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Unit 6, Lesson 17: Modeling with Inequalities

Let's look at solutions to inequalities.

5 mins. think-pair-share, whole class

17.1: Possible Values

The stage manager of the school musical is trying to figure out how many sandwiches he can order with the $83 he collected from the cast and crew. Sandwiches cost $5.99 each, so he lets x represent the number of sandwiches he will order and writes $5.99x \leq 83$. He solves this to 2 decimal places, getting $x \leq 13.86$.

Which of these are valid statements about this situation? (Select **all** that apply.)

Might be true – don't round

1. He can call the sandwich shop and order exactly 13.86 sandwiches. Probably not – 0.86 of a sandwich?
2. He can round up and order 14 sandwiches. No
[✓ 3.] He can order 12 sandwiches.
[✓ 4.] He can order 9.5 sandwiches. Maybe? May sell a half price sandwich
[✓ 5.] He can order 2 sandwiches.
6. He can order -4 sandwiches. No, -4 sandwiches can't be "ordered"

10 mins.

17.2: Elevator

A mover is loading an elevator with many identical 48-pound boxes (boxes). The mover weighs 185 pounds. The elevator can carry at most 2000 pounds. He wants to take all the boxes up the elevator at once, but he's worried about overloading the elevator. Going to be looking at all his possible number of boxes he could take.

CONTEXT → only full boxes or integers

1. Write an inequality that says that the mover will not overload the elevator on a particular ride. Check your inequality with your partner.

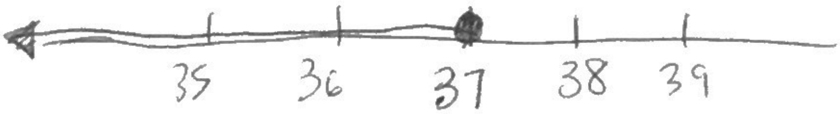
b = number of identical boxes

$$48b + 185 \leq 2000$$

2. Solve your inequality and explain what the solution means.

$b \leq 37.8125$ → the mover can put 37 or fewer full boxes on the elevator

3. Graph the solution to your inequality on a number line.



no more? ≤
no less? ≥

How do you know which way to round?

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4. If the mover asked, "How many boxes can I load on this elevator at a time?," what would you tell them?

31 or fewer full boxes

Are there any other limitations given in the context? (no negative #'s)

15 mins.

17.3: Giving Advice

Your teacher will give you either a problem card or a data card. Do not show or read your card to your partner.

If your teacher gives you the *problem card*:

1. Silently read your card and think about what information you need to answer the question.
2. Ask your partner for the specific information you need.
3. Explain to your partner how you are using the information to solve the problem.
4. Solve the problem and explain your reasoning to your partner.

Q. Which quantity should be the variable?

If your teacher gives you the *data card*:

1. Silently read the information on your card.
2. Ask your partner "What specific information do you need?" and wait for your partner to *ask* for information. *Only* give information that is on your card. (Do not figure out anything for your partner!)
3. Before telling your partner the information, ask, "Why do you need that information?"
4. After your partner solves the problem, ask them to explain their reasoning and listen to their explanation.

Pause here so your teacher can review your work. Ask your teacher for a new set of cards and repeat the activity, trading roles with your partner.

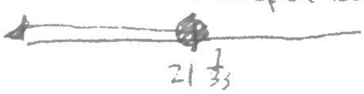
Problem 1

a $-1.65x + 50 \geq 15$

$x \leq 21\frac{7}{33}$

b

could be open too



Q. Is 1.5 loads of laundry a solution to the inequality?

Q. Should we round up or down?

c. Noah's family can wash 21 or fewer loads before needing to add more $ to the card.

Problem 2

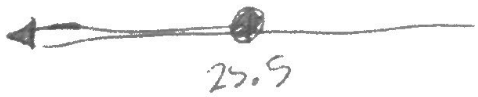
→ What is the formula for Area ▭ = L • w

a. $14 + 2w \leq 65$

$w \leq 25.5$

Q. Can the width be −10? 0? 0.1?

b.



c. Elena can choose widths between very close to zero & 25.5 cm

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Unit 6, Lesson 18: Subtraction in Equivalent Expressions

Let's find ways to work with subtraction in expressions.

5 mins.

18.1: Number Talk: Additive Inverses

Find each sum or difference mentally.

-30 + -10 = -40

-10 + -30 = -40 commutative property of addition (not subtraction!)

-30 – 10 = -40 additive inverse

10 – -30 = 40

5 mins.

18.2: A Helpful Observation

Lin and Kiran are trying to calculate $7\frac{3}{4} + 3\frac{5}{6} - 1\frac{3}{4}$. Here is their conversation:

Lin: "I plan to first add $7\frac{3}{4}$ and $3\frac{5}{6}$, so I will have to start by finding equivalent fractions with a common denominator."

