Name: ____

Honors Math Summer Work - Rising 8th Grade (Summer of 2024)

Dear Rising 8th Grade Honors Math Students,

Attached you will find your Summer Honors Math work. The Summer Work for Honors Math is designed to help you keep your skills sharp over the summer so that you are ready to go in September!

These worksheets are due on the first day of school in September.

There are 2 Parts to the Summer Worksheets.

Part 1 consists of 100 Pre-Algebra problems (Pages 1 - 10)

- Evaluating Algebraic Expressions
- The Distributive Property
- Simplifying Algebraic Expressions
- Solving One Step Equations
- Solving Two Step Equations
- Solving Multi-Step Equations
- Scientific Notation
- Negative Exponents and Simplifying Monomials
- Slope and Rate of Change
- Graphing Linear Equations
- Solving Proportions
- Similar Figures
- Pythagorean Theorem

Part 2 consists of 90 Algebra problems (Pages 11 - 24)

- Solving Multi-Step Equations
- Solving Absolute Value Equations
- Solving Word Problems Algebraically
- Solving and Graphing Inequalities
- Compound Inequalities
- Absolute Value Inequalities
- Finding Slope from 2 Points
- Slope-Intercept Form
- Standard Form
- Point Slope Form

Part 1

Evaluating Algebraic Expressions

1. Substitute the given values for the variables in the expression
2. Evaluate the expression using the order of operations
   - Parentheses/Brackets (inside to outside)
   - Exponents
   - Multiplication/Division (left to right)
   - Addition/Subtraction (left to right)

ex: $9x^2 - 4(y + 3z)$
for $x = -3, y = 2, z = 5$

$9(-3)^2 - 4(2 + 3 \cdot 5)$

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

$9(-3)^2 - 4 \cdot 17$

$9 \cdot 9 - 4 \cdot 17$

$81 - 4 \cdot 17$

$81 - 68 = \boxed{13}$

The Distributive Property

1. Multiply the number outside the parentheses by each term in the parentheses.
2. Keep the addition/subtraction sign between each term.

ex: $5(8x - 3)$

$5(8x - 3)$

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

$\boxed{40x - 15}$

Simplifying Algebraic Expressions

1. Clear any parentheses using the Distributive Property
2. Add or subtract like terms (use the sign in front of each term to determine whether to add or subtract)

ex: $2(3x - 4) - 12x + 9$

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

$6x - 8 - 12x + 9$

$\boxed{-6x + 1}$

Evaluate each expression for $a = 9$, $b = -3$, $c = -2$, $d = 7$. Show your work.

1. $a - cd$	2. $2b^3 + c^2$	3. $\frac{a + d - c}{b}$	4. $(a - b)^2 + d(a + c)$
5. $4c - (b - a)$	6. $\frac{a}{b} - 5a$	7. $2bc + d(12 - 5)$	8. $b + 0.5[8 - (2c + a)]$

Simplify each expression using the Distributive Property.

9. $5(2g - 8)$	10. $7(y + 3)$	11. $-3(4w - 3)$	12. $(6r + 3)2$

Simplify each expression, showing all work.

13. $8(x + 1) - 12x$	14. $6w - 7 + 12w - 3z$	15. $9n - 8 + 3(2n - 11)$	16. $3(7x + 4y) - 2(2x + y)$
17. $(15 + 8d)(-5) - 24d + d$	18. $9(b - 1) - c + 3b + c$	19. $20f - 4(5f + 4) + 16$	20. $8(h - 4) - h - (h + 7)$

Solving One-Step Equations

1. Cancel out the number on the same side of the equal sign as the variable using inverse operations (addition/subtraction; multiplication/division)
2. Be sure to do the same thing to both sides of the equation!

ex: $-18 = 6j$

$$\frac{-18}{6} = \frac{6j}{6}$$

$-3 = j \rightarrow$ $\boxed{j = -3}$

Solving Two-Step Equations

1. Undo operations one at a time with inverse operations, using the order of operations in reverse (i.e. undo addition/subtraction before multiplication/division)
2. Be sure to always do the same thing to both sides of the equation!

ex: $\frac{a}{7} - 12 = -9$

$$\frac{a}{7} - 12 = -9$$
$$+12 \quad +12$$

$$7 \times \frac{a}{7} = 3 \times 7$$

$\boxed{a = 21}$

Solving Multi-Step Equations

1. Clear any parentheses using the Distributive Property
2. Combine like terms on each side of the equal sign
3. Get the variable terms on the same side of the equation by adding/subtracting a variable term to/from both sides of the equation to cancel it out on one side
4. The equation is now a two-step equation, so finish solving it as described above

ex: $5(2x - 1) = 3x + 4x - 1$

$10x - 5 = 3x + 4x - 1$

$10x - 5 = 7x - 1$
$-7x \quad -7x$

$3x - 5 = -1$
$+5 \quad +5$

$$\frac{3x}{3} = \frac{4}{3}$$

$\boxed{x = \frac{4}{3}}$

Solve each equation, showing all work.

1. $f - 64 = -23$	22. $-7 = 2d$	23. $\frac{b}{-12} = -6$	24. $13 = m + 21$
5. $5x - 3 = -28$	26. $\frac{w + 8}{-3} = -9$	27. $-8 + \frac{h}{4} = 13$	28. $22 = 6y + 7$
9. $8x - 4 = 3x + 1$	30. $-2(5d - 8) = 20$	31. $7r + 21 = 49r$	32. $-9g - 3 = -3(3g + 2)$
. $5(3x - 2) = 5(4x + 1)$	34. $3d - 4 + d = 8d - (-12)$	35. $f - 6 = -2f + 3(f - 2)$	36. $-2(y - 1) = 4y - (y + 2)$

Scientific Notation

Standard Form to Scientific Notation: move the decimal after the first non-zero digit and eliminate any trailing zeros. Multiply by 10 to the power equal to the number of places you moved the decimal point. If the original number was greater than 1, the exponent is positive. If the number was less than 1, the exponent is negative.

ex: 0.0000571

0.00005.71

Original number < 1, so negative exponent

$= \boxed{5.71 \times 10^{-5}}$

Scientific Notation to Standard Form: move the decimal point the number of places indicated by the exponent. If the exponent is positive, move the decimal right. If negative, move left.

