MA364 Lesson 1

Introduction To Math 364

8 January 2009

Outline

- Who We Are
- Course Admin
- Complex Numbers
  - Course Guide
  - Complex Numbers Similar to Polar Coordinates
  - Intro to Complex Numbers
  - The Complex Plane
  - Complex Conjugate
  - Daily Problem Help
- Polar Form of Complex Numbers, Powers and Roots
  - Complex Numbers in Polar Form
  - Multiplication and Division in Polar Form
  - Powers and Roots of Complex Numbers
- Look Forward
  - Course Guide

Major Bowman's Experiences Military - Lieutenant

- Graduated Engineer Officer Basic Course

Major Bowman's Experiences Military - Lieutenant

Major Bowman's Experiences Military - Lieutenant

Major Bowman's Experiences Military - Lieutenant

- Graduated Engineer Officer Basic Course

Major Bowman's Experiences Military - Lieutenant

- Graduated Engineer Officer Basic Course
- Graduated Airborne School

Major Bowman's Experiences Military - Lieutenant

- Graduated Engineer Officer Basic Course
- Graduated Airborne School
- First Station, Fort Hood with First Cavalry

Major Bowman's Experiences Military

Major Bowman's Experiences Military - Lieutenant

- Graduated Engineer Officer Basic Course
- Graduated Airborne School
- First Station, Fort Hood with First Cavalry

Major Bowman's Experiences Military - Lieutenant

- Graduated Engineer Officer Basic Course
- Graduated Airborne School
- First Station, Fort Hood with First Cavalry
- JROTC Training for Bosnia - Platoon Leader in Bosnia

Major Bowman's Experiences Military - Lieutenant

Major Bowman's Experiences Military - Lieutenant

Major Bowman's Experiences Military - Lieutenant

Major Bowman's Experiences Military - Lieutenant

Major Bowman's Experiences Military - Lieutenant

- Graduated Engineer Officer Basic Course
- Graduated Airborne School
- First Station, Fort Hood with First Cavalry
- JROTC Training for Bosnia - Platoon Leader in Bosnia

Major Bowman's Experiences Military - Lieutenant

- Graduated Engineer Officer Basic Course
- Graduated Airborne School
- First Station, Fort Hood with First Cavalry
- JROTC Training for Bosnia - Platoon Leader in Bosnia
- My Son Andrew born while I was in Bosnia

Major Bowman's Experiences Military - Lieutenant

Major Bowman's Experiences Military - Lieutenant

- Graduated Engineer Officer Basic Course
- Graduated Airborne School
- First Station, Fort Hood with First Cavalry
- JROTC Training for Bosnia - Platoon Leader in Bosnia
- My Son Andrew born while I was in Bosnia

Major Bowman's Experiences Military - Lieutenant

- Graduated Engineer Officer Basic Course
- Graduated Airborne School
- First Station, Fort Hood with First Cavalry
- JROTC Training for Bosnia - Platoon Leader in Bosnia
- My Son Andrew born while I was in Bosnia
- XO at the National Training Center

Major Bowman's Experiences Military - Lieutenant

- Graduated Engineer Officer Basic Course
- Graduated Airborne School
- First Station, Fort Hood with First Cavalry
- JROTC Training for Bosnia - Platoon Leader in Bosnia
- My Son Andrew born while I was in Bosnia
- XO at the National Training Center
- Fire Team Leader in Wild Land Forest Fires in Montana

Major Bowman's Experiences Military - Lieutenant

Major Bowman's Experiences Military - Lieutenant

Major Bowman's Experiences Military - Lieutenant

Major Bowman's Experiences Military - Captain

- Graduated Engineer Advanced Course

Major Bowman's Experiences Military - Captain

- Graduated Engineer Advanced Course
- Daughter Sarah born at the Advanced Course

Major Bowman's Experiences Military - Captain

- Graduated Engineer Advanced Course
- Daughter Sarah born at the Advanced Course
- Graduated CAS3

Major Bowman's Experiences Military - Captain

- Graduated Engineer Advanced Course
- Daughter Sarah born at the Advanced Course
- Graduated CAS3
- Master's of Science in Engineering Management, University of Missouri

