Section 3.3a – Eliminating Brackets, Fractions, and Decimals

This booklet belongs to:_____ Block: _____

Eliminating Brackets

- In math we have a term called **Distributivity**

Example: $a(b+c) = ab + ac$

- $a \cdot (b+c) = \boldsymbol{a} \cdot \boldsymbol{b} + \boldsymbol{a} \cdot \boldsymbol{c}$
- *the a multiplies with both terms inside the brackets*
- This is **DISTRIBUTIVITY**
- I use the term **WATERBOMB**

$$a(b+c) = ab + ac$$

Example:

$2(r+6) = 2$

$2(r+6) = 2$ Waterbomb

$2r + 12 = 2$

$2r + 12 - 12 = 2 - 12$ Subtract 12 from both sides

$2r = -10$

$\frac{2r}{2} = \frac{-10}{2}$ Divide both sides by 2

$$r = -5$$

- Whenever there are **Brackets**, you **Multiply in to them**
- **DISTRIBUTE**, **WATERBOMB**, whichever term you prefer

Example 1: $4(s+4)=28$

$4s+16=28$ • Multiply in the 4 to both terms in the brackets

$4s+16-16=28-16$ • Subtract 16 from both sides of the equation

$4s=12$

$\frac{4s}{4}=\frac{12}{4}$ • Divide both sides by 4 to isolate the variable

$s=3$

- If is just a negative symbol $-$, this means -1

Example 2: $-(r-5)=10$

$-r+5=10$ • Multiply the -1 into the terms in the brackets

$-r+5-5=10-5$ • Subtract 5 from both sides of the equation

$-r=5$ • We don't want $-r$, we want r

$(-1)(-r)=5(-1)$ • Multiply both sides by -1

$r=-5$

Example 3: $3(x+4)-4(x+6)=2(x-3)$

Solution 3: Remember the **sign in front of a number belongs to it**. So, for the second set of brackets, we are multiplying in a -4

$3(x+4)-4(x+6)=2(x-3)$ → $3(x+4)-4(x+6)=2(x-3)$

$3x+12-4x-24=2x-6$ • Watch your signs, this is where mistakes happen

$-x-12=2x-6$ • Subtract $2x$ from both sides, simplify

$x-2x-12=2x-6-2x$ → $-x-12=-6$

$-x-12+12=-6+12$ → $-x=6$ • Add 12 to both sides, simplify

$-x(-1)=6(-1)$ • Multiply both sides by -1

$\boldsymbol{x=-6}$ **Every step is logical and maintains the balance of the Equation**

Eliminating Multiple Fractions

- How do you get rid of 1 denominator?

$\frac{t}{2} = 4$

- We **multiply** that **fraction** by the **denominator** or any **MULTIPLE** of it

You see we **multiply by a multiple** because it gives us a **WHOLE NUMBER RESULT**, **ELIMINATING** the **FRACTION**

Watch:

Multiple of 2

$4 \cdot \frac{1}{2} = 2$

Whole Number Result

Multiple of 2

$8 \cdot \frac{1}{2} = 4$

Whole Number Result

- So, what if we have multiple denominators?

Example 4: Solve for the unknown.

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

- To **cancel out** the $2, 3, and\ 4$ respectively I would need to multiply everything by $2\ and\ 3\ and\ 4$.
- But to get rid of **all of them at once**, I need to multiply them all by their **Lowest Common Multiple!**
- Using the **LCM** will give me a **WHOLE NUMBER** result for **every fraction**

Solution 4:

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

- 1st what is the LCM of $2, 3, and\ 4$? It's 12!
- Then **multiply every term** by it

$\mathbf{12} \cdot \frac{1}{2}x - \frac{2}{3} \cdot \mathbf{12} = \frac{1}{4} \cdot \mathbf{12}$

- Multiply every fraction by the LCM

$\frac{12}{2}x - \frac{24}{3} = \frac{12}{4}$

- Remember the multiplication is with the numerator only

$6x - 8 = 3$

- Simplify the fractions

$6x - 8 + 8 = 3 + 8$

- Add 8 to both sides of the equation

$6x = 11$

$\frac{6x}{6} = \frac{11}{6}$

- Divide both sides by 6

$x = \frac{11}{6}$

- You **MUST** multiply every term to **KEEP THAT BALANCE!!!**

There are a couple other approaches you can take. Let's see this one first.

- You can get a Common Denominator first, then when you multiply by the LCM they will all just cancel

Example 5: Solve for the unknown

Solution 5: $\frac{2}{3}x - \frac{1}{9} = \frac{7}{18}$

The LCM is 18, use equivalent fractions to get fractions with the same denominator

$\frac{6}{6} \cdot \frac{2}{3}x - \frac{1}{9} \cdot \frac{2}{2} = \frac{7}{18} \quad \rightarrow \quad \frac{12}{18}x - \frac{2}{18} = \frac{7}{18}$

Once you have this, multiplying everything by 18, just eliminates the denominators.

