Common Factoring | MPM2D

For the next while we will be focusing on a skill called **factoring.** Factoring a polynomial is the opposite of expanding a polynomial:

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

Expand → ← Factor

Today we will be **common factoring.** We will be factoring polynomials by looking for a GCF first. Mr. Smith will walk you through some structured examples.

Examples: Factor the following polynomials by finding a GCF first

$6x + 3$	
GCF of Coefficients	3
GCF of Variable Parts	/
GCF of Polynomial	3

$= 3\left(\frac{6x}{3} + \frac{3}{3}\right)$

$= 3(2x + 1)$

$8x^2 - 7x$	
GCF of Coefficients	/
GCF of Variable Parts	x
GCF of Polynomial	x

$= x\left(\frac{8x^2}{x} - \frac{7x}{x}\right)$

$= x(8x - 7)$

$3x^2 + 12x + 9$	
GCF of Coefficients	3
GCF of Variable Parts	/
GCF of Polynomial	3

$= 3\left(\frac{3x^2}{3} + \frac{12x}{3} + \frac{9}{3}\right)$

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

$25k^6 + 15k^4$	
GCF of Coefficients	5
GCF of Variable Parts	k^4
GCF of Polynomial	$5k^4$

$= 5k^4\left(\frac{25k^6}{5k^4} + \frac{15k^4}{5k^4}\right)$

$= 5k^4(5k^2 + 3)$

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$21c^4d^3 - 28c^2d^5 + 7cd^3$		$5x^5y^3 - 7w^5z^2$	
GCF of Coefficients	7	GCF of Coefficients	/
GCF of Variable Parts	cd^3	GCF of Variable Parts	/
GCF of Polynomial	$7cd^3$	GCF of Polynomial	/
$= 7cd^3\left(\frac{21c^4d^3}{7cd^3} - \frac{28c^2d^5}{7cd^3} + \frac{7d^3}{7cd^3}\right)$ $= 7cd^3(3c^3 - 4cd^2 + 1)$		The GCF is 1, this cannot be common factored.	

Note: You can ALWAYS check that you have factored correctly by expanding and simplifying. You should get back what you started with!

For example, common factor the following expression and then check your answer at the right.

Factor $5x^2 - 10x$

$= 5x(x - 2)$

Check: $5x(x-2)$

$= 5x^2 - 10x$ ✓

Examples: Binomial common factors

Factor the following:

a) $3x(y + 1) + 7z(y + 1)$

$= (y+1)(3x + 7z)$

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

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

GCF

* Think of $(y+1)$ as the GCF and do the division mentally

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Often there is no common factor for all terms in a polynomial, but some of the terms may have a common factor. You can sometimes still factor by factoring groups of terms first, instead of factoring the entire polynomial.

Examples: Factor the following by grouping two separate ways

a) $ax + ay + 2x + 2y$

$= (ax + ay) + (2x + 2y)$

$= a(x + y) + 2(x + y)$

$= (x + y)(a + 2)$

OR

$= (ax + 2x) + (ay + 2y)$

$= x(a + 2) + y(a + 2)$

$= (a + 2)(x + y)$

b) $9x^2 + 15x + 3x + 5$

$= (9x^2 + 15x) + (3x + 5)$

$= 3x(3x + 5) + 1(3x + 5)$

$= (3x + 5)(3x + 1)$

OR

$= (15x + 5) + (9x^2 + 3x)$

$= 5(3x + 1) + 3x(3x + 1)$

$= (3x + 1)(5 + 3x)$

OR

$= (3x + 1)(3x + 5)$

You try to common factor the following:

a) $8x + 24$	$GCF = 8$
$= 8(x + 3)$	
b) $4x^5 - 8x^4 + 12x^2$	$GCF = 4x^2$
$= 4x^2(x^3 - 2x^2 + 3)$	
c) $14x^2y^3 - 35x^5y^2$	$GCF = 7x^2y^2$
$= 7x^2y^2(2y - 5x^3)$	

d) $(15x^2 + 25x) + (12x + 20)$

$= 5x(3x + 5) + 4(3x + 5)$

$= (3x + 5)(5x + 4)$