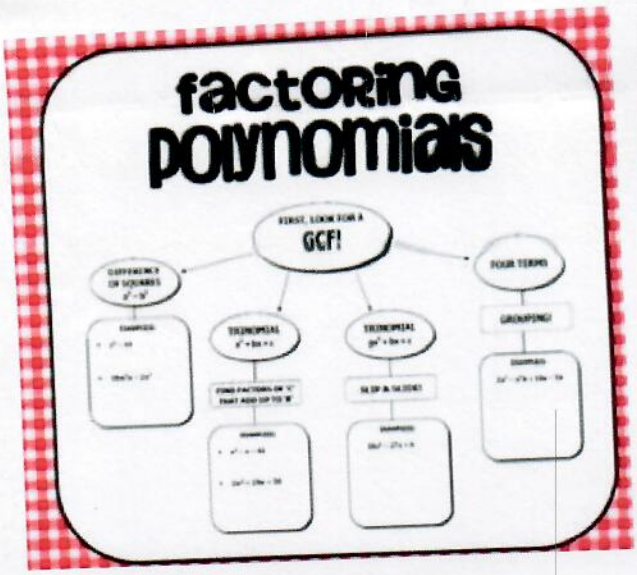

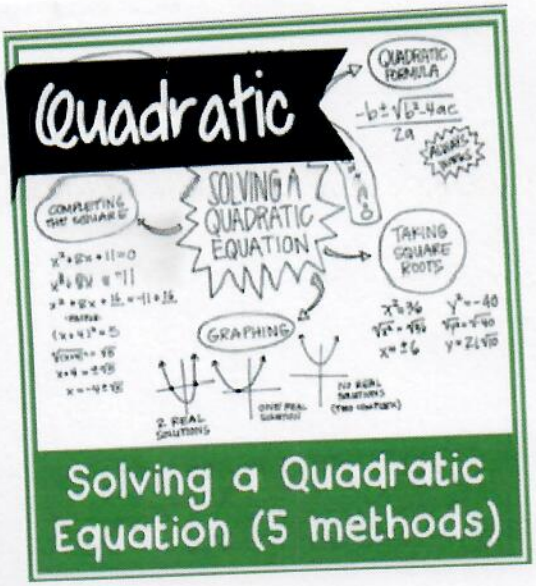

CP Algebra 2

Unit 2-1: Factoring and Solving Quadratics

Name: Working Copy Period_____ Mrs. Gattis Packet 2018

Learning Targets:

	0. I can add, subtract and multiply polynomial expressions
Factoring Quadratic Expressions	1. I can factor using GCF.
	2. I can factor by grouping.
	3. I can factor when a is one.
	4. I can factor when a is not equal to one.
	5. I can factor perfect square trinomials.
	6. I can factor using difference of squares.
Solving Quadratic Equations	7. I can solve by factoring.
	8. I can solve by taking the square root.
	9. I can perform operations with imaginary numbers.
	10. I can solve by completing the square.
	11. I can solve equations using the quadratic formula (with rationalized denominators).
	12. I can use the discriminant to determine the number and type of solutions.
	13. I can write quadratic equations given the real solutions.

	Learning Target	Final Check Page Number	Final Check Completed	Practice Completed	Self – Assessment of Understanding
	0. I can add, subtract and multiply polynomial expressions	4-5			Date: 0 1 2 3 4
Factoring Quadratic Expressions	1. I can factor using GCF.	10			Date: 0 1 2 3 4
	2. I can factor by grouping.	11			Date: 0 1 2 3 4
	3. I can factor when a is one.	12			Date: 0 1 2 3 4
	4. I can factor when a is not equal to one.	13			Date: 0 1 2 3 4
	5. I can factor perfect square trinomials.	18			Date: 0 1 2 3 4
	6. I can factor using difference of squares.	19			Date: 0 1 2 3 4
Solving Quadratic Equations	7. I can solve by factoring.	26			Date: 0 1 2 3 4
	8. I can solve by taking the square root.	27			Date: 0 1 2 3 4
	9. I can perform operations with imaginary numbers.	31			Date: 0 1 2 3 4
	10. I can solve by completing the square.	36			Date: 0 1 2 3 4
	11. I can solve equations using the quadratic formula (with rationalized denominators).	41-42			Date: 0 1 2 3 4
	12. I can use the discriminant to determine the number and type of solutions.	42			Date: 0 1 2 3 4
	13. I can write quadratic equations given the real solutions.	43			Date: 0 1 2 3 4

Operations on Polynomials

Date: _____

After this lesson and practice, I will be able to …

☐ Add, subtract, and multiply polynomials (LT 0)

To put an expression in standard form, simply put in decreasing order of powers.

The degree is equal to the highest power.

Ex. $2x^5 - 6x^4 - 9x^3 + x^2 - 4$ is in standard form. The degree is 5.

	Put in standard form (descending order)	Degree (highest exp.)
1) $-2x + 4x^2 + 1 + 8x^3$	$8x^3 + 4x^2 - 2x + 1$	3
2) $x + 3x^5 - 2$	$3x^5 + x - 2$	5

To add & subtract polynomials, simply combine like terms. (CLT)

Ex. $7x^3 + 2x^3 + 4x =$ $9x^3 + 4x$ Notice, we do NOT add the exponents.

4) $(5x^2 - 4x - 8) + (2x^2 + 3x + 6) =$ $7x^2 - x - 2$

5) $(50x^2 - 12x - 3) - (8x^3 - 9x^2 - 2x + 4) =$ $-8x^3 + 59x^2 - 10x - 7$

To multiply polynomials, use the F.O.I.L. method or BOX method.

6) $(x - 4)(x + 6)$

$x^2 - 4x + 6x - 24$

$x^2 + 2x - 24$

7) $(5x + 3)(8x - 4)$

$40x^2 + 24x - 20x - 12$

$40x^2 + 4x - 12$

8) $(3x - 5)^2$

$9x^2 - 30x + 25$

9) $8x(2x^2 - 3x + 4)$

$16x^3 - 24x^2 + 32x$

10) $(2x - 7)(3x^2 + x - 3)$

$6x^3 - 19x^2 - 13x + 21$

11) $(3x - 1)^3$

$(3x - 1)(9x^2 - 6x + 1)$

	$3x^2$	x	-3
$2x$	$6x^3$	$2x^2$	$-6x$
-7	$-21x^2$	$-7x$	$+21$

	$9x^2$	$-6x$	$+1$
$3x$	$27x^3$	$18x^2$	$3x$
-1	$-9x^2$	$+6x$	-1

$27x^3 - x^2 + 9x - 1$

Final Checks LT 0

LT 0. I can add, subtract and multiply polynomial expressions

Assessment Score: 0 1 2 3 4

Perform the indicated operation.

23. $(6x^2 + 1) + (5x^2 - 4)$ $11x^2 - 3$

24. $(2x^3 + 11x + 2) - (x^3 - 2x + 7)$

$x^3 + 13x - 5$

25. $(x^2 - 3x + 3) - (x^2 + x - 1)$

$-4x + 4$

26. $(14 - 16x) + (10x - 5)$

$-6x + 9$

27. $(8x^3 - 1) - (20x^3 + 2x^2 - x - 5)$

$-12x^3 - 2x^2 - x + 4$

28. $6x - (22x + 3 - 36x^2 + x^3)$

$-16x - 3 - x^3 + 36x^2$

29. $(4x^2 - 15x + 16) + (2x - 20)$

$4x^2 - 13x$

30. $(7x^3 - 2 + x^2 + 13x) - (4x^3 + 10)$

$3x^3 + 8 + x^2 + 13x$

31. $(-3x^3 + 4x - 9) - (2x^3 + x^2 - x)$

$-5x^3 + x^2 + 5x - 9$

32. $(6x^2 - 18x + 3) - (14x^2 - 12x + 9)$

$-8x^2 - 6x - 6$

33. $(15 - 10x^3 - 2x^2 + x) - (x^2 + 7x)$

$-10x^3 - 3x^2 - 6x + 15$

34. $(50x - 3) - (8x^3 + 9x^2 + 2x + 4)$

$-8x^3 - 9x^2 + 48x - 7$

35. $(4x - 33 + 9x^2) + (20x^3 - 19x + 3)$

$20x^3 + 9x^2 - 15x - 30$

36. $(12x^3 - 5x^2 - 70x + 1) + (-17x^3 + 56x)$

$-5x^3 - 5x^2 - 14x + 1$

37. $x(x^2 + 9x - 5)$

$x^3 + 9x - 5x$

38. $12x^2(x - 8)$

$12x^3 - 96x^2$

39. $-2x(x + 4)$

$-2x^2 - 4x$

40. $2x(3x^2 - x + 6)$

$6x^3 - 2x^2 + 12x$

41. $(x - 2)(x - 4)$ $x^2 - 6x + 8$

42. $(x + 8)(x - 1)$

$x^2 + 7x - 8$

43. $(x + 3)(x^2 - x - 2)$

	x^2	$-x$	-2
x	x^3	$-x^2$	$-2x$
3	$3x^2$	$-3x$	-6

$x^3 + 2x^2 - 5x - 6$

44. $(x+9)(x^2 - 6x + 4)$

$x^3 + 3x^2 - 50x + 36$

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45. $(2x - 1)(3x^3 - x + 3)$ $-6x^4-3x^3-2x^2+7x-3$

46. $(6x + 2)(2x^2 + x + 1)$ $12x^3+10x^2+8x+2$

47. $(x+9)(x^2 - 2x + 6)$ $x^3+7x^2-12x+54$

48. $(2x- 3)(4x^2 - 3x + 3)$ $8x^3-18x^2+15x-9$

49. $(x+9)(x-9)$ x^2-81

50. $(x+2)(x-2)$ x^2-4

51. $(x + 5)^2$ $x^2+10x+25$

52. $(x - 3)^2$ x^2-6x+9

53. $(x - 4)^3$ $(x-4)(x^2-8x+16)$ $x^3-12x^2+48x-64$

54. $(x + 6)^3$ $x^3+18x^2+108x+216$

55. $(x+1)^3$ $(x+1)(x^2+2x+1)$ x^3+3x^2+3x+1

56. $(3x+ 4)^2$ $9x^2+24x+16$

ANSWERS:

23) $11x^2 - 3$ 24) $x^3+13x-5$ 25) $-4x+4$ 26) $-6x + 9$ 27) $-12x^3-2x^2-x+4$

28) $-x^3 + 36x^2 - 16x - 3$ 30) $3x^3 + x^2 + 13x - 12$ 32) $-8x^2 - 6x - 6$

34) $-8x^3 - 9x^2 + 48x - 7$ 36) $-5x^3 - 5x^2 - 14x + 1$ 38) $12x^3 - 96x^2$ 3

39) $-2x^2 - 8x$ 40) $6x^3 - 2x^2 + 12x$ 42) $x^2 + 7x - 8$ 44) $x^3 + 3x^2 - 50x + 36$

46) $12x^3 + 10x^2 + 8x + 2$ 48) $8x^3 - 18x^2 + 15x - 9$ 49) $x^2 - 81$ 50) $x^2 - 4$

52) $x^2 - 6x + 9$ 54) $x^3 + 18x^2 + 108x + 216$ 56) $9x^2 + 24x + 16$

Factoring Basics

Date: _____

After this lesson and practice, I will be able to ...

- ☐ factor using GCF. (LT 1)
- ☐ factor when a is one. (LT 3)
- factor by grouping. (LT 2)
- factor when a is not one. (LT 4)

When we've modeled real-life situations with functions before, it's been with LINEAR functions (example: at-bats vs. runs in baseball, GB vs. cost of a data plan, etc.).

Suppose we wanted to determine how high you could throw a tennis ball? What would the path of the ball look like?

Parabola

As you can see, in order to model situations such as these, we require a function family that is not LINEAR. For situations such as these, we can use the QUADRATIC family of functions.
A Quadratic Function has a degree of 2.

(Throughout the year, we will be studying several different families of functions. We will learn how to graph and solve each type of function. We're going to start Quadratics with solving!)

Quadratic Function:
function that can be written in the form $f(x) = ax^2 + bx + c$ where $a \neq 0$.

Standard Form of a Quadratic EQUATION: $ax^2 + bx + c = 0$

You might recognize these from previous math classes! Try to solve a quadratic equation using the usual method we used to solve linear equations …

$$x^2 - 8x + 7 = -5$$

It turns out we'll need some new (and some not so new) skills in order to solve quadratic equations. One of those essential skills is **factoring**.

To **factor completely** is to write a polynomial as a product of (linear) prime polynomials with integer coefficients. Make sure your final answers contain only unfactorable pieces (PRIME).
We will factor polynomials of all degrees not just quadratic of degree 2.

Factored Form of a Quadratic EQUATION:

$$(x - r_1)(x - r_2) = 0$$

Factor Using Greatest Common Factor (GCF) (LT 1)

The 1st step in factoring any expression is to always look for the greatest common factor that will go into each term evenly. This will be the GREATEST number that will divide into ALL coefficients & the VARIABLES that are common to ALL terms. If the variables have exponents, you factor out the HIGHEST exponent that they ALL have in common which is the lowest exponent.

Example 1: Factor completely, If not factorable, write PRIME.

A) $14x^2 - 21x$

$7x(2x-3)$

B) $80n^7 + 8n^4 + 16n^3$

$8n^3(10n^4 + n + 2)$

C) $2x^3y - 2y$

$6x^5y - 2y$ ✗

~~$2y(x^3 - 1)$~~

$2y(3x^4 - 1)$

D) $5(x+1) - 3y(x+1)$

$(5-3y)(x+1)$

This is called a common BINOMIAL factor.

E) $3a(b-2) - 4a^2(b-2)$

$(3a - 4a^2)(b-2) = a(3-4a)(b-2)$

While the following technique does not necessarily apply exclusively to QUADRATIC expressions, it will provide us the skills necessary to factor quadratics.

Factor By Grouping (LT 2)

Factor by grouping - pairing together binomials that have common monomial factors:

$$ra + rb + sa + sb = r(a + b) + s(a + b)$$
$$= (r + s)(a + b)$$

When a polynomials contains 4 terms, it can often be factored by grouping (FBG).

Ex) Factor: $5x + 5y + ax + ay$

a) Group by pairs and pull out GCF ⟶ $5(x+y) + a(x+y)$

b) Pull out common binomial ⟶ $(x+y)$ $(5+a)$

then multiply times the sum or diff of 2 gcfs — common binomial — gcf + gcf)

Example 2: Factor completely, If not factorable, write PRIME.

A) $9x + 3y - 3bx - by$

$3(3x+y) - b(3x+y)$

$(3-b)(3x+y)$

B) $5x^3 - 35x^2 + 2x - 14$

$5x^2(x-7) + 2(x-7)$

$(5x^2 + 2)(x-7)$

Example 3: Factor completely, if not factorable, write PRIME.

A) $3n^3 - 18n^2 - 2n + 12$

$3n^2(n-6) - 2(n-6)$

$(3n^2 - 2)(n-6)$

B) $x^3 - 6x^2 + 7x - 42$

$x^2(x-6) + 7(x-6)$

$(x^2+7)(x-6)$

B) $9r^3 + 15r^2 - 3r - 5$

$3r^2(3r+5) - 1(3r+5)$

$(3r^2-1)(3r+5)$

C) $u^4 + u^2v^2 - 7u^2 - 7v^2$

$u^2(u^2+v^2) - 7(u^2+v^2)$

$(u^2-7)(u^2+v^2)$

Factoring when a is one (LT 3)

You probably remember doing this kind of factoring in Algebra 1 and/or Geometry.

Recall:

If the constant is a negative, then we need 2 different signs one +, one −

If the constant is a positive, then we need either both + or both −.

The sign of 2nd term which tell us which one! *Same sign sum... Different signs difference*

Write in $Ax^2 + Bx + C$ form - Look for the factors that multiple to AC and add/subtract B.
Split the middle term and FBG.

Example 4: Factor completely, If not factorable, write PRIME. (Remember GCF first!)

A) $x^2 - 11x + 10$

10 / 1 | 10

$x^2 - 10x - 1x + 10$

$x(x-10) - 1(x-10)$

$(x-1)(x-10)$

B) $x^2 - 4x - 21$

$(x-7)(x+3)$

21 / 7 | 3

C) $x^3 + 2x^2 - 15x$

$x(x^2 + 2x - 15)$

$x(x+5)(x-3)$

15 / 5 | 3

Example 5: Factor completely, If not factorable, write PRIME.

A) $x^2 - 17x + 72$

$(x-9)(x-8)$

B) $x^2 - 8x + 12$

$(x-6)(x-2)$

Example 5: Factor completely, if not factorable, write PRIME. (continued)

C) $4x^2+20x-24$

$4(x^2+5x-6)$ watch signs

$4(x+6)(x-1)$

D) $6x^5+30x^4+36x^3$

$6x^3(x^2+5x+6)$

$6x^2(x+2)(x+3)$

Factoring when a is not one (LT 4)

Example 6: Factor completely, If not factorable, write PRIME.

A) $7x^2-43x+6$

42: 1 | 42

$7x^2-42x-x+6$

$7x(x-6)-1(x-6)$

$(7x-1)(x-6)$

B) $12x^2+37x+11$

132: 11 | 12; 22 | 6; 33 | 4

$12x^2+33x+4x+11$

$3x(4x+11)+1(4x+11)$

$(3x+1)(4x+11)$

C) $3x^2+11x+8$

24: 3 | 8

$3x^2+3x+8x+8$

$3x(x+1)+8(x+1)$

$(3x+8)(x+1)$

D) $7x^2+37x-30$

$7x^2+42x-5x-30$

$7x(x+6)-5(x+6)$

$(x+6)(7x-5)$

210: 7 | 30; 14 | 15; 21 | 10; 35 | 6; 70 | 3

42

Example 7: Factor completely, If not factorable, write PRIME. If expressions are factored more than once, write ALL the factors as your final product.

