SOLVE EACH OF THE FOLLOWING QUADRATIC EQUATIONS OVER THE SET OF COMPLEX NUMBERS. Neatly show all steps.

1. Solve the following quadratic equations by the square root method. Leave your answers in simplest radical form.
   A. \(10x^2 = 120\)
   B. \((x + 3)^2 + 8 = 0\)

2. Solve the following quadratic equation by completing the square. Leave your answers in simplest radical form, if necessary.
   A. \(9z^2 - 12z - 8 = 0\)
   B. \(4x^2 + 12x - 7 = 0\)

3. Solve the following quadratic equation by completing the square. Round your answers to the nearest \(100^{th}\).
   \(x^2 - 2x - 7 = 0\)

4. Determine the number of roots and the nature of the roots, over the set of complex numbers, for each quadratic equation.
   A. \(x^2 + 8x + 14 = 0\)
   B. \(4x - 2x^2 = 5\)

5. Solve the following quadratic equation using the quadratic formula. Leave your answer in simplest radical form.
   \(2p^2 + 2p + 1 = 0\)
6. Solve each of the following quadratic equations using any convenient method. Leave your answer in simplest radical form. Show steps.
   
   A. \( x^2 + 4x + 4 = 12 \)  
   B. \( (x - 1)(x + 1) = 5(x - 1) \)  
   C. \( x^4 - 9x^2 + 8 = 0 \)  

7. Find the value of \( k \) so that \( x^2 + 11x + k = 0 \) has only one solution.

8. A landscape contractor wants to make an exposed gravel border of uniform width around a rectangular pool in a garden. The pool is 10 feet long and 6 feet wide. There is enough material to cover 36 square feet. How wide should the border be? Draw and label a diagram.

   Variable Key:  
   Diagram:

   Work & Solution:
9. A lot is in the shape of a right triangle. The longer leg of the triangle is 20 meters longer than twice the length of the shorter leg. The hypotenuse is 10 meters longer than the longer leg. Find the lengths of the three sides of the lot. Draw and label a diagram.

Work & Solution: 

Diagram:

10. Bicyclists A and B leave the same point P at the same time at right angles. B travels 7 km/h faster than A. After 3 hours they are 39 km apart. Find the speed of each.

11. The amount \( s \) (in pounds per acre) of sugar produced from sugarbeets can be modeled by the function \( s = -0.0655n^2 + 7.855n + 5562 \) where \( n \) is the amount (in pounds per acre) of nitrogen fertilizer used. How much fertilizer should you use to maximize sugar production?

12. You want to plant a rectangular garden along part of a 40 foot side of your house. To keep out animals, you will enclose the garden with wire mesh along its three open sides. You will also cover the garden with mulch. If you have 50 feet of mesh and enough mulch to cover 100 square feet, what should the garden's dimensions be?
13. Graph \( y = 2x^2 - 10x + 7 \). State the equation of the axis of symmetry and the vertex. Show all work! Do not use a graphing utility.

14. The total number of dollars spent on recreation in the United States from 1980 to 1988 can be approximated by the model

\[
S = 116,289 + 9506.7t + 841.45t^2,
\]

where the spending is measured in millions of dollars and the time \( t \) represents the year, with \( t = 0 \) corresponding to 1980.

A. Use a graphing utility to graph the recreational spending function.

B. Using the graph, predict when total recreational spending will reach $300,000,000,000.

15. For 1980 through 1995, the annual sales, \( S \) (in 1000’s of $\$$), of a photography studio can be modeled by \( S = -\frac{1}{8}t^2 + 3t + 42 \), where \( t = 0 \) represents 1980. During which year(s) did the studio have sales of $59,000? During which year(s) did the studio have sales of $65,500? Show work to justify your answers.

16. A golf ball is hit from the ground, and its height in feet above the ground is modeled by the function \( h(t) = -16t^2 + 180t \), where \( t \) represents the time in seconds after the ball is hit. How long is the ball in the air?
17. Graph the system of inequalities.
   \[ y \leq -x^2 + 9 \]
   \[ y \geq x^2 + 5x - 3 \]

18. A rectangular stage in a park is being decorated for a 4th of July celebration. The stage has an area of 450 square feet. A skirt made out of weatherproof material is placed around the stage (from the top of the stage to the ground) so that people cannot see underneath the stage. Is 80 feet of skirting material enough to create a skirt that covers all four sides of the stage? **Solve using a system of equations.**

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**Answers:**

1A. \( \pm 2\sqrt{3} \)  
1B. \(-3\pm 2i\sqrt{2}\)  
2A. \( \frac{2\pm 2\sqrt{3}}{3} \)  
2B. \( \frac{1}{2}, \frac{7}{2} \)  
3. \(-1\pm i\)  
5. \( -\frac{1+i}{2} \)  
6A. \(-2\pm 2\sqrt{3}\)  
6B. 4, 1  
6C. \( \pm 1, \pm 2\sqrt{2}\)  
7. \( \frac{121}{4} \)  
8. 1 foot  
9. 50m, 120m, 130m  
10. A: 5km/hr ; B: 12 km/hr  
11. 60 pounds  
12. \( = 22.8' \times 4.4' \)  
13. V(2.5, -5.5)  
14. \( \approx 10.17 \) years  
15. 1989 and 1994; sales never reached $65,000  
16. 11.25 sec.  
18. No