## Math 9 Notes - LG 8

Solving One Step Equations - Addition \& Subtraction
Watch: https://youtu.be/Efcmwu0QO3g


$$
\mathrm{An}=\mathrm{sign} \text { is kind of like a seesaw }
$$

So remember, whatever you do to one side you need to do to the other.

Solve means we find the value of unknown number (variable)
Opposite operations:

- opposite of addition is $\qquad$
- opposite of subtraction is $\qquad$

| $x+3=5$ | $g-2=4$ | $10=2+j$ | $5=y-7$ |
| :--- | :--- | :--- | :--- |

We can use the same method with fractions *remember to use a common denominator*
Review:
$\frac{3}{5}-\frac{1}{2}=$
$\frac{2}{3}+\frac{1}{2}=$

| $x-\frac{5}{6}=\frac{2}{6}$ | $m+\frac{1}{8}=\frac{3}{4}$ | $\frac{4}{5}=c+\frac{6}{10}$ |
| :--- | :--- | :--- |

## LG 8 Adapted - Algebra

Expectation \#1: Solve one-step linear equations with rational coefficients.

Algebraic equations are equations that have a letter or symbol that represents an unknown number. The goal of algebra is to find out what that unknown number is.

All techniques we use to find the unknown number try to get the letter (variable) alone. This way we know what one of the variables is worth.

## Solving Algebraic equations

## Example 1: Adding

$x+5=10$
We have a variable added with a number. To get the variable alone, we can subtract away the number (5).
But what we do to one side, we equally do to the other side.
$x+5=10$
$-5-5$


So, this means:


Example 2: Subtracting
$y-5=10$
We have a variable added with a number. To get the variable alone, we can add 5 to make it zero.
But what we do to one side, we equally do to the other side.


So, this means:


Name:

## Practice!

1) a) $x+4=12$
b) $z-5=9$
c) $h+4=-2$
d) $-6+c=-3$
е) $2=i+9$
f) $3+4=j+12$
${ }_{\mathrm{g}}{ }^{14-2}=g-5$
h) $a+3=26+7$
i) $f-6=40-6$

Answers:
a) $x=8$
b) $z=14$
c) $h=-6$
d) $\mathrm{c}=3$
e) $i=-7$
f) $j=-5$
g) $g=17$
h) $a=30$
i) $f=40$

Name: $\qquad$

Solve each equation.

1) $x+9=12$
2) $s-1=10$
3) $3=z-11$
4) $5+y=7$
5) $8=2+q$
6) $6=n-4$
7) $r-2=5$
8) $6=m+6$
9) $\mathrm{p}+7=8$
10) $4+a=13$

Name: $\qquad$
Answer Key One-Step Equations: Integers Add/Sub Level $1:$ S1

Solve each equation.

1) $x+9=12$
2) $s-1=10$
$x=3$
3) $3=z-11$
4) $5+y=7$
$z=14$
$y=2$
5) $8=2+q$
6) $6=n-4$
$q=6$
$\mathrm{n}=10$
7) $r-2=5$
8) $6=m+6$
$r=7$
$\mathrm{m}=0$
9) $\mathrm{p}+7=8$
10) $4+a=13$

$$
p=1
$$

$a=9$
2) For these ones, you will need to remember how to add and subtract fractions! Example:
$P+\frac{1}{4}=\frac{1}{2}$
We subtract $1 / 4$ on each side
$P=\frac{1}{2}-\square$
Make the bottoms the same by multiplying so they are both out of 4 . This can be done by multiplying each side by 2.

a) $K-\frac{2}{5}=\frac{3}{5}$
b) $F+\frac{1}{2}=\frac{7}{8}$
c) $C-\frac{3}{8}=\frac{5}{16}$
d) $\frac{2}{9}+F=\frac{1}{3}$
e) $\frac{1}{15}=B-\frac{4}{5}$
f) $\frac{2}{3}=\frac{1}{4}+I$
$\frac{21}{5}=I(y$
$\frac{51}{31}=81 a$
$\frac{b}{T}=1(P$
$\frac{91}{11}=010$
$\frac{8}{\varepsilon}= \pm 19 \quad T=21(0$

