7.4 Solving Polynomials in Factored Form

Learning Target:

- I can solve a quadratic equation.

Success Criteria:

- I can use the Zero-Product Property.
- I can factor polynomials using the GCF.
- I can use the Zero-Product Property to solve real-life problems.

I can use the zero- product property.

A polynomial is in factored form when it is written as a product of factors

Standard Form	Factored Form
$2x^2+5x+2$	$(x+2)(2x+1)$

*Use the Zero-Product Property when: one side of equation is in factored form (parentheses) + other side is equal to 0.

The solutions of a polynomial equation are called: roots.

Examples: Solve each equation.

1) $3x(x - 6) = 0$

$\frac{\cancel{3}x}{\cancel{3}} = \frac{0}{3}$ $\boxed{x=0}$

$x - \cancel{6} = 0$, $+\cancel{6}\ +6$ $\boxed{x=6}$

2) $(x + 5)(x - 4) = 0$

$x + \cancel{5} = 0$, $-\cancel{5}\ -5$ $\boxed{x=-5}$

$x - \cancel{4} = 0$, $+\cancel{4}\ +4$ $\boxed{x=4}$

You-Try: Solve each equation.

1) $x(x - 1) = 0$

$\boxed{x=0}$

$x - \cancel{1} = 0$, $+\cancel{1}\ +1$ $\boxed{x=1}$

2) $(z - 6)(z - 8) = 0$

$z - \cancel{6} = 0$, $+\cancel{6}\ +6$ $\boxed{z=6}$

$z - \cancel{8} = 0$, $+\cancel{8}\ +8$ $\boxed{z=8}$

7.4 Solving Polynomials in Factored Form

When two or more roots of an equation are the same number, the equation has repeated roots.

Examples: Solve each equation.

1) $(4x + 5)(4x - 5) = 0$

$4x+\cancel{5}=0$ $4x-\cancel{5}=0$

$-\cancel{5}\ -5$ $+\cancel{5}\ +5$

$\frac{4x}{4}=\frac{-5}{4}$ $\frac{\cancel{4}x}{\cancel{4}}=\frac{5}{4}$

$\boxed{x=-1.25}$ $\boxed{x=1.25}$

2) $(c + 6)^2 = 0$

$(c+6)(c+6)=0$

$c+\cancel{6}=0$ $c+6=0$

$-\cancel{6}\ -6$ $-6\ -6$

$\boxed{c=-6}$ $c=-6$

repeated roots

You-Try: Solve each equation.

1) $(a + 5)(a - 2)(a - 7) = 0$

$a+\cancel{5}=0$ $a-\cancel{2}=0$ $a-\cancel{7}=0$

$-\cancel{5}\ -5$ $+\cancel{2}\ +2$ $+\cancel{7}\ +7$

$\boxed{a=-5}$ $\boxed{a=2}$ $\boxed{a=7}$

2) $(b+3)^3 = 0$

$(b+3)(b+3)(b+3)=0$

$b+\cancel{3}=0$

$-\cancel{3}\ -3$

$\boxed{b=-3}$ repeated root

I can factor polynomials equations using the GCF.

To solve a polynomial equation using the Zero-Product Property, you may need to Factor the polynomial, or write it as a product of polynomials. Look for the GCF or greatest common factor of the terms of the polynomial. (This is a monomial that divides evenly into each term.)

reverse distributive

*Review: Greatest Common Factor = highest # they can be divided by & variables in common

What is the greatest number that you can divide each set of terms by?

1) 8, 4, 48

$\boxed{4}$

2) 3, 9, 54

$\boxed{3}$

3) 4, 3, 16

$\boxed{1}$

4) x, x^2

$\boxed{x}$

5) $2x, 8x^2, 12x^3$

$\boxed{2x}$

6) x^5, x^3, x^2

$\boxed{x^2}$

List the greatest common factor of the following terms:

1) $8x + 16$

$8(x+2)$

2) $x + x^2$

$x(1+x)$

3) $4x^3 + 8x^2 + 16x$

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

7.4 Solving Polynomials in Factored Form

Examples: Solve the following equations by factoring out the GCF.

