

Factoring by Grouping

**Example:**  $2x^3 - 3x^2 - 8x + 12$

$$(2x^3 - 3x^2) + (-8x + 12) \quad \longleftarrow \text{Group terms that have a common factor.}$$

$$x^2(2x - 3) - 4(2x - 3) \quad \longleftarrow \text{Factor the GCF out of each group.}$$

$$(2x - 3)(x^2 - 4) \quad \longleftarrow \text{Factor out the common factor } (2x - 3).$$

$$(2x - 3)(x - 2)(x + 2) \quad \longleftarrow \text{Factor the difference of two perfect squares.}$$

**1. Factoring by Grouping**

Factor completely.

(a)  $2x(x - 6) + 5(x - 6)$

$$(x - 6)(2x + 5)$$

(b)  $(x^3 - 5x^2) + (3x - 15)$

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

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

(c)  $6x^3 - 3x^2 + 8x - 4$

$$(6x^3 - 3x^2) + (8x - 4)$$

$$3x^2(2x - 1) + 4(2x - 1)$$

$$(2x - 1)(3x^2 + 4)$$

(d)  $4x^5 - 12x^4 - 16x^3 + 48x^2$

$$4x^2[x^3 - 3x^2 - 4x + 12]$$

$$4x^2[(x^3 - 3x^2) + (-4x + 12)]$$

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

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

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

3.  $x^2(4x + 1) + 3(4x + 1)$

$$(4x + 1)(x^2 + 3)$$

**Additional Problems**

Factor.

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

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

4.  $x^3 - 3x^2 + 3x - 9$

$$(x^3 - 3x^2) + (3x - 9)$$

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

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

5.  $x^3 - 3x^2 - 3x + 9$

$$(x^3 - 3x^2) + (-3x + 9)$$

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

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

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

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

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

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

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

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

$$2(x+4)(x^2+1)$$

• IF YOU FORGET  
TO PULL A  
GCF OUT,  
PULL IT OUT  
LATER  
GCF OF 2  
IN HERE

$$10. (x^3 + x^2) + (2x + 2)$$

$$x^2(x+1) + 2(x+1)$$

$$(x+1)(x^2+2)$$

$$12. (5n^3 - 4n^2) + (25n - 20)$$

$$n^2(5n-4) + 5(5n-4)$$

$$(5n-4)(n^2+5)$$

$$14. (a^3 + 13a^2) + (3a - 65)$$

$$a^2(a+13) - 5(a+13)$$

$$(a+13)(a^2-5)$$

$$16. (z^3 - 4z^2) + (3z - 12)$$

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

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

$$18. (y^2 + y) + (5xy + 5x)$$

$$y(y+1) + 5x(y+1)$$

$$(y+1)(y+5x)$$

$$7. (x^3 - 4x^2) + (3x + 12)$$

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

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

$$9. (5y^2 + 15y) + (2y - 6)$$

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

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

$$11. (c^3 + 7c^2) + (5c + 35)$$

$$c^2(c+7) + 5(c+7)$$

$$(c+7)(c^2+5)$$

$$13. (y^3 - 9y^2) + (y - 9)$$

$$y^2(y-9) + 1(y-9)$$

$$(y-9)(y^2+1)$$

$$15. (x^2 + 8x) + (xy - 8y)$$

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

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

$$17. (2s^3 - 3s^2) + (18s - 27)$$

$$s^2(2s-3) + 9(2s-3)$$

$$(2s-3)(s^2+9)$$

$$19. (x^4 - 4x^3) + (x + 4)$$

$$x^3(x-4) - 1(x-4)$$

$$(x-4)(x^3-1)$$