Factoring by Grouping #4 pg. 1

what is the title...

1. $n^3+4n^2+3n+12$
$n^2(n+4)+3(n+4)$
$(n^2+3)(n+4)$

2. $n^3-3n^2+8n-24$
$n^2(n-3)+8(n-3)$
$(n^2+8)(n-3)$

3. $10n^3+4n^2+15n+6$
$2n^2(5n+2)+3(5n+2)$
$(2n^2+3)(5n+2)$

4. $14n^3-77n^2+8n-44$
$7n^2(2n-11)+4(2n-11)$
$(7n^2+4)(2n-11)$

5. n^3+n^2-6n-6
$n^2(n+1)-6(n+1)$
$(n^2-6)(n+1)$

6. $28n^3+8n^2-21n-6$
$4n^2(7n+2)-3(7n+2)$
$(4n^2-3)(7n+2)$

7. $90n^3-27n^2+10n-3$
$9n^2(10n-3)+1(10n-3)$
$(9n^2+1)(10n-3)$

*8. $x^3+4x^2-9x-36$
$x^2(x+4)-9(x+4)$
$(x^2-9)(x+4)$
$(x+3)(x-3)(x+4)$

*9. $x^3-16x+10x^2-160$
$x(x^2-16)+10(x^2-16)$
$(x+10)(x^2-16)$
$(x+10)(x+4)(x-4)$

10. $10x^2+16x+5xy+8y$
$2x(5x+8)+y(5x+8)$
$(2x+y)(5x+8)$

11. $12x^3-21x^2+8xy-14y$
$3x^2(4x-7)+2y(4x-7)$
$(3x^2+2y)(4x-7)$

12. $x^3 + x^2y + xy^2 + y^3$

$x^2(x+y) + y^2(x+y)$

$(x^2+y^2)(x+y)$

13. $2x^3 + 8x^2 - 15x - 60$

$2x^2(x+4) - 15(x+4)$

$(2x^2-15)(x+4)$

*14. $20x^3 + 48x^2 - 5x - 12$

$4x^2(5x+12) - 1(5x+12)$

$(4x^2-1)(5x+12)$

$(2x+1)(2x-1)(5x+12)$

#4 pg. 2

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Study Guide and Intervention

Factoring Using the Distributive Property

Factor by Using the Distributive Property The Distributive Property has been used to multiply a polynomial by a monomial. It can also be used to express a polynomial in factored form. Compare the two columns in the table below.

Multiplying	Factoring
$3(a + b) = 3a + 3b$	$3a + 3b = 3(a + b)$
$x(y - z) = xy - xz$	$xy - xz = x(y - z)$
$6y(2x + 1) = 6y(2x) + 6y(1)$ $= 12xy + 6y$	$12xy + 6y = 6y(2x) + 6y(1)$ $= 6y(2x + 1)$

Example 1 **Use the Distributive Property to factor $12mn + 80m^2$.**

Find the GCF of $12mn$ and $80m^2$.

$12mn = 2 \cdot 2 \cdot 3 \cdot m \cdot n$

$80m^2 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 5 \cdot m \cdot m$

GCF $= 2 \cdot 2 \cdot m$ or $4m$

Write each term as the product of the GCF and its remaining factors.

$12mn + 80m^2 = 4m(3 \cdot n) + 4m(2 \cdot 2 \cdot 5 \cdot m)$
$= 4m(3n) + 4m(20m)$
$= 4m(3n + 20m)$

Thus $12mn + 80m^2 = 4m(3n + 20m)$.

Example 2 **Factor $6ax + 3ay + 2bx + by$ by grouping.**

$6ax + 3ay + 2bx + by$
$= (6ax + 3ay) + (2bx + by)$
$= 3a(2x + y) + b(2x + y)$
$= (3a + b)(2x + y)$

Check using the FOIL method.

$(3a + b)(2x + y)$
$= 3a(2x) + (3a)(y) + (b)(2x) + (b)(y)$
$= 6ax + 3ay + 2bx + by$ ✓

Exercises

Factor each polynomial.

