Solving Equations with Algebra Tiles Warm-Up

Solve at least 3 ways: $4h + 32 = 60$

7AF4.1; #52

Solve at least 3 ways: $4x + 2 = 22$

7AF4.1; #53

$(4x^2 - 2x + 8) - (x^2 + 3x - 2)$

A) $3x^2 + x + 6$

B) $3x^2 + x + 10$

C) $3x^2 - 5x + 6$

D) $3x^2 - 5x + 10$

Find the solution and describe how each of the incorrect answers is obtained.

Algebra 1: 10.0 ; #40

For each of these warm-ups, identify the grade level and describe a strategy that you would introduce to students in order to develop the foundation necessary for solving these equations in middle school math.

Warm-up Solutions

$$4h+32=60$$
$$4h+32=60+32-32$$
$$4h=60-32$$
$$4h=28$$
$$4\bullet h=4\bullet 7$$
$$h=7$$

$$4x+2=22$$
$$4x+2=22+2-2$$
$$4x=22-2$$
$$4x=20$$
$$4\bullet x=4\bullet 5$$
$$x=5$$

$$4h+32=60$$
$$h+h+h+h+32=32+28$$
$$h+h+h+h=7+7+7+7$$
$$h=7$$

$$4x+2=22$$
$$x+x+x+x+2=20+2$$
$$x+x+x+x=5+5+5+5$$
$$x=5$$

$$4h+32=60$$
$$4h+32-32=60-32$$
$$4h=28$$
$$\frac{\cancel{4}h}{\cancel{4}}=\frac{\cancel{4}\cdot 7}{\cancel{4}}$$
$$h=7$$

$$4x+2=22$$
$$4x+2-2=22-2$$
$$4x=20$$
$$\frac{\cancel{4}x}{\cancel{4}}=\frac{\cancel{4}\cdot 5}{\cancel{4}}$$
$$x=5$$

$$\left(4x^2-2x+8\right)-\left(x^2+3x-2\right)$$

A) $3x^2+x+6$; only first term is accurate

B) $3x^2+x+10$; first and third terms are accurate

C) $3x^2-5x+6$; first and second terms are accurate

D) $3x^2-5x+10$; correct answer

Algebra 1: 10.0 ; #40

For each of these warm-ups, identify the grade level and describe a strategy that you would introduce to students in order to develop the foundation necessary for solving these equations in middle school math.

Solving Equations with Algebra Tiles

Standards: 7AF4.1*: Solve two-step linear equations and inequalities in one variable over rational numbers, interpret the solution or solutions in the context from which they arose, and verify the reasonableness of the results.

Algebra 1; 4.0* Students simplify expression prior to solving linear equations and inequalities in one variable, such as $3(2x-5)+4(x-2)=12$.

Algebra 1; 5.0* Students solve multi-step problems, including word problems, involving linear equations and linear inequalities in one variable and provide justification for each step.

Objective: Students will use manipulatives and apply math properties to solve equations.

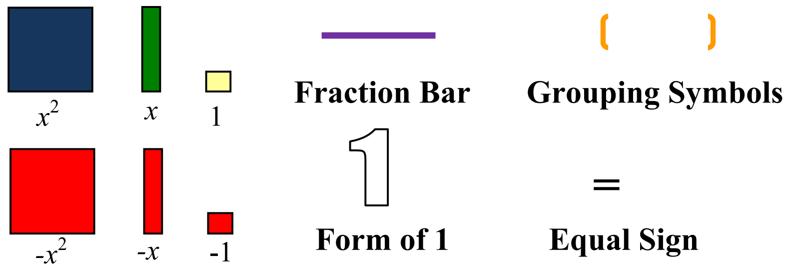
Materials: For each group of students: Algebra Tiles, Grouping Symbols, Forms of 1, Fraction Bar, Equal Signs, Equation Cards, Answer Sheet, paper and pencil for keeping score.

Introduction to Activity (*Lowering affective filter*): Explain to students that the game they will play will provide practice with solving equations, and that they already know the math properties needed for success.

