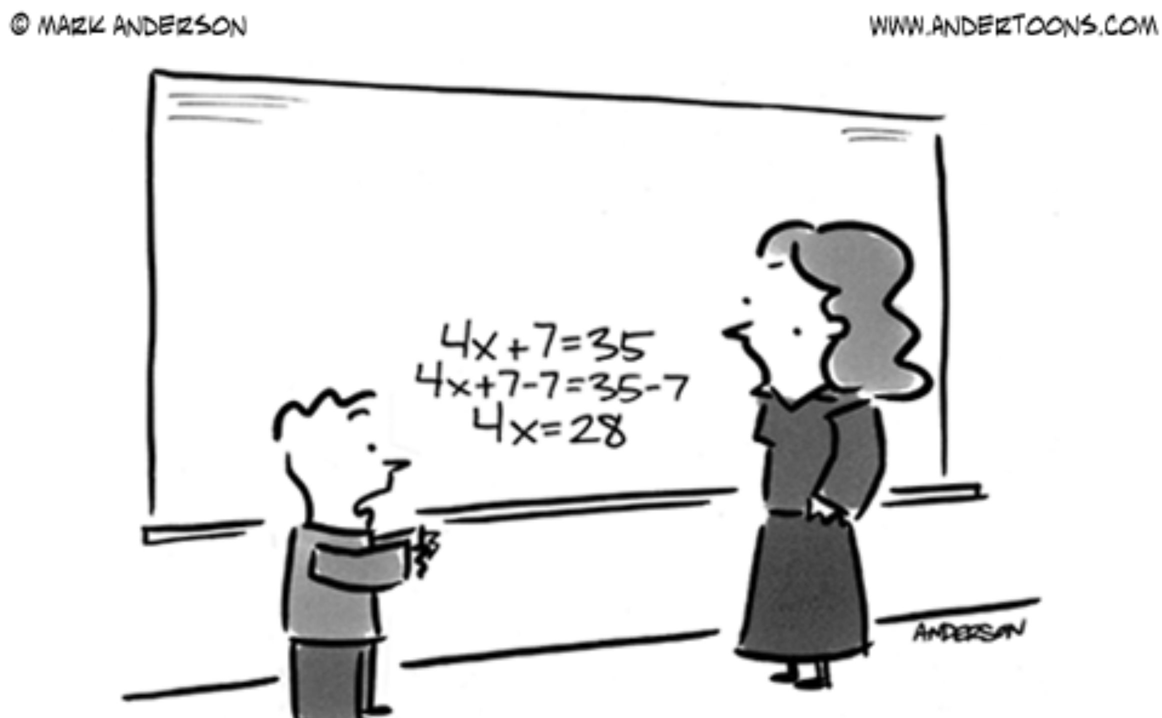
<u>Unit 1 - Algebra</u>

Chapter 3 – Polynomials

MPM1D

School Cartoon #6446



"You *knew* X was 7 the *whole time* and you *never said anything*?!"

Unit 1: Algebra

Chapter 3: Polynomials

3.2 Work With Exponents

Part 1: Exponents Investigation

One day Sammy decided to try a new place for lunch. He went to a new restaurant called Barney's Burgers. He loved the food so much that when he got back to school he told two of his friends. Suppose that this trend continues and every day each new customer tells two new friends at school about Barney's Burgers. How many new customers will Barney get each day?

a) Complete the chart using your knowledge of exponents

Day	New Customers	Expanded Form	Power
1	2	2	2^1
2	4	2 x 2	2^2
3	8	2x2x2	2^3
4	16	2x2x2x2	2^4

b) Use this model to determine how many new customers Barney should expect on Day 7. Show your work.

new customers on day 7 = $2^7 = 128$

Barney should expect 128 new customers on day 7.

c) Use this model to determine how many new customers Barney should expect on Day 14. Is this answer realistic? Why or why not? new customers on day 14 = $2^{14} = 16384$

This is not realistic because there are probably not even that many people at the school.

d) Suppose that each new customer told three friends instead of two, and that this trend continued

i) How many new customers should Barney expect after 2 days?

new customers after 2 days = $3 \times 3 = 3^2 = 9$

Barney should expect 9 new customers after 2 days.

ii) How many new customers should Barney expect after 4 days?

new customers after 4 days = $3^4 = 81$

Barney should expect 81 new customers after 4 days.

Brain Teaser: A rectangular sheet of paper measures 25 cm by 9 cm. The dimensions of a square sheet of paper with the same area are...

$$A_{rectangle} = 25 \times 9$$
$$= 225$$

For a square:

$$Area = l^2$$
$$225 = l^2$$
$$l = \sqrt{225}$$
$$l = 15$$

The square is 15 cm by 15 cm.

Part 2: Exponents

Repeated multiplication of the same number by itself can be expressed as a power. The number is said to be in exponential form.

