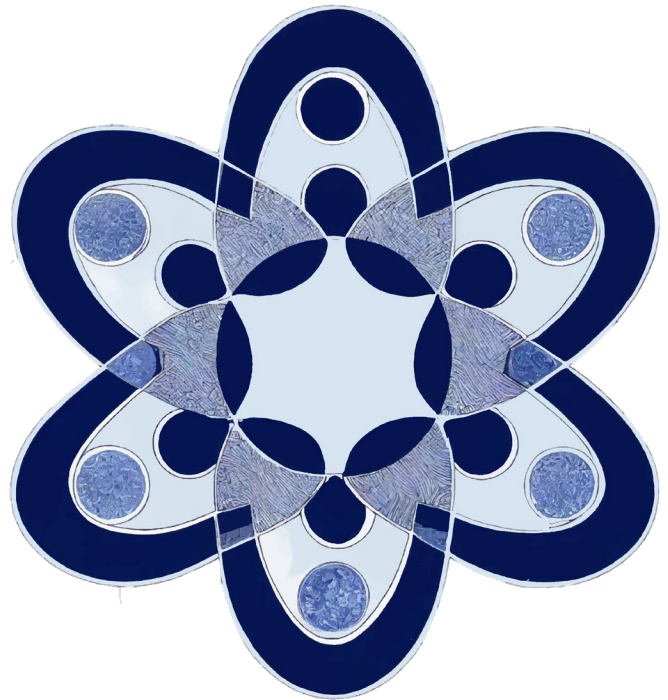


**QUADRATIC EQUATIONS PRACTICE:  
SOLVE BY QUADRATIC FORMULA**

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**COMPLEX ROOTS SOLUTIONS**

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# Quadratic Equations with Complex Roots

## Worksheet

Solve by using the Quadratic formula. Show all work for full credit.

1.  $x^2 - 4x + 1 = 0$

11.  $x^2 + x + 4 = 0;$

2.  $x^2 + x + 1 = 0$

12.  $x^2 - 6x + 13 = 0$

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

13.  $7x^2 - 4x + 3 = 0$

4.  $x^2 - 4x + 9 = 0;$

14.  $x^2 - 4x + 10 = 0$

5.  $x^2 + 2x + 5 = 0$

15.  $x^2 + 6x + 20 = 0$

6.  $x^2 - x + 10 = 0$

16.  $x^2 - 2x + 5 = 0;$

7.  $x^2 + 3x + 7 = 0$

17.  $3x^2 - 4x + 8 = 0$

8.  $x^2 + 3x + 7 = 0$

18.  $3x^2 - 4x + 8 = 0$

9.  $x^2 + 4x + 13 = 0$

19.  $2x^2 - 6x + 13 = 0$

10.  $x^2 - 2x + 10 = 0$

20.  $4x^2 - 5x + 9 = 0$

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## Solutions: Complex Roots Worksheet

### 1) Detailed Steps for Solving $x^2 - 4x + 1 = 0$

$$1. x = \frac{-(-4) \pm \sqrt{(-4)^2 - 4 \cdot 1 \cdot 1}}{2 \cdot 1}$$

$$= \frac{4 \pm \sqrt{16 - 4}}{2}$$

$$= \frac{4 \pm \sqrt{12}}{2}$$

$$= \frac{4 \pm 2\sqrt{3}}{2}$$

$$= 2 \pm \sqrt{3}$$

$$\text{Solutions: } x = 2 + \sqrt{3}, 2 - \sqrt{3}$$

### 2) Detailed Steps for Solving $x^2 + x + 1 = 0$

$$1. x = \frac{-1 \pm \sqrt{(1)^2 - 4 \cdot 1 \cdot 1}}{2 \cdot 1}$$

$$= \frac{-1 \pm \sqrt{1 - 4}}{2}$$

$$= \frac{-1 \pm \sqrt{-3}}{2}$$

$$= \frac{-1 \pm i\sqrt{3}}{2}$$

$$\text{Solutions: } x = -\frac{1}{2} + i\frac{\sqrt{3}}{2}, -\frac{1}{2} - i\frac{\sqrt{3}}{2}$$

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### 3) Detailed Steps for Solving $5x^2 + 6x + 2 = 0$

$$\begin{aligned} 1. \ x &= \frac{-6 \pm \sqrt{6^2 - 4 \cdot 5 \cdot 2}}{2 \cdot 5} \\ &= \frac{-6 \pm \sqrt{36 - 40}}{10} \\ &= \frac{-6 \pm \sqrt{-4}}{10} \\ &= \frac{-6 \pm 2i}{10} \\ &= \frac{-3 \pm i}{5} \end{aligned}$$

$$\text{Solutions: } x = \frac{-3}{5} \pm \frac{1}{5}i$$

### 4) Detailed Steps for Solving $x^2 - 4x + 9 = 0$

$$\begin{aligned} 1. \ x &= \frac{-(-4) \pm \sqrt{(-4)^2 - 4 \cdot 1 \cdot 9}}{2 \cdot 1} \\ &= \frac{4 \pm \sqrt{16 - 36}}{2} \\ &= \frac{4 \pm \sqrt{-20}}{2} \\ &= \frac{4 \pm 2i\sqrt{5}}{2} \\ &= 2 \pm i\sqrt{5} \end{aligned}$$