## One-Step Fraction Equations

Solve the following equations:
a) $x=\frac{1}{3}+\frac{4}{6}$
b)
$a+\frac{1}{2}=\frac{5}{2}$
c)
$y+\frac{1}{3}=\frac{8}{6}$
d) $w-\frac{4}{3}=\frac{10}{6}$
${ }^{\text {e) }} b-\frac{2}{6}=\frac{7}{3}$
f) $r-\frac{1}{4}=\frac{2}{3}$
g) $\frac{1}{2}=e-\frac{10}{4}_{\text {Һ) }} \frac{4}{7}=u+\frac{3}{14}_{\text {i) }}^{\frac{2}{3}=m+\frac{14}{21}}$
a) $x=\frac{1}{3}+\frac{4}{6}$
b) $a+\frac{1}{2}=\frac{5}{2}$
$\frac{5}{2}{ }^{\text {c) }} y+\frac{1}{3}=\frac{8}{6}$
$x=1$
$a=2$
$\mathrm{y}=1$
d)

$$
\begin{gathered}
w-\frac{4}{3}=\frac{10}{6} \quad \text { e) } b-\frac{2}{6}=\frac{7}{3} \quad r-\frac{1}{4}=\frac{2}{3} \\
\mathbf{w = 3}
\end{gathered}
$$

g) $\begin{array}{rlrl}\frac{1}{2}= \\ e=3 & e-\frac{10}{4} & \text { h) } \frac{4}{7} & =u+\frac{3}{14} \quad \text { i) } \quad \frac{2}{3}=m+\frac{14}{21} \\ u & =\frac{5}{14} & & \text { m=0 }\end{array}$

## Math 9 Notes - LG 8 <br> Solving One Step Equations - Multiplication \& Division (\& a lil 2-step)

Watch: https://youtu.be/Y2ZXS3dOnzs


Solve means we find the value of unknown number (variable)
Opposite operations:

- opposite of multiplying is $\qquad$
- opposite of dividing is $\qquad$

| $5 \mathrm{R}=15$ | $8=2 \mathrm{x}$ | $\frac{x}{3}=10$ | $\frac{x}{2}=6$ |
| :--- | :--- | :--- | :--- |

Cross Multiplication - use when two fractions are equal to each other (equivalent fractions)
$\frac{1}{2}=\frac{4}{8}$

$$
\frac{5}{6}=\frac{50}{60}
$$

| $\frac{x}{3}=\frac{4}{6}$ | $\frac{25}{5}=\frac{20}{x}$ | $\frac{1}{12}=\frac{x}{60}$ |
| :--- | :--- | :--- |

ONE STEP - CROSS MULTIPLY \& DIVIDE

$$
\frac{1}{2}=\frac{-}{10}=\frac{5}{10} \quad \frac{1}{2}=\frac{5}{2}=\frac{5}{10}
$$

| You |  |  |  |
| :--- | :--- | :--- | :--- |
| try: | $\frac{2}{3}=\overline{12}$ | $\overline{3}=\frac{4}{6}$ | $\overline{5}=4$ |

Example 3: Multiplying
$6 x=18$
Remember, when a number is directly next to a number, it means multiply. To get the variable alone, we can divide $6 x$ by 6 . This will give us 1 x . But what we do to one side, we equally do to the other side.

$$
6 x=18
$$

$\div 6 \div 6$


So, this means:


$$
\begin{aligned}
& \text { Example 4: Dividing } \\
& \frac{y}{4}=8
\end{aligned}
$$

Remember, when a number is directly next to a number, it means multiply.
To get the variable alone, we can divide $6 x$ by 6 . This will give us $1 x$.
But what we do to one side, we equally do to the other side.


So, this means:
$y=\square$

## Practice!

a) $2 x=8$
b) $\frac{x}{4}=4$
c) $7 g=42$
Divide each side by 2 .
Multiply each side by 4.
d) $6=\frac{w}{4}$
е) $\frac{r}{4}=9$
f) $11 i=55$
$s=3!$

カと $=$ M $/ \rho$
$\qquad$

## One-Step Equations: Integers

## Solve each equation.

1) $3 x=36$
2) $\frac{y}{9}=3$
3) $5 \mathrm{p}=25$
4) $14=\frac{a}{2}$
5) $\frac{r}{8}=4$
6) $24=6 c$
7) $\frac{q}{11}=1$
8) $8 u=40$
9) $10=\frac{w}{3}$
10) $7 z=7$

Name:
Answer Key

## One-Step Equations: Integers

Solve each equation.

1) $3 x=36$
2) $\frac{y}{9}=3$

$$
x=12
$$

$$
y=27
$$

3) $5 \mathrm{p}=25$
4) $14=\frac{a}{2}$

$$
p=5
$$

$$
a=28
$$

5) $\frac{r}{8}=4$
6) $24=6 c$

$$
r=32
$$

$$
c=4
$$

7) $\frac{q}{11}=1$
8) $8 u=40$

$$
q=11
$$

$$
\mathbf{u}=\mathbf{5}
$$

9) $10=\frac{w}{3}$
10) $7 z=7$

$$
w=30
$$

$$
z=1
$$

Name: $\qquad$

## One-Step Equations: Integers

Solve each equation.