EXPONENT

$$2^3 = 2 \times 2 \times 2$$

BASE

Express as a power in exponential form:

1) 3×3 $= 3^2$

2) $5 \times 5 \times 5 \times 5$ $= 5^4$

3) $(-2)(-2)(-2)(-2)(-2)$ $= (-2)^5$

4) $h \times h \times h$ $= h^3$

Write in expanded form and then evaluate:

5) 2^3 $= (2)(2)(2) = 8$

6) $(-3)^4$ $= (-3)(-3)(-3)(-3) = 81$

7) -3^4 $= -1(3)(3)(3)(3) = -81$

8) $\left(\frac{2}{3}\right)^3$ $= \left(\frac{2}{3}\right)\left(\frac{2}{3}\right)\left(\frac{2}{3}\right) = \frac{8}{27}$

Note: $\left(\frac{a}{b}\right)^x = \frac{a^x}{b^x}$

Therefore:

$\left(\frac{2}{3}\right)^3 = \frac{2^3}{3^3} = \frac{8}{27}$

Find the Trend

Evaluate each of the following:

$(-2)^2$	$(-2)^3$	$(-2)^4$	$(-2)^5$
$= 4$	$= -8$	$= 16$	$= -32$

If the base of the power is negative:

- and the exponent is an even # , the answer will be POSITIVE

- and the exponent is an odd # , the answer will be NEGATIVE

Part 3: Substitute and Evaluate

Evaluate the expression for the given values of the variables:

9) $6x^2$ for $x = 5$

$6x^2$

$= 6(5)^2$

$= 6(25)$

$= 150$

10) $6x^2 - 2x - 24$ for $x = -6$

$6x^2 - 2x - 24$

$= 6(-6)^2 - 2(-6) - 24$

$= 6(36) + 12 - 24$

$= 216 + 12 - 24$

$= 204$

3.3 Discover the Exponent Laws

DO IT NOW

I have a bag containing 24 coloured marbles. The colours are red, green and blue. There are twice as many red marbles as green marbles, and one more red marble than blue marble. How many of each colour marble are there?

Red: 10

Green: 5

Blue: 9

Part 1: Exponent Laws Investigation

Product Rule: Complete the following table

Product	Expanded Form	Single Power
$3^2 \cdot 3^4$	$(3 \times 3) \times (3 \times 3 \times 3 \times 3)$ $= 3 \times 3 \times 3 \times 3 \times 3 \times 3$	3^6
$4^3 \cdot 4^3$	$(4\times4\times4)\times(4\times4\times4)$ $=4\times4\times4\times4\times4\times4$	4^6
$2^3 \cdot 2^4 \cdot 2^2$	$(2\times2\times2)\times(2\times2\times2\times2)\times(2\times2)$ $=2\times2\times2\times2\times2\times2\times2\times2\times2$	2^9
$k^3 \cdot k^5$	$(k\times k\times k)\times(k\times k\times k\times k\times k)$ $=k\times k\times k\times k\times k\times k\times k\times k$	k^8
create your own example		

Describe any trends you see:

When multiplying powers with the same base, keep the base the same and add the exponents.

Quotient Rule: Complete the following table

Quotient	Expanded Form	Single Power
$5^5 \div 5^3$	$\frac{5 \times 5 \times \cancel{5} \times \cancel{5} \times \cancel{5}}{\cancel{5} \times \cancel{5} \times \cancel{5}}$	5^2
$7^4 \div 7^1$	$\frac{7\times7\times7\times\cancel{7}}{\cancel{7}}$	7^3
$10^6 \div 10^4$	$\frac{10\times10\times\cancel{10}\times\cancel{10}\times\cancel{10}\times\cancel{10}}{\cancel{10}\times\cancel{10}\times\cancel{10}\times\cancel{10}}$	10^2
$x^8 \div x^5$	$\frac{(x)(x)(x)\cancel{(x)}\cancel{(x)}\cancel{(x)}\cancel{(x)}\cancel{(x)}}{\cancel{(x)}\cancel{(x)}\cancel{(x)}\cancel{(x)}\cancel{(x)}}$	x^3
create your own example		

Describe any trends you see:

When dividing powers with the same base, keep the base the same and subtract the exponents.

Power of a Power Rule: Complete the following table

Power of a Power	Expanded Form	Single Power
$(2^2)^3$	$(2^2) \times (2^2) \times (2^2)$ $= (2 \times 2) \times (2 \times 2) \times (2 \times 2)$ $= 2 \times 2 \times 2 \times 2 \times 2 \times 2$	2^6
$(5^3)^4$	$(5^3) \times (5^3) \times (5^3) \times (5^3)$ $= (5 \times 5 \times 5) \times (5 \times 5 \times 5) \times (5 \times 5 \times 5) \times (5 \times 5 \times 5)$ $= 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5$	5^{12}
$(10^4)^2$	$(10^4) \times (10^4)$ $= (10 \times 10 \times 10 \times 10) \times (10 \times 10 \times 10 \times 10)$ $= 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$	10^8
Create your own example		

Describe any trends you see:

A power of a power can be written as a single power by keeping the base the same and multiplying the exponents.