1) $4x^2 + 12x = 0$

$4x(x+3)=0$

$\frac{\cancel{4}x}{\cancel{4}}=\frac{0}{4}$ $\quad x+\cancel{3}=0$, $\cancel{-3}\ -3$

$\boxed{x=0}$ $\quad \boxed{x=-3}$

2) $-1\cancel{0}a^2 = 8a$

$+\cancel{10}a^2 \quad +10a^2$

$10a^2+8a=0$

$2a(5a+4)=0$

$\frac{2a}{2}=\frac{0}{2}$ $\quad 5a+4=0$

$5a=-4$

$\boxed{a=0}$ $\quad \boxed{a=-0.8}$

3) $10x^3 = 15x^2$

$-15x^2 \ -1\cancel{5}x^2$

$10x^3-15x^2=0$

$5x^2(2x-3)=0$

$5x^2=0$ $\quad 2x-3=0$

$x^2=0$ $\quad 2x=3$

$x=\sqrt{0}$ $\quad \boxed{x=1.5}$

$\boxed{x=0}$

You-Try: Solve the following equations.

2) $a^2 + 7a = 0$

$a(a+7)=0$

$\boxed{a=0}$ $\quad a+\cancel{7}=0$, $\cancel{-7}\ -7$

$\boxed{a=-7}$

2) $3s^2 - 9s = 0$

$3s(s-3)=0$

$\frac{\cancel{3}s}{\cancel{3}}=\frac{0}{3}$ $\quad s-\cancel{3}=0$, $\cancel{+3}\ +3$

$\boxed{s=0}$ $\quad \boxed{s=3}$

3) $4x^2 = 2x$

$-2x \ -\cancel{2x}$

$4x^2-2x=0$

$2x(2x-1)=0$

$\frac{\cancel{2}x}{\cancel{2}}=\frac{0}{2}$ $\quad 2x-1=0$

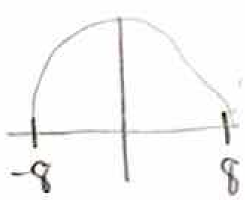
$2x=1$

$\boxed{x=0}$ $\quad \boxed{x=0.5}$

__I can use the zero-product property to solve real-life problems.__

You can model the arch of an entrance to a train tunnel by using the equation $y = -\frac{5}{16}(x+8)(x-8)$, where x and y are measured in feet. The x-axis represents the ground. Find the width of the entrance at ground level.

$0=-\frac{5}{16}(x+8)(x-8)$



$x+\cancel{8}=0$ $\quad x-\cancel{8}=0$

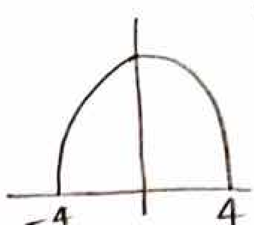
$\cancel{-8}\ -8$ $\quad \cancel{+8}\ +8$

$x=-8$ $\quad x=8$

$\boxed{16\text{ ft}}$

You-Try: You can model the entrance to a mine shaft using the equation $y = -\frac{1}{2}(x+4)(x-4)$, where x and y are measured in feet. The x-axis represents the ground. Find the width of the entrance at ground level.

$0=-\frac{1}{2}(x+4)(x-4)$



$x+4=0$ $\quad x-4=0$

$x=-4$ $\quad x=4$

$\boxed{8\text{ ft}}$

__Closure:__ What I learned today was…

7.5 Factoring $x^2 + bx + c = 0$

Learning Target:

- I can solve a quadratic equation.

Success Criteria:

- I can factor $x^2 + bx + c$.
- I can use factoring to solve real-life problems.

p= ← product (mult.)
ac
b
s= ↑ sum (add)

pack for Spring break

I can factor $ax^2 + bx + c$.

