# *Factoring and Applications Lesson #6:*
## *Solving Quadratic Equations Using Factoring*

In this lesson, we introduce an application of factoring, namely the solution to polynomial equations and in particular, quadratic equations. Some students may have covered this lesson as an enrichment in the *Foundations of Mathematics and Pre-Calculus Grade 10 Book*.

### *Investigating the Zero Product Law*

Complete the following:

- The statement $x - 3 = 0$ is true only if $x =$ ______.
- The statement $x + 1 = 0$ is true only if $x =$ ______.
- The statement $(x - 3)(x + 1) = 0$ is true if $x =$ ______ or if $x =$ ______.
- The statement $x(x + 1) = 0$ is true if ______________________.

### *The Zero Product Law*

The last two statements in the investigation above are examples of what is called The Zero Product Law which states the following:

If the **product** of multiple factors is **equal to zero**,
then at least **one of the factors must be equal zero**.

- Complete. If $a \times b = 0$, then $a =$ _____ or $b =$ _____ .

- Complete the following by solving for $x$ in each equation:

**a)** $8x = 0$ **b)** $8(x + 2)(x - 7) = 0$ **c)** $x(x + 2)(x - 7) = 0$ **d)** $(2x + 1)(3x - 2) = 0$

a) $x = 0$

b) $x = -2$ $x = 7$

c) $x = 0, -2, 7$

d) $2x + 1 = 0$, $2x = -1$, $\frac{2x}{2} = \frac{-1}{2}$, $x = -\frac{1}{2}$ ; $3x - 2 = 0$, $3x = 2$, $\frac{3x}{3} = \frac{2}{3}$, $x = \frac{2}{3}$

roots, zeros or x-intercepts

**e)** Why is it acceptable to divide by 8 first in (a) and (b)?

**f)** Why is it **not** acceptable to divide by $x$ first in (c)?

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All the above equations are polynomial equations in which one side is a polynomial expression and the **other side equals zero**.

The **solution** to a polynomial equation is given by stating the value(s) of the variable which make(s) the left side and the right side equal. These values are said to **satisfy** the equation.

We can use the Zero Product Law to solve polynomial equations of various types.
In this lesson, we will focus on quadratic equations using factoring and the zero product law.

## *Solving Quadratic Equations*

Consider the equation $x^2 - 2x - 3 = 0$. Factoring the left side leads to $(x-3)(x+1) = 0$. This is true if $x = 3$ or if $x = -1$. Since the equation is satisfied by both $x = 3$ and $x = -1$, the solutions to the equation are $x = 3$ **and** $x = -1$, sometimes written as $x = -1, 3$.

*Class Ex. #1*

Complete the solution to the equation $x^2 - 9x + 20 = 0$.

$x^2 - 9x + 20 = 0$

$(x - \quad)(x - \quad) = 0$

$x - \quad = 0$ or $x - \quad = 0$ The solutions are $x =$ ____ and $x =$ ______

$x =$ ____ or $x =$ ______ or $x =$ ___ , ___

*Class Ex. #2*

Solve the equation by using the Zero Product Law.

**a)** $x^2 - 81 = 0$ **b)** $4x^2 - 9 = 0$ **c)** $10x^2 - 90x = 0$ **d)** $10x^2 - 90 = 0$

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

$\boxed{x = \pm 9}$

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

$\boxed{x = \pm \frac{3}{2}}$

$10x(x-9)=0$

$\boxed{x = 0, 9}$

$10(x^2-9)=0$

$10(x+3)(x-3)=0$

$\boxed{x = \pm 3}$

$ax^2+bx+c=0$

*always zero the equation

*Class Ex. #3*

Solve the equation.

**a)** $\underbrace{3x^2 - 13x - 10}_{-30} = 0$ $(-15, 2)$

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

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

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

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

**b)** $5x^2 + 30x = -25$

$5x^2 + 30x + 25 = 0$

$5(x^2 + 6x + 5) = 0$

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

$\boxed{x = -5, -1}$

**Complete Assignment Questions #1 - #4**

$\boxed{\#1-4}$

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