Summary of Exponent Laws:

Product Rule	$x^a \cdot x^b = x^{a+b}$
Quoutient Rule	$x^a \div x^b = x^{a-b}$
Power of a Power Rule	$(x^a)^b = x^{a \times b}$
Zero Exponent Rule	$x^0 = 1$

Part 2: Summary of Exponent Laws

Product Rule

When multiplying powers with the **same base,** keep the same BASE and ADD the exponents.

General Rule:

$$x^a \cdot x^b = x^{a+b}$$

Quotient Rule

When dividing powers with the **same base,** keep the same BASE and SUBTRACT the exponents.

General Rule:

$$x^a \div x^b = x^{a-b}$$

Power of a Power Rule

A power of a power can be written as a single power by MULTIPLYING the exponents.

General Rule:

$$(x^a)^b = x^{a \times b}$$

Powers with a Rational Base

When you have a single power with a rational base, you can evaluate it by applying the exponent to the NUMERATOR and the DENOMINATOR.

Rule:

$$\left(\frac{a}{b}\right)^x = \frac{a^x}{b^x}$$

Part 3: Apply the Product Rule

$$x^a \cdot x^b = x^{a+b}$$

Write each product as a single power. Then, evaluate the power where possible.

1) $3^2 \times 3^3$

$= 3^{2+3}$

$= 3^5$

$= 243$

2) $5^2 \times 5 \times 5^2$

$= 5^{2+1+2}$

$= 5^5$

$= 3125$

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

$= x^{2+7}$

$= x^9$

4) $(a^4)(a^4)(a^5)$

$= a^{4+4+5}$

$= a^{13}$

5) $(-2)^4 \times (-2)^3$

$= (-2)^{4+3}$

$= (-2)^7$

$= -128$

6) $\left(\frac{1}{2}\right)^3 \times \left(\frac{1}{2}\right)^2$

$= \left(\frac{1}{2}\right)^{3+2}$

$= \left(\frac{1}{2}\right)^5$

$= \frac{1^5}{2^5}$

$= \frac{1}{32}$

Part 4: Apply the Quotient Rule $x^a \div x^b = x^{a-b}$

Write each quotient as a single power. Then, evaluate the power where possible.

7) $8^7 \div 8^5$

$= 8^{7-5}$

$= 8^2$

$= 64$

8) $4^7 \div 4 \div 4^3$

$= 4^{7-1-3}$

$= 4^3$

$= 64$

9) $x^{70} \div x^{40} \div x^{29}$

$= x^{70-40-29}$

$= x^1$

$= x$

10) $\frac{x^7}{x^3}$

$= x^{7-3}$

$= x^4$

11) $\frac{(-0.5)^6}{(-0.5)^3}$

$= (-0.5)^{6-3}$

$= (-0.5)^3$

$= -0.125$

12) $\frac{\left(\frac{3}{4}\right)^3 \times \left(\frac{3}{4}\right)^2}{\left(\frac{3}{4}\right)^5}$

$= \frac{\left(\frac{3}{4}\right)^5}{\left(\frac{3}{4}\right)^5}$

$= \left(\frac{3}{4}\right)^{5-5}$

$= \left(\frac{3}{4}\right)^0$

$= 1$

13) $\frac{a^5 a^2}{a^6 a^1}$

$= \frac{a^{5+2}}{a^{6+1}}$

$= \frac{a^7}{a^7}$

$= a^{7-7}$

$= a^0$

$= 1$

Note: An exponent of zero always gives the answer of 1

Part 5: Apply the Power of a Power Rule $(x^a)^b = x^{a \times b}$

Write each power of a power as a single power. Then, evaluate the power where possible.

14) $(3^2)^4$

$= 3^{2\times4}$

$= 3^8$

$= 6561$

15) $[(-2)^3]^4$

$= (-2)^{3\times4}$

$= (-2)^{12}$

$= 4096$

16) $\left[\left(\frac{2}{3}\right)^2\right]^2$

$= \left(\frac{2}{3}\right)^{2\times2}$

$= \left(\frac{2}{3}\right)^4$

$= \frac{2^4}{3^4}$

$= \frac{16}{81}$

17) $(3ab^7)^2$

$= (3)^2(a)^2(b^7)^2$

$= 9a^2b^{7\times2}$

$= 9a^2b^{14}$

Summary of Exponent Laws

Product Rule	$x^a \cdot x^b = x^{a+b}$
Quotient Rule	$x^a \div x^b = x^{a-b}$
Power of a Power Rule	$(x^a)^b = x^{a\times b}$
Power with a Rational Base	$\left(\frac{a}{b}\right)^x = \frac{a^x}{b^x}$
Zero Exponent Rule	$x^0 = 1$