Writing a polynomial as a product of factors is called factoring.

To factor $ax^2 + bx + c$, you need to find p and q such that $p+q=b$ $\quad p \cdot q = c$.
$(x+p)(x+q)$

Before you can factor an equation, the equation must be equal to 0.

Factoring $x^2 + bx + c$, when b and c are positive

Example: Factor each polynomial.

1) $x^2 + 10x + 16$

$a=1 \quad b=10 \quad c=16$

16, 8, 2, 10

$\boxed{(x+8)(x+2)}$

2) $x^2 + 7x + 6 = 0$

$a=1 \quad b=7 \quad c=6$

6, 6, 1, 7

$(x+6)(x+1)=0$

$x+\cancel{6}=0 \quad x+1=0$
$\cancel{-6} \; -6 \quad -1 \; -1$

$\boxed{x=-6} \quad \boxed{x=-1}$

You-Try: Factor the polynomials.

1) $x^2 + 9x + 8 = 0$

$a=1 \quad b=9 \quad c=8$

8, 8, 1, 9

$(x+8)(x+1)=0$

$x+\cancel{8}=0 \quad x+1=0$
$\cancel{-8} \; -8 \quad -1 \; -1$

$\boxed{x=-8} \quad \boxed{x=-1}$

2) $x^2 + 9x + 14$

$a=1 \quad b=9 \quad c=14$

14, 7, 2, 9

$\boxed{(x+7)(x+2)}$

7.5 Factoring $x^2 + bx + c = 0$

$y_1 = ac/X$

$y_2 = ac/X + X$

always top #

Table → last column for b

Factoring $x^2 + bx + c$ when b is negative and c is positive

Example: Factor the polynomial.

1) $x^2 - 8x + 12 = 0$

$a=1 \quad b=-8 \quad c=12$

12
-6 -2
-8

$(X-6)(X-2)=0$

$X-6=0 \quad X-2=0$

$\boxed{X=6} \quad \boxed{X=2}$

2) $x^2 - 13x = -36$

$+36 \quad +36$

$X^2-13X+36=0$

$a=1 \quad b=-13 \quad c=36$

36
-9 -4
-13

$(X-9)(X-4)=0$

$X-9=0 \quad X-4=0$

$\boxed{X=9} \quad \boxed{X=4}$

You-Try: Factor each polynomial.

1) $x^2 + 35 = 12x$

$-12X \quad -12x$

$X^2-12X+35=0$

$a=1 \quad b=-12 \quad c=35$

35
-7 -5
-12

$(X-7)(X-5)=0$

$X-7=0 \quad X-5=0$

$\boxed{X=7} \quad \boxed{X=5}$

2) $x^2 - 14x + 36 = 12$

$-12 \quad -12$

$X^2-14X+24=0$

$a=1 \quad b=-14 \quad c=24$

24
-12 -2
-14

$(X-12)(X-2)=0$

$X-12=0 \quad X-2=0$

$\boxed{X=12} \quad \boxed{X=2}$

Factoring $x^2 + bx + c$ when c is negative

Example: Factor the polynomial.

1) $4x - 21 = -x^2$

$+x^2 \quad +x^2$

$X^2+4X-21=0$

$a=1 \quad b=4 \quad c=-21$

-21
7 -3
4

$(X+7)(X-3)=0$

$X+7=0 \quad X-3=0$

$\boxed{X=-7} \quad \boxed{X=3}$

You-Try: Factor each polynomial.

1) $x^2 + 2x - 15 = 0$ $\quad a=1 \quad b=2 \quad c=-15$

-15
5 -3
2

$(X+5)(X-3)=0$

$X+5=0 \quad X-3=0$

$\boxed{X=-5} \quad \boxed{X=3}$

2) $x^2 - x = 42$

$-42 \quad -42$

$X^2-X-42=0$ $\quad a=1 \quad b=-1 \quad c=-42$

-42
-7 6
-1

$(X-7)(X+6)=0$

$X-7=0 \quad X+6=0$

$\boxed{X=7} \quad \boxed{X=-6}$

7.5 Factoring $x^2 + bx + c = 0$

Factoring out the GCF

This should always be considered first when trying to factor any polynomial - it will only become easier.

