Grade 9: Unit 5- Polynomials

Section 5.1 Modeling Polynomials

Polynomial:

- an algebraic **expression** that contains one term or a sum of terms.
- The term(s) may contain variables (which will have whole number exponents).
- And a term may be a number.

$3x + 1$ → is a polynomial. It contains a variable (whose exponent is 1) and numbers. Since it is an **expression**, there is no equal sign.

→ This polynomial has two **terms**. A term is a number, or a variable, or the product of numbers and variables. Terms are separated by + or − . Therefore, 3x, is one term and 1, is another term.

→ In the term, 3x, the 3 is called the **numerical coefficient**. This is the number in front of the variable, it's the numerical factor of a term. X is called the **variable**.

→ 1 is called the **constant term**. There is no variable attached to this number. It is the number in the expression that does not change.

Note:

An algebraic expression that contains a term with a variable in the denominator, such as $\frac{3}{n}$, or the square root of a variable, such as $\sqrt{n}$, **is not a polynomial**.

Types of Polynomials

We can classify a polynomial by the numbers of terms it has. Polynomials with 1, 2, or 3 terms have special names.

A **monomial** has 1 term; for example: $5x$, 9 , $-2p^2$
A **binomial** has 2 terms; for example: $2c - 5$, $2m^2 + 3m$, $x + y$
A **trinomial** has 3 terms; for example: $2h^2 - 6h + 4$, $x + y + z$

Example: Identify (i) the variable
(ii) the number of terms
(iii) the numerical coefficient(s)
(iv) the constant term and
(v) the type of polynomial

a). $3x^2 + 2x - 1$
(i) x
(ii) 3
(iii) 3 and 2
(iv) -1
(v) trinomial

b). $6xy - x^3$
(i) x
(ii) 2
(iii) 6 and -1
(iv) none
(v) binomial

c). $xy + 6 - z + 2x^2$
(i) x , y and z
(ii) 4
(iii) +1, – 1 and 2.
(iv) $+6$
(v) just a polynomial
(more than 3 terms does not have a special name).

Equivalent Polynomials - are polynomials that have exactly the same terms, but the terms could be in a different order.

$3x^2 + 2x - 1$ is equivalent to $2x + 3x^2 - 1$ but not equivalent to $1 + 2x - 3x^2$ **Why?**

Both these polynomials have
+3 with x^2
+2 with x and
a constant term of – 1

This polynomial is different because
it has – 3 with x^2 and
a constant term of + 1

Degree of a Polynomial

Degree: The term with the greatest exponent.

Rules for determining the degree:

- The **degree of a monomial** is the sum of the exponents of its variables.

Monomial	**Degree**
$4x^2$	2
9ab	2

- The **degree of a polynomial with one variable** is the highest power of the variable in any one term.

Polynomials	**Degree**
$6x^2 + 3x$	2
$7 + x^2 - 1$	2

Example: Name the coefficients, degree and the constant term of each polynomial.

A: $-3x^2 + 4x - 5$

B: $3 + 2ab - b$

C: $-6 - 5x$

Solution:

A:
Coefficients: -3 and 4
Degree: 2
Constant Term: -5

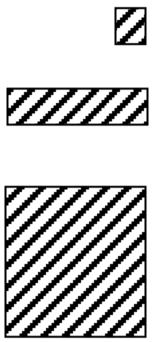
B:
Coefficients: -1 and 2
Degree: 2
Constant Term: 3

C:
Coefficients: -5
Degree: 1
Constant Term: -6

<u>Modeling Polynomials</u>

In algebra we use algebra tiles to model integers and variables.

Shaded tiles represent **positive** tiles

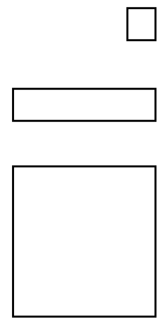


= $+1$

= $+x$

= $+x^2$

Non-shaded tiles represent **negative** tiles



= -1

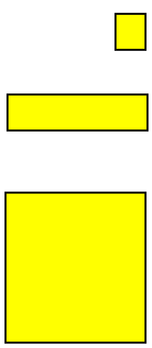
= $-x$

= $-x^2$

Colors can also be used to represent a tile.

IN YOUR TEXTBOOK:

Yellow is Positive

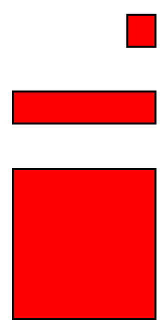


= $+1$

= $+x$

= $+x^2$

Red is Negative



= -1

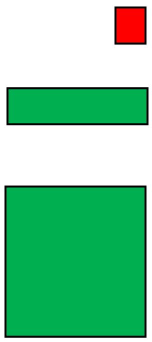
= $-x$

= $-x^2$

The variable most commonly used is X, however, any variable can be used.

REAL ALGEBRA TILES:

Green and Red is Positive

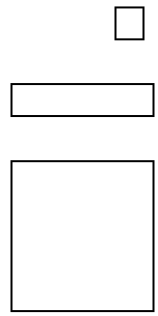


= + 1

= + x

= + x^2

White is Negative



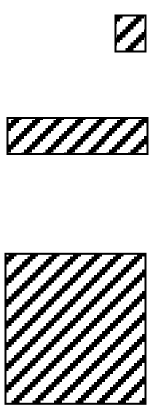
= -1

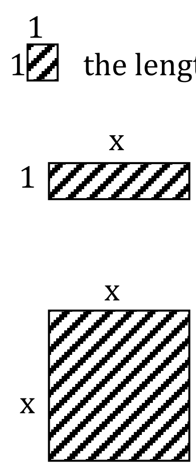
= $-$ x

= $-$ x^2

**** To be clear in your notes: **Shaded is Positive** **Unshaded is Negative**

Algebra tiles get their name from the area of their tiles. Remember length × width = area





= + 1 because the length and width of the tile is 1 and 1× 1 = 1

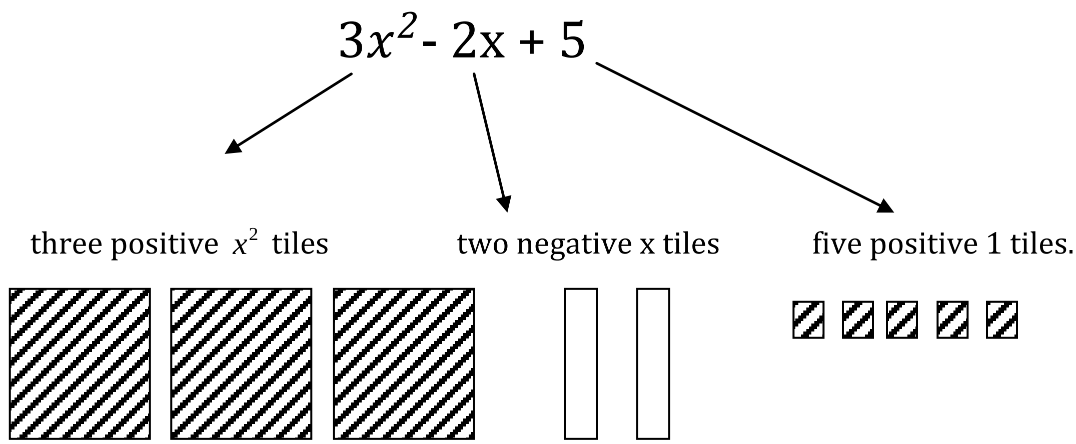
= + x because the length is x and the width is 1 and 1× x = x

= + x^2 because the length and width of the tile is x and x × x = x^2

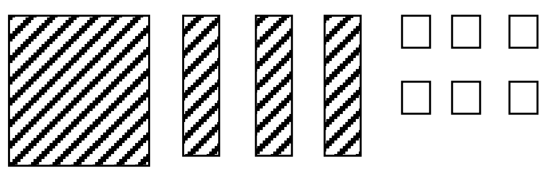
Examples:

