A2R

UNIT 9: COMPLEX NUMBERS

PROBLEM SETS

Information in parenthesis is ixl.com reference for practice on the topic.

9.1: Imaginary Numbers (A2: H.1, H.8)
9.2: Complex Numbers (A2: H.1 – H.8)
9.3: Solving Quadratic Equations with Complex Solutions (A2: J.4, J.8, J.9 these may not all result in complex roots)
9.4: The Discriminant of a Quadratic (A2: J.10)

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Algebra 2R Unit 9: Complex Numbers

9.1 Problem Set – Imaginary Numbers

FLUENCY

1. The imaginary number i is defined as

   (1) -1 (3) $\sqrt{-4}$

   (2) $\sqrt{-1}$ (4) $(-1)^2$ _____

2. Which of the following is equivalent to $\sqrt{-128}$?

   (1) $8\sqrt{2}$ (3) $-8\sqrt{2}$

   (2) $8i$ (4) $8i\sqrt{2}$ _____

3. The sum $\sqrt{-9}+\sqrt{-16}$ is equal to

   (1) 5 (3) $7i$

   (2) $5i$ (4) 7 _____

4. Which of the following powers of i is *not* equal to one?

   (1) i^{16} (3) i^{32}

   (2) i^{26} (4) i^{48} _____

5. Which of the following represents all solutions to the equation $\frac{1}{3}x^2+10=7$?

   (1) $x=\pm 3i$ (3) $x=\pm i$

   (2) $x=\pm 5i$ (4) $x=\pm 2i$ _____

6. Solve each of the following incomplete quadratics. Express your answers in simplest radical form.

   (a) $2x^2+100=-62$ (b) $\frac{2}{3}x^2+20=2$

7. Which of the following represents the solution set of $\frac{1}{2}x^2 - 12 = -37$?

(1) $\pm 7i$ (3) $\pm 5i\sqrt{2}$

(2) $\pm 7i\sqrt{2}$ (4) $\pm 3i\sqrt{2}$

8. Simplify each of the following powers of i into either $-1, 1, i,$ or $-i$.

(a) i^2 (b) i^3 (c) i^4 (d) i^{11}

(e) i^{41} (f) i^{30} (g) i^{25} (h) i^{36}

(i) i^{51} (j) i^{45} (k) i^{80} (l) i^{70}

9. Which of the following is equivalent to $i^7 + i^8 + i^9 + i^{10}$?

(1) 1 (3) $1 - i$

(2) $2 + i$ (4) 0

10. When simplified the sum $5i^{18} + 7i^{25} + 2i^{28} + 6i^{43}$ is equal to

(1) $2 - 4i$ (3) $5 - 7i$

(2) $-3 + i$ (4) $8 + i$

11. The product $(6 + 2i)(4 - 3i)$ can be written as

(1) $24 - 6i$ (3) $2 + 5i$

(2) $18 + 10i$ (4) $30 - 10i$

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Algebra 2R Unit 9: Complex Numbers
9.2 Problem Set – Complex Numbers

FLUENCY

1. Find each of the following sum or difference.

(a) $(6+3i)+(-2+9i)$ (b) $(-7+i)-(3+5i)$ (c) $(10-3i)+(6-8i)$

(d) $(-2+7i)-(15-6i)$ (e) $(15+2i)+(5-5i)$ (f) $(-1+i)-(-5-6i)$

2. Which of the following is equivalent to $3(5+2i)-2(3-6i)$?

(1) $9+18i$ (3) $9-6i$

(2) $21+8i$ (4) $21-2i$

3. Find each of the following products in simplest $a+bi$ form.

(a) $(5-2i)(-1+7i)$ (b) $(3+9i)(2+4i)$ (c) $(-4-i)(-2+6i)$

4. Complex conjugates are two complex numbers that have the form $a+bi$ and $a-bi$. Find the following products of complex conjugates:

(a) $(5-7i)(5+7i)$ (b) $(10+i)(10-i)$ (c) $(-3+8i)(-3-8i)$

(d) What's true about the product of two complex conjugates?

