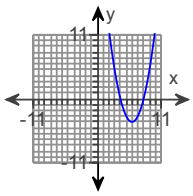
$y = f(x-4) - 6$



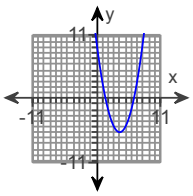
- **A.**



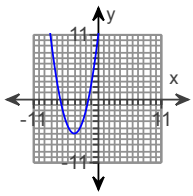
- **B.**



- **C.**



- **D.**



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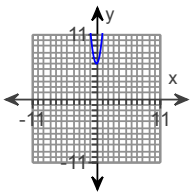
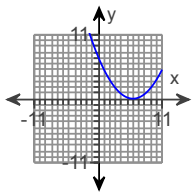
10. Use transformations of the graphs of $y = x^2$ or $y = |x|$ to sketch a graph of f by hand.

$f(x) = 5x^2 + 6$

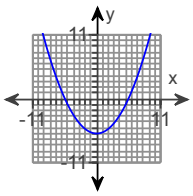
A.



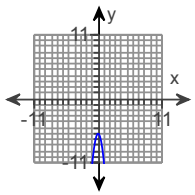
B.



C.



D.



11. How can the graph of $f(x) = -4|x|$ be obtained from the graph of $y = |x|$?

A. Stretch it vertically with factor -4 and reflect it across the x-axis.

B. Stretch it vertically with factor 4 and reflect it across the x-axis.

C. Stretch it vertically with factor -4 and reflect it across the y-axis.

D. Stretch it vertically with factor 4 and reflect it across the y-axis.

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

$f(x) = 17x^6 + 4x + 7$

A. Degree: 7; leading coefficient: 17

B. Not a polynomial function.

C. Degree: 6; leading coefficient: 17

D. Degree: 17; leading coefficient: 6

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

$f(x) = -15 - 16x^4 + 13x - 5x^3 + 12x^2$

A. Degree: -15; leading coefficient: -16

B. Degree: 4; leading coefficient: -16

C. Not a polynomial function.

D. Degree: 4; leading coefficient: -15

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

$f(x) = \sqrt[3]{64x^9 + 27x^3}$

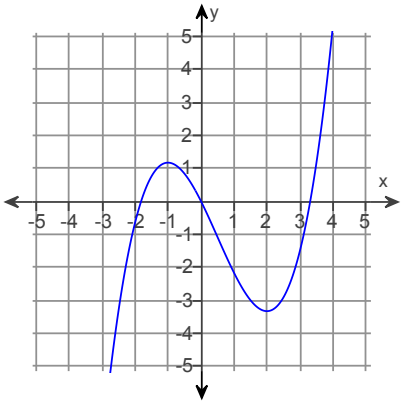
A. Degree: 3; leading coefficient: 4

B. Degree: 4; leading coefficient: 3

C. Degree: 9; leading coefficient: 4

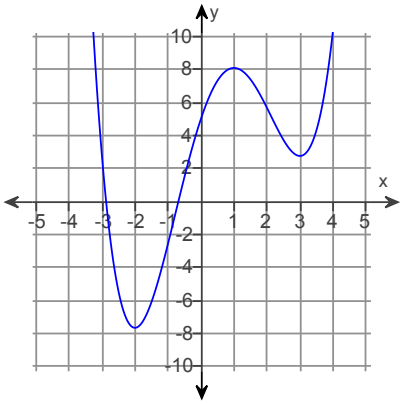
D. Not a polynomial function

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



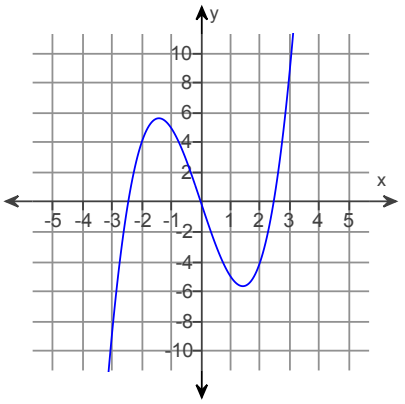
- **A.** No absolute maximum
  No absolute minimum
- **B.** Absolute maximum: ∞
  Absolute minimum: $-\infty$
- **C.** Absolute maximum: -1
  Absolute minimum: 2
- **D.** Absolute maximum: approx. 1.17
  Absolute minimum: approx. -3.33