1. Use algebra tiles to model each expression.

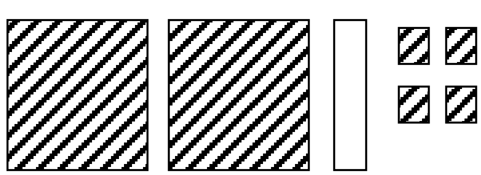
a). $3x^2 - 2x + 5$



b). $x^2 + 3x - 6$

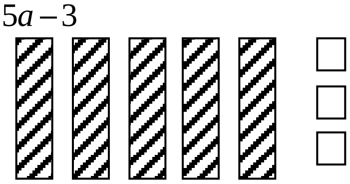


c) $2b^2 - b + 4$



Remember any variable can be used instead of x.

d). $5a - 3$

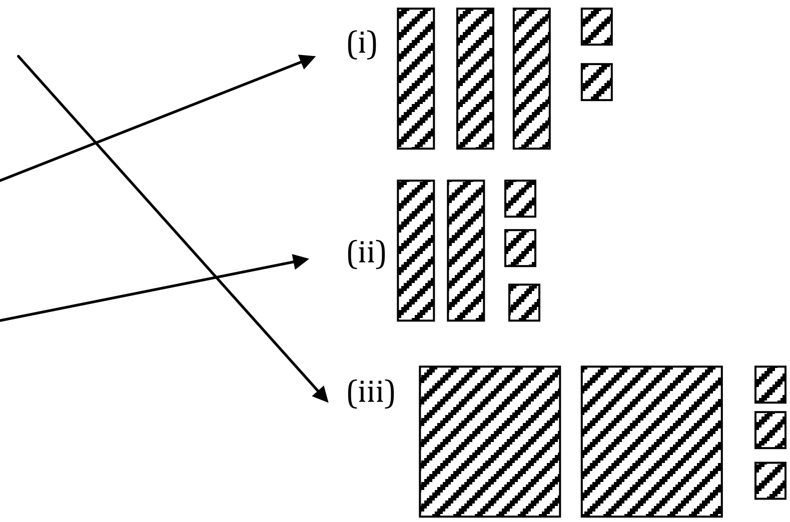


2. Match the following polynomials to the appropriate diagram.

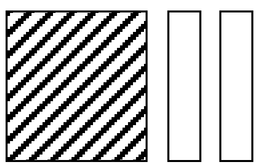
A: $2x^2 + 3$

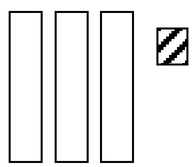
B: $3x + 2$

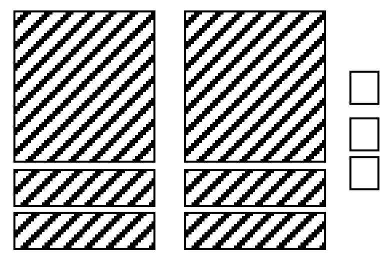
C: $2x + 3$



3. Write a polynomial expression for each diagram below.

a). 

b). 

c). 

Answers:

a). $x^2 - 2x$ b). $-3x + 1$ c). $2x^2 + 4x - 3x$

A polynomial should be written in **descending order**. This means the exponent of the variable should decrease from left to right.

Ex: The polynomial $2k - 4k^2 + 7$ is properly written as $-4k^2 + 2k + 7$ in descending order.

4. Rearrange the following polynomials in descending order.

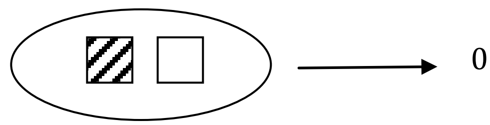
a). $-2p + 4p^2 - 9$ b). $5x^2 + 7 - 8x$ c). $33 + 90c + 100c^2$

Answers:

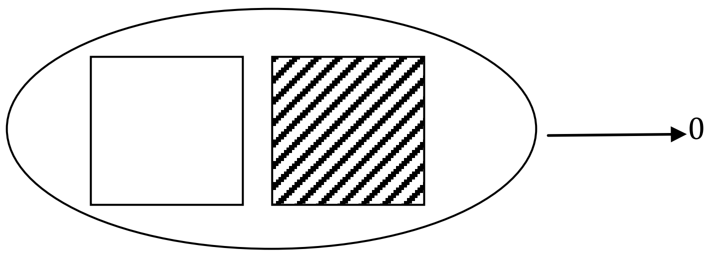
a). $4p^2 - 2p - 9$ b). $5x^2 - 8x + 7$ c). $100c^2 + 90c + 33$

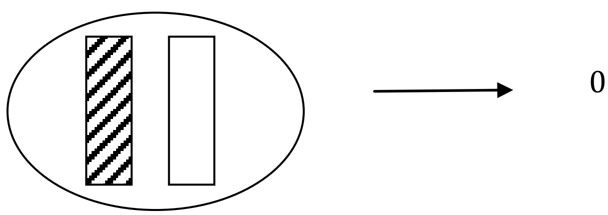
Section 5.2 Like Terms and Unlike Terms

When you worked with integers, a +1 tile and a -1 tile formed a **zero pair**.



The same applies for the x and x^2 tiles.





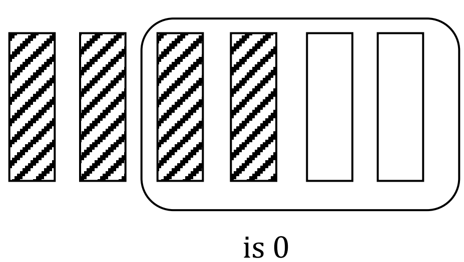
Any two **opposite colored tiles** of the **same size** has a sum of **zero.** We can combine these tiles because they are **like terms**.

Like Terms – terms that have the same variable, raised to the same exponent.

Examples: a). 4x and – 2x
b). +1 and +8
c). x^2 and – $3x^2$

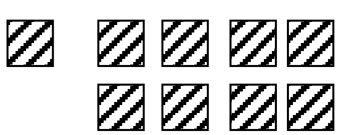
Like terms can be combined or simplified. Sketch the tiles above and cancel the zero pairs where possible, to simplify the polynomial.

a). 4x and – 2x



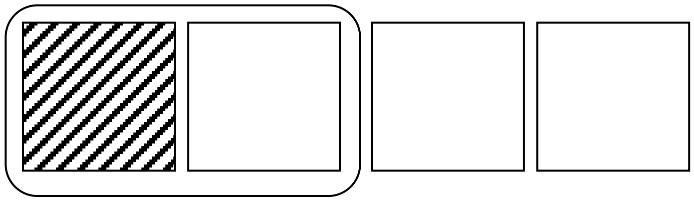
Simplified: 2x

b). +1 and +8



Simplified : 9

c). x^2 and – $3x^2$



is 0

Simplified: $-2x^2$

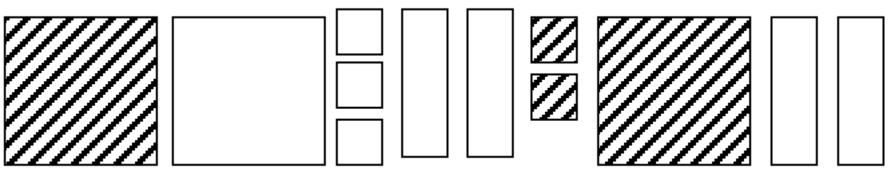
Unlike Terms - terms which contain different variables entirely or are the same variable raised to different exponents.

Examples: a). $x + y$
b). $2x + 3$
c). $4x + 2x^2$

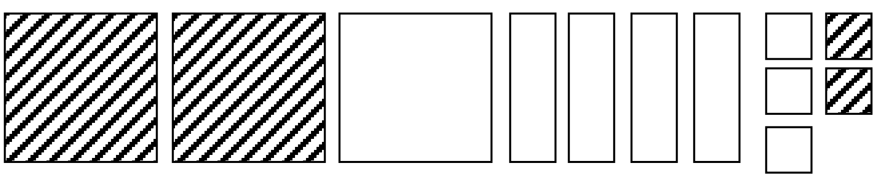
These are simplified as much as possible already because they don't contain any like terms.