3.3b - Exponent Laws

Part 1: Do It Now

Simplify and evaluate each of the following expressions:

1) $(3^2)(3^5)$ $= 3^{2+5} = 3^7 = 2187$

2) $\frac{y^{10}}{y}$ $= y^{10-1} = y^9$

3) $(y^3)^4$ $= y^{3\times4} = y^{12}$

4) $3xy - 2xy$ $= 1xy$

Note: *#4 is a subtraction question. Simplifying this is called 'collecting like terms'.*

Complete the following table:

Product Rule	$x^a \cdot x^b = x^{a+b}$
Quotient Rule	$x^a \div x^b = x^{a-b}$
Power of a Power Rule	$(x^a)^b = x^{a \times b}$
Power with a Rational Base	$\left(\frac{a}{b}\right)^x = \frac{a^x}{b^x}$
Zero Exponent Rule	$x^0 = 1$
Negative Exponent Rule	$x^{-a} = \frac{1}{x^a}$

Part 2: Negative Exponents

Any non-zero number raised to a negative exponent is equal to its RECIPROCAL raised to the opposite positive power

1) x^{-3}

$= \frac{1}{x^3}$

2) 5^{-2}

$= \frac{1}{5^2}$

$= \frac{1}{25}$

3) $\frac{x^3}{x^5}$

$= x^{3-5}$

$= x^{-2}$

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

You Try:

a) $x^5 \div x^9$

$= x^{5-9}$

$= x^{-4}$

$= \dfrac{1}{x^4}$

b) $\dfrac{\cancel{6}^{2}x^3}{\cancel{3}_{1}x^7}$

$= \dfrac{2x^3}{1x^7}$

$= 2x^{3-7}$

$= 2x^{-4}$

$= \dfrac{2}{x^4}$

Part 3: Simplify Expressions Using Exponent Laws

4) $5x^2 \cdot 2x^7$

$= (5)(2)(x^2)(x^7)$

$= 10x^{2+7}$

$= 10x^9$

5) $2a^2b^3 \cdot 3a^6b^4$

$= (2)(3)(a^2)(a^6)(b^3)(b^4)$

$= 6a^{2+6}b^{3+4}$

$= 6a^8b^7$

> ***Hint:*** *start by multiplying coefficients together. Then looks for powers with the same base and simplify by writing them as a single power by following the proper exponent laws.*

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

$= (5)^2(x^3)^2$

$= 25x^{3\times 2}$

$= 25x^6$

7) $(x^4y^3)^2$

$= (x^4)^2(y^3)^2$

$= (x^{4\times 2})(y^{3\times 2})$

$= x^8y^6$

> ***Hint:*** *the exponent outside of the brackets must be applied to all coefficients and variables inside the brackets using the proper exponent laws.*

8) $\dfrac{12k^2m^8}{4k^5m^5}$

$= \dfrac{3k^2m^8}{1k^5m^5}$

$= \dfrac{3k^{2-5}m^{8-5}}{1}$

$= \dfrac{3k^{-3}m^3}{1}$

$= \dfrac{3m^3}{k^3}$

9) $\dfrac{-2uv^3 \cdot 8u^2v^2}{(4uv^2)^2}$

Hint: *start by simplifying the numerator and denominator separately as much as possible using exponent laws. Then reduce the coefficients if possible and use the quotient rule to simplify powers with the same base.*

$= \dfrac{-16u^{1+2}v^{3+2}}{(4)^2(u)^2(v^2)^2}$

$= \dfrac{-16u^3v^5}{16u^2v^4}$

$= -1u^{3-2}v^{5-4}$

$= -1uv$

10) $\dfrac{(3m^2n)^2}{(2mn)(3m^2n)}$

$= \dfrac{(3)^2(m^2)^2(n)^2}{(2)(3)(m)(m^2)(n)(n)}$

$= \dfrac{\cancel{9}\,3\,m^4n^2}{\cancel{6}\,2\,m^3n^2}$

$= \dfrac{3m^{4-3}n^{2-2}}{2}$

$= \dfrac{3m^1n^0}{2}$

$= \dfrac{3m}{2}$

You try:

a) $\dfrac{5c^3d \cdot 4c^2d^2}{(2c^2d)^2}$

$= \dfrac{5(4)(c^3)(c^2)(d)(d^2)}{(2)^2(c^2)^2(d)^2}$

$= \dfrac{{}^{5}\cancel{20}c^5d^3}{{}^{1}\cancel{4}c^4d^2}$

$= 5c^{5-4}d^{3-2}$

$= 5cd$

b) $\dfrac{(3xy)^3}{9x^4y^4}$

$= \dfrac{(3)^3(x)^3(y)^3}{9x^4y^4}$

$= \dfrac{{}^{3}\cancel{27}x^3y^3}{{}^{1}\cancel{9}x^4y^4}$

$= \dfrac{3x^{3-4}y^{3-4}}{1}$

$= \dfrac{3x^{-1}y^{-1}}{1}$

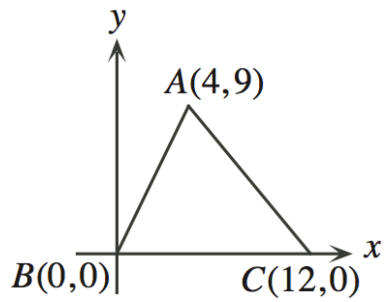
$= \dfrac{3}{x^1y^1}$

$= \dfrac{3}{xy}$

3.4 Communicate With Algebra

Brain Teaser:

In the diagram, what is the area of the triangle?



$$A_{triangle} = \frac{(base)(height)}{2}$$

$$= \frac{(12)(9)}{2}$$

$$= 54 \text{ units}^2$$

Part 1: DO IT NOW

A hockey team gets 2 points for a win, 1 point for a tie, and 0 points for a loss.

a) Write an equation for determining the amount of points a team has:

Points = 2(wins) + 1(ties) + 0(losses)

b) If the Penguins win 54 games, tie 8, and lose 20; how many points will they get?

Points = 2(54) + 1(8) + 0(20)

Points = 108 + 8 + 0

Points = 116

Part 2: Terms

Term: an expression formed by the **product** of numbers and or variables.

Example of a term:

$$4x^2$$

The number in front of the variable is called the coefficient.

Identify the coefficient and the variable for the expression $4x^2$:

Coefficient: 4

Variable: x^2

Practice with Terms

Identify the coefficient and the variable of each term:

a) Jim earns \$7 per hour at his part-time job. If he works for x hours, his earnings, in dollars, are $7x$.
b) The depth, in meters, of a falling stone in a well after t seconds is $-4.9t^2$
c) The area of a triangle with base b and height h is $\frac{1}{2}bh$
d) The area of a square with side length k is k^2

Expression	Coefficient	Variable	Comments
$7x$	7	x	
$-4.9t^2$	-4.9	t^2	The negative sign is included with the coefficient
$\frac{1}{2}bh$	$\frac{1}{2}$	bh	The variable can consist of more than one letter or symbol
k^2	1	k^2	When the coefficient is not shown, it is 1.

Part 3: Polynomials

Polynomial: an algebraic expression consisting of one or more terms connected by addition or subtraction operators

Example of a polynomial:

$$3x^2 + 2x$$

A polynomial can be classified by the number of terms it has:

A MONOMIAL is a polynomial with only one term.

A BINOMIAL is a polynomial with two terms.

A TRINOMIAL is a polynomial with three terms.

A 4-TERM POLYNOMIAL is a polynomial with four terms.

Classify each polynomial by the number of terms it has:

Polynomial	Number of Terms	Type of Polynomial
$3x^2 + 2x$	2	BINOMIAL
$-2m$	1	MONOMIAL
$4x^2 - 3xy + y^2$	3	TRINOMIAL
$a - 2b + c - 3$	4	4-TERM POLYNOMIAL

Hint: *You can find the number of terms by looking for theaddition and subtraction operators that separate the terms*

Part 4: Degree of a Term

Degree of a term: the sum of the exponents on the variables in a term

Example of determining the degree of a term:

Term: $5x\ y^{2}\quad{}^{3}$

Sum of Exponents on Variables: 2 + 3 = 5

Degree of Term: 5

Find the degree of each term by adding the exponents of the variables:

Term	Sum of Exponents	Degree of Term
x^2	2	2
$3y^4$	4	4
$0.7uv$	$1+1=2$	2
$-2a^2b$	$2+1=3$	3
-5	0	0

Note:

- a variable that appears to have no exponent actually has an exponent of 1
- a constant has a degree of 0

Part 5: Degree of a Polynomial

The ***degree of a polynomial*** is equal to the degree of the highest-degree term in the polynomial

Example:

Polynomial: $\overset{6}{3x^2y^4} + \overset{4}{11x^2y^2} + \overset{5}{y^5}$

Highest-Degree Term: $3x^2y^4$

Degree of highest-degree term: $2+4=6$

Degree of polynomial: 6

Find the degree of each polynomial:

Polynomial	Term with Highest Degree	Degree of Term with Highest Degree	Degree of Polynomial
$x + 3$	x	1	1
$5x^2 - 2x$	$5x^2$	2	2
$3y^3 + 0.2y - 1$	$3y^3$	3	3
$7x^2y^4 + x^6y$	x^6y	$6+1=7$	7

Part 6: Apply Our Knowledge!

Mr. Jensen works part time as a golf instructor. He earns $125 for the season, plus $20 for each children`s lesson and $30 for each adult lesson that he gives.

a) Write an expression that describes Mr. Jensen's total earnings for the season. Identify the variables and what they stand for.