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



- **A.** Absolute maximum: ∞
  Absolute minima: -2 and 3
- **B.** Absolute maximum: approx. 8.08
  Absolute minimum: approx. -7.67
- **C.** Absolute maximum: approx. 8.08
  Absolute minima: approx. -7.67 and 2.75
- **D.** No absolute maximum
  Absolute minimum: approx. -7.67

17. Use the graph to determine if f is odd, even, or neither.



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

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

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

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

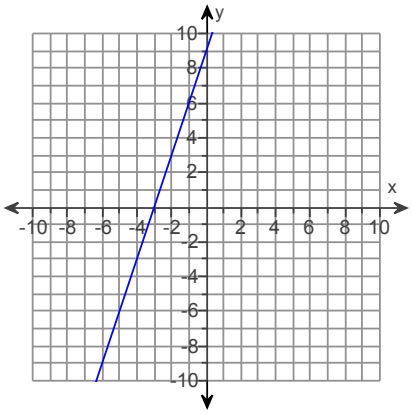
19. Determine whether the function is odd, even, or neither.

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

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

---

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



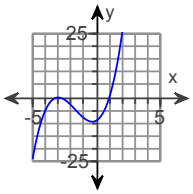
- **A.** -3, negative
- **B.** 3, positive
- **C.** -3, positive
- **D.** 3, negative

---

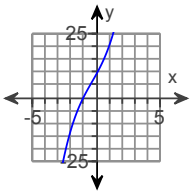
21. Pick which graph satisfies the given conditions.

Polynomial of degree 3 with three distinct real zeros and a positive leading coefficient.

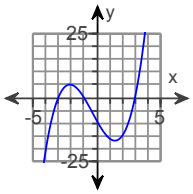
- **A.**



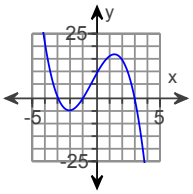
- **B.**



- **C.**



- **D.**



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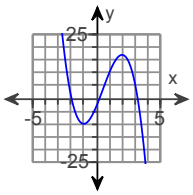
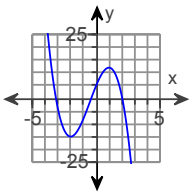
22. Pick which graph satisfies the given conditions.

Degree 3 with turning points at $(-2, 10)$ and $(1, -17)$.

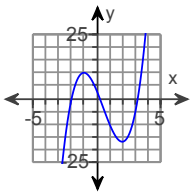
- **A.**



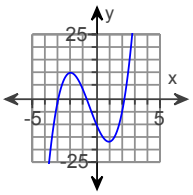
- **B.**



- **C.**



- **D.**



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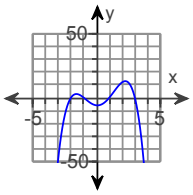
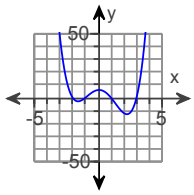
23. Pick which graph satisfies the given conditions.

Degree 4 with 4 x-intercepts and a negative leading coefficient.

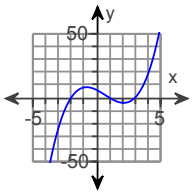
A.



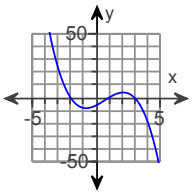
B.



C.



D.



24. Evaluate the function f at the indicated value.

$f(0)$ for $f(x) = \begin{cases} x - 6, \text{ if } x < 4 \\ 8 - x, \text{ if } x \geq 4 \end{cases}$

A. 8

B. -2

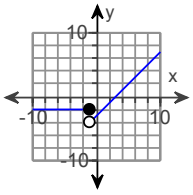
C. 4

D. -6

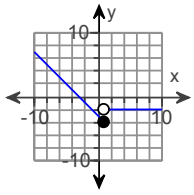
25. Graph the function.

$f(x) = \begin{cases} -2, & \text{if } x \geq 1 \\ -3 - x, & \text{if } x < 1 \end{cases}$

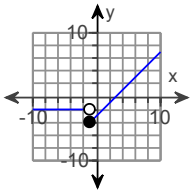
A.



