Functions and Applications

Chapter 3: Working with Quadratic Functions

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3.4 Solving Quadratic Equations by Factoring

Learning Goals:

- All quadratic equations of the form $ax^2 + bx + c = d$ must be expressed in the form $ax^2 + bx + (c - d) = 0$ before factoring. Doing this is necessary because the zeros of the corresponding function, $f(x) = ax^2 + bx + (c - d)$, are the roots of the equation $ax^2 + bx + c = d$.
- If a quadratic equation of the form $ax^2 + bx + c = 0$ can be written in factored form, then the solutions of the quadratic equation can be determined by setting each of the factors to zero and solving the resulting equations.

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3.4 Solving Quadratic Equations by Factoring

Learning Goals:

- When factoring quadratic equations in the form $ax^2 + bx + c = 0$, apply the same strategies you used to factor quadratic expressions. These strategies include looking for
  - a common factor
  - a pair of numbers r and s, where $rs = ac$ and $r + s = b$
  - familiar patterns such as a difference of squares or perfect squares
- Not all quadratic expressions are factorable. As a result, not all quadratic equations can be solved by factoring. To determine whether $ax^2 + bx + c = 0$ is factorable, multiply a and c. If two numbers can be found that multiply to give the product ac and also add to give b, then the equation can be solved by factoring. If not, then factoring cannot be used. If this is the case, then other methods must be used.

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3.4 Solving Quadratic Equations by Factoring

Solve by factoring

$0 = x^2 - 5x - 24$

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

So Either $(x - 8) = 0$ OR $(x + 3) = 0$

$x = 8$ $x = -3$

The roots of this parabola are (8,0) and (-3,0)

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3.4 Solving Quadratic Equations by Factoring

Solve by factoring

$-36 = x^2 + 12x$

$0 = x^2 + 12x + 36$

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

So Either $(x + 6) = 0$ OR $(x + 6) = 0$

$x = -6$ $\quad$ $x = -6$

The one root of this parabola is (-6,0)

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3.4 Solving Quadratic Equations by Factoring

Solve by factoring, verify the solution:

$(x+3)(x-1)= 2(x - 5)(x+3)$

$(x^2 +2x -3)= 2(x^2 -2x -15)$

$x^2 +2x -3= 2x^2 -4x -30$

$0 = 2x^2 -4x -30 - x^2 -2x +3$

$0 = x^2 -6x -27$

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3.4 Solving Quadratic Equations by Factoring

ctd...

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

So Either

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

$x = 9$ $\quad$ $x = -3$

So the solutions to these parabolas (where they intersect) is when x = 9 and when x = -3

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3.4 Solving Quadratic Equations by Factoring

ctd...

CHECK!

LHS: Sub x = 9	RHS: Sub x = 9
$(x+3)(x-1)$	$2(x-5)(x+3)$
$=((9)+3)((9)-1)$	$=2((9)-5)((9)+3)$
$= (12)(8)$	$= 2(4)(12)$
$= 96$	$= 96$

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3.4 Solving Quadratic Equations by Factoring

ctd...

CHECK!

LHS: Sub x = -3	RHS: Sub x = -3
(x+3)(x-1)	2(x-5)(x+3)
=((-3)+3)((-3)-1)	=2((-3)-5)((-3)+3)
= (0)(-4)	= 2(-8)(0)
= 0	= 0

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Example:

12. A helicopter drops an aid package. The height of the package above the ground at any time is modelled by the function $h(t) = -5t^2 - 30x + 675$, where $h(t)$ is the height in metres and t is the time in seconds. How long will it take the package to hit the ground?

$h(t) = -5t^2 - 30t + 675$

$0 = -5t^2 - 30t + 675$

$0 = -5(t^2 + 6t - 135)$

$0 = -5(t + 15)(t - 9)$

The solutions are t = -15 and t=9

The package must hit the ground at t = 9. Since it started dropping at t = 0, it must have fell for 9 sec.

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Homework:

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