Earnings = 20 (child lessons) + 30 (adult lessons) + 125

b) If Mr. Jensen gave **8 children's** lessons and **6 adult lessons**, what were his total earnings?

Earnings = 20(8) + 30(6) + 125

Earnings = 160 + 180 + 125

Earnings = $465

Review of Terms

TERM____________ : an expression formed by the product of numbers and/or variables

POLYNOMIAL__________ : an algebraic expression consisting of one or more terms connected by addition or subtraction signs.

DEGREE OF TERM______ : the sum of the exponents on the variables in a term

DEGREE OF POLYNOMIAL: equal to the degree of the highest-degree term in a polynomial

3.5 Collecting Like Terms

Brain Teaser

At King's, the ratio of males to females writing the Pascal Contest is 3 : 7. If there are 21 males writing the Contest, what is the total number of students writing?

49

Part 1: DO IT NOW

1) What is the degree of the term: $3x^2yz$

4

2) What is the degree of this polynomial:

$$3a^2b^3c + 2ab^4c^2 - 7abc^2$$

7

3) Classify the polynomial from question **2)** by name:

Trinomial

Part 2: Like Terms

Like Terms are terms that have the EXACT same

VARIABLES with the EXACT same **EXPONENTS**

These are like terms:	These are NOT like terms:
$3x^2y$ and $15x^2y$	$3x^2y$ and $3x^2y^2$

Identify the like terms in this polynomial:

$$3x^3 - 5x + 2x^3 + 3 - 1 + 4x + 12x^3 - 120$$

$3x^3, 2x^3, 12x^3$ are like terms.

$-5x, 4x$ are like terms

$3, -1, -120$ are like terms.

Identify the like terms in this polynomial:

$$5x^2y - 9xy + 6x^2y + 17.3x - 2xy + 4x^2y + 92x - 133xy$$

$5x^2y, 6x^2y, 4x^2y$ are like terms

$-9xy, -2xy, -133xy$ are like terms

$17.3x, 92x$ are like terms.

Part 3: Collecting Like Terms

*When **adding/subtracting like terms, keep the variables the same, and add/subtract only the coefficients.***

Example:

$6x + 4 + 8x + 3$

$= 6x + 8x + 4 + 3$ **Step 1:** Rearrange like terms into groups

$= 14x + 7$ **Step 2:** Add/Subtract the like terms

Practice Collecting Like Terms

1) $3x + 4x$ $= 7x$

2) $3x^2 + 5x^2 + 3$ $= 8x^2 + 3$

Practice Collecting Like Terms

3) $2b - b + 7 - 8 + 3b$

$= 2b - 1b + 3b + 7 - 8$

$= 4b - 1$

4) $3x^2 + 2 - 6x + 9x - 3x^2$

$= 3x^2 - 3x^2 - 6x + 9x + 2$

$= 0x^2 + 3x + 2$

$= 3x + 2$

5) $2x^2 - 3y^2 + xy + 2y^2 - 8x^3$

$= -8x^3 + 2x^2 + xy - 3y^2 + 2y^2$

$= -8x^3 + 2x^2 + xy - y^2$

Note: degree of terms should be in descending order (highest degree terms on the left).

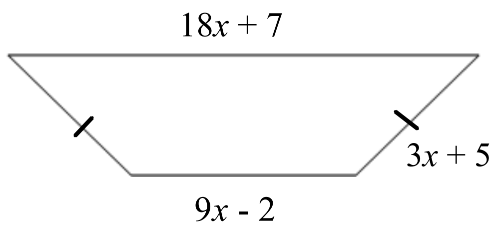
6) $a^2b + 2ab - ab^2 + 2ab^2 - 3ab + a^2b$

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

$= 2a^2b + ab^2 - ab$

7) Part 4: Apply Our Knowledge!

a) Write an expression in simplest form for the perimeter of the given shape



Perimeter $= 18x + 7 + 9x - 2 + 3x + 5 + 3x + 5$

$= 18x + 9x + 3x + 3x + 7 - 2 + 5 + 5$

$= 33x + 15$

b) Evaluate the expression if x = 5. (What is the perimeter?)

Perimeter $= 33x + 15$

$= 33(5) + 15$

$= 165 + 15$

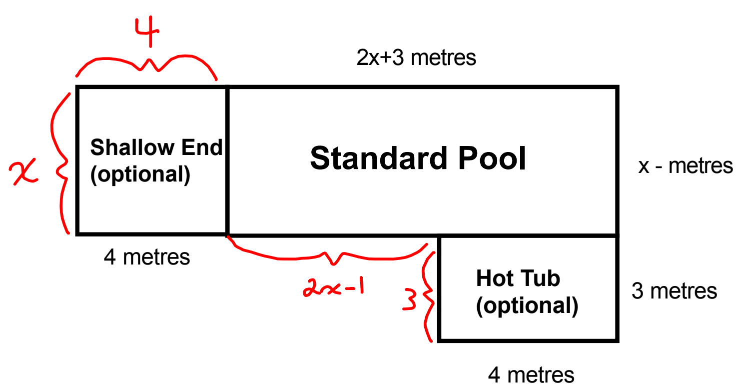
$= 180$ units.