5. Show that the product of $a+bi$ and $a-bi$ is the purely real number a^2+b^2.

6. The product of $(-8+2i)$ and its conjugate is equal to

(1) $64+4i$ (3) 68

(2) 60 (4) $60-4i$

7. The complex computation $(6+2i)(6-2i)-(3-4i)(3+4i)$ can be simplified to

(1) 15 (3) -10

(2) 39 (4) -35

8. Perform the following complex calculation. Express your answer in simplest $a+bi$ form.

$$(8+5i)(3+2i)-(4+i)(4-i)$$

9. Perform the following complex calculation. Express your answer in simplest $a+bi$ form.

$$7(3-5i)+(4-2i)(-6+7i)$$

10. Simplify the following complex expression. Write your answer in simplest $a+bi$ form.

$$(5+2i)^2+(2-i)^2$$

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Algebra 2R Unit 9: Complex Numbers

9.3 Problem Set – Solving Quadratic Equations with Complex Solutions

FLUENCY

1. Solve each of the following quadratic equations. Express your solutions in simplest $a+bi$ form. Check.

(a) $x^2+4x+20=12x-5$

(b) $x^2=x-1$

(c) $2x^2-25x+27=-15x-10$

(d) $8x^2+36x+24=12x+5$

(e) $x^2+6x+15=8x-2$

(f) $4x^2+38x+50=10x-35$

2. Which of the following represents the solution set to the equation $x^2 - 2x + 2 = 0$?

(1) $x = -1$ or 2 (3) $x = 2 \pm i$

(2) $x = 1 \pm 2i$ (4) $x = 1 \pm i$

3. The solutions to the equation $x^2 + 6x + 11 = 0$ are

(1) $x = -3 \pm i\sqrt{2}$ (3) $x = -6 \pm i\sqrt{11}$

(2) $x = -3 \pm 2i\sqrt{2}$ (4) $x = -6 \pm 2i\sqrt{11}$

4. Using the discriminant, $b^2 - 4ac$, determine whether each of the following quadratics has real or imaginary zeroes.

(a) $y = 2x^2 - 7x + 6$ (b) $y = 3x^2 + 2x + 1$ (c) $y = x^2 - 8x + 14$

(d) $y = 2x^2 - 12x + 26$ (e) $y = -2x^2 + 6x - 5$ (f) $y = 4x^2 - 4x + 1$

5. Which of the following quadratics, if graphed, would lie entirely above the x-axis? Try to use the discriminant to solve this problem and then graph to check.

(1) $y = 2x^2 + x - 21$ (3) $y = x^2 - 4x + 7$

(2) $y = x^2 - x - 6$ (4) $y = x^2 - 10x + 16$

REASONING

6. For what values of c will the quadratic $y = x^2 + 6x + c$ have no real zeroes? Set up and solve an inequality for this problem.

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Algebra 2R Unit 9: Complex Numbers

9.4 Problem Set – The Discriminant of a Quadratic

SKILLS

1. For each of the following quadratic equations, determine the number and the nature of the roots by first calculating the quadratic's discriminant.

   (a) $2x^2+4x+5=0$ (b) $9x^2-12x+4=0$ (c) $4x^2-13x+3=0$

   (d) $x^2+8x+11=0$ (e) $4x^2+4x-7=0$ (f) $36x^2-12x+1=0$

   (g) $-3x^2+4x-8=0$ (h) $3x^2+8x+4=0$ (i) $x^2+8x+41=0$

2. The roots of $x^2+4x-7=0$ are

   (1) unequal and rational (3) unequal and irrational

   (2) unequal and imaginary (4) equal and rational _____

3. Which of the following quadratics has imaginary roots?

   (1) $x^2+3x-5=0$ (3) $2x^2-3x+1=0$

   (2) $x^2+6x+10=0$ (4) $x^2-7x+10=0$ _____

4. Which of the following quadratic, when graphed, would touch the x-axis exactly once?

   (1) $y=x^2-2x-3$ (3) $y=x^2+5x-2$

   (2) $y=2x^2+3x+7$ (4) $y=x^2-12x+36$ _____

5. If graphed, which of the following parabolas would lie entirely below the x-axis?

(1) $y = x^2 + 5x + 10$ (3) $y = -2x^2 + 6x - 5$

(2) $y = -2x^2 - 5x + 3$ (4) $y = x^2 + 6x + 9$

6. Which parabola below, when graphed, would cross the x-axis at two unequal irrational locations?

(1) $y = 2x^2 + 11x + 12$ (3) $y = 9x^2 - 6x + 1$

(2) $y = x^2 + 2x - 4$ (4) $y = 2x^2 + 4x + 9$

REASONING

7. Determine all values of a that will cause the parabola $y = ax^2 + 10x + 1$ to cross the x-axis at two distinct locations.

8. Consider the parabola whose equation is $y = x^2 - 4x$ and the line whose equation is $y = 2x + b$, where b is some unknown constant. Determine the value of b such that the line and the parabola will intersect at exactly one location. Then, sketch the system of equations on the axes below. Label their intersection point.