Major Bowman's Experiences Military - Captain

- Graduated Engineer Advanced Course
- Daughter Sarah born at the Advanced Course
- Graduated CAS3
- Master's of Science in Engineering Management, University of Missouri
- Moved to Germany - Assistant S3 for 130th Engineer Brigade

Major Bowman's Experiences Military - Captain

- Graduated Engineer Advanced Course
- Daughter Sarah born at the Advanced Course
- Graduated CAS3
- Master's of Science in Engineering Management, University of Missouri
- Moved to Germany - Assistant S3 for 130th Engineer Brigade
- Graduated from Ranger School

Major Bowman's Experiences Military - Captain

Major Bowman's Experiences Military - Captain

Major Bowman's Experiences Military - Captain

- Graduated Engineer Advanced Course
- Daughter Sarah born at the Advanced Course
- Graduated CAS3
- Master's of Science in Engineering Management, University of Missouri
- Moved to Germany - Assistant S3 for 130th Engineer Brigade
- Graduated from Ranger School

Major Bowman's Experiences Military - Captain

- Graduated Engineer Advanced Course
- Daughter Sarah born at the Advanced Course
- Graduated CAS3
- Master's of Science in Engineering Management, University of Missouri
- Moved to Germany - Assistant S3 for 130th Engineer Brigade
- Graduated from Ranger School
- Deployed to Iraq

Major Bowman's Experiences Military - Captain

- Took Command of A54th Engineer Battalion in Iraq

Major Bowman's Experiences Military - Captain

Major Bowman's Experiences Military - Captain

Major Bowman's Experiences Military - Captain

Major Bowman's Experiences Military - Captain

Major Bowman's Experiences Military - Captain

Major Bowman's Experiences Military - Captain

Major Bowman's Experiences Military - Captain

Major Bowman's Experiences Military - Captain

Major Bowman's Experiences Military - Captain

- Took Command of A54th Engineer Battalion in Iraq

Major Bowman's Experiences Military - Captain

- Took Command of A54th Engineer Battalion in Iraq
- Redeployed company and reorganized as Infantry

Major Bowman's Experiences Military - Captain

- Took Command of A54th Engineer Battalion in Iraq
- Redeployed company and reorganized as Infantry
- Trained to go to Afghanistan - Including Riot Control

Major Bowman's Experiences Military - Captain

Major Bowman's Experiences Military - Captain

Major Bowman's Experiences Military - Captain

Major Bowman's Experiences Military - Captain

Major Bowman's Experiences Military - Captain

- Took Command of A54th Engineer Battalion in Iraq
- Redeployed company and reorganized as Infantry
- Trained to go to Afghanistan - Including Riot Control

Major Bowman's Experiences Military - Captain

- Took Command of A54th Engineer Battalion in Iraq
- Redeployed company and reorganized as Infantry
- Trained to go to Afghanistan - Including Riot Control
- Company Commander at CMTC

Major Bowman's Experiences Military - Captain

- Took Command of A54th Engineer Battalion in Iraq
- Redeployed company and reorganized as Infantry
- Trained to go to Afghanistan - Including Riot Control
- Company Commander at CMTC
- Son Nathan Born while in Command

Major Bowman's Experiences Military - Captain

Major Bowman's Experiences Military - Captain

- Took Command of A54th Engineer Battalion in Iraq
- Redeployed company and reorganized as Infantry
- Trained to go to Afghanistan - Including Riot Control
- Company Commander at CMTC
- Son Nathan Born while in Command

Major Bowman's Experiences Military - Captain

- Took Command of A54th Engineer Battalion in Iraq
- Redeployed company and reorganized as Infantry
- Trained to go to Afghanistan - Including Riot Control
- Company Commander at CMTC
- Son Nathan Born while in Command
- Changed Command - Worked for 1ID Engineer Brigade