Examples: Write a simplified expression for the algebra tiles below.

1).

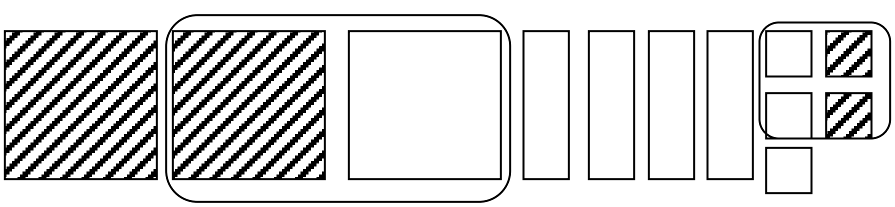


You can rearrange the tiles so you have like terms next to each other.



These tiles represent the polynomial $2x^2 - x^2 - 4x - 3 + 2$

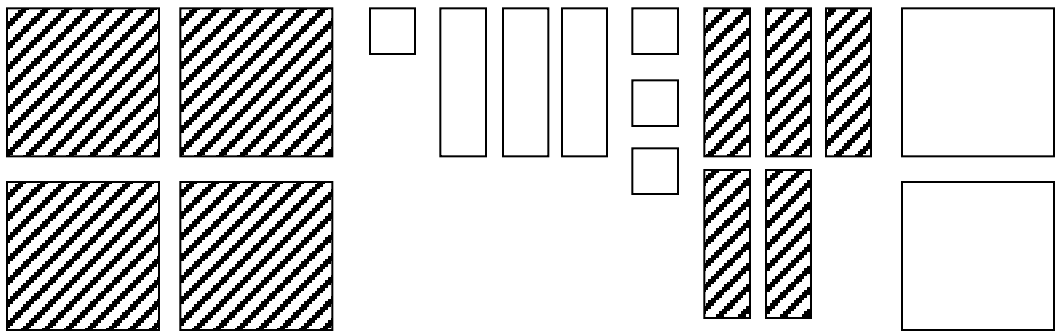
Cancel zero pairs to simplify.



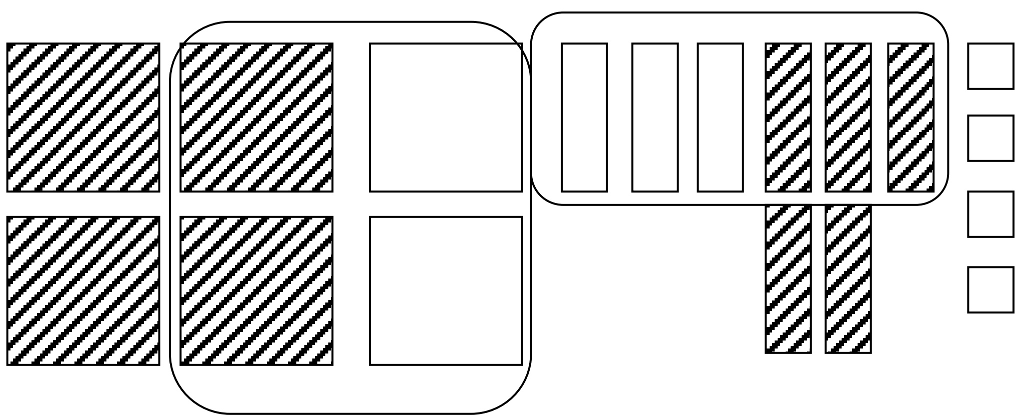
Answer: $x^2 - 4x - 1$

Therefore, without tiles, the polynomial $2x^2 - x^2 - 4x - 3 + 2$ simplifies to $x^2 - 4x - 1$

2). Sketch the simplified expression using algebra tiles for: $4n^2 - 1 - 3n - 3 + 5n - 2n^2$



Rearranged:



Simplified answer: $2n^2 + 2n - 4$

Therefore the polynomial $4n^2 - 1 - 3n - 3 + 5n - 2n^2$ simplified to $2n^2 + 2n - 4$.

Can you see how to simplify like terms without using tiles?

$4n^2 - 1 - 3n - 3 + 5n - 2n^2$ means $4n^2$ and $-2n^2 = 2n^2$

$-1 - 3n - 3 + 5n$ means $-3n$ and $5n = 2n$

$-1 - 3$ means -1 and $-3 = -4$

It's just like adding Integers. Be careful of the signs.

Answer: $2n^2 + 2n - 4$

3). Simplify each polynomial **without using tiles**.

A: $3x + 5x$

$= 8x$

B: $-13a - 10a$

$= -23a$

C: $16n + n - 17n$

$= 0$

D: $-j + 7k - 3j$

$= -4j + 7k$

E: $8a - 2b - 6a - 3b$

$= 2a - 5b$

F: $-q + 7q + 11n + 11p - 8q$

$= -2q + 11n + 11p$

4. Wayne was asked to write an expression equivalent to $2x - 7 - 4x + 8$.

His solution was:

$2x - 7 - 4x + 8$

$= 2x - 4x - 7 + 8$

$= 2x - 1$

a). What errors did he make?

→ When he combined $2x - 4x$, he said the answer was $2x$ and it should have been $-2x$.

→ When he combined $-7 + 8$, he said the answer was -1 and it should have been $+1$.

b). Show the correct simplification.

$2x - 7 - 4x + 8$

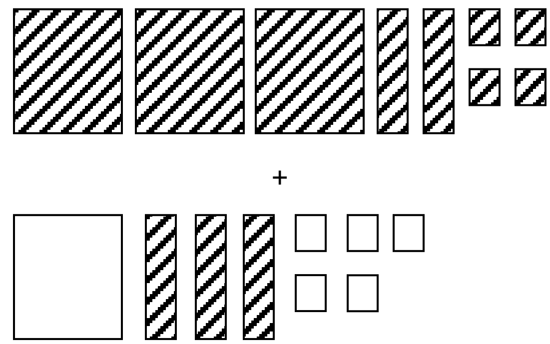
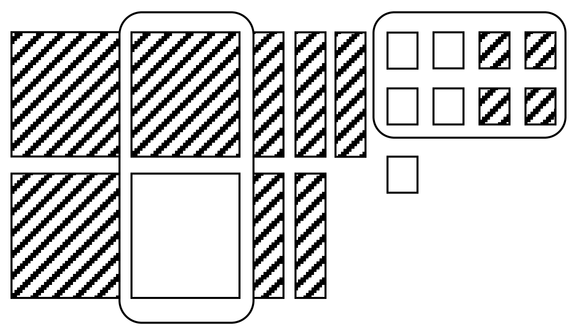
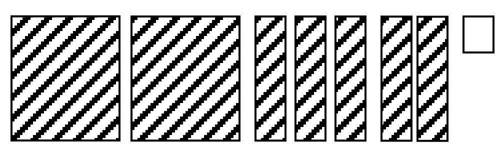
$= 2x - 4x - 7 + 8$

$= -2x + 1$

Section 5.3 Adding Polynomials

To add or subtract separate polynomials, you just need to combine like terms.

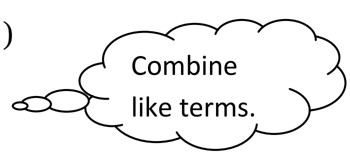
Example 1: Find the sum of each set of polynomials, using algebra tiles and symbolically.

