

# Solving Linear Equations and Inequalities

This booklet belongs to: \_\_\_\_\_

LESSON #	DATE	QUESTIONS FROM NOTES	Questions that I find difficult
1.		Pg.	
2.		Pg.	
3.		Pg.	
4.		Pg.	
5.		Pg.	
6.		Pg.	
7.		Pg.	
8.		Pg.	
9.		Pg.	
10.		Pg.	
11.		REVIEW	
12.		TEST	

Your teacher has important instructions for you to write down below.

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## Solving Linear Equations and Inequalities

IRP	#	Daily Topic	Key Ideas
<p>E3 model and solve problems using linear equations of the form:</p> $ax = b^*$ $\frac{x}{a} = b, a \neq 0^*$ $ax + b = c^*$ $\frac{x}{a} + b = c, a \neq 0^*$ $a(x + b) = c^*$ $ax + b = cx + d$ $a(bx + c) = d(ex)$ $\frac{a}{x} = b, a \neq 0^*$ <p>*where a, b, c, d, e, and f [C, CN, FS, V]</p>	1.	<b>Introduction to Solving Linear Equations (pg. 4-7)</b> <ul style="list-style-type: none"> <li>Model the solution of a given linear equation using concrete or pictorial representations, and record the process.</li> </ul>	<b>Algebra stones and Algebra Tiles.</b> Solve $x + 5 = 10$ , $x - 7 = 10$ , $2x = 10$ , $\frac{x}{3} = 10$
	2.	<b>Solving equations of the form <math>ax+b=c</math> and <math>a/c +b=c</math> (pg. 8-10)</b> <ul style="list-style-type: none"> <li>Solve a given linear equation symbolically.</li> <li>Solve a given problem using a linear equation and record the process.</li> </ul>	Solve. $4m+3=31$ & $\frac{2}{5}m - 5 = 3$
	3.	<b>Solving equations of the form <math>a(x+b)=c</math> and <math>ax+b=cx+d</math>(pg. 11-14)</b> <ul style="list-style-type: none"> <li>Determine, by substitution, whether a given rational number is a solution to a given linear equation.</li> </ul>	Solve. $4(m+3)=40$ & $6m+3=2m+15$  Is $m=5$ a solution to the equation $2(m+2) = 14$ ?
	4.	<b>More practice with <math>ax+b=cx+d</math> (Pg. 15-18)</b> <ul style="list-style-type: none"> <li>Identify and correct an error in a given incorrect solution of a linear equation</li> </ul>	Solve. $2(m+1)+4m=4(m-2)+6$ .
	5.	<b>Solve equation with fractions. (Pg. 19-23)</b> <ul style="list-style-type: none"> <li>Solve a given linear equation symbolically.</li> </ul>	Solve $\frac{m}{3} + \frac{2m}{5} - \frac{1}{2} = 2$
	6.	<b>Solve Linear equations without numbers. (Pg. 24-28)</b> <ul style="list-style-type: none"> <li>Solve a given linear equation symbolically.</li> </ul>	Solve for m. $A(m + n) = B$
<p>B4 explain and illustrate strategies to solve single variable linear inequalities with rational coefficients within a problem-solving context.</p>	7.	<b>Introduction to linear inequalities (Pg. 29-33)</b> <ul style="list-style-type: none"> <li>Translate a given problem into a single variable linear inequality using the symbols <math>\geq</math>, <math>&gt;</math>, <math>&lt;</math>, or <math>\leq</math>.</li> <li>Determine if a given rational number is a possible solution of a given linear inequality.</li> </ul>	Write an expression to represent the following statement: <b>Melanie needs at least \$280 for snow boarding.</b>
	8.	<b>Inequalities that Include Addition and Subtraction (Pg. 34-37)</b> <ul style="list-style-type: none"> <li>Generalize and apply a rule for subtracting a positive or negative number to determine the solution of a given inequality.</li> <li>Generalize and apply a rule for multiplying or dividing by a positive or negative number to determine the solution of a given inequality.</li> <li>Solve a given linear inequality algebraically and explain the process orally or in written form.</li> <li>Verify the solution of a given linear inequality using substitution for multiple elements in the solution.</li> </ul>	Solve $2x + 5 < 25$ and verify your solution.  True or False. If $-2x > -10$ then $x > 5$ .
	9.	<b>Solving Problems with Linear Inequalities (Pg. 38-41)</b> <ul style="list-style-type: none"> <li>Compare and explain the process for solving a given linear equation to the process for solving a given linear inequality.</li> <li>Graph the solution of a given linear inequality on a number line.</li> <li>Compare and explain the solution of a given linear equation to the solution of a given linear inequality.</li> <li>Solve a given problem involving a single variable linear inequality and graph the solution.</li> </ul>	Vertical Wireless charges \$50/ month plus \$0.25 for all minutes above 400 minutes per month. Frue Gal has decided that she does not want to pay more than \$70 per month. Write an inequality to represent how many minutes she can use per month without going over her \$70 limit. Approximate your solution on the number line
	10.	<b>Chapter Review and Practice Test</b> <ul style="list-style-type: none"> <li>Help students develop sound study habits.</li> <li>Many students will graduate high school saying they do not know how to study for math tests.</li> </ul>	
	11.	<b>Go over Practice Test</b>	
	12.	<b>Unit Evaluation</b>	

### Key Terms

	Definition	Example
Binomial	A polynomial consisting of two terms.	$2b^3 + 5$ Is a binomial
Coefficient	A number in front of a variable.	$2b^3 + 5$ The 2 is the coefficient.
Constant	A number that does not change.	$2b^3 + 5$ The 5 is the constant.
Equation	A statement where two expressions are equal.	$2b^3 + 5 = 2b + 1$ is an equation. $A = \pi r^2$ Is an equation.
Evaluate	Determine the answer.	Evaluate $2+3 \rightarrow 5$
Expand	A direction to multiply the number in front of the brackets by each of the terms inside the brackets.	$2m(3m - 5n) = 6m^2 - 10mn$
Expression	A collection of variables and or numbers that represents a quantity.	$2b^3 + 5$ Is an expression. $\pi r^2$ Is also an expression.
Inequality	A statement where two expressions are not equal.	$6 > 1$ , $2x + 3 < 5$ And $x \neq 4$ are examples of inequalities.
Inverse operation	Inverse operations have opposite effects.	(+, -) are inverse operations.
Like Term	Terms that have the same variables to the same exponents.	$5m, 3m$ and $m$ are like terms. $2n$ & $5m$ are not like terms.
Monomial	An algebraic expression consisting of one term.	$2b^3$ Is a monomial. $5$ Is a monomial.
Simplify	A direction to combine or reduce terms.	$4m + 5m - 3m$ Can be simplified to $6m$ .
Solve	A direction to determine the value of a variable.	The solution to $x + 8 = 18$ is $x=10$ .
Substitute	A direction to replace the variable(s) with specific values.	If 3 were substituted for $x$ in $2x + 1$ , the value of the expression would be 7.
Term	A quantity. A constant, a variable or the product of a constant and a variable could represent this quantity.	$2b^3 + 5$ $2b^3$ Is a term. $5$ Is a term.
Trinomial	A polynomial consisting of three terms.	$2b^3 + 2m + 5$
Variable	A letter that is used to represent a number.	$2b^3 + 5$ The $b$ is the variable.

## Introduction to Solving Linear Equations

**Challenge #1:** Solve each riddle using any strategy that works.

1. Five less than ten times a number is equal to fifty-five. What is the number?

$$\begin{aligned} 10m - 5 &= 55 \\ 10m &= 60 \\ m &= 6 \end{aligned}$$

Rate the riddle:  
Easy, Medium, Hard

2. Three times the sum of two and a number is equal to twenty-one. What is the number?

$$\begin{aligned} 3(m+2) &= 21 \\ m+2 &= 7 \\ m &= 5 \end{aligned}$$

Rate the riddle:  
Easy, Medium, Hard

3. A number is divided by four, increased by two and the result is 8. What is the number?

$$\begin{aligned} \frac{m}{4} + 2 &= 8 \\ \frac{m}{4} &= 6 \\ m &= 24 \end{aligned}$$

Rate the riddle:  
Easy, Medium, Hard

4. The sum of four times a number is the same as two times a number increased by seven. What is the number?

$$\begin{aligned} 4m + 1 &= 2m + 7 \\ 2m &= 6 \\ m &= 3 \end{aligned}$$

Rate the riddle:  
Easy, Medium, Hard

What made certain riddles harder than others?

### □ Introduction to Algebra Stones and Algebra Tiles □

**Challenge #2:** Write an expression to represent set of algebra stones.

Let  $\diamond = x$ ,  $\blacklozenge = -x$ ,  $\circ = 1$  and  $\bullet = -1$

5. Expression:

$$\begin{array}{l} \diamond\diamond \\ \diamond\diamond \circ\circ \\ \diamond\diamond \circ\circ \end{array}$$

$$9x + 4$$

6. Expression:

$$\begin{array}{l} \diamond\diamond\diamond \\ \diamond\diamond\diamond \bullet\bullet \\ \diamond\diamond\diamond \bullet\bullet \end{array}$$

$$12x - 6$$

7. Expression:

$$\begin{array}{l} \blacklozenge\blacklozenge \\ \blacklozenge\blacklozenge \circ \\ \blacklozenge\blacklozenge \circ\circ\circ \end{array}$$

$$-8x + 4$$

8. Expression:

$$\begin{array}{l} \blacklozenge \\ \blacklozenge\blacklozenge \\ \blacklozenge\blacklozenge \bullet\bullet \end{array}$$

One of the major contributions of mathematics to our world has been to provide us tools to solve complex problems in an orderly, repeatable and understandable way. The challenges above are your important steps to being able to solve more complex problems.

Do you think you can figure out what  $x$  equals in  $\frac{2}{3}x + 7 = 5(x + 1) - 7$  quickly?

Could you explain to a friend how to solve it?

Could create a system to solve this problem?

**Challenge #3: Write an equation to represent each set of algebra stones.**

Let  $\diamond = x$ ,  $\blacklozenge = -x$ ,  $\circ = 1$  and  $\bullet = -1$

Write an equation:  
 9.  $x + 3 = 14$

12. Modify the picture to show how many  $\circ$  would be needed to balance one  $\diamond$ ?  $\diamond = 11 \circ$   
 $x = 11$

10.  $x - 6 = 10$

13. Modify the picture to show how many  $\circ$  would be needed to balance one  $\diamond$ ?  $\diamond = 16 \circ$   
 $x = 16$

11.  $3x = 15$

14. Modify the picture to show how many  $\circ$  would be needed to balance one  $\diamond$ ?  $\diamond = 5 \circ$   
 $x = 5$

**Write an equation to represent each set of algebra tiles and solve the equation.**

Let  $\boxed{+x}$ ,  $\boxed{-x}$ ,  $\boxed{+}$ ,  $\boxed{-}$

Write an equation:  
 15.  $x + 4 = 12$

18. Modify the algebra tiles to show how many one tiles would be needed to balance one x tile?  $x = 8$

16.  $x - 6 = 9$

19. Modify the algebra tiles to show how many one tiles would be needed to balance one x tile?  $x = 15$

17.  $4x = -12$

20. Modify the algebra tiles to show how many one tiles would be needed to balance one x tile?  $x = -3$

**Will the scales be balanced after each change? Modify each drawing to support your answer.**

21. 5 Is added to both sides.

yes

25. What happens to  $m - 5 = 6$  if both sides of the equation are increased by 5?  

$$\begin{array}{r} m - 5 = 6 \\ +5 \quad +5 \\ \hline m = 11 \end{array}$$

22. 5 Is subtracted from both sides.

yes

26. What happens to  $m + 5 = 6$  if both sides of the equation are decreased by 5?  

$$\begin{array}{r} m + 5 = 6 \\ -5 \quad -5 \\ \hline m = 1 \end{array}$$

23. Both sides are multiplied by 2.

yes

27. What happens to  $\frac{m}{5} = 5$  if both sides of the equation are multiplied by 2?  

$$\begin{array}{r} \frac{m}{5} = 5 \cdot 2 \\ \frac{2m}{2} = 10 \\ \hline m = 10 \end{array}$$

24. Both sides are divided by 2.

yes

28. What happens to  $2m = 6$ , if both sides of the equation are divided by 2?  

$$\begin{array}{r} \frac{2m}{2} = \frac{6}{2} \\ \hline m = 3 \end{array}$$

**Definition: Inverse Operations**

29. The inverse of adding 5 is subtracting 5.
30. The inverse of subtracting 7 is adding 7.
31. The inverse of multiplying by 2 is  $\div$  by 2.
32. The inverse of dividing by 2 is  $\times$  by 3.
33. Additive inverses,  $(+,-)$ , add to 0 and multiplicative inverses,  $(\times,\div)$ , multiply to 1.
- $+5 -5 = 0$                        $2 \div 2 = 1$      $\frac{1}{2} \times \frac{2}{1} = 1$

Perform the inverse operation to isolate x.

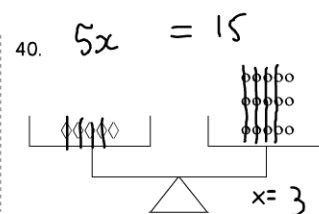
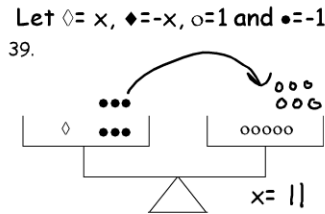
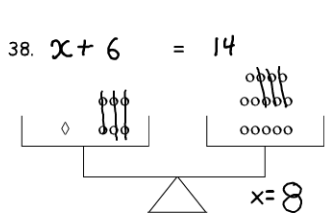
34.  $x + 5 = 10$   
 $-5 \quad -5$   
 $x = 5$

35.  $x - 7 = 10$   
 $+7 \quad +7$   
 $x = 17$

36.  $\frac{2x}{2} = \frac{10}{2}$   
 $x = 5$

37.  $3\left(\frac{x}{3}\right) = (0)3$   
 $x = 30$

Write an equation and use algebra stones to solve the equation.



What specific operation must be performed to isolate x?

41.  $x + 3 = 14$   
 $-3$

42.  $x - 6 = 10$   
 $+6$

43.  $3x = 15$   
 $\div 3$

44.  $\frac{x}{4} = 20$   
 $\times 4$

45.  $-5x = 30$   
 $\div -5$

46.  $7 + x = 16$   
 $-7$

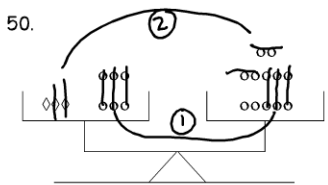
47.  $\frac{x}{-3} = -9$   
 $\times (-3)$

48.  $-18 = -3x$   
 $\div -3$

**Important note**

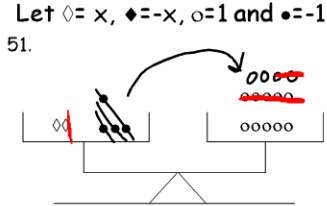
49. It is very possible to do the above problems without showing any work. These are warm up questions and practicing these skills now, will make solving questions like  $2(m+1) + 4m = 4(m-2) + 6$  &  $2(m-1) + \frac{5m}{2} = \frac{2}{3}(m+3)$ , possible. By the way the answers are  $m = -2$  and  $m = 24/23$ . It took me about 1 minute and ten seconds to solve both © Can you beat that time?

