

# Guided Pre-Class Practice

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## Department of Mathematics, CSULA

## Math 1040 Pre-Calculus – Fall 2019

*Instructor: Hillary Vo***Guided Pre-Class Practice****Topic:** Operations with Complex Numbers (Imaginary Numbers)**Date assigned:** 08/23/2019**Date due:** 08/30/2019**Time estimate to complete this assignment:** 50 minutes**Materials needed:** an account on MyOpenMath.com, any devices connected to the Internet, online videos (see Appendix 1), pre-class worksheets (see Appendix 2), pencils, and papers.**Overview/ Introduction****What is this lesson about?**

*Introduce to Lesson:* We have learned that some quadratic equations have no real solutions. *For instance*, the quadratic equation  $x^2 = -1$  has no real solutions because the square of any real number  $x$  is never a negative number. To overcome this deficiency, mathematicians created an expanded system of numbers using the imaginary unit  $i$ , defined as  $i = \sqrt{-1}$ . Note that  $i^2 = -1$ .

This **guided pre-class practice** is about the basic ideas of complex numbers that you need to learn such as: definitions of complex numbers and complex conjugates, plotting complex numbers on a complex plane, and operations of complex numbers such as adding and subtracting complex numbers.

**Why do we care?**

*Background:* This is a Pre-calculus course and a main prerequisite for Calculus courses. While participating in this lesson, you have already learned about the operations with real numbers such as adding, subtracting, multiplying, and dividing. Thus, it is a perfect time for you to discover a new concept of the number system which is called a complex number and its operations. The complex number in a rectangular form is one of the most important topics in any Pre-calculus and Calculus courses. You need to understand this topic well to be well-prepared for a next lesson of complex numbers in a polar form. Furthermore, the knowledge of complex numbers is very necessary for your future majors including Electrical engineering majors, Mathematics majors, Physics majors, and so on.

Through this **guided pre-class practice**, you are assigned to read an online text-book from our course website [www.MyOpenMath.com](http://www.MyOpenMath.com) (Section 8.1), watch assigned videos, and practice pre-class worksheets. Once completing well all assignments in this **guided pre-class practice**, you will have a great opportunity to understand basic ideas of complex numbers in a rectangular form. It also trains you to develop an excellent skill of self-directed learning. You will gain a lot of valuable experience about how to learn, understand, and solve math problems on your own after reading and watching these helpful resources.

*Next steps:* You will be able to apply the knowledge of complex numbers that you have learned from these pre-class activities to prepare, discuss and solve many different kinds of practice problems in the advanced in-class and post-class activities.

### Learning Objectives

#### Basic Objectives for preparatory work

- Give a definition and examples of complex numbers.
- Give examples of complex conjugates.
- Plot a point on a complex plane.
- Add complex numbers.
- Subtract complex numbers.

#### Advanced Objectives for classwork and after class work

- Multiply complex numbers.
- Divide complex numbers.
- Solve a quadratic equation involving complex numbers.
- Find the absolute values of complex numbers.
- Use complex numbers to solve real-world problems.

#### Pre-class Individual Space Activities and Resources [50 minutes]

Procedure	Purpose	Estimated Time	Learning Objective
<i>Step 1:</i> Read Section 8.1 on <a href="http://www.MyOpenMath.com">www.MyOpenMath.com</a> course website.	Introduce students to some basic ideas about complex numbers.	12 minutes	#1 (basic) through #4 (basic)
<i>Step 2:</i> Watch the video 1 “Introduction to Complex Numbers” (see Appendix 1), then answer <b>question 1</b> (see Appendix 2): Give a definition and three examples of complex numbers.	Provide students with the definition of complex numbers and give some examples of complex numbers.	7 minutes	#1 (basic)
<i>Step 3:</i> Answer <b>question 2</b> (see Appendix 2): Express an imaginary number in standard form:  a) $\sqrt{-16}$ b) $\sqrt{-20}$	Check on students’ understanding of writing a complex number in standard form of $a + bi$ .	3 minutes	#1 (basic)
<i>Step 4:</i> Go over Section 8.1 again (if necessary), then answer <b>question 3</b> (see Appendix 2): Give three examples of complex conjugates.	Introduce students to some basic ideas of complex conjugates.	5 minutes	#2 (basic)