ex: 3.5×10^3

Positive exponent, so move decimal right

$3.500. = \boxed{3{,}500}$

Negative Exponents & Simplifying Monomials

Zero Exponent: Any number raised to the zero power equals 1

ex: $y^0 = 1$

Negative Exponent: Move the base to the opposite side of the fraction line and make the exponent positive

ex: $x^{-4} = \frac{1}{x^4}$

Monomial x Monomial: Multiply the coefficients and add the exponents of like bases

ex: $(4x^3)(2x^5) = 8x^8$

Monomial ÷ Monomial: Divide the coefficients and subtract the exponents of like bases

ex: $\frac{a}{a^6} = a^{-5} = \frac{1}{a^5}$

Power of a Monomial: Raise each base (including the coefficient) to that power. If a base already has an exponent, multiply the two exponents

ex: $(-2fg^5)^3 = -8f^3g^{15}$

Power of a Quotient: Raise each base (including the coefficient) to that power. If a base already has an exponent, multiply the two exponents

ex: $\left(\frac{5d^3}{c}\right)^2 = \frac{25d^6}{c^2}$

Convert each number to Scientific Notation.

37. 67,000,000,000	38. 0.0009213	39. 0.00000000004	40. 3,201,000,000,000,000

Convert each number to Standard Form.

41. 5.92×10^{-5}	42. 1.1×10^{7}	43. 6.733×10^{-8}	44. 3.27×10^{2}

Simplify each expression. Write your answers using only positive exponents.

5. w^{-9}	46. $\frac{m^5}{m^2}$	47. $f^5 \cdot f^3$	48. $\left(\frac{h^2}{g}\right)^3$
9. $(a^5)^2$	50. $\frac{1}{b^{-3}}$	51. z^0	52. $4r^6 \cdot 3r \cdot 2r^2$
3. $\frac{9p^{-2}}{3q^{-3}}$	54. $\frac{8d^3}{2cd^{-2}}$	55. $(g^4h)^2 \cdot (2g^3h^{-1})^2$	56. $(6a)^0$
7. $(-3n^2k^4)^2$	58. $\left(\frac{w^5x^{-2}y}{w^2xy^4}\right)^3$	59. $\frac{6 \cdot 10^7}{2 \cdot 10^3}$	60. $(1.5 \cdot 10^{-6}) \cdot (4 \cdot 10^9)$

Slope & Rate of Change

Finding the Slope Given Two Points: Use the coordinates from the points in the slope formula:

$$\text{Slope } (m) = \frac{y_2 - y_1}{x_2 - x_1}$$

ex: $(4, -2), (-3, 8)$ — $x_1 = 4$, $y_1 = -2$, $x_2 = -3$, $y_2 = 8$

$$m = \frac{8 - (-2)}{-3 - 4} = \frac{10}{-7} = \boxed{-\frac{10}{7}}$$

Finding the Rate of Change From a Table: Determine the amount the dependent variable (y) is changing and the amount the independent variable (x) is changing.

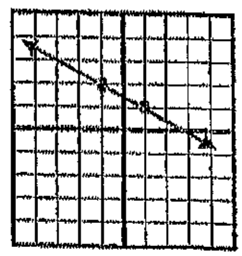
$$\text{Rate of Change} = \frac{\text{change in } y}{\text{change in } x}$$

ex:

		+2	+2	+2	
x	# months	3	5	7	9
y	Cost ($)	80	130	180	230
		+50	+50	+50	

$$m = \frac{50}{2} = \boxed{25 \text{ dollars/month}}$$

Finding the Slope From a Graph: Choose 2 points on the graph. Find the vertical change (rise) and horizontal change (run) between the 2 points and write it as a fraction $\frac{\text{rise}}{\text{run}}$. (Up is positive, down is negative, right is positive, and left is negative).



rise = +1
run = -2

$$m = \frac{1}{-2} = \boxed{-\frac{1}{2}}$$

Graphing Linear Equations

Slope-Intercept Form: $y = mx + b$ (m ← slope, b ← y-intercept)

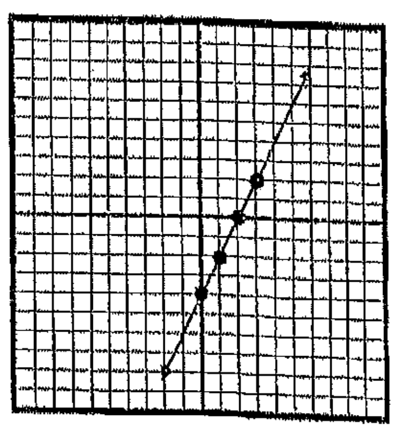
ex: $y = 2x - 4$

y-intercept: -4

slope: $2 = \frac{2}{1}$ ← rise / ← run

How To Graph:

1. Make a point on the y-axis at the y-intercept.
2. Use the slope to determine where to make the next point. The numerator tells you the rise (how far up/down) and the denominator tells you the run (how far right/left) to make the next point.
3. Repeat to make more points and then connect the points with a line.



Find the slope of the line that passes through the points. Show your work.

61. (-5, 3), (2, 1)	62. (8, 4), (11, 6)	63. (9, 3), (9, -1)	64. (-4, -2), (-6, 4)

Find the rate of change. Show your work.

65.

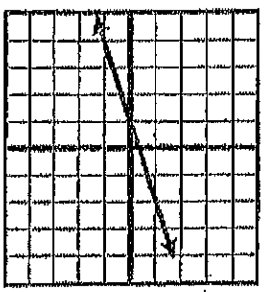
Number of Hours	3	6	9	12
Distance (in miles)	135	270	405	540

66.

Number of Weeks	1	3	5	7
Pounds	173	169	165	161

Find the slope of the line.

67.



