

# 8-2 Factoring by GCF

Warm Up

Lesson Presentation

Lesson Quiz

Holt McDougal Algebra 1

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Factor each polynomial. Check your answer.

1.  $8x^4 - 12x^2$

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

2.  $-12ab^3 + 20b$

$4b(-3ab^2 + 5)$

3.  $16m^2 - 2n^3 + 30m$

$2(8m^2 - n^3 + 15m)$

4.  $27j^4 - 72j^3 + 9j$

$9j(3j^3 - 8j^2 + 1)$

5.  $-5x^5 + 35x^4 - 30x^3$

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

6.  $16x^6y + 16x^2y^4 + 32x^3y^2$

$16z^2y(z^4 + y^3 + 2zy)$

## Answers to Factoring Polynomials

- |  |  |                                  |                        |
|--|--|----------------------------------|------------------------|
| 1) $5mp^4(6m^2n^2 + 5mp^3 + 5m + 1)$   | 2) $8x^2(-9x^5yz^2 + 2x^3y + 4yz^2 - 12z)$ |                                  |                        |
| 3) $7xyz(9yz^2 - 4x^3 + 12xy^2 - 6xz)$ | 4) $9p^5q^4r^2(-3p^5q - 10r^4 - 4r + 8)$   |                                  |                        |
| 5) $6(a^4 + 5b^3 + 6b^2)$              | 6) $2(7y + 5x + 9)$                        | 7) $4(7b^7 - b^2 + a)$           | 8) $8(-y^2 + 6x - 9)$  |
| 9) $5(-4k^4 - 2k^2 + 3k - 3)$          | 10) $5m^2(5m^5 + 3m^3 - 2m^2 + 2)$         | 11) $3n(5n^4 - 3n^2 + 3n + 4)$   |                        |
| 12) $x^2(2x^3 + 5x^2 - 3x + 3)$        | 13) $5x^2(2x^3 - 2x^2 + 5x - 1)$           | 14) $4a^6(-5a^5 - a^2 + 5a + 5)$ |                        |
| 15) $3(5x^2 + 2x - 4)$                 | 16) $5(4b^3 + b - 2)$                      | 17) $4n^2(4n^5 + 4n^2 + 3)$      | 18) $5(2x^3 + 5x + 3)$ |
| 19) $2(-3 + 5v + 5v^2)$                | 20) $5n(-4 + 2n - 5n^2)$                   | 21) $5k(-k + 4)$                 | 22) $4(2x + 1)$        |
| 23) $5(r + 1)$                         | 24) $n(n^6 + 2)$                           | 25) $4m^2(5m^2 + 1)$             | 26) $-4p^2(p + 1)$     |

Feb 20-7:06 AM

### 8-2 Factoring by GCF

Sometimes the GCF of terms is a binomial. This GCF is called a common binomial factor. You factor out a common binomial factor the same way you factor out a monomial factor.

$$7x + 5x$$

$$(7 + 5)x = 12x$$

$$10(k-2) + 7k(k-2)$$

$$(10+7k)(k-2)$$

$$9m^2(m+7) + 5(m+7)$$

$$(9m^2+5)(m+7)$$

Feb 20-7:18 AM

## 8-2 Factoring by GCF

### Check It Out! Example 3

Factor each expression.

a.  $4s(s + 6) - 5(s + 6)$       b.  $7x(2x + 3) + (2x + 3)$

c.  $3x(y + 4) - 2y(x + 4)$       d.  $5x(5x - 2) - 2(5x - 2)$

## 8-2 Factoring by GCF

You may be able to factor a polynomial by grouping. When a polynomial has four terms, you can make two groups and factor out the GCF from each group.

## 8-2 Factoring by GCF

### Example 4A: Factoring by Grouping

Factor each polynomial by grouping.  
Check your answer.

$$6h^4 - 4h^3 + 12h - 8$$

$$2(3h^4 - 2h^3 + 6h - 4)$$

$$(6h^4 - 4h^3) + (12h - 8)$$

Group terms that have a common number or variable as a factor.

$$2h^3(3h - 2) + 4(3h - 2)$$

Factor out the GCF of each group.

$$2h^3(3h - 2) + 4(3h - 2)$$

$(3h - 2)$  is another common factor.

$$(3h - 2)(2h^3 + 4)$$

Factor out  $(3h - 2)$ .