<i>Step 5:</i> Watch the video 2 “Plot numbers on the complex plane” (see Appendix 1).	Describe how to plot a point on a complex plane.	3 minutes	#3 (basic)
<i>Step 6:</i> Answer <b>question 4</b> (see Appendix 2): Plot this complex number on the complex plane: $3 - 4i$	Check on students’ understanding of plotting a complex number on the complex plane.	3 minutes	#3 (basic)
<i>Step 7:</i> Watch the video 3 “Adding and Subtracting Complex Number”.	Show students how to add and subtract complex numbers.	4 minutes	#4 (basic)
<i>Step 8:</i> Practice <b>question 5</b> (see Appendix 2): a) Add $5 - 4i$ and $2 + 7i$ b) Subtract $2 + 5i$ from $3 - 6i$	Check on students’ understanding of adding and subtracting complex numbers.	3 minutes	#4 (basic)
<i>Step 9:</i> Double check your answers before submitting your papers.	Build students confidence of their work and their carefulness in solving mathematics problems.	3 minutes	#1 (basic) through #4 (basic)
<i>Step 10:</i> Watch the Video 4: “Multiplying and Dividing Complex Numbers” and then practice <b>question 6</b> (see Appendix 2).	Prerequisite for starting the advanced objectives for classwork and after classwork later.	7 minutes	#1 (advanced)

### Appendix 1

#### Video Resources

Video 1: “Introduction to Complex Numbers”

[https://www.youtube.com/watch?time\\_continue=191&v=NeTRNpBI17I](https://www.youtube.com/watch?time_continue=191&v=NeTRNpBI17I)

Video 2: “Plotting Numbers on the Complex Plane”

<https://www.khanacademy.org/math/algebra2/introduction-to-complex-numbers-algebra-2/the-complex-plane-algebra-2/v/plotting-complex-numbers-on-the-complex-plane>

Video 3: “Adding and Subtracting Complex Numbers” <https://www.youtube.com/watch?v=SGhTjioGqqA>

Video 4: “Multiplying and Dividing Complex Numbers” <https://www.youtube.com/watch?v=O9xQali0NX0>

**Appendix 2****Pre-class Activities**

**Part A: (Question #1 to #5)** Please complete this pre-class assignment by 12:00 pm, on Friday 08/30/2019, then submit it online through our course website (Math 1040/ Section 8.1 Complex Numbers):

- You can choose either to type your answers by selecting Text Entry box **or** to upload your papers under files of: .pdf, .doc, and/or .docx.
- For questions 3 and 5, you must provide your own examples.
- If you do not have access to the Internet at your area, please let me know in advance and we will make alternative arrangements.
- This pre-class assignment will be graded for a total of 5 participation points.

**Question 1** (1pts): Give a definition and three examples of complex numbers

**Question 2** (1pts): Express the imaginary number in standard form

- a)  $\sqrt{-16}$
- b)  $\sqrt{-20}$

**Question 3** (1pts): Give three examples of complex conjugates

**Question 4** (1pts): Plot this complex number on the complex plane:  $3 - 4i$

**Question 5** (1pts): Add and subtract these complex numbers

- a) Add  $5 - 4i$  and  $2 + 7i$
- b) Subtract  $2 + 5i$  from  $3 - 6i$

**Part B: (Entry ticket)** Please practice and bring this **question #6** to class for group discussion on 08/30/2019

**Question 6:** Multiply and divide complex numbers

- a) Multiply  $(4 - 3i)(5 + 2i)$
- b) Divide  $(2 + 5i)$  by  $(3 - 2i)$

**Question?** If you have any questions, please come to my office hours (Monday and Wednesday 12:00 pm – 1:00 pm at ST-F213) **or** contact me via e-mail: [hvo14@calstatela.edu](mailto:hvo14@calstatela.edu).