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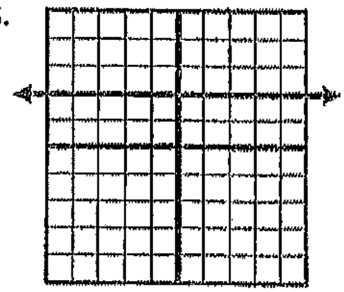

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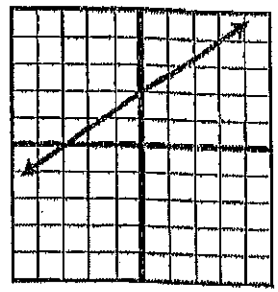
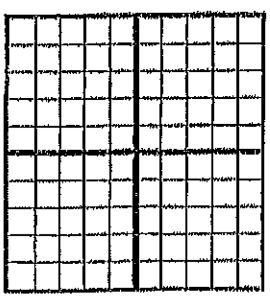
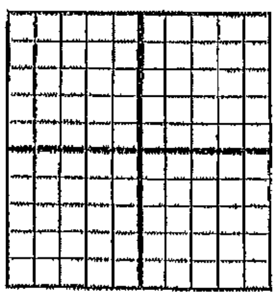


Graph the line.

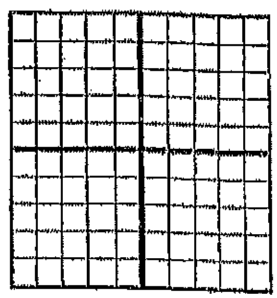
70. $y = -x - 3$



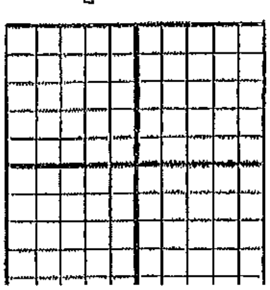
71. $y = \frac{1}{3}x + 2$



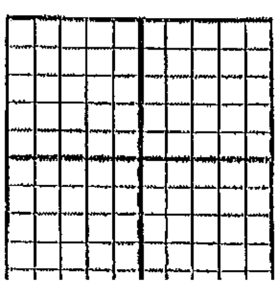
72. $y = -3x - 1$



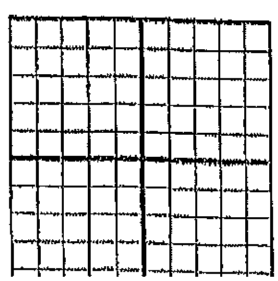
73. $y = -\frac{3}{2}x - 2$



74. $y = 2x + 1$



75. $y = \frac{1}{4}x$



Solving Proportions

1. Set the two cross-products equal to each other
2. Solve the equation for the variable

ex: $\frac{m}{4} = \frac{3}{5}$

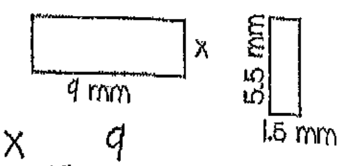
$\frac{5m}{5} = \frac{12}{5}$

$m = 2.4$

Similar Figures

1. To find a missing side length, set up a proportion, matching up corresponding sides.
2. Solve the proportion using the steps above.

ex:



$\frac{x}{1.5} = \frac{9}{5.5}$

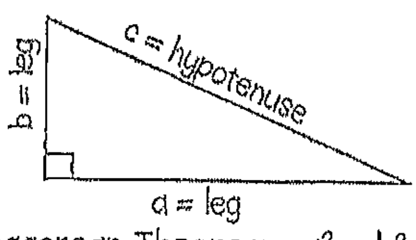
$x = 2.\overline{45}$ mm

The Pythagorean Theorem

*** The Pythagorean Theorem applies to right triangles only **

The sides next to the right angle (a & b) are legs

The side across from the right angle (c) is the hypotenuse

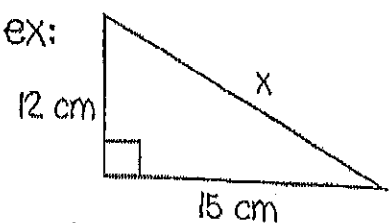


Pythagorean Theorem: $a^2 + b^2 = c^2$

To find the hypotenuse: add the squares of the legs and then find the square root of the sum

To find a leg: subtract the square of the given leg from the square of the hypotenuse and then find the square root of the difference

ex:



x is the hypotenuse

$12^2 + 15^2 = x^2$

$144 + 225 = x^2$

$369 = x^2$

$x = \sqrt{369}$ ≈ 19.2 cm

ex: $a = ?$, $b = 3$, $c = 6$

a is a leg

$a^2 + 3^2 = 6^2$

$a^2 + 9 = 36$

$a^2 = 36 - 9 = 27$

$a = \sqrt{27}$ ≈ 5.2

Solve each proportion, showing all work.

'6. $\frac{6}{7} = \frac{4}{m}$	77. $\frac{12}{5} = \frac{k}{3}$	78. $\frac{h}{7} = \frac{8}{2}$	79. $\frac{22}{n} = \frac{9}{36}$	80. $\frac{4}{21} = \frac{3}{c}$

Assume each pair of figures is similar. Find the missing side length, showing all work.

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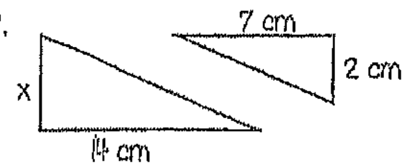

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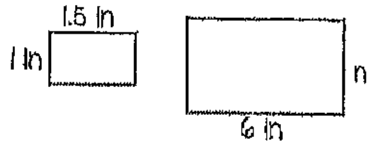

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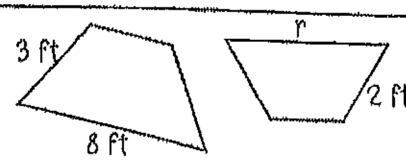

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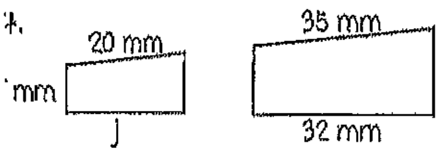

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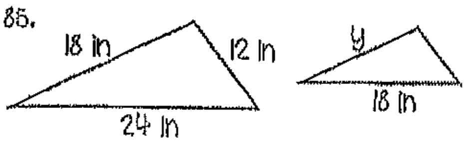

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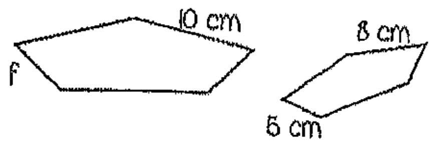

Find the missing side length in each right triangle to the nearest tenth. Show your work!