Prior Knowledge:

Additive Identity (Zero Pair): Any number or term and its opposite equals zero.	$-1+1=0$ $x+(-x)=0$ $-4x^2+4x^2=0$	
Subtracting Integer Rule: Add the opposite.	$5-3$ $=5+(-3)$ $++\,+++---$ $=2$	
	$5-(-3)$ $=5+3$ $++++++++$ $=8$	
Equality Properties: Whatever is done to one side of an equation that ***changes its value***, must be done to the other side to keep the sides equal.	$3+x=9$ $3\underline{-3}+x=9\underline{-3}$ Subtract 3 from both sides. $x=6$	$\frac{x}{2}=5$ $\left(\frac{\cancel{2}}{1}\right)\frac{x}{\cancel{2}}=(2)5$ Multiply both sides by 2. $x=10$

Algebra Tiles:

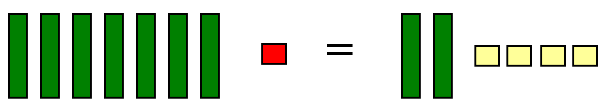


Example 1: $7x-1=2x+4$

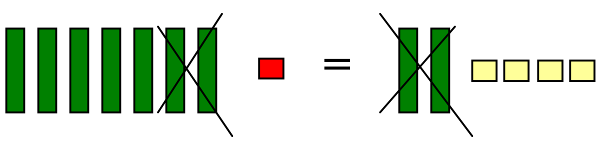
Rewrite the equation as addition.

$$7x-1=2x+4$$
$$7x+(-1)=2x+4$$

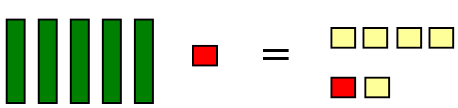
'Build' the equation using algebra tiles. *No like terms in this equation.*



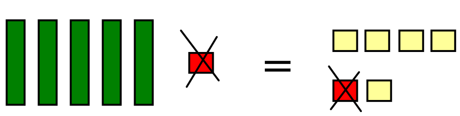
Goal is to find the value of one x. In order to do this we must isolate the x's on one side of the equal sign. Are all the x's on one side of the equal sign? [no] We need to make sure they are all on one side. What can we remove to make sure all the x's are on one side of equal? [take 2 x's away from each side of equal] (Equality Property of Subtraction).



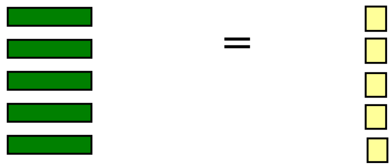
Are the x's isolated on one side of equal? [no] What else is on the side with them? [negative 1] Is there a like term on the other side so we can remove like terms? [no] How can we remove negative 1 from one side? [use a zero, add zero to the other side] (Additive Inverse).



Remove like terms from each side of equal to isolate the variable. What are the like terms? [negative 1] (Subtraction Property of Equality).



Since all the x's are on one side of the equal sign, we can arrange the 1's to find the value of each x (Equality Property of Division).



Since 5 x's equal 5, one x equals 1; $\therefore x = 1$

Check:

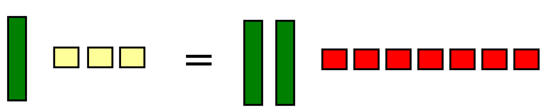
$$7x - 1 = 2x + 4$$
$$7x + (-1) = 2x + 4$$
$$7x - 2x + (-1) = 2x - 2x + 4$$
$$5x + (-1) = 4$$
$$5x + 1 + (-1) = 4 + 1$$
$$5x = 5$$
$$\frac{\cancel{5}x}{\cancel{5}} = \frac{\cancel{5}}{\cancel{5}}$$
$$x = 1$$

You Try 1: $x + 3 = 2x - 7$

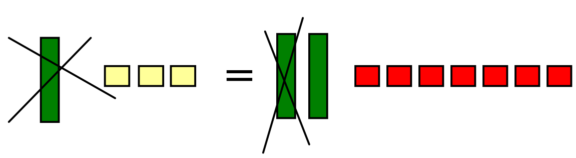
$x + 3 = 2x - 7$

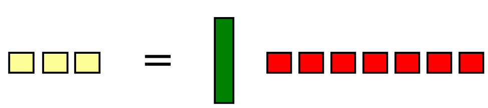
$x + 3 = 2x + (-7)$

Build it.

