Unit 3
Lesson 3
Completing the Square

Ways to Graph a Parabola: $y = a(x-h)^2 + k$ and $y = a(x - int.)(x - int.)$

- What if a quadratic equation is in standard form? $y = ax^2 + bx + c$
- Recall from Math I: The vertex can be found using $\left(\frac{-b}{2a}, y\right)$ and the axis of symmetry is $x = \frac{-b}{2a}$.

✓ Complete the information for each parabola. Graph on the calculator to verify your vertex.

$y = -2x^2 - 12x - 16$	$y = 3x^2 + 10x - 2$	$y = 2x^2 + 15x + 29$
1. Vertex: (-3, 2)	1. Vertex: (-1.6̄, -10.3̄)	1. Vertex:
2. Maximum or Minimum	2. Maximum or Minimum	2. Maximum or Minimum
3. Axis of Symmetry: x = -3	3. Axis of Symmetry: x = -1.6̄	3. Axis of Symmetry:
4. y – intercept: (0, -16)	4. y – intercept: (0, -2)	4. y – intercept:
5. x – intercepts: (-4, 0), (-2, 0)	5. x – intercepts: (-3.52, 0) (.19, 0)	5. x – intercepts:
6. Domain: ℝ, (-∞, ∞)	6. Domain: ℝ (-∞, ∞)	6. Domain:
7. Range: (-∞, 2]	7. Range: [-10.3, ∞)	7. Range:

❖ **COMPLETING THE SQUARE** will allow us to find **ALL** solutions (rational, irrational & imaginary).

1) **REWRITE** as $x^2 + bx + c = 0$ as $x^2 + bx = -c$
2) $x^2 + bx +$ _____ $= -c +$ _____
3) **COMPLETE THE SQUARE** by taking half of b; square it and ADD IT TO BOTH SIDES of the equation in the blanks.
4) **FACTOR** the perfect square trinomial.
5) Take the **SQUARE ROOT** of both sides. Don't forget to include a $\pm$ to create 2 solutions.
6) **SOLVE** both equations. **SIMPLIFY** all irrational and complex solutions.