A) $18x^2-90x+100$

$2(9x^2-45x+50)$

$2(9x^2-15x-30x+50)$

$2(3x(3x-5)-10(3x-5)$

$2(3x-10)(3x-5)$

450: 10 | 45; 25 | 18; 2 | 225; 5 | 90; 15 | 30

B) $6x^2-21x-27$

18: 9 | 2

$3(2x^2-7x-9)$

$3(2x^2-9x+2x-9)$

$3(x(2x-9)+1(2x-9))$

$3(x+1)(2x-9)$

C) $15y^2-8y+1$

15: 3 | 5

$15y^2-3y-5y+1$

$3y(5y-1)-1(5y-1)$

$(3y-1)(5y-1)$

D) $5y^2-25y-30$

$5(y^2-5y-6)$

$5(y-6)(y+1)$

6: 1 | 6; 2 | 3

watch sign

Final Checks LT 1-4

LT 1. I can factor using GCF.

Assessment Score: 0 1 2 3 4

1) $-5x^3 - 10x^2 - 15$ $-5(x^3+2x^2+3)$

2) $-2n^5 - 10n^3 + 2n^2$ $2n^2(-n^3-5n+1)$

3) $-15k^7 - 5k^3 - 25k^2$ $-5k^2(3k^5+k+5)$

4) $4v^4 - 2v^3 + v^2$ $v^2(4v^2-2v+1)$

5) $2k - 6k^2 + 10k^4$ $2k(1-3k+5k^3)$

6) $2x^4 + 6x + 10$ $2(x^4+3x+5)$

7) $-3b^4 + 3b^2 - 3b^5$ $3b^2(-b^2+1-b^3)$

8) $5x^8 - 5x^6 - 5x^5$ $5x^5(x^3-x-1)$

9) $4 - 8v - 8v^2$ $4(1-2v-2v^2)$

10) $10 + 20n^2 + 15n^4$ $5(2+4n^2+3n^4)$

11) $10x^2 + 4x + 6$ $2(5x^2+2x+3)$

12) $25b^5 - 20b^6 + 10b^8$ $5b^5(5-4b+2b^3)$

13) $24x^3y^3 - 8y^3 - 80x + 40$ $8(3x^3y^3-y^3-10x+5)$

14) $20x^2y + 20x + 15y + 15$ $5(4x^2y+4x+3y+3)$

15) $72xy^2 + 40x^2y - 48x^2 - 80x$ $8x(9y^2+5xy-6x-10)$

16) $-40x^3y - 45x + 25y + 30$ $5(-8x^3y-9x+5y+6)$

LT 2. I can factor by grouping. **Assessment Score: 0 1 2 3 4**

1) $3x^3-3x^2+4x-4$ $(3x^2+4)(x-1)$

2) $12b^3+15b^2+20b+25$ $(3b^2+5)(4b+5)$

3) $3p^3-5p^2+15p-25$ $(p^2+5)(3p-5)$

4) $15a^3+5a^2+9a+3$ $(5a^2+3)(3a+1)$

5) $6b^3-4b^2+3b-2$ $(2b^2+1)(3b-2)$

6) $15a^3-3a^2+25a-5$ $(3a^2+5)(5a-1)$

7) $2a^3+8a^2+a+4$ $(2a^2+1)(a+4)$

8) $2x^3-3x^2+4x-6$ $(x^2+2)(2x-3)$

9) $5r^3-2r^2+15r-6$ $(5r-2)(r^2+3)$

10) $10b^3-25b^2+2b-5$ $(5b^2+1)(2b-5)$

11) $9m^3+6m^2+6m+4$ $(3m^2+2)(3m+2)$

12) $3n^3+4n^2+3n+4$ $(n^2+1)(3n+4)$

13) $x^3+5x^2+3x+15$ $(x^2+3)(x+5)$

14) $5b^3+5b^2+b+1$ $(5b^2+1)(b+1)$

15) $56xy+7x^3+64y+8x^2$ $(7x+8)(8y+x^2)$

16) $21xy+49x^2-3y-7x$ $(7x-1)(3y+7x)$

17) $72mn+192m+12n+32$ $4(6m+1)(3n+8)$

18) $10uv+25u-2v^2-5v$ $(5u-v)(2v+5)$

LT 3. I can factor when a is equal to one.

Assessment Score: 0 1 2 3 4

1) $b^2 - 18b + 80$ $(b-10)(b-8)$

2) $r^2 + 6r - 16$ $(r+8)(r-2)$

3) $x^2 - 13x + 40$ $(x-5)(x-8)$

4) $x^2 + 6x - 7$ $(x+7)(x-1)$

5) $a^2 + 3a - 54$ $(a-6)(a+9)$

6) $v^2 + 3v + 2$ $(v+1)(v+2)$

7) $b^2 + 17b + 70$ $(b+10)(b+7)$

8) $v^2 + 16v + 60$ $(v+6)(v+10)$

9) $r^2 + 5r + 6$ $(r+3)(r+2)$

10) $b^2 + 14b + 48$ $(b+6)(b+8)$

11) $m^2 - 3m$ $m(m-3)$

12) $r^2 + 6r - 27$ $(r+9)(r-3)$

13) $p^2 + 5p + 4$ $(p+1)(p+4)$

14) $a^2 - 12a + 20$ $(a-2)(a-10)$

15) $x^2 + 11x + 10$ $(x+10)(x+1)$

16) $x^2 - 4x + 4$ $(x-2)(x-2)$

17) $n^2 - 2n - 80$ $(n+8)(n-10)$

18) $x^2 + 5x - 6$ $(x-1)(x+6)$

LT 4. I can factor when a is not equal to one.

Assessment Score: 0 1 2 3 4

1) $5x^2 - 46x + 48$ $(5x-6)(x-8)$

2) $3x^2 - 14x - 80$ $(3x+10)(x-8)$

3) $7p^2 - 46p + 24$ $(7p-4)(p-6)$

4) $3v^2 - 28v + 32$ $(3v-4)(v-8)$

5) $7x^2 - 58x - 45$ $(7x+5)(x-9)$

6) $7v^2 + 38v + 40$ $(7v+10)(v+4)$

7) $5p^2 + 44p + 32$ $(5p+4)(p+8)$

8) $7m^2 - 53m - 90$ $(7m+10)(m-9)$

9) $3x^2 - 35x + 72$ $(3x-8)(x-9)$

10) $4x^2 + 37x + 9$ $(x+9)(4x+1)$

11) $4m^2 + 28m + 45$ $(2m+9)(2m+5)$

12) $9a^2 - 64a + 60$ $(a-6)(9a-10)$

13) $8r^2 + 57r + 54$ $(r+6)(8r+9)$

15) $10x^2 - 13x - 30$ $(2x-5)(5x+6)$

17) $10p^2 + 39p + 14$ $(2p+7)(5p+2)$

19) $6x^2 + 17x - 14$ $(3x-2)(2x+7)$

21) $9n^2 + 14n - 8$ $(n+2)(9n-4)$

14) $9x^2 - 14x - 8$ $(x-2)(9x+4)$

16) $9x^2 + 56x + 12$ $(x+6)(9x+2)$

18) $9r^2 - 6r - 8$ $(3r+2)(3r-4)$

20) $6x^2 - 17x - 10$ $(2x+1)(3x-10)$

22) $8p^2 + 50p + 63$ $(4p+7)(2p+9)$

MORE LT 1 Practice

Factor completely. Write PRIME is the polynomial does not factor:

1) $5ax - 5a$ $5a(x-1)$

2) $5xz + 2xy - 3yz$ prime

3) $24ab^4 + 12ab^3 - 18ab^2$ $6ab^2(4b^2+2b-3)$

4) $3n^2 + 9$ $3(n^2+3)$

5) $x(x+y) - y(x+y)$ $(x-y)(x+y)$

6) $25k^3 + 20k^2 + 10k$ $5k(5k^2+4k+2)$

7) $8x^2 + 5x - 7$ $(2x-1)(4x-7)$

8) $7ab^5 - 56ab$ $7ab(b^4-8)$

9) $mnx^2 - nx^2 + m^3x$ $x(mnx - nx + m^3)$

10) $x^2(x^2 - 5) + 6(x^2 - 5)$ $(x^2-5)(x^2+6)$

11) $6k^3 - 18k^2$ $6k^2(k-3)$

12) $12m^7 - 8m^5 + 20m^3$ $4m^3(3m^4-2m^2+5)$

13) $6xy - 6xz - 6x$ $6x(y-z-6)$

14) $3x^4 + 12x^2 - 33$ $3(x^4+4x^2-11)$

More LT2 Pratice

Factor completely. Write PRIME is the polynomial does not factor:

15) $8a^4b^4 - 28a^3b^3 + 4a^2b^2$ $4a^2b^2(2a^2b^2-7ab+1)$

16) $4k^2 + 18k^3 - 6k^4$ $2k^2(2+9k-3k^2)$

17) $x^2 + 3x + xk + 3k$ $(x+3)(x+k)$

18) $a^2 - 2a + ad - 2d$ $(a-2)(a+d)$

19) $uv + 5u + v^2 + 5v$ $(u+v)(v+5)$

20) $m^3 + m^2n + mn^2 + n^3$ $(m+n)(m^2+n^2)$

21) $2ab + 14a + b + 7$ $(2a+1)(b+7)$

22) $5x^2y + x^2 - 10y - 2$ $(5y+1)(x^2-2)$

23) $2br + 8b - 3r - 12$ $(2b-3)(r+4)$

24) $x^2 + 3x - xy - 3y$ $(x+3)(x-y)$

25) $ac - ad + bc - bd$ $(a+b)(c-d)$

26) $3x^2 + 6x - y + 3$ Prime

27) $x^4 + x^3 - 7x - 7$ $(x^3-7)(x+1)$

28) $y^3 + 3y^2 + 3y + 9$ $(y+3)(y^2+3)$

29) $y^3 + y^2 + 2y + 2$ $(y^2+2)(y+1)$

30) $10a + 10b + xa + xb$ (answers below) $(a+b)(10+x)$

LT1-2 Answers Scrambled Look for the answer you have & lightly cross it out.

prime	$6ab^2(4b^2 + 2b - 3)$	$2k^2(2 + 9k - 3k^2)$	$6k^2(k - 3)$
$4a^2b^2(2a^2b^2 - 7ab + 1)$	$7ab(b^4 - 8)$	$5k(5k^2 + 4k + 2)$	prime
$(x + y)(x - y)$	$(x+3)(x-y)$	$(a+b)(c-d)$	prime
$(a+d)(a-2)$	$3(x^4 + 4x^2 - 11)$	$(2b-3)(r+4)$	$(m^2+n^2)(m+n)$
$3(n^2 + 3)$	$(x+3)(x+k)$	$(5y+1)(x^2-2)$	$6x(y - z - 1)$
$(10+x)(a+b)$	$(y+3)(y^2+3)$	$x(mnx - nx + m^3)$	$(2a+1)(b+7)$
$(x - 1)$	$(v+5)(u+v)$	$4m^3(3m^4 - 2m^2 + 5)$	$(y+1)(y^2+2)$
$(x^2 - 5)(x^2 + 6)$	$(x+1)(x^3-7)$		

More LT 3-4 Practice

Factor completely. Write PRIME is the polynomial does not factor:

1) $X^2 - X - 42$
$(x-7)(x+6)$

2) $X^2 + 4X - 21$
$(x+7)(x-3)$

3) $X^2 - 2X - 63$
$(x-9)(x+7)$

4) $X^2 - 11X + 18$
$(x-9)(x-2)$

5) $X^2 - 18X + 72$
$(x-6)(x-12)$

6) $X^2 - 7X + 6$
$(x-6)(x-1)$

7) $X^2 - 9X + 18$
$(x-3)(x-6)$

8) $X^3 + 11X^2 + 10X$
$x(x+10)(x+1)$

8) $5X^3 - 40X^2 + 60X$
$5x(x-6)(x-2)$

10) $4X^2 + 8X - 60$
$4(x+5)(x-3)$

11) $X^6 + 8X^4 - 20X^2$
$y^2(x+10)(x^2-2)$

12) $2X^2 + 9X - 18$
$(2x-3)(x+6)$

13) $3X^2 + 10X - 8$
$(3x-1)(x+4)$

14) $6X^2 - X - 15$
$(3x-5)(2x+3)$

15) $3X^2 + 5X + 2$
$(3x+2)(x+1)$

16) $4X^2 - 17X - 15$
$(4x+3)(x-5)$

17) $8X^2 - 25X + 3$
$(x-3)(8x-1)$

18) $8X^2 - 6X - 5$
$(4x-5)(2x+1)$

19) $8X^2 + 10X - 3$
$(2x+3)(4x-1)$

20) $6X^2 + 19X + 3$
$(6x+1)(x+3)$

21) $6X^2 + X - 2$
$(3x+2)(2x-1)$

22) $6X^2 - 17X - 3$
$(6x+1)(x-3)$

23) $8X^2 - 2X - 15$
$(2x-3)(4x+5)$

24) $3X^2 - 15X + 18$
$3(x-2)(x-3)$

25) $7X^2 + 2X + 1$
Prime

26) $2X^2 - X - 15$
$4(x+5)(x-3)$

27) $8X^3 - 18X$

28) $10X^3Y^2 - 25X^2Y^2 - 35XY^2$
$5xy(2x-7)(x+1)$

29) $3X^3Y - 10X^2Y + 8XY$
$xy(3x+2)(x-4)$

30) $15X^2Y - 10XY - 25Y = 5y(3x-5)(x+1)$

LT 3-4 MIXED-UP ANSWERS

$(x - 6)(x - 1)$
$4(x + 5)(x - 3)$
$(4x + 3)(x - 5)$
$3(x - 3)(x - 2)$
$x(x + 10)(x + 1)$
$2x(2x + 3)(2x - 3)$
$(x + 5)(x - 3)$
$(2x + 1)(4x - 5)$
$(6x + 1)(x + 3)$
$x^2(x^2 + 10)(x^2 - 2)$
$(x - 7)(x + 6)$
$(4x - 1)(2x + 3)$
$(3x + 2)(2x - 1)$
$(3x - 2)(x + 4)$
$(8x - 1)(x - 3)$
$(x - 6)(x - 12)$
$(2x - 3)(x + 6)$
$(6x + 1)(x - 3)$
$xy(3x - 4)(x - 2)$
$(3x - 5)(2x + 3)$
$5xy^3(2x - 7)(x + 1)$
$(4x + 5)(2x - 3)$
$(x - 9)(x + 7)$
$(x + 7)(x - 3)$
$5x(x - 6)(x - 2)$
prime
$5y(3x - 5)(x + 1)$
$(3x + 2)(x + 1)$
$(x - 9)(x - 2)$
$(x - 6)(x - 3)$

More Factoring

Date: _____

After this lesson and practice, I will be able to ...

- ☐ factor perfect square trinomials. (LT 5)
- ☐ factor using difference of squares. (LT 6)

When factoring, there are types of polynomials that are so common that it is helpful to know the patterns so you can identify the factors quickly.

Factoring Perfect Square Trinomials (LT 5)

Let's start by factoring $x^2+14x+49$ using our familiar methods:

49
7 | 7

$(x+7)(x+7) = (x+7)^2$

Observe:

- The last term is a perfect square. The first term is a perfect square.
- The middle term is twice the product of the quantities being squared in the 1st and 3rd terms.
- 2nd sign positive

- Algebraically:

$x^2 + 2xy + y^2 = (x+y)^2$

$x^2 - 2xy + y^2 = (x-y)^2$

If the A and C product is large, check for Perfect Square Trinomial

Example 1: Determine if the quadratic is a perfect square trinomial.

A) $x^2+50x+100$ B) x^2-6x+9 C) $16x^2+24x+9$

$\sqrt{100} = 10$ $\sqrt{9} = 3$ $\sqrt{1609} = 12$

no $10 = 20$ $+3$ yes $\frac{12}{24}$ yes

6

Example 2: Factor completely the perfect square trinomials from above.

A) B) $(x-3)^2$ C) $(4x+3)^2$

Example 3: Factor completely using the perfect square trinomial pattern.

A) $9x^2-24x+16$ C) $25r^2+30r+9$

$(3x-4)^2$ $(5r+3)^2$

Factoring Using Difference of Two Squares (LI 6)

Let's start by factoring $x^2 - 25$ using our familiar methods: What are A, B, and C in this problem?

$(x+5)(x-5)$ $b=0$ $\frac{25}{5|5}$ $x^2+0x+0x-25$

Observe:

- The last term is a perfect square. The first term is a perfect square.
- The two factors are identical except for the sign.
- These 2 factors are called CONJUGATES

$X^2 - Y^2 =$ $(x+y)(x-y)$

but **$X^2 + Y^2$ is PRIME** under Real Number

Note: Can also use if not a perfect square. Just take $\sqrt{}$

$x^2 - 5 = (x+\sqrt{5})(x-\sqrt{5})$

Example 4: Factor completely. If not factorable, write prime

A) $x^2 - 121$
$(x+11)(x-11)$

B) $4x^2 - 49$
$(2x+7)(2x-7)$

C) $x^2 + 4$
prime

Example 5: Factor completely, If not factorable, write PRIME.