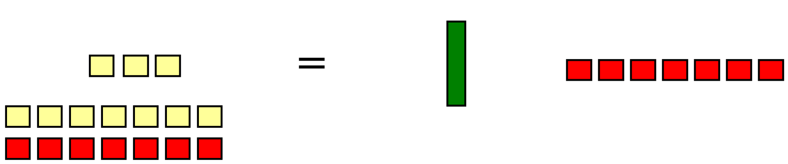


Remove like terms from each side; Equality Property of Subtraction.

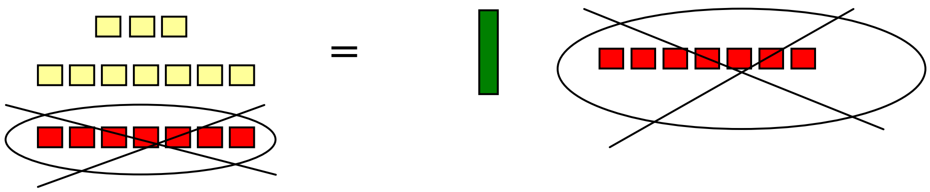




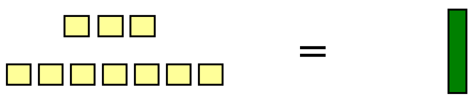
Since x is not isolated, and there are no other like terms, use the Additive Inverse.



Remove like terms to isolate x; Equality Property of Subtraction.



Solution.



$$x = 10$$

Check:

$$\begin{aligned}
x + 3 &= 2x - 7 \\
x + 3 &= 2x + (-7) \\
x - x + 3 &= 2x - x + (-7) \\
3 &= x + (-7) \\
3 + 7 &= x + 7 + (-7) \\
10 &= x
\end{aligned}$$

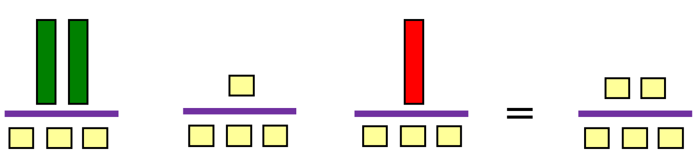
Example 2: $\frac{2x}{3} + \frac{1}{3} - \frac{x}{3} = \frac{2}{3}$

Rewrite the equation as addition.

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

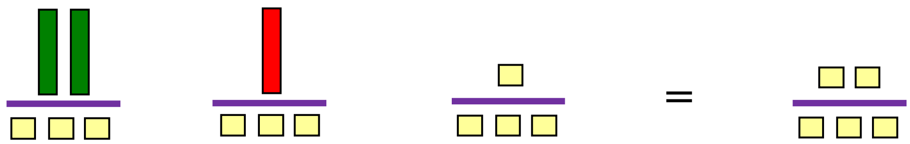
$$\frac{2x}{3} + \frac{1}{3} + \left(\frac{-x}{3}\right) = \frac{2}{3}$$

'Build' the equation using algebra tiles.

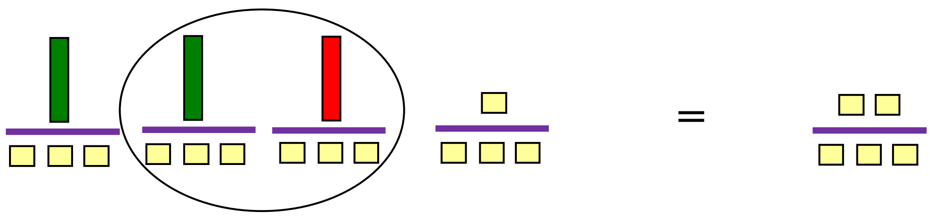


Note in this equation the LCD is 3. This could have been solved at 2x + 1 – x = 2.