**Challenge #4: Write an equation to represent each set of algebra stones.**



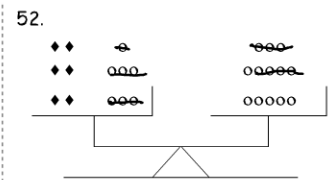
Modify the picture to show how many  $\circ$  would be needed to balance one  $\diamond$ ?

$$\begin{aligned} \diamond &= 2\circ \\ x &= 2 \end{aligned}$$



Modify the picture to show how many  $\circ$  would be needed to balance one  $\diamond$ ?

$$\begin{aligned} &= 7\circ \\ x &= 7 \end{aligned}$$

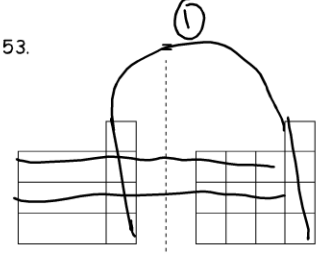


Modify the picture to show how many  $\circ$  would be needed to balance one  $\diamond$ ?

$$\begin{aligned} \diamond &= 1\circ \\ \diamond &= -1\circ \\ x &= -1 \end{aligned}$$

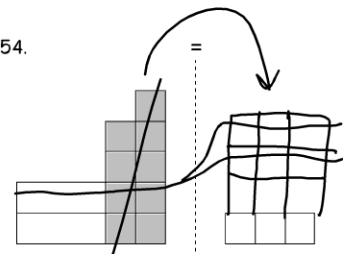
**Challenge #5: Write an equation to represent each set of algebra tiles and solve the equation**

Let  $\boxed{+x}$ ,  $\boxed{-x}$ ,  $\boxed{+}$ ,  $\boxed{-}$



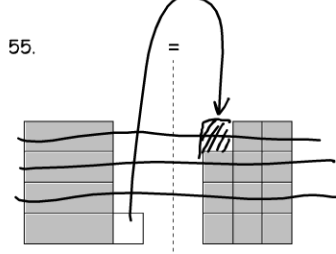
Modify the algebra tiles to show how many one tiles would be needed to balance one x tile?

$$x = 3$$



Modify the algebra tiles to show how many one tiles would be needed to balance one x tile?

$$x = 3$$



Modify the algebra tiles to show how many one tiles would be needed to balance one x tile?

$$\begin{aligned} -x &= -3 \\ x &= 3 \end{aligned}$$

**Challenge #6:**

56. Solve.  $4m + 3 = 31$

$$\begin{array}{r} 4m + 3 = 31 \\ -3 \quad -3 \\ \hline 4m = 28 \\ m = 7 \end{array}$$

Write down the steps to solve the challenge to the left.

① Subtract 3 on Both Sides

② Divide both sides by 4

How could you check to make sure your solution is a solution? Plug  $m=7 \rightarrow 4m+3 = 31$

$$\begin{aligned} 4(7)+3 &= 31 \\ 28+3 &= 31 \checkmark \end{aligned}$$

Solve for m.

57. Solve.  $4m+3=31$

Subtract 3 from both sides.

$$4m+3-3=31-3$$

$$4m=28$$

Divide both sides by 4.

$$\frac{4m}{4} = \frac{28}{4}$$

$$m=7$$

Check your answer by substituting  $m=7$  into the original equation.

$$4(7)+3=28+3=31$$

$m=7$  is the solution.

58.  $3m-5=25$   
 $+5 +5$

$$3m=30$$

$$m=10$$

59.  $5m-15=40$

$$+15 +15$$

$$5m=55$$

$$m=11$$

60.  $6m-5=-25$   
 $+5 +5$

$$6m=-20$$

$$m = \frac{-20}{6}$$

$$= -\frac{10}{3}$$

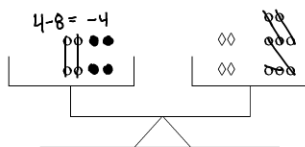
61.  $-2m-5=25$   
 $+5 +5$

$$-2m=30$$

$$m = -15$$

How many  $\diamond$  are needed to balance one  $\circ$ ?

62.  $4 = 4x + 8$

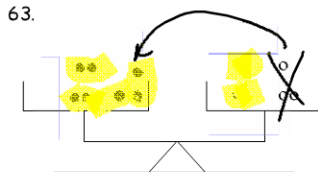


How many  $\circ$  are needed to balance one  $\diamond$ ?

$$4 \bullet = 4 \diamond$$

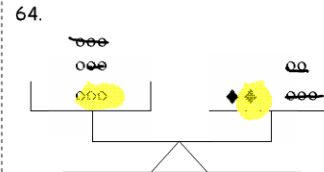
$$\bullet = \diamond \quad 1 \diamond = 1 \bullet$$

Let  $\circ = x$ ,  $\diamond = -x$ ,  $\bullet = 1$  and  $\blacklozenge = -1$



How many  $\circ$  are needed to balance one  $\diamond$ ?

$$\bullet = -2$$



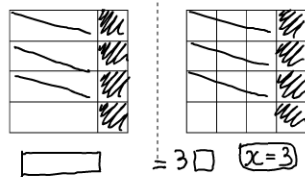
How many  $\circ$  are needed to balance one  $\diamond$ ?

$$\blacklozenge = 2 \circ$$

$$\blacklozenge = -2$$

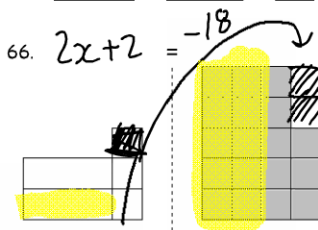
Modify the algebra tiles to show how many one tiles would be needed to balance one x tile?

65.  $4x+4 = 16$

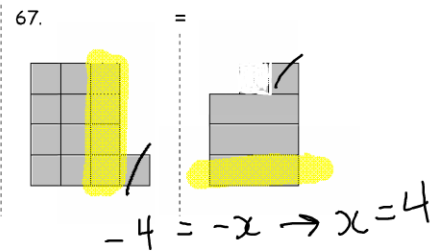


$$= 3 \square \quad (x=3)$$

Let  $\square = +x$ ,  $\blacksquare = -x$ ,  $\square = +$ ,  $\blacksquare = -$



$$x = -10$$



$$-4 = -x \rightarrow x = 4$$

Challenge #7:

68. Solve.  $\frac{2}{5}m - 5 = 3$

$$+5 +5$$

$$5 \left( \frac{2}{5}m = 8 \right) 5$$

$$\frac{10m}{10} = \frac{40}{10} \quad m=4$$

Write down the steps to solve the challenge to the left.

Subtract 5 both sides

$\times$  by 5 b.s.

$\div 10$  b.s.



Solve equations involving fractions.

<p>69. Solve. <math>\frac{2}{5}m - 5 = 3</math></p> <p><b>F.E.L.T.S.A.D.</b></p> <p>Eliminate the fractions by multiplying both sides by five.</p> $\left(\frac{2}{5}m - 5 = 3\right)5$ <p>Multiply every term by five.</p> $\frac{10}{5}m - 25 = 15$ <p>Reduce, add 25 to both sides and divide both sides by two.</p> $2m - 25 + 25 = 15 + 25$ $2m = 40$ $\frac{2m}{2} = \frac{40}{2}$ $m = 20$ <p>Check your answer by substituting <math>m=20</math> into the original equation.</p> $\frac{2}{5}(20) - 5 \stackrel{?}{=} 3$ $8 - 5 = 3$ <p><math>m=20</math> is the solution.</p>	<p>70. Solve. <math>\frac{3}{2}m - 5 = 25</math></p> $2\left(\frac{3}{2}m - 5 = 25\right)2$ $3m = 60$ $m = 20$	<p>71. Solve. <math>\frac{5m}{2} - 15 = 10</math></p> $2\left(\frac{5m}{2} - 15 = 10\right)2$ $5m = 50$ $m = 10$	
<p>76. Solve.</p> $\frac{-2m - 5 = 39}{-2m = 44}$ $m = -22$	<p>77. Solve.</p> $\left(\frac{-4m - 4 = 5}{-4m - 12 = 15}\right)3$ $-4m = 27$ $m = -\frac{27}{4}$	<p>78. Solve.</p> $\frac{-25 = -4m + 15}{-40 = -4m}$ $10 = m$	<p>79. Solve. <math>\frac{5m}{3} - 7 = 10</math></p> $\frac{5m}{3} = 17$ $5m = 51$ $m = \frac{51}{5}$
<p>80. <math>\frac{3m}{5} - 5 = -3</math></p> $5\left(\frac{3m}{5} - 5 = -3\right)5$ $3m = 10$ $m = \frac{10}{3}$	<p>81. Spot the error and solve. <math>-33 = 3m + 3</math></p> $\leftarrow -36$ $-30 = 3m$ $-10 = m$ <p><math>m = -12</math></p>	<p>82. Spot the error and solve.</p> $\frac{-15}{3} \frac{m}{3} - 5 = 25$ $-m - 5 = 75$ $-m = 80$ $m = -80$	<p>83. Is this wrong?</p> $3m - 6 = -30$ <p>Divide by 3</p> $m - 2 = 10$ $m = 12$ <p>Correct ✓</p> <p><math>m = -12</math> ✓</p>

Write an equation and solve the equation.

84. A number is multiplied by negative two and then decreased by five and the result is twenty-nine. Find the number.

$$\begin{array}{r} -2n - 5 = 29 \\ -2n = 34 \\ n = -17 \end{array}$$

85. The sum of three times a number and three is negative twenty-seven. Find the number.

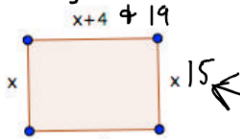
$$\begin{array}{r} 3n + 3 = -27 \\ -3 \quad -3 \\ \hline 3n = -30 \\ n = -10 \end{array}$$

86. Three times the opposite of a positive number increased by five is negative twenty-five. Find the number.

$$\begin{array}{r} -n + 5 = -25 \\ -5 \quad -5 \\ \hline -n = -30 \\ n = 30 \end{array}$$

Write an equation and solve the equation.

87. Bock Sout has 68 meters of fencing to build a fence. He wants the length to be 4 meters longer than the width. Write an algebraic equation and determine the dimensions of the rectangular fence.



$$\begin{array}{r} P = 68 = x + x + x + 4 + x + 4 \\ 68 = 4x + 8 \\ -8 \quad -8 \\ \hline 60 = 4x \\ 15 = x \end{array}$$

Check  
 $15 + 15 + 19 + 19 = 68$  ✓

88. Guud Riter received \$400 dollars in advance plus \$2 for every internet download of his Ebook. How many downloads are need for Guud to make \$4200?

$$\begin{array}{r} 2x + 400 = 4200 \\ -400 \quad -400 \\ \hline 2x = 3800 \\ x = 1900 \end{array}$$

1900 Ebooks  
 must be downloaded.

89. The formula to convert degrees Celsius to degrees Fahrenheit is  $F = \frac{9}{5}C + 32$ . Use this formula to convert 102 Fahrenheit to degrees Celsius.

$$\begin{array}{r} 102 = \frac{9}{5}C + 32 \\ -32 \quad -32 \\ \hline 5(70 = \frac{9}{5}C) 5 \\ \hline 350 = 9C \\ \frac{350}{9} = \frac{9C}{9} \\ 38.\bar{8}^\circ \end{array}$$

Challenge #8:

90. Solve.  $4(m+3)=40$

$$\begin{array}{r} 4m + 12 = 40 \\ -12 \quad -12 \\ \hline 4m = 28 \\ \frac{4m}{4} = \frac{28}{4} \\ m = 7 \end{array}$$

check  $4(7+3)$   
 $4(10) = 40$  ✓

Write down the steps to solve the challenge to the left.

- ① Expand (x4)
- ② -12
- ③ ÷ 4

## Solving Linear Equations that include Brackets

<p>91. Solve. <math>4(m+3)=40</math>  <b>F.E.L.T.S.A.D.</b>                  Expand the left side.  <math>4m+12=40</math></p> <p>Subtract 12 from both sides  <math>4m+12-12=40-12</math>  <math>4m=28</math></p> <p>Divide both sides by 4.  <math>\frac{4m}{4} = \frac{28}{4}</math>  <math>m=7</math></p> <p>Check your answer by substituting <math>m=7</math> into the original equation.  <math>4(7+3)=40</math>  <math>m=7</math> is the solution.</p>	<p>92. <math>3(m-5)=25</math>  <math>3m-15=25</math>  <math>3m=40</math>  <math>m=\frac{40}{3}</math></p> <hr style="border-top: 1px dashed black;"/> <p>94. <math>\frac{6(m-5)}{6} = \frac{-6}{6}</math>  <math>m-5=-1</math>  <math>m=4</math> ✓</p> <p>OR <math>6m-30=-6</math>  <math>6m=24</math>  <math>m=4</math> ✓</p>	<p>93. <math>-5(m-1)=20</math>  <math>-5m+5=20</math>  <math>-5m=15</math>  <math>m=-3</math></p> <hr style="border-top: 1px dashed black;"/> <p>95. <math>-2(m-5)=25</math>  <math>-2m+10=25</math>  <math>-2m=15</math>  <math>m=\frac{-15}{2}</math> ✓ or <math>-7.5</math></p>
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### Challenge #9: Draw a picture to represent equation and solve.

Let  $\diamond = x$ ,  $\blacklozenge = -x$ ,  $\circ = 1$  and  $\bullet = -1$

96.  $3(x+2) = 9$

Solve for  $x = 1$

97.  $4(2-x) = 12$

Solve for  $x$ .  
 $-x = 1$   
 $x = -1$

98.  $3(x-7) = -9$

Solve for  $x = -10$

### Challenge #10:

99. Which of the following number(s) is a solution to  $m+5=2m+4$ ; -1, 1, 5

①  $(-1)+5 = 2(-1)+4$  X  
 $4 \neq -2+4$

①  $1+5 = 2(1)+4$  ✓  
 $6 = 2+4$

⑤  $5+5 = 2(5)+4$  X  
 $10 \neq 10+4$

Explain how to answer the question.

Plug each value in for  $m$  & see if the left side = the right side.

1 is the only solution.

## Solutions to Equations

### Definition:

A number is a **solution** to an equation if it can be substituted into the equation and make the left side of the equation equal the right side of the equation.

*Rewrite the above definition using your own words or an example.*

100. Is  $m=1$  a solution to  $m + 5 = 2m + 4$ ?

Let's check. When  $m=1$  is substituted into the equation, the left side is equal to the right side.

$$(1) + 5 = 6 \text{ and } 2(1) + 4 = 6$$

Since  $6 = 6$ ,  $m=1$  is a solution.

101. Is  $m=5$  a solution to  $m + 5 = 2m + 4$ ?

Let's check. When  $m=5$  is substituted into the equation, the left side does not equal the right side.

$$(5) + 5 = 10 \text{ and } 2(5) + 4 = 14$$

Since  $10 \neq 14$ ,  $m=5$  is not a solution.

State whether each number is a solution to each equation.