Algebra	**Algebra Tiles**
The sum is: $(3x^2 + 2x + 4) + (-x^2 + 3x - 5)$ We can remove the brackets: $3x^2 + 2x + 4 + - x^2 + 3x – 5$	
Group like terms (probably easiest way) $3x^2 + - x^2 + 2x + 3x + 4 – 5$	
Combine like terms and use zero property: $2x^2 + 5x - 1$	

Example 2: Add symbolically (using algebra)

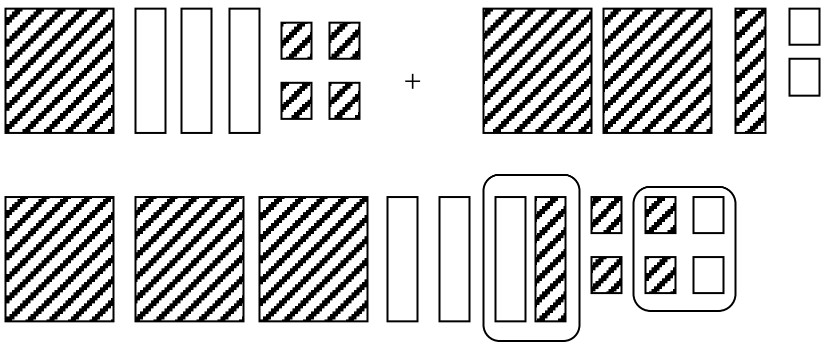
$(-2x^2 - 3x) + (2x + x^2)$

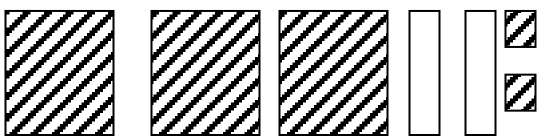
$= -2x^2 + x^2 - 3x + 2x$



$= -x^2 - 1x$

Example 3: Add: using algebra tiles. Write your answer using tiles and symbolically.





$= 3x^2 – 2x + 2$

You can add polynomials horizontally and vertically.

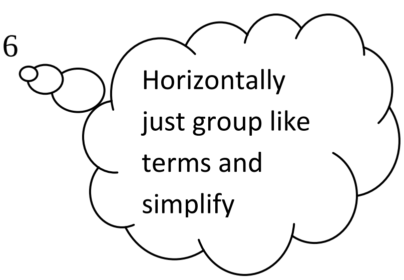
Try: $(7n + 14) + (-6n^2 + n – 6)$

Horizontally

$7n + 14 + -6n^2 + n – 6$

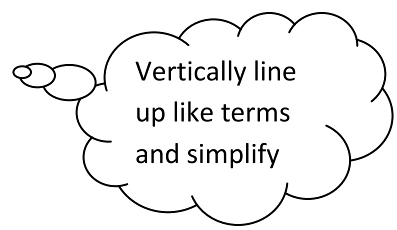
$= -6n^2 + n + 7n + 14 – 6$

$= -6n^2 + 8n + 8$



Vertically

$$\begin{array}{r} -6n^2 + n - 6 \\ +\quad 7n + 14 \\ \hline -6n^2 + 8n + 8 \end{array}$$



Example 4: Add $(2x^2 + 3x – 2) + (-x^2 + 7x – 3)$ both horizontally and vertically.

Horizontally

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

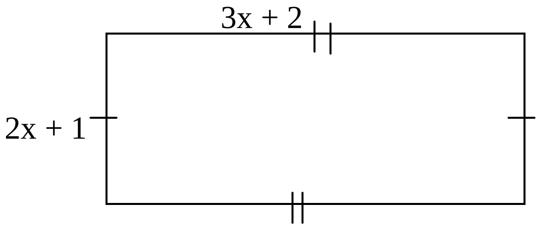
$2x^2 + -x^2 + 3x + 7x - 2 - 3$

$= x^2 + 10x – 5$

Vertically

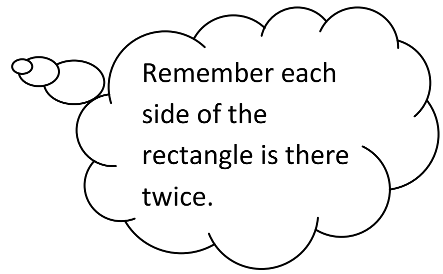
$$\begin{array}{r} 2x^2 + 3x - 2 \\ + -x^2 + 7x - 3 \\ \hline x^2 + 10x - 5 \end{array}$$

Example 5: Write a polynomial for the **perimeter** of this rectangle.



Perimeter: add up all the sides.

$$\begin{array}{r} 2x + 1 \\ 2x + 1 \\ 3x + 2 \\ + \quad 3x + 2 \\ \hline 10x + 6 \end{array}$$



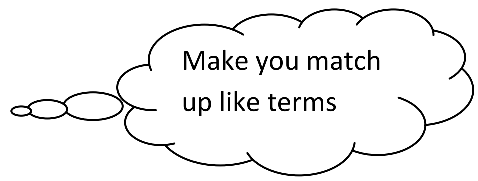
Example 6: Adding polynomials in two variables

Add: $(2a^2 + a - 3b - 7ab + 3b^2) + (-4b^2 + 3ab + 6b - 5a + 5a^2)$

$= 2a^2 + a - 3b - 7ab + 3b^2 + -4b^2 + 3ab + 6b - 5a + 5a^2$

$= 2a^2 + 5a^2 + 3b^2 - 4b^2 + a - 5a - 3b + 6b - 7ab + 3ab$

$= 7a^2 - b^2 - 4a + 3b - 4ab$



Question:

A student added $(4x^2 - 8x + 1) + (2x^2 - 6x - 2)$ as follows.

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

$= 4x^2 - 8x + 1 + 2x^2 - 6x - 2$

$= 4x^2 + 2x^2 - 8x - 6x + 1 - 2$

$= 6x^2 - 2x - 1$

(i) Is the students work correct?
(ii) If not, explain where the student made any errors and write the correct answer.

Answer: This student is not correct, they made a mistake combining their x-term.
$-8x - 6x = -14x$ not $-2x$

Correct answer: $6x^2 - 14x - 1$

<u>Section 5.4 Subtracting Polynomials</u>

Remember from earlier this year the word **"opposite".**

What is the **opposite of 2.4**?
Answer: -2.4

What is the **opposite of -10**?
Answer: 10

By definition, opposite numbers have a sum of zero. The same idea applies to polynomials. **Opposite polynomials will have a sum of zero**.

What is the **opposite of 2x**?
Answer: $-2x$

What is the **opposite of $-x^2$** ?
Answer: x^2

Example 1: What is the opposite of each polynomial listed below?

a). $-5x$ b). 11 c). $-24x^4$

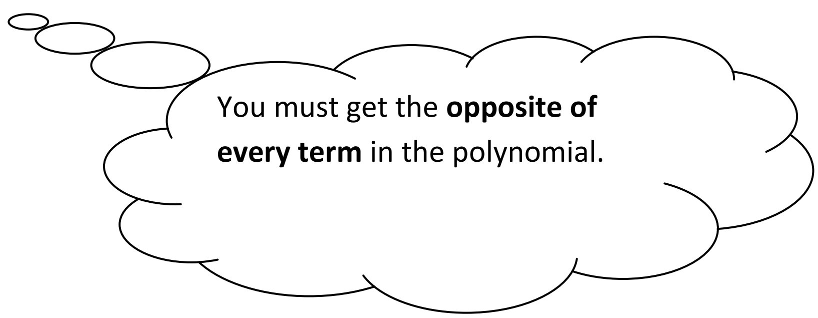
} Getting the opposite of a monomial is just like getting the opposite of a #.

Answers: a). $5x$ b). -11 c). $24x^4$

How do you think you will get the opposite of a binomial or trinomial?

d). $2x + 3$

Answer: $-2x - 3$

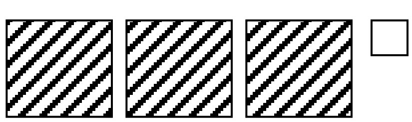


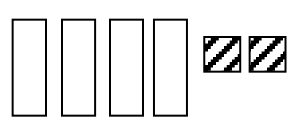
e). $4x^2 - 7x + 3$

Answer: $-4x^2 + 7x - 3$

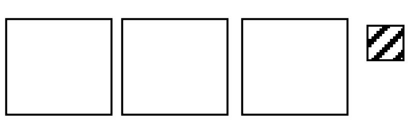
f). $(-2xy - 2y^2 + 3x^2)$ Answer: $2xy + 2y^2 - 3x^2$

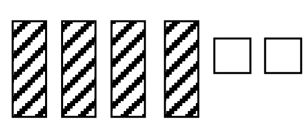
Example 2: Sketch the opposite of the polynomial using algebra tiles.

a). 

b). 