Arrange like terms together; Commutative Property of Addition.

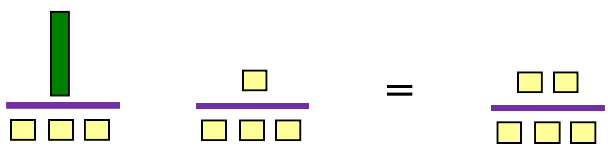


Find and remove any zeros; Additive Inverse.

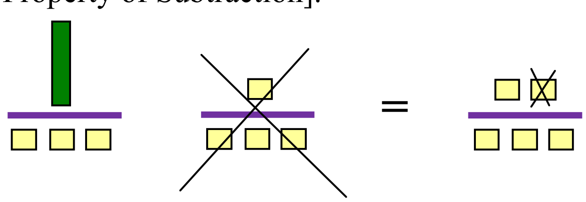


Note the two-thirds was decomposed to one-third and one-third.

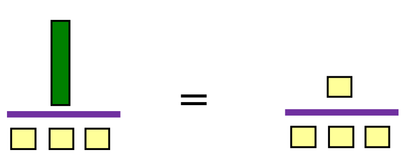
Goal is to find the value of one x. In order to do this we must isolate the x's on one side of the equal sign. Are all the x's on one side of the equal sign? [no] We need to make sure they are all on one side.



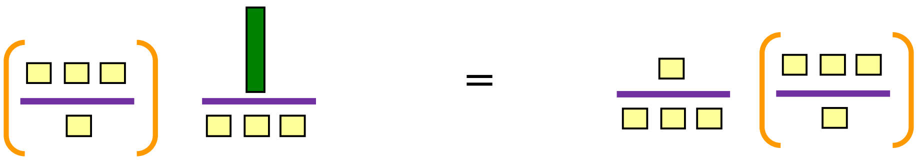
What should we remove to isolate x? $\left[\frac{1}{3}\right]$Remove from just one side? [no, both-Equality Property of Subtraction].



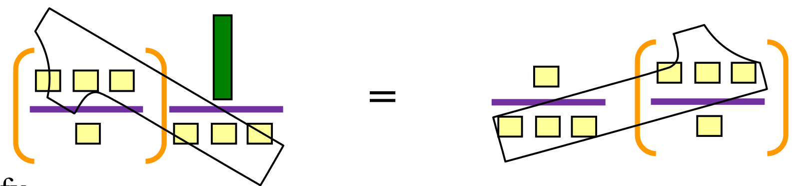
Are the x's isolated on one side of equal? [no, it is being divided by 3] How can we remove 'divided by 3'? [inverse operation, multiply both sides by 3] (Equality Property of Multiplication).



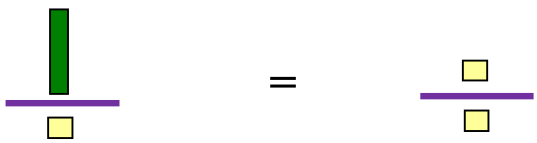
Use the fraction bar and grouping symbols to clear denominators by using inverse operations.

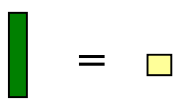


Are there any forms of ‘1’? [yes, 3 divided by 3 on each side of equal sign]