102. Is  $m=12$  a solution to the equation  $m + 2 = 14$ ?

$$12 + 2 = 14 \checkmark$$

yes

103. Is  $m=8$  a solution to the equation  $m - 2 = 10$ ?

$$8 - 2 \neq 10$$

NO

104. Is  $m=5$  a solution to the equation  $4m + 2 = 22$ ?

$$4(5) + 2 = 22 \checkmark$$

yes

105. Is  $m=5$  a solution to the equation  $2(m + 2) = 14$ ?

$$2(5 + 2) = 14$$

$$2(7) = 14 \checkmark$$

106. Is  $m=-2$  a solution to the equation  $m + 2 = 2m - 8$ ?

$$-2 + 2 = 2(-2) - 8$$

$$0 \neq -12$$

NO

107. Is  $m=1$  a solution to the equation  $4m + 2 = 2m - 8$ ?

$$4(1) + 2 = 2(1) - 8$$

$$6 \neq -6$$

NO

Solve each equation and check your answer.

108.  $-2(m - 5) = 24$

$$-2m + 10 = 24$$

$$-2m = 14$$

$$m = -7$$

Check

$$-2(-7 - 5)$$

$$-2(-12) = 24 \checkmark$$

109.  $-27 = 3(m + 3)$

$$-27 = 3m + 9$$

$$\begin{array}{r} -9 \\ -9 \end{array}$$

$$-36 = 3m$$

$$-12 = m$$

Check

$$-27 = 3(-12 + 3)$$

$$= 3(-9) \checkmark$$

110.  $-25 = -3(m - 5)$

$$-25 = -3m + 15$$

$$-40 = -3m$$

$$\frac{40}{3} = m \checkmark$$

Check

$$-25 = -3\left(\frac{40}{3} - 5\right)$$

$$= -40 + 15$$

$$= -25 \checkmark$$

111.  $3(m - 2) = -21$

$$m - 2 = -7$$

$$m = -5 \checkmark$$

Check

$$3(-5 - 2)$$

$$3(-7) = -21 \checkmark$$

**Challenge #11: How many  $\circ$  are needed to balance one  $\diamond$ ?**

Let  $\diamond = x$ ,  $\blacklozenge = -x$ ,  $\circ = 1$  and  $\bullet = -1$

112.

How many  $\circ$  are needed to balance one  $\diamond$ ?  $x = 2$

113.

How many  $\circ$  are needed to balance one  $\diamond$ ?  $x = 3$

114.

How many  $\circ$  are needed to balance one  $\diamond$ ?  $x = -1$

**Challenge #12: Write an equation and solve it by rearranging the algebra tiles.**

Let  $\boxed{+x}$ ,  $\boxed{-x}$ ,  $\boxed{+}$ ,  $\boxed{-}$

115.

Modify the algebra tiles to show how many one tiles would be needed to balance one x tile?

$x = 3$

116.

Modify the algebra tiles to show how many one tiles would be needed to balance one x tile?

$x = 2$

117.

Modify the algebra tiles to show how many one tiles would be needed to balance one x tile?

$-x = -3$   
 $x = 3$

**Challenge #13:**

118. Solve.  $6m+3=2m+15$

$$\begin{array}{r} 6m+3=2m+15 \\ -2m \quad -2m \\ \hline 4m+3=15 \\ 4m=12 \\ m=3 \end{array}$$

Write down the steps to solve the challenge to the left.

$$\begin{array}{l} -2m \text{ b.s.} \\ \hline +3 \text{ b.s.} \\ \hline \div 4 \text{ b.s.} \\ \hline \text{Check} \end{array}$$

Check your answer:

$$\left. \begin{array}{l} 6(3)+3 \\ 18+3 \\ 21 \checkmark \end{array} \right\} \left. \begin{array}{l} 2(3)+15 \\ 6+15 \\ 21 \checkmark \end{array} \right.$$

Solve equations that have variables on both sides.

119. Solve.  $6m+3=2m+15$

Subtract  $2m$  from both sides.

$$6m-2m+3=2m-2m+15$$

$$4m+3=15$$

Subtract three from both sides.

$$4m+3-3=15-3$$

$$4m=12$$

Divide both sides by 4.

$$\frac{4m}{4} = \frac{12}{4}$$

$$m=3$$

Check your answer by substituting  $m=3$  into the original equation.

$$6(3)+3=21 \quad 21=2(3)+15$$

$m=3$  is the solution.

120. Solve.  $5m+1=3m-7$

$$\begin{array}{r} -3m \quad -3m \\ \hline 2m+1 = -7 \\ 2m = -8 \\ m = -4 \end{array}$$

121. Solve.  $13m+5=11m-7$

$$\begin{array}{r} -11m \quad -11m \\ \hline 2m+5 = -7 \\ 2m = -12 \\ m = -6 \end{array}$$

122. Solve.  $2m+10=7m-15$

$$\begin{array}{r} -2m \quad -2m \\ \hline 10 = 5m + 15 \\ -15 \quad -15 \\ \hline -5 = 5m \\ -1 = m \end{array}$$

123. Solve.  $-3m+18=6m-6$

$$\begin{array}{r} +3m \quad +3m \\ \hline 18 = 9m - 6 \\ 24 = 9m \\ \frac{24}{9} = m \\ m = \frac{8}{3} \end{array}$$

124.  $2m+3=-7m-15$

$$9m+3 = -15$$

$$9m = -18$$

$$m = -2$$

125. Solve.  $2m+20=-7m-15$

$$\begin{array}{r} +7m \quad +7m \\ \hline 9m+20 = -15 \\ 9m = -35 \\ m = \frac{-35}{9} \end{array}$$

126. Solve.  $-3m-10=-7m-14$

$$\begin{array}{r} +7m \quad +7m \\ \hline 4m-10 = -14 \\ 4m = -4 \\ m = -1 \end{array}$$

127. Spot the error and solve.

$$3m+3=7m-12$$

~~$3m+3=7m-12$~~   
 ~~$3m-7m = -12-3$~~   
 ~~$-4m = -15$~~   
 ~~$m = \frac{15}{4}$~~   
 ~~$m = \frac{15}{4}$~~

$-4m+3 = -12$  ✓  
 $-4m = -15$  ✓  
 $m = \frac{4}{15}$  ✗  
 $m = \frac{15}{4}$  ✓

128. Spot the error and solve.

$$-24 = 3(m+2)$$

~~$-24m = 3m+6$~~   
 ~~$-27m = 6$~~   
 ~~$m = \frac{6}{27}$~~

$-24 = 3m+6$   
 $-30 = 3m$   
 $m = \frac{6}{27} = \frac{2}{9}$

129. Spot the error and solve.

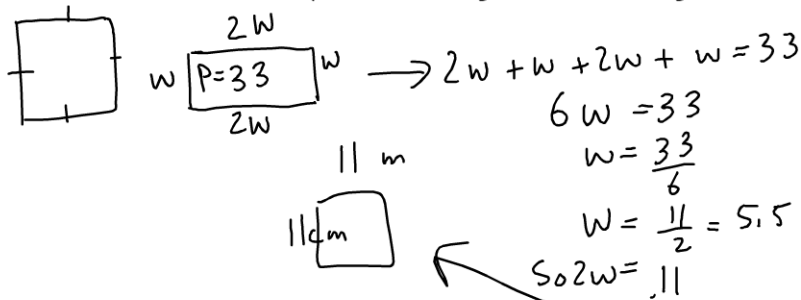
$$-5m+20=-7m-15$$

~~$+20 = -2m-15$~~   
 ~~$35 = -2m$~~   
 ~~$-35/2 = m$~~

$m = \frac{-35}{2}$  or  $-17.5$

Challenge #14:

130. A square sheet of paper is folded in half to form a rectangle. The perimeter of the rectangle is 33 cm. Determine the dimension of the square if the length of the rectangle is twice as long as the width?



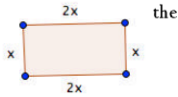
The Square is 11cm by 11cm

Solve using algebraic equations.

131. A square sheet of paper is folded in half to form a rectangle. The perimeter of the rectangle is 33 cm. Determine the dimensions of the square if the length of the rectangle is twice as long as the width?

Possible solution strategy:

Let the width =  $x$  and length =  $2x$   
 Perimeter = 33  
 $2x + 2x + x + x = 33$   
 $6x = 33$   
 $x = 5.5$   
 The dimensions of the rectangle are 5.5 cm by 11 cm. Therefore, the dimensions of the square is 11 cm by 11 cm.



132. Jon cycles 3 times further than he runs. Yesterday he biked and ran a total of 56 kilometers. How far did he run?

Let run =  $r$   
 cycle =  $3r$   
 $r + 3r = 56$   
 $4r = 56$   
 $r = \frac{56}{4}$   
 $r = 14$   
 He ran 14 km.

133. Daniel went to favorite clothing store. He knows he is going to spend at least \$200. He knows the owner will give him a 20% discount on anything he spends. How much can he spend before the discount if the total bill after the discount cannot pass \$500?

$x = \$$  above \$200  
 & he will only pay 80% of bill  
 $0.8(x + 200) = 500$   
 $0.8x + 160 = 500$   
 $0.8x = 340$   
 $x = 425$   
 He can spend  $200 + 425 = 625$

Solve for  $\diamond$  using algebra stones.

Let  $\diamond = x$ ,  $\blacklozenge = -x$ ,  $\circ = 1$  and  $\bullet = -1$

134. Solve for  $\diamond$ .

$4x + 3$        $3x + 7$

$x = 4$        $4(4) + 3 = 19 \checkmark$   
 $\diamond = \circ \circ \circ \circ$        $3(4) + 7 = 19 \checkmark$

135. Solve for  $\diamond$ .

$\diamond = \circ \circ$

136. Solve for  $\diamond$ .

Solve for  $x$  using algebra tiles.

Let  $+x$ ,  $-x$ ,  $+$ ,  $-$

137.  $4x - 5 = -13$

$x = -2$   
 $\square = \blacksquare$

138.

$6 = x$

139.

$x = 3$

## A Strategy to Consider

Now that the equations are getting more complex, it may be helpful to review these steps.

- Eliminate Fractions by multiplying both sides by the common denominator.
- Eliminate brackets by Expanding.
- Collect Like Terms on each side of the equal sign.
- Get variables to same side by Subtracting or Adding variables to each side.
- Get constants to same side by Subtracting or Adding constants to each side.
- Isolate the variable by Dividing both sides by the coefficient.

The acronym is FELTSAD\*. Some people have felt sad☹ until they figure out how to solve the equation. \*(Apply from left to right. The F and E can be applied in any order. The S and A can be applied in any order). Here is an example of this.

	$2(m-1) + \frac{5m}{2} = \frac{2}{3}(m+3)$	<i>This is a very difficult question. You will be able to do this at the end of this unit.</i>
F	$\left[ 2(m-1) + \frac{5m}{2} = \frac{2}{3}(m+3) \right] \times 6$	F. Fractions. Multiply each side by 6.
E	$12(m-1) + \frac{30m}{2} = \frac{12}{3}(m+3)$ $12(m-1) + 15m = 4(m+3)$	E. Expand. Eliminate the brackets.
LT	$12m - 12 + 15m = 4m + 12$	LT. Like Terms. Collect like terms on the left side.
S	$27m - 12 = 4m + 12$	S. Subtract. Subtract 4m from both sides.
A	$23m - 12 = 12$	A. Add. Add 12 to both sides.
D	$23m = 24$	D. Divide. Divide both sides by 23.
	$m = \frac{24}{23}$	Check your answer. This answer would be best checked with a calculator.

### Challenge #15:

140. Solve.  $2(m+1)+4m=4(m-2)+6$ .

$$\begin{array}{r}
 2m+2+4m=4m-8+6 \\
 6m+2=4m-2 \\
 \underline{-4m \quad -4m} \\
 2m+2=-2 \\
 \underline{-2 \quad -2} \\
 2m=-4 \\
 m=-2
 \end{array}$$

Write down the steps to solve the challenge to the left.

- ① Expand
- ② Collect like terms
- ③ Subtract 4m from b.s.
- ④ Subtract 2 from b.s.
- ⑤  $\div 2$       ⑥ Check answer



141. Solve.  $2(m+1)+4m=4(m-2)+6$ .

**F.E.L.T.S.A.D.**

Expand both sides.

$$2m+2+4m=4m-8+6.$$

Collect like terms on both sides.

$$6m+2=4m-2$$

Subtract 4m from both sides.

$$6m-4m+2=4m-4m-2$$

$$2m+2=-2$$

Subtract two from both sides and divide both sides by two.

$$2m+2-2=-2-2$$

$$2m=-4$$

$$\frac{2m}{2} = \frac{-4}{2}$$

$$m=-2$$

Check your answer.

$$M=-2$$

142. Solve.  $4(m-1)-6m=-10(2m-1)-1$

$$4m-4-6m=-20m+10-1$$

$$-2m-4=-20m+9$$

$$+20m \quad +20m$$

$$18m-4=9$$

$$+4 \quad +4$$

$$18m=13$$

$$m = \frac{13}{18}$$

143. Solve.  $3(m-1)+6m=5(2m-1)+1$

$$3m-3+6m=10m-5+1$$

$$9m-3=10m-4$$

$$-9m \quad -9m$$

$$-3=m-4$$

$$+4 \quad +4$$

$$1=m$$

144. Solve.  $3(m-1)+m=5(m-1)+3m$

$$3m-3+m=5m-5+3m$$

$$4m-3=8m-5$$

$$-4m \quad -4m$$

$$-3=4m-5$$

$$+5 \quad +5$$

$$2=4m$$

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

145. Spot the error:  $4(m-1)+2=3(2m-1)+1$

$$4(m-1)+2=3(2m-1)+1 \quad \checkmark$$

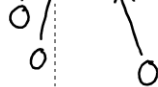
$$4m-4+2=6m-1+1 \quad \times$$

$$4m-2=6m+0 \quad \times$$

$$-2=2m \quad \times$$

$$-1=m \quad \times$$

$$m=-1$$



$$m=0$$

Solve.

146.  $2(m-1)+m=5(m-1)+3m$

$$2m-2+m=5m-5+3m$$

$$3m-2=8m-5$$

$$-3m \quad -3m$$

$$-2=5m-5$$

$$+5 \quad +5$$

$$3=5m$$

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

147.  $-2(m-1)+2=3(2m-1)+1$

$$-2m+2+2=6m-3+1$$

$$-2m+4=6m-2$$

$$+4=8m-2$$

$$+2 \quad +2$$

$$6=8m$$

$$\frac{6}{8} = m$$

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

148.  $5+5m-15=30-10$

$$5m-10=20$$

$$+10 \quad +10$$

$$5m=30$$

$$m=6$$

Solve for m.

149. Solve.

$$4m - 2 + 3m = -24 + 4$$

$$7m - 2 = -20$$

$$7m = -18$$

$$m = \frac{-18}{7}$$

150. Solve.

$$10 - 5m - 20 = 20 - 10$$

$$-5m - 10 = 10$$

$$\begin{array}{r} -5m - 10 = 10 \\ +10 \quad +10 \\ \hline -5m = 20 \end{array}$$

$$m = -4$$

151. Spot the error and solve.

$$4(m-1) + 2 = 2(5m-1) + 1$$

$$4m - 4 + 2 = 10m - 2 + 1 \quad \checkmark$$

$$4m - 2 = 10m + 1 \quad \times$$

$$-6m - 2 = 1 \quad \times$$

$$-6m = 3 \quad \times$$

$$m = 3/6$$

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

Challenge #16: Eliminating Fractions

152. Do not solve  $\frac{m}{3} = 5$ . In words

explain what you could do to eliminate the fraction.