7. $a = 6, b = 8, c = ?$	88. $a = ?, b = 9$ cm, $c = 13$ cm	89. $a = 7, b = ?, c = 14$	90. $a = 14$ in, $b = 14$ in, $c = ?$

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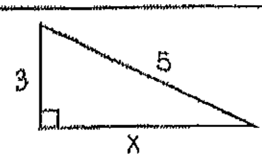

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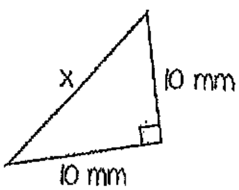

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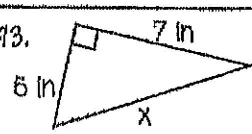

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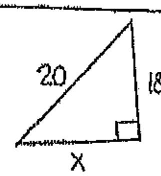

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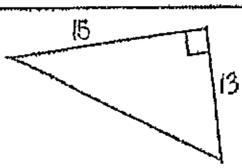

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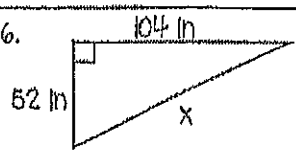

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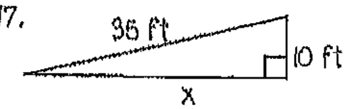

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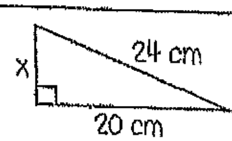


Determine whether or not you can form a right triangle from the given side lengths. Explain.

. 18, 22, 26	100. 5, 12, 13

10

Part 2

Solving Multi-Step Equations

1. Clear parentheses using the distributive property.
2. Combine like terms within each side of the equal sign.
3. Add/subtract terms to both sides of the equation to get the terms with variables on one side and constant terms on the other side.
4. Isolate the variable by multiplying/dividing both sides of the equation by the number with the variable.

Ex: $3(2x - 5) - 3 = 2x + 8 + 6x$

$$6x - 15 - 3 = 2x + 8 + 6x$$
$$6x - 18 = 8x + 8$$
$$-8 \qquad -8$$
$$6x - 26 = 8x$$
$$-6x \qquad -6x$$
$$\frac{-26}{2} = \frac{2x}{2}$$
$$-13 = x \rightarrow \boxed{x = -13}$$

Solving Absolute Value Equations

1. Isolate the absolute value.
2. Break the absolute value equation into two separate equations. For the first equation, set the expression inside the absolute value notation equal to the opposite side of the equation. For the second equation, make the number on the opposite side negative.
3. Solve each equation.

Ex: $-3|3x+2| - 2 = -8$

$$-3|3x+2| - 2 = -8$$
$$+2 \qquad +2$$
$$\frac{-3|3x+2|}{-3} = \frac{-6}{-3}$$
$$|3x+2| = 2$$
$$3x + 2 = 2 \qquad 3x + 2 = -2$$
$$x = 0 \qquad x = -\frac{4}{3}$$
$$\boxed{x = \{0, -\tfrac{4}{3}\}}$$

Solving Word Problems Algebraically

1. Define a variable.
2. Write an equation.
3. Solve the equation.
4. Label your answer with the appropriate units.

Ex: Bobby is 4 years younger than twice Jimmy's age. If Bobby is 26 years old, how old is Jimmy?

Let j = Jimmy's age

$$2j - 4 = 26$$
$$j = 15$$

→ **Jimmy is 15 years old**

Solve each equation.

1. $-3x - 9 = -27$	2. $25 + 2(n + 2) = 30$	3. $-9b - 6 = -3b + 48$
4. $5 - (m - 4) = 2m + 3(m - 1)$	5. $-24 - 10k = -8(k + 4) - 2k$	6. $f - (-19) = 11f + 23 - 20f$
7. $\frac{3}{4}d - \frac{1}{2} = \frac{3}{8} + \frac{1}{2}d$	8. $-0.5g + 13 = 3g$	9. $-5(h + 12) - (4h - 2) = h - 8$
10. $\lvert 3x + 4\rvert = 16$	11. $3\lvert x - 5\rvert = 27$	12. $-8\lvert 2x - 6\rvert + 4 = -60$

Solve each word problem algebraically.

13. The sum of two consecutive integers is one less than three times the smaller integer. Find the two integers.	14. The length of a rectangular picture is 5 inches more than three times the width. Find the dimensions of the picture if its perimeter is 74 inches.

Solving & Graphing Inequalities

1. Solve the inequality as if it is an equation.
2. If you multiply or divide both sides of the inequality by a negative number, flip the inequality sign.
3. Write your answer with the variable on the left of the inequality sign.
4. Graph the solution on a number line. Make an open circle on the number if the number is not included in the solution (< or >) and make a closed circle if the number is included (≤ or ≥). Shade to the left for less than (< or ≤) and shade to the right for greater than (> or ≥).

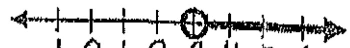
Ex: $-24 > 3x - 6 - 9x$

$-24 > -6x - 6$

$+6 \qquad\quad +6$

$\frac{-18}{-6} > \frac{-6x}{-6}$

$3 < x \rightarrow \boxed{x > 3}$



Compound Inequalities

"Or" Inequalities

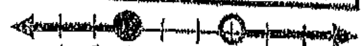
1. Solve each inequality separately and graph the solution to each on one number line.

Ex: $x + 2 > 6$ or $-2x \geq -2$

$x + 2 > 6$ or $\frac{-2x}{-2} \geq \frac{-2}{-2}$

$-2 \quad -2$

$\boxed{x > 4 \quad \text{or} \quad x \leq 1}$



"And" Inequalities:

1. Isolate the variable, making sure to do the same thing to all 3 parts of the inequality.
2. Graph the solution to each part of the compound inequality and see where those graphs overlap. The overlapping part is the solution.

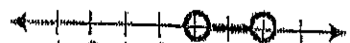
Ex: $3 < 2x - 3 < 7$

$3 < 2x - 3 < 7$

$+3 \qquad +3 \quad +3$

$\frac{6}{2} < \frac{2x}{2} < \frac{10}{2}$

$\boxed{3 < x < 5}$



Absolute Value Inequalities

1. Isolate the absolute value.
2. Change the absolute value inequality into a compound inequality. For > or ≥, turn it into an "or" inequality. For < or ≤, turn it into an "and" inequality. For the first inequality, keep everything the same, except eliminate the absolute value symbols. For the second inequality, make the number on the opposite side negative and flip the inequality sign.
3. Solve and graph the compound inequality.