1. $x^2 - 6x + 8 = 0$

$(x-4)(x-2)=0$

$x-4=0$ $\quad$ $x-2=0$

$+4\ +4$ $\quad$ $+2\ +2$

$x=4$ $\quad$ $x=2$

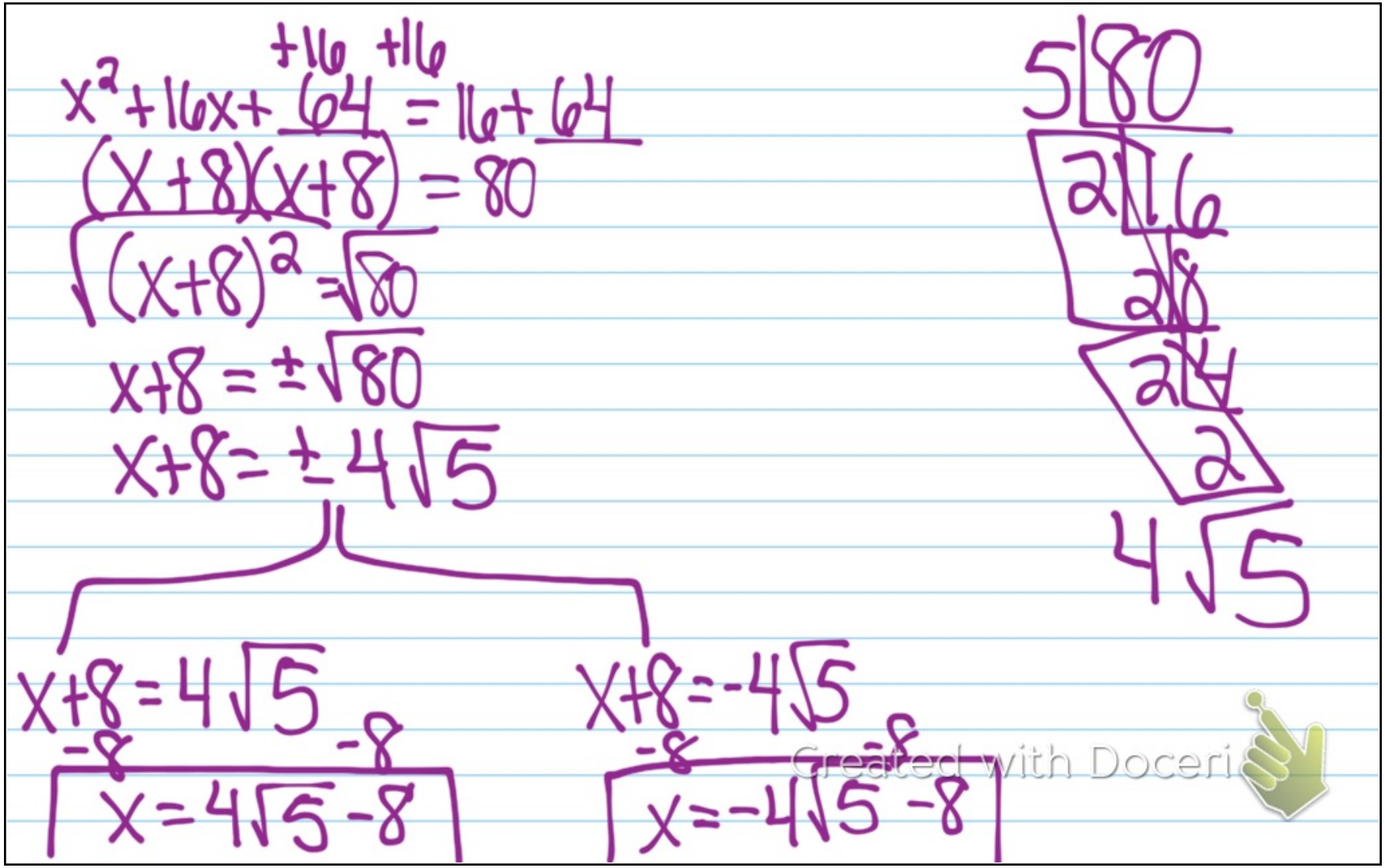
2. $x^2 + 16x - 16 = 0$

$+16\ +16$

$x^2+16x+64=16+64$

$(x+8)(x+8)=80$

$(x+8)^2=80$


+16 +16
$x^2+16x+64=16+64$
$(x+8)(x+8)=80$
$\sqrt{(x+8)^2}=\sqrt{80}$
$x+8=\pm\sqrt{80}$
$x+8=\pm4\sqrt{5}$
$x+8=4\sqrt{5}$
-8 -8
$x=4\sqrt{5}-8$
$x+8=-4\sqrt{5}$
-8 -8
$x=-4\sqrt{5}-8$
5|80
2|16
2|8
2|4
2
$4\sqrt{5}$
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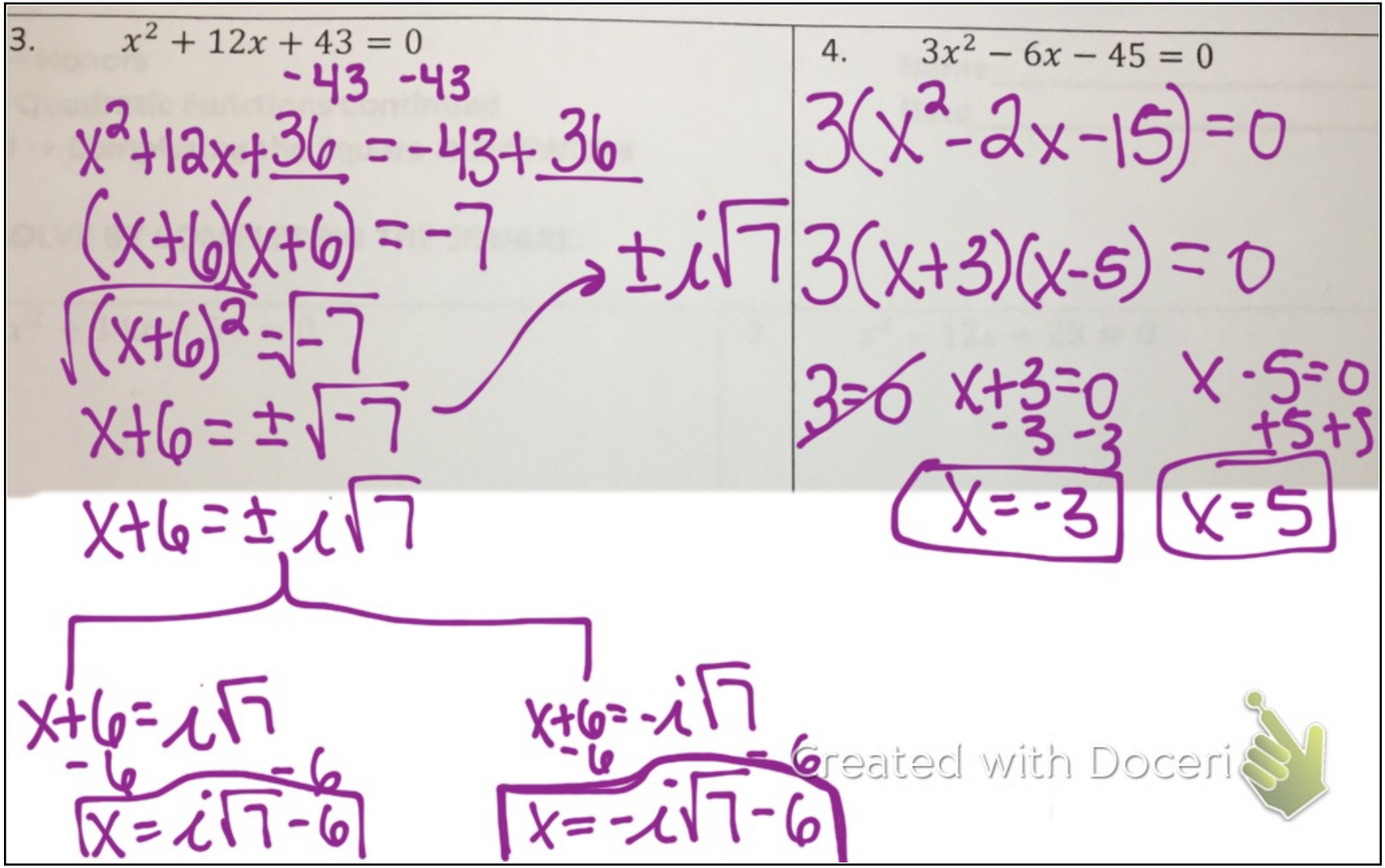
3. $x^2 + 12x + 43 = 0$
-43 -43
$x^2+12x+36 = -43+36$
$(x+6)(x+6) = -7$
$\sqrt{(x+6)^2} = \sqrt{-7}$
$x+6 = \pm\sqrt{-7}$
$\pm i\sqrt{7}$
$x+6 = \pm i\sqrt{7}$
$x+6 = i\sqrt{7}$
$-6 \quad -6$
$x = i\sqrt{7} - 6$
$x+6 = -i\sqrt{7}$
$-6 \quad -6$
$x = -i\sqrt{7} - 6$
4. $3x^2 - 6x - 45 = 0$
$3(x^2-2x-15) = 0$
$3(x+3)(x-5) = 0$
$3 \neq 0$
$x+3 = 0$