⊗ both sides by 3

153. Do not solve  $\frac{2m}{5} = 4$ . In words

explain what you could do to eliminate the fraction.

⊗ both sides by 5

154. Do not solve  $\frac{m}{3} + \frac{2m}{5} = 2$ . In

words explain what you could do to eliminate the fractions.

⊗ both sides by 15

Challenge #17:

155. Solve  $\left(\frac{m}{3} + \frac{2m}{5} - \frac{1}{2} = 2\right) \cdot 30$

$$\frac{30m}{3} + \frac{60m}{5} - \frac{30}{2} = 60$$

$$10m + 12m - 15 = 60$$

$$22m = 75$$

$$m = \frac{75}{22}$$

Write down the steps to solve the challenge to the left.

- ① ⊗ b.s. by lowest common denominator
- ② Reduce
- ③ Collect like terms
- ④ Isolate m
- ⑤ check answer

Solving equations that require eliminating more than one fraction.

<p>156. Solve <math>\frac{m}{3} + \frac{2m}{5} - \frac{1}{2} = 2</math>.</p> <p><b>F.E.L.T.S.A.D.</b> Multiply both sides by 30.</p> $\left(\frac{m}{3} + \frac{2m}{5} - \frac{1}{2} = 2\right) \times 30$ <p>Multiply every term by 30.</p> $\frac{30m}{3} + \frac{60m}{5} - \frac{30}{2} = 60$ <p>Reduce.</p> $10m + 12m - 15 = 60$ <p>Collect like terms on the left side.</p> $22m - 15 = 60$ <p>Add 15 to both sides.</p> $22m = 72$ <p>Divide both sides by 22</p> $m = \frac{72}{22} = \frac{36}{11}$	<p>157. <math>\left(\frac{m}{2} + \frac{2m}{3} - \frac{1}{2} = 2\right) \times 6</math></p> $\frac{6m}{2} + \frac{12m}{3} - \frac{6}{2} = 12$ $3m + 4m - 3 = 12$ $7m = 15$ $m = \frac{15}{7}$	<p>158. <math>\left(\frac{5m}{2} + \frac{m}{3} = \frac{1}{2}m + 5\right) \times 6</math></p> $\frac{30m}{2} + \frac{6m}{3} = \frac{6}{2}m + 30$ $15m + 2m = 3m + 30$ $17m = 3m + 30$ $\begin{array}{r} 17m = 3m + 30 \\ -3m \quad -3m \\ \hline 14m = 30 \\ m = \frac{30}{14} \rightarrow \left(\frac{15}{7}\right) \end{array}$
<p>159. <math>\left(\frac{m}{3} + 5m = \frac{1}{2}m + 2\right) \times 6</math></p> $\frac{6m}{3} + 30m = \frac{6}{2}m + 12$ $2m + 30m = 3m + 12$ $32m = 3m + 12$ $\begin{array}{r} 32m = 3m + 12 \\ -3m \quad -3m \\ \hline 29m = 12 \\ m = \frac{12}{29} \end{array}$	<p>160. <math>\left(m - \frac{m}{3} = \frac{1}{4}m + 4\right) \times 12</math></p> $12m - \frac{12m}{3} = \frac{12}{4}m + 48$ $12m - 4m = 3m + 48$ $8m = 3m + 48$ $5m = 48$ $m = \frac{48}{5}$	

Challenge #18:

161. Solve  $\frac{m+2}{3} = \frac{2m-1}{5}$ .

Alternate Solution Strategy

$$\left(\frac{m}{3} + \frac{2}{3} = \frac{2m}{5} - \frac{1}{5}\right) \times 15$$

$$\frac{15m}{3} + \frac{30}{3} = \frac{30m}{5} - \frac{15}{5}$$

$$5m + 10 = 6m - 3$$

$$\begin{array}{r} 5m + 10 = 6m - 3 \\ -5m \quad -5m \\ \hline 10 = m - 3 \\ 13 = m \\ m = 13 \end{array}$$

Write down the steps to solve the challenge to the left.

- ① Break fractions apart
- ② ~~×~~ b.s. by LCD
- ③ reduce
- ④ Isolate m
- ⑤ check answer

- ①  $\left(\frac{m+2}{3} = \frac{2m-1}{5}\right) \times 15$
- ②  $\frac{15(m+2)}{3} = \frac{15(2m-1)}{5}$
- ③  $5(m+2) = 3(2m-1)$
- ④ Expand & solve

Solve for m.

Strategy #1 ↓

Strategy #2 ↓

162. Solve  $\frac{m+2}{3} = \frac{2m-1}{5} *$ .

**F.E.L.T.S.A.D.**

Multiply both sides by 15.

$$\left(\frac{m+2}{3} = \frac{2m-1}{5}\right) \times 15$$

Multiply every term by 15.

$$\frac{15(m+2)}{3} = \frac{15(2m-1)}{5}$$

Reduce and expand.

$$5(m+2) = 3(2m-1) *$$

$$5m + 10 = 6m - 3$$

Subtract 5m from both sides.

$$10 = m - 3$$

$$m = 13$$

\*This step could be achieved by cross-multiplying at the beginning.

163. Solve.  $\frac{6(5m+2)}{2} = \frac{6(3m-1)}{3}$

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

$$15m + 6 = 6m - 2$$

$$\frac{-6m \quad -6m}{9m + 6 = -2}$$

$$\frac{-6 \quad -6}{9m = -8}$$

$$m = \frac{-8}{9}$$

164. Solve.  $\frac{m+5}{4} = \frac{2m+4}{5}$

$$\left(\frac{m}{4} + \frac{5}{4} = \frac{2m}{5} + \frac{4}{5}\right) 20$$

$$\frac{20m}{4} + \frac{100}{4} = \frac{40m}{5} + \frac{80}{5}$$

$$5m + 25 = 8m + 16$$

$$25 = 3m + 16$$

$$9 = 3m$$

$$3 = m$$

165. Solve.  $\frac{15(2m-2)}{5} = \frac{15(-2m+1)}{3}$

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

$$6m - 6 = -10m + 5$$

$$16m - 6 = 5$$

$$16m = 11$$

$$m = \frac{11}{16}$$

166. Solve.  $\frac{3m+2}{3} = \frac{m+1}{5}$

$$\left(\frac{3m}{3} + \frac{2}{3} = \frac{m}{5} + \frac{1}{5}\right) 15$$

$$\frac{45m}{3} + \frac{30}{3} = \frac{15m}{5} + \frac{15}{5}$$

$$15m + 10 = 3m + 3$$

$$12m + 10 = 3$$

$$12m = -7$$

$$m = \frac{-7}{12}$$

167. Spot the error and solve.

$$\frac{m}{4} + 5m = \frac{1}{2}m + 2$$

$$\frac{4m}{4} + 5m = \frac{4}{2}m + 8$$

$$m + 5m = 2m + 8$$

$$4m = 8$$

$$m = 2$$

$$m = \frac{8}{19}$$

168. Spot the error and solve.

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

$$\frac{36m-24}{4} = \frac{-12m+12}{3} \checkmark$$

$$9m - 6 = -4m + 3$$

$$13m = 9$$

$$m = \frac{9}{13}$$

$$m = \frac{9}{13}$$

169. Solve.  $\left(\frac{5m}{2} + \frac{m}{5} = \frac{1}{2}m + 5\right) 10$

$$\frac{50m}{2} + \frac{10m}{5} = \frac{10}{2}m + 50$$

$$25m + 2m = 5m + 50$$

$$27m = 5m + 50$$

$$22m = 50$$

$$m = \frac{50}{22}$$

$$m = \frac{25}{11}$$

Solve for m.

170. Solve.  $\frac{m-2}{5} = \frac{-2m+1}{4}$

$$\frac{20(m-2)}{5} = \frac{(-2m+1)20}{4}$$

$$4(m-2) = (-2m+1)5$$

$$4m-8 = -10m+5$$

$$14m-8 = 5$$

$$14m = 13$$

$$m = \frac{13}{14} \checkmark$$

171. Solve.  $\left(\frac{m}{2} + \frac{2m}{3} - \frac{1}{4} = 1\right) 12$

$$\frac{12m}{2} + \frac{24m}{3} + \frac{12}{4} = 12$$

$$6m + 8m + 3 = 12$$

$$14m + 3 = 12$$

$$14m = 9$$

$$m = \frac{9}{14}$$

172. Solve.  $\frac{m+1}{5} = \frac{-3m+2}{3}$

$$\left(\frac{m}{5} + \frac{1}{5} = \frac{-3m}{3} + \frac{2}{3}\right) 15$$

$$\frac{15m}{5} + \frac{15}{5} = \frac{-45m}{3} + \frac{30}{3}$$

$$3m + 3 = -15m + 10$$

$$18m + 3 = 10$$

$$18m = 7$$

$$m = \frac{7}{18}$$

□ What should you do first? Expand or eliminate fractions? Does it matter? □

Challenge #19:

173. Solve  $\frac{2}{3}(m+5)+1=6$ .

$$\left(\frac{2}{3}m + \frac{10}{3} + 1 = 6\right) 3$$

$$2m + 10 + 3 = 18$$

$$2m + 13 = 18$$

$$2m = 5$$

$$m = \frac{5}{2} \checkmark$$

Write down the steps to solve the challenge to the left.

- 1 Expand by  $\frac{2}{3}$
- 2  $\times$  by 3
- 3 Reduce.
- 4 Collect like terms.
- 5 Isolate

Challenge #20: Use a different strategy than above.

174. Solve  $\left(\frac{2}{3}(m+5)+1=6\right) 3$

$$\frac{6}{3}(m+5)+3=18$$

$$2(m+5)+3=18$$

$$2m+10+3=18$$

$$2m+13=18$$

$$2m=5$$

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

Write down the steps to solve the challenge to the left.

- Multiply each term by 3.  $\left(\frac{2}{3}(m+5)\right), 1, 6$
- Reduce
- Expand.
- Collect like terms.
- Isolate.

Solve.

<p>175. Solve <math>\frac{2}{3}(m+5)+1=6</math></p> <p><b>F.E.L.T.S.A.D.</b> Expand the left side.</p> $\frac{2}{3}m + \frac{10}{3} + 1 = 6$ <p>Multiply both sides by 3.</p> $\left(\frac{2}{3}m + \frac{10}{3} + 1 = 6\right) \times 3$ $\frac{6}{3}m + \frac{30}{3} + 3 = 18$ <p>Reduce and collect like terms on the left side.</p> $2m + 10 + 3 = 18$ $2m + 13 = 18$ <p>Subtract 13 and divide by two.</p> $2m = 5$ $m = 2.5$	<p>176. Expand and then solve.</p> $\frac{2}{3}(m+4)-1=6$ $\left(\frac{2}{3}m + \frac{8}{3} - 1 = 6\right) \times 3$ $2m + 8 - 3 = 18$ $2m + 5 = 18$ $2m = 13$ $m = \frac{13}{2}$	<p>177. Expand and then solve.</p> $\frac{2}{3}(m+2)+3=9$ $\left(\frac{2}{3}m + \frac{4}{3} + 3 = 9\right) \times 3$ $2m + 4 + 9 = 27$ $2m + 13 = 27$ $2m = 14$ $m = 7$
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Eliminate fractions first!

<p>178. Solve <math>\frac{2}{3}(m+5)+1=6</math></p> <p><b>F.E.L.T.S.A.D.</b> Eliminate fractions by multiplying both sides by three.</p> $\left(\frac{2}{3}(m+5)+1=6\right) \times 3$ <p>Multiply each term by three.</p> $\frac{6}{3}(m+5)+3=18$ <p>Reduce, expand and collect like terms.</p> $2(m+5)+3=18$ $2m+10+3=18$ $2m+13=18$ <p>Subtract 13 and divide by two.</p> $2m=5$ $m=2.5$	<p>179. Eliminate fractions and then solve.</p> $\left(\frac{4}{6}(m+4)-1=6\right) \times 6$ $\frac{24}{6}(m+4)-6=36$ $4(m+4)-6=36$ $4m+16-6=36$ $4m+10=36$ $\frac{4m}{4} = \frac{26}{4}$ $m = \frac{13}{2}$	<p>180. Eliminate fractions and then solve.</p> $\left(\frac{1}{2}(m-2)+4=6\right) \times 2$ $\frac{2}{2}(m-2)+8=12$ $m-2+8=12$ $m+6=12$ $m=6$
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\*Which way do you like better? Expanding first or getting rid of fractions first?

Solve.

181. Spot the error and solve

$$\frac{1}{3}(m-2) + 4 = 6$$

$$\left(\frac{1}{3}(m-2) + 4 = 6\right) 3$$

$$\frac{3}{3} \frac{m-2}{3} + 12 = 18$$

$$3m - 6 + 12 = 18$$

$$3m + 6 = 18$$

$$3m = 12$$

$$m = 4$$

$$\boxed{m = 2}$$

182.  $\frac{3}{4}(m-1) + 4 = 6$

$$\left(\frac{3}{4}m - \frac{3}{4} + 4 = 6\right) 4$$

$$3m - 3 + 16 = 24$$

$$3m + 13 = 24$$

$$3m = 11$$

$$m = \frac{11}{3}$$

183.  $\left(\frac{5}{2}(m-2) + 2 = 5\right) 2$

$$5(m-2) + 4 = 10$$

$$5m - 10 + 4 = 10$$

$$5m - 6 = 10$$

$$5m = 16$$

$$m = \frac{16}{5}$$

184. Solve.

$$\frac{1}{2}(m-1) + 2 = \frac{1}{3}(m-2)$$

$$\left(\frac{1}{2}m - \frac{1}{2} + 2 = \frac{1}{3}m - \frac{2}{3}\right) 6$$

$$3m - 3 + 12 = 2m - 4$$

$$3m + 9 = 2m - 4$$

$$m + 9 = -4$$

$$\begin{array}{r} m + 9 = -4 \\ -9 \quad -9 \\ \hline m = -13 \end{array}$$

185. Solve.

$$\left(\frac{1}{3}(3m-2) + 2 = \frac{1}{2}(m-4)\right) 6$$

$$\frac{6}{3}(3m-2) + 12 = \frac{6}{2}(m-4)$$

$$2(3m-2) + 12 = 3(m-4)$$

$$6m - 4 + 12 = 3m - 12$$

$$6m + 8 = 3m - 12$$

$$3m + 8 = -12$$

$$\begin{array}{r} 3m + 8 = -12 \\ -8 \quad -8 \\ \hline 3m = -20 \\ m = \frac{-20}{3} \end{array}$$

186. Spot the error and solve.

$$\frac{1}{2}(m-1) + 2 = \frac{1}{5}(m-3)$$

$$\frac{m}{2} - \frac{1}{2} + \frac{2}{2} = \frac{m}{5} - \frac{3}{5}$$

$$\left(\frac{m}{2} - \frac{1}{2} + \frac{2}{2} = \frac{m}{5} - \frac{3}{5}\right) 10$$

$$\frac{10m}{2} - \frac{10}{2} + \frac{20}{2} = \frac{10m}{5} - \frac{30}{5}$$

$$5m - 5 + 20 = 2m - 6$$

$$5m + 15 = 2m - 6 \rightarrow 3m = -21$$

$$m = -7$$

$$m = \frac{-21}{3}$$

$$m = -7$$

## Solving Linear Equations Without Numbers

### Challenge #21:

187. Show that the solution to  $a(m+n)=h$  is

$$m = \frac{h-an}{a}$$

$$\begin{array}{r} am+an = h \\ -an \quad -an \\ \hline am = h-an \\ \hline m = \frac{h-an}{a} \end{array}$$

188. Is  $m = \frac{h-an}{a}$  the same as  $m = \frac{h}{a} - n$ ? How

do you know. *yes*

$$\begin{array}{r} \frac{h-an}{a} \\ \frac{h}{a} - \frac{an}{a} \\ \frac{h}{a} - n \end{array}$$



Solve for  $m$ .

