# **Algebra 2 Unit Test Guide**

## Complex Numbers Unit Test

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| **Item** | **Lesson Coverage** | **Objective** | **Mathematical Practice Standard** | **Lesson Page** | **Assessment Item** |
| 1 | Lesson 2: No Real Solutions | In this section, you will characterize graphs and equations that have no real solutions.  | Look for and express regularity in repeated reasoning. | p. 2-6 | How many real solutions does $-15x^{2}-3=2(7x^{2}-1.5)$ have?\_\_\_\_\_ real solutions**Answer: 1** |
| 2 | Lesson 2: No Real Solutions | In this section, you will characterize systems of equations and graphs that have no real solutions. | Look for and express regularity in repeated reasoning. | p. 8-13 | Use the image to answer the question.How many real solutions are there for the system of equations graphed on the coordinate plane?\_\_\_\_ real solutions**Answer: 0** |
| 3 | Lesson 3: The Existence of Imaginary Numbers | In this section, you will show that the set of imaginary numbers is a subset of the set of all numbers, separate from the set of real numbers. | Make sense of problems and persevere in solving them. | p. 2-6 | The imaginary numbers are a subset of what type of number(s)?**Answer: complex** |
| 4 | Lesson 3: The Existence of Imaginary Numbers | In this section, you will show that the set of imaginary numbers is a subset of the set of all numbers, separate from the set of real numbers. | Make sense of problems and persevere in solving them. | p. 2-6 | In the number $7+3i$, what type of number is 3𝑖?**Answer: imaginary** |
| 5 | Lesson 3: The Existence of Imaginary Numbers | In this section, you will re-express numbers containing the square root of negative numbers as complex numbers. | Make sense of problems and persevere in solving them. | p. 8-12 | Solve the equation $-x^{2}-3x=5-3x$ and re-express the answer as a complex number with the imaginary unit.$\pm $ \_\_\_\_\_**Answer:** $i\sqrt{5}$ |
| 6 | Lesson 4: The Complexity of Numbers | In this section, you will show that every number is a complex number composed of a real part and an imaginary part. | Look for and express regularity in repeated reasoning. | p. 2-5 | What is the imaginary part of the simplest form of the complex number $9.2-3\sqrt{-8}$?**Answer:** $-6i\sqrt{2}$ |
| 7 | Lesson 6: Properties of Complex Numbers | In this section, you will show that the Commutative and Associative Properties hold for the set of complex numbers. | Look for and make use of structure. | p. 2-7 | Which of the following is equivalent to the expression $(i⋅\sqrt{5})^{2}⋅3$, which shows that the Associate Property of Multiplication holds true for complex numbers?**Answer:** $i∙(\sqrt{5}∙3)$ |
| 8 | Lesson 6: Properties of Complex Numbers | In this section, you will show that the Distributive Property holds for the set of complex numbers. | Look for and make use of structure. | p. 8-14 | Apply the Distributive Property to show $3i[\left(2i\right)+\left(-3i-5\right)]$ in its simplest form.\_\_\_\_\_ - \_\_\_\_\_ *i***Answer: 3; 15** |
| 9 | Lesson 7: Operations with Complex Numbers | In this section, you will use the properties of complex numbers to add complex numbers.  | Make sense of problems and persevere in solving them. | p. 2-6 | Use the properties of complex numbers to simplify $\left(\sqrt{49}+5i\right)+(8-\sqrt{-4}$.**Answer:** $8+10i$ |
| 10 | Lesson 7: Operations with Complex Numbers | In this section, you will use the properties of complex numbers to subtract complex numbers.  | Make sense of problems and persevere in solving them. | p. 8-12 | Calculate the subtraction $(8.5-1.8i)-(-1.3+2.7i)$. Provide the answer in the form of 𝑎+𝑏𝑖.**Answer:** $9.8-4.5i$ |
| 11 | Lesson 7: Operations with Complex Numbers | In this section, you will use the properties of complex numbers to multiply complex numbers. | Make sense of problems and persevere in solving them. | p. 14-19 | Multiply $(-10+5i) (-10-5i)$.**Answer: 125** |
| 12 | Lesson 8: Complex Numbers & Quadratic Equations | In this section, you will test quadratic equations to see that they have two solutions, though the solutions may involve imaginary or complex numbers. | Use appropriate tools strategically. | p. 2-5 | Which of the following quadratic equations has roots of $2+i$  and $2-i$?Equation 1: $x^{2}-4x+5=0$Equation 2: $x^{2}+4x+5=0$**Answer: 1** |