Ex: $|x + 1| - 3 \geq -1$

$|x + 1| - 3 \geq -1$

$+3 \quad +3$

$|x + 1| \geq 2$

$x + 1 \geq 2$ or $x + 1 \leq -2$

$-1 \quad -1 \qquad\qquad -1 \quad -1$

$\boxed{x \geq 1 \quad \text{or} \quad x \leq -3}$

Solve each inequality. Graph the solution on a number line.

15. $-6x + 3 > -39$	16. $25 - 3(n - 2) \geq -8n + 6$
17. $8g - 6(g + 1) < 4(2g - 9)$	18. $7k + 1 \leq 8$ or $-7 < k - 10$
19. $-4 < 3b + 2 \leq 20$	20. $9 < -3m < 24$
21. $y + (-6) \geq -13$ or $-3y + 8 > -7$	22. $\lvert 2x + 5 \rvert < 13$
23. $7\lvert w - 6 \rvert \geq 21$	24. $-2\lvert 3m \rvert + 3 < -51$

Finding Slope from 2 Points

<u>Slope Formula</u>: $m = \frac{y_2 - y_1}{x_2 - x_1}$

<u>Special Cases</u>:

$\frac{0}{\#} \rightarrow$ slope = 0 $\qquad \frac{\#}{0} \rightarrow$ slope is undefined

Ex: Find the slope of the line that passes through the points (-9, -3) and (7, -7)

$$m = \frac{-7-(-3)}{7-(-9)} = \frac{-4}{16} = \boxed{-\frac{1}{4}}$$

Slope-Intercept Form

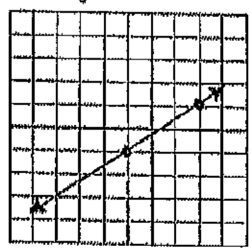
$y = mx + b$

m = slope & b = y-intercept

<u>Graphing from Slope-Intercept Form</u>:

1. Make a point at the y-intercept.
2. Use the slope $\left(\frac{\text{rise}}{\text{run}}\right)$ to make more points.
3. Connect the points to form a line.

Ex: Graph $y = \frac{2}{3}x - 1$



y-intercept is -1
slope = $\frac{2}{3}$, (so from the y-intercept go up 2 & right 3)

Standard Form

$Ax + By = C$

A, B, & C are integers & A is not negative

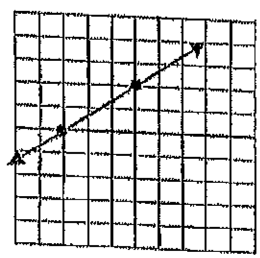
<u>Graphing Using Intercepts</u>:

1. Find the x-intercept by substituting 0 for y.
2. Find the y-intercept by substituting 0 for x.
3. Make a point at each intercept and then connect the points to form a line.

Ex: Graph $2x - 3y = -6$

x-intercept: $2x - 3(0) = -6$
$2x = -6 \rightarrow x = -3$
(-3, 0)

y-intercept: $2(0) - 3y = -6$
$-3y = -6 \rightarrow y = 2$
(0, 2)



Point-Slope Form

$y - y_1 = m(x - x_1)$

m = slope & (x_1, y_1) is a point on the graph

<u>Converting Point-Slope Form to Slope-Intercept Form</u>:

1. Distribute m.
2. Move y_1 to the other side of the equation.

<u>Converting Slope-Intercept Form to Standard Form</u>:

1. Bring the x term to the left.
2. If there are fractions in the equation, multiply everything through by the least common denominator.
3. If A is negative, multiply everything through by -1.

Ex: Write the equation of the line passing through the points (-1, 2) and (3, 4) in point-slope form. Then convert it to slope-intercept and standard form.

$$m = \frac{4-2}{3-(-1)} = \frac{2}{4} = \frac{1}{2}$$

<u>Point-Slope Form</u>: $\boxed{y - 2 = \frac{1}{2}(x+1)}$

<u>Convert to Slope-Intercept Form</u>:

$\rightarrow y - 2 = \frac{1}{2}x + \frac{1}{2} \rightarrow \boxed{y = \frac{1}{2}x + \frac{5}{2}}$

<u>Convert to Standard Form</u>:

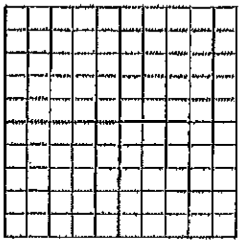
$\rightarrow -2\left(-\frac{1}{2}x + y = \frac{5}{2}\right) \rightarrow \boxed{x - 2y = -5}$

Find the slope of the line that passes through the pair of points.

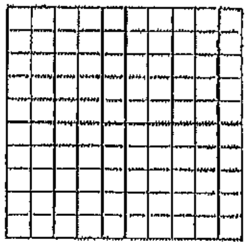
25. (9, -3) and (9, -8)	26. (-8, 5) and (3, -6)	27. (7, -1) and (15, 9)

Graph each line.

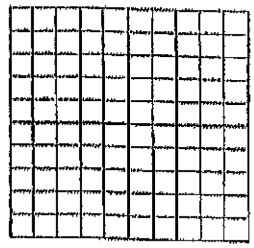
28. $y = -\frac{3}{2}x + 2$



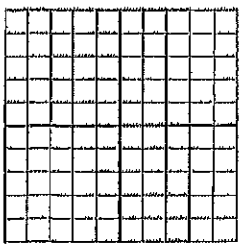
29. $y = x - 3$



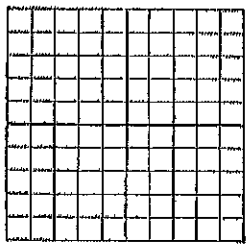
30. $y = \frac{1}{3}x + 5$



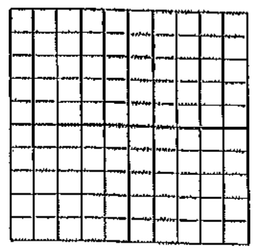
31. $2x - y = -2$



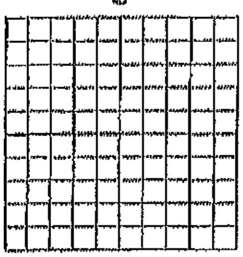
32. $x + y = 4$



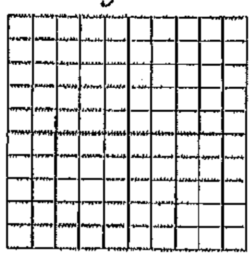
33. $3x + 4y = -12$



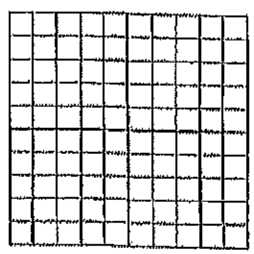
34. $y + 3 = \frac{1}{2}(x + 2)$



35. $y - 1 = \frac{2}{3}(x - 3)$



36. $y - 2 = 0$



Write the equation of the line in point-slope, slope-intercept, and standard form.

