## Section 3.3b - Inequalities and Word Problems

This booklet belongs to: $\qquad$ Block: $\qquad$

- Inequalities are equations that give a range of possible answers

Here is how we define them:
$x>4 \quad>$ mean strictly greater than 4
$t<2 \quad<$ mean strictly less than 2
$r \leq 3 \quad \leq$ mean less than or equal to 3
$q \geq-7 \geq$ mean greater than or equal to -7


So, we treat the inequality symbol exactly the same as an equal sign when applying our Algebraic Logic. There is one minor detail that changes; stay tuned.

Example 1: Solve for the unknown in the equation: $t+7>4$

## Solution 1:

- Subtract 7 from both sides

$$
\begin{gathered}
t+7-7>4-7 \\
t>-3
\end{gathered}
$$

- It graphs like this:


Example 2: $\quad$ Solve for the unknown in the equation: $\quad \frac{r}{4} \leq 7$

## Solution 2:

$4 \cdot \frac{r}{4} \leq 7 \cdot 4$
$r \leq 28$


Example 3: $\quad$ Solve for the unknown in the equation: $3 t-5 \geq 4$

## Solution 3:

$$
\begin{aligned}
& 3 t-5+5 \geq 4+5 \\
& 3 t \geq 9 \\
& \frac{3 t}{3} \geq \frac{9}{3} \\
& t \geq 3
\end{aligned}
$$



* If at any point you MULTIPLY OR DIVIDE by a NEGATIVE, you FLIP the inequality
* Manipulation of MULTI-STEP questions all works the same. Just don't forget to FLIP the inequality when every time you multiply or divide by a NEGATIVE.

Example 4: $\quad$ Solve for the unknown in the equation: $\quad-3 m \geq 12$

## Solution 4:

$\frac{-3 m}{-3} \geq \frac{12}{-3}$
$m \leq-4$

Example 5: $\quad$ Solve for the unknown in the equation: $\quad-\frac{1}{4} r-\frac{2}{3} \geq \frac{1}{6}$

## Solution 5:

$$
\begin{aligned}
& 12 \cdot-\frac{1}{4} r-\frac{2}{3} \cdot 12 \geq \frac{1}{6} \cdot 12 \\
& -\frac{12}{4} r-\frac{24}{3} \geq \frac{12}{6} \\
& -3 r-8 \geq 2 \\
& -3 r-8+8 \geq 2+8 \\
& -3 r \geq 10 \\
& \frac{-3 r}{-3} \geq \frac{10}{-3} \quad \rightarrow \quad r \leq-\frac{10}{3}
\end{aligned}
$$

- Multiply everything by the LCM:12
- Multiply to the NUMERATOR only
- Simplify the Fractions
- Add 8 to both sides of the equation
- Divide both sides by -3
- Since we divided by a negative we have to FLIP the inequality


## Word Problems

* The hard part is converting the words to variables and numbers
* Start by identifying your unknowns and any other unknown with respect to your first one (you'll see in an example)


## Example 6:

A number multiplied by 2 and then adding 7 results in 23 , what is the number?

## Solution 6:

- How do I write this?
- Follow along

Let n be our number
$n$

Multiplied by two means
$2 n$
Adding 7
Result is 23
$2 n+7$
$=23$

So,

$$
\begin{gathered}
2 n+7=23 \\
2 n+7-7=23-7 \\
2 n=16 \\
\frac{2 n}{2}=\frac{16}{2} \\
n=8
\end{gathered}
$$

## Example 7:

The sum of 3 consecutive numbers is 48 . What are the numbers?

## Solution 7:

- Consecutive means one right after another so, if my first number is $n$ :

I have: $n$

$$
n+1 \quad n+2
$$

Sum means addition:

$$
\begin{aligned}
& n+n+1+n+2=48 \rightarrow \quad 3 n+3=48 \\
& 3 n=45 \\
& \frac{3 n}{3}=\frac{45}{3} \quad \rightarrow \quad n=15 \text { The Numbers are: } \\
& 15,16, \text { and } 17
\end{aligned}
$$

## Section 3.3b - Practice Questions

- Inequalities represent an equation where one side is either greater than, lesser than or equal to the other side.
- The rules and logic of balance still work the same way.


## EMERGING LEVEL QUESTIONS

1. $x+3>7$
2. $3 x \leq 12$
3. $\quad \frac{x}{4} \leq 12$
4. $t-7<-4$
5. $-5 q \geq 13$
6. $3(d+4) \geq 15$

## PROFICIENT LEVEL QUESTIONS

7. $\frac{2}{3} t+\frac{1}{4}<2$


## EXTENDING LEVEL QUESTIONS

9. $\frac{2}{3}\left(\frac{1}{4}-\frac{1}{6} t\right) \geq \frac{1}{3}$
10. $\frac{1}{2}\left(\frac{2}{3}-\frac{4}{7} t\right) \geq \frac{1}{3}$

## Word Problems

Discover the equation in the following sentences. Then solve.
11. You open a book and the sum (addition) of the two pages is 111 . What are the two pages?
12. In Victoria, a taxi charges $\$ 3.00$ and then $\$ 0.60$ for every kilometer you travel. How far can you go for \$19.20?
13. The second angle of a triangle is four times as large as the first angle. The third angle is 30 degrees bigger than the first. What are the measurements of the three angles? (Angles in a triangle add to 180 degree)
14. If I have $\$ 2.05$ and there are 3 dimes in the pile, how many quarters do I have?
15. If you double a number and add 36 , you get five times the original number. What is the original number?
16. Three consecutive numbers such that first number plus twice the second, plus five less than the third is 27. What are the three numbers?

Answer Key - Section 3.3b

| 1. $x>4$ | 2. $t<3$ | 3. $x \leq 4$ | 4. $q \leq-\frac{13}{5}$ |
| :---: | :---: | :---: | :---: |
| 5. $x \leq 48$ | 6. $d \geq 1$ | 7. $t<\frac{21}{8}$ | 8. $z \geq-\frac{5}{2}$ |
| 9. $t \leq-\frac{3}{2}$ | 10. $t \leq 0$ | 11. Pages: 55 and 56 | 12. $\mathrm{km}=27$ |
| 13. $25,100,55$ | 14. $q=7$ | 15. $n=12$ | 16. $7,8,9$ |

## Extra Work Space