$-3 \quad -3$
$x = -3$
$x-5 = 0$
$+5 \quad +5$
$x = 5$
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1) **BEGIN** with $ax^2 + bx + c = 0$ and **MULTIPLY** "a" to "c"
2) **REWRITE** $x^2 + bx = -c \cdot a$
3) $x^2 + bx +$ _____ $= -c \cdot a +$ _____
4) **COMPLETE THE SQUARE** by taking half of b; square it and ADD IT TO BOTH SIDES of the equation in the blanks.
5) **FACTOR** the perfect square trinomial.
6) Take the **SQUARE ROOT** of both sides. Don't forget to include a $\pm$ to create 2 solutions.
7) **SOLVE** both equations. **SIMPLIFY** all irrational and complex solutions.
8) **DIVIDE** by "a" and **REDUCE** all final solutions.

5. $3x^2 + 10x - 8 = 0$

$x^2+10x-24=0$
$(x+\frac{12}{3})(x-\frac{2}{3})=0$
$(x+4)(3x-2)=0$
$x=-4 \quad x=2/3$

$x^2+10x-24=0$
$x^2+10x+25=24+25$
$\sqrt{(x+5)^2}=\sqrt{49}$
$x+5=\pm 7$
$x+5=7 \quad -5 \quad -5$
$x=2/3$
$x+5=-7 \quad -5 \quad -5$
$x=-12/3$
$=-4$