# Flipped IN-CLASS Lesson Plan

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### Flipped IN-CLASS Lesson Plan

**Topic:**        **Operations with Complex Numbers (Imaginary Numbers)**

**Date:**         08/30/2019

**Time estimate to complete this assignment:** 85 minutes

**Materials needed:** an account on MyOpenMath.com, any devices connected to the Internet, online videos (see Appendix 1), pre-class worksheets (see Appendix 2), in-class worksheets (see Appendix 3 and 4), pencils, papers, chalks, and scientific calculators (if necessary).

Learning Objectives	Basic Objectives for preparatory work	Advanced Objectives for classwork and after classwork
1	Give a definition and examples of complex numbers.	Multiply complex numbers.
2	Give examples complex conjugates.	Divide complex numbers.
3	Plot a point on a complex plane.	Solve a quadratic equation involving complex numbers.
4	Add complex numbers.	Find the absolute values of complex numbers.
5.	Subtract complex numbers.	Use complex numbers to solve real-world problems.

### Flipped IN-CLASS Lesson Plan [85 minutes]

	Time Planned	Activity	Rationale	Resource Needed
<i>Beginning of class period</i>	6 minutes	<ul style="list-style-type: none"> <li>- Review the pre-class assignments (<b>question 1 to 5</b> from the Pre-class activities, see Appendix 2).</li> <li>- Collect students' entry tickets (<b>question 6</b> from the Pre-class activities, see Appendix 2).</li> </ul>	Check on students' understanding of the basic objectives of learning complex numbers.	<ul style="list-style-type: none"> <li>- Papers, pencils and chalks.</li> <li>- All videos (see Appendix 1)</li> <li>- Problem sheets (see Appendix 2).</li> <li>- Section 8.1 (Complex Numbers).</li> </ul>
<i>Middle of period 1</i>	8 minutes	- Teach a mini-lecture based on Q&A from the Pre-class activities.	Make sure students understand well all basic	<ul style="list-style-type: none"> <li>- Papers, pencils and chalks.</li> <li>- Course website:</li> </ul>

		- Ask and answer questions for any misconceptions.	objectives of complex numbers.	<a href="http://www.MyOpenMath.com">www.MyOpenMath.com</a>
<i>Middle of period 2</i>	15 minutes	- Introduce students to a new lecture on multiplying and dividing complex numbers.  - Discuss examples 1 and 2 (see Appendix 3).	- Help students get to know the operations with complex numbers  - Clarify misconceptions about complex numbers.	- Papers, pencils and chalks.  - Video 4 (see Appendix 1).  - Course website: <a href="http://www.MyOpenMath.com">www.MyOpenMath.com</a>
<i>Middle of period 3</i>	6 minutes	- Assign students to work in group for <b>question 6</b> .  - Use think-pair-share strategy: form groups of 3 to 4 students each, let students show their own work first, and then have them share and discuss results with their partners.	- Apply what they have learned into practice problems.  - Check on students' understanding of multiplying and dividing complex numbers.	- Papers, pencils and chalks.  - Video 4 (see Appendix 1).  - <b>Question 6</b> (see Appendix 2).  - Course website: <a href="http://www.MyOpenMath.com">www.MyOpenMath.com</a>
<i>Middle of period 4</i>	10 minutes	- Introduce new practice problems on the board.  - Continue using Think-pair-share technique: <ul style="list-style-type: none"> <li>• Students make notes on their own, then share notes with their partners.</li> <li>• Each group need to show work on the board, then present answers to the class.</li> </ul>	- Make sure each student participates in class activities.  - Use physical movement on the board: one of the most useful methods to help students engage more in class.  - Check on students' understanding.  - Clarify misconceptions (if any).	- Papers, pencils and chalks.  - Course website: <a href="http://www.MyOpenMath.com">www.MyOpenMath.com</a>
<i>Middle of period 5</i>	12 minutes	- Continue explaining advanced objectives # 2 and #3.  - Practice homework problems.	Allow students to learn more knowledge of complex numbers.	- Papers, pencils, and chalks.  - Course website: <a href="http://www.MyOpenMath.com">www.MyOpenMath.com</a>
<i>Middle of period 6</i>	8 minutes	- Show more advanced examples 3 and 4 (see Appendix 3).  - Give students a chance to discuss and ask questions.	Help students to understand deeper by exploring more advanced examples and solving different kinds of quadratic equations	- Papers, pencils, and chalks.  - A list of examples for in-class activities.  - Course website:



		- Arrange students to work in groups.	involving complex numbers.	<a href="http://www.MyOpenMath.com">www.MyOpenMath.com</a>
<i>Middle of period 7</i>	10 minutes	- Finish the last advanced objectives: the application of complex numbers in real-world problems.  - Discuss example 5 (see Appendix 3).	- Give students many benefits of understanding the application of complex numbers in the real-life.  - Encourage students to engage more into the topic of complex numbers.	- Papers, pencils, and chalks.  - An example of complex numbers in the real-life.  - Course website: <a href="http://www.MyOpenMath.com">www.MyOpenMath.com</a>
<i>End of class period</i>	10 minutes	- Recall all advanced objectives of the complex number topic.  - Manage students to self-directed learning and share results with their partners.  - Provide a hand-out of four problems as an <b>Exit-ticket</b> (see Appendix 43).	- Provide students a great time to ask and answer questions before the lecture ends.  - Correct and remark on misconceptions (if any) at the last minutes.  - Check on students' understanding at the end of the class.	- Papers, pencils, and chalks.  - Course website: <a href="http://www.MyOpenMath.com">www.MyOpenMath.com</a>  - Scientific calculators (if necessary).  - Practice problem sheets.  - Exit-ticket sheets.

### Flipped AFTER CLASS Work Plan [Extra view beforehand]

Advanced Learning Objective	Activity and Rationale	Instructions to Students
<p>Multiply complex numbers.</p> <p>Divide complex numbers.</p> <p>Solve a quadratic equation involving complex numbers.</p> <p>Find the absolute values of complex numbers.</p> <p>Use complex numbers to solve real-world problems.</p>	<p><b>Instructors:</b></p> <ul style="list-style-type: none"> <li>- Provide students homework.</li> <li>- Upload all homework online.</li> <li>- Offer homework solutions when students complete it.</li> </ul> <p><b>Students:</b> It is a great opportunity for students to practice and check on their understanding.</p> <ul style="list-style-type: none"> <li>- Review Section 8.1 on the course website <a href="http://www.MyOpenMath.com">www.MyOpenMath.com</a></li> <li>- Write one-page summary sheet for Section 8.1.</li> <li>- Complete homework Section 8.1 online on the course website <a href="http://www.MyOpenMath.com">www.MyOpenMath.com</a>.</li> </ul>	<ul style="list-style-type: none"> <li>- Homework Section 8.1 is due online on the course website <a href="http://www.MyOpenMath.com">www.MyOpenMath.com</a></li> <li>- Students need to complete homework Section 8.1 by Monday, 09/02/2019.</li> <li>- When finishing this homework assignment, students will be able to see the homework solutions.</li> </ul>

**Question?** If you have any questions in regard to this assignment, here are my office hours (Monday and Wednesday 12:00 pm – 1:00 pm at ST-F213) and e-mail: [hvo14@calstatela.edu](mailto:hvo14@calstatela.edu).