Answers:

a). 

b). 

When subtracting polynomials you must remember to **ADD THE OPPOSITE** of every term in the polynomial first, then combine like terms.

We will be subtracting polynomials symbolically and using algebra tiles.

Example 3: Subtract using algebra, then simplify.

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

We must add the opposite of every term in this polynomial. The first polynomial does not change.

$= (3x^2 - 6x + 4) + (-7x^2 - 3x + 2)$ Now you are back to adding polynomials.

$= 3x^2 - 7x^2 - 3x - 6x + 4 + 2$

$= -4x^2 - 9x + 6$

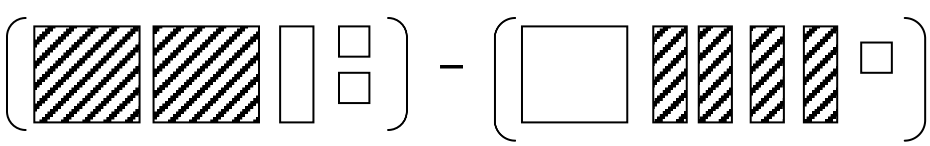
b). $(-2a^2 + a - 1) - (a^2 - 3a + 2)$

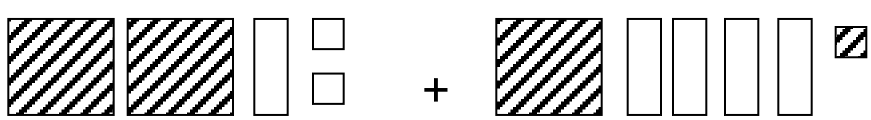
$= (-2a^2 + a - 1) + (-a^2 + 3a - 2)$

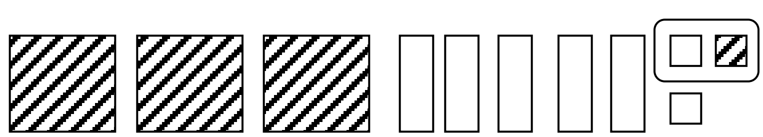
$= -2a^2 - a^2 + a + 3a - 1 - 2$

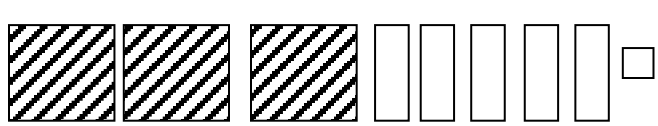
$= -3a^2 + 4a - 3$

Example 4: Subtract using algebra tiles, then simplify.

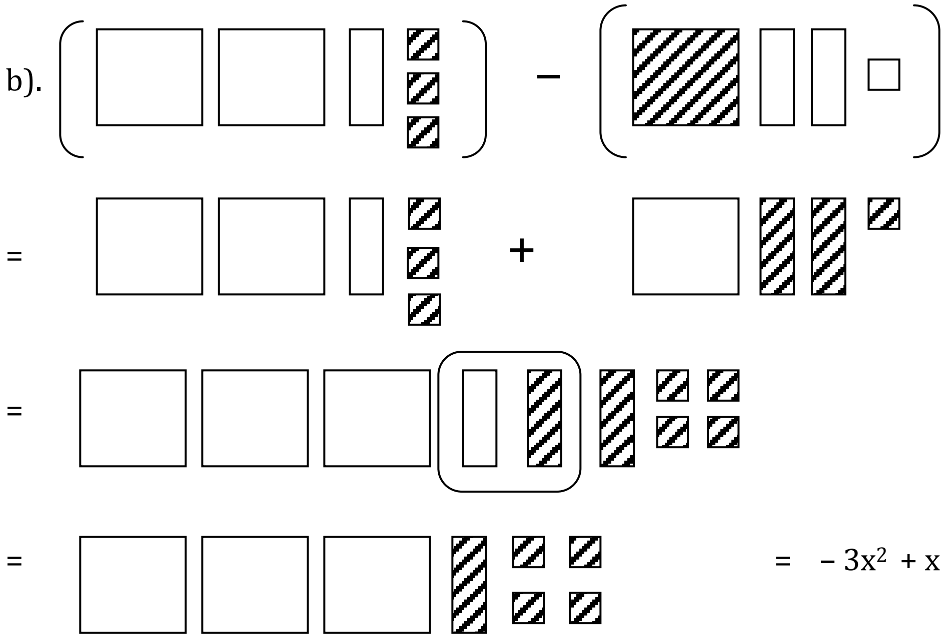
a). 

= 

= 

=  $= 3x^2 - 5x - 1$

b).



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

Just like with adding, we can subtract polynomials horizontally and vertically.

Example 5: Subtract vertically.

a). $(3x^2 + 4x - 1)$
$\underline{-\ (2x^2 - 3x + 2)}$

= $x^2 + 7x - 3$

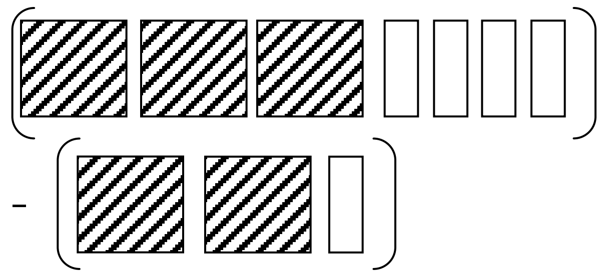
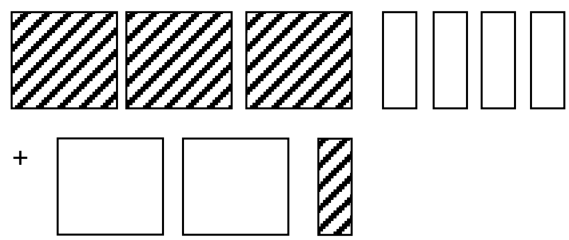
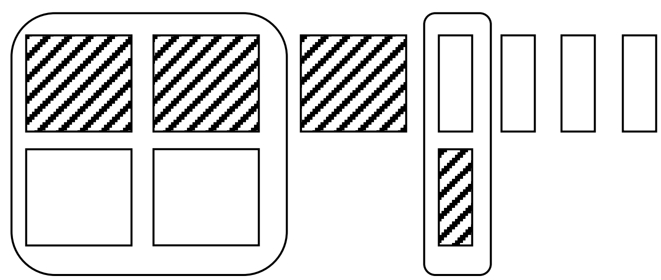
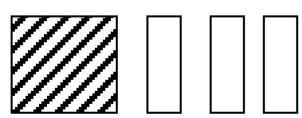
Remember: Add the opposite.
$3x^2 - 2x^2 = x^2$
$4x - -3x = 4x + 3x = 7x$
$-1 - 2 = -3$

b). $(5x^2 - 3xy + 2y^2)$
$\underline{-\ (8x^2 - 7xy - 4y^2)}$

= $-3x^2 + 4xy + 6y^2$

Remember: Add the opposite.
$5x^2 - 8x^2 = -3x^2$
$-3xy - -7xy = -3xy + 7xy = 4xy$
$2y^2 - -4y^2 = 2y^2 + 4y^2\ 6y^2$

Example 6: Subtract using algebra and algebra tiles.