A) $16x^2 - 9$
$(4x+3)(4x-3)$

B) $27m^2 - 75$
$3(9m^2-25)$
$3(3m+5)(3m-5)$

C) $64x^4 - 81$ (16, change)
$(4x^2-9)(4x^2+9)$
$(2x+3)(2x-3)(4x^2+9)$

D) $(a+5)^2 - m^2$
$(a+5-m)(a+5+m)$

E) $y^2 - (9+w)^2$
$(y-9-w)(y+9+w)$

F) $2b^3 - 200b$
$2b(b^2-100)$
$2b(b+10)(b-10)$

) $25 - x^2$
$(5-x)(5+x)$

H) $x^2 - 7$
$(x+\sqrt{7})(x-\sqrt{7})$
prime under rational numbers

I) $x^2 + 100$
Prime under Reals

Final Checks LT 5-6

LT 5. I can factor perfect square trinomials. Assessment Score: 0 1 2 3 4

Factor completely. Write PRIME is the polynomial does not factor:

1) $4x^2 - 16x + 16$ $4(x-2)^2$

2) $27r^2 + 36r + 12$ $3(3r+2)^2$

3) $4r^2 - 20r + 25$ $(2r-5)^2$

4) $9b^2 - 12b + 4$ $(3b-2)^2$

5) $k^2 - 4k + 4$ $(K-2)^2$

6) $25p^2 + 10p + 1$ $(5p+1)^2$

7) $45b^2 - 150b + 125$ $5(3b-5)^2$

8) $25p^2 - 10p + 1$ $(5p-1)^2$

9) $36m^2 + 96m + 64$ $4(3m+4)^2$

10) $9b^2 + 30b + 25$ $(3b+5)^2$

11) $m^2 - 2m + 1$ $(m-1)^2$

12) $25a^2 - 20a + 4$ $(5a-2)^2$

13) $32b^2 - 16b + 2$ $2(4b-1)^2$

14) $32x^2 + 80x + 50$ $2(4x+5)^2$

15) $125n^2 - 100n + 20$ $5(5n-2)^2$

16) $b^2 + 2b + 1$ $(b+1)^2$

17) $25x^2 - 30x + 9$ $(5x-3)^2$

18) $25v^2 - 40v + 16$ $(5v-4)^2$

LT 6. I can factor using difference of squares. **Assessment Score: 0 1 2 3 4**

Factor completely. Write PRIME is the polynomial does not factor:

1) $4b^2 - 1$ $(2b+1)(2b-1)$

2) $9p^2 - 16$ $(3p+4)(3p-4)$

3) $27n^2 - 75$ $3(3n+5)(3n-5)$

4) $27v^2 - 12$ $3(3v+2)(3v-2)$

5) $125m^2 - 20$ $5(5m+2)(5m-2)$

6) $25x^2 - 9$ $(5x+3)(5x-3)$

7) $100v^2 - 4$ $4(5v+1)(5v-1)$

8) $4b^2 - 25$ $(2b+5)(2b-5)$

9) $8a^2 - 18$ $2(2a+3)(2a-3)$

10) $p^2 - 1$ $(p+1)(p-1)$

11) $50x^2 - 2$ $2(5x+1)(5x-1)$

12) $16x^2 - 36$ $4(2x+3)(2x-3)$

13) $16x^2 - 9$ $(4x+3)(4x-3)$

14) $16n^2 - 25$ $(4n+5)(4n-5)$

15) $9r^2 - 25$ $(3r+5)(3r-5)$

16) $2r^2 - 18$ $2(r+3)(r-3)$

17) $p^2 - 4$ $(p+2)(p-2)$

18) $25n^2 - 4$ $(5n+2)(5n-2)$

More LT 6 Practice

Factor completely. Write PRIME is the polynomial does not factor. Use all methods of factoring.

1) $x^2 - 25 = (x+5)(x-5)$

2) $x^2 - 144 = (x+12)(x-12)$

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

4) $9 - x^2$ $(3+x)(3-x)$

5) $2x^2 - 32$ $2(x+4)(x-4)$

6) $2x^3 - 18x$ $2x(x+3)(x-3)$

7) $x^2 - 1$ $(x+1)(x-1)$

8) $15a^3b^3 - 18a^5b^2 + 24ab^4$ $3ab^2(5a^2b - 6a^4 + 8b^2)$

9) $16x^2 - 9$ $(4x+3)(4x-3)$

10) $x^2 + 4$ prime

11) $64x^2 - 81$ $(8x+9)(8x-9)$

12) $625 - x^4$ $(25+x^2)(5-x)(5+x)$

13) $4x^2 - 9$ $(2x+3)(2x-3)$

14) $2x(3x+1) - (3x+1)$ $(2x-1)(3x+1)$

15) $5x^2 - 125$ $5(x+5)(x-5)$

16) $49x^2y^2 - 25z^2$ $(7xy+5z)(7xy-5z)$

17) $30x^2y - 24xy^2 + 36x^3y$ $6xy(5x - 4y + 6x^2)$

18) $25x^4 - 4$ $(5x^2+2)(5x^2-2)$

19) $x^4 - 81$ $(x^2+9)(x+3)(x-3)$

20) $x^2 + 2x + 7x + 14$ $(x+2)(x+7)$

21) $x^2y^2z^2 - 36$ $(xyz+6)(xyz-6)$

22) $x^2 - y^2$ $(x+y)(x-y)$

23) $9x^2 - 1$ $(3x+1)(3x-1)$

24) $(2z-3)^2 - (x+7y)^2$ $(2z-3+x+7y)(2z-3-x-7y)$

25) $(x+y)^2 - z^2$ $(x+y+z)(x+y-z)$

26) $6x + xy + 6y + y^2$ $(6+y)(x+y)$

27) $(x-y)^2 - (y-8)^2$ $= (x-y+y-8)(x-y-y+8)$ $= (x-8)(x-2y+8)$

28) $(a+b)^2 - (c+5)^2$ $(a+b+c+5)(a+b-c-5)$

29) $x^3 + x^2y - xy^2 - y^3$ $(x+y)(x-y)(x+y)$

30) $(x-5)^2 - y^2$ $(x-5+y)(x-5-y)$

31) $x^2 - (y+2)^2$ $(x-y-2)(x+y+2)$

32) $16x^2 + 49y^2$ Prime

33) $(x-6)^2 - 9y^2$ $(x-6+3y)(x-6-3y)$

34) $(3x+y)^2 - (2x+5)^2$ $(5x+y+5)(x-y-5)$

35) $169 - 49x^2$ $(13+7x)(13-7x)$

36) $100 - (x+9y)^2$ $(10+x+9y)(10-x-9y)$

37) $-x^2 + 25$ $(5+x)(5-x)$

38) $2x^3 - 6x^2 + 3x - 9$ $(2x^2+3)(x-3)$

39) $-x^2 + 100$ $(10+x)(10-x)$

40) $x^2 + 1$ (Answers below) Prime

LT6 ANSWERS SCRAMBLED

(3x+1)(2x−1)
(x+5)(x−5)
(4x+3)(4x−3)
2x(x+3)(x−3)
$3ab^2(5a^2b-6a^4+8b^2)$
(xyz+6)(xyz−6)
(8x+9)(8x−9)
(x+y+2)(x−y−2)
(5x+y+5)(x+y−5)

(x−6+3y)(x−6−3y)
(2z−3+x+7y)(2z−3−x−7y)
$6xy(5x-4y+6x^2)$
(2x+3)(2x−3)
(10+x+9y)(10−x−9y)
(x−5+y)(x−5−y)
2(x+4)(x−4)
(13−7x)(13+7x)
(a+b+c+5)(a+b−c−5)

(x+5)(x−5)
(6+y)(x+y)
(x+1)(x−1)
(10+x)(10−x)
prime
(3x+y)(3x−y)
(x+2)(x+7)
$(x-3)(2x^2+3)$

$(x^2+9)(x+3)(x-3)$
(x+y+z)(x+y−z)
(x−8)(x−2y+8)
$(25+x^2)(5+x)(5-x)$
$(5x^2+2)(5x^2-2)$
(3x+1)(3x−1)
(x+y)(x+y)(x−y)
(7xy+5z)(7xy−5z)

(5+x)(5−x)
prime
prime
(x+3)(x−y)
(3+x)(3−x)
(x+y)(x−y)
(x+12)(x−12)

MORE LT 0-6 Practice

Perform the indicated operation and Simplify Completely:

1) $(x^4+3x^2-2x+1)+(2x^3-x^2+x-6)$ $x^4+2x^3+2x^2-x-5$

2) $(3x-6)(2x+5)$ $6x^2-3x-30$

3) $(4x+3)^3$ $64x^3+144x^2+108x+27$

4) $(2x-3)^2$ $4x^2-12x+9$

Factor completely with respect to the integers.

5) $3a^2b+6ab$ $3ab(a+2)$

6) x^2-16 $(x+4)(x-4)$

8) x^2-x-12 $(x-4)(x+3)$

9) $5x^2+x-4$ $(5x-4)(x+1)$

11) $a^3+3a^2+5a+15$ $(a^2+5)(a+3)$

12) $16x^2-49$ $(4x+7)(4x-7)$

13) x^3+12x^2+16x $x(x^2+12x+16)$

14) $4x^3+8x^2-3x-6$ $(4x^2-3)(x+2)$

15. $9x^2-4$ $(3x+2)(3x-2)$

16. $3x^2-48$ $3(x+4)(x-4)$

21. $200x^2-50$ $50(2x+1)(2x-1)$

27. x^3-2x^2+4x-8 $(x^2+4)(x-2)$

28. $30x^3+40x^2+3x+4$ $(3x+4)(10x^2+1)$

29. $x^3+2x^2+5x+10$ $(x^2+5)(x+2)$

30. x^3-2x^2+4x-8 $(x^2+4)(x-2)$

31. $9x^3+18x^2+7x+14$ $(9x^2+7)(x+2)$

32. $-2x^3-4x^2-3x-6$ $-1(2x^2+3)(x+2)$

33. $2x^3+4x^2+4x+8$ $2(x^2+2)(x+2)$

34. $18x^3+30x^2+3x+5$ $(6x^2+1)(3x+5)$

35. $2x^3-2x^2+5x-5$ $(2x^2+5)(x-1)$

36. $2x^3+3x^2-32x-48$ $(x+4)(x-4)(2x+3)$

37. $5x^3 - 20x^2 + 3x - 12$

$(x-4)(5x^2+3)$

38. $18x^3 - 2x^2 + 27x - 3$

$(2x^2+27)(9x-1)$

39. $7x^3 + 14x^2 + 7x$

$7x(x+1)(x-1)$

40. $3x^2 - 24x + 48$

$3(x-4)(x-4)$

41. $2x^3 - 4x^2 - 3x + 6$

$(2x^2-3)(x-2)$

42. $6x^3 - 18x^2 - 2x + 6$

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

45. $3x^4 - 300x^2$

$3x^2(x+10)(x-10)$

46. $28x^3 - 7x$

$7x(2x+1)(2x-1)$

47. $3x^4 + 3x^3 + 6x^2 + 6x$

$3x(x^2+2)(x+1)$

48. $x^4 + 12x^3 + 4x^2 + 48x$

$x(x^2+4)(x+12)$

49. $10x^3 - 20x^2 - 2x + 4$

$2(5x^2-1)(x-2)$

50. $18x^3 - 9x^2 - 18x + 9$

$9(x+1)(x-1)(2x-1)$

Some Answers 1) $x^4 + 2x^3 + 2x^2 - x - 5$ 2) $6x^2 + 3x - 30$ 3) $64x^3 + 144x^2 + 108x + 27$
4) $4x^2 - 12x + 9$ 5) $3ab(a+2)$ 6) $(x-4)(x+4)$ 8) $(x-4)(x+3)$
9) $(5x-4)(x+1)$ 11) $(a^2+5)(a+3)$ 12) $(4x+7)(4x-7)$ 13) $x(x^2+12x+16)$
14) $(4x^2-3)(x+2)$ 15) $(3x-2)(3x+2)$ 16) $3(x+4)(x-4)$ 21) $50(2x+1)(2x-1)$
28) $(10x^2+1)(3x+4)$ 30) $(x^2+4)(x-2)$ 32) $(-2x^2-3)(x+2)$ *or* $-1(2x^2+3)(x+2)$
34) $(6x^2+1)(3x+5)$ 36) $(x+4)(x-4)(2x+3)$ 38) $(2x^2+3)(9x-1)$ 39) $7x(x+1)^2$ 40) $3(x-4)^2$
42) $2(3x^2-1)(x-3)$ 45) $3x^2(x+10(x-10)$ 46) $7x(2x+1)(2x-1)$
48) $x(x^2+4)(x+12)$ 49) $(5x^2-1)(2x-4)$ 50) $9(x+1)(x-1)(2x-1)$

LT 1-6 More Review of Factoring

15) $xw + xy + xz$

$x(w+y+z)$

16) $x^4 - x^2 - 30$

$(x^2-6)(x^2+5)$

17) $x^2 - (2y+3z)^2$

$(x+2y+3z)(x-2y-3z)$

18) $5x^3 - 45x$

$5x(x+3)(x-3)$

20) $6x^2 + 8x - 3x - 4$

$(2x-1)(3x+4)$

21) $x^8 - 1$

$(x^4+1)(x^2+1)(x+1)(x-1)$

22) $2y^4 - y^3 + 16y - 8$

will factor more later → $(y^3+8)(2y-1)$

23) $x^4 + 2x^2 - 3$

$(x^2+3)(x+1)(x-1)$

24) $4x^3 - 12x^2 - 40x$

$4x(x-5)(x+2)$

25) $(a+2b)^2 - (2a-3b)^2$

$(3a-b)(-a+5b)$

26) $(2m-5n)^2 - (4m+3n)^2$

$4(3m-n)(m+4n)$

ANSWERS:
15) $x(w + y + z)$ 16) $(x^2+5)(x^2-6)$ 17) $(x+2y+3z)(x-2y-3z)$ 18) $5x(x+3)(x-3)$
20) $(2x-1)(3x+4)$ 21) $(x^4+1)(x^2+1)(x-1)(x+1)$ 22) $(y+2)(y^2-2y+4)(2y-1)$
23) $(x+1)((x-1)(x^2+3)$ 24) $4x(x-5)(x+2)$ 25) $(3a-b)(-a+5b)$
26) $4(3m-n)(-m-4n)$ or $-4(3m-n)(m+4n)$

Even More LT 0-6 Practice CPA2 Name_____

Simplify Completely: BOX

1) $(6x^3-4x^2+5)-(2x^3+6x^2-7)$ $4x^3-10x^2+12$

2) $-6x^3(4x^2-3x+5)$ $-24x^5+18x^4-30x^3$

3) $(2x+3)(4x^2-6x+1)$ $8x^3-16x+3$

4) $(x-2)^3$ $x^3-6x^2+12x-8$

Factor Completely. Write PRIME if it can't be factored:

5) $4x^3y^2-2x^2y$ $2x^2y(2x-1)$

6) $25-x^2$ $(5+x)(5-x)$

8) $x^2-7x+10$ $(x-5)(x-2)$

9) $8x^2+26x+15$ $(4x+3)(2x+5)$

11) $x^4-x^3y-4x+4y$ $(x^3-4)(x-y)$

12) $25x^2+16$ Prime

13) x^3-13x^2-36x $x(x^2-13x-36)$

14) $9y^4-6y^2+12y^2-8$ $(3y^2-2)(3y^2+4)$

15) $2ax-2ay-2az$ $2a(x-y-z)$

16) $(x+y)^2-z^2$ $(x+y+z)(x+y-z)$

17) $3x^3-48x$ $3x(x+4)(x-4)$

19) $3xy-9x+y-3$ $(y-3)(3x+1)$

20) x^4-81 $(x^2+9)(x+3)(x-3)$

21) $x^4+3x^3-27x-81$ $(x+3)(x^3-27)$ will factor more later

22) x^4-2x^2-8 $(x+2)^2(x-2)$

23) $3x^3+9x^2-12x$ $3x(x+4)(x-1)$

24) $(3x+2y)^2-(5x-4y)^2$ $4(4x-y)(-x+3y)$

ANSWERS

1) $4x^3-10x^2+12$ 2) $-24x^5+18x^4-30x^3$ 3) $8x^3-16x+3$

4) $x^3-6x^2+12x-8$ 5) $2x^2y(2x-1)$ 6) $(5+x)(5-x)$

8) $(x-5)(x-2)$ 9) $(4x+3)(2x+5)$ 11) $(x^3-4)(x-y)$

12) prime 13) $x(x^2-13x-36)$ 14) $(3y^2+4)(3y^2-2)$ 15) $2a(x-y-z)$

16) $(x+y+z)(x+y-z)$ 17) $3x(x+4)(x-4)$ 19) $(y-3)(3x+1)$

20) $(x^2+9)(x+3)(x-3)$ 21) $(x+3)(x-3)(x^2+3x+9)$ 22) $(x-2)(x+2)(x^2+2)$

23) $3x(x+4)(x-1)$ 24) $4(4x-y)(-x+3y)$ or $-4(4x-y)(x-3y)$

23
~~20~~

Solving Quadratic Equations

Date: _____

After this lesson and practice, I will be able to …

- ☐ solve by factoring. (LT 7)
- ☐ solve by taking the square root. (LT 8)

It's finally time to start solving! The first way of solving combines factoring and the **zero product property**. Here's what that property states:

If $ab = 0$, then $a = 0$ and/or $b = 0$.

You'll first want to get your standard form equation set equal to 0. Then get it in factored form. To get an equation in factored form, just write it in standard form, then factor! ☺

$ax^2 + bx + c = 0$

Once the quadratic equation is in factored form, use the **zero product property**. Essentially to do this, you just try to find the value for x that makes the equation zero.

Example 1: Solve by factoring.