Example: Factoring out the GCF first, then factor.

1) $5x^2 + 15x = -10$

$+10 \quad +10$

$5x^2+15x+10=0$

$5(x^2+3x+2)=0$ $\quad a=1 \quad b=3 \quad c=2$

$5(x+2)(x+1)=0$

2 1 2 3

$x+2=0 \qquad x+1=0$

$\boxed{x=-2} \qquad \boxed{x=-1}$

You-Try: Factor each polynomial.

1) $4x^2 + 32x + 60 = 0$ $\quad a=1 \quad b=8 \quad c=15$

$4(x^2+8x+15)=0$

15 5 3 8

$4(x+5)(x+3)=0$

$x+5=0 \qquad x+3=0$

$\boxed{x=-5} \qquad \boxed{x=-3}$

2) $3x^2 + 81 = 36x$ $\quad a=1 \quad b=-12 \quad c=27$

$-36x \quad -36x$

27 -9 -3 -12

$3x^2-36x+81=0$

$3(x^2-12x+27)=0$

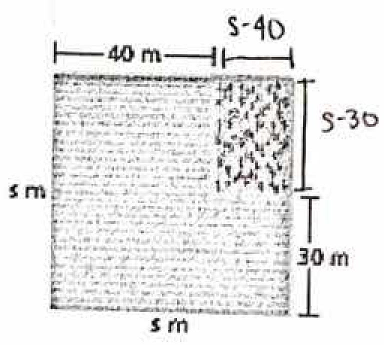
$3(x-9)(x-3)=0$

$x-9=0 \qquad x-3=0$

$\boxed{x=9} \qquad \boxed{x=3}$

I can use factoring to solve real-life problems.

A farmer wants a rectangular pumpkin patch in the northeast corner of a square plot of land. The area of the pumpkin patch is 600 square meters. What is the area of the square plot of land?



$(s-40)(s-30)=600$

$s^2-30s-40s+1200=600$

$s^2-70s+1200=600$

$-600 \quad -600$ $\qquad a=1 \quad b=-70 \quad c=600$

$s^2-70s+600=0$

600 -60 -10 -70

$(s-60)(s-10)=0$

$s-60=0 \qquad s-10=0$

$s=60 \qquad \cancel{s=10}$

Area $= 60 \cdot 60$

$= \boxed{3600 \text{ m}^2}$

7.6 Factoring $ax^2 + bx + c = 0$

Learning Target:

- I can solve a quadratic equation.

Success Criteria:

- I can factor $ax^2 + bx + c$.
- I can use factoring to solve real-life problems.

ac

b

Factoring $ax^2 + bx + c$, when ac is Positive Check for GCF first

Example: Factor each polynomial.

1) $4x^2 + 13x + 3 = 0$ $a=4$ $b=13$ $c=3$

12, 12, 1, 13

$(\frac{4x}{4} + \frac{12}{4})(4x+1)=0$

$(x+3)(4x+1)=0$

$x+3=0$ $4x+1=0$

$\boxed{x=-3}$ $4x=-1$ $\boxed{x=-0.25}$

2) $9x^2 - 21x = -6$
$+6$ $+6$

$a=3$ $b=-7$ $c=2$

6, -6, -1, -7

$9x^2-21x+6=0$

$3(3x^2-7x+2)=0$

$3(\frac{3x}{3}-\frac{6}{3})(3x-1)=0$

$3(x-2)(3x-1)=0$

$x-2=0$ $3x-1=0$

$\boxed{x=2}$ $3x=1$

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

You-Try: Factor the polynomials.