| 13 | Lesson 8: Complex Numbers & Quadratic Equations | In this section, you will estimate what the graph of a quadratic equation looks like based on the equation and its roots. | Make sense of problems and persevere in solving them. | p. 7-12 | Which of the following accurately describes what the graph of $y=5x^{2}+50x+125$ looks like, with the repeated root of $x=-5$?Statement #1: The graph opens downward.Statement #2: The graph has a vertex to the right of the x-axis.Statement #3: The graph touches the x-axis once.Statement # \_\_\_**Answer: 3** |
| 14 | Lesson 9: Two Solutions for all Quadratic Equations | In this section, you will use the discriminant to determine the number of real solutions to a quadratic equation. | Use appropriate tools strategically. | p. 2-5 | Use the discriminant to determine the number of real solutions of $3x^{2}+6x-42=0$.\_\_\_\_ real solution(s)**Answer: 2** |
| 15 | Lesson 9: Two Solutions for all Quadratic Equations | In this section, you will solve quadratic equations and express their solutions as complex numbers. | Make sense of problems and persevere in solving them. | p. 7-11 | Use the quadratic formula to solve the quadratic equation $10x^{2}+5x=5x-8$. Express its solutions in the form $a\pm bi$.**Answer:** $0\pm \frac{2\sqrt{5}}{5}i$ |
| 16 | Lesson 10: Complex Numbers & Higher Order Polynomials | In this section, you will test solutions to polynomial equations to show they can have real solutions, complex solutions, or both. | Make sense of problems and persevere in solving them. | p. 2-5 | One of the solutions to the equation $x^{3}+5x^{2}+10x+50=0$ is −5. Find the full solution set. Which of the following options correctly describes the solution set?Option #1: It has one real solution and two non-real solutions.Option #2: It has one non-real solution and two real solutions. Option #3: It has three real solutions.Option # \_\_\_\_**Answer: 1** |
| 17 | Lesson 10: Complex Numbers & Higher Order Polynomials | In this section, you will show that if a complex number is a solution to a polynomial equation, its conjugate is also a solution. | Construct viable arguments and critique the reasoning of others. | p. 7-11 | Solve the equation $-7x^{2}-10=-12x$. Write your conjugate pair solution(s) as two values separated by a ± sign.*x* = \_\_\_\_\_**Answer:** $\frac{6}{7}\pm \frac{i\sqrt{34}}{7}$ |
| 18 | Lesson 10: Complex Numbers & Higher Order Polynomials | In this section, you will show that for every polynomial equation, real solutions correspond to *x*-intercepts, but complex solutions do not. | Construct viable arguments and critique the reasoning of others. | p. 13-17 | Use the image to answer the question.The equation $y=x^{4}+3x^{3}-x^{2}-3x$ has four solutions and is shown in the graph. Which of the following student statements is true?Statement #1: The equation has four non-real solutions because there are four x-intercepts.Statement #2: The equation has three real solutions because there are three turning points on the graph.Statement #3: The equation has four real solutions because there are four x-intercepts.Statement # \_\_\_\_ is true.**Answer: 3** |
| 19 | Lesson 11: The Fundamental Theorem of Algebra | In this section, you will examine quadratic equations to learn how the Fundamental Theorem of Algebra applies to quadratic polynomials. | Construct viable arguments and critique the reasoning of others. | p. 2-8 | Show that the Fundamental Theorem of Algebra is true for the quadratic polynomial $-4x^{2}-24x-36=0$ by using the quadratic formula. Which of the following statements accurately describes the solution set?**Answer: There are two identical solutions.** |
| 20 | Lesson 11: The Fundamental Theorem of Algebra | In this section, you will apply the Fundamental Theorem of Algebra given the degree of a polynomial to find the number of roots. | Make sense of problems and persevere in solving them. | p. 10-16 | Apply the Fundamental Theorem of Algebra to find the number of roots for the equation $12x-6x^{2}+3x^{4}=6x^{3}+2x-x^{4}$.\_\_\_\_\_ roots**Answer: 4** |