$\cancel{18} \cdot \frac{12}{\cancel{18}}x - \cancel{18} \cdot \frac{2}{\cancel{18}} = \cancel{18} \cdot \frac{7}{\cancel{18}} \quad \rightarrow \quad 12x - 2 = 7$

$12x - 2 + 2 = 7 + 2$ Add 2 to both sides

$12x = 9$

$\frac{12x}{12} = \frac{9}{12}$ Divide both sides by 12

$\boldsymbol{x = \frac{9}{12}}$

- The last style of Elimination is similar to the first approach, but rather than multiply with the numerator, we can divide by the denominator first
- This gives us a solution we then multiply with the numerator. It keeps the numbers smaller!

Example 6: We will use the **same equation as Example 4**, hopefully you will see the subtle difference

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

Solution 6:

$\mathbf{12} \cdot \frac{1}{2}x - \frac{2}{3} \cdot \mathbf{12} = \frac{1}{4} \cdot \mathbf{12}$	• **Divide by the denominator** and then **multiply the result by the numerator**
$6 \cdot 1x - 2 \cdot 4 = 1 \cdot 3$	• You'll see this **eliminates the fractions** right away
$6x - 8 = 3$	• Notice we end up at the same point in **Example 4**
$6x - 8 + 8 = 3 + 8$	• Add 8 to both sides
$6x = 11$	
$\frac{6x}{6} = \frac{11}{6}$	• Divide both sides by 6
$x = \frac{11}{6}$	

- **All three** of the above methods **produce an accurate conclusion**
- I suggest you **pick one that you find the most straightforward** and use it regularly
- Being fluid in your **logic is the goal**, so put your understanding in the **process not the product**

Eliminating Decimals

- It's really quite simple; we just need to know what decimals are?
- Decimals are **base 10 fractions**

$$0.1 = \frac{1}{10} \quad tenth$$

$$0.01 = \frac{1}{100} \quad hundredth$$

$$0.001 = \frac{1}{1000} \quad thousandth$$

So, the LCM of decimals is always going to be: 10, 100, 1000, etc.

Example 7: Solve for the unknown in the equation: $0.4x + 0.6 = 0.8$

Solution 7:

$0.4x \cdot \mathbf{10} + 0.6 \cdot \mathbf{10} = 0.8 \cdot \mathbf{10}$
- Multiply every term by the LCM: 10

$4x + 6 = 8$
- Simplify the Equation

$4x + 6 - 6 = 8 - 6$
- Subtract both sides by 6

$4x = 2$

$\frac{4x}{4} = \frac{2}{4}$
- Divide both sides by 4

$x = \frac{2}{4} = \frac{1}{2}$
- Simplify your final answer

Example 8: Solve for the unknown in the equation: $0.3x - 0.06 = 0.24$

Solution 8: You need to multiply by the LCM, so the tenth won't do, need hundredth

$0.3x \cdot 100 - 0.06 \cdot 100 = 0.24 \cdot 100$
- Multiply every term by the LCM: 100

$30x - 6 = 24$
- Simplify the Equation

$30x - 6 + 6 = 24 + 6$
- Add 6 to both sides

$30x = 30$

$\frac{30x}{30} = \frac{30}{30}$
- Divide both sides by 30

$x = 1$
- Simplify your final answer

Putting it all Together

- What happens when we have the full meal deal?
- I'm **talking about fractions or decimals AND brackets** all in one?

- Well we could WATERBOMB in the fractions, but then we end up with a whole bunch of fractions…. Not ideal.
- So, let's **multiply by the LCD first** and **then WATERBOMB to remove the brackets**
- See the examples below.

Example 9: Solve the following: $\frac{2}{3}(x-5)-\frac{3}{4}(-x+3)+\frac{1}{6}(7+x)=\frac{1}{2}(x-5)$

Solution 9:

$\frac{2}{3}(x-5)-\frac{3}{4}(-x+3)+\frac{1}{6}(7+x)=\frac{1}{2}(x-5)$

Identify the LCM of 12. Use this to multiply with each term to remove the fractions.

$12\cdot\frac{2}{3}(x-5)-12\cdot\frac{3}{4}(-x+3)+12\cdot\frac{1}{6}(7+x)=12\cdot\frac{1}{2}(x-5)$

Either **multiply with the numerator** and **then divide**, OR **divide with the denominator** first and **then multiply with the numerator**.

$8(x-5)-9(-x+3)+2(7+x)=6(x-5)$

WATERBOMB to remove brackets (watch your signs)

$8x-40+9x-27+14+2x=6x-30$

Group Like Terms (Sign in front belongs to the number!)