Major Bowman's Experiences Military - Captain

- Took Command of A54th Engineer Battalion in Iraq
- Redeployed company and reorganized as Infantry
- Trained to go to Afghanistan - Including Riot Control
- Company Commander at CMTC
- Son Nathan Born while in Command
- Changed Command - Worked for 1ID Engineer Brigade
- Moved to Naperville for Master's Degree at University of Illinois Chicago

Major Bowman's Experiences Military - Captain

Major Bowman's Experiences Military - Major

- Promoted to Major at the Naperville VFW

Major Bowman's Experiences Military - Major

Major Bowman's Experiences Military - Major

Major Bowman's Experiences Military - Major

- Promoted to Major at the Naperville VFW

Major Bowman's Experiences Military - Major

- Promoted to Major at the Naperville VFW
- Graduated from UIC

Major Bowman's Experiences Military - Major

Major Bowman's Experiences Military - Major

Major Bowman's Hobbies

- Hobbies
  - Brewing Beer
  - Riding dirt bikes with my Son Andrew
  - Lifting Weights
  - Listening to Music
  - Driving and working on my 1965 Mustang
  - Snow boarding with my Son Andrew
  - Driving my Volvo S60 R

Major Bowman's Hobbies

Major Bowman's Hobbies

Why I am Here

1. I want to help you be the best leader you can be! Soldiers deserve it!

Why I am Here

1. I want to help you be the best leader you can be! Soldiers deserve it!
2. Our soldiers die everyday, make their sacrifice worth it!

Why I am Here

1. I want to help you be the best leader you can be! Soldiers deserve it!
2. Our soldiers die everyday, make their sacrifice worth it!
3. Oh! And I will teach you math also!

Who Are You

- A Little Exercise to find out who you are

Who Are You

- A Little Exercise to find out who you are
- **Oh No Not a Quiz!!!!**

My Web Page

- My Web Site

Instructional Memorandum - Goals

1. My goal is to increase your mathematical literacy to allow you to be successful in engineering.
2. Look at the MA364 Web Site for the schedule.
3. Notice Home Work 1 is posted and due on 29 January.
4. This class may challenge you! Accept the Challenge!

Instructional Memorandum - Objectives

1. The overall course objective is to give you a solid background in mathematics.
2. Review the Block Objectives there are eight of them. This will help you in knowing where we are going.

Instructional Memorandum - Admin

1. Grading - 3000 points:
   - 15% on five problem sets
   - 25% Instructor Points - quizzes and other
   - 30% on two WPRs
   - 30% on the TEE.
2. Problem sets are due at the start of class. Late papers will have 10% deducted per day up to 48 hours then they will be worth 0, but are still due. Documentation is required as always.
3. The Kreyszig Text is required and will be brought to class along with your laptop everyday.

Class Preparation

1. Class Preparation
   - 1.1 Come to class having completed the reading assignment and worked the problems listed in the course guide
   - 1.2 Read in two phases:
     - 1.2.1 Initial Scan - highlight formulas
     - 1.2.2 Second Read - try to understand concepts or examples
     - 1.2.3 Do the problems and come to class with questions

Instructor Points

1. Graded quizzes may be given weekly, depending on how many we take I will drop some of the lowest scores.

Bonus Points

1. **Bonus Point Opportunities**
   1.1 Cadets who bring in an application of that days topic that is not listed in the book or course guide will be eligible for bonus points, positive spot reports, or an additional low quiz drop. Cadets will vote on the relevance and quality of the application. I will be the final vote. Cadet should include a video, computer application, or physical model and be able to defend their application.

Last bit of Admin

1. Use Outlook to schedule AI with me when needed.

Last bit of Admin

2. I am learning too! Together we can make this class exciting and rewarding.

Outline

Who We Are
Course Admin
Complex Numbers
- Course Guide
- Complex Numbers Similar to Polar Coordinates
- Intro to Complex Numbers
- The Complex Plane
- Complex Conjugate
- Daily Problem Help

Polar Form of Complex Numbers, Powers and Roots
- Complex Numbers in Polar Form
- Multiplication and Division in Polar Form
- Powers and Roots of Complex Numbers

Look Forward
- Course Guide

Objectives

Complex Numbers (Kreyszig 13.1, 13.2, 13.5, and 13.6)

1. Understand the geometry of the complex plane and of rectangular and polar representations.
2. Convert from rectangular to polar representations (Euler's formula) and polar to rectangular representations (trigonometry).
3. Perform arithmetic with complex numbers, including multiplication, division, powers, roots, exponentiation, and logarithms.