### Appendix 3

#### A List of Examples for in-class Activities

**Example 1:** Multiply complex numbers

- a)  $6i(5 - 2i)$
- b)  $(3 + 4i)(-8i)$
- c)  $(\sqrt{14} + i\sqrt{10})(\sqrt{14} - i\sqrt{10})$
- d)  $(2 - 5i)(6 + 3i)$

**Example 2:** Divide complex numbers

- a)  $\frac{3}{4-5i}$
- b)  $\frac{6+2i}{4i}$
- c)  $\frac{4+7i}{1-2i}$
- d)  $\frac{(5-3i)+(5+i)}{(1+6i)-(2-4i)}$

**Example 3:** Solve the quadratic equations

- a)  $x^2 + 4 = 0$
- b)  $3x^2 - 2x + 5 = 0$
- c)  $\frac{3}{2}t^2 - 6t + 9 = 0$
- d)  $1.4t^2 - 2t = 10$



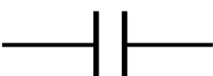
**Example 4:** Find the absolute values of the complex numbers

- a)  $-8i$
- b)  $5i$
- c)  $-6 + i$
- d)  $9 - 4i$
- e)  $-4 - 7i$
- f)  $8 + 14i$

**Example 5:** *The application of complex numbers in a real-world problem*

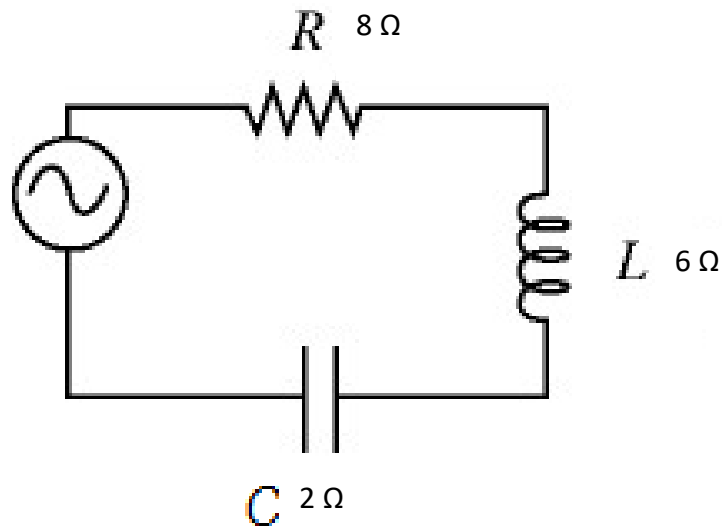
**ELECTRICITY.** Circuit components such as resistors (R), inductors (L), and capacitors (C) all oppose the flow of current. This opposition is called resistance for resistors and reactance for inductors and capacitors. A circuit's total opposition to current flow is *impedance*. All of these quantities are measured in ohms ( $\Omega$ ). The impedance for a series circuit is the sum of the impedances for the individual components.

The following table shows the relationship between a component's resistance or reactance and its contribution to impedance:

Components	Resister (R)	Inductor (L)	Capacitor (C)
Symbol			
	$a\Omega$	$b\Omega$	$c\Omega$
Impedance	$a$	$bi$	$-ci$

*Note:* While a component's resistance or reactance is a real number, its impedance is a complex number.

Find the impedance of the circuit shown below:



*Answer for example 5:*  
*Impedance of circuit =  $8 + 6i + (-2i) = 8 + 4i$  ( $\Omega$ )*

**Appendix 4****Exit-ticket Activities**

*Please finish these problems and remember to submit them to me before you leave.*

*This activity will count 8 participation points.*

**Problem 1:** Multiply and divide complex numbers

- a) Multiply  $(7 - 5i)(4 + 6i)$
- b) Divide  $(12 + 10i)$  by  $(2 - 3i)$

**Problem 2:** Solve the quadratic equation  $x^2 - 8 = -36$

**Problem 3:** Find the absolute value of the complex number  $-4 + 3i$

# Advanced Post-Class Practice

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**Advanced Post-Class Practice**

**Topic:** Operations with Complex Numbers (Imaginary Numbers)

**Date assigned:** 08/30/2019

**Date due:** 09/02/2019

**Time estimate to complete this assignment:** 120 minutes

**Materials needed:** an account on MyOpenMath.com, any devices connected to the Internet, online videos involving the topic of complex numbers, post-class worksheets (see Appendix 5), pencils, and papers.

The advanced post-class practice is given for students to complete after the class meeting.