Algebra	Algebra Tiles
$(3x^2 - 4x) - (2x^2 - x)$	
$(3x^2 - 4x) + (-2x^2 + x)$	
$3x^2 - 2x^2 - 4x + x$	
$x^2 - 3x$	

Example 7:

A student subtracted like this:
$(2y^2 - 3y + 5) - (y^2 + 5y - 2)$

$= 2y^2 - 3y + 5 - y^2 + 5y - 2$

$= 2y^2 - y^2 - 3y + 5y + 5 - 2$

$= y^2 - 2y + 3$

(i) Explain why the solution is incorrect.
(ii) What is the correct answer? Show your work.

Answer:

(i) They added the opposite incorrectly. They only got the opposite of y^2, when they should have gotten the opposite of every term in the polynomial, including the opposite of 5y and –2.

(ii) $(2y^2 - 3y + 5) - (y^2 + 5y - 2)$

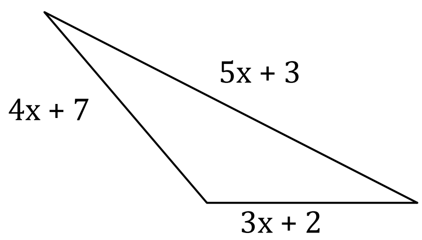
$= 2y^2 - 3y + 5 - y^2 - 5y + 2$

$= 2y^2 - y^2 - 3y - 5y + 5 + 2$

$= y^2 - 8y + 7$

Application of Adding and Subtracting

1a. Write a simplified expression for the perimeter of the triangle.



Answer: $(5x + 3) + (4x + 7) + (3x + 2)$

$= 5x + 4x + 3x + 3 + 7 + 2$

$= 12x + 12$

b. If the value of x = 4 cm ,what is the perimeter of the triangle?

Perimeter $= 12x + 12$

$= 12(4) + 12$

$= 48 + 12$

$= 60$ cm

2. Subtract $2x^2 + 2x + 5$ from $5x^2 - 7x + 4$

Means: $(5x^2 - 7x + 4) - (2x^2 + 2x + 5)$

$= 5x^2 - 7x + 4 - 2x^2 - 2x - 5$

$= 3x^2 - 9x - 1$

3. Subtract the sum of $a + b$ and $2a - b$ from $4a - 4b$.

Sum: $(a + b) + (2a - b) = 3a$

Answer: $(4a - 4b) - (3a)$

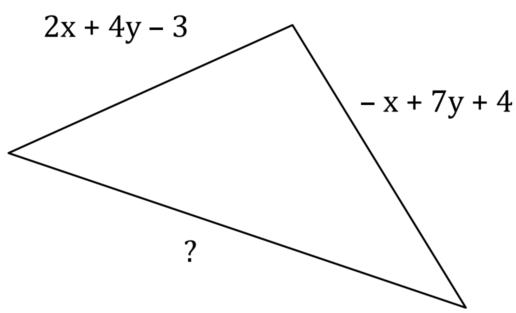
$= 4a - 4b - 3a$

$= a - 4b$

4. Write a monomial that describes the perimeter.

Perimeter: $4x + x + 2x + x + 2x + 2x = 12x$

5. Find the missing side if the Perimeter is $5x + 3y - 2$.



Need sum of given sides first.

$(2x + 4y - 3) + (-x + 7y + 4)$

$= x + 11y + 1$

Subtract sum of sides from Perimeter

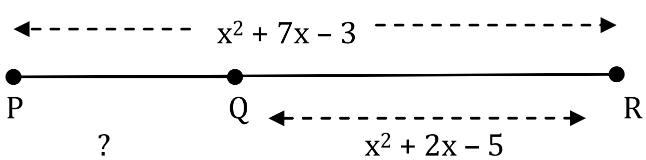
$(5x + 3y - 2) - (x + 11y + 1)$

$= 5x + 3y - 2 - x - 11y - 1$

$= 4x - 8y - 3$

... is the length of the missing side.

6. Find the length of PQ.

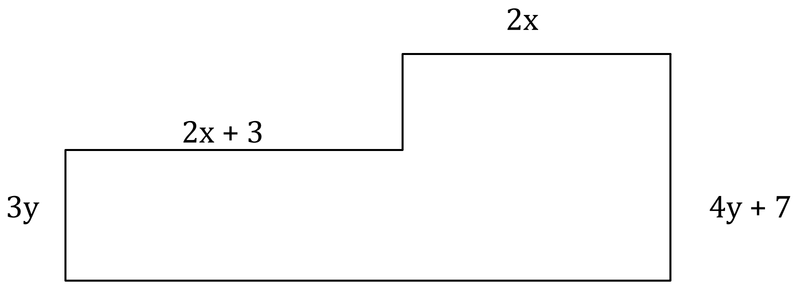


Answer: $(x^2 + 7x - 3) - (x^2 + 2x - 5)$

$= x^2 + 7x - 3 - x^2 - 2x + 5$

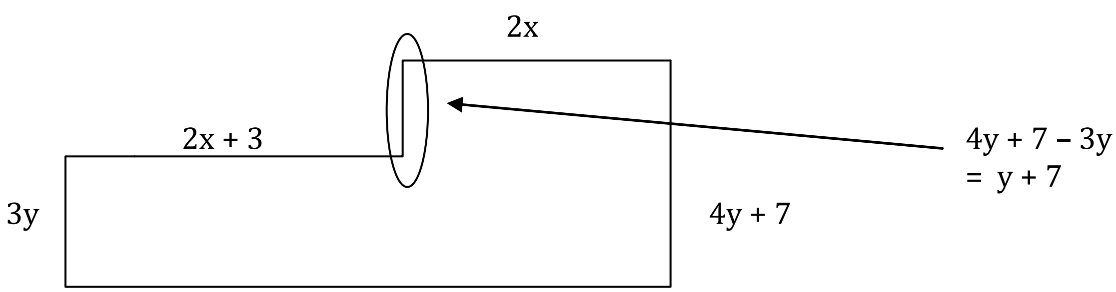
$= 5x + 2$

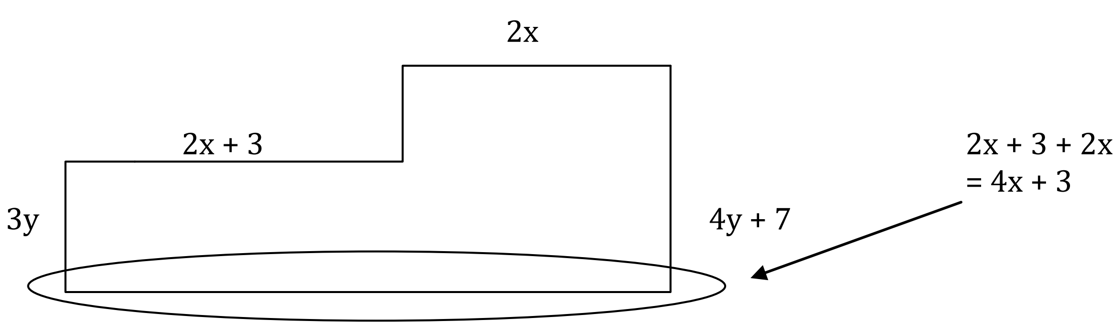
7a. Write a simplified expression for the perimeter.



Perimeter means to add up all the sides. How many sides does this shape have?

6 sides, but we are only given 4 so we need find the other 2 missing sides.





Perimeter = (3y) + (2x + 3) + (y + 7) + (2x) + (4y + 7) + (4x + 3)
= 8y + 8x + 20

b). What is the perimeter if x = 1 cm and y = 2cm ?
= 8y + 8x + 20
= 8 (2) + 8 (1) + 20 = 16 + 8 + 20 = 44 cm.

Multiplying Polynomials (Sec 5.5 and Sec 5.6)

Remember:

When multiplying or dividing ….

+ and + = +	− and + = −
− and − = +	+ and − = −

We will only be multiplying a polynomial by a monomial. The monomial could be a constant term, ex: 3(2x) or 3(2x + 2) or it could contain a variable, ex: 3x (2x) or 3x (2x + 2), etc.

Students will be expected to multiply polynomials using symbolically, using area model and algebra tiles.