1) $4x^2 + 12 = -14x$
$+14x$ $+14x$

$a=2$ $b=7$ $c=6$

12, 4, 3, 7

$4x^2+14x+12=0$

$2(2x^2+7x+6)=0$

$2(\frac{2x}{2}+\frac{4}{2})(2x+3)=0$

$2(x+2)(2x+3)=0$

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

$\boxed{x=-2}$ $2x=-3$ $\boxed{x=-1.5}$

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

$0=4x^2-7x+3$ $a=4$ $b=-7$ $c=3$

12, -4, -3, -7

$0=(\frac{4x}{4}-\frac{4}{4})(4x-3)$

$0=(x-1)(4x-3)$

$x-1=0$ $4x-3=0$

$\boxed{x=1}$ $4x=3$

$\boxed{x=\frac{3}{4}}$

Factoring $ax^2 + bx + c$ when ac is Negative

Example: Factor the polynomial. $a=2$ $b=-5$ $c=-7$

1) $2x^2 - 5x - 7$

-14, -7, 2, -5

$(2x-7)(\frac{2x}{2}+\frac{2}{2})$

$\boxed{(2x-7)(x+1)}$

7.6 Factoring $ax^2 + bx + c = 0$

Factoring $ax^2 + bx + c$ when a is Negative

Example: Factor the polynomial.

1) $-4x^2 - 8x = -\cancel{5}$

$+5 \quad +\cancel{5}$

$-4x^2 - 8x + 5 = 0$

-20; $+10$, -2; $+8$

$-1(4x^2 + 8x - 5) = 0$

$-1\left(\frac{4x}{2} + \frac{10}{2}\right)\left(\frac{4x}{2} - \frac{2}{2}\right) = 0$

$-1(2x+5)(2x-1) = 0$

$2x + 5 = 0 \qquad 2x - 1 = 0$

$2x = -5 \qquad 2x = 1$

$\boxed{x = \frac{-5}{2}} \qquad \boxed{x = \frac{1}{2}}$

You-Try: Factor each polynomial.

1) $-2y^2 - 5y - 3$ $\quad a=2 \quad b=5 \quad c=3$

$-1(2y^2 + 5y + 3)$

6; 2, 3; 5

$-1\left(\frac{2y}{\cancel{2}} + \frac{2}{2}\right)(2y+3)$

$\boxed{-1(y+1)(2y+3)}$

2) $31x + 15 = -14x^2$

$+14x^2 \qquad +14x^2$

$14x^2 + 31x + 15 = 0$

210; 10, 21; 31

$\left(\frac{14x}{7} + \frac{21}{7}\right)\left(\frac{14x}{2} + \frac{10}{2}\right) = 0$

$(2x+3)(7x+5) = 0$

$2x + 3 = 0 \qquad 7x + 5 = 0$

$2x = -3 \qquad 7x = -5$

$\boxed{x = \frac{-3}{2}} \qquad \boxed{x = \frac{-5}{7}}$

3) $2x^2 + 5 = 7\cancel{x}$ $\quad a=2 \quad b=-7 \quad c=5$

$-7x \quad -\cancel{7x}$

$2x^2 - 7x + 5 = 0$

10; -5, -2; -7

$(2x-5)\left(\frac{2x}{2} - \frac{2}{2}\right) = 0$

$(2x-5)(x-1) = 0$

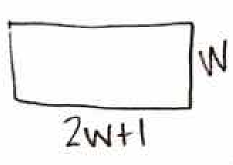
$2x - 5 = 0 \qquad x - 1 = 0$

$2x = 5 \qquad \boxed{x = 1}$

$\boxed{x = \frac{5}{2}}$

I can use factoring to solve real-life problems.

The length of a rectangular game reserve is 1 mile longer than twice the width. The area of the reserve is 55 square miles. What is the width of the reserve?