6. $4x^2 - 8x + 3 = 0$

$x^2-8x+12=0$
$(x-\frac{6}{4})(x-\frac{2}{4})=0$
$(x-3/2)(x-1/2)$
$(2x-3)(2x-1)$

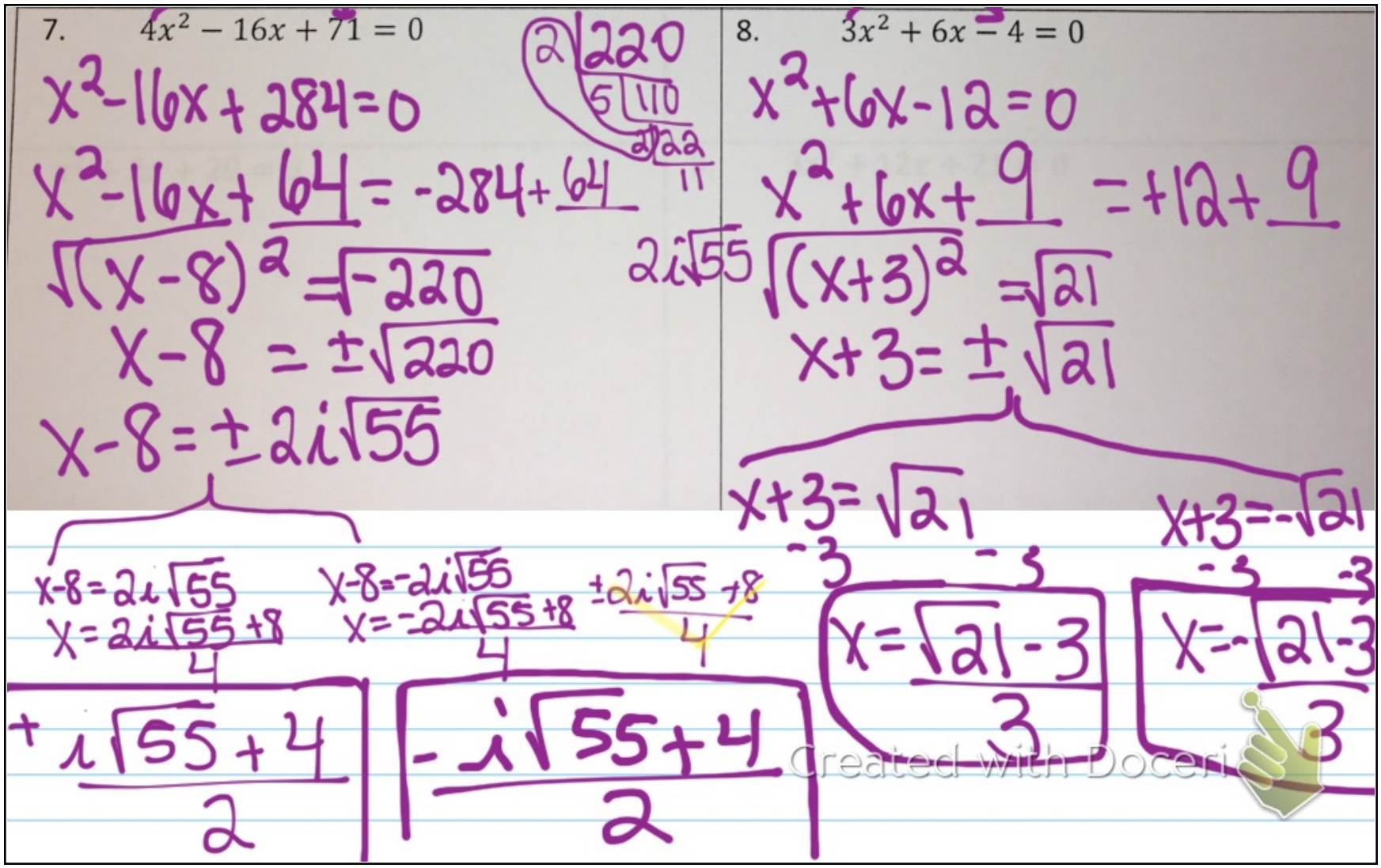
$x^2-8x+12=0$

$(x-\frac{6}{4})(x-\frac{2}{4})=0$

$(x-3/2)(x-1/2)$

$(2x-3)\ (2x-1)$

$3/2 \quad 1/2$


7. $4x^2 - 16x + 71 = 0$
$x^2 - 16x + 284 = 0$
$x^2 - 16x + 64 = -284 + 64$
$\sqrt{(x-8)^2} = \sqrt{-220}$
$x - 8 = \pm\sqrt{220}$
$x - 8 = \pm 2i\sqrt{55}$
2 | 220
5 | 110
2 | 22
11
$2i\sqrt{55}$
$x - 8 = 2i\sqrt{55}$
$x = \frac{2i\sqrt{55} + 8}{4}$