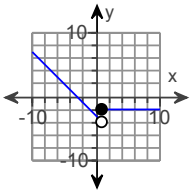
B.



C.



D.



26. Divide. Write with positive exponents.

$$\frac{15x^7 - 25x^4}{-5x^7}$$

A. $-3 + \frac{5}{x^3}$

B. $-3 - 25x^4$

C. $-3 + 5x^3$

D. $15x^7 + \frac{5}{x^3}$

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

$2x^3 + 3x^2 + 4x - 10,\ x + 1$

- **A.** Quotient: $2x^2 + x + 3$; remainder: -13
- **B.** Quotient: $2x^2 + 5x + 9$; remainder: -1
- **C.** Quotient: $2x^2 + 5x + 9$; remainder: 1
- **D.** Quotient: $2x^2 + x + 3$; remainder: 13

28. Divide.

$$\frac{x^5 + 3x^4 - 7x - 65}{x - 2}$$

- **A.** $x^4 + x^3 + 10x^2 + x + 33 + \frac{1}{x-2}$
- **B.** $x^4 - 5x^3 + 10x^2 - 20x + 33 + \frac{1}{x-2}$
- **C.** $x^4 + 5x^3 + 10x^2 + 20x + 33 + \frac{1}{x-2}$
- **D.** $x^4 + 5x^3 + 10x^2 + 20x + 33$

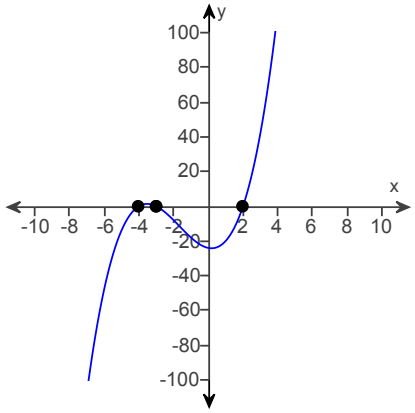
29. Divide.

$$\frac{x^4 + x^2 + 8}{x^2 - x + 4}$$

- **A.** $x^2 + x - 2 + \frac{6x + 16}{x^2 - x + 4}$
- **B.** $x^2 + x - 2 + \frac{-6x - 16}{x^2 - x + 4}$
- **C.** $x^2 + x - 2 + \frac{-6x + 16}{x^2 - x + 4}$
- **D.** $x^2 - x - 2 + \frac{-6x - 16}{x^2 - x + 4}$

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

y = f(x)



- **A.** (x + 2), (x − 4), (x − 3)
- **B.** (x − 2), (x + 4), (x + 3)
- **C.** (x − 2), (x − 4), (x + 3)
- **D.** (x + 2), (x + 4), (x − 3)

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

$f(x) = x^3 - 12x^2 + 47x - 60$; 5 is a zero

- **A.** f(x) = (x − 4)(x + 3)(x − 5)
- **B.** f(x) = (x − 4)(x − 3)(x − 5)
- **C.** f(x) = (x + 4)(x + 3)(x + 5)
- **D.** f(x) = (x + 4)(x − 3)(x + 5)

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

$f(x) = 3x^3 + 25x^2 + 42x - 40$; − 4 is a zero

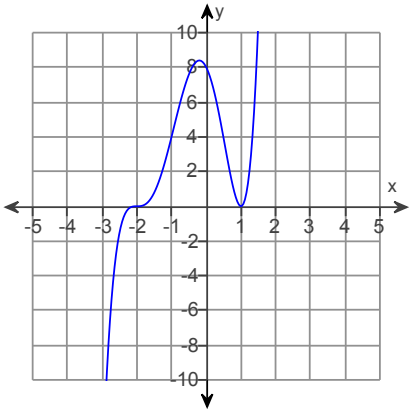
- **A.** $f(x) = \left(x - \frac{2}{3}\right)(x + 5)(x + 4)$
- **B.** $f(x) = \left(x + \frac{2}{3}\right)(x + 5)(x + 4)$
- **C.** $f(x) = 3\left(x + \frac{2}{3}\right)(x + 5)(x + 4)$
- **D.** $f(x) = 3\left(x - \frac{2}{3}\right)(x + 5)(x + 4)$