**Post-class Activities and Deliverables:** You will apply your knowledge of complex numbers to solve homework assignments Section 8.1 (see Appendix 5). After completing this lesson, you will be able to:

- Give a definition and examples of complex numbers.
- Give examples of complex conjugates.
- Plot a point on a complex plane.
- Add complex numbers.
- Subtract complex numbers.
- Multiply complex numbers.
- Divide complex numbers.
- Solve a quadratic equation involving complex numbers.
- Find the absolute values of complex numbers.
- Use complex numbers to solve real-world problems.

**Connections to Future Lesson Plan(s):** In this lesson plan, you have learned about the operations with complex numbers in a rectangular form. In the future lesson plan (probably on Wednesday 11/13/2019), you will continue learning more topics of complex numbers in a polar form (which belong to the trigonometric part).

**Question?** *If you have any questions, please come to my office hours (Monday and Wednesday 12:00 pm – 1:00 pm at ST-F213) or contact me via e-mail: [hvo14@calstatela.edu](mailto:hvo14@calstatela.edu).*

**Note:** If you do not have access to the Internet at your area, please let me know in advance and we will make alternative arrangements.

## The Flipped AFTER CLASS Work Plan [120 minutes]

Advanced Learning Objectives	Activity and Rationale	Instructions to Students
<p>Multiply complex numbers.</p> <p>Divide complex numbers.</p> <p>Solve a quadratic equation involving complex numbers.</p> <p>Find the absolute values of complex numbers.</p> <p>Use complex numbers to solve real-world problems.</p>	<p><b>Instructor:</b></p> <p>On <a href="http://www.MyOpenMath.com">www.MyOpenMath.com</a>:</p> <ul style="list-style-type: none"> <li>- Assign students some most important practice problems involving the complex numbers in a rectangular form.</li> <li>- Prepare and upload online homework for Section 8.1.</li> <li>- Provide students homework solutions after they complete submitting their homework .</li> </ul> <p><b>Students:</b></p> <ul style="list-style-type: none"> <li>- <i>Step 1:</i> Review Section 8.1 from the course website <a href="http://www.MyOpenMath.com">www.MyOpenMath.com</a></li> <li>- <i>Step 2:</i> Write one-page summary sheet for Section 8.1 Complex Numbers in rectangular form.</li> <li>- <i>Step 3:</i> Practice problems involving the complex numbers.</li> <li>- <i>Step 4:</i> Complete homework Section 8.1 online on the course website <a href="http://www.MyOpenMath.com">www.MyOpenMath.com</a></li> </ul>	<ul style="list-style-type: none"> <li>- Homework Section 8.1 (see Appendix 5) must be done online on the course website: <a href="http://www.MyOpenMath.com">www.MyOpenMath.com</a>.</li> <li>- Homework Due: on Monday, 09/02/2019 by 12:00pm.</li> <li>- Students need to carefully follow all instructions steps by steps.</li> <li>- Homework solutions: when students finish submitting their homework assignments, they will be able to see homework solutions under each homework question.</li> </ul> <p><b>Purpose:</b></p> <ul style="list-style-type: none"> <li>❖ It is a great time for students to learn, review, and practice homework assignments that involve the complex numbers.</li> <li>❖ Thanks to the homework solutions, students have an opportunity to check on their understanding or any misconceptions about the complex numbers.</li> </ul>

**Reflection Assignment:**

Please answer three following reflection questions:

1. How are the absolute value of a complex number and the geometry – Pythagorean Theorem related?
2. How do you perceive a flipped-classroom contributing to your ability to learn this math content and improve your critical thinking (Math 1040 Pre-Calculus – Section 8.1 Complex Numbers)?
3. What concepts are the most complicated for you to understand in the topic of complex numbers?

**DUE:** This reflection assignment will be due on Monday, 09/02/2019 by 12:00 pm on [www.MyOpenMath.com](http://www.MyOpenMath.com) (under Math 1040/ Students and Instructor Reflection Forum).