1. $24x + 48y$ — $24(x + 2y)$
2. $30mn^2 + m^2n - 6n$ — $n(30mn + m^2 - 6)$
3. $q^4 - 18q^3 + 22q$ — $q(q^3 - 18q^2 + 22)$
4. $9x^2 - 3x$ — $3x(3x - 1)$
5. $4n + 6n - 8mn$ — $2(2m + 3n - 4mn)$
6. $45s^3 - 15s^2$ — $15s^2(3s - 1)$
7. $14c^3 - 42c^5 - 49c^4$ — $7c^3(2 - 6c^2 - 7c)$
8. $55p^2 - 11p^4 + 44p^5$ — $11p^2(5 - p^2 + 4p^3)$
9. $14y^3 - 28y^2 + y$ — $y(14y^2 - 28y + 1)$
10. $4x + 12x^2 + 16x^3$ — $4x(1 + 3x + 4x^2)$
11. $4a^2b + 28ab^2 + 7ab$ — $ab(4a + 28b + 7)$
12. $6y + 12x - 8z$ — $2(3y + 6x - 4z)$
13. $x^2 + 2x + x + 2$ — $(x + 1)(x + 2)$
14. $6y^2 - 4y + 3y - 2$ — $(2y + 1)(3y - 2)$
15. $4m^2 + 4mn + 3mn + 3n^2$ — $(4m + 3n)(m + n)$
16. $12ax + 3xz + 4ay + yz$ — $(3x + y)(4a + z)$
17. $12a^2 + 3a - 8a - 2$ — $(4a + 1)(3a - 2)$
18. $xa + ya + x + y$ — $(x + y)(a + 1)$

Lesson 9-2

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Study Guide and Intervention (continued)

Factoring Using the Distributive Property

Solve Equations by Factoring The following property, along with factoring, can be used to solve certain equations.

Zero Product Property	For any real numbers a and b, if $ab = 0$, then either $a = 0$, $b = 0$, or both a and b equal 0.

Example **Solve $9x^2 + x = 0$. Then check the solutions.**

Write the equation so that it is of the form $ab = 0$.

$9x^2 + x = 0$ — Original equation
$x(9x + 1) = 0$ — Factor the GCF of $9x^2 + x$, which is x.
$x = 0$ or $9x + 1 = 0$ — Zero Product Property
$x = 0$ $\quad x = -\frac{1}{9}$ — Solve each equation.

The solution set is $\left\{0, -\frac{1}{9}\right\}$.

CHECK Substitute 0 and $-\frac{1}{9}$ for x in the original equation.

$9x^2 + x = 0$ $\qquad$ $9x^2 + x = 0$
$9(0)^2 + 0 = 0$ $\qquad$ $9\left(-\frac{1}{9}\right)^2 + \left(-\frac{1}{9}\right) = 0$
$0 = 0$ ✓ $\qquad$ $\frac{1}{9} + \left(-\frac{1}{9}\right) = 0$
$0 = 0$ ✓

Exercises

Solve each equation. Check your solutions.

1. $x(x + 3) = 0$ — $\{0, -3\}$
2. $3m(m - 4) = 0$ — $\{0, 4\}$
3. $(r - 3)(r + 2) = 0$ — $\{-2, 3\}$
4. $3x(2x - 1) = 0$ — $\left\{0, \frac{1}{2}\right\}$
5. $(4m + 8)(m - 3) = 0$ — $\{-2, 3\}$
6. $5s^2 = 25s$ — $\{0, 5\}$
7. $(4c + 2)(2c - 7) = 0$ — $\left\{-\frac{1}{2}, \frac{7}{2}\right\}$
8. $5p - 15p^2 = 0$ — $\left\{0, \frac{1}{3}\right\}$
9. $4y^2 = 28y$ — $\{0, 7\}$
10. $12x^2 = -6x$ — $\left\{-\frac{1}{2}, 0\right\}$
11. $(4a + 3)(8a + 7) = 0$ — $\left\{-\frac{7}{8}, -\frac{3}{4}\right\}$
12. $8y = 12y^2$ — $\left\{0, \frac{2}{3}\right\}$
13. $x^2 = -2x$ — $\{-2, 0\}$
14. $(6y - 4)(y + 3) = 0$ — $\left\{-3, \frac{2}{3}\right\}$
15. $4m^2 = 4m$ — $\{0, 1\}$
16. $12x = 3x^2$ — $\{0, 4\}$
17. $12a^2 = -3a$ — $\left\{-\frac{1}{4}, 0\right\}$
18. $(12a + 4)(3a - 1) = 0$ — $\left\{-\frac{1}{3}, \frac{1}{3}\right\}$