Daily Problems: 13.1: 1-2, 6-19, 13.2: 1-30

Outline

Who We Are
Course Admin
Complex Numbers
- Course Guide
- Complex Numbers Similar to Polar Coordinates
- Intro to Complex Numbers
- The Complex Plane
- Complex Conjugate
- Daily Problem Help

Polar Form of Complex Numbers, Powers and Roots
- Complex Numbers in Polar Form
- Multiplication and Division in Polar Form
- Powers and Roots of Complex Numbers

Look Forward
- Course Guide

Review of Polar Coordinates

1. Cartesian Coordinates are $f(x, y)$ where every point is given with x and y coordinates. Polar Coordinates are $f(r, \theta)$ where every point is given with radius r and angle θ.

Review of Polar Coordinates

1. Cartesian Coordinates are $f(x, y)$ where every point is given with x and y coordinates. Polar Coordinates are $f(r, \theta)$ where every point is given with radius r and angle θ.
2. The relation between the two systems are as follows:

Review of Polar Coordinates

1. Cartesian Coordinates are $f(x, y)$ where every point is given with x and y coordinates. Polar Coordinates are $f(r, \theta)$ where every point is given with radius r and angle θ.
2. The relation between the two systems are as follows:
   2.1 $x^2 + y^2 = r^2$

Review of Polar Coordinates

1. Cartesian Coordinates are $f(x, y)$ where every point is given with x and y coordinates. Polar Coordinates are $f(r, \theta)$ where every point is given with radius r and angle θ.
2. The relation between the two systems are as follows:
   2.1 $x^2 + y^2 = r^2$
   2.2 $x = r\cos\theta, \quad y = r\sin\theta$

Review of Polar Coordinates

1. Cartesian Coordinates are $f(x, y)$ where every point is given with x and y coordinates. Polar Coordinates are $f(r, \theta)$ where every point is given with radius r and angle θ.
2. The relation between the two systems are as follows:
   2.1 $x^2 + y^2 = r^2$
   2.2 $x = r\cos\theta, \quad y = r\sin\theta$
   2.3 $\tan\theta = \frac{y}{x}, \quad \theta = \arctan\frac{y}{x}$

Review of the Unit Circle and Angles you should know.

1. The Unit Circle is a circle with radius $r = 1$

Review of the Unit Circle and Angles you should know.

1. The Unit Circle is a circle with radius $r = 1$
2. This simplifies our polar coordinates to the following

Review of the Unit Circle and Angles you should know.

1. The Unit Circle is a circle with radius $r = 1$
2. This simplifies our polar coordinates to the following
   2.1 $x^2 + y^2 = 1$

Review of the Unit Circle and Angles you should know.

1. The Unit Circle is a circle with radius $r = 1$
2. This simplifies our polar coordinates to the following
   2.1 $x^2 + y^2 = 1$
   2.2 $x = \cos\theta, \quad y = \sin\theta$

Review of the Unit Circle and Angles you should know.

1. The Unit Circle is a circle with radius $r = 1$
2. This simplifies our polar coordinates to the following
   2.1 $x^2 + y^2 = 1$
   2.2 $x = \cos\theta, \quad y = \sin\theta$
   2.3 $\tan\theta = \frac{y}{x}, \quad \theta = \arctan\frac{y}{x}$

Review of the Unit Circle and Angles you should know.

1. The Unit Circle is a circle with radius $r = 1$
2. This simplifies our polar coordinates to the following
   2.1 $x^2 + y^2 = 1$
   2.2 $x = \cos\theta, \quad y = \sin\theta$
   2.3 $\tan\theta = \frac{y}{x}, \quad \theta = \arctan\frac{y}{x}$
   2.4 The following will always be satisfied:

$$\cos^2\theta + \sin^2\theta = 1$$

Review of the Unit Circle and Angles you should know.