**Appendix 5****Online Homework (Assignment 8.1: Complex Numbers) for Post-class activities****Learning Objectives: All Basic and Advanced Learning Objectives**

1. (1 point)

Express  $\sqrt{-36}$  as a complex number in standard form:  $a + bi$

*Answer:*  $0 + 6i$

2. (1 point)

Express  $1 + \sqrt{-9}$  as a complex number in standard form:  $a + bi$

*Answer:*  $1 + 3i$

3. (1 point)

Perform the indicated operations & simplify, give your answer in standard form.

Add:  $(10 - 5i) + (3 + 22i)$

*Answer:*  $13 + 17i$

Subtract:  $(10 - 5i) - (3 + 22i)$

*Answer:*  $7 - 27i$

4. (1 point)

Express  $\sqrt{-121} - \sqrt{-64}$  as a complex number in standard form:

*Answer:*  $3i$

5. (1 point)

Simplify the following expression  $7(3 + 18i)$

*Answer:*  $21 + 126i$

6. (1 point)

Evaluate the expression  $(2 + 4i)(-1 + 4i)$  and write the result in the form  $a + bi$ .

*Answer:*  $-18 + 4i$

7. (1 point)

Evaluate the expression  $(2 + i)(-2 - i)$  and write the result in the form  $a + bi$ .

**Hint:** Watch the following video “Multiplying Complex Numbers”

<https://www.myopenmath.com/assessment/watchvid.php?url=http%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3DFmr3o2zkwLM>

*Answer:*  $-3 - 4i$

8. (1 point)

What is the complex conjugate of the number  $8 + 9i$ ?

*Answer:*  $8 - 9i$

9. (1 point)



The complex conjugate of  $-2 - 18i$  is?

Answer:  $-2 + 18i$

10. (1 point)

Evaluate the expression  $\frac{4-3i}{2i}$  and write the result in standard form  $a + bi$ .

**Hint:** Watch the following video “Dividing Complex Numbers”

<https://www.myopenmath.com/assessment/watchvid.php?url=http%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3DXBJbJAwM1c>

Answer:  $-\frac{3}{2} - 2i$

11. (1 point)

Simplify the following Expression  $\frac{7+5i}{3+2i}$

Enter the answer as reduced fraction, when necessary.

Answer:  $\frac{31}{13} + \frac{1}{13}i$

12. (1 point)

Simplify the following expression  $\frac{1+7i}{7-6i}$

Enter the answer as reduced fraction, when necessary.

Answer:  $-\frac{7}{17} + \frac{11}{17}i$

13. (1 point)

Let  $f(x) = x^2 + 3x + 3$ .

Evaluate the function for the following, write your answers in standard form  $a + bi$

a)  $f(4 + i)$

Answer:  $30 + 11i$

b)  $f(-i)$

Answer:  $2 - 3i$

14. (1 point)

Find the absolute value of the complex number  $-3 + 10i$

Answer:  $\sqrt{109}$

15. (1 point)

Solve the equation:  $-5(n - 3)^2 = 10$



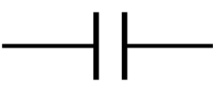
Answer:  $3 \pm i\sqrt{2}$

**A bonus question:** *The application of complex numbers in a real-world problem*

- This question is considered as an **Extra credit** question.
- It counts **2** points.

**ELECTRICITY.** Circuit components such as resistors (R), inductors (L), and capacitors (C) all oppose the flow of current. This opposition is called resistance for resistors and reactance for inductors and capacitors. A circuit's total opposition to current flow is *impedance*. All of these quantities are measured in ohms ( $\Omega$ ). The impedance for a series circuit is the sum of the impedances for the individual components.

*Hints:* The following table shows the relationship between a component's resistance or reactance and its contribution to impedance:

Components	Resister (R)	Inductor (L)	Capacitor (C)
Symbol			
	$a\Omega$	$b\Omega$	$c\Omega$
Impedance	$a$	$bi$	$-ci$

Find the impedance of the circuit shown below:

