

Multiplying & Dividing Complex Numbers in Trigonometric Form

Precalculus Worksheet · Grade 11–12

Name: _____

Date: _____

Learning Objectives

- Convert complex numbers from trigonometric form to standard form using unit circle values
- Multiply complex numbers in trigonometric form by multiplying moduli and adding angles
- Divide complex numbers in trigonometric form by dividing moduli and subtracting angles

Problems

1. Convert the complex number in trig form to standard form.

$$2(\cos 30^\circ + i\sin 30^\circ)$$

2. Convert the complex number in trig form to standard form.

$$4(\cos 60^\circ + i\sin 60^\circ)$$

3. Convert the complex number in trig form to standard form. First reduce the angle to be within 0° to 360° .

$$5(\cos 420^\circ + i\sin 420^\circ)$$

4. Convert the complex number in trig form to standard form. First reduce the angle to be within 0° to 360° .

$$\sqrt{2}(\cos 405^\circ + i\sin 405^\circ)$$

5. Multiply the two complex numbers in trig form, then write the product in standard form.

$$3(\cos 45^\circ + i\sin 45^\circ) \cdot 2(\cos 45^\circ + i\sin 45^\circ)$$

6. Multiply the two complex numbers in trig form, then write the product in standard form.

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$$4(\cos 120^\circ + i\sin 120^\circ) \cdot 2(\cos 30^\circ + i\sin 30^\circ)$$

7. Divide the two complex numbers in trig form, then write the quotient in standard form.

$$\frac{6(\cos 270^\circ + i\sin 270^\circ)}{2(\cos 90^\circ + i\sin 90^\circ)}$$

8. Divide the two complex numbers in trig form, then write the quotient in standard form.

$$\frac{10(\cos 315^\circ + i\sin 315^\circ)}{5(\cos 45^\circ + i\sin 45^\circ)}$$

9. Multiply the two complex numbers in trig form, reduce the resulting angle if needed, then write the product in standard form.

$$3\left(\cos \frac{2\pi}{3} + i\sin \frac{2\pi}{3}\right) \cdot 4\left(\cos \frac{5\pi}{6} + i\sin \frac{5\pi}{6}\right)$$

10. Divide the two complex numbers in trig form, reduce the resulting angle to the range 0° to 360° if needed, then write the quotient in standard form.

$$\frac{12(\cos 75^\circ + i\sin 75^\circ)}{4(\cos 300^\circ + i\sin 300^\circ)}$$

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Multiplying & Dividing Complex Numbers in Trigonometric Form — Answer Key

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Answer Key

1. Answer: $\sqrt{3} + i$

- $\cos 30^\circ = \sqrt{3}/2$ and $\sin 30^\circ = 1/2$ from the unit circle
 - Distribute 2: $2 \cdot (\sqrt{3}/2) + i \cdot 2 \cdot (1/2)$
 - Result: $\sqrt{3} + i$
-

2. Answer: $2 + 2i\sqrt{3}$

- $\cos 60^\circ = 1/2$ and $\sin 60^\circ = \sqrt{3}/2$ from the unit circle
 - Distribute 4: $4 \cdot (1/2) + i \cdot 4 \cdot (\sqrt{3}/2)$
 - Result: $2 + 2i\sqrt{3}$
-

3. Answer: $5/2 + (5\sqrt{3}/2)i$

- $420^\circ - 360^\circ = 60^\circ$, so use 60°
 - $\cos 60^\circ = 1/2$ and $\sin 60^\circ = \sqrt{3}/2$
 - Distribute 5: $5 \cdot (1/2) + i \cdot 5 \cdot (\sqrt{3}/2)$
 - Result: $5/2 + (5\sqrt{3}/2)i$
-

4. Answer: $1 + i$

- $405^\circ - 360^\circ = 45^\circ$, so use 45°
 - $\cos 45^\circ = \sqrt{2}/2$ and $\sin 45^\circ = \sqrt{2}/2$
 - Distribute $\sqrt{2}$: $\sqrt{2} \cdot (\sqrt{2}/2) + i \cdot \sqrt{2} \cdot (\sqrt{2}/2)$
 - $\sqrt{2} \cdot \sqrt{2}/2 = 2/2 = 1$, so result is $1 + i$
-

5. Answer: $-6 + 0i$ (which equals -6)

- Multiply moduli: $3 \cdot 2 = 6$
 - Add angles: $45^\circ + 45^\circ = 90^\circ$
 - Product: $6(\cos 90^\circ + i \sin 90^\circ)$
 - $\cos 90^\circ = 0$, $\sin 90^\circ = 1$
 - Result: $6(0 + i \cdot 1) = 6i$
-

6. Answer: $-8 + 0i$ (which equals -8)

- Multiply moduli: $4 \cdot 2 = 8$
 - Add angles: $120^\circ + 30^\circ = 150^\circ$
 - Product: $8(\cos 150^\circ + i \sin 150^\circ)$
 - $\cos 150^\circ = -\sqrt{3}/2$, $\sin 150^\circ = 1/2$
 - Result: $8 \cdot (-\sqrt{3}/2) + i \cdot 8 \cdot (1/2) = -4\sqrt{3} + 4i$
-

7. Answer: $-3 + 0i$ (which equals -3)

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- Divide moduli: $6 \div 2 = 3$
- Subtract angles: $270^\circ - 90^\circ = 180^\circ$
- Quotient: $3(\cos 180^\circ + i \sin 180^\circ)$
- $\cos 180^\circ = -1$, $\sin 180^\circ = 0$
- Result: $3(-1 + 0i) = -3$

8. Answer: $-2 + 0i$ (which equals -2)

- Divide moduli: $10 \div 5 = 2$
- Subtract angles: $315^\circ - 45^\circ = 270^\circ$
- Quotient: $2(\cos 270^\circ + i \sin 270^\circ)$
- $\cos 270^\circ = 0$, $\sin 270^\circ = -1$
- Result: $2(0 + i \cdot (-1)) = -2i$

9. Answer: $6\sqrt{3} - 6i$

- Multiply moduli: $3 \cdot 4 = 12$
- Add angles: $2\pi/3 + 5\pi/6 = 4\pi/6 + 5\pi/6 = 9\pi/6 = 3\pi/2$
- Product: $12(\cos(3\pi/2) + i \sin(3\pi/2))$
- $\cos(3\pi/2) = 0$, $\sin(3\pi/2) = -1$
- Result: $12(0 + i \cdot (-1)) = -12i$

10. Answer: $-(3\sqrt{6})/4 + (3\sqrt{2})/4 \cdot i$ (simplified from $3(\cos 135^\circ + i \sin 135^\circ)$)

- Divide moduli: $12 \div 4 = 3$
- Subtract angles: $75^\circ - 300^\circ = -225^\circ$
- Add 360° to get a positive angle: $-225^\circ + 360^\circ = 135^\circ$
- Quotient: $3(\cos 135^\circ + i \sin 135^\circ)$
- $\cos 135^\circ = -\sqrt{2}/2$, $\sin 135^\circ = \sqrt{2}/2$
- Distribute 3: $3 \cdot (-\sqrt{2}/2) + i \cdot 3 \cdot (\sqrt{2}/2) = -3\sqrt{2}/2 + (3\sqrt{2}/2)i$

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