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Lesson 1.4 – Solving Quadratic & Quadratic-like Equations (pages 230 – 244) in Red 9/10 textbook)

*Last lesson, we solved **linear equations** of the form $ax + b = 0$. Linear equations only have **one solution.***

*This lesson, we will solve **quadratic equations** of the form $ax^2 + bx + c = 0$. Quadratic equations can have up to **two solutions.***

1. Consider the equation $x^2 + 3x - 10 = 0$. Demonstrate that $x = 2$ and $x = -5$ are both solutions to this equation.

$(2)^2 + 3(2) - 10 = 0$
$4 + 6 - 10 = 0$
$10 - 10 = 0$

$(-5)^2 + 3(-5) - 10 = 0$
$25 - 15 - 10 = 0$
$10 - 10 = 0$

I. Solving Simple Power Equations

Equations of the form $x^2 = k$

If $x^2 = k$ then
- $x = \pm\sqrt{k},\ if\ k > 0$
- $x = 0,\ if\ k = 0$
- $no\ real\ solutions, if\ k < 0$

1. Solve for x: $3x^2 - 1 = 8$
   $3x^2 = 9$
   $x^2 = 3$
   $x = \pm\sqrt{3}$

2. Solve for x: $5 - 2x^2 = 11$
   $-2x^2 = 6$
   $x^2 = -3$ No solution

3. Solve for x: $(x + 3)^2 = 36$
   $x + 3 = \pm\sqrt{36}$
   $x + 3 = \pm 6$
   $x = -3 \pm 6$
   $x = 3, x = -9$

4. Solve for x: $(x - 4)^2 = 7$
   $x - 4 = \pm\sqrt{7}$
   $x = 4 \pm \sqrt{7}$

II. Solving Quadratics by Factoring

The Zero Product Property

(or Null Factor Law as your book calls it…)

When the product of two or more numbers is zero, then at least one of those numbers is zero.

If $ab = 0$, then either $a = 0$ or $b = 0$

5. Solve for x: $x^2 = 3x$
   $x^2 - 3x = 0$
   $x(x - 3) = 0$
   $x = 0,\quad x - 3 = 0$
   $x = 0,\quad x = 3$

6. Solve for x: $x^2 + 3x = 28$

$x^2 + 3x - 28 = 0$

$(x + 7)(x - 4) = 0$

$x + 7 = 0, \quad x - 4 = 0$

$x = -7, \quad x = 4$

7. Solve for x: $5x^2 = 3x + 2$

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

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

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

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

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

8. Solve for x: $\frac{x-2}{x} = \frac{6+x}{2}$

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

$2x - 4 = 6x + x^2$

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

$(x + 2)^2 = 0$

$x + 2 = 0$

$x = -2$

9. Solve for x: $\frac{1}{x} + \frac{4}{x+6} = 1$

$(x + 6)(1) + 4(x) = (x)(x + 6)$

$x + 6 + 4x = x^2 + 6x$

$x^2 + x - 6 = 0$

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

$x = -3, \quad x = 2$

10. Solve for x: $x^2 - 121 = 0$

$(x + 11)(x - 11) = 0$

$x = -11, \quad x = 11$

III. Practice on Your Own

11. Solve for x: $x^2 - 4x - 32 = 0$

$(x - 8)(x + 4) = 0$

$x = 8, \ x = -4$

12. Solve for x: $4x^2 = 9$

$4x^2 - 9 = 0$

$x^2 = 9/4 \qquad x = \pm 3/2$

13. Solve for x: $x^2 = 225$

$x = 25$

Recall the different methods for factoring quadratic polynomials:

- **Splitting the Middle Term**
- **Difference of Squares Pattern**
- **Perfect Square Pattern**