$+\frac{i\sqrt{55} + 4}{2}$
$x - 8 = -2i\sqrt{55}$
$x = \frac{-2i\sqrt{55} + 8}{4}$
$\pm 2i\sqrt{55} + 8$
4
$-\frac{i\sqrt{55} + 4}{2}$
8. $3x^2 + 6x = 4 = 0$
$x^2 + 6x - 12 = 0$
$x^2 + 6x + 9 = +12 + 9$
$\sqrt{(x+3)^2} = \sqrt{21}$
$x + 3 = \pm\sqrt{21}$
$x + 3 = \sqrt{21}$
$-3 \quad -3$
$x = \frac{\sqrt{21} - 3}{3}$
$x + 3 = -\sqrt{21}$
$-3 \quad -3$
$x = -\frac{\sqrt{21} - 3}{3}$
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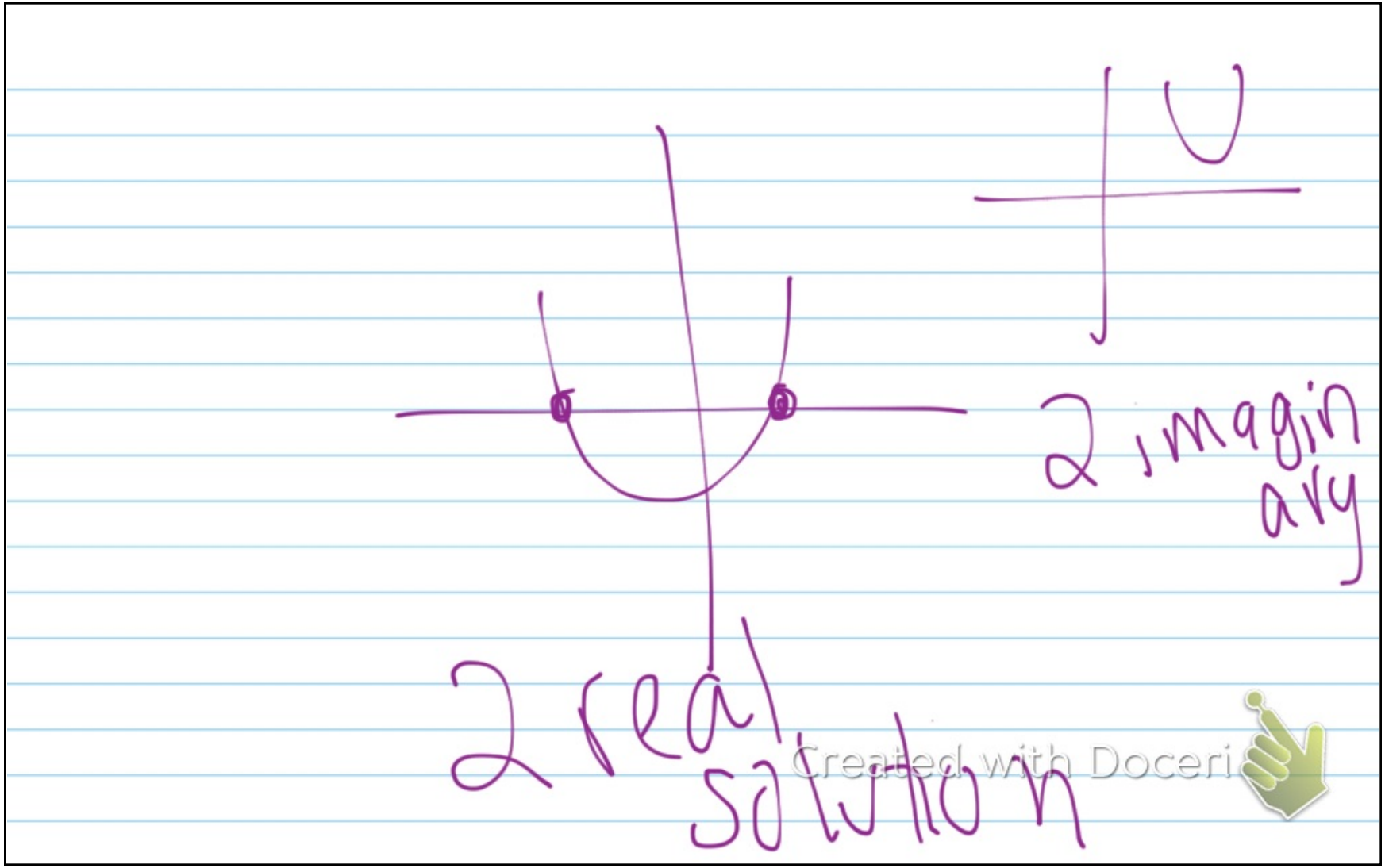
Page 10-11 Even HW