37. Line passing through point (3, 5) with a slope of 1	38. Line passing through points (-4, 2) and (0, 3)	39. Line passing through points (1, 3) and (2, 5)

Parallel & Perpendicular Lines

Parallel Lines have the *same slope* but different y-intercepts.

Perpendicular Lines have *opposite reciprocal slopes.*

Writing Equations of Parallel Lines:

1. Find the slope of the original line by first converting it to slope-intercept form if it is in Standard Form. The slope of the line parallel will have that same slope.
2. Use the given point along with the slope you just found to write the equation of the line in point-slope form.
3. Convert the point-slope form equation to slope-intercept form.

Writing Equations of Perpendicular Lines:

1. Find the slope of the original line. The slope of the line perpendicular will have the opposite (negative) reciprocal slope.
2. Use the given point along with the slope you just found to write the equation of the line in point-slope form.
3. Convert the point-slope form equation to slope-intercept form.

Ex: Write the equation of the line that is parallel to the line $y = 3x - 5$ and passes through the point (-2, 4).

$y = 3x - 5$

m = 3, so slope of parallel line is 3, too

→ $y - 4 = 3(x + 2)$

→ $y - 4 = 3x + 6$

→ $\boxed{y = 3x + 10}$

Ex: Write the equation of the line that is perpendicular to the line $x - 3y = -6$ and passes through the point (-1, 1).

$x - 3y = -6$ → $-3y = -x - 6$

→ $y = \frac{1}{3}x + 2$

$m = \frac{1}{3}$, so slope of perpendicular line is -3

→ $y - 1 = -3(x + 1)$

→ $y - 1 = -3x - 3$

→ $\boxed{y = -3x - 2}$

Linear Inequalities

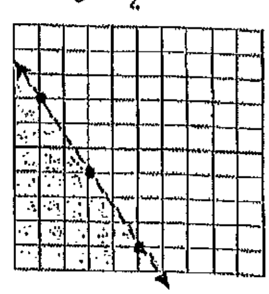
1. Convert the linear inequality in slope-intercept form. Be sure the y is on the left and remember to flip the inequality sign if you multiply or divide by a negative.
2. Graph the line as if it is an equation, except use a dotted line if the inequality sign is < or >. If the sign is ≤ or ≥, use a regular solid line.
3. Shade above the line for a "greater than" inequality (> or ≥). Shade below the line for a "less than" inequality (< or ≤). (For vertical lines, shade to the right for greater than and to the left for less than).

Ex: $-3x - 2y > 8$

$$\begin{array}{r} -3x - 2y > 8 \\ +3x \qquad\quad +3x \\ \hline -2y > 3x + 8 \end{array}$$

$$\frac{-2y}{-2} > \frac{3x}{-2} + \frac{8}{-2}$$

$$y < -\frac{3}{2}x - 4$$



Determine whether the lines are parallel, perpendicular, or neither. Justify your answer.

40. $y = 2x - 8$ $y = \frac{1}{2}x + 6$	41. $y = x$ $x + y = -2$	42. $3x + 2y = 18$ $y + 4 = -\frac{3}{2}(x - 4)$

Write the equation of the line parallel to the given line that passes through the given point in slope-intercept form.

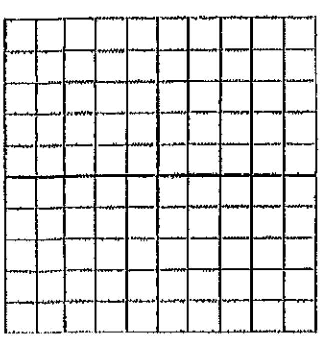
43. $y = -4x - 2$; $(0, -1)$	44. $2x - y = -4$; $(2, 5)$

Write the equation of the line perpendicular to the given line that passes through the given point in slope-intercept form.

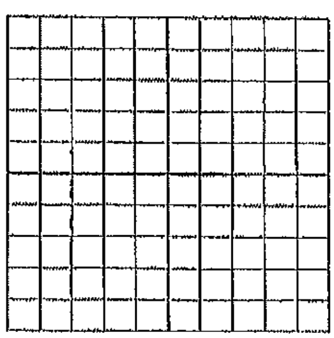
45. $y = \frac{2}{3}x - 9$; $(-6, -2)$	46. $4x + y = -6$; $(4, 5)$

Graph the solution to each linear inequality.

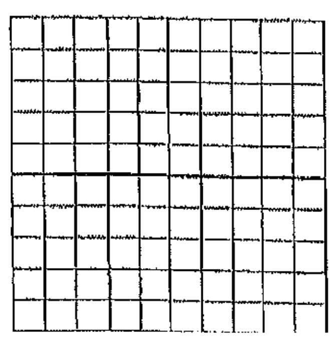
47. $y \leq -4x - 3$



48. $2x - y < 1$



49. $x + 3y > 3$



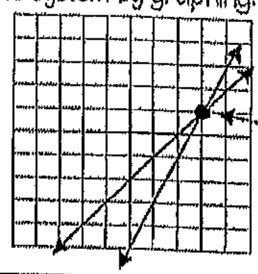
Solving Systems of Equations by Graphing

1. Graph both lines on the same coordinate plane.
2. Find the point where the lines meet, and write that solution as an ordered pair.

