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Inches and Centimeters. Daniel measured several things in inches and in centimeters and he made the following table:

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Pen (length)	$5\frac{6}{16}$	13.6	0.3952
Phone	$3\frac{10}{16}$	9.1	0.3984

He conjectured that "inches over centimeters" is a constant, which is approximately equal to 0.39.

Liana said this is wrong, because the conversion table in her book says 1 inch = 2.54 centimeters. Therefore, dividing both sides by centimeters, we get:

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Please help Daniel and Liana figure out why they can't agree.

Daniel is stating the rate of inches per centimeter whereas Liana, is stating the rate of centimeters per inch. they are both correct but are proving opposite points.

Liana → 1 inch = 2.54 cm

$\frac{1 \text{ inch}}{2.54} = \frac{2.54 \text{ cm}}{2.54}$

.39 in = 1 cm

or

1 cm = .39 in. which is Daniel's point.

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Please help Daniel and Liana figure out why they can't agree.

My thoughts on Liana are the same. I think that her statement is correct in that she is making a direct relationship between the number of centimeters in one inch. I am not sure about Daniels statement in number 2. However in statement 3 he appears to agree with what Liana states about the relationship between centimeters and inches. I think a key part to this is the language used in "inches/centimeters" & centimeter/inch.

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Please help Daniel and Liana figure out why they can't agree.

I think Daniel and Liana have different interpretations of the same comparison (inch/centimeter). Liana's claim is a number statement since $\frac{1\text{in}}{1\text{cm}} = \frac{1\text{in}}{1/2.54\text{in}} = 2.54$.

Whereas, Daniel is comparing the units as $\frac{1\text{in}}{2.54\text{cm}}$.

His table is not a one-to-one comparison like Liana's.
His table derives a ratio of inches: centimeters.
Liana's shows how many centimeters are in one inch.

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Please help Daniel and Liana figure out why they can't agree.

Daniel and Liana are having trouble communicating. This is evident because they are using the same symbols to represent different ideas. For example, Liana translates "inch/centimeter = 2.54" to mean "Inches measured by centimeter is the value 2.54 because it takes 2.54 cm to equal one inch". Daniel uses the same sentence "inch/centimer" to equal .39. He seems to understand inch/centimeter in such a way that a ratio would be presented. He collected data of several length (measuring both cm and in) and then calculated the ratio in/cm = .39. He interpreted this to mean there is .39 of an inch per centimeter.

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Please help Daniel and Liana figure out why they can't agree.

1 in = 2.54 cm

$\frac{1\text{ in}}{2.54\text{ cm}} = \frac{2.54/\text{cm}}{2.54\text{ cm}}$

.39 in / cm =

If we consider Daniel's thinking, the number of inches per centimeter is really equal to 0.39. It is inches measured in terms of the no. of centimeter.

Liana is correct with her conversion that 1 in = 2.54 cm but inch / cm = 2.54 is not right because the no. of inches measured in terms of cm should be 0.39 not 2.54

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$\frac{cm}{inch}$

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Please help Daniel and Liana figure out why they can't agree.

I believe that Daniel is right because for all values of in./cm actually equals 0.39... Not 2.54!

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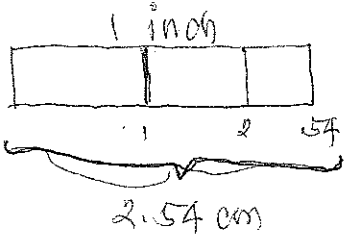
Both of them are right. They just differ on how they explain it and the manner of communications they need to convey their ideas.

Liana:

1 inch = 2.54 cm.



There is 2.54 cm for every inch of measurement.

Daniel:

centimeter/inch = 2.54

centimeter per inch = 2.54

Daniel just move on further when he divide both sides by cm. and he get $\frac{1}{2.54} = 0.39$ in/cm.

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Daniel is correct because his calculations maintain a one to one ratio with his calculations and logic. Liana is incorrect because she does not maintain a one to one ratio with her calculations. She divided one centimeter to each side of the equation 1in = 2.54cm, but 1cm ≠ 2.54cm. Although dividing a large number by a small number gives you a number bigger than 1, dividing a large unit of measure by a small unit of measure gives you a number smaller than 1 because

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the smaller unit has to be represented by a bigger number. The bigger unit must have a smaller number. So,

$$\frac{\text{big units}}{\text{small units}} \Rightarrow \frac{\text{small numbers}}{\text{big numbers}} < 1.$$

Liana is wrong. Daniel is correct.