1. The Unit Circle is a circle with radius $r = 1$
2. This simplifies our polar coordinates to the following
   2.1 $x^2 + y^2 = 1$
   2.2 $x = \cos\theta, \quad y = \sin\theta$
   2.3 $\tan\theta = \frac{y}{x}, \quad \theta = \arctan\frac{y}{x}$
   2.4 The following will always be satisfied:

$$\cos^2\theta + \sin^2\theta = 1$$

3. You should know or memorize the sin and cos of these common angles: $0,\ \pi/6,\ \pi/4,\ \pi/3,\ \pi/2$ and their counterparts in the other three quadrants of the unit circle.

Outline

Who We Are
Course Admin
Complex Numbers
- Course Guide
- Complex Numbers Similar to Polar Coordinates
- Intro to Complex Numbers
- The Complex Plane
- Complex Conjugate
- Daily Problem Help

Polar Form of Complex Numbers, Powers and Roots
- Complex Numbers in Polar Form
- Multiplication and Division in Polar Form
- Powers and Roots of Complex Numbers

Look Forward
- Course Guide

The complex number z

1. We now are ready to handle equations without real solutions like $x^2 = -1$.

The complex number z

2. A **complex number** z is an ordered pair (x, y) of real numbers x and y, where

The complex number z

2. A **complex number** z is an ordered pair (x, y) of real numbers x and y, where

$$z = (x, y)$$

The complex number z

2. A **complex number** z is an ordered pair (x, y) of real numbers x and y, where
$$z = (x, y)$$

3. x is the **real part** and y is the **imaginary part** of z, written as

The complex number z

2. A **complex number** z is an ordered pair (x, y) of real numbers x and y, where
$$z = (x, y)$$

3. x is the **real part** and y is the **imaginary part** of z, written as
$$x = \operatorname{Re} z, \qquad y = \operatorname{Im} z$$

The complex number z

2. A **complex number** z is an ordered pair (x, y) of real numbers x and y, where
$$z = (x, y)$$

3. x is the **real part** and y is the **imaginary part** of z, written as
$$x = \operatorname{Re} z, \qquad y = \operatorname{Im} z$$

4. $(0, 1)$ is called the **imaginary unit** similar to a unit vector in vector calculus. This imaginary unit is denoted by i,
$$i = (0, 1)$$

Addition and Multiplication of Complex Numbers

Complex Number manipulation is similar to vector manipulation!

Addition and Multiplication of Complex Numbers

Complex Number manipulation is similar to vector manipulation!

1. When adding complex numbers we add the like terms.

Addition and Multiplication of Complex Numbers

Complex Number manipulation is similar to vector manipulation!

1. When adding complex numbers we add the like terms.
2. For multiplication it is convenient to write our z in a different way:

Addition and Multiplication of Complex Numbers

Complex Number manipulation is similar to vector manipulation!

1. When adding complex numbers we add the like terms.
2. For multiplication it is convenient to write our z in a different way:

$$z = (x, y) = x + iy$$

Addition and Multiplication of Complex Numbers

Complex Number manipulation is similar to vector manipulation!

1. When adding complex numbers we add the like terms.
2. For multiplication it is convenient to write our z in a different way:

$$z = (x, y) = x + iy$$

$$\text{also} \quad i^2 = -1 \quad \text{and} \quad i = \sqrt{-1}$$

3. So if we multiply $z_1 z_2 = (x_1 + iy_1)(x_2 + iy_2)$. We get:

Addition and Multiplication of Complex Numbers

Complex Number manipulation is similar to vector manipulation!

1. When adding complex numbers we add the like terms.
2. For multiplication it is convenient to write our z in a different way:

$$z = (x, y) = x + iy$$

$$\text{also} \quad i^2 = -1 \quad \text{and} \quad i = \sqrt{-1}$$

3. So if we multiply $z_1 z_2 = (x_1 + iy_1)(x_2 + iy_2)$. We get:

$$z_1 z_2 = x_1 x_2 + i x_1 y_2 + i y_1 x_2 + i^2 y_1 y_2 = (x_1 x_2 - y_1 y_2) + i(x_1 y_2 + x_2 y_1)$$

Addition and Multiplication of Complex Numbers

Complex Number manipulation is similar to vector manipulation!