A) $(x+4)(3x-2) = 0$

$x+4=0$ $\quad 3x-2=0$

$x=-4$ $\quad 3x=2$

$x=2/3$

B) $2x - 6x^2 = 0$

$2x(1-3x)=0$

$2x=0$ $\quad 1-3x=0$

$x=0$ $\quad x=-1/3$

B) $x^2 - x - 12 = 0$

$(x-4)(x+3)=0$

$x=4$ $\quad x=-3$

C) $2(x-5)(3x+7) = 0$

$2=0$ no $\quad x-5=0$ $\quad x=5$ $\quad 3x+7=0$ $\quad x=-7/3$

D) $x(8x+1)(2x-9) = 0$

$x=0$ $\quad x=-1/8$ $\quad x=9/2$

E) $2n^2 - 13n + 23 = 3$

$2n^2-13n+20=0$ $\quad 40$, $5 \mid 8$

$2n^2-8n-5n+20=0$

$2n(n-4)-5(n-4)=0$

$(2n-5)(n-4)=0$

$n=5/2$ $\quad n=4$

*F) $15x^6 + 12x^5 - 105x^4 - 84x^3 = 0$

$3x^3(5x^3+4x^2-35x-28)$

$3x^2(x^2(5x+4)-7(5x+4))$

$3x^2(x^2-7)(5x+4)=0$

$x=0$ $\quad x=\pm\sqrt{7}$ $\quad x=-4/5$

G) $2x^2+12x=80$ GCF

$2x^2+12x-80=0$ $\frac{40}{1}$

$2(x^2+6x-40)=0$

$2(x+10)(x-4)=0$

$x=-10 \quad x=4$

H) $7r^2+20r-36=-4$ $\frac{32}{1\,|\,32}$ $28\ 8$

$7r^2+20r-32=0$

$7r^2+28r-8r-32=0$

$7r(r+4)-8(r+4)=0$

$(7r-8)(r+4)=0$ $r=\frac{8}{7}, -4$

Sometimes you won't be able to factor as nicely as you did above. What's different about the equations in Example 2? no bx term

LT8

For these, you can solve by getting x^2 alone, and then take the square root.
You can also get a binomial squared alone, and then take the square root.
DO NOT FORGET THE + and - !

Example 2: Solve. If necessary, simplify all radicals *and* give the radical rounded to 2 decimal places.

A) $5x^2-180=0$

$5x^2=180$

$x^2=36$

$x=\pm 6$

$5(x^2-36)=0$

$5(x+6)(x-6)=0$

$x=-6, 6$

B) $3x^2=24$

$x^2=8$

$x=\pm 2\sqrt{2}$

H) $100x^2-10=0$

$x^2=\frac{10}{100}$

$x=\pm\frac{\sqrt{10}}{10}$

C) $4x^2-25=0$

$4x^2=25$

$x^2=\frac{25}{4}$

$x=\pm\frac{5}{2}$

D) $x^2-\frac{1}{4}=0$

$x^2=\frac{1}{4}$

$x=\pm\frac{1}{2}$

$7x^2=2100$

$x=\pm\sqrt{300}$

$x=\pm 10\sqrt{3}$

E) $(3x+4)^2=9$

$3x+4=\pm 3$

$3x=-4\pm 3$

$3x=-1$ $3x=-7$

$x=-1/3, -7/3$

F) $8(2x-3)^2=16$

$(2x-3)^2=2$

$2x-3=\pm\sqrt{2}$

$2x=3\pm\sqrt{2}$

$x=\frac{3\pm\sqrt{2}}{2}$

G) ~~$2n^4-13n^2+23=3$~~ it

$9x^2-24x+16=1$

$(3x-4)^2=1$

$3x-4=\pm 1$

$3x=4\pm 1$

$3x=5 \quad 3x=3$

$x=\frac{5}{3} \quad x=1$

Always make sure your radical answers are always simplified! Here's a quick review …

A) $\sqrt{180}$ $\sqrt{5\cdot 2\cdot 2\cdot 9}$ $6\sqrt{5}$

B) $\sqrt{252}$ $\sqrt{4\cdot 7\cdot 9}$ $2\cdot 3\sqrt{7}$

C) $\sqrt{54p^3}$ $\sqrt{9\cdot 6\cdot p^2\cdot p}$ $3p\sqrt{6p}$

D) $\sqrt{\frac{4}{81}}$ $\frac{2}{9}$

E) $\sqrt{\frac{7}{16}}$ $\frac{\sqrt{7}}{4}$

Final Checks LT 7-8

LT 7. I can solve by factoring

Assessment Score: 0 1 2 3 4

Solve each equation by factoring.

1) $a^2 - 2a + 1 = 0$ $a = 1$

2) $n^2 - 7n + 12 = 0$ $n = 4, 3$

3) $m^2 - 3m + 2 = 0$ $m = 2, 1$

4) $b^2 + 8b + 15 = 0$ $b = -5, -3$

5) $7m^2 - 451 = -3$ $m = 8, -8$

6) $b^2 - b - 7 = 5$ $b = -3, 4$

7) $n^2 + 8n + 20 = 4$ $n = -4$

8) $4b^2 + 20b + 13 = -3$ $b = -4, -1$

9) $b^2 - 3b - 45 = -5$ $b = -5, 8)$

10) $3p^2 + 6p - 5 = 4$ $p = 1, -3$

11) $a^2 + 5a - 13 = -7$ $a = -6, 1$

12) $7v^2 + 7v - 217 = -7$ $v = -6, 5$

13) $x^2 + 14 = 9x$ $x = 2, 7$

14) $x^2 - 2x = 0$ $x = 0, 2$

15) $4n^2 = -12n + 112$ $n = 4, -7$

16) $n^2 + 28 = 11n$ $n = 7, 4$

17) $x^2 + 21 = -10x$ $x = -7, -3$

18) $-48m = -90 - 6m^2$ $m = 5, 3$

LT 8. I can solve by taking the square root. **Assessment Score: 0 1 2 3 4**

Solve each equation using the square root method.

1) $x^2+9=91$ $\sqrt{82}, -\sqrt{82}$

2) $p^2+7=76$ $\sqrt{69}, -\sqrt{69}$

3) $-8x^2=-512$ ± 8

4) $x^2+4=94$ $\pm 3\sqrt{10}$

5) $x^2+6=47$ $\pm\sqrt{41}$

6) $-10k^2=-220$ $\pm\sqrt{22}$

7) $4k^2=76$ $\pm\sqrt{19}$

8) $-7x^2=-693$ $\pm 3\sqrt{11}$

9) $7x^2-3=564$ ± 9

10) $-1-2x^2=-99$ ± 7

11) $7x^2-9=509$ $\pm\sqrt{74}$

12) $7x^2-6=512$ $\pm\sqrt{74}$

13) $2r^2+1=17$ $\pm 2\sqrt{2}$

14) $-5-8p^2=-29$ $\pm\sqrt{3}$

15) $36p^2-10=15$ $\pm\frac{5}{6}$

16) $2k^2+2=122$ $\pm 2\sqrt{15}$

17) $1+16n^2=2$ $\pm\frac{1}{4}$

18) $16x^2-5=76$ $\pm\frac{9}{4}$

Practice w/ Square Roots from Unit 1

Unit 1 LT 3 I can simplify square roots **Name**_____

Simplify each square root

1) $\sqrt{8} = \sqrt{4} \cdot \sqrt{2}$ $2\sqrt{2}$

2) $\sqrt{45}$ $3\sqrt{5}$

3) $\sqrt{50}$ $\sqrt{25}\sqrt{2}$ $5\sqrt{2}$

4) $\sqrt{12}$ $2\sqrt{3}$

5) $\sqrt{98}$ $7\sqrt{2}$

6) $\sqrt{48} = \sqrt{16}\sqrt{3}$ $4\sqrt{3}$

7) $\sqrt{125}$ $5\sqrt{5}$

8) $\sqrt{20}$ $2\sqrt{5}$

9) $\sqrt{72} = \sqrt{4}\sqrt{2}\sqrt{9}$ $6\sqrt{2}$

10) $\sqrt{63}$ $3\sqrt{7}$

11) $\sqrt{144}$ 12

12) $\sqrt{32} = \sqrt{4}\sqrt{4}\sqrt{2}$ $4\sqrt{2}$

13) $\sqrt{75}$ $5\sqrt{3}$

14) $\sqrt{200}$ $10\sqrt{2}$

15) $5\sqrt{18} = 5\sqrt{9} \cdot \sqrt{2}$ $15\sqrt{2}$

16) $3\sqrt{28}$ $3 \cdot \sqrt{4}\sqrt{7}$ $6\sqrt{7}$

17) $2\sqrt{1000}$ $2\sqrt{100}\sqrt{10}$ $20\sqrt{10}$

18) $\sqrt{1{,}000{,}000}$ 1000

19) $3\sqrt{128}$ $3 \cdot \sqrt{64}\sqrt{2}$ $24\sqrt{2}$

20) $8\sqrt{27}$

21) $4\sqrt{80}$ $4 \cdot \sqrt{4}\sqrt{4}\sqrt{5}$ $16\sqrt{5}$

22) $-3\sqrt{54}$ $-3\sqrt{9}\sqrt{6}$ $-9\sqrt{6}$

23) $-7\sqrt{40}$ $-7\sqrt{4}\sqrt{10}$ $-14\sqrt{10}$

24) $-8\sqrt{121}$ $-8 \cdot 11$ -88

25) $2\sqrt{500}$ $2\sqrt{100}\sqrt{5}$ $20\sqrt{5}$

26) $-4\sqrt{24}$ $-4\sqrt{4}\sqrt{6}$ $-8\sqrt{6}$

27) $3\sqrt{175}$ $3\sqrt{25}\sqrt{7}$ $15\sqrt{7}$

28) $5\sqrt{108}$ $5\sqrt{2}\sqrt{9}\sqrt{2}\sqrt{3}$ $30\sqrt{3}$

ANSWERS SCRAMBLED $7\sqrt{2}$ $3\sqrt{7}$ $5\sqrt{5}$ $6\sqrt{2}$ $2\sqrt{2}$ $10\sqrt{2}$ $5\sqrt{2}$ $4\sqrt{2}$ $4\sqrt{3}$ $2\sqrt{5}$ $2\sqrt{3}$ 12 $3\sqrt{5}$ $5\sqrt{3}$ $6\sqrt{7}$ $24\sqrt{3}$ $24\sqrt{2}$ $15\sqrt{2}$ $16\sqrt{5}$ 1000 $20\sqrt{10}$ $-8\sqrt{6}$ $30\sqrt{3}$ $-14\sqrt{10}$ $20\sqrt{5}$ $15\sqrt{7}$ $-9\sqrt{6}$ -88

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Imaginary and Complex Numbers

After this lesson and practice, I will be able to … Date: _____

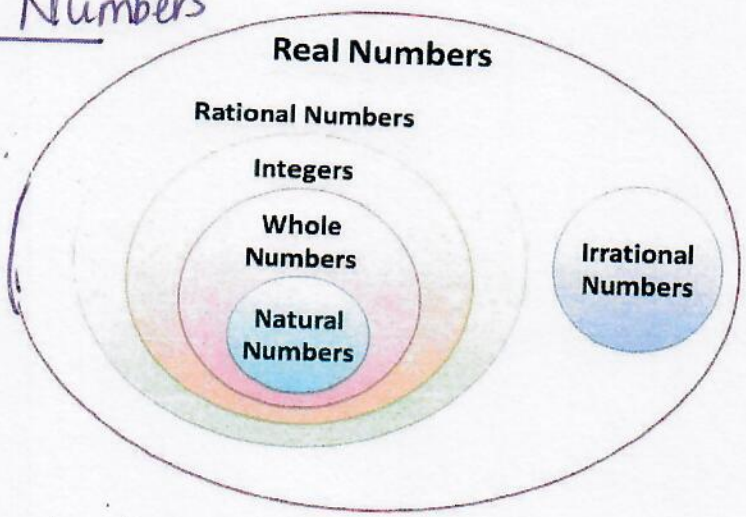
- ☐ perform operations with imaginary numbers. (LT 9)

Warm Up: Solve the equation $x^2 + 121 = 0$

This quadratic equation has NO real solutions. However, there do ~~exist~~ are existing solutions outside the REAL number system. Let's review that number system …

Complex Numbers

Imaginary Numbers



An **imaginary number** is any number whose square is -1. We use the letter ***i*** to represent imaginary numbers.

Here's the most important thing: $i^2 = -1$

That means that $i = \sqrt{-1}$ $\quad i^3 = -i$ $\quad i^4 = 1$

Here's a quick example: $\sqrt{-4} = i\sqrt{4} = 2i$

There is an i key on your calculator. Change your mode to a+bi.
Sometimes it will help you. Always show your work to prove you did it by hand.

Example 1: Simplify each radical completely.

A) $\sqrt{-5}$ $\quad i\sqrt{5}$

B) $\sqrt{-36}$ $\quad 6i$

C) $\sqrt{-12}$ $\quad i\sqrt{4 \cdot 3}$ $\quad 2i\sqrt{3}$

29
~~15~~

D) $\sqrt{-49}$

$7i$

E) $5\sqrt{-54}$

$5i\sqrt{9}\sqrt{6}$

$15i\sqrt{6}$

F) $\sqrt{-120}$

$i\sqrt{10\cdot4\cdot3}$

$2i\sqrt{30}$

So that's imaginary numbers. When you combine a real number with an imaginary number, you get a **complex number**. A **complex number** is a real number plus an imaginary number. The standard form of complex numbers looks like this: $a+bi$

NEVER leave i to any power except 1 in your final answer. Simplify and combine like terms.

Example 2: Write each expression as a complex number in standard form. $(a+bi)$

A) $(12-11i)+(-8+3i)$

$4-8i$

B) $(15-9i)-(24-9i)$

-9

C) $2(4-3i)-(10+6i)$

$8-6i-10-6i$

$-2-12i$

(Recall $i^2=-1$)

Example 3: Write each expression as a complex number in standard form.

A) $4i(-6+i)$

$-24i+4i^2$

$-4-24i$

B) $(9-2i)(-4+7i)$

$-36+8i+63i-14i^2$

$-36+71i+14$

$-24+71i$

C) $(4-i)(4+i)$

$16-4i+4i-i^2$

$16-(-1)$

17

conjugate

Example 4: Write each expression as a complex number in standard form.

A) $(9-i)+(-6+7i)$

$3+6i$

B) $-4-(1+i)+(2+3i)$

$-4-1-i+2+3i$

$-3+2i$

C) $(2-7i)(2+7i)$

$4-49i^2$

$4+49$

53

D) $-5i(8-9i)$

$-40i+45i^2$

$-45-40i$

E) $(-8+2i)(4-7i)$

$-32+8i+56i-14i^2$

$-18+64i$

F) $(3+4i)^2$

$9+24i+16i^2$

$-7+24i$

Let's return to the equation from the beginning of class: $x^2 + 121 = 0$. You are now prepared to solve equations to find all solutions, whether they are REAL or COMPLEX (imaginary)

Example 5: Solve. Give all real and complex solutions.

A) $4x^2+72=0$

$4x^2=-72$

$x^2=-18$

$x=\pm\sqrt{-18}$

$x=\pm3i\sqrt{2}$

B) $4x^2+23=3$

$4x^2=-20$

$x^2=-5$

$x=\pm\sqrt{-5}$

$x=\pm i\sqrt{5}$

C) $2x^2+44=4$

$2x^2=-40$

$x^2=-20$

$x=\pm\sqrt{-20}$

$x=\pm2i\sqrt{5}$

Final Checks LT 9

LT 9 I can perform operations with imaginary numbers. **Assessment Score: 0 1 2 3 4**

Simplify

1) $(8i) - (6 - 2i)$ $-6+10i$

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

3) $(-6i) - (i)$ $-7i$

4) $(-2i) - (6i)$ $-8i$

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

6) $(-5 - 6i) + (7i)$ $-5+i$

7) $(-7i)(3i)$ 21

8) $(3i)(-8 - 8i)$ $24-24i$

9) $(-4i)(-4 + 2i)$ $8+16i$

10) $3(-5i)$ $-15i$

11) $(-8i)(-5i)$ -40

12) $(4i)(-4i)(2i)$ $32i$

13) $(-i)(-8 - 2i)$ $-2+8i$

14) $(-3i)(5 + 4i)$ $12-15i$

Solve each equation using the square root method. Simplify your answers.

15) $p^2 + 2 = -1$ $\pm i\sqrt{3}$

16) $2p^2 = -18$ $\pm 3i$

17) $5v^2 = -35$ $\pm i\sqrt{7}$

18) $n^2 + 6 = -12$ $\pm 3i\sqrt{2}$

19) $4p^2 = -320$ $\pm 4i\sqrt{5}$

20) $-3r^2 = 96$ $\pm 4i\sqrt{2}$

21) $m^2 + 1 = -9$ $\pm i\sqrt{10}$

22) $n^2 + 6 = -7$ $\pm i\sqrt{13}$

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Completing the Square

After this lesson and practice, I will be able to …
☐ solve by completing the square. (LT 10)

Date: _____

Do you remember perfect square trinomials? We learned how to factor them earlier in the unit. Let's use that to help us solve an equation!

Example 1: Solve by finding square roots $x^2 - 8x + 16 = 25$

$(x-4)^2 = 25$

$x - 4 = \pm 5$

$x = 4 \pm 5$ $\quad x = 9$ or -1

That's a pretty great way to solve quadratic equations, but unfortunately, we won't always have nice perfect square trinomials in our equations. Luckily for us, there's a way to *create* perfect square trinomials. It's called **completing the square** …

Set up the following scenarios with your papers and fill in the table accordingly.

Equation	Number of 1-tiles needed to complete the square	Expression written as a square
$x^2 + 2x + \_1\_$		$(x + \_1\_)^2$
$x^2 + 4x + \_4\_$		$(x + \_2\_)^2$
$x^2 + 6x + \_9\_$		$(x + \_3\_)^2$
$x^2 + 8x + \_16\_$		$(x + \_4\_)^2$
$x^2 + 10x + \_25\_$		$(x + \_5\_)^2$

Answer these questions with your group. Consider the general statement $x^2 + bx + c = (x + d)^2$.

a. How is d related to b?

d is $\frac{1}{2}$ of b

b. How is c related to d?

$c = d \cdot d = d^2$

c. How can you obtain the numbers in the second column of the table directly from the coefficients of x in the expressions from the first column?

take $\frac{1}{2}$ of b, square it + add it

Let's practice completing the square before we solve …

Example 2: Find the value of c that makes x^2+bx+c a perfect square trinomial. Then write the expression as the square of a binomial.