Special Cases:

- parallel lines: no solution
- coincident lines (lines that are the same): infinitely many solutions

Ex: Solve the system by graphing: $\begin{cases} y = x - 2 \\ y = 2x - 5 \end{cases}$



Solving Systems of Equations Using Substitution

1. Solve one of the equations for x or y.
2. Replace the x or y in the other equation with the expression you found in step 1 that equals that variable.
3. Solve the equation.
4. Substitute the solution you found in step 3 with the variable in your step 1 equation to solve for the other variable.
5. Write your solution as an ordered pair.

Ex: Solve the system by substitution: $\begin{cases} x + 3y = 4 \\ 2x - 3y = -1 \end{cases}$

$x + 3y = 4 \rightarrow x = -3y + 4$

$2x - 3y = -1 \rightarrow 2(-3y + 4) - 3y = -1$

$\rightarrow -6y + 8 - 3y = -1$

$\rightarrow -9y + 8 = -1$

$\rightarrow -9y = -9 \rightarrow \boxed{y = 1}$

$\rightarrow x = -3y + 4 \rightarrow x = -3(1) + 4 \rightarrow \boxed{x = 1}$

solution: $\boxed{(1, 1)}$

Solving Systems of Equations Using Elimination

1. Write both equations in Standard Form.
2. Multiply neither, one, or both of the equations by constants so that either the x coefficients or the y coefficients are opposites (i.e. 2 and -2).
3. Add the two equations. The terms with the opposite coefficients will cancel out.
4. Solve the equation for the variable that didn't cancel out.
5. Substitute the solution you found in step 4 for the variable in any of the equations, and solve to find the other variable.
6. Write your solution as an ordered pair.

Ex: Solve the system by elimination: $\begin{cases} 3x + 4y = 2 \\ -2x + 2y = -6 \end{cases}$

Multiplying by -2 will give the y-terms opposite coefficients

$3x + 4y = 2$

$-2(-2x + 2y = -6)$

$\rightarrow \begin{array}{r} 3x + 4y = 2 \\ + \; 4x - 4y = 12 \\ \hline 7x \quad\quad = 14 \end{array} \rightarrow \boxed{x = 2}$

$\rightarrow 3x + 4y = 2 \rightarrow 3(2) + 4y = 2$

$\rightarrow 6 + 4y = 2 \rightarrow 4y = -4 \rightarrow \boxed{y = -1}$

solution: $\boxed{(2, -1)}$

Systems of Equations Word Problems

1. Define 2 variables.
2. Write 2 equations.
3. Solve the system of equations using the method of your choice.
4. Label your solution with the appropriate units.

Ex: A 24 question test contains some 3 point questions and some 5 point questions. If the test is worth 100 points, how many of each type of questions are there?

Let x = # of 3 point questions
y = # of 5 point questions

$x + y = 24$

$3x + 5y = 100$

solve using substitution or elimination → solution: (10, 14)

→ There were 10 3-point questions and 14 5-point questions

Solve each system of equations by graphing.

50. $\begin{cases} y = \frac{1}{2}x - 4 \\ y = -x - 1 \end{cases}$

51. $\begin{cases} y = 2x + 1 \\ -y = -2x + 1 \end{cases}$

52. $\begin{cases} x - 2y = 4 \\ -3x + 2y = -8 \end{cases}$

Solve each system of equations using substitution.

53. $\begin{cases} y = 2x + 3 \\ 5x - 2y = -6 \end{cases}$

54. $\begin{cases} x + 4y = 5 \\ -2x + 5y = 16 \end{cases}$

55. $\begin{cases} 9y - 7x = -13 \\ -9x + y = 15 \end{cases}$

Solve each system of equations using elimination.

56. $\begin{cases} 3x - 7y = -29 \\ -4x + 7y = 27 \end{cases}$

57. $\begin{cases} -4x - 8y = -48 \\ 8x + 3y = -34 \end{cases}$

58. $\begin{cases} 3x - 7y = 21 \\ 6x = 14y + 42 \end{cases}$

Solve each word problem using a system of equations.

59. Joe bought 5 apples and 4 bananas for \$6. Dawn bought 3 apples and 6 bananas for \$6.30. How much does each apple and each banana cost?

60. Wesley and Brian have a total of 87 baseball cards. Wesley has 30 less than twice as many cards as Brian. How many baseball cards do they each own?

Exponent Rules

Zero Exponent: Any base raised to the zero power equals 1. Ex: $(-9)^0 = \boxed{1}$

Negative Exponent: Move the base to the opposite side of the fraction bar and make the exponent positive. Ex: $3^{-4} = \frac{1}{3^4} = \boxed{\frac{1}{81}}$

Monomial x Monomial: Multiply the coefficients and add the exponents of like bases. Ex: $(-2x^3)(8x^{-5}) = -16x^{-2} = \boxed{\frac{-16}{x^2}}$

Monomial ÷ Monomial: Divide the coefficients and subtract the exponents of like bases. Ex: $\frac{4ab^3}{4a^2b^2} = 1a^{-1}b^1 = \boxed{\frac{b}{a}}$

Power of a Monomial: Raise each base (including the coefficient) to that power. If a base already has an exponent, multiply the two exponents. Ex: $(3x^3y^2)^3 = 3^3x^9y^6 = \boxed{27x^9y^6}$

Power of a Quotient: Raise each base (including the coefficients) to that power. If a base already has an exponent, multiply the two exponents. Ex: $\left(\frac{5a^3b}{2c^{-1}}\right)^2 = \frac{5^2a^6b^2}{2^2c^{-2}} = \boxed{\frac{25a^6b^2c^2}{4}}$

Multiplying & Dividing Numbers in Scientific Notation

Multiplying Numbers in Scientific Notation:
Multiply the coefficients and add the exponents. If necessary, "fix" the answer to put it in Scientific Notation.

Ex: $(3 \times 10^4)(5.8 \times 10^7)$

$= (3 \times 5.8) \times 10^{4+7}$

$= 17.4 \times 10^{11}$

$= (1.74 \times 10^1) \times 10^{11} = \boxed{1.74 \times 10^{12}}$

Dividing Numbers in Scientific Notation:
Divide the coefficients and subtract the exponents. If necessary, "fix" the answer to put it in Scientific Notation.