1. When adding complex numbers we add the like terms.
2. For multiplication it is convenient to write our z in a different way:

$$z = (x, y) = x + iy$$

$$\text{also} \quad i^2 = -1 \quad \text{and} \quad i = \sqrt{-1}$$

3. So if we multiply $z_1 z_2 = (x_1 + iy_1)(x_2 + iy_2)$. We get:

$$z_1 z_2 = x_1 x_2 + i x_1 y_2 + i y_1 x_2 + i^2 y_1 y_2 = (x_1 x_2 - y_1 y_2) + i(x_1 y_2 + x_2 y_1)$$

$$\text{or} \quad z_1 z_2 = (x_1 x_2 - y_1 y_2,\ x_1 y_2 + x_2 y_1)$$

Outline

Who We Are
Course Admin
Complex Numbers
- Course Guide
- Complex Numbers Similar to Polar Coordinates
- Intro to Complex Numbers
- The Complex Plane
- Complex Conjugate
- Daily Problem Help

Polar Form of Complex Numbers, Powers and Roots
- Complex Numbers in Polar Form
- Multiplication and Division in Polar Form
- Powers and Roots of Complex Numbers

Look Forward
- Course Guide

The Complex Plane

The complex plane is similar to cartesian coordinates where x represented the coordinate along the horizontal axis, and y represented the coordinate along the vertical axis.

The complex plane also has perpendicular axes where once again the x or real component is along the horizontal or real axis and the y or imaginary component is along the vertical or imaginary axis.

This is described as the cartesian coordinate system.

Outline

Who We Are
Course Admin
Complex Numbers
- Course Guide
- Complex Numbers Similar to Polar Coordinates
- Intro to Complex Numbers
- The Complex Plane
- Complex Conjugate
- Daily Problem Help

Polar Form of Complex Numbers, Powers and Roots
- Complex Numbers in Polar Form
- Multiplication and Division in Polar Form
- Powers and Roots of Complex Numbers

Look Forward
- Course Guide

Subtraction and Division

1. When subtracting complex numbers we subtract the like terms.

Subtraction and Division

1. When subtracting complex numbers we subtract the like terms.
2. For division we introduce the complex conjugate. The **complex conjugate** $\bar{z}$ of a complex number $z = x + iy$ is obtained geometrically by reflecting the point z in the real axis and is defined by:

Subtraction and Division

1. When subtracting complex numbers we subtract the like terms.
2. For division we introduce the complex conjugate. The **complex conjugate** $\bar{z}$ of a complex number $z = x + iy$ is obtained geometrically by reflecting the point z in the real axis and is defined by:

$$\bar{z} = x - iy$$

Subtraction and Division

1. When subtracting complex numbers we subtract the like terms.
2. For division we introduce the complex conjugate. The **complex conjugate** $\bar{z}$ of a complex number $z = x + iy$ is obtained geometrically by reflecting the point z in the real axis and is defined by:

$$\bar{z} = x - iy$$

3. I find the division or quotient $z = \frac{z_1}{z_2}$ is easiest to obtain by multiplying the numerator and denominator by the complex conjugate of the denominator and then simplifying.

Subtraction and Division

1. When subtracting complex numbers we subtract the like terms.
2. For division we introduce the complex conjugate. The **complex conjugate** $\bar{z}$ of a complex number $z = x + iy$ is obtained geometrically by reflecting the point z in the real axis and is defined by:

$$\bar{z} = x - iy$$

3. I find the division or quotient $z = \frac{z_1}{z_2}$ is easiest to obtain by multiplying the numerator and denominator by the complex conjugate of the denominator and then simplifying.

$$z = \frac{z_1}{z_2} = \frac{z_1}{z_2} \cdot \frac{\overline{z_2}}{\overline{z_2}} = \frac{x_1 + iy_1}{x_2 + iy_2} \cdot \frac{x_2 - iy_2}{x_2 - iy_2}$$