$w(2w+1) = 55$

$2w^2 + w = 55$

$2w^2 + w - 55 = 0$

-110; 11, -10; 1

$(2w+11)\left(\frac{2w}{2} - \frac{10}{2}\right) = 0$

$(2w+11)(w-5) = 0$

$2w + 11 = 0 \qquad w - 5 = 0$

$2w = -11 \qquad \boxed{w = 5}$

~~$w = -5.5$~~

7.7 Factoring Special Products

Learning Target:

- I can solve a quadratic equation.

Success Criteria:

- I can factor the difference of two squares.
- I can factor perfect square trinomials.
- I can use factoring to solve real-life problems.

I can factor the difference of two squares.

$x^2 - 81$

$x^2 + 0x - 81$

$(x+9)(x-9)$

-81; 9, -9; 0

Difference of Two Squares Pattern:

$$\boxed{a^2 - b^2 = (a-b)(a+b)}$$

Example: Factor the polynomials.

1) $x^2 - 64$

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

2) $25b^2 - 36$

$(5b-6)(5b+6)$

You-Try: Factor the polynomial.

1) $100 - m^2$

$(10-m)(10+m)$

2) $16b^2 - 49$

$(4b-7)(4b+7)$

I can factor perfect square trinomials.

$x^2 + 6x + 9$

$(x+3)(x+3)$

$(x+3)^2$

9; 3, 3; 6

Perfect Square Trinomial Pattern

$$\boxed{x^2 + 2ax + a^2 = (x+a)^2}$$

$$\boxed{x^2 - 2ax + a^2 = (x-a)^2}$$

7.7 Factoring Special Products

Example: Factor each polynomial.

1) $n^2 + 8n + 16$

$\boxed{(n+4)^2}$

2) $4x^2 - 12x + 9$

$\boxed{(2x-3)^2}$

You-Try: Factor each polynomial.

1) $m^2 - 2m + 1$

$\boxed{(m-1)^2}$

2) $9z^2 + 36z + 36$

$\boxed{(3z+6)^2}$

Solving a Polynomial Equation

Example: Solve the polynomial equation.

1) $x^2 + 3x + \frac{9}{4} = 0$

$\left(x+\frac{3}{2}\right)^2 = 0$

$x + \frac{3}{2} = 0$ $\boxed{x = -\frac{3}{2}}$

2) $n^2 - 81 = 0$

$(n-9)(n+9) = 0$

$\boxed{n=9}$ $\boxed{n=-9}$

You-Try: Solve the polynomial equation.

1) $a^2 + 6a + 9 = 0$

$(a+3)(a+3) = 0$

$\boxed{a=3}$

7.7 Factoring Special Products

<u>**I can use factoring to solve real-life problems.**</u>

A bird picks up a golf ball and drops it while flying. The function represents the height y (in feet) of the golf ball t seconds after it is dropped. The ball hits the top of a 32-foot-tall pine tree. After how many seconds does the ball hit the tree?

$y = 81 - 16t^2$

$$\cancel{32} = 81 - 16t^2$$
$$\cancel{-32} \quad -32$$
$$0 = 49 - 16t^2$$
$$0 = (7-4t)(7+4t)$$
$$7-4t=0 \qquad 7+4t=0$$
$$-4t=-7 \qquad 4t=-7$$
$$\boxed{t=1.75} \qquad \cancel{t=-1.75}$$

You-Try: What if the golf ball does not hit the pine tree. After how many seconds does the ball hit the ground?

$$0=81-16t^2$$
$$0=(9-4t)(9+4t)$$
$$0=9-4t \qquad 0=9+4t$$
$$-9=-4t \qquad -9=4t$$
$$\boxed{t=2.25} \qquad \cancel{t=-2.25}$$

7.8 Factoring Polynomials Completely

Learning Target:

- I can solve a quadratic equation.

Success Criteria:

- I can factor polynomials by grouping.
- I can factor polynomials completely.
- I can use factoring to solve real-life problems.

I can factor polynomials by grouping.

Used for polynomials with four terms. Factor the GCF out of each pair of terms.
Look for and factor out the common binomial factor.