1) $\mathbf{1 0}=\mathrm{z}+6$
2) $8 y=48$
3) $\mathrm{q}-12=1$
4) $18=\frac{a}{2}$
5) $\frac{r}{3}=7$
6) $\mathbf{1 1}=\mathrm{m}-4$
7) $t-19=2$
8) $1+s=3$
9) $24=4 \mathrm{c}$
10) $\frac{v}{5}=9$

Name : $\qquad$
Answer Key

## One-Step Equations: Integers

## Solve each equation.

1) $10=z+6$
2) $8 y=48$

$$
z=4
$$

3) $\mathrm{q}-12=1$
4) $18=\frac{a}{2}$

$$
q=13
$$

5) $\frac{r}{3}=7$
6) $\mathbf{1 1}=m-4$

$$
r=21
$$

$$
\text { 7) } t-19=2
$$

8) $1+s=3$

$$
t=21
$$

9) $24=4 \mathrm{c}$
10) $\frac{\mathrm{v}}{5}=9$

$$
c=6
$$

$$
v=45
$$

Math 9 Notes - LG 8
Solving Two Step Equations - Whole Numbers
Watch: https://youtu.be/njfnZLqyRvk
Opposite of addition is $\qquad$ $\&$ the opposite of subtraction is $\qquad$ .

Opposite multiplication is $\qquad$ \& the opposite of division is $\qquad$ .

When doing an inverse (opposite) operation we do it in the OPPOSITE order of BEDMAS! This means we do $\qquad$ before $\qquad$ _.

Goal: to solve for $\mathbf{x}$ (will look like $\mathbf{x}=$ ___) $\quad$|  | + | then | x | $\div$ |
| :--- | :--- | :--- | :--- | :--- |

| $4 x-2=10$ | $5=-3-2 x$ | $2+\frac{x}{3}=17$ | $9=\frac{y}{3}-5$ |
| :--- | :--- | :--- | :--- |

Examples with the variable as the denominator (on the bottom):

| $\frac{15}{x}=3$ | $\frac{14}{y}=7$ | $2+\frac{12}{x}=8$ |
| :--- | :--- | :--- |

Name:

## Side skill: turning whole numbers into fractions

You can turn any number into a fraction by putting it over 1.
Example and Practice:


12345

If the letter is on the bottom of a fraction:
Cross multiply! But how?
Example:

$$
\frac{20}{x}=5
$$

Step 1: Turn the 5 into a fraction (make it over 1)


Name:
TA:

Step 2: Multiply each bottom by the top on the other side of the equals sign. The answer to the multiply goes in the top spot.

$\Rightarrow \frac{20}{x}=\frac{5}{-}$
For the one with " $x$ ", imagine there is an invisible " 1 " in front of it.


$$
\Rightarrow \quad 20=5 x
$$

Solve the rest normally:
$20=5 x$


## Practice:

a)

b) $\frac{55}{z}=11$

Step 1: turn 4 into a fraction over 1. Step 2: divide each side by 4.
c) $\frac{27}{d}=-3$
d) 24
$\frac{24}{2 p}=4$
e) 30
$\frac{30}{3 y}=5$
f)


Warning, answer may be a fraction.



## Whole Numbers Over 1 and Cross Multiply

Make these numbers into fractions.
a) 5
b) 13
c) 2
d) 134
e) 1013
f) 1302031

Solve the following with cross multiplication.
a) $\frac{8}{x}=2$
b) $\frac{12}{x}=3$
c) $\frac{20}{x}=10$
d) $6=\frac{18}{x}$
e) $7=\frac{21}{y}$
f) $\frac{6}{x}=\frac{2}{3}$
g) $\frac{3}{4}=\frac{9}{a}$
Һ) $\frac{5}{6}=\frac{10}{c}$
i) $\frac{72}{6 c}=6$

Name:

## Answers

Make these numbers into fractions.
a) 5
b) 13
$\frac{13}{1}$
d) 134
e) 1013
1302031
$\frac{134}{1}$

c) 2
$\frac{2}{1}$
f) 1302031
1

Solve the following with cross multiplication.
a) $\frac{8}{x}=2$
b) $\frac{12}{x}=3$
c) $\frac{20}{x}=10$
$x=4$
$X=4$
$X=2$
d)

$$
6=\frac{18}{x}
$$

e) $7=\frac{21}{y}$
f) $\frac{6}{x}=\frac{2}{3}$
$X=3$
$y=3$
$X=9$
g)

$$
\frac{3}{4}=\frac{9}{a}
$$

h)
$\underset{\substack{ \\c=12}}{\frac{5}{c}}$
i) $\quad \begin{aligned} & \frac{72}{6 c}=6 \\ & c=2\end{aligned}$

## Checking your answer:

Two students are given the question:

## $12 H=48$

Bill thinks the answer is 2. Anis thinks the answer is 4 . Check their answers to see who is right.