More about the Complex Conjugate

1. The Complex Conjugate allows us to switch from complex to real. We multiply a complex number by its complex conjugate and get a real number. Where $z\bar{z} = x^2 + y^2$

More about the Complex Conjugate

1. The Complex Conjugate allows us to switch from complex to real. We multiply a complex number by its complex conjugate and get a real number. Where $z\bar{z} = x^2 + y^2$
2. More manipulation gives us some useful formulas. If we add or subtract we get, $z + \bar{z} = 2x, z - \bar{z} = 2iy$. If we solve for x and y we get:

More about the Complex Conjugate

1. The Complex Conjugate allows us to switch from complex to real. We multiply a complex number by its complex conjugate and get a real number. Where $z\bar{z} = x^2 + y^2$
2. More manipulation gives us some useful formulas. If we add or subtract we get, $z + \bar{z} = 2x, z - \bar{z} = 2iy$. If we solve for x and y we get:

$$\operatorname{Re} z = x = \frac{1}{2}(z + \bar{z}), \qquad \operatorname{Im} z = y = \frac{1}{2i}(z - \bar{z})$$

Outline

Who We Are
Course Admin
Complex Numbers
- Course Guide
- Complex Numbers Similar to Polar Coordinates
- Intro to Complex Numbers
- The Complex Plane
- Complex Conjugate
- Daily Problem Help

Polar Form of Complex Numbers, Powers and Roots
- Complex Numbers in Polar Form
- Multiplication and Division in Polar Form
- Powers and Roots of Complex Numbers

Look Forward
- Course Guide

Daily Problem Help

Questions?

Outline

Who We Are
Course Admin
Complex Numbers
- Course Guide
- Complex Numbers Similar to Polar Coordinates
- Intro to Complex Numbers
- The Complex Plane
- Complex Conjugate
- Daily Problem Help

Polar Form of Complex Numbers, Powers and Roots
- Complex Numbers in Polar Form
- Multiplication and Division in Polar Form
- Powers and Roots of Complex Numbers

Look Forward
- Course Guide

The Polar Form of Complex Numbers is a direct reflection of the polar form we already know. We still use r and θ.

The Polar Form of Complex Numbers is a direct reflection of the polar form we already know. We still use r and θ.

1. Since our x and y are still defined as $x = r\cos\theta,\ y = r\sin\theta$ it is easy to define z our complex number in polar form.
   Remembering that $z = x + iy$ we substitute our polar form of x and y into z and get:

The Polar Form of Complex Numbers is a direct reflection of the polar form we already know. We still use r and θ.

1. Since our x and y are still defined as $x = r\cos\theta,\ y = r\sin\theta$ it is easy to define z our complex number in polar form. Remembering that $z = x + iy$ we substitute our polar form of x and y into z and get:

$$z = r\cos\theta + i\,r\sin\theta = r(\cos\theta + i\sin\theta)$$

The Polar Form of Complex Numbers is a direct reflection of the polar form we already know. We still use r and θ.

1. Since our x and y are still defined as $x = r\cos\theta,\ y = r\sin\theta$ it is easy to define z our complex number in polar form. Remembering that $z = x + iy$ we substitute our polar form of x and y into z and get:

$$z = r\cos\theta + i\,r\sin\theta = r(\cos\theta + i\sin\theta)$$

2. r is called the **absolute value** of **modulus** of z and is written as $|z|$. We calculate it in the following way:

The Polar Form of Complex Numbers is a direct reflection of the polar form we already know. We still use r and θ.

1. Since our x and y are still defined as $x = r\cos\theta,\ y = r\sin\theta$ it is easy to define z our complex number in polar form. Remembering that $z = x + iy$ we substitute our polar form of x and y into z and get:

$$z = r\cos\theta + i\,r\sin\theta = r(\cos\theta + i\sin\theta)$$

2. r is called the **absolute value** of **modulus** of z and is written as $|z|$. We calculate it in the following way:

$$|z| = r = \sqrt{x^2 + y^2} = \sqrt{z\bar{z}}$$

The Polar Form of Complex Numbers is a direct reflection of the polar form we already know. We still use r and θ.