$19x-53=6x-30$
$-6x \quad -6x$

Use **addition principle** to get all variables on one side of the equation (Make 0)

$13x-53=-30$
$+53 \quad +53$

Use **addition principle** to isolate the variable and non-variable terms (Make 0)

$\frac{13x}{13}=\frac{23}{13}$

Use the **multiplication principle** to divide and isolate the variable (Make 1)

$x=\frac{23}{13}$

DONE

Things to Remember / Understand

- **Multiplying** by the **LCM gets rid** of the **Fractions**
  - **Multiply** with the **Numerator First** and then **Divide the Denominator**
    Or
  - **Divide** with the **Denominator** and **Multiply** the **Result** with the **Numerator** (Keeps Things Smaller)
- **WATERBOMBING gets rid** of **Brackets**
- **Addition Principal gets us to 0 on one side: Addition or Subtraction (Whichever Necessary)**
- **Multiplication Principal gets us to 1 on one side: Multiplication or Division (Whichever Necessary)**
- **Take it One Step at a Time**
- **It is about Equation Manipulation not the Answer**

Section 3.3 – Practice Questions

- Eliminate the **Brackets (WATERBOMB)** – Distributive Property
- Then solve for the unknown – these are MULTI-STEP Equations

EMERGING LEVEL QUESTIONS

1. $2(x + 4) = 8$

2. $-3(s - 7) = -5$

3. $4(t + 2) = 2(t - 3)$

4. $-5(6 - z) = 3(z + 4)$

5. $-2(4t + 54) = 3(-t + 5)$

6. $3(3q - 4) = 2(4q + 5)$

7. $3(4r-3)=5(-2r+6)+2$

8. $8(3t-12)=12t$

PROFICIENT LEVEL QUESTIONS

Eliminate the fractions, using LCM, then solve for the unknown.

9. $\frac{t}{6}+\frac{1}{3}=\frac{1}{2}$

10. $\frac{7}{8}x-\frac{1}{16}+\frac{3}{4}x=\frac{1}{4}+x$

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

12. $\frac{7}{2}q - 3q = -\frac{11}{2}q + \frac{3}{2} + \frac{5}{2}q$

13. $1 + \frac{y}{5} = \frac{2}{3}y + \frac{12}{5}$

14. $\frac{4}{5}x - \frac{1}{2}x = \frac{3}{10}x + 4$

Eliminate the decimals, using factors of 10, solve for the unknown.

15. $0.04k = 0.8$

16. $0.2x + 0.22x = 0.84$

17. $2.1y - 2.8 = 5.6$

18. $1.7w + 5 - 1.62w = 0.4w + 4.68$

19. $0.3 + 0.4x = 0.2 - 0.25x$

20. $0.05 - 0.5x = 0.1 - 0.25x$

21. $0.6x - 0.01 = 0.02x + 0.29$

22. $1.05 - 0.62x = 0.85 - 0.22x$

EXTENDING LEVEL QUESTIONS

The following questions are challenging MULTI-STEP questions. The Answer is provided below. SHOW THE STEPS that shows me you UNDERSTAND.

23. $\frac{1}{3}(5x - 3) + \frac{1}{2}(1 - x) = \frac{1}{4}(x - 2)$

Answer: $x = 0$

24. $\frac{2}{3}\left(\frac{7}{8}-\frac{x}{4}\right)-\frac{3}{8}=\frac{5}{8}$

Answer: $x=-\frac{5}{2}$

25. $\frac{1}{4}(8x+4)-17=-\frac{1}{2}(4x-8)$

Answer: $x=5$

26. $0.25(8y + 4) - 17 = -0.5(4y - 8)$

Answer: $y = 5$

27. $\frac{3}{4}(-x + 1) + \frac{1}{2}(4 - 3x) = -\frac{2}{3}(x + 5) + \frac{5}{6}(x - 2)$

Answer: $x = \frac{93}{29}$

Answer Key – Section 3.3

1. $x = 0$	2. $s = \frac{26}{3}$	3. $t = -7$	4. $z = 21$	5. $t = -\frac{123}{5}$	6. $q = 22$
7. $r = \frac{41}{22}$	8. $t = 8$	9. $t = 1$	10. $x = \frac{1}{2}$	11. $x = -12$	12. $q = \frac{3}{7}$
13. $y = -3$	14. $No\ Solution$	15. $k = 20$	16. $x = 2$	17. $y = 4$	18. $w = 1$
19. $x = -\frac{2}{13}$	20. $x = -\frac{1}{5}$	21. $x = \frac{15}{29}$	22. $x = \frac{1}{2}$	23. $x = 0$	24. $x = -\frac{5}{2}$
25. $x = 5$	26. $y = 5$	27. $x = \frac{93}{29}$			

Extra Work Space