14. Solve for x: $16 - 169x^2 = 0$

$x^2 = 169/16$ $x = 13/4$

15. Solve for x: $\frac{7}{17}x^2 = \frac{175}{4352}$

$x = \sqrt{\frac{175}{4352} \times \frac{17}{7}} = \pm\frac{5}{16}$

16. Solve for x: $\frac{11}{15}x^2 - \frac{1100}{1815} = 0$

$x = \sqrt{\frac{1100}{1815} \times \frac{15}{11}} = \pm\frac{10}{11}$

17. Solve for x: $12x^2 - 19x = 0$

$x(12x - 19) = 0$

$x = 0,$ $x = 19/12$

18. Solve for x: $x^2 - 10x - 39 = 0$

$(x - 13)(x + 10) = 0$

$x = 13,$ $x = -10$

19. Solve for x: $6x^2 - 95x + 75 = 0$

$(x - 15)(6x - 5) = 0$

$x = 15,$ $x = 5/6$

20. Solve for x: $30x^2 - 31x + 5 = 0$

$30x^2 - 25x - 6x + 5 = 0$ $5(6x - 5) - 1(6x - 5) = 0$ $(6x - 5)(5x - 1) = 0$

$x = 15,\ x = 5/6$

IV. Quadratic-Like Equations

21. Solve for x: $x^4 - 13x^2 + 36 = 0$

$(x^2 - 4)(x^2 - 9) = (x - 2)(x + 2)(x - 3)(x + 3)$

22. Solve for x: $x^3 - 16x^2 + 48x = 0$

$x(x^2 - 16x + 48) = 0$

$x(x - 12)(x - 4) = 0$ $x = 0, x = 12, x = 4$

23. Solve for x: $(x - 1)^{-\frac{1}{2}}(x - 7) + 4(x - 1)^{\frac{1}{2}} = 0$

$(x - 1)^{-\frac{1}{2}}[(x - 7) + 4(x - 1)] = 0$

$(x - 1)^{-\frac{1}{2}}[x - 7 + 4x - 4] = 0$

$(x - 1)^{-\frac{1}{2}}[5x - 11] = 0$

$x = 11/5$

24. The equation $4x^4 - 9x^3 + 2x^2 = 0$ has three real solutions, A, B, and C. Where A < B < C. Solve for A, B, and C.

$4x^4 - 9x^3 + 2x^2 = 0$
$x^2(4x^2 - 9x + 2) = 0$
$x^2(4x^2 - 8x - x + 2) = 0$
$x^2(4x(x-2) - (x-2)) = 0$
$x^2(4x-1)(x-2) = 0$
$x = 0, x = \frac{1}{4}, x = 2$

25. Solve for t: $\frac{8}{2-t} + \frac{2}{2+t} + \frac{4}{4-t^2} = 0$

$\frac{8(2+t)}{(2-t)(2+t)} + \frac{2(2-t)}{(2+t)(2-t)} + \frac{4}{4-t^2} = 0$
$8(2+t) + 2(2-t) + 4 = 0$
$16 + 8t + 4 - 2t + 4 = 0$
$6t = -24$
$t = -4$

26. Solve for x: $\frac{x+1}{x-1} + \frac{-4}{x+3} + \frac{8}{x^2+2x-3} = 0$

$\frac{(x+1)(x+3)}{(x-1)(x+3)} = \frac{-4(x-1)}{(x+3)(x-1)} + \frac{8}{x^2+2x-3}$
$(x+1)(x+3) = -4(x-1) + 8$
$x^2 + 4x + 3 = -4x + 4 + 8$
$x^2 + 4x + 3 = -4x + 12$
$x^2 + 8x - 9 = 0$
$(x+9)(x-1) = 0$
$x = -9,$ ~~$x = 1$~~

27. Solve for x: $\frac{1}{x+3} - \frac{1}{x+4} = \frac{1}{2}$

$\frac{2(x+4)}{2(x+3)(x+4)} - \frac{2(x+3)}{2(x+4)(x+3)} = \frac{(x+4)(x+3)}{2(x+4)(x+3)}$
$2(x+4) - 2(x+3) = (x+4)(x+3)$
$2x + 8 - 2x - 6 = x^2 + 7x + 12$
$0 = x^2 + 7x + 10$
$0 = (x+5)(x+2)$
$x = -5, x = -2$