## 8-2 Factoring by GCF

### Example 4A Continued

Factor each polynomial by grouping.  
Check your answer.

**Check**  $(3h - 2)(2h^3 + 4)$  *Multiply to check your solution.*

$$3h(2h^3) + 3h(4) - 2(2h^3) - 2(4)$$

$$6h^4 + 12h - 4h^3 - 8$$

$$6h^4 - 4h^3 + 12h - 8$$

*The product is the original polynomial.*

## 8-2 Factoring by GCF

$$(r^2 + 6)(4r + 1)$$

### Check It Out! Example 4b

Factor each polynomial by grouping.

$$\underline{4r^3} + r^2 + 24r + \underline{6}$$

$$(4r^3 + 24r) + (r^2 + 6)$$

*Group terms.*

$$4r(r^2 + 6) + 1(r^2 + 6)$$

*Factor out the GCF of each group.*

$$4r(r^2 + 6) + 1(r^2 + 6)$$

*$(r^2 + 6)$  is a common factor.*

$$(r^2 + 6)(4r + 1)$$

*Factor out  $(r^2 + 6)$ .*

## 8-2 Factoring by GCF

### Example 4B: Factoring by Grouping

Factor each polynomial by grouping.

$$\begin{aligned} (5y^4 - 15y^3) + (y^2 - 3y) & \quad (6b^3 + 8b^2) + (9b + 12) \\ 5y^3(y-3) + y(y-3) & \quad 2b^2(3b+4) + 3(3b+4) \\ (5y^3+y)(y-3) & \quad (2b^2+3)(3b+4) \end{aligned}$$

## 8-2 Factoring by GCF

### Helpful Hint

If two quantities are opposites, their sum is 0.

$$\begin{aligned} (5 - x) + (x - 5) \\ 5 - x + x - 5 \\ -x + x + 5 - 5 \\ 0 + 0 \\ 0 \end{aligned}$$

## 8-2 Factoring by GCF

Recognizing opposite binomials can help you factor polynomials. The binomials  $(5 - x)$  and  $(x - 5)$  are opposites. Notice  $(5 - x)$  can be written as  $-1(x - 5)$ .

$$-1(x - 5) = (-1)(x) + (-1)(-5) \quad \text{Distributive Property.}$$

$$= -x + 5 \quad \text{Simplify.}$$

$$= 5 - x \quad \text{Commutative Property of Addition.}$$

$$\text{So, } -1(x - 5) = (5 - x)$$

## 8-2 Factoring by GCF

### Example 5: Factoring with Opposites

Factor  $2x^3 - 12x^2 + 18 - 3x$  by grouping.

$$(2x^3 - 12x^2) + (18 - 3x)$$

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

$$7x + 3x$$

$$10x$$

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

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

s a  
r.

## 8-2 Factoring by GCF

### Check It Out! Example 5a

Factor each polynomial by grouping.

$$(15x^2 - 10x^3) + (8x - 12)$$

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

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

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

## 8-2 Factoring by GCF

### Check It Out! Example 5b

Factor each polynomial by grouping.

$$8y - 8 - x + xy$$

$$(8y + xy) + (-8 - x)$$

$$y(8 + x) - 1(8 + x)$$

$$(y - 1)(x + 8)$$



**8-2 Factoring by GCF****Lesson Quiz: Part I**

**Factor each polynomial. Check your answer.**

1.  $16x + 20x^3$

2.  $4m^4 - 12m^2 + 8m$

**Factor each expression.**

3.  $7k(k - 3) + 4(k - 3)$

4.  $3y(2y + 3) - 5(2y + 3)$

**8-2 Factoring by GCF****Lesson Quiz: Part II**

**Factor each polynomial by grouping. Check your answer.**

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

6.  $7p^4 - 2p^3 + 63p - 18$

7. A rocket is fired vertically into the air at 40 m/s. The expression  $-5t^2 + 40t + 20$  gives the rocket's height after  $t$  seconds. Factor this expression.