$$\text{Solutions: } x = 2 + i\sqrt{5}, 2 - i\sqrt{5}$$

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**5) Detailed Steps for Solving  $x^2 + 2x + 5 = 0$**

$$1. x = \frac{-2 \pm \sqrt{2^2 - 4 \cdot 1 \cdot 5}}{2 \cdot 1}$$

$$= \frac{-2 \pm \sqrt{4 - 20}}{2}$$

$$= \frac{-2 \pm \sqrt{-16}}{2}$$

$$= \frac{-2 \pm 4i}{2}$$

$$= -1 \pm 2i$$

Solutions:  $x = -1 + 2i, -1 - 2i$

**6) Detailed Steps for Solving  $x^2 - x + 10 = 0$**

$$1. x = \frac{-(-1) \pm \sqrt{(-1)^2 - 4 \cdot 1 \cdot 10}}{2 \cdot 1}$$

$$= \frac{1 \pm \sqrt{1 - 40}}{2}$$

$$= \frac{1 \pm \sqrt{-39}}{2}$$

$$= \frac{1 \pm i\sqrt{39}}{2}$$

Solutions:  $x = \frac{1+i\sqrt{39}}{2}, \frac{1-i\sqrt{39}}{2}$

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**7) Detailed Steps for Solving  $7x^2 - 4x + 3 = 0$**

$$\begin{aligned} 1. \ x &= \frac{-(-4) \pm \sqrt{(-4)^2 - 4 \cdot 7 \cdot 3}}{2 \cdot 7} \\ &= \frac{4 \pm \sqrt{16 - 84}}{14} \\ &= \frac{4 \pm \sqrt{-68}}{14} \end{aligned}$$

$$\text{Solutions: } x = \frac{4 \pm i\sqrt{68}}{14}$$

**8) Detailed Steps for Solving  $x^2 + 3x + 7 = 0$**

$$\begin{aligned} 1. \ x &= \frac{-3 \pm \sqrt{3^2 - 4 \cdot 1 \cdot 7}}{2 \cdot 1} \\ &= \frac{-3 \pm \sqrt{9 - 28}}{2} \\ &= \frac{-3 \pm \sqrt{-19}}{2} \\ &= \frac{-3 \pm i\sqrt{19}}{2} \end{aligned}$$

$$\text{Solutions: } x = \frac{-3+i\sqrt{19}}{2}, \frac{-3-i\sqrt{19}}{2}$$

**9) Detailed Steps for Solving  $x^2 + 4x + 13 = 0$**

$$\begin{aligned} 1. \ x &= \frac{-4 \pm \sqrt{4^2 - 4 \cdot 1 \cdot 13}}{2 \cdot 1} \\ &= \frac{-4 \pm \sqrt{16 - 52}}{2} \end{aligned}$$

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$$= \frac{-4 \pm \sqrt{-36}}{2}$$

$$= \frac{-4 \pm 6i}{2}$$

$$= -2 \pm 3i$$

Solutions:  $x = -2 + 3i, -2 - 3i$

### 10) Detailed Steps for Solving $x^2 - 2x + 10 = 0$

$$1. x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4 \cdot 1 \cdot 10}}{2 \cdot 1}$$

$$= \frac{2 \pm \sqrt{4 - 40}}{2}$$

$$= \frac{2 \pm \sqrt{-36}}{2}$$

$$= \frac{2 \pm 6i}{2}$$

$$= 1 \pm 3i$$

Solutions:  $x = 1 + 3i, 1 - 3i$

### 11) Detailed Steps for Solving $x^2 + x + 4 = 0$

$$1. x = \frac{-1 \pm \sqrt{1^2 - 4 \cdot 1 \cdot 4}}{2 \cdot 1}$$

$$= \frac{-1 \pm \sqrt{1 - 16}}{2}$$

$$= \frac{-1 \pm \sqrt{-15}}{2}$$

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$$= \frac{-1 \pm i\sqrt{15}}{2}$$

$$\text{Solutions: } x = -\frac{1}{2} + \frac{i\sqrt{15}}{2}, -\frac{1}{2} - \frac{i\sqrt{15}}{2}$$