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

$f(x) = x^3 - 5x^2 - 2x + 24$; zeros: 3, − 2, 4

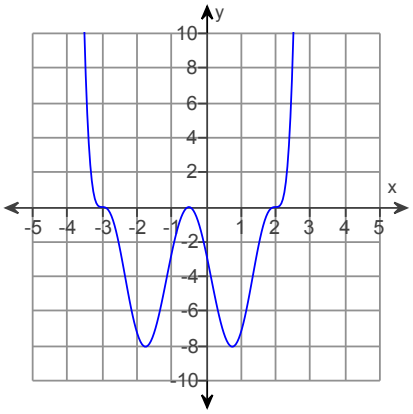
- **A.** f(x) = (x + 3)(x + 2)(x + 4)
- **B.** f(x) = (x − 3)(x + 2)(x − 4)
- **C.** f(x) = (x − 3)(x − 2)(x − 4)
- **D.** f(x) = (x + 3)(x − 2)(x + 4)

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



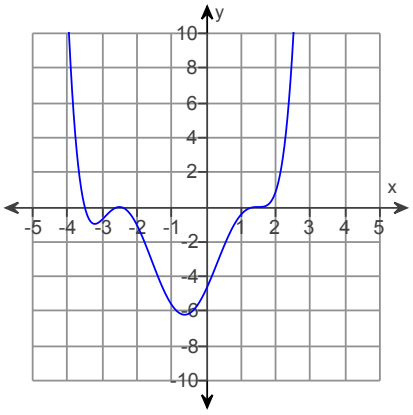
- **A.** −2 (odd), 1 (even)
- **B.** −2 (even), 1 (even)
- **C.** −2 (odd), 1 (odd)
- **D.** −2 (even), 1 (odd)

35. 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), $-\frac{1}{2}$ (odd), 2 (even)
- **B.** −3 (even), $-\frac{1}{2}$ (odd), 2 (even)
- **C.** −3 (even), $-\frac{1}{2}$ (even), 2 (odd)
- **D.** −3 (odd), $-\frac{1}{2}$ (even), 2 (odd)

36. 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.** −3.5 (even), −2.5 (odd), 1.5 (even)
- **B.** −3.5 (odd), −2.5 (even), 1.5 (odd)
- **C.** −3.5 (odd), −2.5 (even), 1.5 (even)
- **D.** −3.5 (even), −2.5 (odd), 1.5 (odd)

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

$f(x) = 7x^4 + 9x^3 - 26x^2 - 36x - 8$

- **A.** Zeros: $1, \frac{2}{7}, 2, -2$
- **B.** Zeros: $-1, \frac{2}{7}, 2, -2$
- **C.** Zeros: $-1, -\frac{2}{7}, 2, -2$
- **D.** Zeros: $1, \frac{2}{7}, 2, -2$

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

$f(x) = 4x^4 + 16x^3 - 21x^2 - 4x + 5$

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

39. Solve the polynomial equation graphically or numerically.

$x^3 - 4x^2 - 25x + 100 = 0$

- **A.** 25, 4, 100
- **B.** $-5, 4, 5$
- **C.** $-4, 4, 5$
- **D.** 4

40. Solve the polynomial equation symbolically.

$x^3 - 100x = 0$

- **A.** $0, 20, -20$
- **B.** $20, -20$
- **C.** $0, 10, -10$
- **D.** $10, -10$

41. Solve the polynomial equation graphically or numerically.

$6x^3 + 19x^2 + 8x - 5 = 0$

- **A.** $-1, \frac{1}{3}, \frac{5}{2}$
- **B.** $\frac{1}{3}, \frac{1}{3}, -\frac{5}{2}$
- **C.** $-1, -\frac{5}{2}, \frac{1}{3}$
- **D.** $-\frac{1}{3}, -\frac{5}{2}, \frac{1}{3}$

---

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

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

- **A.** $f(x) = 3(x - 8i)(x + 8i)$
- **B.** $f(x) = (3x - 8i)(3x + 8i)$
- **C.** $f(x) = 3\left(x^2 + 64\right)$
- **D.** $f(x) = 3x^2 + 64$