Solution: Replace the variable $(H)$ with each of their numbers (Bill's number and then Anisa's number) to check if it makes sense.


1) Determine if the following answers make sense for each equation

| a) $3+x=20, x=17$ | b) | $\frac{f}{4}=12, f=32$ |
| :--- | :--- | :--- | :--- |
|  |  |  |
| c) $5 y=35, y=6$ | d) | $E-\frac{1}{3}=\frac{1}{2}, E=\frac{5}{6}$ |

2)Solve the following and check your answer.
a) $x+5=10$
b) $16=x-5$
c) $7 y=21$
d) $\frac{n}{4}=8$
e) $\frac{1}{4}+g=\frac{3}{4}$
f) $\frac{27}{d}=9$

$$
\begin{aligned}
& \delta=\rho \Leftrightarrow \quad \frac{T}{i}=b_{i} \\
& r \varepsilon=4\langle\rho \\
& \varepsilon=\{10
\end{aligned}
$$

## Expectation \#2: Solve two-step linear equations with rational coefficients.

Two step equations are simply questions that require two steps. This often combines the skills you have learned.

When solving each question, use your skills in the opposite order of operations.

Example:
$2 x+3=11$
Step 1: Start by using your adding/subtract skills before using your multiply/divide skills. So, let's subtract away the 3!
$2 x+3=11$
$-3 \quad-3$


So,


Step 2: Now, let's use our multiply/divide skills!

$$
2 x=8
$$

$\div 2 \div 2$
$\qquad$
$x=\square$

Name:

Practice:
a) $2 b-2=6$
b) $5 a+2=12$

Step 1: Add 2 to both sides

Step 2: divide each side by 2
c) $3 g-5=19$
d) $18=5 e+3$
e) $\frac{x}{4}-2=1$

Step 1: Add 2 to both sides

Step 2: multiply each side by 4
g) $5.5=1.5+2 r$
Step 1: subtract 1.5 from each side Step 2: divide each side by 2
$\qquad$

## Two-Step Equations: Whole Numbers

Solve each equation.

1) $9 c+1=10$
2) $6 y-5=7$
3) $8=3 a-4$
4) $\frac{m}{5}+9=11$
5) $13+7 x=27$
6) $17-q=6$
7) $\frac{n-31}{4}=2$
8) $1+2 r=35$
9) $42+5 t=8 t$
10) $4 p-3=17$
$\qquad$

## Answer Key

## Two-Step Equations: Whole Numbers

Solve each equation.

1) $9 c+1=10$
2) $6 y-5=7$
$c=1$
3) $8=3 a-4$
4) $\frac{m}{5}+9=11$
$a=4$

$$
m=10
$$

5) $13+7 x=27$
6) $17-q=6$
$x=2$
7) $\frac{n-31}{4}=2$
8) $1+2 r=35$
$n=39$
9) $42+5 t=8 t$
10) $4 p-3=17$
$t=14$
$p=5$

## Solving Two-Step Equations

Multiplication \& Division - Negative Coefficients
Name: $\qquad$ Date:
Solve the equations.
(1) $-3 x+20=-10$
(2) $25+10 x=-55$
(3) $-33=75+12 x$
(4) $5=\frac{x}{11}-1$
(5) $8=-6-2 x$
(6) $\frac{x}{3}+8=25$
(7) $-8 x+61=-35$
(8) $17=\frac{x}{5}+6$
(9) $-6 x-21=27$
(10) $\frac{x}{-8}+1=-2$
(11) $1+\frac{x}{-10}=-3$
(12) $10=\frac{x}{5}+2$
(13) $-63+9 x=27$
(14) $\frac{x}{4}-5=-12$
(15) $-5 x+18=-42$