## 12) Detailed Steps for Solving $x^2 - 6x + 13 = 0$

$$1. x = \frac{-(-6) \pm \sqrt{(-6)^2 - 4 \cdot 1 \cdot 13}}{2 \cdot 1}$$

$$= \frac{6 \pm \sqrt{36 - 52}}{2}$$

$$= \frac{6 \pm \sqrt{-16}}{2}$$

$$= \frac{6 \pm 4i}{2}$$

$$= 3 \pm 2i$$

$$\text{Solutions: } x = 3 + 2i, 3 - 2i$$

## 13) Detailed Steps for Solving $x^2 + 2x + 8 = 0$

$$1. x = \frac{-2 \pm \sqrt{2^2 - 4 \cdot 1 \cdot 8}}{2 \cdot 1}$$

$$= \frac{-2 \pm \sqrt{4 - 32}}{2}$$

$$= \frac{-2 \pm \sqrt{-28}}{2}$$

$$= \frac{-2 \pm i\sqrt{28}}{2}$$

$$= -1 \pm i\sqrt{7}$$

$$\text{Solutions: } x = -1 + i\sqrt{7}, -1 - i\sqrt{7}$$



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**14) Detailed Steps for Solving  $x^2 - 4x + 10 = 0$**

$$\begin{aligned} 1. \ x &= \frac{-(-4) \pm \sqrt{(-4)^2 - 4 \cdot 1 \cdot 10}}{2 \cdot 1} \\ &= \frac{4 \pm \sqrt{16 - 40}}{2} \\ &= \frac{4 \pm \sqrt{-24}}{2} \\ &= \frac{4 \pm i\sqrt{24}}{2} \\ &= 2 \pm i\sqrt{6} \end{aligned}$$

Solutions:  $x = 2 + i\sqrt{6}, 2 - i\sqrt{6}$

**15) Detailed Steps for Solving  $x^2 + 6x + 20 = 0$**

$$\begin{aligned} 1. \ x &= \frac{-6 \pm \sqrt{6^2 - 4 \cdot 1 \cdot 20}}{2 \cdot 1} \\ &= \frac{-6 \pm \sqrt{36 - 80}}{2} \\ &= \frac{-6 \pm \sqrt{-44}}{2} \\ &= \frac{-6 \pm i\sqrt{44}}{2} \\ &= -3 \pm i\sqrt{11} \end{aligned}$$

Solutions:  $x = -3 + i\sqrt{11}, -3 - i\sqrt{11}$

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**16) Detailed Steps for Solving  $x^2 - 2x + 5 = 0$** 

$$1. x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4 \cdot 1 \cdot 5}}{2 \cdot 1}$$

$$= \frac{2 \pm \sqrt{4 - 20}}{2}$$

$$= \frac{2 \pm \sqrt{-16}}{2}$$

$$= \frac{2 \pm 4i}{2}$$

$$= 1 \pm 2i$$

Solutions:  $x = 1 + 2i, 1 - 2i$

**17) Detailed Steps for Solving  $3x^2 - 4x + 8 = 0$** 

$$1. x = \frac{-(-4) \pm \sqrt{(-4)^2 - 4 \cdot 3 \cdot 8}}{2 \cdot 3}$$

$$= \frac{4 \pm \sqrt{16 - 96}}{6}$$

$$= \frac{4 \pm \sqrt{-80}}{6}$$

$$= \frac{4 \pm i\sqrt{80}}{6}$$

$$= \frac{2 \pm i(2\sqrt{5})}{3}$$

Solutions:  $x = \frac{2}{3} + \frac{2i\sqrt{5}}{3}, \quad \frac{2}{3} - \frac{2i\sqrt{5}}{3}$

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**18) Detailed Steps for Solving  $3x^2 - 4x + 8 = 0$**

$$\begin{aligned} 1. \ x &= \frac{-(-4) \pm \sqrt{(-4)^2 - 4 \cdot 3 \cdot 8}}{2 \cdot 3} \\ &= \frac{4 \pm \sqrt{16 - 96}}{6} \\ &= \frac{4 \pm \sqrt{-80}}{6} \\ &= \frac{4 \pm i\sqrt{80}}{6} \\ &= \frac{2 \pm i\sqrt{20}}{3} \end{aligned}$$

$$\text{Solutions: } x = \frac{2}{3} + \frac{i\sqrt{20}}{3}, \quad \frac{2}{3} - \frac{i\sqrt{20}}{3}$$

**19) Detailed Steps for Solving  $2x^2 - 6x + 13 = 0$**

$$\begin{aligned} 1. \ x &= \frac{-(-6) \pm \sqrt{(-6)^2 - 4 \cdot 2 \cdot 13}}{2 \cdot 2} \\ &= \frac{6 \pm \sqrt{36 - 104}}{4} \\ &= \frac{6 \pm \sqrt{-68}}{4} \\ &= \frac{6 \pm i\sqrt{68}}{4} \\ &= \frac{3 \pm i\sqrt{17}}{2} \end{aligned}$$

$$\text{Solutions: } x = \frac{3}{2} + \frac{i\sqrt{17}}{2}, \quad \frac{3}{2} - \frac{i\sqrt{17}}{2}$$

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## 20) Detailed Steps for Solving $4x^2 - 5x + 9 = 0$

$$1. x = \frac{-(-5) \pm \sqrt{(-5)^2 - 4 \cdot 4 \cdot 9}}{2 \cdot 4}$$

$$= \frac{5 \pm \sqrt{25 - 144}}{8}$$

$$= \frac{5 \pm \sqrt{-119}}{8}$$

$$= \frac{5 \pm i\sqrt{119}}{8}$$

$$\text{Solutions: } x = \frac{5}{8} \pm \frac{\sqrt{119}}{8}i$$

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Quadratic Equations Practice Worksheet

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