| 21 | Lesson 11: The Fundamental Theorem of Algebra | In this section, you will solve polynomial equations and justify their solutions using the Fundamental Theorem of Algebra. | Make sense of problems and persevere in solving them. | p. 18-23 | A polynomial equation includes the term $8x^{5}$. According to the Fundamental Theorem of Algebra, which statement must be true?**Answer: The equation has at least 5 roots.** |
| 22 | Lesson 4: The Complexity of Numbers | In this section, you will show that every number is a complex number composed of a real part and an imaginary part. | Look for and express regularity in repeated reasoning. | p. 2-5 | In 3–5 sentences, describe why real numbers and purely imaginary numbers are also complex numbers composed of real and imaginary parts. Also, describe how to identify the real part versus the imaginary part of a complex number.**Answer: The student should note that purely imaginary numbers have a real part with a value of zero, while real numbers have an imaginary part of**$0i$**. The student should also note that the real part is identified by not having an imaginary unit with it, while the imaginary part will be the part that includes the imaginary unit i.** |
| 23 | Lesson 10: Complex Numbers & Higher Order Polynomials | In this section, you will show that if a complex number is a solution to a polynomial equation, its conjugate is also a solution. | Construct viable arguments and critique the reasoning of others. | p. 7-11 | In 3–5 sentences, explain why complex solutions come in conjugate pairs. Consider the structure of the quadratic formula in your response.**Answer: Students should note that because there is a ± sign in front of the radical in the quadratic formula, every equation will have a solution derived from**$\frac{-b+\sqrt{b^{2}-4ac}}{2a}$**and a solution derived from**$\frac{-b-\sqrt{b^{2}-4ac}}{2a}$**. The solution is imaginary whenever**$b^{2}-4ac$**is negative, since this requires taking the square root of a negative number. Because the ± sign separates the real and imaginary terms in the complex solution, quadratic equations always yield a conjugate pair as a solution.** |
| 24 | Lesson 10: Complex Numbers & Higher Order Polynomials | In this section, you will show that for every polynomial equation, real solutions correspond to *x*-intercepts, but complex solutions do not. | Construct viable arguments and critique the reasoning of others. | p. 13-17 | Can a polynomial have four solutions but only two *x*-intercepts? In 1–2 sentences, explain how this can or cannot occur.**Answer: The student should explain that a polynomial can have four total solutions with only two *x*-intercepts. This is possible when the solution set contains two real values and two non-real values.** |
| 25 | Lesson 11: The Fundamental Theorem of Algebra | In this section, you will examine quadratic equations to learn how the Fundamental Theorem of Algebra applies to quadratic polynomials. | Construct viable arguments and critique the reasoning of others. | p. 2-8 | Use the Fundamental Theorem of Algebra to determine which of the following equations have two solutions. Explain your reasoning in 3–5 sentences.1. $-9x+4x\_{3}^{2}=0$
2. $-2x^{2}-5=0$
3. $\frac{5}{7}x^{2}=0$
4. $0x^{2}+7x$-2=0
5. $0x^{3}-x^{2}+2x+4=0$

**Answer: The student should note that according to the Fundamental Theorem of Algebra, all quadratic equations must have two solutions since they have a maximum exponent of 2. The student should note, therefore, that equations a, b, and c all have two solutions because they are all quadratics, even though equation a is not written in standard form, the b term is missing from equation b, and both the b and c terms are missing from equation c. The student should note that equation e also has two solutions because there is no value to the term with exponent of degree 3, since the coefficient is 0; the equation is a quadratic even though it does not appear to be one, and so it has two solutions. Finally, the student should use similar reasoning to determine that equation d does not have two solutions; a quadratic must have a coefficient not equal to 0 attached to the term with the exponent of 2, and this equation has 0 attached to the term with this exponent. Thus, equation d is the only one of the equations that does not have two solutions.** |