## Solving Two-Step Equations

## Multiplication \& Division - Negative Coefficients

 ANSWERKEY隹
(1) $-3 x+20=-10$ $-3 x=-30$ $x=10$
(2) $25+10 x=-55$ $10 x=-80$ $x=-8$
(3) $-33=75+12 x$
$-108=12 x$ $-9=x$
(4) $5=\frac{x}{11}-1$
$6=\frac{x}{11}$
$66=x$
(5) $\begin{gathered}8=-6-2 x \\ 14=-2 x \\ -7=x\end{gathered}$
(6) $\frac{x}{3}+8=25$
$\frac{x}{3}=17$
$x=51$
(7) $\begin{gathered}-8 x+61=-35 \\ -8 x=-96 \\ x=12\end{gathered}$
(8) $17=\frac{x}{5}+6$
$11=\frac{x}{5}$
$55=x$
(9) $-6 x-21=27$
$-6 x=48$ $x=-8$
(10) $\frac{x}{-8}+1=-2$

$$
\begin{gathered}
\frac{x}{-8}=-3 \\
x=24
\end{gathered}
$$

(11) $1+\frac{x}{-10}=-3$

$$
\begin{aligned}
& \frac{x}{-10}=-4 \\
& x=40
\end{aligned}
$$

(12) $10=\frac{x}{5}+2$
$8=\frac{x}{5}$
$40=x$
(13)

$$
\begin{array}{cc}
-63+9 x=27 & \text { (14) } \frac{x}{4}-5=-12 \\
9 x=90 & \frac{x}{4}=-7 \\
x=10 & x=-28
\end{array}
$$

(15) $-5 x+18=-42$
$-5 x=-60$
$x=12$

## Math 9 Notes - LG 8

Solving Two Step Equations - Distributive Property Watch: https://www.youtube.com/watch?v=bonzMy_1vGs\&t=2s


Review: $2(x+3)$
$(5-x)(6)$

$$
\frac{1}{2}(x-4)
$$

Use distributive property $1^{\text {st }}$ and then solve. Remember to use the opposite order of operations.


| $2(x+1)=8$ | $3(2 x+4)=18$ | $20=4(2 x-5)$ |
| :--- | :--- | :--- |

Expectation \#3: Solve multi-step linear equations with rational coefficients (using the distributive law).
Recall distributive property/law: when you have a number outside of the brackets, it means multiply the number into each term inside the brackets.

Below are two methods to solve a question that uses distributive law.
Example: $3(x+4)=18$

## Method 1

Step 1: Multiply the number into each term in the brackets.

$$
\begin{aligned}
& (3)(x)=3 x \\
& (3)(4)=12
\end{aligned}
$$

So, we end up with:


Step 2: Solve the rest with regular algebra rules Subtraction:
$3 x+12=18$
$-12 \quad-12$

## $\mathbf{3 x}=\square$

Divide:

$$
3 x=6
$$

$$
\div 3 \quad \div 3
$$

$$
x=\square
$$

Method 2
*only use when the variable " $x$ " is inside the brackets
Step 1: Divide each side by the number outside the brackets


Step 2: solve the rest with regular algebra rules
Subtraction:

$$
\begin{gathered}
x+4=6 \\
-2 \quad-2 \\
x=\square
\end{gathered}
$$

## Practice:

b) $5(y-2)=25$
a) $2(x+4)=16$

Step 1: divide each side by 2
Step 2: subtract 4 from both sides

Step 1: multiply 5 by " $y$ " and 2
Step 2: add 10 to both sides
Step 3: divide each side by 5
c) $30=5(x-3)$
d) $32=4(2 k+2)$
e) $4(2 x+3)=12$
f) $3(2 h-9)=3$
g) $\quad \frac{1}{3}(3 x+9)=8$

Step 1: multiply each side by 3 Step 2: subtract 9 from both sides Step 3:?
h) $\frac{1}{4}(8 g+4)=5$

## Distributive Property Algebra

Solve the following equations:
a) $x=2(3+4)$
b) $20=2(x+5)$
c) $6=3(y-3)$
d) $12=4(z-7) \quad$ e) $24=3(u+5) \quad$ f) $\quad 22=2(r+4)$
g) $30=15(e-1)$ һ) $4(d+3)=36 \quad$ i) $\quad 5(x-1)=0$
j) $3(2 x+4)=36$
k) $6(2 x-3)=6$
$5(2 x-20)=0$

Solve the following equations:
a) $x=2(3+4)$
b) $20=2(x+5)$
c) $6=3(y-3)$
$x=14$
$x=5$
$y=5$
d) $12=4(z-7)$
e) $24=3(u+5) \quad$ f) $22=2(r+4)$
$z=10$
$u=3$
r=7
g) $30=15(e-1)$ h) $4(d+3)=36 \quad$ i) $\quad 5(x-1)=0$
$\mathrm{e}=3$
$d=6$
$x=1$
j) $\quad 3\left(\begin{array}{c}2 x+4) \\ \mathrm{x}=4\end{array}\right.$
k) $6(\underset{\mathrm{x}=2}{ }(2 x-3)=6$
$5(2 x-20)=0$
$\mathrm{x}=10$