Simplify



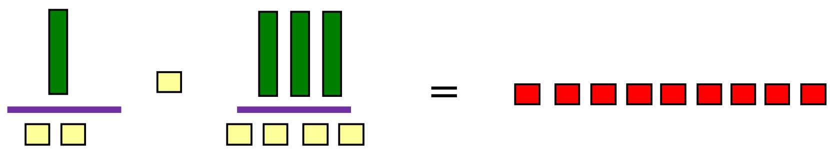


$x = 1$

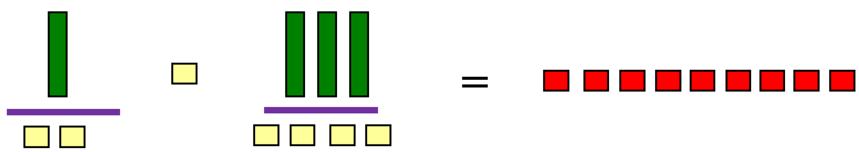
Check:
$$\frac{2x}{3} + \frac{1}{3} + \left(\frac{-x}{3}\right) = \frac{2}{3}$$
$$\frac{2x - x}{3} + \frac{1}{3} = \frac{2}{3}$$
$$\frac{x}{3} + \frac{1}{3} = \frac{2}{3}$$
$$\frac{x}{3} + \frac{1}{3} - \frac{1}{3} = \frac{2}{3} - \frac{1}{3}$$
$$\frac{x}{3} = \frac{1}{3}$$
$$\left(\frac{\cancel{3}}{1}\right)\frac{x}{\cancel{3}} = \frac{1}{\cancel{3}}\left(\frac{\cancel{3}}{1}\right)$$
$$\frac{x}{1} = \frac{1}{1}$$
$$x = 1$$

You Try 2: $\frac{x}{2}+1+\frac{3x}{4}=-9$

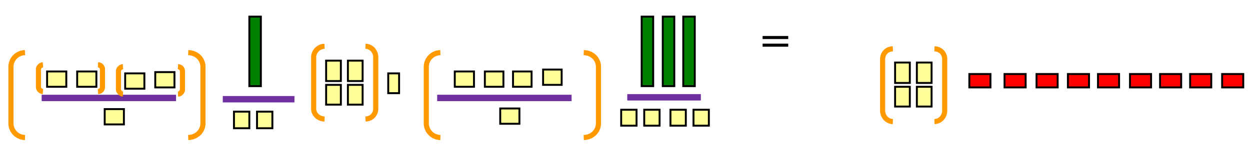
Build it.



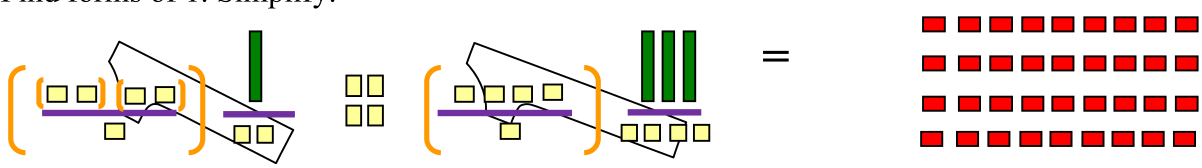
Organize it.



Clear denominator. Multiply all terms by 4.



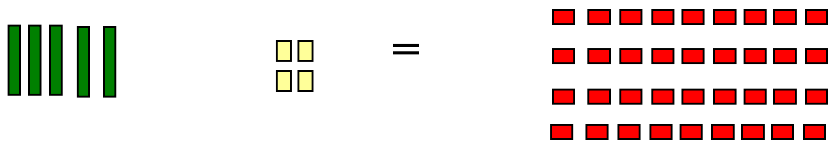
Find forms of 1. Simplify.



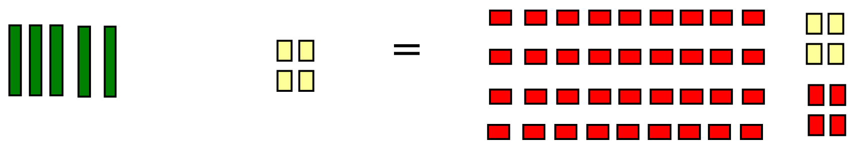
Multiply.

Simplify fractions.

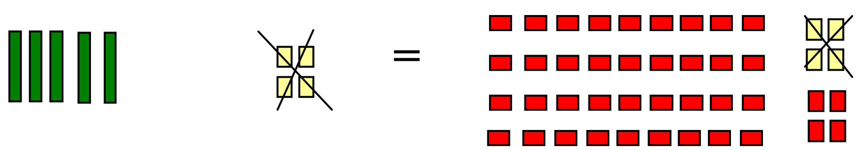
Combine like terms.