189.  $m + 5 = 30$

$$m = 25$$

190.  $m - 5 = 30$

$$m = 35$$

191.  $5m = 30$

$$m = 6$$

192.  $\frac{m}{2} = 30$

$$m = 60$$

193.  $m + n = 30$   
 $-n \quad -n$

$$m = 30 - n$$

194.  $m - n = 30$   
 $+n \quad +n$

$$m = 30 + n$$

195.  $\frac{nm}{n} = \frac{30}{n}$

$$m = \frac{30}{n}$$

196.  $\left(\frac{m}{n} = 30\right)n$

$$m = 30n$$

197.  $m + n = x$   
 $-n \quad -n$

$$m = x - n$$

198.  $m - n = x$   
 $+n \quad +n$

$$m = x + n$$

199.  $\frac{nm}{n} = \frac{x}{n}$

$$m = \frac{x}{n}$$

200.  $\left(\frac{m}{n} = x\right)n$

$$m = xn$$

201.  $m + ng = x$   
 $-ng \quad -ng$

$$m = x - ng$$

202.  $m - ng = x$   
 $+ng \quad +ng$

$$m = x + ng$$

203.  $\frac{ngm}{ng} = \frac{x}{ng}$

$$m = \frac{x}{ng}$$

204.  $\left(\frac{m}{ng} = x\right)ng$

$$m = xng$$



Solve for m.

$$205. \begin{array}{r} 2m + 5 = 35 \\ -5 \quad -5 \\ \hline 2m = 30 \\ \frac{2m}{2} = \frac{30}{2} \\ m = 15 \end{array}$$

$$206. \begin{array}{r} 2m - 5 = 35 \\ +5 \quad +5 \\ \hline 2m = 40 \\ m = 20 \end{array}$$

$$207. \begin{array}{r} 2(m+1) = 30 \\ 2m+2 = 30 \\ 2m = 28 \\ m = 14 \end{array}$$

$$208. \begin{array}{r} \frac{m}{2} + 10 = 30 \\ -10 \quad -10 \\ \hline \frac{m}{2} = 20 \\ m = 40 \end{array}$$

$$209. \begin{array}{r} 2m + n = 35 \\ -n \quad -n \\ \hline 2m = 35 - n \\ \frac{2m}{2} = \frac{35 - n}{2} \\ m = \frac{35 - n}{2} \end{array}$$

$$210. \begin{array}{r} 2m - n = 35 \\ +n \quad +n \\ \hline 2m = 35 + n \\ \frac{2m}{2} = \frac{35 + n}{2} \\ m = \frac{35 + n}{2} \end{array}$$

$$211. \begin{array}{r} 2(m+n) = 30 \\ 2m+2n = 30 \\ 2m = 30 - 2n \\ \frac{2m}{2} = \frac{30 - 2n}{2} \\ m = \frac{30 - 2n}{2} \\ \text{or } m = 15 - n \end{array}$$

$$212. \begin{array}{r} \frac{m}{2} + n = 30 \\ -n \quad -n \\ \hline \left(\frac{m}{2} = 30 - n\right)^2 \\ m = 60 - 2n \end{array}$$

$$213. \begin{array}{r} Am + n = B \\ -n \quad -n \\ \hline \frac{Am}{A} = \frac{B-n}{A} \\ m = \frac{B-n}{A} \end{array}$$

$$214. \begin{array}{r} Am - n = B \\ +n \quad +n \\ \hline \frac{Am}{A} = \frac{B+n}{A} \\ m = \frac{B+n}{A} \end{array}$$

$$215. \begin{array}{r} A(m+n) = B \\ Am + An = B \\ -An \quad -An \\ \hline \frac{Am}{A} = \frac{B-An}{A} \\ m = \frac{B-An}{A} \\ \text{or } m = \frac{B}{A} - n \end{array}$$

$$216. \begin{array}{r} \frac{m}{A} + n = B \\ -n \quad -n \\ \hline \left(\frac{m}{A} = B - n\right) A \\ \frac{Am}{A} = AB - An \\ m = AB - An \end{array}$$

Challenge #22:

217. The formula  $F = \frac{9}{5}C + 32$  converts degrees

Celsius to degrees Fahrenheit. Solve for c and write a formula that converts Fahrenheit to Celsius.

$$\begin{array}{r} f = \frac{9}{5}C + 32 \\ -32 \quad -32 \\ \hline (f - 32 = \frac{9}{5}C) \cdot 5 \\ \frac{5(f - 32)}{5} = \frac{9C}{5} \\ c = \frac{5f}{9} - \frac{160}{9} \end{array}$$

Write down the steps to solve the challenge to the left.

- ① Subtract 32 from b.s.
- ② ~~×~~ b.s. by 5
- ③  $\div$  b.s. by 9

Rearrange a formula to solve equations

218. The formula  $F = \frac{9}{5}C + 32$  converts degrees Celsius to degrees Fahrenheit. Solve for  $c$  and write a formula that converts Fahrenheit to Celsius.

Possible solutions strategy:  
Subtract 32 from both sides.

$$F - 32 = \frac{9}{5}C$$

Multiply both sides by 5

$$(F - 32 = \frac{9}{5}C) \cdot 5$$

$$5(F - 32) = 9C$$

Divide both sides by 9.

$$\frac{5}{9}(F - 32) = C$$

Other strategies could lead to:

$$\frac{5F}{9} - \frac{160}{9} = C$$

219. The formula for the area of a triangle is  $A = \frac{bh}{2}$ . Annie knows the value of the area and the height. Write a formula to find the base value. (Solve for  $b$ .)

$$(A = \frac{bh}{2}) \cdot 2$$

$$\frac{2A}{h} = \frac{bh}{h}$$

$$b = \frac{2A}{h}$$

220. Determine the length of the base if the Area is  $46\text{cm}^2$  and the height is  $10\text{cm}$  long.

$$b = \frac{2(46)}{10}$$

$$b = 9.2$$

221. The formula for the perimeter of a rectangle is  $P = 2(w + l)$ , Sonil knows the perimeter and the length, write a formula to help him find the value of  $w$ . (Solve for  $w$ .)

$$P = 2w + 2L$$

$$P - 2L = 2w$$

$$\frac{P - 2L}{2} = w$$

222. Determine the width if the perimeter is  $59\text{cm}$  and the length is  $12\text{cm}$  long.

$$w = \frac{59 - 2(12)}{2}$$

$$= \frac{35}{2} = 17.5$$

Challenge #23:

223. Solve.  $\frac{M}{2} = \frac{3}{5}$

⊗  $\times$  by 10

$$\frac{10M}{2} = \frac{30}{5}$$

$$5M = 6$$

$$M = \frac{6}{5}$$

Cross ⊗

$$5M = 6$$

$$M = \frac{6}{5}$$

Write down the steps to solve the challenge to the left.

- ① ⊗ by 10
- ② Isolate.

224. Solve.  $\frac{1}{M} = \frac{3}{5}$

⊗  $\times$  by 5m

$$\frac{5M}{M} = \frac{15m}{5}$$

$$5 = 3m$$

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

Cross ⊗

$$5 = 3m$$

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

Write down the steps to solve the challenge to the left.

- ① ⊗ by 5m
- ② Isolate

Solve for M.

<p>225. <math>\frac{M}{2} = \frac{3}{5}</math></p> <p>Solution: Multiply by lowest common denominator.</p> $\left(\frac{M}{2} = \frac{3}{5}\right) \times 10$ $\frac{10M}{2} = \frac{30}{5}$ $5M = 6$ <p>Divide both sides by 5.</p> $M = \frac{6}{5}$	<p>226. <math>\frac{1}{M} = \frac{3}{5}</math></p> <p>Solution: Multiply by lowest common denominator.</p> $\left(\frac{1}{M} = \frac{3}{5}\right) \times 5M \rightarrow$ <p>Divide both sides by 3.</p> $\frac{5M}{3} = \frac{15M}{3}$ $M = 5$ <p>Divide both sides by 3.</p> $M = \frac{5}{3}$	<p>227. <math>\frac{5}{2} = \frac{M}{5}</math></p> $25 = 2m$ $\frac{25}{2} = m$	<p>228. <math>\frac{1}{2} = \frac{3}{M}</math></p> $m = 6$
<p>229. <math>\frac{M}{3} = \frac{3}{2}</math></p> $2m = 9$ $m = \frac{9}{2}$	<p>230. <math>\frac{5}{M} = \frac{3}{2}</math></p> $10 = 3m$ $\frac{10}{3} = m$	<p>231. <math>\frac{4}{3} = \frac{M}{5}</math></p> $20 = 3m$ $\frac{20}{3} = m$	<p>232. <math>\frac{2}{3} = \frac{5}{M}</math></p> $2m = 15$ $m = \frac{15}{2}$

Use the equation to the left to solve for M, B and A in the empty boxes.

<p>233. Solve for M.</p> $\frac{ABM}{AB} = \frac{C}{AB}$ $M = \frac{C}{AB}$	<p>234. Solve for B.</p> $\frac{ABM}{AM} = \frac{C}{AM}$ $B = \frac{C}{AM}$	<p>235. Solve for M.</p> $\left(\frac{M}{AB} = C\right) AB$ $\frac{MAB}{AB} = \frac{CAB}{AB}$ $M = CAB \checkmark$ $M = ABC \checkmark$	<p>236. Solve for B.</p> $\frac{M}{AB} = C$ <p>Hint: Cross multiply</p> $M = ABC$ <p>Divide both sides by AC.</p> $B = \frac{M}{AC}$
<p>237. Solve for M.</p> $M \left(\frac{AB}{M} = C\right) M$ $\frac{AB}{C} = \frac{CM}{C}$ $M = \frac{AB}{C}$	<p>238. Solve for B.</p> $\left(\frac{AB}{M} = C\right) M$ $\frac{AB}{A} = \frac{CM}{A}$ $B = \frac{CM}{A}$	<p>239. Solve for M.</p> $A \left(\frac{M}{A} = \frac{C}{B}\right) A$ $M = \frac{AC}{B}$	<p>240. Solve for B.</p> $\left(\frac{M}{A} = \frac{C}{B}\right) AB$ $\frac{MAB}{A} = \frac{CAB}{B}$ $\frac{MB}{M} = \frac{CA}{M}$ $B = \frac{CA}{M} \text{ or } \frac{AC}{M}$

$\frac{x+4}{4} \neq \frac{x+4}{A}$  because  $\frac{1+5}{5} = \frac{6}{5}$  Not  $\frac{1+5}{5} \neq \frac{2}{1}$

Visit [www.mathbeacon.ca](http://www.mathbeacon.ca) for support.

Solve for m.

241.  $A(M+N)=AB$

$$AM+AN=AB$$

$$\frac{AM}{A} = \frac{AB-AN}{A}$$

$$M = B - N$$

242.  $5M+2N=6B$

$$\frac{5M}{5} = \frac{6B-2N}{5}$$

$$M = \frac{6B-2N}{5}$$

243.  $2A(M-N)=8$

$$2AM-2AN=8$$

$$2AM = 8+2AN$$

$$M = \frac{8+2AN}{2AM} \text{ or } \frac{4+AN}{AM}$$

244.  $4N(A+M)=10$

$$4AN+4MN=10$$

$$\frac{-4AN}{-4AN} \quad \frac{-4AN}{-4AN}$$

$$\frac{4MN}{4N} = \frac{10-4AN}{4N}$$

$$M = \frac{10-4AN}{4N}$$

$$m = \frac{5-2AN}{2N}$$

245.  $A(N-M)=AB$

$$AN-AM=AB$$

$$\frac{-AM}{-A} = \frac{AB-AN}{-A}$$

$$M = -B + N$$

246.  $5M-2N=6B$

$$\frac{5M}{5} = \frac{6B+2N}{5}$$

$$M = \frac{6B+2N}{5}$$

## Introduction to Linear Inequalities

### Challenge #24:

247. Melanie is planning a snow boarding trip. She needs at least \$280 to go on the trip. Her know-it-all big brother writes a mathematical statement to express this situation.

Here is what he came up with:

- Let  $m$  = moneyneeded and  $m = \$ 280$

She really wants to correct him, but his answer seems right. Would you make any changes to the above statements?

$$m \geq \$280$$

$\$280$  or more

248. What does this picture mean?



Which of the following are true?

- A. 50 is a solution ✓
- B. -10 is a solution ✗
- C. 1 is a solution ✗
- D.  $x$  is greater than 1. ✓
- E.  $x$  is greater than or equal to one. ✗
- F.  $x < 1$  ✗
- G.  $x \leq 1$  ✗
- H.  $x > 1$  ✓
- I.  $x \geq 1$  ✗

A, D, H

249. Which letter or letters is(are) the best answer(s)?

D & F

Inequality notes:

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Use one of the symbols  $>$  or  $<$  to complete each inequality.

250. $5 < 9$	251. $20 > -4$	252. $5 > -10$	253. $11 > -13$	254. $-3 < -2$
255. $-4 > -7$	256. $-3 < 10$	257. $-7 < 3$	258. $24 > 12$	259. $5 < 5.1$

Define a variable and use of the symbols; =, ≠, >, ≥, <, & ≤, to represent each situation

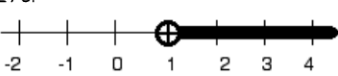
<p>260. Melanie needs at least \$280 for snow boarding.</p> <p>Let <math>x</math> = money needed*  <math>x \geq 280</math>  <small>*Any variable could be used as long as you define it</small></p>	<p>261. Dave Makes less than \$15 in tips per night</p> <p><math>t &lt; 15</math></p>	<p>262. Al Makes more than \$100 a day</p> <p><math>A &gt; 100</math></p>
<p>263. Baby david Weighs less than 12 pounds</p> <p><math>D &lt; 12</math></p>	<p>264. Joni Makes at least \$100 more per year than Jerry</p> <p><math>J \geq 100</math></p>	<p>265. Sall's minimum height is 148cm tall.</p> <p><math>S \geq 148</math></p>
<p>266. Hal Makes \$210 per day</p> <p><math>H = 210</math></p>	<p>267. Ray doesn't make more than \$120 a day.</p> <p><math>R \leq 120</math></p>	<p>268. Rita's maximum vertical leap is 20 inches</p> <p><math>R \leq 20</math></p>

Which of the statements is the given number a solution to?