A) $x^2+16x+c$

$b=16$

$c=8^2=64$

B) $x^2+22x+c$

$c=11^2=121$

C) x^2-9x+c

$c=\left(\frac{9}{2}\right)^2=\frac{9}{4}$

D) x^2+6x+c

$c=3^2=9$

E) $x^2-15x+c$

$c=\left(\frac{-15}{2}\right)^2=\frac{225}{4}$

Solving quadratic equations of the form $x^2+bx+c=0$ ***by completing the square***

Steps to solving a quadratic equation by COMPLETING THE SQUARE:

1) Make sure the coefficient of x^2 is 1. (If it isn't...divide by a suitable number!)
2) Put the constant on the right side and $x^2 + bx$ on the left side.
3) Take $\frac{1}{2}$ the coefficient of x, square it, and add it to BOTH sides!!
4) Factor & solve using the square root method!

Example 3: Solve by completing the square: (If b is odd, use fractions not decimals)

A) $x^2 + 12x = 28$

$x^2 + 12x + \boxed{36} = 28 + \boxed{36}$

$(x+6)^2=64$

$x+6=\pm 8$

$x=-6\pm 8$

$x=-14 \quad x=2$

B) $x^2 - 6x + 5 = 0$

$x^2-6x+\underline{9}=-5+\underline{9}$

$(x-3)^2=4$

$x-3=\pm 2$

$x=3\pm 2$

$x=5 \quad x=1$

C) $x^2 - 9x + 20 = 0$

$x^2-9x+\underline{\frac{81}{4}}=-20+\frac{81}{4}$

$\left(x-\frac{9}{2}\right)^2=\frac{1}{4}$

$x-\frac{9}{2}=\pm\frac{1}{2}$

$x=\frac{9}{2}\pm\frac{1}{2}$

$x=5 \quad x=4$

D) $x^2 - 12x + 4 = 0$

$x^2 - 12x + 36 = -4 + 36$

$(x-6)^2 = 32$

$x = 6 \pm \sqrt{32}$

$x = 6 \pm 4\sqrt{2}$

Write original equation.

Write left side in the form $x^2 + bx$.

Complete the square.

Write left side as a binomial squared.

Take square roots of each side.

Solve for x.

Simplify.

E) $x^2 - 8x + 36 = 0$

$(x-4)^2 = -36 + 16$

$x - 4 = \pm\sqrt{-20}$

$x = 4 \pm 2i\sqrt{5}$

Example 4: Solve each equation by completing the square.

A) $x^2 - 10x + 8 = 0$

$x^2 - 10x + 25 = -8 + 25$

$(x-5)^2 = 17$

$x = 5 \pm \sqrt{17}$

B) $x^2 + 4x - 4 = 0$

$x^2 + 4x + 4 = 4 + 4$

$(x+2)^2 = 8$

$x = -2 \pm 2\sqrt{2}$

C) $x^2 + 4x + 1 = 0$

$x^2 + 4x + 4 = -1 + 4$

$(x+2)^2 = 3$

$x = -2 \pm \sqrt{3}$

D) $x^2 + 6x + 12 = 0$

$x^2 + 6x + 9 = -12 + 9$

$(x+3) = -3$

$x = -3 \pm i\sqrt{3}$

E) $x^2 - 3x - 5 = 0$

$x^2 - 3x + \frac{9}{4} = 5 + \frac{9}{4}$

$(x - \frac{3}{2})^2 = \frac{29}{4}$

$x - \frac{3}{2} = \frac{\pm\sqrt{29}}{2}$

$x = \frac{3}{2} \pm \frac{\sqrt{29}}{2}$

or $x = \frac{3 \pm \sqrt{29}}{2}$

Solving quadratic equations of the form $ax^2+bx+c=0, a\neq 1$ ***by completing the square.***

Example 5: Solve by completing the square:

A) $2x^2+8x+14=0$ ÷ by 2

$x^2+4x+\underline{4}=-7+\underline{4}$

$(x+2)^2=-3$

$x=-2\pm i\sqrt{3}$

B) $3x^2-36x+150=0$

$x^2-12x+\underline{36}=-50+\underline{36}$

$(x-6)^2=-14$

$x=6\pm i\sqrt{14}$

C) $2x^2+x=6$

$x^2+\frac{1}{2}x+\frac{1}{16}=3+\frac{1}{16}$

$(x+\frac{1}{4})^2=\frac{49}{16}$

$x=-\frac{1}{4}\pm\frac{7}{4}$

$x=-2 \quad x=\frac{3}{2}$

D) $x^2+21x=-98$

$x^2+21x+\frac{21^2}{4}=-98+\frac{441}{4}$

$(x+\frac{21}{2})^2=\frac{49}{4}$

$x+\frac{21}{2}=\pm\frac{7}{2}$

$x=-\frac{21}{2}\pm\frac{7}{2}$

$x=-7 \quad x=-14$

E) $3x^2-7x=6$

$x^2+\frac{7}{3}x+\frac{49}{36}=2+\frac{49}{36}$

$(x+\frac{7}{6})^2=\frac{121}{36}$

$x=-\frac{7}{6}\pm\frac{11}{6}$

$x=-3, \frac{2}{3}$

Final Checks LT 10

LT 10 I can solve by completing the square.

Assessment Score: 0 1 2 3 4

Solve by Completing the Square

1) $m^2+4m-77=0$ $m=7,-11$

2) $4b^2-16b-24=0$ $2\pm\sqrt{10}$

3) $b^2+6b+93=0$ $-3\pm 2i\sqrt{21}$

4) $n^2-18n+56=0$ $n=4,14$

5) $k^2-8k+61=0$ $K=4\pm 3i\sqrt{5}$

6) $n^2+6n+5=0$ $n=-1,5$

7) $a^2-2a-35=-10$ $a=1\pm\sqrt{26}$

8) $k^2-4k-38=-6$ $K=8,-4$

$x^2+2x-12=2$ $-1\pm\sqrt{15}$

10) $x^2-16x-48=-4$ $x=8\pm 6\sqrt{3}$

11) $p^2+18p+12=-3$ $-9\pm\sqrt{66}$

12) $x^2-8x+20=5$ $x=5,3$

13) $x^2-10x-73=2$ $x=15,-5$

14) $p^2+12p+41=9$ $p=-4,-8$

15) $5n^2+10n+34=4$ $-1\pm i\sqrt{5}$

16) $6v^2-12v+85=9$ $\frac{3\pm i\sqrt{105}}{3}$

17) $7x^2+14x-53=3$ $-4, 2$

18) $2b^2-8b+94=7$ $\frac{4\pm i\sqrt{158}}{2}$

The Quadratic Formula

Date: _____

After this lesson and practice, I will be able to ...

- ☐ solve using the quadratic formula (with rationalized denominators). (LT 11)
- ☐ use the discriminant to determine the number and type of solutions. (LT 12)
- ☐ write quadratic questions given the real solutions. (LT 13)

So far, you have learned three strategies for solving quadratic equations ... they are:

1. Factoring
2. Square Root
3. Completing Square

We will learn atleast one more using calculator

Each strategy has its own benefit depending on the characteristics of the equation. Today you're going to see the fourth and final way of solving quadratic equations. It's one of the most famous formulas in mathematics and it works on ***ALL*** quadratic equations!

Let's first derive the Quadratic Formula using completing the square:

$ax^2 + bx + c = 0$ subtract c

$ax^2 + bx = -c$ divide by a

$x^2 + \frac{b}{a}x + \frac{b^2}{4a^2} = \frac{-c}{a} + \frac{b^2}{4a^2}$

$\left(x + \frac{b}{2a}\right)^2 = \frac{-4ac^2}{4a^2} + \frac{b^2}{4a^2}$

$x + \frac{b}{2a} = \frac{\pm\sqrt{b^2-4ac}}{2a}$

"song"

$x = \frac{-b}{2a} \pm \frac{\sqrt{b^2-4ac}}{2a}$ or $\frac{-b \pm \sqrt{b^2-4ac}}{2a}$

The Quadratic Formula: For any quadratic equation $ax^2 + bx + c = 0$, the solutions are ...

$$x = \frac{-b+\sqrt{b^2-4ac}}{2a} \quad \text{or} \quad x = \frac{-b-\sqrt{b^2-4ac}}{2a}$$

sometimes written as one solution with $\pm$: $$x = \frac{-b\pm\sqrt{b^2-4ac}}{2a}$$

Example 1: Solve each equation. Write your solutions as exact values in simplest form (no decimals)

A) $3x^2 - 5x = 2$

$3x^2-5x-2=0$

$a=3 \quad b=-5 \quad c=-2$

$x = \frac{5 \pm \sqrt{25-4(3)(-2)}}{2(3)}$

$= \frac{5 \pm \sqrt{49}}{6} = \frac{5 \pm 7}{6}$

$x = 2, -\frac{1}{3}$

B) $2x^2 + 8x = -12$ (+12 +12)

$a=2 \quad b=8 \quad c=12$

or

$a=1 \quad b=4 \quad c=6$

$x = \frac{-4 \pm \sqrt{16-4(1)(6)}}{2}$

$x = \frac{-4 \pm \sqrt{-8}}{2}$

$x = \frac{-4 \pm 2i\sqrt{2}}{2}$

$= -2 \pm i\sqrt{2}$

C) $9x^2 + 12x + 4 = 0$

$a=9 \quad b=12 \quad c=4$

$x = \frac{-12 \pm \sqrt{144-4}}{2(9)}$

$x = \frac{-12 \pm 0}{18}$

$x = -\frac{2}{3}$

D) $4x^2 - 8x + 1 = 0$

$x = \frac{8 \pm \sqrt{64-4(4)(1)}}{2(4)}$

$x = \frac{8 \pm \sqrt{48}}{8} = \frac{8 \pm 4\sqrt{3}}{8}$

$x = \frac{2 \pm \sqrt{3}}{2}$

E) $2x^2 = 7x - 8$

$2x^2-7x+8=0$

$x = \frac{7 \pm \sqrt{49-4(2)(8)}}{2(2)}$

$x = \frac{7 \pm \sqrt{-15}}{4}$

$x = \frac{7 \pm i\sqrt{15}}{4}$

A) 49 B) -8 C) 0

D) 48 E) -15

As we've seen, quadratic equations can have real or complex solutions. Let's discover how to quickly determine which type of solution a given quadratic equation has …

Discriminant: Given $ax^2+bx+c=0$, the discriminant is b^2-4ac. (not $\sqrt{b^2-4ac}$)

The discriminant does not include the radical symbol!

Fill out the table below.

Equation	***Value of Discriminant*** b^2-4ac	***Number (0, 1 or 2) and Type of Solutions (Real or Complex)***
A) $3x^2-5x=2$	$25-4(3)(-2)=49$	2 real rational solutions
B) $2x^2+8x=-12$	$16-4(1)(6)=-8$	2 complex solution
C) $9x^2+12x+4=0$	$144-4(9)(4)=0$	1 real solution
D) $4x^2-8x+1=0$	$64-4(4)(1)=48$	2 real irration solutions
E) $2x^2=7x-8$	$49-4(2)(8)=-15$	2 complex solutions

Summary:

Value of Discriminant	**Number and Types of Solutions**
Positive	2 real (rational or irrational)
Zero	1 real (double solution)
Negative	2 complex (conjugate pairs)

Example 2: Find the discriminant and give the number and type of solutions. Do not solve.

A) $x^2+10x+23=0$ B) $x^2+10x+25=0$ C) $x^2+10x+27=0$

$100-4(1)(23)=8$ $100-4(1)(25)=0$ $100-4(1)(27)=-8$

0 1 (2) 0 (1) 2 0 1 (2)

Real or complex Real or complex Real or complex

(zero real)

One more use for the discriminant!

If the discriminant is a perfect square, the quadratic expression is factorable under rational numbers.
If it is not a perfect square, the quadratic expression is prime under rational numbers.

We now know how to find the solutions of a quadratic equation.
Next we will do the reverse: ***Find the quadratic equation given the solutions.***
We will use this in the next unit.

Factored Form – $(x-r_1)(x-r_2)=0$, given r_1 and r_2 are solutions.

Example 1: Write a quadratic equation in factored form with the following solutions:

A) 2 and -4 B) 4 C) $-\frac{1}{2}$ and -7

$(x-2)(x+4)=0$ $(x-4)(x-4)=0$ $(x+\frac{1}{2})(x+7)=0$

$(x-4)^2=0$ OR $(2x+1)(x+7)=0$

Example 2: Write a quadratic equation in factored form with the following solutions.

A) -1 and 3 B) -4 and 0 C) -10

$(x+1)(x-3)=0$ $(x+4)(x-0)=0$ $(x+10)(x+10)=0$

$x(x+4)=0$ $(x+10)^2=0$

D $\pm\sqrt{7}$ $(x-\sqrt{7})(x+\sqrt{7})=0$

Example 3: Write a quadratic equation in **STANDARD** form with the following solutions.

A) -2 and 2 B) -5 C) -5 and 1/4

$(x+2)(x-2)=0$ $(x+5)^2$ $(x+5)(x-\frac{1}{4})=0$

$x^2-4=0$ $x^2+10x+25=0$ OR $(x+5)(4x-1)=0$

$4x^2+19x-5=0$

D) $\pm\sqrt{5}$

$(x+\sqrt{5})(x-\sqrt{5})=0$

$x^2-5=0$

Final Checks LT 11-13

LT 11. I can solve equations using the quadratic formula (with rationalized denominators).

Assessment Score: 0 1 2 3 4

Solve using the quadratic formula.

1) $2x^2 - 2x - 12 = 0$ $x = 3, -2$

2) $-3x^2 - 3x - 1 = 0$ $\frac{-3 \pm i\sqrt{3}}{6}$

3) $-5x^2 + 2x - 4 = 0$ $\frac{1 \pm i\sqrt{19}}{5}$

4) $5n^2 + 2n + 2 = 0$ $\frac{1 \pm 3i}{5}$

5) $-4x^2 - 4x + 2 = 0$ $\frac{-1 \pm \sqrt{3}}{2}$

6) $5x^2 + 4x - 8 = 0$ $\frac{-2 \pm 2\sqrt{11}}{5}$

7) $-n^2 + 3n - 4 = 0$ $\frac{3 \pm i\sqrt{7}}{2}$

8) $-p^2 - 3p + 9 = 0$ $\frac{-3 - 3\sqrt{5}}{2}$

9) $-2n^2 + n + 3 = 0$ $-1, \frac{3}{2}$

10) $-a^2 + 10 = 4a$ $-2 \pm \sqrt{14}$

11) $3n^2 - 1 = 3n$ $\frac{3 \pm \sqrt{21}}{6}$

12) $-3x^2 + x = 2$ $\frac{1 \pm i\sqrt{23}}{6}$

13) $-2x^2+3=-4x$ $\frac{2\pm\sqrt{10}}{2}$

14) $-x^2=-5x-10$ $\frac{5\pm\sqrt{65}}{2}$

15) $5n^2-2n-7=3n^2$ $\frac{1\pm\sqrt{15}}{2}$

16) $2b^2+5b-6=b$ $b=1,-3$

17) $5n^2-3n-10=2n+n^2-3$ $\frac{5\pm\sqrt{137}}{8}$

18) $4x^2+4x-6=-2+3x^2$ $-2\pm2\sqrt{2}$

LI 12. I can use the discriminant to determine the number and type of solutions.

Assessment Score: 0 1 2 3 4

Find the discriminant. Then state the number and type of solutions.

1) $3k^2+8k-5=-10$ 4 2real

2) $-6n^2+5n+4=5$ 1 2real

3) $7r^2-3r-5=-9$ -103 2imag

4) $6r^2+10r=4$ 196 2real

5) $-x^2-2x-8=-7$ 0 1real

6) $8r^2-8r+10=8$ 0 1real

7) $-6m^2+3m+3=9$ -135 2imag

8) $-3m^2-m-6=-10$ 49 2real

9) $5n^2+n-4=-6$ -39 2imag

10) $-6n^2+9n-14=-5n$ -140 2img

11) $7x^2+3x-2=9x^2$ -7 2imag

12) $16v^2+10=6+12v^2-8v$ 0 1real

13) $4k^2-14=-14+10k$ 100 2real

14) $4x^2-7=-12-4x$ -64 2imag

) $3n^2-2n-8=-3$ 64 2real

16) $-6v^2-16v-5=-13v$ -111 2imag

4.2

LT 13. I can write quadratic equations given the real solutions. **Assessment Score: 0 1 2 3 4**

Write an equation having the given solutions in factored form AND standard form.

Given Solutions	Factored Form	Standard Form
1) -3 and 2	$(x+3)(x-2)=0$	$x^2+x-6=0$
2) 8 and 1	$(x-8)(x-1)=0$	$x^2-9x+8=0$
3) 0 and 2	$x(x-2)=0$	$x^2-2x=0$
4) -1 and -5	$(x+1)(x+5)=0$	$x^2+6x+5=0$
5) -2 and 7	$(x+2)(x-7)=0$	$x^2-5x-14=0$
6) 3 and 9	$(x-3)(x-9)=0$	$x^2-12x-27=0$
7) 2 and -10	$(x-2)(x+10)=0$	$x^2+8x-20=0$
8) -5 and -6	$(x+5)(x+6)=0$	$x^2+11x+30=0$
9) $-\sqrt{6}$ & $\sqrt{6}$ ↑add	$(x-\sqrt{6})(x+\sqrt{6})=0$	$x^2-6=0$
10) $\pm\sqrt{2}$	$(x-\sqrt{2})(x+\sqrt{2})=0$	$x^2-2=0$

More Review LT 7 and 10, 11 **CP Algebra 2 Name**_____

LT 7. I can solve by factoring. And
LT 10. I can solve by completing the square.
11. I can solve equations using the quadratic formula (with rationalized denominators).

Solve. Factor if possible. Use completing the square or quadratic formula for those that don't factor.