Kiran: "It would be a lot easier if we could start by working with the $1\frac{3}{4}$ and $7\frac{3}{4}$. Can we rewrite it like $7\frac{3}{4} + 1\frac{3}{4} - 3\frac{5}{6}$?"

Lin: "You can't switch the order of numbers in a subtraction problem like you can with addition; 2 – 3 is not equal to 3 – 2."

Kiran: "That's true, but do you remember what we learned about rewriting subtraction expressions using addition? 2 – 3 is equal to 2 + (-3)."

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cummulative property

1. Write an expression that is equivalent to $7\frac{3}{4} + 3\frac{5}{6} - 1\frac{3}{4}$ that uses addition instead of subtraction.

$$7\frac{3}{4} + 3\frac{5}{6} + \left(-1\frac{3}{4}\right)$$

2. If you wrote the terms of your new expression in a different order, would it still be equivalent? Explain your reasoning.

It works as long as you change subtraction to addition & make $1\frac{3}{4}$ negative.

10 ways

18.3: Organizing Work

	5	3
2	$2\cdot5$	$2\cdot3$

$(2\cdot5)+(2\cdot3)$

$2(5+3)$

1. Write two expressions for the area of the big rectangle.

$\frac{1}{2}(8y + x + 12)$

$4y + \frac{1}{2}x + 6$

	$8y$	x	12
$\frac{1}{2}$	$\frac{1}{2}\cdot 8y$	$\frac{1}{2}x$	$\frac{1}{2}\cdot 12$

2. Use the distributive property to write an expression that is equivalent to $\frac{1}{2}(8y + -x + -12)$. The boxes can help you organize your work.

distribution works the same for negatives

	$8y$	$-x$	-12
$\frac{1}{2}$	$4y$	$-\frac{1}{2}x$	-6

$4y + \left(-\frac{1}{2}x\right) + (-6)$

3. Use the distributive property to write an expression that is equivalent to $\frac{1}{2}(8y - x - 12)$.

$4y - \frac{1}{2}x - 6$

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Are you ready for more?

In a day care group, nine babies are five months old and 12 babies are seven months old. How many full months from now will the average age of the 21 babies first surpass 20 months old?

Lesson 17 Summary

We can represent and solve many real-world problems with inequalities. Whenever we write an inequality, it is important to decide what quantity we are representing with a variable. After we make that decision, we can connect the quantities in the situation to write an expression, and finally, the whole inequality.

As we are solving the inequality or equation to answer a question, it is important to keep the meaning of each quantity in mind. This helps us to decide if the final answer makes sense in the context of the situation.

For example: Han has 50 centimeters of wire and wants to make a square picture frame with a loop to hang it that uses 3 centimeters for the loop. This situation can be represented by $3 + 4s = 50$, where s is the length of each side (if we want to use all the wire). We can also use $3 + 4s \leq 50$ if we want to allow for solutions that don't use all the wire. In this case, any positive number that is less or equal to 11.75 cm is a solution to the inequality. Each solution represents a possible side length for the picture frame since Han can bend the wire at any point. In other situations, the variable may represent a quantity that increases by whole numbers, such as with numbers of magazines, loads of laundry, or students. In those cases, only whole-number solutions make sense.

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Lesson 18 Summary

Working with subtraction and signed numbers can sometimes get tricky. We can apply what we know about the relationship between addition and subtraction—that subtracting a number gives the same result as adding its opposite—to our work with expressions. Then, we can make use of the properties of addition that allow us to add and group in any order. This can make calculations simpler. For example:

$$\frac{5}{8} - \frac{2}{3} - \frac{1}{8}$$

$$\frac{5}{8} + -\frac{2}{3} + -\frac{1}{8}$$

$$\frac{5}{8} + -\frac{1}{8} + -\frac{2}{3}$$

$$\frac{4}{8} + -\frac{2}{3}$$

We can also organize the work of multiplying signed numbers in expressions. The product $\frac{3}{2}(6y - 2x - 8)$ can be found by drawing a rectangle with the first factor, $\frac{3}{2}$, on one side, and the three terms inside the parentheses on the other side:

	$6y$	$-2x$	-8
$\frac{3}{2}$			

Multiply $\frac{3}{2}$ by each term across the top and perform the multiplications:

	$6y$	$-2x$	-8
$\frac{3}{2}$	$\frac{3}{2} \cdot 6y$	$\frac{3}{2} \cdot -2x$	$\frac{3}{2} \cdot -8$

	$6y$	$-2x$	-8
$\frac{3}{2}$	$9y$	$-3x$	-12

Reassemble the parts to get the expanded version of the original expression:

$$\frac{3}{2}(6y - 2x - 8) = 9y - 3x - 12$$