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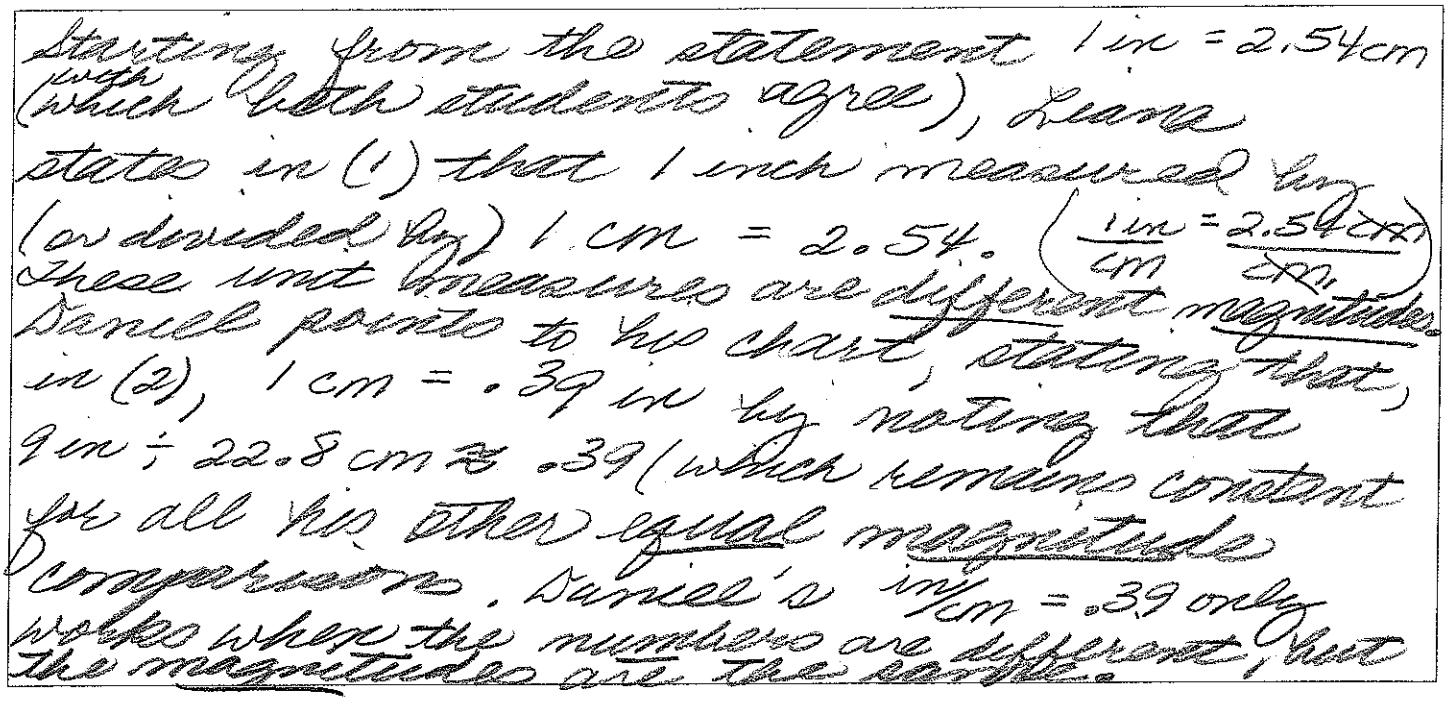

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Please help Daniel and Liana figure out why they can't agree.

Daniel is wrong when he says inches/centimeters = 0.39.
This is because $1 = \frac{1\text{ in.}}{2.54\text{ cm}} = 0.39\ \text{in/cm} \Rightarrow \text{cm/in} = 0.39$ ~~X~~

Other than that, both students seem to be correct.
Liana is comparing $\frac{1\text{ in.}}{1\text{ cm}} = \frac{2.54\text{ cm}}{1\text{ cm}} = 2.54 \Rightarrow \text{in/cm} = 2.54$,
This is correct. Ignoring Daniel's error, we find that the ratio of inches to centimeters of an object is 0.39.
In this regard, he is correct.