1) $X^2 + 10X - 24 = 0$

$= 0$

Ans. $X =$ 2 **or** $X =$ -12

2) $X^2 + 12X = 28$

$x = 2, -14$

3) $X^2 + 18X + 56 = 0$

-4, -14

4) $X^2 - 6X = 5$

$3 \pm \sqrt{14}$

5) $X^2 - 9X + 20 = 0$

5, 4

6) $X^2 - 5X = 50$

-5, 10

7) $X^2 = 8X - 15$

5, 3

8) $X^2 - X = 1$

$\frac{1 \pm \sqrt{5}}{2}$

9) $4X^2 + 8X - 12 = 0$

1, -3

Solve by completing the square:

10) $2X^2 - 4X - 8 = 0$

$1 \pm \sqrt{5}$

11) $2X^2 - 6X - 10 = 0$

$\frac{3 \pm \sqrt{29}}{2}$

12) $2X^2 + X - 6 = 0$

$\frac{3}{2}, -2$

ANSWERS: 1) $2, -12$ 2) $2, -14$ 3) $-4, -14$ 4) $3 \pm \sqrt{14}$ 5) 5, 4 6) $-5, 10$ 7) 5, 3

8) $\frac{1 \pm \sqrt{5}}{2}$ 9) $1, -3$ 10) $1 \pm \sqrt{5}$ 11) $\frac{3 \pm \sqrt{29}}{2}$ 12) $\frac{3}{2}, -2$

LT 7,8,10,11 Solving Equations **Name** _____

Solve for x:

1) $x^2+7x+10=0$

$0=(x+5)(x+2)=0$

$x=-5, -2$

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

$(x-6)(x-2)=0$

$x=6, 2$

3) $x^2-49=0$

$(x+7)(x-7)=0$

$x=-7, 7$

---

4) $x^2+5x-6=0$

$(x+6)(x-1)=0$

$x=-6, 1$

5) $x^2-7x-18=0$

$(x-9)(x+2)=0$

$x=9, -2$

6) $x^2-5x=0$

$x(x-5)=0$

$x=0 \quad x=5$

---

7) $2x^2+5x-3=0$

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

$x=\frac{1}{2}, -3$

8) $3x^2-8x+4=0$

$(3x-2)(x-2)=0$

$x=\frac{2}{3}, 2$

9) $2x^2-3x-5=0$

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

$x=\frac{5}{2}, -1$

---

10) $3x^2+x-10=0$

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

$5/3, -2$

11) $4x^2-25=0$

$(2x+5)(2x-5)=0$

$x=\frac{5}{2}, \frac{-5}{2}$

12) $2x^2+7x=0$

$x(2x+7)=0$

$x=0 \quad x=-\frac{7}{2}$

---

13) $5x^2+29x+20=0$

$(5x+4)(x+5)=0$

$x=\frac{-4}{5}, -5$

14) $6x^2-19x+15=0$

$(3x-2)(2x-3)=0$

$6x^2-9x-10x+15$ $x=2/3, 3/2$

Answers Scrambled (+2 that don't match anything!) $\left\{\frac{3}{5},-1\right\}\{2,6\}\left\{\frac{3}{2},\frac{5}{3}\right\}\{-2,-5\}\left\{0,-\frac{7}{2}\right\}$

$\{-6,1\}\left\{-\frac{4}{5},-5\right\}\{0,5\}\left\{\frac{5}{2},-\frac{5}{2}\right\}\left\{\frac{5}{2},-1\right\}\left\{\frac{5}{3},-2\right\}\{7,-7\}\left\{\frac{3}{2},\frac{5}{2}\right\}\left\{\frac{2}{3},2\right\}\left\{\frac{1}{2},-3\right\}\{-2,9\}$

45

More Unit 2-1 Mixed Review LT 7-13

Name_____

1. Solve the following equations by the square root method. Solve for all solutions, including imaginary numbers. (LT 8)

a. $8x^2 - 70 = 11x^2 + 5$ $x = \pm 5i$

b. $9x^2 - 13 = 0$ $x = \pm\frac{\sqrt{13}}{3}$

2. Solve the following quadratic equations by factoring. (LT7)

a. $4x^2 + 16x + 12 = 0$ $x = 3, -1$

b. $3x^2 - 10x + 8 = 0$ $x = -2/3, 4$

c. $x^2 - 64 = 0$ $x = \pm 8$

5. Rewrite each number in the standard form for complex numbers, $a + bi$. Reduce fractions and simplify radicals. (LT 9)

a. $\sqrt{-11}$ $i\sqrt{11}$

b. $(-3 - 10i) + (-6 - 5i)$ $-9 - 15i$

c. $\frac{\sqrt{-27}}{6}$ $\frac{i\sqrt{3}}{2}$

d. i^3 $-i$

e. i^{42} -1 SKIP

f. $(1 - 2i)(-4 + 3i)$ $2 + 11i$

g. $\frac{(5 + 2i)}{(2 - 3i)}$ SKIP $\frac{4 + 19i}{13}$

6. Use the Quadratic Formula to solve $x^5 + x + 1 = 0$ (LT 11) or $\frac{-1 \pm i\sqrt{3}}{2}$

7. Use "completing the square" to solve the following equation. (LT 10) $2x^2 + 10x - 3 = 0$ $\frac{-5 \pm \sqrt{31}}{2}$

8. Solve the following equations. LT 7,8,10,11)

a. $-5x^2 = -125$ ± 5

b. $-3y^2 + 11 = 95$ $\pm 2i\sqrt{7}$

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More Unit 2-1 Mixed Review LT 7-13 (cont)

9. Find the discriminant of the following quadratic equations and put it on the first blank. On the second blank, state the number of real solutions for the equation. (LT12(

a. $3x^2 - 4x + 5 = 2x + 3$ 12 2 real solutions

b. $2x^2 + 8x + 8 = 0$ 0 1 real solutions

13. Solve the following equations for real or imaginary solutions using the method indicated. Carefully show all of the work and simplify your answers as much as possible to simplified radical form and/or the standard form for complex numbers. (LT 10,11)

a. $x^2 + 20x + 80 = 0$ completing the square a. $-10 \pm 2\sqrt{5}$

b. $2x^2 + 3x = -5$ completing the square b. $-3/4 \pm 1/2\, i$

c. $2x - 9x^2 = 3x + 2 - 10x^2$ Quadratic Formula c. $2, -1$

d. $5x^2 + 2x + 3 = 0$ Quadratic Formula d. $\frac{-1 \pm i\sqrt{14}}{5}$

15. Find the approximate real roots (or real zeros) of the following quadratic equation, rounded to the nearest hundredth. (multiple choice)

$y = 3x^2 + 2x - 6$

a) no real roots b) -1.75, 1.15 c) 1.08, -1.85 d) 1.12, -1.79

LT 7,8,9,10,11 NAME_____

LT 7. I can solve by factoring.
LT 8. I can solve by taking the square root.
LT 9 I can perform operations with imaginary numbers.
LT 10. I can solve by completing the square.
LT 11. I can solve equations using the quadratic formula (with rationalized denominators).

I. Solve using the square root method.

(1) $3x^2 + 12 = 2x^2 + 61$

x = ± 7

Don't Forget ± Symbol!

(2) $4x^2 + 26 = -38$

x = ± 41

II. Solve by completing the square.

(3) $x^2 - 8x + 15 = 0$

x = 5 or 3

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

x = $\frac{-3 \pm \sqrt{17}}{2}$

✓

1) $ax^2 + bx = c$
2) half of b, square it,& add it to both sides.
3) change trinomial, to binomial^2
4) square root method

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

III. Solve using the quadratic formula.

***Get in standard form first! $ax^2 + bx + c = 0$

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

x = $3/2, -1$

(6) $3x^2 + 2x = -3$

x = $\frac{-1 \pm 3\sqrt{2}}{3}$

V. Use the discriminant to determine the number of real solutions.

☑ $b^2 - 4ac$ (+) 2, (0) 1, (–) 0

(8) $2x^2 + x = 6$

-47 2 complex

VII. Simplify. $i^0 = 1, i = \sqrt{-1}, i^2 = -1, i^3 = -i$

) (18-5i)+(-3+11i)

15-6i

11) (2+5i)-(3-i)

-1+6i

12) (3+7i)(4-8i)

68+4i

48

LT 12. I can use the discriminant to determine the number and type of solutions.

CP Algebra 2 Discriminant Name _____

Fill in the chart:

Equation	Standard Form	b^2-4ac Discriminant	Number and type of Solutions/Roots
1. **$6x^2 + 3x + 4 = 0$**	$6x^2+3x+4=0$	-87	0 real 2 complex
2. $x^2 = -6x - 9$	$x^2+6x+9=0$	0	1 real
3. $3x^2 - 6 = -5x$	$3x^2+5x-6=0$	97	2 real
4. $2x^2 - x = -4$	$2x^2-x+4=0$	-31	0 real 2 complex

LT 1 – 6 - factoring Name _____

Practice 5-4Factoring Quadratic Expressions - Factor each expression completely.

1. $x^2 + 4x + 4$
2. $x^2 - 7x + 10$
3. $x^2 + 7x - 8$
4. $x^2 - 6x$
5. $2x^2 - 9x + 4$
6. $x^2 + 2x - 35$
7. $x^2 + 6x + 5$
8. $x^2 - 9$
9. $x^2 - 13x - 48$
10. $x^2 - 4$
11. $4x^2 + x$
12. $x^2 - 29x + 100$
13. $x^2 - x - 6$
14. $9x^2 - 1$
15. $3x^2 - 2x$
16. $x^2 - 64$
17. $x^2 - 25$
18. $x^2 - 81$
19. $x^2 - 36$
20. $x^2 - 100$
21. $x^2 - 1$
22. $4x^2 - 1$
23. $4x^2 - 36$
24. $9x^2 - 4$
25. $x^2 - 7x - 8$
26. $x^2 + 13x + 36$
27. $x^2 - 5x + 6$
28. $x^2 + 5x + 4$
29. $x^2 - 21x - 22$
30. $x^2 + 13x + 40$
31. $2x^2 - 5x - 3$
32. $x^2 + 10x - 11$
33. $x^2 - 14x + 24$
34. $5x^2 + 4x - 12$
35. $2x^2 - 5x - 7$
36. $2x^2 + 13x + 15$
37. $3x^2 - 7x - 6$
38. $3x^2 + 16x + 21$
39. $x^2 + 5x - 24$
40. $x^2 + 34x - 72$
41. $x^2 - 11x$
42. $3x^2 + 21x$
43. $x^2 + 8x + 12$
44. $x^2 - 10x + 24$
45. $x^2 + 7x - 30$
46. $x^2 - 2x - 168$
47. $x^2 - x - 72$
48. $4x^2 - 25$
49. $x^2 - 121$
50. $x^2 + 17x + 16$
51. $10x^2 - 17x + 3$
52. $4x^2 + 12x + 9$
53. $4x^2 - 4x - 15$
54. $9x^2 - 4$
55. $x^2 + 6x - 40$
56. $2x^2 - 8$
57. $x^2 + 18x + 77$
58. $2x^2 - 98$
59. $x^2 + 21x + 98$
60. $x^2 + 20x + 84$
61. $9x^2 + 30x + 16$
62. $8x^2 - 6x - 27$
63. $x^2 - 3x - 54$
64. $x^2 - 169$
65. $25x^2 - 9$
66. $7x^2 + 49$
67. $2x^2 - 10x - 28$
68. $x^2 + 8x + 12$
69. $x^2 - 2x - 35$
70. $x^2 + 2x - 63$
71. $20x^2 - 11x - 3$
72. $12x^2 + 4x - 5$
73. $4x^2 - 5x - 6$
74. $8x^2 + 22x - 21$
75. $3x^2 - 3x - 168$

50
47

LT 7. I can solve by factoring. Name _____

LT 8. I can solve by taking the square root.

LT 10. I can solve by completing the square.

11. I can solve equations using the quadratic formula (with rationalized denominators).

Practice 5-5 Quadratic Equations Solve each equation by factoring, by taking square roots, by completing the square or by using the quadratic formula.

1. $x^2 - 18x - 40 = 0$
2. $16x^2 = 56x$
3. $5x^2 = 15x$
4. $x^2 - 6x - 7 = 0$
5. $x^2 - 49 = 0$
6. $x^2 + 2x + 1 = 0$
7. $x^2 - 1 = 0$
8. $x^2 - 3x - 4 = 0$
9. $x^2 + 9x^2 + 20 = 0$
10. $6x^2 + 9 = -55x$
11. $(x + 5)^2 = 36$
12. $2x^2 - 3x = 0$
13. $2x^2 + x - 10 = 0$
14. $-4x^2 + 3x = -1$
15. $5x^2 - 6x + 1 = 0$
16. $3x^2 + 1 = -4x$
17. $-2x^2 + 2 = -3x$
18. $6x^2 + 1 = 5x$
19. $-2x^2 - x + 1 = 0$
20. $3x^2 + 5x = 2$
21. $x^2 - 6x = -8$
22. $x^2 + 6 = -7x$
23. $6x^2 + 18x = 0$
24. $2x^2 + 5 = 11x$
25. $3x^2 - 7x + 2 = 0$
26. $2x^2 - 3x = -1$
27. $2x^2 - x = 6$
28. $x^2 - 144 = 0$
29. $4x^2 + 2 = 6x$
30. $5x^2 + 2 = -7x$
31. $7x^2 + 6x - 1 = 0$
32. $2x^2 - 6x = -4$
33. $11x^2 - 12x + 1 = 0$
34. $7x^2 + 1 = -8x$
35. $x^2 + 9 = -10x$
36. $(x - 2)^2 = 18$
37. $x^2 - 8x + 7 = 0$
38. $x^2 - 16 = 0$
39. $x^2 + 6x = -8$
40. $x^2 + 3 = 4x$
41. $2x^2 + 6 = -7x$
42. $6x^2 + 2 = 7x$
43. $(x + 7)^2 = \frac{49}{16}$
44. $9x^2 - 8x = 1$
45. $10x^2 + 7x + 1 = 0$
46. $4x^2 + 2 = -9x$
47. $3x^2 + 4 = 8x$
48. $4x^2 + 5 + 9x = 0$
49. $9x^2 + 10x = -1$
50. $2x^2 + 9x + 4 = 0$
51. $2x^2 + 6x = -4$
52. $11x^2 - 1 = -10x$
53. $4x^2 = 1$
54. $6x^2 = 12x$
55. $25x^2 - 9 = 0$
56. $2x^2 + 11x = 6$
57. $8x^2 - 6x + 1 = 0$
58. $x^2 + 11 = -12x$
59. $6x^2 + 2 = 13x$
60. $x^2 = 121$
61. $4x^2 - 11x = 3$
62. $8x^2 + 6x + 1 = 0$
63. $x^2 + 9x + 8 = 0$
64. $x^2 + 8x = -12$
65. $x^2 + 6x = 40$
66. $2x^2 = 8$
67. $x^2 = x + 6$
68. $x^2 + 2x - 6 = 0$
69. $x^2 - 12 = 0$
70. $3x^2 + 4x = 6$
71. $7x^2 - 105 = 0$
72. $16x^2 = 81$
73. $x^2 + 5x + 4 = 0$
74. $x^2 + 36 = -13x$
75. $x^2 + 6 = 5x$

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LT 8. I can solve by taking the square root. LT 9. I can perform operations with imaginary numbers.

Practice 5-6 Complex Numbers Name _____

LT 9. I can perform operations with imaginary numbers

Simplify each expression.

26. $\sqrt{40}$ **27.** $\sqrt{-88}$ **28.** $-\sqrt{-36}$

29. $(1 + 5i) + (1 - 5i)$ **30.** $(3 + 2i) - (3 + 2i)$ **31.** $4 - \sqrt{-25}$

32. $(2 + 6i) - (7 + 9i)$ **33.** $(1 + 5i)(1 - 5i)$ **34.** $(1 + 5i)(6 - 3i)$

35. $(5 - 6i)(6 - 2i)$ **36.** $(3 + 4i)(3 + 4i)$ **37.** $(2 + 3i)(2 - 3i)$

38. $(2 + 2i)(2 - 2i)$ **39.** $(-3 - 2i)(1 - 3i)$ **40.** $(3 + 3i) - (4 - 3i)$

41. $\sqrt{-48}$ **42.** $\sqrt{-300}$ **43.** $\sqrt{-75}$

44. $\sqrt{-16} + 2$ **45.** $(4 - i)(4 - i)$ **46.** $(4 + 2i)(1 - 7i)$

47. $(1 + 3i)(1 - 7i)$ **48.** $(2 + 4i)(-3 - 2i)$ **49.** $(11 - 12i)(11 + 12i)$

50. $(2 + 3i) + (-4 + 5i)$ **51.** $(5 + 14i) - (10 - 2i)$ **52.** $(5 + 12i)(5 - 12i)$

53. $(3 + 4i)(1 - 2i)$ **54.** $(6 + 2i)(1 - 2i)$ **55.** $(5 - 13i)(5 - 13i)$

56. $\sqrt{-44}$ **57.** $-\sqrt{-63}$ **58.** $\sqrt{-8}$

59. $(2 + 3i)(4 + 5i)$ **60.** $(5 + 4i) - (-1 - 2i)$ **61.** $(1 + 2i)(-1 - 2i)$

62. $(-1 + 4i)(1 - 2i)$ **63.** $(6 + 2i) + (1 - 2i)$ **64.** $(3 + 2i)(3 + 2i)$

65. $(-2 + 3i) + (4 + 5i)$ **66.** $(5 + 4i)(1 + 2i)$ **67.** $(-1 - 5i)(-1 + 5i)$

LT 8. I can solve by taking the square root.

Solve each equation.

68. $x^2 + 80 = 0$ **69.** $5x^2 + 500 = 0$ **70.** $2x^2 + 40 = 0$ **71.** $3x^2 + 36 = 0$

72. $3x^2 + 75 = 0$ **73.** $2x^2 + 144 = 0$ **74.** $4x^2 + 1600 = 0$ **75.** $4x^2 + 1 = 0$

76. $2x^2 + 10 = 0$ **77.** $4x^2 + 100 = 0$ **78.** $x^2 + 9 = 0$ **79.** $9x^2 + 90 = 0$

LT10. I can solve by completing the square. Name _____

Practice 5-7

Completing the Square

Solve each quadratic equation by completing the square.