<p>269. 3.5</p> <p>A. <math>x &gt; 2</math> ✓          B. <math>x \geq 4</math> ✗          C. <math>x \leq 3</math> ✗          D. <math>x &lt; -2</math> ✗</p> <p>A</p>	<p>270. 4</p> <p>A. <math>x &gt; 4</math> ✗          B. <math>x \geq 4</math> ✓          C. <math>x \neq 100</math> ✓          D. <math>x &lt; 4</math> ✗</p> <p>B, C</p>	<p>271. 7</p> <p>A. <math>x &gt; 6.99</math> ✓          B. <math>x \geq 7.01</math> ✗          C. <math>x \neq 7</math> ✗          D. <math>x \leq 7</math> ✓</p> <p>A, D</p>	<p>272. -2</p> <p>A. <math>x &gt; -1</math> ✗          B. <math>x \geq 3</math> ✗          C. <math>x \neq 7</math> ✓          D. <math>x \leq -1</math> ✓</p> <p>C, D</p>
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Challenge #25: Write each graph in words and as an equation or an inequality.

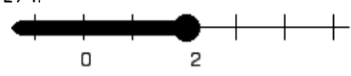
273.



Word Statement:  
Greater than 1

Inequality: Use symbols.  
 $x > 1$


274.



Word Statement:  
Less than or equal to 2

Inequality: Use symbols.  
 $x \leq 2$

275.

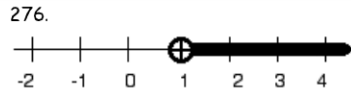


Word Statement:  
Does not equal -1

Inequality: Use symbols.  
 $x \neq -1$

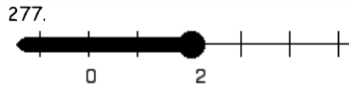
Graph each of the following statements on the number line.

- A solid dot is used on the number line for the following  $=, \leq, \geq$ .
- A hollow dot is used on the number line for the following  $>, <, \neq$ .



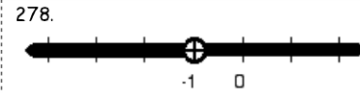
Word Statement:  
X is greater than 1.

Inequality:  $x > 1$   
(The hollow dot means not equal to, so  $\geq$  is not used)



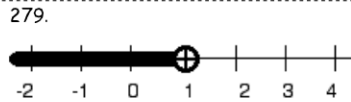
Word Statement:  
X is less than or equal to 2,

Inequality:  $x \leq 2$



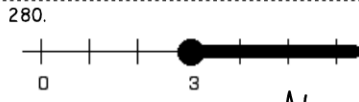
Word Statement:  
X does not equal 1,

Inequality:  $x \neq -1$



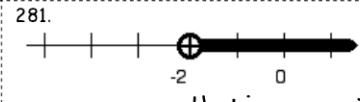
Word Statement: # less than 1

Inequality:  $x < 1$



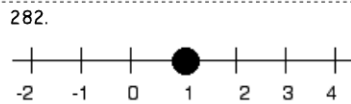
Word Statement: # equal to or greater than 3.

Inequality:  $x \geq 3$



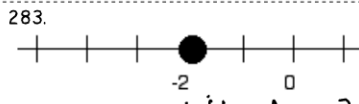
Word Statement: # bigger than 2.

Inequality:  $x > -2$



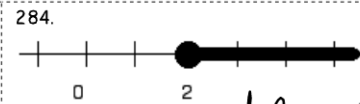
Word Statement: # that = 1

Inequality:  $x = 1$



Word Statement: # that = -2

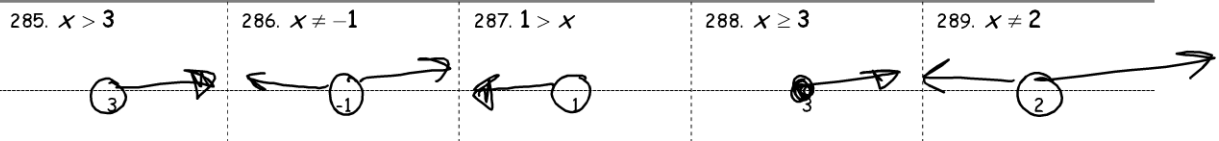
Inequality:  $x = -2$



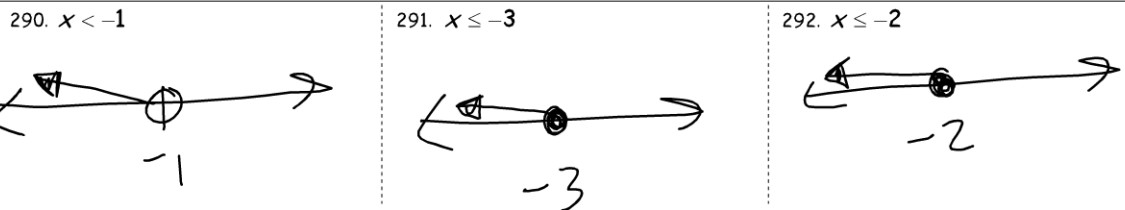
Word Statement: at least 2.

Inequality:  $x \geq 2$

Sketch a line graph to represent each inequality.



Sketch the each inequality



Use a symbol to write an inequality that corresponds to each statement

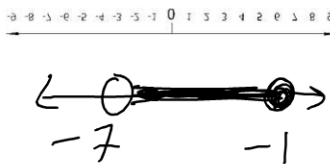
293. X is greater than 7. $x > 7$	294. 3.2 is less than or equal to x. $3.2 \leq x$	295. m is at most 7. $m \leq 7$	296. n is positive $n > 0$
297. y does not equal 2. $y \neq 2$	298. X is at least 4. $x \geq 4$	299. X is negative. $x < 0$	300. Y is equal to 4. $y = 4$

Challenge #26:

301. Write an inequality for all the numbers bigger than or equal to negative 4 and less than 11.

$$-4 \leq x < 11$$

302. Sketch  $-7 < x \leq -1$ .



303. Sellotz earns a 9% commission on all sales over \$5000. Write an inequality to represent all the dollar values that allows Sellotz to earn a commission.

Define the variable:

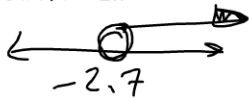
$x = \text{Sellotz gets a commission}$

Inequality:

$$x > 5000$$

Sketch a line graph to represent each inequality.

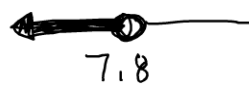
304.  $x > -2.7$



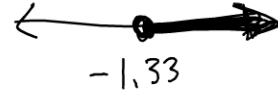
305.  $x \neq \frac{2}{5}$



306.  $7.8 > x$



307.  $x \geq -1.33$



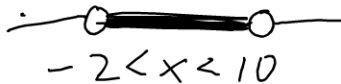
Write a compound inequality.

308. Write an inequality for all the numbers bigger than or equal to negative 4 and less than 11.

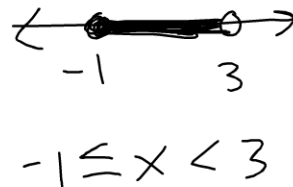
Possible solution strategy

- Bigger than or equal to  $-4 \rightarrow x \geq -4$
- Less than  $11 \rightarrow x < 11$
- Combine  $-4 \leq x < 11$

309. Write an inequality for all the numbers less than negative 10 and greater than negative 2.



310. Write an inequality for all the numbers that are at least -1 and less than 3.



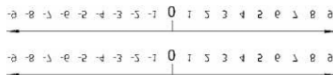


For each inequality, graph the possible values of  $x$  on the number line.

311.  $-7 < x \leq -1$

Possible solution Strategy:

- Graph  $x > -7$  and  $x \leq -1$



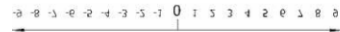
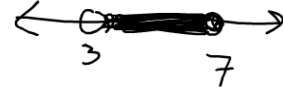
- The solution is the overlap.



312.  $-5 < x < 3$



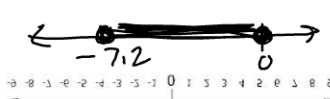
313.  $7 \geq x > 3$



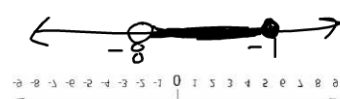
314. Approximate  $-4 < x < 3.8$  on the number line.



315. Approximate  $-7.2 \leq x \leq 0$  on the number line.



316. Approximate  $-1 \geq x > -8$  on the number line.



Define a variable and write an inequality to express each situation.

317. Sellotz earns a 9% commission on all sales over \$5000. Write an inequality to represent all the dollar values that allows Sellotz to earn a commission.

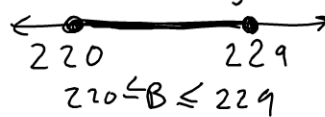
Possible solution Strategy:

Define the variable: C = Commission

Inequality:  $C \geq \$5000$

318. Bill cans pickled green beans. The mass must be between 220 grams and 229 grams or the can will be rejected by his supervisor. Express the inequality algebraically.

$B =$  Bean weight



319. Insurance companies charge more money for drivers who drive further. If you live further than 15km or more from your job the rate goes up. Express all the distances that will not lead to an insurance rate increase.

$L =$  Distances that get lower rate

$L < 15$

320. Grissinda is building a square pen for her pet hedge hog in her back yard. She has no more than 20m of fencing available. Write an inequality to represent all the possible side length.

$L =$  Possible side lengths

$0 < L < 20$

321. William wants to build a square patio for summer BBQs. The patio can be at most 16m<sup>2</sup>. Write an inequality to represent all the possible side lengths.

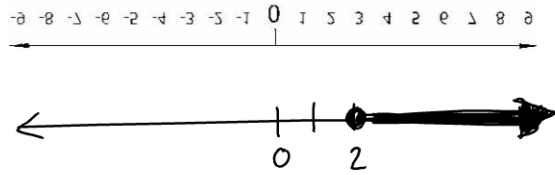
$L =$  P<sub>o</sub>

$0 < L < 16$

Inequalities that Include Addition and Subtraction

Challenge #27:

322. Solve  $x + 5 \geq 7$  on the number line.



Write  $x + 5 \geq 7$  in a more efficient way.

$$x \geq 2$$

Check three solutions from the simplified inequality with the initial inequality to test your answer.

$x = 5$   $5 + 5 \geq 7$  ✓  
 $x = 10$   $10 + 5 \geq 7$  ✓  
 $x = 100$   $100 + 5 \geq 7$  ✓  
 Answers will vary.

Generalize a rule for adding and subtracting rational numbers.

323. Given  $x + a > 5$  or  $x + a \geq 5$  explain what you need to do to isolate  $x$ .

Subtract  $a$  from both sides.

324. Given  $x - a > 5$  or  $x - a \geq 5$  explain what you need to do to isolate  $x$ .

add  $a$  to both sides.

Solve for  $x$  and verify your solution by substituting 3 different numbers into the inequality.

325.  $x + 5 \geq 7$

Possible solution strategy:

•  $x + 5 \geq 7$

Subtract five from both sides.

•  $x + 5 - 5 \geq 7 - 5 \rightarrow x \geq 2$

Test three numbers that are greater than or equal to 2. Eg 2, 3, & 10

$(2) + 5 \geq 7$   $(3) + 5 \geq 7$  &  $(10) + 5 \geq 7$

328.  $2x + 5 < 25$

$$\frac{2x + 5}{-5 \quad -5} < \frac{25}{-5}$$

$$2x < 20$$

$$x < 10$$

Check  $x = 0$  &  $x = -10$

326.  $x - 5 < -4$

$$+5 \quad +5$$

$$x < 1$$

Check  $x = 0$  &  $x = -10$

$0 - 5 < -4$  ✓  $-10 - 5 < -4$  ✓

327.  $\frac{2x}{2} > \frac{8}{2}$

$$x > 4$$

Check  $x = 10$  ✓  
 $x = 100$  ✓

329.  $3x - 2 \neq -20$

$$+2 \quad +2$$

$$3x \neq -18$$

$$x \neq -6$$

Check  $x = 10$  &  $x = -10$

330.  $\frac{2(x+5)}{2} < \frac{18}{2}$

$$x + 5 < 9$$

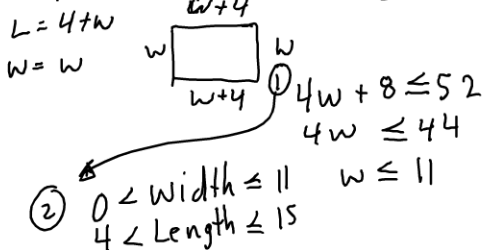
$$x < 4$$

$$x = 3$$
 ✓

$$x = 0$$
 ✓

Challenge #28:

331. Sargent has up to 50 meters of fencing material available to build a fence. He wants his fence to be 4 meters longer than it is wide. Write and solve an inequality to represent the possible side lengths.



332. A golf club charges a yearly fee of \$2000 plus \$100 for each round of golf. Ty Ger cannot afford anymore than \$4500 per year for golf. Express the number of rounds of golf he can play as an inequality.

$4500 \geq \text{\#rounds}(100) + 2000$  *yearly fee*

$$4500 \geq 100r + 2000$$

$$2500 \geq 100r$$

$$25 \geq r$$

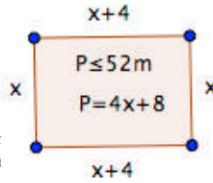
He can play at most 25 rounds

Define a variable, write an inequality and solve the inequality.

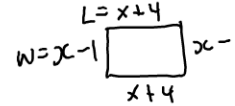
333. Sargent has up to 52 meters of fencing material available to build a fence. He wants his fence to be 4 meters longer than it is wide. Write and solve an inequality to represent the possible side lengths.

Possible solution strategy:  
Draw a picture! Many students forget that a rectangle has 4 sides ☹️  
Let width =  $x$  and Length =  $x+4$ .

Write an inequality:  
 $4x+8 \leq 52$   
 $4x \leq 44$   
 $x \leq 11$   
∴ The width must be less than or equal to 11 and the length must be less than or equal to 15.



334. A rectangle has a length of  $x+4$  cm and a width of  $x-1$  cm. Determine the possible values of  $x$  if the perimeter can be at most 48 cm long.



$48 \geq 4x + 6$   
 $42 \geq 4x$   
 $11.5 \geq x$   
 $L \leq 11.5 + 4 = 15.5$   
 $w \leq 11.5 - 1 = 10.5$

Dimensions  
 $5 \leq \text{Length} \leq 15.5$   
 $0 \leq \text{width} \leq 10.5$   
\* width  $\neq 0$   
\* length is 5 more than the width.

335. A golf club charges a yearly fee of \$2000 plus \$100 for each round of golf. Ty Ger cannot afford anymore than \$4500 per year for golf. Express the number of rounds of golf he can play this year as an inequality.

Possible solution strategy:  
Let  $x$  = number of rounds Ty can play.

Write an inequality:  
 $100x + 2000 \leq 4500$   
 $100x \leq 2500$   
 $x \leq 25$   
Ty can play no more than 25 rounds of golf this year.

336. When a number is tripled and then decreased by 7 the result is less than 29. Determine all the solutions.

$$3n - 7 < 29$$

$$3n < 36$$

$$n < 12$$

All #s less than 12 are solutions.