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Please help Daniel and Liana figure out why they can't agree.

Daniel and Liana have different perspectives on how to present the ratio or comparison of inches and cm. Liana seems to be saying, "If you divide an inch by cm, you will have 2.54 cm in that inch." Daniel is using the table of data and dividing the inches by the cm will give you 0.39... They are both correct in a sense, however, Liana's method can be misleading since dividing a measurement in inches by the same measurement in cm will give you 2.54.

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He conjectured that "inches over centimeters" is a constant, which is approximately equal to 0.39.

Liana said this is wrong, because the conversion table in her book says 1 inch = 2.54 centimeters. Therefore, dividing both sides by centimeters, we get:

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Please help Daniel and Liana figure out why they can't agree.

I think that the ratios by both need to be better defined. I still think Liana is wrong in her statement inch/centimeter = 2.54. She should define the slash as "measured by" instead of "dividing both sides by cm" which she states in the statement directly above (1). Daniel should also clarify that he means "inches per centimeters = .39..." if in fact that is what he means since there is no language stating this -- He does go on to state that "2.54 is the number of centimeters per inch" which is (in my thinking), a correct statement.

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The symbol : $-$, / , $\div$ That usually represents division can actually be confusing when words are applied. Sometimes the division symbol can stand for the words: "measured by", "per", "divided by" and even the word "over." This is terrible! Because both parties use the symbol with different meanings. A person can not divide inches by centimeters, but one can use a number to represent an inch measured by a number of centimeters. I beleive both people are correct, but are having a communication error. When Liana says: "inches/centimeter = 2.54" she uses the word division, but the solution should say: "inches measured by cm is 2.54" When Daniel says that his table shows "in/cm = 0.39" he really means the rate: "a measurment in inches, divided by a measurment in cm is 0.39... in for every cm."

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• Both are correct in some ways and not communicating their reasoning effectively
• Liana (Daniel) needs to keep her units when doing her conversion, while Daniel (Liana) is making a "numberless statement" while ~~Liana~~ Daniel is making one of magnitude.
• Also, there is a difference b/w "per" and "measured by" one being a ratio of 2 and one being a division problem.
Per = for Measured by = ÷

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Daniel said that inches over centimeters is a constant = 0.39

$\frac{\text{inch}}{\text{centimeter}} = \frac{0.39}{1} \Rightarrow \frac{1}{2.54} = 0.39$ Daniel uses substitution to prove he is right and not by proportion. If he uses proportion that will be equal to inch = .39 cm which is wrong.

Liana said that 1 in = 2.54 cm which is according to the book.

$\frac{\text{inch}}{\text{cm}} \times \frac{2.54}{1}$ 1 inch = 2.54 cm. Liana uses proportion to solve her equation. If she uses substitution she will end up wrong.

I think Liana + Daniel are both correct. They just need to explain more about their way of solving this problem.

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The major issue is with the communication of their ideas, the writing of their math symbols and their interpretation. Both have the right concept just different ways of conveying their idea. One thing I notice is that Liana's math is based on just numbers no magnitudes and Daniels math involves magnitudes.

inch / centimeter for Liana means in a inch there are this many centimeters

inches/centimeters for Daniel means a inch divide by a centimeter

Liana is working with the conversion of an inch to a centimeter.

Daniel is working with the actual measurement he did. No conversion

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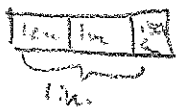
The fundamental difference is in the definition of some terms.

Liana states: inch/cm = 2.54.

She means (looking @ her process) "inches measured by cm" = 2.54"

or if we divide an inch into cm pts we'll have 2.54 pieces.



Daniel states: inches/cm = 0.39.

Using his table, we can deduce that he means there are 0.39 in in 1 cm or 0.39 in = 1 cm.

While neither student communicated their ideas correctly, both failed to logically defend their statements, neither is entirely correct/incorrect.

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$\frac{in}{cm} = .39$

1 in = 2.54 cm
equivalence statement
1 in measured by 1 cm = 2.54

Liana reads the statement as a magnitude statement.

Daniel is reading this magnitude as a number statement. This is why he divides 1 in by 2.54 cm and gets .39.

They are communicating their points effectively and are actually using reciprocals of each other