Ex: $\frac{3.6 \times 10^5}{7.2 \times 10^2}$

$= (3.6 \div 7.2) \times 10^{5-2}$

$= 0.5 \times 10^3$

$= (5 \times 10^{-1}) \times 10^3 = \boxed{5 \times 10^2}$

Exponential Growth & Decay

Exponential Growth: $y = a(1 + r)^t$

Exponential Decay: $y = a(1 - r)^t$

y = new amount, a = initial amount, r = rate of change (as a decimal), t = time

Ex: You bought a new car for \$25,000. If the car's value depreciates at a rate of 12% per year, how much will the car be worth in 5 years?

use exponential decay formula

$y = 25{,}000(1 - 0.12)^5$

$= 25{,}000(0.88)^5$

$= \boxed{\$13{,}193.30}$

Compound Interest: $A = P(1 + \frac{r}{n})^{nt}$

A = new balance, P = principal (starting value), r = interest rate (as a decimal), n = number of times the interest is compounded annually, t = time (in years)

Ex: You invest \$5,000 in an account with a 2.5% interest rate, compounded monthly. How much money will be in the account after 20 years?

$A = 5{,}000(1 + \frac{0.025}{12})^{12 \cdot 20}$

$= 5{,}000(1 + \frac{0.025}{12})^{240}$

$= \boxed{\$8{,}239.32}$

Simplify each expression completely. Write your answer using only positive exponents.

61. $x^6 \cdot x^4$	62. $(5^3)^2$	63. $-6a^2b^{-4}c \cdot 4ab^2$
64. $\frac{a^3b^{-6}}{c^{-2}}$	65. $\left(\frac{-2x^6y}{3z^5}\right)^3$	66. $\left(8w^3q^{-5}\right)^0$
67. $\frac{24d^5f^{-5}g^8}{36d^{-3}f^9g^2}$	68. $\left(2b^{-3}d^6\right)^4 \cdot 3b^7d$	69. $\left(\frac{-4a^4b^2c^{-1}}{6a^9}\right)^{-1}$

Find each product or quotient. Write your answer in Scientific Notation.

70. $\left(9.8 \times 10^3\right)\left(2.4 \times 10^7\right)$	71. $\frac{9.3 \times 10^3}{3 \times 10^9}$	72. $\frac{4.5 \times 10^{13}}{9.0 \times 10^7}$

Find the new amount.

73. The population of Watesville decreases at a rate of 1.6% per year. If the population was 62,500 in 2014, what will it be in 2020?	74. A population of 30 bunnies is increasing at a rate of 40% per year. How many bunnies will there be in 5 years?	75. If you $15,000 in an account with a 4.5% interest rate, compounded quarterly, how much money will you have in 25 years?

Classifying Polynomials

- Term: each part of a polynomial separated by addition or subtraction
- Degree of a Term: the sum of the exponents of the variables in a term
- Degree of Polynomial: the highest degree of all the terms in a polynomial

Classifying By Number of Terms:

1 term: monomial

2 terms: binomial

3 terms: trinomial

≥ 4 terms: n-term polynomial

Classifying Polynomials By Degree:

0: constant	4: quartic
1: linear	5: quintic
2: quadratic	≥6: nth degree
3: cubic	

Ex: Classify $3x^3 - 9x + 7$.

It is a trinomial because there are 3 terms separated by - and +

The degree of the 1st term is 3, the degree of the 2nd term is 1, and the degree of the 3rd term is 0. So, the degree of the polynomial is 3 since that is the highest degree of all the terms.

→ **Is it a cubic trinomial**

Adding & Subtracting Polynomials

Adding Polynomials:

1. Add like terms together.
2. Write your answer in Standard Form (decreasing order of degree).

Ex: $(4x^2 - 9) + (7x - 9x^2 + 8)$

$(4x^2 - 9) + (7x - 9x^2 + 8)$

$= -5x^2 - 1 + 7x \rightarrow$ **$-5x^2 + 7x - 1$**

Subtracting Polynomials:

1. Turn into an addition problem by changing the – to + between the two polynomials and reversing the sign of each term in the second polynomial.
2. Add like terms together.
3. Write your answer in Standard Form.

Ex: $(3x^2 - 6x - 9) - (2x^2 + 8x - 3)$

$\rightarrow (3x^2 - 6x - 9) + (-2x^2 - 8x + 3)$

$=$ **$x^2 - 14x - 6$**

Multiplying Polynomials

Monomial x Polynomial:

1. Use the Distributive Property to multiply the monomial by each term.
2. Write your answer in Standard Form.

Ex: $4x^2(3x^2 - 8x - 5)$

$4x^2(3x^2 - 8x - 5)$

$=$ **$12x^4 - 32x^3 - 20x^2$**

Binomial x Binomial:

1. FOIL (multiply the two first terms, the two outer terms, the two inner terms, and the two last terms).
2. Combine like terms and write your answer in Standard Form.

Ex: $(x + 3)(2x - 1)$

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

F: $2x^2$ O: $-1x$ I: $6x$ L: -3

$=$ **$2x^2 + 5x - 3$**

Any Polynomial x Any Polynomial:

1. Multiply each term from the first polynomial by each term in the second polynomial.
2. Combine like terms and write your answer in Standard Form.

Ex: $(x + 2)(x^2 - 3x - 8)$

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

$= x^3 - 3x^2 - 8x + 2x^2 - 6x - 16$

$=$ **$x^3 - x^2 - 14x - 16$**

Classify each polynomial by its degree and number of terms.

76. $8x^3 - 9x$	77. $-2 - 4x^2 + 7x$	78. $8x^2y^2$	79. $6x + 5$

Find each sum or difference. Write your answer in Standard Form.

80. $(2h^3 + 6h) + (3h^3 - 7h - 3)$	81. $(8x - 4x^2 + 3) - (7x^2 - 9)$	82. $(-14a^2 - 5) - (5a^2 + 6a - 7)$

Find each product. Write your answer in Standard Form.

83. $5x^3(9x^2 + 4x - 5)$	84. $(x + 4)(x - 3)$	85. $(3n - 8)(4n - 7)$
86. $(2x + 3)(x^2 + x + 3)$	87. $(6x + 1)^2$	88. $4g(2g - 9)(2g + 9)$

Simplify each expression completely. Write your answer in Standard Form.

89. $(x + 2)(x + 8) + (4x^2 + 8x - 3)$	90. $(x + 5)(x - 5) - 6x(x + 1)$