24. $x^2 + 12x + 4 = 0$

25. $x^2 - x - 5 = 0$

26. $3x^2 = -12x - 3$

27. $x^2 - x - 1 = 0$

28. $4x^2 - 8x + 1 = 0$

29. $5x^2 = 8x - 6$

30. $2x^2 - 4x - 3 = 0$

31. $x^2 + 11x = 0$

32. $x^2 = 5x + 14$

33. $2x^2 + x - 1 = 0$

34. $2x^2 + 6x - 7 = 0$

35. $2x^2 = -8x + 45$

36. $x^2 = -3x - 3$

37. $4x^2 = -2x + 1$

38. $3x^2 = -6x + 9$

39. $x^2 = 7x + 12$

40. $x^2 = 3x + 7$

41. $3x^2 = 6x - 9$

42. $x^2 = -3x + 2$

43. $x^2 = -7x - 1$

44. $4x^2 = -3x + 2$

45. $2x^2 = 4x - 5$

46. $2x^2 = 5x + 5$

47. $2x^2 = 6x + 5$

48. $x^2 = 3x$

49. $x^2 = 8x$

50. $4x^2 = -2x - 3$

51. $2x^2 = -2x + 5$

52. $2x^2 = -5x - 5$

53. $3x^2 = -5x + 1$

54. $2x^2 = 2x + 4$

55. $3x^2 = 7x + 8$

56. $2x^2 = -6x + 4$

57. $x^2 = -7x - 9$

58. $2x^2 = 5x$

59. $3x^2 = -42x$

60. $2x^2 = -4x + 5$

61. $4x^2 = -x + 5$

62. $3x^2 = -3x + 1$

63. $x^2 = 3x + 4$

64. $2x^2 = 2x + 8$

65. $3x^2 = x + 4$

66. $x^2 + 2x + 1 = 9$

67. $3x^2 - 18x + 27 = 125$

68. $x^2 - 4x + 4 = 5$

LT 12. I can use the discriminant to determine the number and type of solutions.
LT 11. I can solve equations using the quadratic formula (with rationalized denominators).

Name _____ Class _____ Date _____

Practice 5-8 — The Quadratic Formula

Evaluate the discriminant of each equation. Tell how many solutions each equation has and whether the solutions are real or imaginary.

1. $y = x^2 + 10x - 25$
2. $y = x^2 + 10x + 10$
3. $y = 9x^2 - 24x$
4. $y = 4x^2 - 4x + 1$
5. $y = 4x^2 - 5x + 1$
6. $y = 4x^2 - 3x + 1$
7. $y = x^2 + 3x + 4$
8. $y = x^2 + 7x - 3$
9. $y = -2x^2 + 3x - 5$
10. $y = x^2 - 5x + 4$
11. $y = x^2 + 12x + 36$
12. $y = x^2 + 2x + 3$
13. $y = 2x^2 - 13x - 7$
14. $y = -5x^2 + 6x - 4$
15. $y = -4x^2 - 4x - 1$

LT 11. I can solve equations using the quadratic formula (with rationalized denominators).

Solve each equation using the Quadratic Formula.

16. $x^2 + 6x + 9 = 0$
17. $x^2 - 15x + 56 = 0$
18. $3x^2 - 5x + 2 = 0$
19. $2x^2 + 3x + 5 = 0$
20. $10x^2 - 23x + 12 = 0$
21. $4x^2 + x - 5 = 0$
22. $x^2 + 8x + 15 = 0$
23. $3x^2 + 2x + 1 = 0$
24. $4x^2 + x + 5 = 0$
25. $x^2 - 4x - 12 = 0$
26. $x^2 = 3x + 2$
27. $2x^2 - 5x + 2 = 0$
28. $x^2 + 6x - 4 = 0$
29. $x^2 = 2x - 5$
30. $3x^2 + 7 = -6x$
31. $2x^2 + 6x + 3 = 0$
32. $x^2 = -18x - 80$
33. $x^2 + 9x - 13 = 0$
34. $x^2 - 8x + 25 = 0$
35. $4x^2 + 13x = 12$
36. $3x^2 - 5x = -12$
37. $3x^2 + 4x + 5 = 0$
38. $2x^2 = 3x - 7$
39. $5x^2 + 2x + 1 = 0$
40. $5x^2 + x + 3 = 0$
41. $5x^2 + x = 3$
42. $5x^2 - 2x + 7 = 0$
43. $x^2 - 2x + 3 = 0$
44. $-2x^2 + 3x = 24$
45. $4x^2 = 5x - 6$
46. $x^2 + 6x + 5 = 0$
47. $x^2 - 6x = -8$
48. $x^2 - 6x = -6$

Solve: 49. A model of the daily profits p of a gas station based on the price per gallon g is

$$p = -15{,}000g^2 + 34{,}500g - 16{,}800.$$

Use the discriminant to find whether the station can profit $4000 per day. Explain.

Solve each equation using the Quadratic Formula. Find the exact solutions. Then approximate any radical solutions. Round to the nearest hundredth.

50. $x^2 - 2x - 3 = 0$
51. $x^2 + 5x + 4 = 0$
52. $x^2 - 2x - 8 = 0$
53. $7x^2 - 12x + 3 = 0$
54. $5x^2 + 5x - 1 = 0$
55. $4x^2 + 5x + 1 = 0$
56. $6x^2 + 5x - 4 = 0$
57. $x^2 + x = 6$
58. $x^2 - 13x = 48$
59. $2x^2 + 5x = 0$
60. $x^2 + 3x - 3 = 0$
61. $x^2 - 4x + 1 = 0$
62. $9x^2 - 6x - 7 = 0$
63. $x^2 - 35 = 2x$
64. $x^2 + 7x + 10 = 0$

Practice WS Answers

Practice 5-4

1. $(x+2)^2$ 2. $(x-5)(x-2)$ 3. $(x+8)(x-1)$
$x(x-6)$ 5. $(2x-1)(x-4)$ 6. $(x+7)(x-5)$
7. $(x+5)(x+1)$ 8. $(x+3)(x-3)$ 9. $(x-16)(x+3)$

10. $(x+2)(x-2)$ 11. $x(4x+1)$ 12. $(x-25)(x-4)$
13. $(x-3)(x+2)$ 14. $(3x+1)(3x-1)$ 15. $x(3x-2)$
16. $(x+8)(x-8)$ 17. $(x+5)(x-5)$
18. $(x+9)(x-9)$ 19. $(x+6)(x-6)$
20. $(x+10)(x-10)$ 21. $(x+1)(x-1)$
22. $(2x+1)(2x-1)$ 23. $4(x+3)(x-3)$
24. $(3x+2)(3x-2)$ 25. $(x-8)(x+1)$
26. $(x+9)(x+4)$ 27. $(x-3)(x-2)$
28. $(x+4)(x+1)$ 29. $(x-22)(x+1)$
30. $(x+5)(x+8)$ 31. $(2x+1)(x-3)$
32. $(x+11)(x-1)$ 33. $(x-12)(x-2)$
34. $(x+2)(5x-6)$ 35. $(x+1)(2x-7)$
36. $(x+5)(2x+3)$ 37. $(x-3)(3x+2)$
38. $(x+3)(3x+7)$ 39. $(x+8)(x-3)$
40. $(x+36)(x-2)$ 41. $x(x-11)$ 42. $3x(x+7)$
43. $(x+2)(x+6)$ 44. $(x-6)(x-4)$
45. $(x+10)(x-3)$ 46. $(x-14)(x+12)$
47. $(x-9)(x+8)$ 48. $(2x+5)(2x-5)$
49. $(x+11)(x-11)$ 50. $(x+16)(x+1)$
51. $(5x-1)(2x-3)$ 52. $(2x+3)(2x+3)$
53. $(2x-5)(2x+3)$ 54. $(3x+2)(3x-2)$
55. $(x+10)(x-4)$ 56. $2(x+2)(x-2)$
57. $(x+11)(x+7)$ 58. $2(x+7)(x-7)$
59. $(x+14)(x+7)$ 60. $(x+6)(x+14)$
61. $(3x+2)(3x+8)$ 62. $(2x+3)(4x-9)$
63. $(x-9)(x+6)$ 64. $(x+13)(x-13)$
65. $(5x+3)(5x-3)$ 66. $7(x^2+7)$ 67. $2(x-7)(x+2)$
68. $(x+6)(x+2)$ 69. $(x+5)(x-7)$
70. $(x+9)(x-7)$ 71. $(5x+1)(4x-3)$
72. $(2x-1)(6x+5)$ 73. $(4x+3)(x-2)$
74. $(4x-3)(2x+7)$ 75. $3(x+7)(x-8)$

Practice 5-5

1. 20, −2 2. $0, \frac{7}{2}$ 3. 0, 3 4. 7, −1 5. 7, −7 6. −1
7. 1, −1 8. 4, −1 9. −4, −5 10. $-9, -\frac{1}{6}$ 11. 1, −11
12. $0, \frac{3}{2}$ 13. $2, -\frac{5}{2}$ 14. $1, -\frac{1}{4}$ 15. $1, \frac{1}{5}$ 16. $-1, -\frac{1}{3}$
17. $2, -\frac{1}{2}$ 18. $\frac{1}{2}, \frac{1}{3}$ 19. $-1, \frac{1}{2}$ 20. $-2, \frac{1}{3}$ 21. 4, 2
22. −6, −1 23. 0, −3 24. $\frac{1}{2}, 5$ 25. $2, \frac{1}{3}$ 26. $\frac{1}{2}, 1$
27. $2, -\frac{3}{2}$ 28. 12, −12 29. $\frac{1}{2}, 1$ 30. $-1, -\frac{2}{5}$ 31. $-1, \frac{1}{7}$
32. 1, 2 33. $1, \frac{1}{11}$ 34. $-1, -\frac{1}{7}$ 35. −9, −1
36. 6.24, −2.24 37. 7, 1 38. 4, −4 39. −2, −4 40. 3, 1
41. $-2, -\frac{3}{2}$ 42. $\frac{1}{2}, \frac{2}{3}$ 43. $-\frac{21}{4}, -\frac{35}{4}$ 44. $1, -\frac{1}{9}$
45. $-\frac{1}{2}, -\frac{1}{5}$ 46. $-2, -\frac{1}{4}$ 47. $2, \frac{2}{3}$ 48. $-1, -\frac{5}{4}$
49. $-1, -\frac{1}{9}$ 50. $-4, -\frac{1}{2}$ 51. −2, −1 52. $-1, \frac{1}{11}$
53. $\frac{1}{2}, -\frac{1}{2}$ 54. 0, 2 55. $\frac{3}{5}, -\frac{3}{5}$ 56. $\frac{1}{2}, -6$ 57. $\frac{1}{2}, \frac{1}{4}$
58. −11, −1 59. $2, \frac{1}{6}$ 60. 11, −11 61. $3, -\frac{1}{4}$ 62. $-\frac{1}{2}, -\frac{1}{4}$
63. −8, −1 64. −2, −6 65. 4, −10 66. 2, −2 67. 3, −2
68. 1.65, −3.65 69. 3.46, −3.46 70. 0.9, −2.23
71. 3.87, −3.87 72. $\frac{9}{4}, -\frac{9}{4}$ 73. −1, −4 74. −4, −9 75. 3, 2

Practice 5-6

1. $2i, -4+2i, 12-14i$ 2. $1+i, 1+3i, -7+7i$
3. $-2-3i$ 4. $4-i$ 5. $-2i$ 6. $1+i$ 7. $6i$ 8. $-5+2i$
9. $2-3i$ 10. −4 11. 2 12. 13 13. $\sqrt{2}$ 14. $\sqrt{5}$ 15. 5
16. $\sqrt{29}$ 17. $\sqrt{13}$ 18. $\sqrt{5}$ 19. $3\sqrt{2}$ 20. 3 21. 2
22. $\sqrt{17}$ 23. $3\sqrt{5}$ 24. $\sqrt{10}$ 25. 4 26. $2\sqrt{10}$
27. $2i\sqrt{22}$ 28. $-6i$ 29. 2 30. 0 31. $4-5i$ 32. $-5-3i$
33. 26 34. $21+27i$ 35. $18-46i$ 36. $-7+24i$
37. 13 38. 8 39. $-9+7i$ 40. $-1+6i$ 41. $4i\sqrt{3}$
42. $10i\sqrt{3}$ 43. $5i\sqrt{3}$ 44. $2+4i$ 45. $15-8i$
46. $18-26i$ 47. $22-4i$ 48. $2-16i$ 49. 265
50. $-2+8i$ 51. $-5+16i$ 52. 169 53. $11-2i$
54. $10-10i$ 55. $-144-130i$ 56. $2i\sqrt{11}$ 57. $-3i\sqrt{7}$
58. $2i\sqrt{2}$ 59. $-7+22i$ 60. $6+6i$ 61. $3-4i$
62. $7+6i$ 63. 7 64. $5+12i$ 65. $2+8i$ 66. $-3+14i$
67. 26 68. $\pm 4i\sqrt{5}$ 69. $\pm 10i$ 70. $\pm 2i\sqrt{5}$ 71. $\pm 2i\sqrt{3}$
72. $\pm 5i$ 73. $\pm 6i\sqrt{2}$ 74. $\pm 20i$ 75. $\pm\frac{1}{2}i$ 76. $\pm i\sqrt{5}$
77. $\pm 5i$ 78. $\pm 3i$ 79. $\pm i\sqrt{10}$

Practice 5-7

1. 9 **2.** $\frac{49}{4}$ **3.** 36 **4.** $\frac{9}{4}$ **5.** 16 **6.** 64 **7.** $\frac{441}{4}$ **8.** 1

. $y = (x + 2)^2 - 10; (-2, -10)$

10. $y = (x - 3)^2 - 3; (3, -3)$

11. $y = 4(x + 1)^2 - 8; (-1, -8)$

12. $y = 4\left(x + \frac{1}{2}\right)^2; \left(-\frac{1}{2}, 0\right)$

13. $y = 2(x + 1)^2 - 7; (-1, -7)$

14. $y = -3\left(x + \frac{2}{3}\right)^2 + \frac{1}{3}; \left(-\frac{2}{3}, \frac{1}{3}\right)$

15. $y = -3\left(x - \frac{1}{2}\right)^2 - \frac{1}{4}; \left(\frac{1}{2}, -\frac{1}{4}\right)$

16. $y = (x + 1)^2; (-1, 0)$

17. $y = -5(x - 1)^2 + 6; (1, 6)$

18. $y = -2(x - 1)^2 + 5; (1, 5)$

19. $y = \left(x + \frac{5}{2}\right)^2 - 5; \left(-\frac{5}{2}, -5\right)$

20. $y = -2\left(x - \frac{5}{2}\right)^2 + \frac{3}{2}; \left(\frac{5}{2}, \frac{3}{2}\right)$

21. $y = 6(x - 1)^2 - 5; (1, -5)$

22. $y = -2(x - 2)^2 - 1; (2, -1)$

23. $y = 3\left(x + \frac{3}{2}\right)^2 - \frac{3}{4}; \left(-\frac{3}{2}, -\frac{3}{4}\right)$

24. $-6 \pm 4\sqrt{2}$ **25.** $\frac{1}{2} \pm \frac{\sqrt{21}}{2}$ **26.** $-2 \pm \sqrt{3}$

27. $\frac{1}{2} \pm \frac{\sqrt{5}}{2}$ **28.** $1 \pm \frac{\sqrt{3}}{2}$ **29.** $\frac{4}{5} \pm \frac{i\sqrt{14}}{5}$ **30.** $1 \pm \frac{\sqrt{10}}{2}$

31. $0, -11$ **32.** $7, -2$ **33.** $\frac{1}{2}, -1$ **34.** $-\frac{3}{2} \pm \frac{\sqrt{23}}{2}$

35. $-2 \pm \frac{\sqrt{106}}{2}$ **36.** $-\frac{3}{2} \pm \frac{i\sqrt{3}}{2}$ **37.** $-\frac{1}{4} \pm \frac{\sqrt{5}}{4}$

38. $1, -3$ **39.** $\frac{7}{2} \pm \frac{\sqrt{97}}{2}$ **40.** $\frac{3}{2} \pm \frac{\sqrt{37}}{2}$ **41.** $1 \pm i\sqrt{2}$

42. $-\frac{3}{2} \pm \frac{\sqrt{17}}{2}$ **43.** $-\frac{7}{2} \pm \frac{3\sqrt{5}}{2}$ **44.** $-\frac{3}{8} \pm \frac{\sqrt{41}}{8}$

45. $1 \pm \frac{i\sqrt{6}}{2}$ **46.** $\frac{5}{4} \pm \frac{\sqrt{65}}{4}$ **47.** $\frac{3}{2} \pm \frac{\sqrt{19}}{2}$ **48.** $0, 3$

49. $0, 8$ **50.** $-\frac{1}{4} \pm \frac{i\sqrt{11}}{4}$ **51.** $-\frac{1}{2} \pm \frac{\sqrt{11}}{2}$

52. $-\frac{5}{4} \pm \frac{i\sqrt{15}}{4}$ **53.** $-\frac{5}{6} \pm \frac{\sqrt{37}}{6}$ **54.** $2, -1$

55. $\frac{7}{6} \pm \frac{\sqrt{145}}{6}$ **56.** $-\frac{3}{2} \pm \frac{\sqrt{17}}{2}$ **57.** $-\frac{7}{2} \pm \frac{\sqrt{13}}{2}$

58. $0, \frac{5}{2}$ **59.** $0, -14$ **60.** $-1 \pm \frac{\sqrt{14}}{2}$ **61.** $1, -\frac{5}{4}$

62. $-\frac{1}{2} \pm \frac{\sqrt{21}}{6}$ **63.** $4, -1$ **64.** $\frac{1}{2} \pm \frac{\sqrt{17}}{2}$ **65.** $-1, \frac{4}{3}$

66. $2, -4$ **67.** $3 + \frac{5\sqrt{15}}{3}$ **68.** $2 \pm \sqrt{5}$ **69.** $-\frac{3}{2} \pm \frac{\sqrt{13}}{2}$