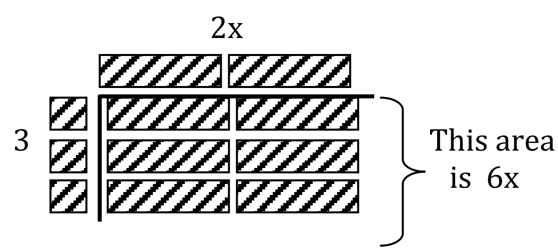
Example 1: 3 (2x)

Using algebra: 3 (2x)

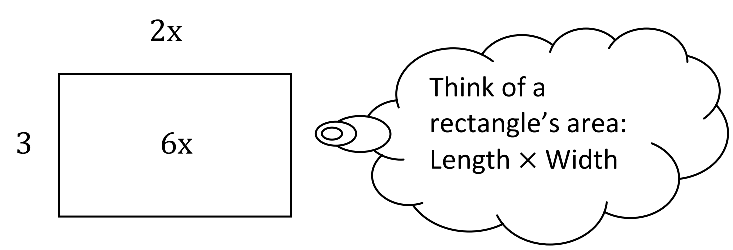
Just multiply the numbers.

3 (2x) = 6x

Using Algebra Tiles: 3 (2x)



Using Area model: 3 (2x)



Example 2: 3(2x + 2)

Using algebra: 3 (2x + 2)

Use distributive property

Multiply each term of the polynomial inside the bracket by the monomial in front of the bracket.

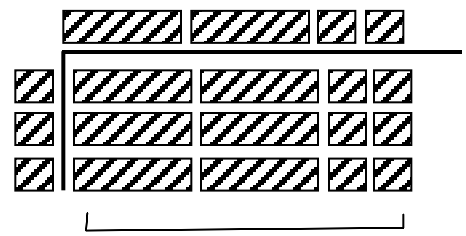
Therefore: $3 \times 2x$ and 3×2

$3\ (2x + 2) = 6x + 6$

Using Algebra Tiles: 3 (2x + 2)

2x + 2

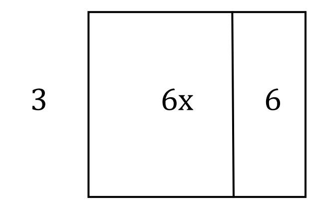
3



This area is 6x + 6

Using Area model: 3 (2x + 2)

2x + 2



Area is 6x + 6

Example 3: 3x(2x)

Using algebra: 3x (2x)

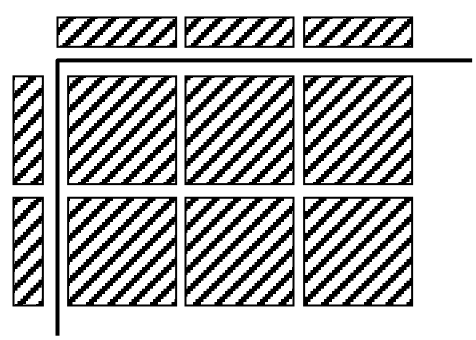
Multiply the numbers and add exponents on the variable… Remember the exponent rules!

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

Using Algebra Tiles: 3x (2x)

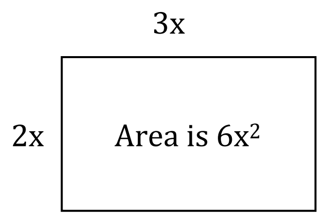
3x

2x



This area is $6x^2$

Using Area model: 3x (2x)



Example 4: 3x(2x + 2)

Using algebra: 3x (2x + 2)

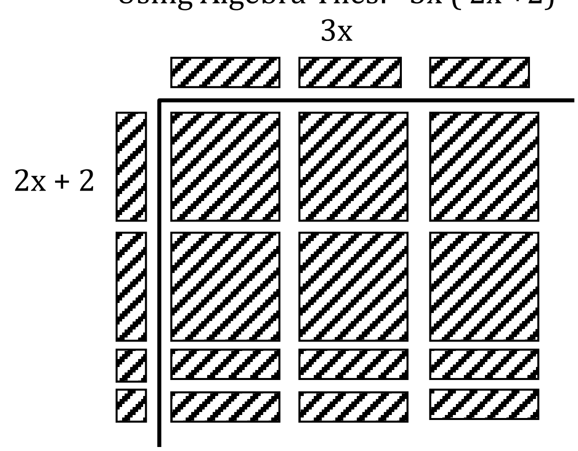
Use distributive property

Multiply each term of the polynomial inside the bracket by the monomial in front of the bracket. Don't forget exponent rule!

Therefore: $3 \times 2x$ and 3×2

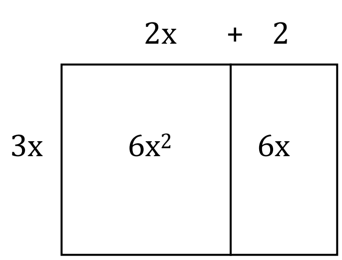
$3x\,(2x + 2) = 6x^2 + 6x$

Using Algebra Tiles: 3x (2x +2)



This area is $6x^2 + 6x$

Using Area model: 3 (2x + 2)

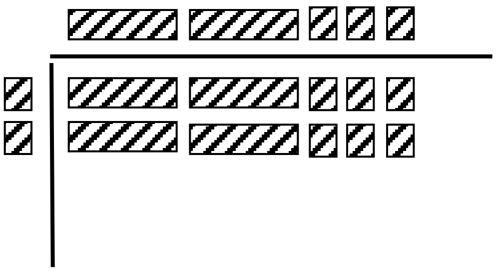


Area is $6x^2 + 6x$

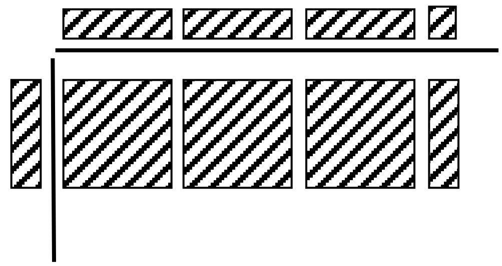
Try These!

1. Multiply using algebra tiles.

A). 2 (2x + 3)



B). x (3x + 1)



Answer: $4x + 6$

Answer: $3x^2 + x$

2. Multiply using distributive property…using algebra. Careful with signs!

A). $3(-2m + 4)$

$= -6m + 12$

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

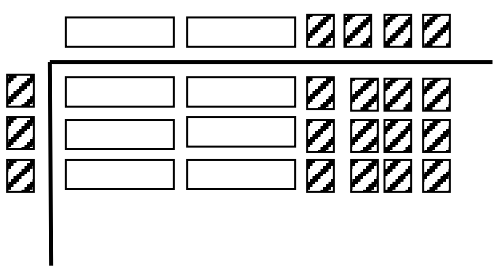
$= -4x - 8$

C). $-2(-n^2 + 2n - 1)$

$= 2n^2 - 4n + 2$

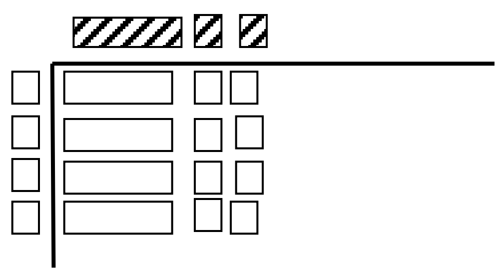
3. How would you sketch negatives with algebra tiles ?

A). $3(-2m + 4)$

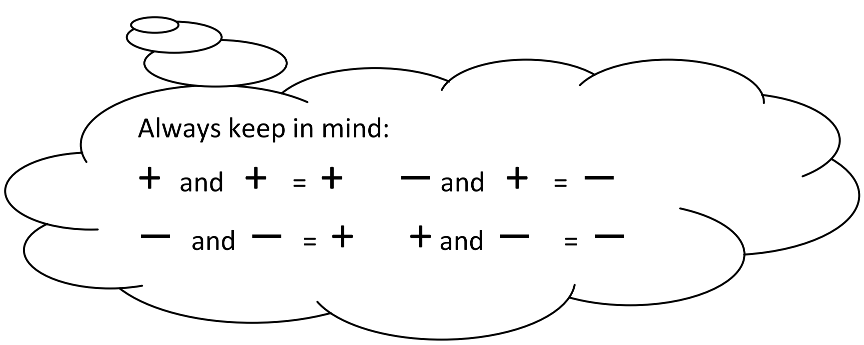


Answer: $= -6m + 12$

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

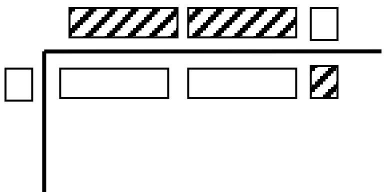


Answer: $= -4x - 8$



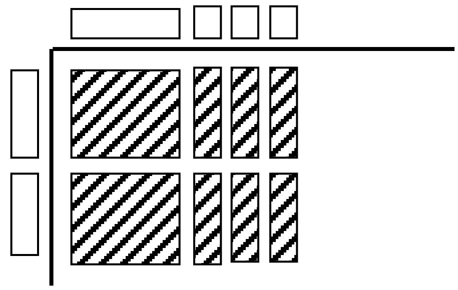
4. Try These using algebra tiles! Check your answer using algebra.

A). $-(2x-1)$



Answer: $-2x+1$

B). $-2x(-x-3)$



Answer: $2x^2+6x$

5. Sketch the answer using the area model: $-2(-n^2+2n-1)$

	$-n^2$	$+2n$	-1
-2	$2n^2$	$-4n$	$+2$

Answer: $= 2n^2-4n+2$

6. Multiply using distributive property.

A: $2(x+10)$

$= 2x+20$

B: $5y(y+1)$

$= 5y^2+5y$

C: $-10(x+2)$

$= -10x-20$

D: $6x(12-x)$

$= 72x-6x^2$

E: $3(x-7)$

$= 3x-21$

F: $-4x(2x-3)$

$= -8x^2+12x$

G: $-6m(m+4)$

$= -6m^2-24m$

H: $-8(x-5)$

$= -8x+40$

I: $3(-8-7x)$

$= -24-21x$

Dividing Polynomials (Sec 5.5 and Sec 5.6)

Remember:

When multiplying or **dividing** ....

+ and + = +	− and + = −
− and − = +	+ and − = −

We will only be dividing a polynomial (one or more terms) by a monomial, symbolically, using algebra tiles and area models. The monomial could be a constant term or contain a variable

Ex: $4x^2 \div 2 = \frac{4x^2}{2}$ or $4x^2 \div 2x = \frac{4x^2}{2x}$ $\frac{4x^2 - 8x}{2}$ or $\frac{4x^2 - 8x}{2x}$, etc.

Dividing Symbolically:

$\frac{4x^2}{2}$	When dividing a monomial by a monomial You just divide the numbers like normal.	$\frac{4x^2}{2} = 2x^2$
$\frac{4x^2}{2x}$	When dividing a monomial by a monomial and there is also a variable in the denominator, you must remember the exponent rule. When dividing powers with the same base, you subtract exponents. Still divide the numerical coefficients like normal.	$\frac{4x^2}{2x} = 2x$
$\frac{4x^2 - 8x}{2}$	you can rewrite the quotient as a sum of two fractions and divide like it is two monomials.	$\frac{4x^2}{2} - \frac{8x}{2} = 2x^2 - 4x$
$\frac{4x^2 - 8x}{2x}$	Rewrite the quotient as a sum of two fractions and divide like it is two monomials. Don't forget the exponent rules when there is a variable in the denominator.	$\frac{4x^2}{2x} - \frac{8x}{2x} = 2x - 4$

NOTE:
However many terms are in the numerator, that's how many terms are in your answer.
When dividing a trinomial by a monomial, you will have a trinomial answer.

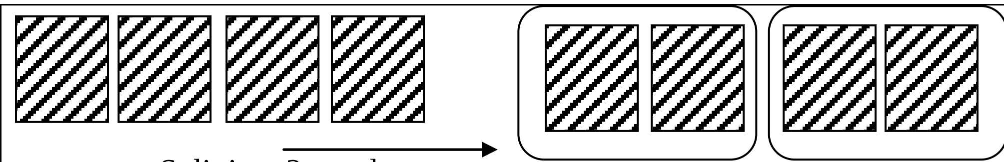
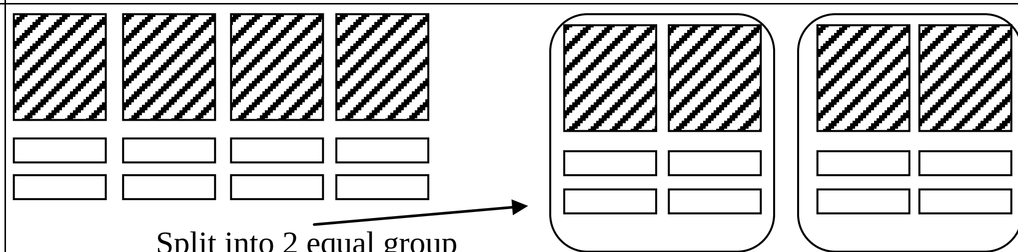
Ex5: $\frac{12m^2 + 6m - 9}{3} = \frac{12m^2}{3} + \frac{6m}{3} - \frac{9}{3} = 4m^2 + 2m - 3$

Be careful when dividing by negatives!

Ex6: $\frac{-3y^2 + 15xy - 21x^2}{-3} = \frac{-3y^2}{-3} + \frac{15xy}{-3} - \frac{21x^2}{-3} = y^2 - 5xy + 7x^2$

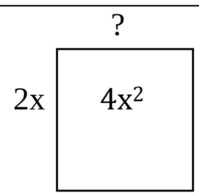
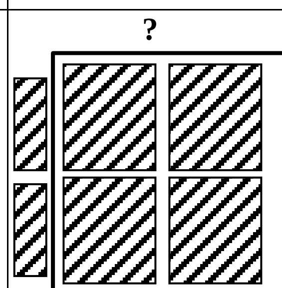
Dividing Using Algebra Tiles

Dividing by 2 means, split the tiles into 2 equal groups.

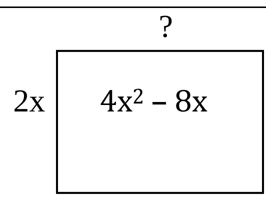
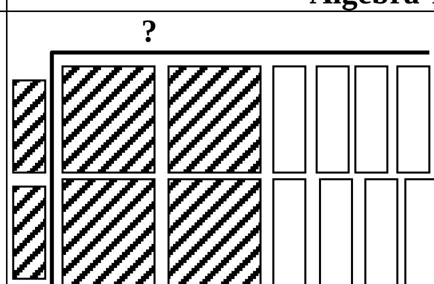
$\frac{4x^2}{2}$	 Split into 2 equal groups $2x^2$ in each group: that's our answer
$\frac{4x^2 - 8x}{2}$	 Split into 2 equal group $2x^2 - 4x$ in each group: that's our answer

Dividing Using an Area Model and Algebra Tiles

a). Find the missing dimension if the area of the rectangle is $4x^2$ and the length is $2x$.

Area Model	Algebra Tiles
 $\frac{4x^2}{2x} = 2x$	 The missing dimension is 2x because $\frac{4x^2}{2x}$

b). Find the missing dimension if the area of the rectangle is $4x^2 - 8x$ and the length is $2x$.

Area Model	Algebra Tiles
 $\frac{4x^2 - 8x}{2x}$ $\frac{4x^2}{2x} - \frac{8x}{2x} = 2x - 4$	 The missing dimension is $2x - 4$ because $\frac{4x^2 - 8x}{2x} = 2x - 4$