Challenge #29:

337. By observation circle all the numbers that are solutions to  $2x > 4$ .

..., ~~1~~, ~~2~~, ~~3~~, ~~4~~, ~~5~~, ~~6~~, ~~7~~, ~~8~~, ~~9~~, ~~10~~, ~~11~~, ~~12~~, ~~13~~, ~~14~~, ~~15~~, ~~16~~, ~~17~~, ~~18~~, ~~19~~, ~~20~~, ~~21~~, ~~22~~, ~~23~~, ~~24~~, ~~25~~, ~~26~~, ~~27~~, ~~28~~, ~~29~~, ~~30~~, ~~31~~, ~~32~~, ~~33~~, ~~34~~, ~~35~~, ~~36~~, ~~37~~, ~~38~~, ~~39~~, ~~40~~, ~~41~~, ~~42~~, ~~43~~, ~~44~~, ~~45~~, ~~46~~, ~~47~~, ~~48~~, ~~49~~, ~~50~~, ~~51~~, ~~52~~, ~~53~~, ~~54~~, ~~55~~, ~~56~~, ~~57~~, ~~58~~, ~~59~~, ~~60~~, ~~61~~, ~~62~~, ~~63~~, ~~64~~, ~~65~~, ~~66~~, ~~67~~, ~~68~~, ~~69~~, ~~70~~, ~~71~~, ~~72~~, ~~73~~, ~~74~~, ~~75~~, ~~76~~, ~~77~~, ~~78~~, ~~79~~, ~~80~~, ~~81~~, ~~82~~, ~~83~~, ~~84~~, ~~85~~, ~~86~~, ~~87~~, ~~88~~, ~~89~~, ~~90~~, ~~91~~, ~~92~~, ~~93~~, ~~94~~, ~~95~~, ~~96~~, ~~97~~, ~~98~~, ~~99~~, ~~100~~, ...

338. Now solve  $2x > 4$ .

$$x > 2$$

339. Are the numbers you circled solutions to the simplified inequality?

yes.

340. By observation circle all the numbers that are solutions to  $-3x > 6$ .

..., ~~1~~, ~~2~~, ~~3~~, ~~4~~, ~~5~~, ~~6~~, ~~7~~, ~~8~~, ~~9~~, ~~10~~, ~~11~~, ~~12~~, ~~13~~, ~~14~~, ~~15~~, ~~16~~, ~~17~~, ~~18~~, ~~19~~, ~~20~~, ~~21~~, ~~22~~, ~~23~~, ~~24~~, ~~25~~, ~~26~~, ~~27~~, ~~28~~, ~~29~~, ~~30~~, ~~31~~, ~~32~~, ~~33~~, ~~34~~, ~~35~~, ~~36~~, ~~37~~, ~~38~~, ~~39~~, ~~40~~, ~~41~~, ~~42~~, ~~43~~, ~~44~~, ~~45~~, ~~46~~, ~~47~~, ~~48~~, ~~49~~, ~~50~~, ...

341. Now solve  $-3x > 6$ .

$$x < -2$$

342. Are the numbers you circled solutions to the simplified inequality?

yes

When an inequality is multiplied or divided by a negative number, the inequality symbol changes direction. For example if  $-2x > 8$ , and  $x < -4$ .

343. Create a rule for multiplying or dividing by a negative number to determine the solution of an inequality:

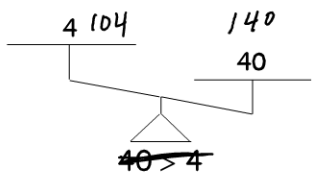
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Challenge #30:

344.

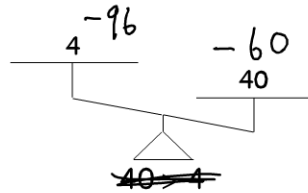


Increase both sides by 100.

$$104 < 140$$

Is the inequality still true?  
yes

345.

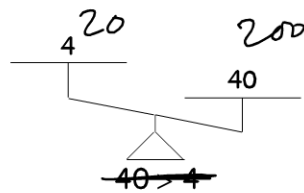


Decrease both sides by 100.

$$-96 < -60$$

Is the inequality still true?  
yes

346.

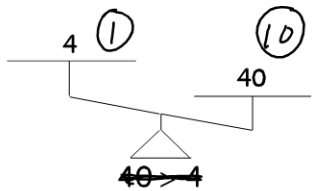


Multiply both sides by 5.

$$20 < 200$$

Is the inequality still true?  
yes

347.

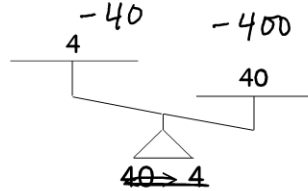


Divide both sides by 4.

$$1 < 10$$

Is the inequality still true?  
yes.

348.

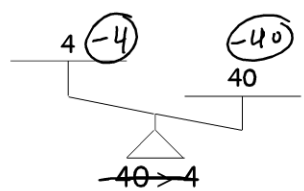


Multiply both sides by -10.

$$-40 \neq -400$$

Is the inequality still true?  
NO.  
 $-40 > -400$

349.



Divide both sides by -1.

$$-4 \neq -40$$

Is the inequality still true?  
NO  
 $-4 > -40$

350. When an inequality is multiplied or divided by a negative number what do you have to remember to do?  
Change the direction of the sign.

Describe what was done to the first inequality to result in the second inequality.

351.  $x + 4.5 > 7.8$   
 $x > 3.3$

$-4.5$

352.  $-2x < 18$   
 $x > -9$

$\div -2$

353.  $5x - 1 \leq 19$   
 $x \leq 4$

$+1$  & then  $\div 5$

True or false.

354. T or F.  
If  $x - 5 > 12$  then  
 $x > 17$ .

T

355. T or F.  
If  $x + 5 > -4$  then  
 $x < -9$ .

F  
 $x > -9$

356. T or F.  
If  $-2x > -10$  then  
 $x > 5$ .

F  
 $x < 5$

357. T or F.  
If  $-3x > -30$  then  
 $10 > x$ .

T  
 $x < 10$

358. T or F.  
If  $2(x - 5) > -14$  then  
 $(x - 5) < -7$ .

F.  
 $x - 5 > -7$

359. T or F.  
If  $-3x + 6 > -9$  then  
 $x - 2 < 3$ .

T  
 $\frac{-3x+6}{-3} > \frac{-9}{-3}$   
 $x - 2 < 3$  ✓

360. T or F.  
If  $-2(x + 6) > 16$  then  
 $-8 > x + 6$ .

T  
 $\frac{-2(x+6)}{-2} > \frac{16}{-2}$   
 $x + 6 < -8$   
 $-8 > x + 6$

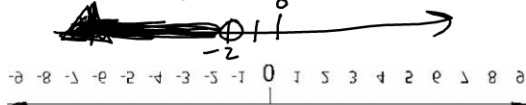
361. T or F.  
If  $x - 10 > 20$  then  
 $30 < x$ .

T.  
 $x > 30$

Challenge #31:

362. Solve  $-6m + 3 > 2m + 19$  and graph your solution on a number line.

$$\begin{array}{r} -6m + 3 > 2m + 19 \\ -2m \quad -2m \\ \hline -8m + 3 > +19 \\ -3 \quad -3 \\ \hline -8m > 16 \\ m < -2 \end{array}$$



Write down the steps to solve the challenge to the left.

- ① Subtract  $2m$  b.s.
- ② Subtract  $3$  b.s.
- ③  $\div$  b.s by  $-8$  & flip sign  $> \rightarrow <$
- ④ Graph.
- ⑤ Check answer.

## □ Solving Problems with Linear Inequalities □

Solve each inequality.

<p>363. Solve <math>-6m+3 &gt; 2m+19</math>.</p> <p>Subtract 2m from both sides.  <math>-6m-2m+3 &gt; 2m-2m+19</math>  <math>-8m+3 &gt; 19</math></p> <p>Subtract three from both sides.  <math>-8m+3-3 &gt; 19-3</math>  <math>-8m &gt; 16</math></p> <p>Divide both sides by -8 and flip the inequality.  <math>\frac{-8m}{-8} &lt; \frac{16}{-8}</math>  <math>m &lt; -2</math></p> <p>Check your answer by substituting any number less than -2 into both sides of the equation.</p>	<p>364. <math>-5m+3 \leq -7</math></p> $\begin{aligned} -5m &\leq -10 \\ m &\geq 2 \end{aligned}$	<p>365. <math>-24m+5 \geq -7</math></p> $\begin{aligned} -5 &-5 \\ \hline -24m &\geq -12 \\ m &\leq \frac{12}{24} = \frac{1}{2} \\ \hline m &\leq \frac{1}{2} \end{aligned}$
<p>366. <math>5m-1 &gt; -3m+2</math></p> $\begin{aligned} +3m &+3m \\ \hline 8m-1 &> 2 \\ 8m &> 3 \\ m &> \frac{3}{8} \end{aligned}$	<p>367. <math>-13m+5 \geq 11m-3</math></p> $\begin{aligned} -11m &-11m \\ \hline -24m+5 &\geq -3 \\ -24m &\geq -8 \\ m &\leq \frac{1}{3} \end{aligned}$	

Pay close attention! □ Bonnie thinks she has a really cool way of solving inequalities. □

368. Solve  $6m-2 < 3m-2$   
 Convert  $6m-2 < 3m-2$  to  $6m-2 = 3m-2$   
 $6m-2 = 3m-2$   
 $3m-2 = -2$   
 $3m = 0$   
 $m = 0$   
 Convert back  
 $m = 0$  convert back  $m < 0$

True.

370. Does her strategy work? Why or why not?  
 yes, because a negative was not  $\div$  or  $\times$ .

369. Solve  $-3m-5 < 1m-4$   
 Convert  $-3m-5 < 1m-4$  to  $-3m-5 = 1m-4$   
 $-3m-5 = 1m-4$   
 $-4m-8 = -4$   
 $-4m = 4$   
 $m = -1$   
 Convert back  
 $m = -1$  convert back  $m < -1$

Test point  $m = -2$   
 $-3(-2) - 5 < 1(-2) - 4$   
 $+1 < -6$   
 NO!!!

371. Does her strategy work? Why or why not?  
 No, A negative was divided. The answer is  $m > -1$ .

372. Which has more solutions  $2x+7=9$  or  $2x+7 > 9$ . Explain your answer.

$\begin{aligned} 2x+7 &= 9 \\ 2x &= 2 \\ x &= 1 \end{aligned}$ <p>1 solution</p>	$\begin{aligned} 2x+7 &> 9 \\ x &> 1 \end{aligned}$ <p>(infinite solutions)</p>
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Write down the steps to solve the challenge to the left.

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Solve each inequality on the number line.

373.  $-2x + 5 \geq -17$   
 $-2x \geq -22$   
 $x \leq 11$

374.  $2(x-5) - 3 < -12$   
 $2x - 10 < -15$   
 $2x < -5$   
 $x < -2.5$

375.  $-12x + 30 > 8x + 50$   
 $-8x - 8x$   
 $-20x + 30 > 50$   
 $-20x > 20$   
 $x < -1$

376.  $\left(-\frac{2x}{5} - 3 < x + 7\right) \cdot 5$   
 $-2x - 15 < 5x + 35$   
 $-7x - 15 < 35$   
 $-7x < 50$   
 $x > -\frac{50}{7}$

377. Spot the error.  
 $-7(x+2) \geq 5(x-1)$   
 $-7x - 14 \geq 5x - 5$   
 $-12x - 14 \geq -5$   
 $-12x \geq 9$   
 $x \leq 9/12 \rightarrow x \leq 0.75$   
 $\leq \leq$

378.  $-\frac{2}{3}(x+6) < 6$   
 $\left(-\frac{2}{3}x + 4 < 6\right) \cdot 3$   
 $-2x + 12 < 18$   
 $-2x < 6$   
 $x > -3$

Challenge #32:

379. Many banks now allow you to invest up to \$5000 per year in high interest savings accounts without being taxed. Saevmor, has already invested \$2320 this year. He is trying to put as much money as possible in this account. Write and solve an inequality to represent how much he can still invest without being taxed.  $x$  = amount he can invest.

$5000 \geq x + 2320$   
 $2680 \geq x$   
 $x \leq 2680$   
 He can invest at most \$2680.

380. Tok Alut, is trying to decide between two phone plans. His options include:

- Chatzilla economy plan: \$20/ month and \$0.80 for every minute above 300 minutes.
- Chatzilla premium plan: \$70/ month and \$0.10 for every minute above 300 minutes.

Write and solve an inequality to explain when it is more economical to choose the premium plan.

Economy =  $0.8m + 20$ .  $m$  = additional minutes.  
 Premium =  $0.1m + 70$ .

When is Economy < Premium  
 $(0.8m + 20 < 0.1m + 70) \cdot 10$   
 $8m + 200 < m + 700$   
 $7m < 500$   
 $m < 71.4286$ .

Economy is a better deal if talks at most 71 minutes.

Define a variable, write an inequality and solve each problem.

381. Many banks now allow you to invest up to \$5000 per year in high interest savings accounts without being taxed. Saevmor, has already invested \$2320 this year. He is trying to put as much money as possible in this account. Write and solve an inequality to represent how much he can still invest without being taxed.

Possible solution strategy:

Let  $x$  = the amount of money he can still invest  $x + 2320 \leq 5000$

$x \leq 2680$

Saevmor can still invest up to \$2680.

382. Suzy's shoes store pays there employees an hourly rate plus a bonus for sales over \$2500 per week. Niakee sold \$1882.75 in the first three days of the week. Write and solve an inequality to represent how what sale amounts will lead to a bonus.

$x$  = additional sales amounts that lead to bonus.

$$2500 \leq 1882.75 + x$$

$$617.25 \leq x$$

$$x \geq 617.25$$

She still needs to sell 617.25 to receive the bonus.

383. Tok Alut, is trying to decide between to phone planes. His options include:

- Chatzilla economy plan: \$20/ month and \$0.80 for every minute above 300 minutes.
- Chatzilla premium plan: \$70/ month and \$0.10 for every minute above 300 minutes.

Write an inequality to explain when it is more economical to choose the premium plan.

Possible solution strategy:

Let  $m$  = number of additional minutes.

Economy plan  $\rightarrow \$20 + 0.8m$

Premium plan  $\rightarrow \$70 + 0.1m$

Economy costs less than premium when:

$$\$20 + 0.8m < \$70 + 0.1m$$

$$\$20 + 0.7m < \$70$$

$$0.7m < \$50$$

$$m < 71.4285$$

The economy plan is a better deal if Tok plans to use less than 71 additional minutes or a total of 371 monthly minutes.

384. Gabmore Wireless charges \$40/ month plus \$0.50 for all minutes above 500 minutes per month. Budd Jet has decided that he does not want to pay more than \$60 per month. Write and solve an inequality to represent how many minutes she can use per month without going over her \$60 limit

$$\$60 \leq \$40 + 0.5m.$$

$$\$20 \leq 0.5m$$

$$40 \leq m$$

He can use 40 minutes above 500 for a total of 540 and still meet his budget.



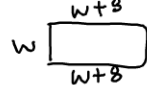
Define a variable, write an inequality and solve each problem.