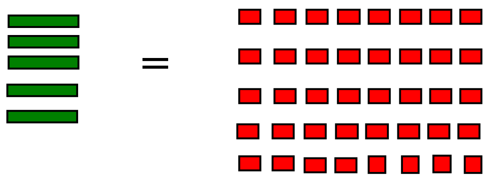
Additive Inverse.



Remove like terms from each side.



Since 5 x's equal negative 40, 1 x equals negative 8.



$x = -8$

Check:

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

$$\left(\frac{2 \cdot 2}{1}\right)\frac{x}{2} + (4)1 + \left(\frac{4}{1}\right)\frac{3x}{4} = (4)(-9)$$

$$\frac{2 \cdot \cancel{2} \cdot x}{1 \cdot \cancel{2}} + 4 + \frac{\cancel{4} \cdot 3 \cdot x}{1 \cdot \cancel{4}} = -36$$

$$2x + 4 + 3x = -36$$

$$2x + 3x + 4 = -36$$

$$5x + 4 = -36$$

$$5x + 4 - 4 = -36 - 4$$

$$5x = -40$$

$$\frac{\cancel{5}x}{\cancel{5}} = \frac{-8 \cdot \cancel{5}}{\cancel{5}}$$

$$x = -8$$

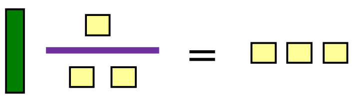
Example 3: $x + .5 = 3$

Rewrite as fraction.

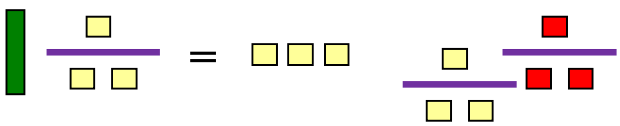
$$x + .5 = 3$$

$$x + \frac{1}{2} = 3$$

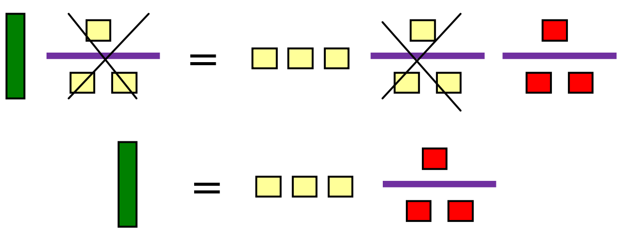
Build it.



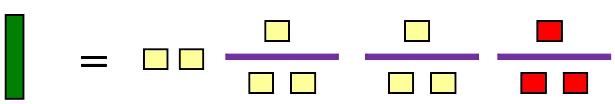
Use Additive Inverse.



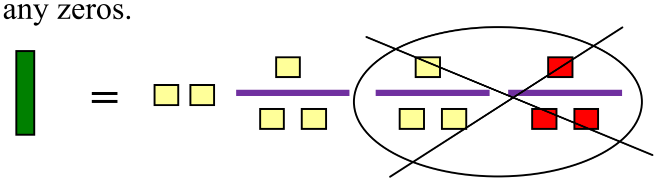
Use the Equality Property of Subtraction.



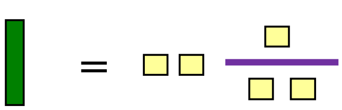
Decompose.



Remove any zeros.



Solution.



Check:

$$x + .5 = 3$$

$$x + \frac{1}{2} = 3$$

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

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

$$x = 2 + \frac{1}{2} + \frac{1}{2} - \frac{1}{2}$$

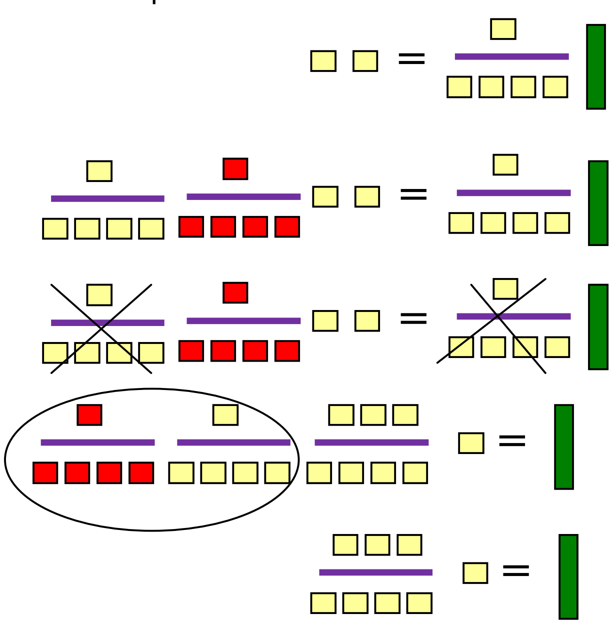
$$x = 2 + \frac{1}{2}$$

$$x = 2\frac{1}{2}$$

You Try 3: $2 = .25 + x$

$$2 = .25 + x$$

$$2 = \frac{1}{4} + x$$



$$2 = .25 + x$$

$$2 = \frac{1}{4} + x$$

$$2 + \frac{1}{4} - \frac{1}{4} = \frac{1}{4} + x$$

Check:

$$2 - \frac{1}{4} = x$$

$$1 + \frac{1}{4} + \frac{3}{4} - \frac{1}{4} = x$$

$$1 + \frac{3}{4} = x$$

$$1\frac{3}{4} = x$$

The Game!

We've reviewed enough to begin 'the game'. There is a variety of ways to use the game for solving equations practice.

Objective: Playing for points. Solve the equation correctly using algebra tiles, earn a point. Person with the most point wins.

Cut Algebra Tiles, Grouping Symbols and Fraction Bars out of construction paper; draw Equal Signs on cardstock, copy Equations on cardstock, copy answer sheet on printer paper, copy Forms of 1 on Transparency.

Suggestion: Students should work in small groups (4-5). Each student should have a 'like term' organizer and algebra tiles. The group should have a set of equation cards and answer sheet. One player can be the score keeper, and answer checker (this role can rotate). Place the equations face down. First player takes the top card and all students try to solve the problem. If the player whose turn it is gets the correct answer, the player gets the point and no other players can earn a point. If the player whose turn it is does not get the correct answer, all other players who did get the correct answer can earn a point.

Equations (Copy on Cardstock; Cut)

1. $3x-10=4+x$	2. $5x+4=4x+5$
3. $x+3=2x-7$	4. $2x-1=x-3$
5. $2x+3=4x-5$	6. $6x+4=x-11$
7. $11-\frac{x}{2}=\frac{x}{3}-14$	8. $29x+4=28+13x$
9. $7x-11=-19+3x$	10. $11x+9=4x+30$
11. $4x+14=\frac{6x}{5}+7$	12. $\frac{3x}{8}-9=13+\frac{x}{8}$
13. $15-x=2(x+3)$	14. $14-\frac{x}{8}=\frac{3x}{4}-21$

15. $9x = 4x - 25$	16. $3x - 7 = 5x + 1$
17. $\frac{x+4}{5} = \frac{x-6}{7}$	18. $\frac{2x-1}{3} = 4x + 3$
19. $4x + 31 - x = 40$	20. $14 - 2x + 4x = 20$
21. $\frac{2x}{5} + 3 - \frac{4x}{5} = \frac{1}{5}$	22. $26 = 3x - 2 - 7x$
23. $12 - .5 = .25 + x$	24. $.75x = 6$

Answers to Equations

1. $x = 7$	2. $x = 1$
3. $x = 10$	4. $x = -2$
5. $x = 4$	6. $x = -3$
7. $x = 30$	8. $x = 1.5$
9. $x = -2$	10. $x = 3$
11. $x = -2.5$	12. $x = 88$
13. $x = 3$	14. $x = 40$
15. $x = -5$	16. $x = -4$
17. $x = -29$	18. $x = -1$
19. $x = 3$	20. $x = 3$
21. $x = 7$	22. $x = -7$
23. $x = 11.25$	24. $x = 8$

Forms of 1 (Copy on Transparency)