

# 04 Numerical Expressions and Operations

Content Area: **Math**  
Course(s):  
Time Period: **Full Year**  
Length: **5-6 weeks**  
Status: **Published**

## General Overview, Course Description or Course Philosophy

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Senior Math Analysis CP is designed for seniors who will pursue liberal arts or humanities in college. The main course objective is to strengthen and extend the concepts of algebra, geometry, and problem solving, including modeling and reasoning. The course integrates ideas of functions and trigonometry with explorations in world-life applications. Additionally, students are provided SAT review and exposure to college placement exam experiences.

## OBJECTIVES, ESSENTIAL QUESTIONS, ENDURING UNDERSTANDINGS

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Objectives: Student will strengthen their understanding and develop their fluency working with rational numbers, radical expressions, and the complex number system. Students will operate with and solve equations within each of these number systems.

Essential Questions:

- Why do we classify numbers into different categories?
- How are various operations carried out across the different number systems?

Enduring Understandings:

- The real numbers consists of all of the rational numbers and all of the irrational numbers
- the square root of a non-square number will be an irrational number
- the complex number systems uses  $i$  to represent the principal root for the square root of  $-1$
- there is a complex number  $i$  such that  $i^2 = -1$ , and every complex number has the form  $a + bi$  with  $a$  and  $b$  real.
- the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

## CONTENT AREA STANDARDS

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| MA.N-Q.A.1 | Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. |
| MA.N-Q.A.2 | Define appropriate quantities for the purpose of descriptive modeling.  |
| MA.N-Q.A.3 | Choose a level of accuracy appropriate to limitations on measurement when reporting   |

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|             | quantities.   |
| MA.K-12.2   | Reason abstractly and quantitatively.   |
| MA.K-12.6   | Attend to precision.  |
| MA.K-12.7   | Look for and make use of structure.   |
| MA.K-12.8   | Look for and express regularity in repeated reasoning.  |
| MA.N-CN.A.1 | Know there is a complex number $i$ such that $i^2 = -1$ , and every complex number has the form $a + bi$ with $a$ and $b$ real.   |
| MA.N-CN.A.2 | Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.   |
| MA.N-CN.A.3 | Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.   |
| MA.N-CN.B.4 | Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number.               |
| MA.N-CN.B.5 | Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation.  |
| MA.N-CN.C.7 | Solve quadratic equations with real coefficients that have complex solutions.   |
| MA.N-RN.A.2 | Rewrite expressions involving radicals and rational exponents using the properties of exponents.  |
| MA.N-RN.B.3 | Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational. |

## **RELATED STANDARDS (Technology, 21st Century Life & Careers, ELA Companion Standards are Required)**

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| CS.K-12.1.a  | Include the unique perspectives of others and reflect on one's own perspectives when designing and developing computational products.   |
| CS.K-12.2.b  | Create team norms, expectations, and equitable workloads to increase efficiency and effectiveness.  |
| CS.K-12.2.c  | Solicit and incorporate feedback from, and provide constructive feedback to, team members and other stakeholders.   |
| CS.K-12.2.d  | Evaluate and select technological tools that can be used to collaborate on a project.   |
| CS.K-12.3.a  | Identify complex, interdisciplinary, real-world problems that can be solved computationally.  |
| CS.K-12.3.b  | Decompose complex real-world problems into manageable sub-problems that could integrate existing solutions or procedures.   |
| CS.K-12.3.c  | Evaluate whether it is appropriate and feasible to solve a problem computationally.   |
| LA.RH.9-10.4 | Determine the meaning of words and phrases as they are used in a text, including vocabulary describing political, social, or economic aspects of history and the social sciences; analyze the cumulative impact of specific word choices on meaning and tone. |
| LA.RH.9-10.5 | Analyze how a text uses structure to emphasize key points or advance an explanation or analysis.  |
| LA.RH.9-10.7 | Integrate quantitative or technical analysis (e.g., charts, research data) with qualitative analysis in print or digital text, to analyze information presented via different mediums.  |

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| LA.RST.9-10.2 | Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.   |
| LA.RST.9-10.3 | Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.   |
| LA.RST.9-10.4 | Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics. |
| LA.RST.9-10.5 | Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).  |
| LA.RST.9-10.6 | Determine the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.                     |
| WRK.K-12.P.4  | Demonstrate creativity and innovation.  |
| WRK.K-12.P.5  | Utilize critical thinking to make sense of problems and persevere in solving them.  |
| WRK.K-12.P.8  | Use technology to enhance productivity increase collaboration and communicate effectively.  |

## STUDENT LEARNING TARGETS

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### Declarative Knowledge

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Students will understand that:

- every complex number has the form  $a + bi$  with  $a$  and  $b$  real. Retrieval
- there is a complex number  $i$  such that  $i^2 = -1$ . Retrieval
- The real numbers consists of all of the rational numbers and all of the irrational numbers
- the square root of a non-square number will be an irrational number
- the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

### Procedural Knowledge

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Students will be able to:

- Explain why the rectangular and polar forms of a given complex number represent the same number. Comprehension
- Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane. Comprehension
- Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers). Comprehension
- Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.(★)

### Comprehension

- Define appropriate quantities for the purpose of descriptive modeling. (★) Comprehension
- Explain why the product of a nonzero rational number and an irrational number is irrational. Comprehension

### Comprehension

- Explain why the sum of a rational number and an irrational number is irrational. Comprehension
- Explain why the sum or product of two rational numbers is rational. Comprehension
- Use the relation  $i^2 = -1$  and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. Comprehension
- Use units as a way to understand problems and to guide the solution of multi-step problems. (★) Comprehension

### Comprehension

- Find the conjugate of a complex number. Retrieval
- Use conjugates to find moduli of complex numbers. Retrieval
- Use conjugates to find quotients of complex numbers. Retrieval
- Know that every complex number has the form  $a + bi$  with  $a$  and  $b$  real. Retrieval
- Know there is a complex number  $i$  such that  $i^2 = -1$ . Retrieval
- Rewrite expressions involving radicals and rational exponents using the properties of exponents. Retrieval
- Solve quadratic equations with real coefficients that have complex solutions. Retrieval

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## EVIDENCE OF LEARNING

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### Formative Assessments

- Student feedback/questioning/observation
- Exit Ticket
- Error analysis
- Specific skill assessment/questions
- Survey/polling
- Reflection questions
- Scored/evaluated class work or homework
- Task completion

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### Summative Assessments

Lesson Quizzes

Unit Test

Performance Tasks

## **RESOURCES (Instructional, Supplemental, Intervention Materials)**

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Kuta Software worksheets

Khan Academy Units:

- [Working with units](#)
- [Exponents and Radicals](#)
- [Irrational numbers](#)
- [Complex Numbers](#)

[NJDOE Model Curriculum units:](#)

## **INTERDISCIPLINARY CONNECTIONS**

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Interdisciplinary connections are frequently addressed through modeling and application problems whereby students solve and analyze situations taken from business, physics, engineering, biology, statistics, geography, and numerous other fields. Examples can be found in topic specific textbook problems and digital resources.

## **ACCOMMODATIONS & MODIFICATIONS FOR SUBGROUPS**

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See link to Accommodations & Modifications document in course folder.