3.6 Adding and Subtracting Polynomials

Part 1: DO IT NOW

The Cool Pool Company makes pools and uses the following diagram to calculate the perimeter of pool with different options:

Option 1* – *Bronze package *(standard pool only)*
Option 2* – *Silver package *(standard pool and shallow pool)*
Option 3* – *Gold package *(all sections of the pool are included)*



a) In your group choose either the Bronze, Silver, or Gold package and create a simplified expression for the perimeter of your pool.

BRONZE: $P = (2x+3)+(2x+3)+x+x$
$= 6x+6$

SILVER: $P = (2x+3)+(2x+3)+x+x+4+4$
$= 6x+14$

GOLD: $P = (2x+3)+x+3+4+3+(2x-1)+4+x+4$
$= 6x+20$

b) What is the perimeter of your pool if x=4

BRONZE: $P = 6(4)+6 = 30m$

SILVER: $P = 6(4)+14 = 38m$

GOLD: $P = 6(4)+20 = 44m$

Part 2: Adding Polynomials

Polynomial: an algebraic expression consisting of one or more terms connected by addition or subtraction operators

When **adding** polynomials you can simply remove the brackets and collect the like terms

Example:

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

$= 4x+3+7x+2$ **Step 1:** Remove the Brackets

$= 4x+7x+3+2$ **Step 2:** Rearrange like terms into groups

$= 11x+5$ **Step 3:** Collect the like terms

Practice Adding Polynomials

1) $(3y + 5) + (7y - 4)$

$= 3y + 5 + 7y - 4$

$= 3y + 7y + 5 - 4$

$= 10y + 1$

2) $(2p - 2) + (4p - 7)$

$= 2p - 2 + 4p - 7$

$= 2p + 4p - 2 - 7$

$= 6p - 9$

3) $(6x - 12) + (-9x - 4) + (x + 14)$

$= 6x - 12 - 9x - 4 + x + 14$

$= 6x - 9x + x - 12 - 4 + 14$

$= -2x - 2$

4) $(5x - 4y - 1) + (-2x + 5y + 13)$

$= 5x - 4y - 1 - 2x + 5y + 13$

$= 5x - 2x - 4y + 5y - 1 + 13$

$= 3x + y + 12$

Part 3: Subtracting Polynomials

To **subtract** polynomials, add the opposite polynomial (switch the signs of the terms of the polynomial being subtracted)

Example:

$(3y + 5) - (7y - 4)$

To subtract the polynomial we must add the opposite

The opposite of (7y-4) is: $-7y+4$

$\therefore (3y+5) - (7y-4) = (3y+5)+(-7y+4)$

$= 3y+5-7y+4$

$= 3y-7y+5+4$

$= -4y+9$

OR

Subtracting Polynomials

To subtract polynomials, subtract each of the terms in the second polynomial.

$$(3y + 5) - (7y - 4)$$

$$\therefore (3y+5) - (7y-4) = 3y+5-7y-(-4)$$
$$= 3y+5-7y+4$$
$$= 3y-7y+5+4$$
$$= -4y+9$$

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

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

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

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

$= -3x+1$

6) $(a^2 - 2a + 1) - (-a^2 - 2a - 5)$

$= a^2-2a+1-(-a^2)-(-2a)-(-5)$

$= a^2-2a+1+a^2+2a+5$

$= a^2+a^2-2a+2a+1+5$

$= 2a^2+6$

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

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

$= 3x+y-4z-7x-3y+2z$

$= 3x-7x+y-3y-4z+2z$

$= -4x-2y-2z$

8) $(6x - 12) - (-9x - 4) - (x + 14)$

$= 6x-12-(-9x)-(-4)-x-(+14)$

$= 6x-12+9x+4-x-14$

$= 6x+9x-x-12+4-14$

$= 14x-22$

Part 4: Apply Our Knowledge!

The Burgh Birds players get a $\$x$ bonus added to their base salary for every goal that they score during the playoffs. Here are the salaries and goals scored for the 3 highest scoring players on the Burg Birds during the playoffs last season.

Player	Base salary	Goals in playoffs last season
Bardown Jensen	$1200	18
Wayne Goal	$1300	22
Timmy Toe Drag	$900	5

a) Write and simplify an expression for each player's year end salary.

Bardown Jensen: $1200 + 18x$

Wayne-G: $1300 + 22x$

Timmy: $900 + 5x$

b) Write and simplify an expression for the total amount of money that the owner of the team will need to pay the three players at the end of the season.

Total Paid $= (1200 + 18x) + (1300 + 22x) + (900 + 5x)$

$= 45x + 3400$

c) If x = 25, what is the total amount of money that the owner will need to pay the three players at the end of the season?

Total Paid $= 45(25) + 3400$

$= \$4525$

Review of Key Concepts

- To add polynomials, remove brackets and collect like terms

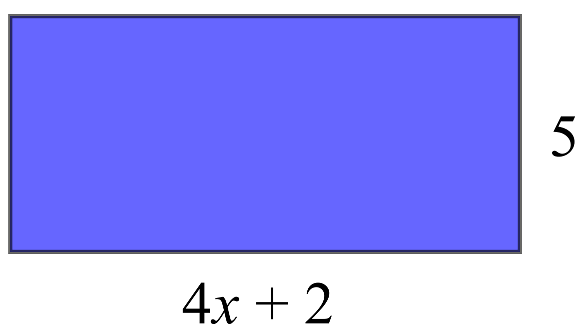
- To subtract a polynomial, add the opposite polynomial

Homework: Complete Worksheet

<u>3.7 Distributive Property</u>

<u>Part 1: DO IT NOW!</u>

Write a simplified expression for the area of the rectangle:



Remember: Area of a rectangle = length x width.

Area of the rectangle = $5(4x+2)$

Before we can simplify the expression we need to learn the distributive property!

Distributive Property

$$a(x+y) = ax + ay$$

When you apply the distributive property, you are getting rid of the brackets by multiplying everything in the brackets by the term in front of the brackets.

Example:

$$5(4x+2)$$
$$= 20x + 10$$

To apply the distributive property, I must multiply both terms in the bracket by 5.

Part 2: Multiply a Constant by a Polynomial

Expand and Simplify the Following:

1) $2(5x+3)$

$= 2(5x)+2(3)$

$= 10x+6$

2) $-2(7x-4)$

> **Note:** Make sure to include the negative sign when distributing the -2. Follow integer rules for multiplication.

$= -2(7x)-2(-4)$

$= -14x+8$

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

> **Note:** You can also apply the distributive property to trinomials.

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

$= -6x^2+15x-12$

4) $2(6m-3)+3(16+4m)$

> **Remember:** You can collect like terms! Like terms have identical variables (same letters and exponents)

$= 2(6m)+2(-3)+3(16)+3(4m)$

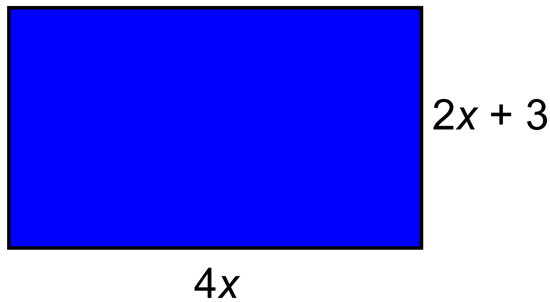
$= 12m-6+48+12m$

$= 12m+12m-6+48$

$= 24m+42$

Part 3: Apply Our Knowledge

5) Write an expression for the area of the rectangle in expanded form:



AREA $= 4x(2x+3)$

$= 4x(2x) + 4x(3)$

$= 8x^2 + 12x$

What is the area of the rectangle if $x = 5$ cm

Area $= 8x^2 + 12x$

$= 8(5)^2 + 12(5)$

$= 8(25) + 60$

$= 200 + 60$

$= 260 \text{ cm}^2$

Part 4: Distribute Variables

Example:

$x(x^2 - 3)$

$= x^3 - 3x$

Remember exponent laws:

$x(x^2) = x^{(1+2)} = x^3$

Expand and Simplify the following:

6) $x(x - 3)$

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

$= x^2 - 3x$

7) $-x(7x - 4)$

$= -x(7x) - x(-4)$

$= -7x^2 + 4x$

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

$= -6x^3 + 15x^2 - 12x$

9) $3m(m - 5) - 1(2m^2 - m)$

For this question you can multiply the second polynomial by -1 or use the properties for subtracting polynomials; both give the same result!

$= 3m^2 - 15m - 2m^2 + m$

$= m^2 - 14m$

10) $\frac{1}{2}(2w - 6) - \frac{2}{3}(9w - 6)$

$= \frac{1}{2}(2w) + \frac{1}{2}(-6) - \frac{2}{3}(9w) - \frac{2}{3}(-6)$

$= \frac{2w}{2} - \frac{6}{2} - \frac{18w}{3} + \frac{12}{3}$

$= w - 3 - 6w + 4$

$= -5w + 1$

Part 5: Nested Brackets

If there is a bracket inside of a bracket, simplify the inner most brackets first and then work your way out.

11) $3[2 + 5(2k - 1)]$

$= 3(2 + 10k - 5)$

$= 3(10k - 3)$

$= 30k - 9$