Math 9 Lesson 3: Algebra and Equations

- Multi-step one-variable linear equations
- Includes distribution, variables on both sides of the equation, and collecting like terms
- Includes rational coefficients, constants, and solutions
- Solving and verifying $1 + 2x = 3 - \frac{2}{3}(x + 6)$
- Solving symbolically and pictorially

1. $2x = 8$
   4

2. $12 = -3a$
   −4

3. $\frac{x}{3} = 5$
   15

4. $7 = -\frac{a}{2}$
   −14

5. $\frac{2}{5} = \frac{\square}{15}$
   $5x = 30$
   $x = 6$

6. $\frac{7}{\square} = \frac{14}{5}$
   $14x = 35$
   $x = \frac{35}{14}$

7. $2x(3 - 2) = 2$
   $2x(1) = 2$
   $x = 1$

8. $-2(3 - 5x) = 4$
   $-6 + 10x = 4$
   $10x = 10$
   $x = 1$

9. $\frac{x}{2} = \frac{3}{5}$
   $5x = 6$
   $x = \frac{6}{5}$

10. $\frac{4}{9} = \frac{2}{x}$
    $4x = 18$
    $x = \frac{9}{2}$

11. $\frac{2}{x} = 5$

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

12. $-3 = \frac{5}{a}$

  $-\frac{5}{3}$

13. $2 - x = 3(x + 1)$

  $2 - x = 3x + 3$

  $-1 = 4x$

  $x = -\frac{1}{4}$

14. $-2(2x - 3) = 4 + x$

  $-4x + 6 = 4 + x$

  $2 = 5x$

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

15. $\frac{2}{x+1} = \frac{3}{4}$

  $3x + 3 = 8$

  $3x = 5$

  $x = \frac{5}{3}$

16. $\frac{2x-3}{5} = \frac{3}{-2}$

  $-4x + 6 = 15$

  $-9 = 4x$

  $x = -\frac{9}{4}$

17. $2 + \frac{1}{2} = \frac{1}{2-3x}$

  $\frac{5}{2} = \frac{1}{2-3x}$

  $10 - 15x = 2$

  $8 = 15x$

  $x = \frac{8}{15}$

18. $2x + \frac{x}{2} + 1 = 5$

  $4x + x + 2 = 10$

  $5x = 8$

  $x = \frac{8}{5}$

19. $\frac{w}{3} - w + 2 = \frac{3}{2}$

  $\times 6$

  $2w - 6w + 12 = 9$

  $3 = 4w$

  $w = \frac{3}{4}$

20. $1 + 2x = 3 - \frac{2}{3}(x + 6)$

    $\times 3$

    $3 + 6x = 9 - 2(x + 6)$

    $3 + 6x = 9 - 2x - 12$

    $8x = -6$

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

21. $3x - 2 = \frac{2}{5}\left(\frac{3x}{2} - 1\right)$

    $\times 10$

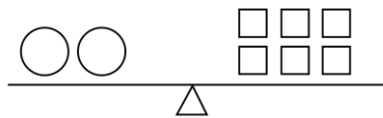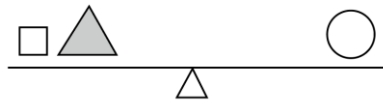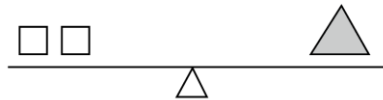 $30x - 20 = 4\left(\frac{3x}{2} - 1\right)$

    $30x - 20 = 6x - 4$

    $24x = 16$

    $x = \frac{16}{24} = \frac{8}{12} = \frac{2}{3}$

22. Challenge:

    a. If the weight one square is 2 kg. How heavy is the weight of a dozen circles?

    $t = 2s = 2(2) = 4$

    $2 + t = c \rightarrow 2 + 4 = c = 6$

    $12c = 12(6) = 72$

    b. $\left(\frac{2}{3}\right)^2 - \left(-\frac{x}{3}\right) \div \frac{2x}{5} - \frac{(-1)^0}{\sqrt{\frac{1}{121}}} = \frac{1}{\frac{1}{x}} - 0!$
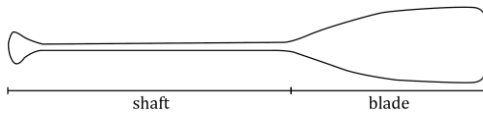
    $\frac{4}{9} + \frac{x}{3} \times \frac{5}{2x} - \frac{1}{\frac{1}{11}} = x - 1$

    $\frac{4}{9} + \frac{5}{6} - 11 = x - 1$

    $x = -\frac{157}{18}$

c.

$$\frac{1+2x}{\frac{3}{2}} - 4\left(\frac{2}{3}\right)^2 \div \frac{-1^2}{\frac{x}{2}} = \frac{1+\frac{1}{2}}{\frac{2}{3}-2}$$

$$\frac{2+4x}{3} - 4 \times \frac{4}{9} \div -\frac{1}{\frac{x}{2}} = \frac{3}{2} \div -\frac{4}{3}$$

$$\frac{2+4x}{3} - \frac{16}{9} \div -\frac{2}{x} = \frac{3}{2} \times -\frac{3}{4}$$

$$\frac{2+4x}{3} - \frac{16}{9} \times -\frac{x}{2} = -\frac{9}{8}$$

$$\frac{2+4x}{3} + \frac{16x}{18} = -\frac{9}{8}$$

$$\times 72$$

$$24(2+4x) + 4(16x) = -9(9)$$

$$48 + 96x + 64x = -81$$

$$160x = -129$$

$$x = -\frac{129}{160}$$

d. See diagram below:

shaft   blade

Suppose the "blade" of a canoe paddle is $\frac{2}{5}$ of its total length.
The shaft portion of the paddle is 100 cm. What is the length of one paddle?

$$100 = \frac{3}{5}x$$

$$500 = 3x$$

$$x = \frac{500}{3}$$

e. My dad was 31 when I was 8.
How old am I if my dad is double my age now?
Let x be time that passed

$$31 + x = 2(8 + x)$$

$$31 + x = 16 + 2x$$

$$15 = x$$

$$\text{Age} = x + 8 = 15 + 8 = 23$$