

# Complex Numbers: Absolute Value & Trigonometric Form

Precalculus Worksheet · Grade 11–12

Name: \_\_\_\_\_

Date: \_\_\_\_\_

## Learning Objectives

- Graph complex numbers on the complex plane using real and imaginary axes
- Calculate the absolute value (modulus) of a complex number using the distance formula
- Convert complex numbers from rectangular form to trigonometric (polar) form

## Problems

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1. Identify the real part and imaginary part of the complex number below.

$$7 - 4i$$

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2. Plot the complex number below by identifying the coordinates on the complex plane. State the ordered pair (a, b) that represents its location.

$$3 + 5i$$

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3. Find the absolute value of the complex number below.

$$4 + 3i$$

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4. Find the absolute value of the complex number below.

$$5 - 12i$$

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5. Find the absolute value of the complex number below. Leave your answer in simplified radical form.

$$-3 + 7i$$

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6. Determine which of the two complex numbers below is closer to the origin by comparing their absolute values.

$$z_1 = -4 + 3i \quad \text{and} \quad z_2 = 1 - 6i$$

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7. Convert the complex number below to trigonometric (polar) form. Round the angle to the nearest degree.

$$1 + i$$

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8. Convert the complex number below to trigonometric (polar) form. Round the angle to the nearest tenth of a degree.

$$3 - 4i$$

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9. Convert the complex number below to trigonometric (polar) form. Round the angle to the nearest tenth of a degree.

$$-2 - 2\sqrt{3}i$$

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10. A complex number  $z$  has absolute value 6 and its angle  $\theta$  is 150 degrees. Write  $z$  in rectangular form ( $a + bi$ ). Leave exact values using radicals where necessary.

$$z = 6(\cos 150^\circ + i\sin 150^\circ)$$

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# Complex Numbers: Absolute Value & Trigonometric Form — Answer Key

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## Answer Key

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### 1. Answer: Real part: 7, Imaginary part: -4

- A complex number is written as  $a + bi$ , where  $a$  is the real part and  $b$  is the imaginary part.
- Here  $a = 7$  and  $b = -4$ .

### 2. Answer: (3, 5)

- The real part  $a = 3$  is plotted on the horizontal (real) axis.
- The imaginary part  $b = 5$  is plotted on the vertical (imaginary) axis.
- The point is at  $(3, 5)$  on the complex plane.

### 3. Answer: 5

- Use the formula  $|z| = \sqrt{a^2 + b^2}$ .
- $|z| = \sqrt{4^2 + 3^2} = \sqrt{16 + 9} = \sqrt{25} = 5$ .

### 4. Answer: 13

- Use the formula  $|z| = \sqrt{a^2 + b^2}$ .
- $|z| = \sqrt{5^2 + (-12)^2} = \sqrt{25 + 144} = \sqrt{169} = 13$ .

### 5. Answer: $\sqrt{58}$

- Use the formula  $|z| = \sqrt{a^2 + b^2}$ .
- $|z| = \sqrt{(-3)^2 + 7^2} = \sqrt{9 + 49} = \sqrt{58}$ .
- $\sqrt{58}$  cannot be simplified further.

### 6. Answer: $z_1$ is closer ( $|z_1| = 5$ , $|z_2| = \sqrt{37} \approx 6.08$ )

- $|z_1| = \sqrt{(-4)^2 + 3^2} = \sqrt{16 + 9} = \sqrt{25} = 5$ .
- $|z_2| = \sqrt{1^2 + (-6)^2} = \sqrt{1 + 36} = \sqrt{37} \approx 6.08$ .
- Since  $5 < 6.08$ ,  $z_1 = -4 + 3i$  is closer to the origin.

### 7. Answer: $z = \sqrt{2}(\cos 45^\circ + i \sin 45^\circ)$

- Find  $r$ :  $r = \sqrt{1^2 + 1^2} = \sqrt{2}$ .
- Find  $\theta$ :  $\theta = \arctan\left(\frac{b}{a}\right) = \arctan\left(\frac{1}{1}\right) = 45^\circ$ .
- Since the complex number is in Quadrant I,  $\theta = 45^\circ$ .
- Write in trig form:  $z = \sqrt{2}(\cos 45^\circ + i \sin 45^\circ)$ .

### 8. Answer: $z = 5(\cos 306.9^\circ + i \sin 306.9^\circ)$

- Find  $r$ :  $r = \sqrt{3^2 + (-4)^2} = \sqrt{9 + 16} = \sqrt{25} = 5$ .
- Find the reference angle:  $\alpha = \arctan\left(\frac{4}{3}\right) \approx 53.1^\circ$ .
- The complex number is in Quadrant IV ( $a > 0$ ,  $b < 0$ ), so  $\theta = 360^\circ - 53.1^\circ = 306.9^\circ$ .

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- Write in trig form:  $z = 5(\cos 306.9^\circ + i \sin 306.9^\circ)$ .
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**9. Answer:  $z = 4(\cos 240^\circ + i \sin 240^\circ)$**

- Find  $r$ :  $r = \sqrt{(-2)^2 + (-2\sqrt{3})^2} = \sqrt{4 + 12} = \sqrt{16} = 4$ .
  - Find the reference angle:  $\alpha = \arctan\left(\frac{2\sqrt{3}}{2}\right) = \arctan(\sqrt{3}) = 60^\circ$ .
  - The complex number is in Quadrant III ( $a < 0, b < 0$ ), so  $\theta = 180^\circ + 60^\circ = 240^\circ$ .
  - Write in trig form:  $z = 4(\cos 240^\circ + i \sin 240^\circ)$ .
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**10. Answer:  $z = -3\sqrt{3} + 3i$**

- Use  $a = r \cos \theta$  and  $b = r \sin \theta$ .
  - $a = 6 \cos 150^\circ = 6 \cdot \left(-\frac{\sqrt{3}}{2}\right) = -3\sqrt{3}$ .
  - $b = 6 \sin 150^\circ = 6 \cdot \frac{1}{2} = 3$ .
  - Write in rectangular form:  $z = -3\sqrt{3} + 3i$ .
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