Example: Factor each polynomial by grouping.

1) $[x^3 + 3x^2][+ 2x + 6]$

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

$\boxed{(x^2+2)(x+3)}$

2) $[4x^3 - 16x^2][- 8x + 32]$

$4x^2(x-4)-8(x-4)$

$\boxed{(4x^2-8)(x-4)}$

You-Try: Factor each polynomial by grouping.

1) $[a^3 + 3a^2][- a - 3]$

$a^2(a+3)-1(a+3)$

$\boxed{(a^2-1)(a+3)}$

2) $[y^2 + yx][+ 2y + 2x]$

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

$\boxed{(y+2)(y+x)}$

7.8 Factoring Polynomials Completely

I can factor polynomials completely.

4 specific guidelines for Factoring polynomials completely:

1. Factor out GCF	$3x^2+6x \rightarrow 3x(x+2)$
2. Look for patterns (Difference of squares OR perfect square)	$x^2-9 \rightarrow (x-3)(x+3)$ OR (x^2-6x+9) $(x-3)^2$
3. Factor with ax^2+bx+c $\overset{ac}{\underset{b}{\times}}$	$3x^2-5x-2$ $\overset{-6}{\underset{-5}{\times}}$ $-6, 1$ $(3x-6)(3x+1)$ $(x-2)(3x+1)$
4. Factor by grouping (4 terms)	$x^3-4x^2+x-4 = x^2(x-4)+1(x-4)$ $(x^2+1)(x-4)$

Example: Factor completely.

1) $3x^3 + 6x^2 - 18x$

$\boxed{3x(x^2+2x-6)}$ $\overset{-6}{\underset{2}{\times}}$

nothing multiplies to -6 and adds to 2 so completely factored

2) $7x^4 - 28x^2$

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

$\boxed{7x^2(x-2)(x+2)}$

You-Try: Factor completely.

1) $2x^3 + 6x^2 - 2x$

$\boxed{2x(x^2+3x-1)}$ $\overset{-1}{\underset{3}{\times}}$

2) $5x^4 - 45x^2$

$5x^2(x^2-9)$

$\boxed{5x^2(x-3)(x+3)}$

7.8 Factoring Polynomials Completely

Solving an Equation by Factoring Completely

Example: Solve Completely.

1) $2x^3 + 8x^2 = 10x$

$-10x \quad -10x$

$2x^3 + 8x^2 - 10x = 0$

$2x(x^2 + 4x - 5) = 0$ $\quad -5 \;\; 5 \;\; -1 \;\; 4$

$2x(x+5)(x-1) = 0$

$2x = 0 \quad x+5=0 \quad x-1=0$

$\boxed{x=0} \quad \boxed{x=-5} \quad \boxed{x=1}$

2) $3x^3 + 6x^2 = 24x$

$-24x \quad -24x$

$3x^3 + 6x^2 - 24x = 0$ $\quad -8 \;\; 4 \;\; -2 \;\; 2$

$3x(x^2 + 2x - 8) = 0$

$3x(x+4)(x-2) = 0$

$3x = 0 \quad x+4=0 \quad x-2=0$

$\boxed{x=0} \quad \boxed{x=-4} \quad \boxed{x=2}$

You-Try: Solve Completely.

1) $w^3 - 8w^2 + 16w = 0$

$w(w^2 - 8w + 16) = 0$

$w(w-4)(w-4) = 0$

$\boxed{w=0} \quad \boxed{w=4}$

2) $c^3 - 7c^2 = -12c$

$+12c \quad +12c$

$c^3 - 7c^2 + 12c = 0$ $\quad 12 \;\; -4 \;\; -3 \;\; -7$

$c(c^2 - 7c + 12) = 0$

$c(c-4)(c-3) = 0$

$\boxed{c=0} \quad c-4=0 \quad c-3=0$

$\boxed{c=4} \quad \boxed{c=3}$