70. $-\frac{3}{2} \pm \frac{i\sqrt{15}}{2}$ **71.** $-\frac{3}{2} \pm \frac{\sqrt{41}}{2}$ **72.** $-\frac{7}{2} \pm \frac{\sqrt{53}}{2}$

73. $-\frac{3}{2} \pm \frac{\sqrt{29}}{2}$ **74.** $3 \pm \sqrt{7}$

Practice 5-8

1. 200; 2 real **2.** 60; 2 real **3.** 576; 2 real **4.** 0; 1 real

5. 9; 2 real **6.** −7; 2 imaginary **7.** −7; 2 imaginary

8. 61; 2 real **9.** −31; 2 imaginary **10.** 9; 2 real **11.** 0; 1 real

12. −8; 2 imaginary **13.** 225; 2 real **14.** −44; 2 imaginary

15. 0; 1 real **16.** −3 **17.** 7, 8 **18.** $\frac{2}{3}, 1$ **19.** $\frac{-3 \pm i\sqrt{31}}{4}$

20. $\frac{3}{2}, \frac{4}{5}$ **21.** $-\frac{5}{4}, 1$ **22.** $-3, -5$ **23.** $\frac{-1 \pm i\sqrt{2}}{3}$

24. $\frac{-1 \pm i\sqrt{79}}{8}$ **25.** $6, -2$ **26.** $\frac{3 \pm \sqrt{17}}{2}$ **27.** $2, \frac{1}{2}$

28. $-3 \pm \sqrt{13}$ **29.** $1 \pm 2i$ **30.** $\frac{-3 \pm 2i\sqrt{3}}{3}$

31. $\frac{-3 \pm \sqrt{3}}{2}$ **32.** $-10, -8$ **33.** $\frac{-9 \pm \sqrt{133}}{2}$ **34.** $4 \pm 3i$

35. $-4, \frac{3}{4}$ **36.** $\frac{5 \pm i\sqrt{119}}{6}$ **37.** $\frac{-2 \pm i\sqrt{11}}{3}$

38. $\frac{3 \pm i\sqrt{47}}{4}$ **39.** $\frac{-1 \pm 2i}{5}$ **40.** $\frac{-1 \pm i\sqrt{59}}{10}$

41. $\frac{-1 \pm \sqrt{61}}{10}$ **42.** $\frac{1 \pm i\sqrt{34}}{5}$ **43.** $1 \pm i\sqrt{2}$

44. $\frac{3 \pm i\sqrt{183}}{4}$ **45.** $\frac{5 \pm i\sqrt{71}}{8}$ **46.** $-5, -1$ **47.** $4, 2$

48. $3 \pm \sqrt{3}$ **49.** No; When $p = 4000$, the discriminant is negative, so there are no real solutions. **50.** $3, -1$

51. $-1, -4$ **52.** $4, -2$ **53.** $\frac{6 \pm \sqrt{15}}{7}$; 1.41, 0.30

54. $\frac{-5 \pm 3\sqrt{5}}{10}$; 0.17, −1.17 **55.** $-1, -\frac{1}{4}$ **56.** $\frac{1}{2}, -\frac{4}{3}$

57. $-3, 2$ **58.** $16, -3$ **59.** $0, -\frac{5}{2}$

60. $\frac{-3 \pm \sqrt{21}}{2}$; 0.79, −3.79 **61.** $2 \pm \sqrt{3}$; 3.73, 0.27

62. $\frac{1 \pm 2\sqrt{2}}{3}$; 1.28, −0.61 **63.** $7, -5$ **64.** $-5, -2$

Unit 1 LT 3 Did you Hear About.. Rationalizing Radicals in denominators

A	B	C	D	E	F	G	H
The	very	sad	guy	who	tried	to	kiss
I	J	K	L	M	N	O	P
his	girl	friend	in	the	fog	and	mist.

Rationalize the denominator and simplify each expression below. Find your answer in the adjacent answer column and notice the word next to it. Write this word in the box containing the letter of that exercise. Keep working and you will hear about a mistake.

= $5\sqrt{2}$

(A) $\frac{5}{\sqrt{3}}$ $\frac{5\sqrt{3}}{3}$

(B) $\frac{2}{\sqrt{7}}$ $\frac{2\sqrt{7}}{7}$

(C) $\frac{20}{\sqrt{5}}$ $\frac{20\sqrt{5}}{5} = 4\sqrt{5}$

(D) $\frac{14}{\sqrt{2}}$ $\frac{14\sqrt{2}}{2} = 7\sqrt{2}$

(E) $\frac{3}{\sqrt{6}}$ $\frac{3\sqrt{6}}{6} = \frac{\sqrt{6}}{2}$

(F) $\frac{4}{\sqrt{10}}$ $\frac{4\sqrt{10}}{10} = \frac{2\sqrt{10}}{5}$

(G) $\frac{11}{\sqrt{11}}$ $\frac{11\sqrt{11}}{11} = \sqrt{11}$

(H) $\frac{3}{\sqrt{12}} = \frac{3}{2\sqrt{3}}$ $\frac{3\sqrt{3}}{6} = \frac{\sqrt{3}}{2}$

(I) $\frac{30}{\sqrt{18}}$ $\frac{30\sqrt{2}}{3\sqrt{2}\sqrt{3}}$

(J) $\frac{8}{\sqrt{20}}$ $\frac{8\sqrt{5}}{2\sqrt{5}\sqrt{5}} = \frac{4\sqrt{5}}{5}$

(K) $\frac{9}{2\sqrt{45}}$ $\frac{9\sqrt{5}}{2\cdot 3\sqrt{5}\sqrt{5}}$

(L) $\frac{\sqrt{7}}{\sqrt{3}}$ $\frac{\sqrt{21}}{3}$ $\frac{3\sqrt{5}}{10}$

(M) $\frac{\sqrt{5}}{\sqrt{10}}$ $\frac{1}{\sqrt{2}} = \frac{\sqrt{2}}{2}$

(N) $\frac{3\sqrt{6}}{\sqrt{2}}$ $3\sqrt{3}$

(O) $\frac{\sqrt{3}}{2\sqrt{6}}$ $\frac{\sqrt{2}}{\sqrt{2}} = \frac{\sqrt{2}}{4}$

(P) $\frac{2\sqrt{3}}{\sqrt{15}} = \frac{2}{\sqrt{5}}$ $\frac{2\sqrt{5}}{5}$

Answers A–H:

$\sqrt{11}$	TO
$\frac{\sqrt{5}}{2}$	WAS
$\frac{\sqrt{2}}{6}$	HUG
$\frac{2\sqrt{10}}{5}$	TRIED
$4\sqrt{5}$	SAD
$\frac{5\sqrt{3}}{3}$	THE
$\frac{3\sqrt{5}}{10}$	BIG
$\frac{\sqrt{6}}{2}$	WHO
$\frac{\sqrt{3}}{2}$	KISS
$\frac{2\sqrt{7}}{7}$	VERY
$7\sqrt{2}$	GUY
$\frac{2\sqrt{6}}{3}$	GIRL

Answers I–P:

$\frac{3\sqrt{2}}{4}$	BUT
$\frac{\sqrt{2}}{4}$	AND
$\frac{\sqrt{21}}{3}$	IN
$\frac{4\sqrt{5}}{5}$	GIRL
$\frac{6\sqrt{2}}{5}$	LOST
$3\sqrt{3}$	FOG
$\frac{3\sqrt{5}}{10}$	FRIEND
$\frac{\sqrt{2}}{2}$	THE
$5\sqrt{2}$	HIS
$\frac{2\sqrt{2}}{5}$	A
$\frac{2\sqrt{5}}{5}$	MIST
$\frac{9\sqrt{3}}{10}$	TODAY

What Do You Get When You Cross a Cooking Utensil With a Mathematical Formula?

Solve each equation below. Find the solution set at the bottom of the page and cross out the letter above it. When you finish, the answer to the title question will remain.

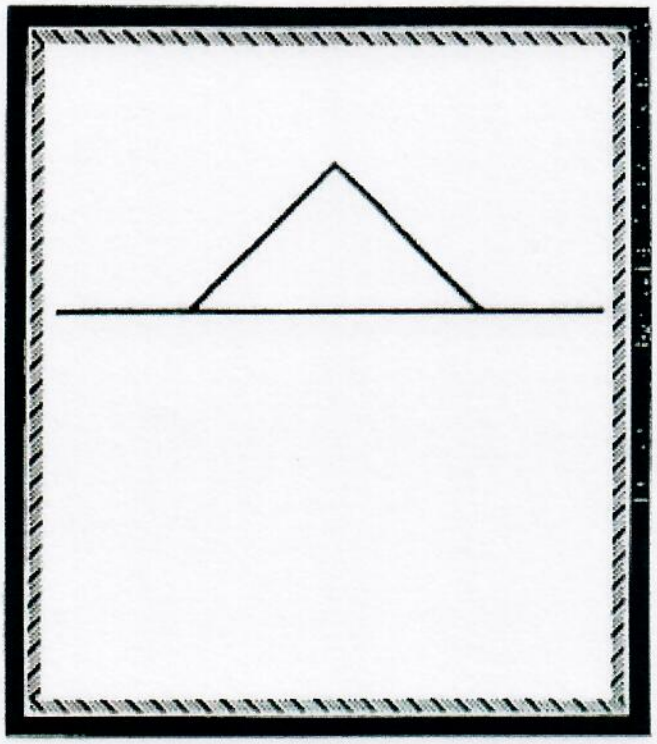
1. $(x-4)^2 = 25$
2. $5(x+7)^2 = 5$
3. $3(x-2)^2 = 36$
4. $x^2 - 10x + 25 = 9$
5. $x^2 - 6x + 9 = 49$
6. $x^2 + 2x + 1 = 64$
7. $x^2 - 18x + 81 = 24$
8. $x^2 + 12x + 36 = 75$
9. $\left(x - \frac{1}{2}\right)^2 = 1$
10. $\left(x - \frac{3}{2}\right)^2 = \frac{7}{4}$
11. $\left(x + \frac{5}{2}\right)^2 = \frac{15}{4}$
12. $2x^2 = 5$
13. $\left(x - \frac{1}{2}\right)^2 = \frac{3}{2}$
14. $\left(x - \frac{3}{5}\right)^2 = \frac{4}{5}$
15. $3\left(x + \frac{7}{3}\right)^2 = 1$

S	T	C	A	H	S	P	E	A	O	L	I	T	I	P	A	D	N	I	X	H
$\{2, 8\}$	$\{9 \pm 2\sqrt{6}\}$	$\{-8, -6\}$	$\left\{\pm\frac{\sqrt{30}}{6}\right\}$	$\{-1, 9\}$	$\left\{\frac{-7 \pm \sqrt{3}}{3}\right\}$	$\left\{\frac{1 \pm 4\sqrt{5}}{5}\right\}$	$\{-6 \pm 5\sqrt{3}\}$	$\left\{\frac{3 \pm 2\sqrt{5}}{5}\right\}$	$\left\{\frac{-7 \pm \sqrt{6}}{2}\right\}$	$\{-4, 10\}$	$\left\{-\frac{1}{2}, \frac{3}{2}\right\}$	$\{-3, 5\}$	$\left\{\pm\frac{\sqrt{10}}{2}\right\}$	$\{-6 \pm 2\sqrt{7}\}$	$\left\{\frac{-5 \pm \sqrt{15}}{2}\right\}$	$\{2 \pm 2\sqrt{3}\}$	$\left\{\frac{3 \pm \sqrt{7}}{2}\right\}$	$\{9 \pm 3\sqrt{5}\}$	$\left\{\frac{1 \pm \sqrt{6}}{2}\right\}$	$\{-9, 7\}$

LT 10 D-52 -Completing the Square "Title of the Picture"

What Is the Title of This Picture?

Solve each equation below by completing the square. Find the solution set in the answer list and notice the letter next to it. Each time the exercise number appears in the code, write this letter above it. Keep working and you will decode the title of the picture.



(1) $x^2 + 6x = 16$

(2) $a^2 + 10a = -21$

(3) $x^2 - 8x = 33$

(4) $n^2 - 4n = 11$

(5) $b^2 + 20b = -80$

(6) $x^2 - 12x = 39$

(7) $m^2 - 6m - 1 = 0$

(8) $t^2 - 8t - 20 = 0$

(9) $x^2 + 12x + 18 = 0$

(10) $y^2 + 2y - 80 = 0$

(11) $x^2 - 10x - 7 = 3$

(12) $k^2 + 16k + 60 = 5$

(13) $x^2 - 24x + 70 = -30$

(14) $y^2 + 30y - 75 = 100$

CODED TITLE:

B	O	Y	S	C	O	U	I	T	E	N	T
11	12	3	14	4	12	7	13	13	8	2	13

A	F	T	E	R	A	S	N	O	W	S	T	O	R	M
5	10	13	8	1	5	14	2	12	6	14	13	12	1	9

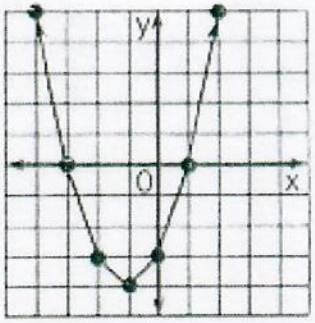
(B) $\{5 \pm \sqrt{35}\}$	(R) $\{2, -8\}$	(W) $\{6 \pm 5\sqrt{3}\}$
(C) $\{2 \pm \sqrt{15}\}$	(F) $\{8, -10\}$	(O) $\{-5, -11\}$
(S) $\{5, -35\}$	(Y) $\{11, -3\}$	(A) $\{-10 \pm 2\sqrt{5}\}$
(N) $\{-3, -7\}$	(E) $\{10, -2\}$	(L) $\{5 \pm 3\sqrt{10}\}$
(U) $\{3 \pm \sqrt{10}\}$	(T) $\{12 \pm 2\sqrt{11}\}$	(M) $\{-6 \pm 3\sqrt{2}\}$

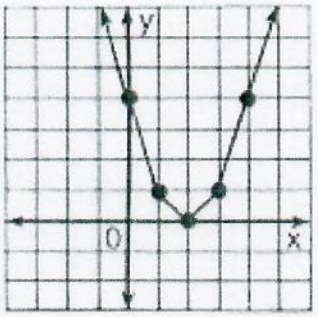
2

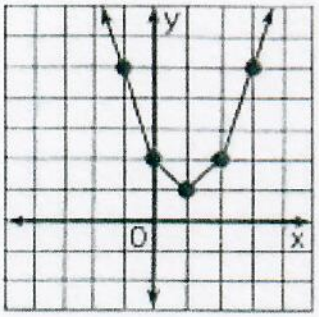
LT 12 D-55 Discriminant and Number of Solutions "Soil Erosion"

How Can You Help Control Soil Erosion?

Use the related graph or the discriminant of each equation to determine how many real number solutions it has. Circle the letter of the correct choice and write this letter in the box containing the exercise number.







(1) $x^2 + 2x - 3 = 0$
(D) two solutions
D (E) one solution
(M) no solutions

(2) $x^2 - 4x + 4 = 0$
(C) two solutions
A (A) one solution
(W) no solutions

(3) $x^2 - 2x + 2 = 0$
(H) two solutions
O (D) one solution
(O) no solutions

	two solutions	one solution	no solutions
(4) $x^2 + 5x + 4 = 0$	K	B	G
(5) $x^2 - 3x = 2$	U	O	A
(6) $y^2 + 10y + 25 = 0$	V	A	I
(7) $2x^2 = 4x - 3$	F	C	H
(8) $4x^2 + 9 = 12x$	S	P	N
(9) $-3n^2 + 5n - 2 = 0$	N	R	S
(10) $\frac{1}{2}x^2 + 3x + 8 = 0$	R	P	L
(11) $\frac{1}{3}t^2 + 3 = 2t$	Y	B	T

7	3	10	1	5	8	2	11	6	9	4
H	O	L	D	U	P	A	B	A	N	K

OBJECTIVE 4–1 To use the related graph or the discriminant of a quadratic equation to determine how many real-number solutions it has

2

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unit
LT 1, 4, 5, 6, 8, 11

CP Algebra 2 **Name**_____

Previous Unit Learning Targets **DO YOU REMEMBER Unit 1?**

1) Write an equation of the line through the points (2,-3) and (-1,0).

LT 8 $m = -1$ $y - 0 = -1(x+1)$ $y = -x - 1$

2) Solve: $|2x - 5| = 3$

LT 5

$2x - 5 = 3$ or $-2x + 5 = 3$

$2x = 8$ $-2x = -2$

$x = 4$ $x = 1$

3) Solve: $7x - 3(x - 2) = 2(5 - x)$

LT 4 $x = 2/3$

4) Solve the system :

$x - 2y = 16$

$-2x - y = -2$ (4, -6)

LT 11

5) Solve the system:

$y = 2x + 7$

$4x - y = -3$ (2, 11)

LT 11

LT 6 **6) Find the x and y intercepts of the line** $3y - x = 4$ y int (0, 4/3) x int (-4, 0)

LT 1 **7) Evaluate:** $-3x^2 + 4x$ **when** $x = -2$ (-20)

LT 4 **8) Solve for x:** $2(3 - (2x + 4)) - 5(x - 7) = 3x + 1$ $x = 4$

ANSWERS

1) $y = -x - 1$ 5) (2,11) 2) $x = 4, 1$ 6)(0, 4/3) (-4,0)

3) $x = \frac{2}{3}$ 7) −20 4) (4, -6) 8) $x = 4$

61

Unit 2-1 LT 1,4,5,6,8,11

Unit 2-1 Review Learning Targets:

can simplify and evaluate algebraic expressions.
4. I can solve equations, solve basic inequalities, and graph inequalities on a number line.
5. I can solve compound inequalities and absolute value inequalities.
6. I can graph linear functions.
8. I can write equations of lines and piecewise functions.
11. I can solve systems of equations by substitution, elimination, and graphing.