2.1: Solve Using a Graphing Calculator
"I WILL …
Solve a quadratic equation using a graphing calculator.
Find the maximum or minimum of a function."

I. Key Terms

A. Solution is an equation of a number that produces a statement

B. Zero is an input of where the graph function crosses the *x*-axis

C. Intersection is where two graphs meet (DOES NOT PRESS THE *X*-AXIS)

II. Method 1: Intersection

A. Plug in the one side of the equation into Y_1 and the other equation into $Y_2 = 0$.

B. Press [2nd], *TRACE*, [5] or *INTERSECT*.

C. The calculator asks you 2 questions: *FIRST CURVE* and *SECOND CURVE*.

D. Then it says, "*GUESS*". Arrow to an answer you want then press [ENTER].

E. Write answer as a *SOLUTION SET*.

Think of this: [2nd] [TRACE] [5] [ENTER] [ENTER] [ENTER]

Ex 1: Solve $f(x) = -2x^3 - 3x^2 + 3$	Ex 2: Solve $x^3 + 9 = 3x^2 + 6x$	Your Turn: Solve $f(x) = x^4 - 3x^3 + 2x^2 - 1$
Ex 3: Solve $\lvert x^2 - 4x - 3 \rvert = x^3 + x - 6$		Your Turn: $\lvert x^3 + 2 \rvert = -x^2 + x + 5$
Ex 4: Solve $\sqrt{x^4 + 2x^2 - 2x - 1} = 0$		Ex 5: $\sqrt{x^2 - 1} - \sqrt{x + 9} = 0$
Ex 5: Solve $\dfrac{2x^2 - x - 3}{8x^2 - 7x - 4} = 0$		Your Turn: $\dfrac{3x^5 - 15x + 5}{x^7 - 8x^5 + 2x^2 - 5} = 0$

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Exercises 2.1

In Exercises 1–6, determine graphically the number of solutions of the equation, but don't solve the equation. You may need a viewing window other than the standard one to find all of the x-intercepts.

1. $x^5 + 5 = 3x^4 + x$

2. $x^3 + 5 = 3x^2 + 24x$

3. $x^7 - 10x^5 + 15x + 10 = 0$

4. $x^5 + 36x + 25 = 13x^3$

5. $x^4 + 500x^2 - 8000x = 16x^3 - 32{,}000$

6. $6x^5 + 80x^3 + 45x^2 + 30 = 45x^4 + 86x$

In Exercises 7–34, use a graphical method to find all real solutions of the equation, approximating when necessary.

7. $x^3 + 4x^2 + 10x + 15 = 0$

8. $x^3 + 9 = 3x^2 + 6x$

9. $x^4 + x - 3 = 0$

10. $x^5 + 5 = 3x^4 + x$

11. $\sqrt{x^4 + x^3 - x - 3} = 0$

12. $\sqrt{8x^4 - 14x^3 - 9x^2 + 11x - 1} = 0$

13. $\sqrt{\frac{2}{5}x^5 + x^2 - 2x} = 0$

14. $\sqrt{x^4 + x^2 - 3x + 1} = 0$

15. $x^2 = \sqrt{x + 5}$

16. $\sqrt{x^2 - 1} - \sqrt{x + 9} = 0$

17. $\dfrac{2x^5 - 10x + 5}{x^3 + x^2 - 12x} = 0$

18. $\dfrac{3x^5 - 15x + 5}{x^7 - 8x^5 + 2x^2 - 5} = 0$

19. $\dfrac{x^3 - 4x + 1}{x^2 + x - 6} = 0$

20. $\dfrac{4}{x + 2} - \dfrac{3}{x + 1} = 0$ [Use parentheses correctly.]

21. $2x^3 - 4x^2 + x - 3 = 0$

22. $6x^3 - 5x^2 + 3x - 2 = 0$

23. $x^5 - 6x + 6 = 0$

24. $x^3 - 3x^2 + x - 1 = 0$

25. $10x^5 - 3x^2 + x - 6 = 0$

26. $\frac{1}{4}x^4 - x - 4 = 0$

27. $2x - \frac{1}{2}x^2 - \frac{1}{12}x^4 = 0$

28. $\frac{1}{4}x^4 + \frac{1}{3}x^2 + 3x - 1 = 0$

29. $\dfrac{5x}{x^2 + 1} - 2x + 3 = 0$

30. $\dfrac{2x}{x + 5} = 1$

31. $|x^2 - 4| = 3x^2 - 2x + 1$

32. $|x^3 + 2| = 5 + x - x^2$

33. $\sqrt{x^2 + 3} = \sqrt{x - 2} + 5$

34. $\sqrt{x^3 + 2} = \sqrt{x + 5} + 4$

In Exercises 35–40, find an exact solution of the equation in the interval shown to the right of each equation. For example, if the graphical approximation of a solution begins .3333, check to see if $\frac{1}{3}$ is the exact solution. Similarly, if your approximation begins 1.414, check to see if $\sqrt{2}$ is a solution because $\sqrt{2} \approx 1.414$.

35. $3x^3 - 2x^2 + 3x - 2 = 0$ $\quad 0 < x < 1$

36. $4x^3 - 3x^2 - 3x - 7 = 0$ $\quad 1 < x < 2$

37. $12x^4 - x^3 - 12x^2 + 25x - 2 = 0$ $\quad 0 < x < 1$

38. $8x^5 + 7x^4 - x^3 + 16x - 2 = 0$ $\quad 0 < x < 1$

39. $4x^4 - 13x^2 + 3 = 0$ $\quad 1 < x < 2$

40. $x^3 + x^2 - 2x - 2 = 0$ $\quad 1 < x < 2$

41. According to data from the U.S. Department of Education, the average cost y of tuition and fees at public four-year institutions in year x is approximated by the equation

$$y = 0.024x^4 - 0.87x^3 + 9.6x^2 + 97.2x + 2196$$

where $x = 0$ corresponds to 1990. If this model continues to be accurate, during what year will tuition and fees reach $4000?

42. Use the equation in Example 5 to determine the year in which the population of Los Angeles reached 2.6 million.