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Lesson 1.3 – Solving Linear & Rational Linear Equations (pages 81-90, 154-156 in Red 9/10 textbook)

I. Warm-up: Balancing Equations

For any equation the left-hand side must always equal the right-hand side. If we add/subtract/multiply/divide the same number of both sides, the equation is still true.

1. Write down the equation that results when:
   a. 5 is added to both sides of $2x - 5 = 7$

   $2x = 12$

   b. 3 is taken from both sides of $5x + 3 = 18$

   $5x = 15$

   c. Both sides of $\frac{3x-2}{4} = -1$ are multiplied by 4.

   $3x - 2 = -4$

   d. Both sides of $5x = -15$ are divided by 5.

   $x = -3$

II. Linear Equations: Solving for x

2. Solve for x: $3x + 7 = 22$. Plug your solution back in for x to check.

$3x = 15$ $x = 5$

3. Solve for x: $11 - 5x = 26$. Plug your solution back in for x to check.

$-5x = 15$ $x = -3$

4. Solve for x: $\frac{x}{3} + 2 = -2$. Plug your solution back in for x to check.

$\frac{x}{3} = -4$ $x = -12$

5. Solve for x: $\frac{4x+3}{5} = -2$. Plug your solution back in for x to check.

$4x + 3 = -10$ $4x = -13$ $x = -\frac{13}{4}$

6. Solve for x: $5(x + 1) - 2x = -7$. Plug your solution back in for x to check.

$5x + 5 - 2x = -7$ $3x = -12$ $x = -4$

7. Solve for x: $5x + 2 = 3x - 5$. Plug your solution back in for x to check.

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

8. Solve for x: $\frac{2x+3}{4} = \frac{x-2}{3}$. Plug your solution back in for x to check.

$3(2x + 3) = 4(x - 2)$ $6x + 9 = 4x - 8$ $2x = -17$ $x = -\frac{17}{2}$

III. Practice on Your Own

9. Solve the equation $-8 + 9r = -5r$

$-8 = -14r$ $r = 4/7$

10. Solve the equation $6x + 5 = 4$

$6x = -1$ $x = -1/6$

11. Solve the equation $10(x + 4) = 5x + 5$

$10x + 40 = 5x + 5$ $5x = -35$ $x = -7$

12. Solve the equation $6(b + 1) + 5 = -6(b - 4) - 7$

$6b + 6 + 5 = -6b + 24 - 7$ $6b + 11 = -6b + 17$ $12b = 6$ $b = 1/2$

13. Solve the equation $\frac{7b+4}{2b-6} = \frac{7}{10}$

$10(7b + 4) = 7(2b - 6)$ $70b + 40 = 14b - 42$ $56b = -82$ $b = -41/28$

14. Solve the equation $\frac{5}{5-a}=\frac{7}{a-2}$

$5(a-2)=7(5-a)$ $5a-10=35-7a$ $12a=45$ $a=15/4$

15. Solve the equation $\frac{2}{x}=\frac{3}{4x}+5$

$\frac{8}{4x}=\frac{3}{4x}+\frac{5(4x)}{4x}$ $8=3+20x$ $5=20x$ $x=1/4$

16. Solve the equation $\frac{x}{7x-3}=\frac{3}{5}$

$5x=3(7x-3)$ $5x=21x-9$ $-16x=-9$ $x=9/16$

17. Solve the equation $4x-\frac{1}{2}(5-x)=-\frac{1}{4}(x+6)$

$4x-\frac{5}{2}+\frac{1}{2}x=-\frac{1}{4}x-\frac{3}{2}$ $4x+\frac{1}{2}x+\frac{1}{4}x=\frac{5}{2}-\frac{3}{2}$ $\frac{16}{4}x+\frac{2}{4}x+\frac{1}{4}x=1$ $\frac{19}{4}x=1$

$x=4/19$

18. Solve the equation $0.4(g-9)=0.9(g-2)$

$0.4g-3.6=0.9g-1.8$ $-1.8=0.5g$ $g=-3.6$

19. Solve the equation $-\frac{1}{3}k+\left(-\frac{2}{5}\right)=1-(-\frac{5}{6}k)$

$-\frac{1}{3}k-\frac{2}{5}=1+\frac{5}{6}k$ $-\frac{2}{6}k-\frac{5}{6}k=1+\frac{2}{5}$ $\frac{-7}{6}k=\frac{7}{5}$ $k=-\frac{6}{5}$

20. Solve the equation $7(x+3)=4(x+3)+2$

$7x+21=4x+12+2$ $7x+21=4x+14$ $3x=-7$ $x=-7/3$

21. Solve the equation $9(x-38778869)+2=-3(x-38778869)-22$

$9x-9(38778869)+2=-3x+3(38778869)-22$

$12x=12(38778869)-24$

$x=38778869-2=38778867$

IV. Rational Equations

For rational equations, write all fractions with the same lowest common denominator, then equate the numerators.

22. Solve for x: $\frac{6}{x}=\frac{2}{3}$. Plug your solution back in for x to check.

$18=2x$ $x=9$

23. Solve for x: $\frac{5}{x+2}=\frac{2}{x-1}$. Plug your solution back in for x to check.

$5(x-1)=2(x+2)$ $5x-5=2x+4$ $3x=9$ $x=3$

24. Solve for x: $\frac{-4x}{x-8}-\frac{11}{x-8}=\frac{25}{x-8}$.

$-4x-11=25$ $-4x=36$ $x=-9$

25. Solve for x: $\frac{3}{4}-\frac{2x}{4x-24}=\frac{8}{x-6}$.

$\frac{3(x-6)}{4(x-6)}-\frac{2x}{4x-24}=\frac{4(8)}{4(x-6)}$ $3x-18-2x=32$ $x=50$

26. Solve for x: $\frac{3}{6x}-\frac{9}{12}=\frac{11}{4x}$.

$\frac{2(3)}{2(6x)}-\frac{9x}{12x}=\frac{3(11)}{3(4x)}$. $6-9x=33$ $-9x=27$ $x=-3$

27. Solve for x: $\frac{18}{5x-10}+\frac{4}{5}=\frac{-6}{x-2}$.

$\frac{18}{5x-10}+\frac{4(x-2)}{5(x-2)}=\frac{5(-6)}{5(x-2)}$ $18+4(x-2)=-30$ $18+4x-8=-30.$ $4x=-40$

$x=-10$

28. Solve for x: $\frac{12}{x^2+5x+6}+\frac{7}{x+3}=\frac{2}{x+2}$.

$\frac{12}{x^2+5x+6}+\frac{7(x+2)}{(x+3)(x+2)}=\frac{2(x+3)}{(x+2)(x+3)}$. $12+7x+14=2x+6$ $5x=-20$

$x=-4$

29. Solve for x: $\frac{1}{10}+\frac{4x}{5x}=\frac{-9}{2x}$.

$\frac{1(x)}{10(x)}+\frac{2(4x)}{2(5x)}=\frac{5(-9)}{5(2x)}$. $x+8x=-45$ $9x=-45$ $x=-5$

30. Solve for x: $\frac{2}{x-6}+\frac{7}{x+2}=\frac{4x+2}{x^2-4x-12}$.

$\frac{2(x+2)}{(x-6)(x+2)}+\frac{7(x-6)}{(x+2)(x-6)}=\frac{4x+2}{x^2-4x-12}$ $2x+4+7x-42=4x+2$ $9x-38=4x+2$

$5x=40$ $x=8$