2 imaginary
2 real solution
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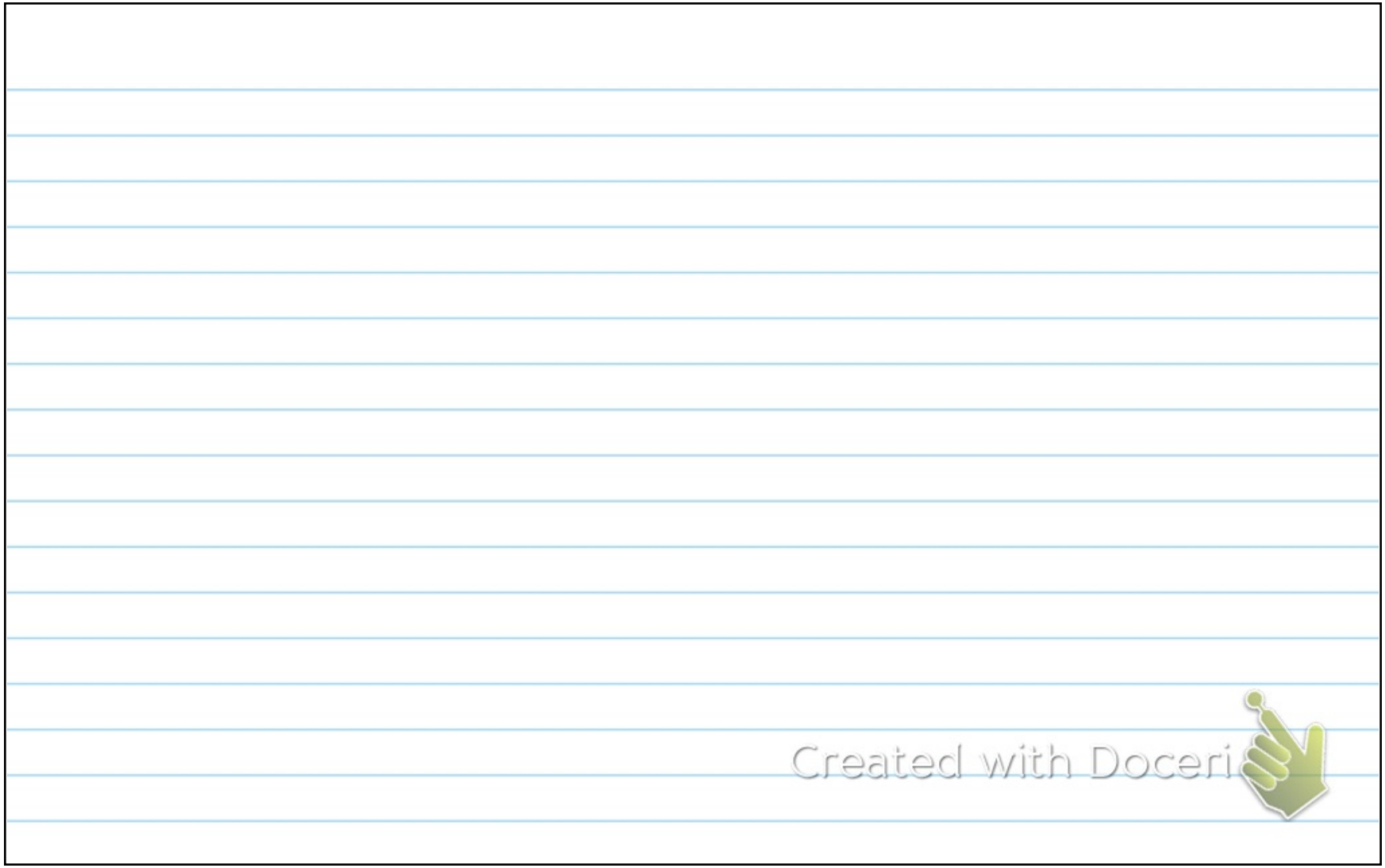
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