---

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

$f(x) = x^3 + 7x^2 - 2x - 14$, $k = -7$

- **A.** $-\sqrt{7}, \pm\sqrt{2}$
- **B.** $-7, \pm 2$
- **C.** $-7, \pm\sqrt{2}$
- **D.** $-\sqrt{7}, \pm 2$

---

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

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

- **A.** $f(x) = x(x + 5i)(x - i)$
- **B.** $f(x) = 5x(x + 1)^2$
- **C.** $f(x) = 5x(x + i)(x - i)$
- **D.** $f(x) = 5x(x + i)^2$

---

45. Solve the polynomial equation.

$x^3 + 3x^2 + 9x + 27 = 0$

- **A.** $x = -\sqrt{3}, -\sqrt{3}, 3i$
- **B.** $x = -3, -\sqrt{3}, -\sqrt{3}$
- **C.** $x = -3, -3i, 3i$
- **D.** $x = -3, 27i, 9i$

1. A. $14 + 4i$

2. A. $-8 + 7i$

3. A. $-112 - 180i$

4. C. $6i$

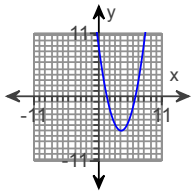
5. C. $4 \pm 6i$

6. B. $x < 4$ or $x > 7$

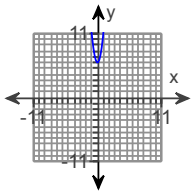
7. A. $x \leq -4$ or $x \geq 4$

8. C. $y = (x - 8)^4 + 3$

9. C.



10. A.



11. B. Stretch it vertically with factor 4 and reflect it across the x-axis.

12. C. Degree: 6; leading coefficient: 17

13. B. Degree: 4; leading coefficient: -16

14. D. Not a polynomial function

15. A. No absolute maximumNo absolute minimum

16. D. No absolute maximumAbsolute minimum: approx. -7.67

17. B. Odd

---

18. A. Even

---

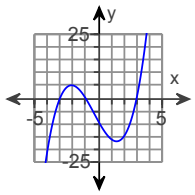
19. B. Neither

---

20. C. -3, positive

---

21. C.



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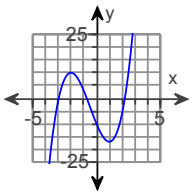
22. D.



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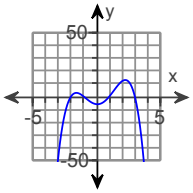
23. A.



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24. D. -6

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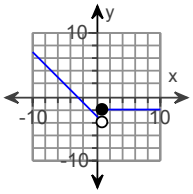
25. D.



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26. A. $-3+\frac{5}{x^3}$

---

27. A. Quotient: $2x^2+x+3$; remainder: -13

---

28. C. $x^4+5x^3+10x^2+20x+33+\frac{1}{x-2}$

---

29. C. $x^2 + x - 2 + \dfrac{-6x + 16}{x^2 - x + 4}$

---

30. B. $(x - 2)$, $(x + 4)$, $(x + 3)$

---

31. B. $f(x) = (x - 4)(x - 3)(x - 5)$

---

32. D. $f(x) = 3\left(x - \dfrac{2}{3}\right)(x + 5)(x + 4)$

---

33. B. $f(x) = (x - 3)(x + 2)(x - 4)$

---

34. A. -2 (odd), 1 (even)

---

35. D. -3 (odd), $-\dfrac{1}{2}$ (even), 2 (odd)

---

36. B. -3.5 (odd), -2.5 (even), 1.5 (odd)

---

37. C. Zeros: -1, $-\dfrac{2}{7}$, 2, -2

---

38. B. Zeros: 1, -5, $\dfrac{1}{2}$, $-\dfrac{1}{2}$

---

39. B. -5, 4, 5

---

40. C. 0, 10, -10

---

41. C. -1, $-\dfrac{5}{2}$, $\dfrac{1}{3}$

---

42. A. $f(x) = 3(x - 8i)(x + 8i)$

---

43. C. -7, $\pm\sqrt{2}$

---

44. C. $f(x) = 5x(x + i)(x - i)$

---

45. C. $x = -3$, $-3i$, $3i$