385. When the difference of a number and seven is tripled the result is bigger than 45.

$$\begin{aligned} \text{triple}(\text{difference}) &> 45 \\ 3(n-7) &> 45 \\ 3n-21 &> 45 \\ 3n &> 66 \\ n &> 22 \end{aligned}$$

386. Wondorf has 64 meters of fencing material available to build a fence. He wants his fence to be 8 meters longer than it is wide. Write and solve an inequality to represent the possible side lengths.

$w = w$   
 $L = w + 8$



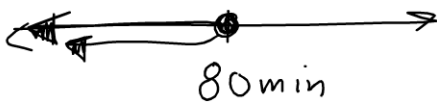
$4w + 16 \leq 64$   
 $4w \leq 48$   
 $w \leq 12$

$0 \leq \text{width} \leq 12$   
 $8 \leq \text{length} \leq 20$   
 \* Length is 8 longer than width.

387. Vertical Wireless charges \$50/ month plus \$0.25 for all minutes above 400 minutes per month. Frue Gal has decided that she does not want to pay more than \$70 per month. Write and solve an inequality to represent how many minutes she can use per month without going over her \$70 limit.

Approximate your solution on the number line.

$$\begin{aligned} \$70 &\geq 50 + 0.25m \\ 20 &\geq 0.25m \\ 80 &\geq m \end{aligned}$$



He can talk at most 80 min.

Solve each inequality to one decimal.

389. Solve.  $5.2m - 8.4 < 1.3m - 1.6$

$$\begin{aligned} 3.9m - 8.4 &< 1.6 \\ 3.9m &< 6.8 \\ m &< 1.7436 \\ m &< 1.7 \end{aligned}$$

390. Solve.  $2(m-1.4) < -7.3m + 8.5$

$$\begin{aligned} 2m - 2.8 &< -7.3m + 8.5 \\ 9.3m - 2.8 &< 8.5 \\ 9.3m &< 11.3 \\ m &< 1.2151 \\ m &< 1.2 \end{aligned}$$

391. Solve.  $-1.8m - 2.4 < 10(m - 2.6)$

$$\begin{aligned} -1.8m - 2.4 &< 10m - 26 \\ -11.8m - 2.4 &< -26 \\ -11.8m &< -23.6 \\ m &> 2 \end{aligned}$$

388. Bes Deal, is trying to decide between two phone plans. Her options include:

- Vertical budget plan: \$30/month and \$0.75 for every minute above 400 minutes.
- Vertical premium plan: \$60/ month and \$0.20 for every minute above 400 minutes.

Write and solve an inequality to explain when it is more economical to choose the premium plan. Approximate your solution on the number line.

$$\begin{aligned} \text{Premium} &< \text{Budget} \\ 60 + 0.2m &< 30 + 0.75m \\ 30 + 0.2m &< 0.75m \\ 30 &< 0.55m \\ 54.54 &< m \end{aligned}$$

Premium is better deal if you talk at least 55 minutes.

### Review Check List

Definitions:		Pg #	Face it ☺☹*
Go to page 3 and write down any definitions that you are unsure of.	Define each word and be able to show your understanding with examples.	3	

		Pg #	Face it ☺☹
Model the solution of a given linear equation using concrete or pictorial representations, and record the process.	Write an expression using algebra stones or algebra tiles to solve equations	4-7	
Determine, by substitution, whether a given rational number is a solution to a given linear equation.	Is $m=5$ a solution to the equation $2(m+2) = 14$ ?	12	
Solve a given linear equation symbolically.	Solve. $6m+3=2m+15$ .	13	
Identify and correct an error in a given incorrect solution of a linear equation	Spot the error and solve. $-5m+20=-7m-15$ $20=-2m-15 \rightarrow 5=-2m \rightarrow -5/2=m$	14,17 & 20	
Represent a given problem using a linear equation.	A number is multiplied by negative two and then decreased by five and the result is twenty-nine. Find the number.	21	
Solve a given problem using a linear equation and record the process.	Bock Sout has 68 meters of fencing to build a fence. He wants the length to be 4 meters longer than the width. Write an algebraic equation and determine the dimensions of the rectangular fence.	10	
Translate a given problem into a single variable linear inequality using the symbols $\geq$ , $>$ , $<$ , or $\leq$ .	Write an expression to represent the following statement: Melanie needs at least \$280 for snow boarding.	30	
Determine if a given rational number is a possible solution of a given linear inequality.	Which of the statements is 3.5 a solution to? $x > 2$ , $x \geq 4$ , $x \leq 3$ , $x < -2$	30	
Generalize and apply a rule for subtracting a positive or negative number to determine the solution of a given inequality.	Given $x + a > 5$ or $x + a \geq 5$ explain what you need to do to isolate x.	34	
Generalize and apply a rule for multiplying or dividing by a positive or negative number to determine the solution of a given inequality.	Create a rule for multiplying or dividing by a negative number to determine the solution of an inequality:	35	
Solve a given linear inequality algebraically and explain the process orally or in written form.	Solve $-6m+3>2m+19$ .	37	
Compare and explain the process for solving a given linear equation to the process for solving a given linear inequality.	Convert $-3m - 5 < 1m - 4$ to $-3m - 5 = 1m - 4$ and solve the equation. Can this strategy be used to solve the inequality?	38	
Graph the solution of a given linear inequality on a number line.	Solve $-2x + 5 \geq -17$ on the number line.	39	
Compare and explain the solution of a given linear equation to the solution of a given linear inequality.	Which has more solutions $2x + 7 = 9$ or $2x + 7 > 9$ . Explain your answer.	38	
Verify the solution of a given linear inequality using substitution for multiple elements in the solution.	Solve $x + 5 \geq 7$ for x and verify your solution by substituting 3 different numbers into the inequality.	34	
Solve a given problem involving a single variable linear inequality and graph the solution.	Vertical Wireless charges \$50/ month plus \$0.25 for all minutes above 400 minutes per month. Frue Gal has decided that she does not want to pay more than \$70 per month. Write an inequality to represent how many minutes she can use per month without going over her \$70 limit. Approximate your solution on the number line.	41	

\*Face it. When you have mastered the content draw a ☺ OR if you are unsure, draw a ☹ and ask for help.

### Practice Test

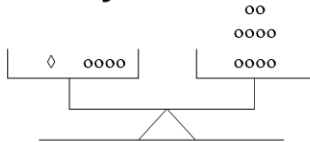
- Write this test and do not look at the answers until you have completed the entire test.
- Mark the test and decide whether or not you are happy with the result. FACE IT!
- Successful students will go back in the guidebook and review any questions they got wrong on this test.

Write an equation to represent each set of algebra stones.

Let  $\diamond = x$ ,  $\blacklozenge = -x$ ,  $\circ = 1$  and  $\bullet = -1$

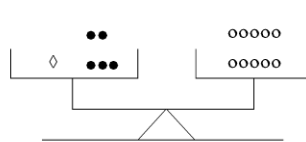
Write an equation:

392.  $x + 3 = 12$



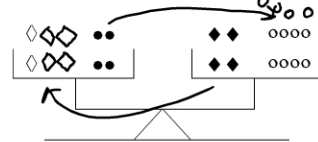
Solve for  $\diamond$ ?  $x = 9$

393.  $x - 5 = 10$



Solve for  $\diamond$ ?  $x = 15$

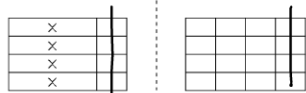
394.  $2x - 4 = -4x + 6$



Solve for  $\diamond$ ?  $x = 2$

Write an equation and solve it by rearranging the algebra tiles.

395.  $4x + 4 = 16$



Modify the algebra tiles to show how many one tiles would be needed to balance one x tile?

$x = 3$

Let  $\boxed{+x}$ ,  $\boxed{-x}$ ,  $\boxed{+}$ ,  $\boxed{-}$

396.  $-2x + 2 = 5x + 5$



Modify the algebra tiles to show how many one tiles would be needed to balance one x tile?

$-3x = -3$   
 $x = 1$

397.  $4x - 1 = 3x - 2$



Modify the algebra tiles to show how many one tiles would be needed to balance one x tile?

$x = -1$

Solve for the unknown.

398.  $5m - 15 = 40$

$+15 +15$   
 $5m = 55$   
 $m = 11$

399.  $\frac{2m}{3} - 5 = 25$

$3 \left( \frac{-2m}{3} = 30 \right) 3$   
 $-2m = 90$   
 $m = -45$

400.  $-2(m - 5) = 25$

$-2m + 10 = 25$   
 $-2m = 15$   
 $m = -\frac{15}{2}$  or  $-7.5$

401. Which of the following number(s) is a solution to  $m + 5 = 2m + 6$ ; -1, 1, 5

$\checkmark$  (-1)  $-1 + 5 = 2(-1) + 6$   
 $4 = 4$   
 $\times$  (1)  $1 + 6 = 2 + 6$  (-1)  
 $\times$  (5)  $5 + 5 = 10 + 6$

402. Do not solve  $\frac{m}{3} + \frac{2m}{5} = 2$ .

Explain what you could do to eliminate the fractions.

(X) both sides by 15.

403. Solve.  $-3m - 10 = -7m - 14$

$+7m +7m$   
 $4m + 10 = -14$   
 $-10 -10$   
 $4m = -24$   
 $m = -6$

Solve for m.

404.  $2(m+1)+4m=4(m-2)+6$ .

$$2m+2+4m=4m-8+6$$

$$6m+2=4m-2$$

$$2m+2=-2$$

$$\begin{array}{r} -2 \quad -2 \\ \hline 2m = -4 \end{array}$$

$$m = -2$$

405. Solve.  $\left(m - \frac{m}{3} = \frac{1}{4}m + 4\right) \cdot 12$

$$12m - \frac{12m}{3} = \frac{12m}{4} + 48$$

$$12m - 4m = 3m + 48$$

$$8m = 3m + 48$$

$$5m = 48$$

$$m = \frac{48}{5}$$

406. Solve.  $\left(\frac{m+2}{3} = \frac{2m-1}{5}\right) \cdot 15$

$$\frac{15m}{3} + \frac{30}{3} = \frac{30m}{5} - \frac{15}{5}$$

$$5m + 10 = 6m - 3$$

$$10 = m - 3$$

$$13 = m$$

407. Solve  $\left(\frac{2}{3}(m+5)+1=6\right) \cdot 3$

$$2(m+5)+3=18$$

$$2m+10+3=18$$

$$2m+13=18$$

$$2m=5$$

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

408. Solve for m.  $2(m+n)=a$

$$2m+2n=a$$

$$\frac{2m}{2} = \frac{a-2n}{2}$$

$$m = \frac{a-2n}{2}$$

409. Solve.  $\frac{c}{M} = \frac{ad}{b}$ . Solve for m

$$\frac{cb}{ad} = \frac{M}{ad}$$

$$M = \frac{bc}{ad}$$

410. Which of the following is 4 one of the solutions to:

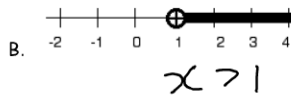
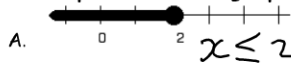
E.  $x > 4$

F.  $x \geq 4$  ✓

G.  $x \neq 100$  ✓

H.  $x < 4$  ✗

411. Write an inequality to represent each graph.



412. Write an inequality for all the numbers bigger than or equal to negative 4 and less than 11.

$$-4 \leq x < 11$$

413. Solve each inequality and state three rational numbers that are solutions to  $2x+5 < 25$ .

$$2x < 20$$

$$x < 10$$

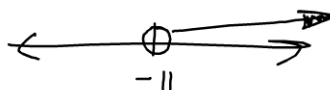
Possible solutions.

$$8, 4, 2$$

414. Solve  $-3x-4 < 29$  and express your answer on the number line.

$$-3x < 33$$

$$x > -11$$



415. Solve  $\left(-\frac{2x}{5} - 3 < x + 7\right) \cdot 5$  and

express your answer on the number line.

$$-\frac{10x}{5} - 15 < 5x + 35$$

$$-2x - 15 < 5x + 35$$

$$-7x - 15 < 35$$

$$-7x < 50$$

$$x < \frac{-50}{7}$$

Spot the error.

416. Spot the error and solve.

$$15 \downarrow \frac{m}{3} - 5 = 25$$

$$-m - 5 = 75$$

$$-m = 80 \quad \leftarrow 90$$

$$m = -80$$

$$m = -90$$

417. Spot the error and solve.

$$-7(x+2) \geq 5(x-1)$$

$$-7x - 14 \geq 5x - 5$$

$$-12x - 14 \geq -5$$

$$-12x \geq 9$$

$$\times \frac{1}{12} \rightarrow x \leq 0.75$$

$$\leq \leq$$

418. T or F.

If  $\frac{2(x+6)}{-2} > 16$  then  $-8 > x+6$ . T

419. T or F.

If  $-3x > -30$  then  $10 > x$ . T

$$\frac{-3x}{-3} > \frac{-30}{-3}$$

$$x < 10$$

420. Three times the opposite of a positive number increased by five is negative twenty-five. Find the number.

$$3(-n) + 5 = -25$$

$$-3n + 5 = -25$$

$$-3n = -30$$

$$n = 10$$

421. An author received \$6000 dollars in advance plus \$3 for sale of his new book. How many books must be sold for the author to make a total of \$9600?

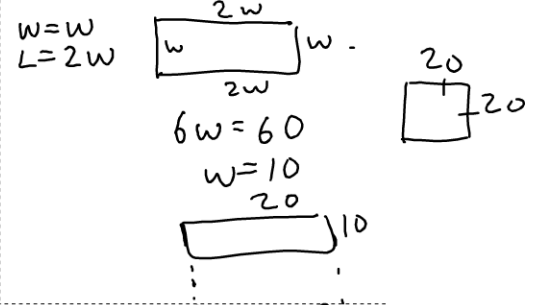
$$6000 + 3n = 9600$$

$$3n = 3600$$

$$n = 1200$$

He must sell 1200 workbooks.

422. A square sheet of paper is folded in half to form a rectangle. The perimeter of the rectangle is 60 cm. Determine the dimension of the square if the length of the rectangle is twice as long as the width?



423. Sargent has up to 50 meters of fencing material available to build a fence. He wants his fence to be 4 meters longer than it is wide. Define a variable, write and solve an inequality to represent the possible side lengths.

$w = w$   
 $L = w + 4$

$$4w + 8 = 50$$

$$4w = 42$$

$$w = \frac{42}{4} = \frac{21}{2} = 10.5$$

$$L = 10.5 + 4 = 14.5$$

$$0 < w \leq 10.5$$

$$4 < L \leq 14.5$$

424. Tok Lesh, is trying to decide between two phone plans. His options include:

- Chatzilla economy plan: \$30/ month and \$0.70 for every minute above 400 minutes.
- Chatzilla premium plan: \$80/ month and \$0.05 for every minute above 400 minutes.

Write and solve an inequality to explain when it is more economical to choose the premium plan.

Premium < Economy.

$$80 + 0.05m < 30 + 0.7m$$

$$8000 + 5m < 3000 + 70m$$

$$8000 < 3000 + 65m$$

$$5000 < 65m$$

$$76.92 < m$$

$m > 76.92$  Premium is better deal after 77 min.

Answer Key for this Guidebook will be uploaded  
for download for Sept. 1<sup>st</sup> 2009

Detailed web solutions will be available for Sept  
1<sup>st</sup> 2009