1. Since our x and y are still defined as $x = r\cos\theta,\ y = r\sin\theta$ it is easy to define z our complex number in polar form. Remembering that $z = x + iy$ we substitute our polar form of x and y into z and get:

$$z = r\cos\theta + i\,r\sin\theta = r(\cos\theta + i\sin\theta)$$

2. r is called the **absolute value** of **modulus** of z and is written as $|z|$. We calculate it in the following way:

$$|z| = r = \sqrt{x^2 + y^2} = \sqrt{z\bar{z}}$$

3. Notice how similar it looks to the radius or hypotonus and how r is a real number! The number r or $|z|$ is the distance from the origin to the point z.

Finding θ in the complex plane is exactly the same as before.

Finding θ in the complex plane is exactly the same as before.

1. θ is called the **argument** of z and is denoted by $\arg z$, where $\theta = \arg z$ and is again given by:

Finding θ in the complex plane is exactly the same as before.

1. θ is called the **argument** of z and is denoted by $\arg z$, where $\theta = \arg z$ and is again given by:

$$\tan\theta = \frac{y}{x} \qquad (z \neq 0)$$

Finding θ in the complex plane is exactly the same as before.

1. θ is called the **argument** of z and is denoted by $\arg z$, where $\theta = \arg z$ and is again given by:

$$\tan\theta = \frac{y}{x} \qquad (z \neq 0)$$

2. This θ we find is the directed angle from the positive x-axis to the vector OP and angles are measured in radians and positive in the counterclockwise direction.

Outline

Who We Are
Course Admin
Complex Numbers
- Course Guide
- Complex Numbers Similar to Polar Coordinates
- Intro to Complex Numbers
- The Complex Plane
- Complex Conjugate
- Daily Problem Help

Polar Form of Complex Numbers, Powers and Roots
- Complex Numbers in Polar Form
- Multiplication and Division in Polar Form
- Powers and Roots of Complex Numbers

Look Forward
- Course Guide

Multiplication

$$z_1 z_2 = r_1 r_2 [\cos(\theta_1 + \theta_2) + i \sin(\theta_1 + \theta_2)]$$

Division

$$\frac{z_1}{z_2} = \frac{r_1}{r_2} [\cos(\theta_1 - \theta_2) + i \sin(\theta_1 - \theta_2)]$$

Outline

Who We Are
Course Admin
Complex Numbers
- Course Guide
- Complex Numbers Similar to Polar Coordinates
- Intro to Complex Numbers
- The Complex Plane
- Complex Conjugate
- Daily Problem Help

Polar Form of Complex Numbers, Powers and Roots
- Complex Numbers in Polar Form
- Multiplication and Division in Polar Form
- Powers and Roots of Complex Numbers

Look Forward
- Course Guide

Powers - De Moivre's Formula

$$z^n = r^n(\cos n\theta + i \sin n\theta).$$

Roots

$$\sqrt[n]{z} = \sqrt[n]{r}\left(\cos\frac{\theta + 2k\pi}{n} + i \sin\frac{\theta + 2k\pi}{n}\right)$$

Outline

Who We Are
Course Admin
Complex Numbers
- Course Guide
- Complex Numbers Similar to Polar Coordinates
- Intro to Complex Numbers
- The Complex Plane
- Complex Conjugate
- Daily Problem Help

Polar Form of Complex Numbers, Powers and Roots
- Complex Numbers in Polar Form
- Multiplication and Division in Polar Form
- Powers and Roots of Complex Numbers

Look Forward
- Course Guide

Course Guide

Complex Numbers, Exponential Form, Trigonometric Functions (Kreyszig 13.5, 13.6)

1. Understand the geometry of the complex plane and of rectangular and polar representations.
2. Convert from rectangular to polar representations (Euler's formula) and polar to rectangular representations (trigonometry).
3. Perform arithmetic with complex numbers, including multiplication, division, powers, roots, exponentiation, and logarithms.

Daily Problems: 13.1: 1-2, 6-19, 13.2: 1-30

Questions?

See You Next Class!