Multiplication and Division of Decimals

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CHAPTER 1 Multiplication and Division of Decimals

CHAPTER OUTLINE

1.1 Multiplying Decimals and Whole Numbers

Introduction

The Science Museum Field Trip

Mrs. Andersen is planning a field trip to the Science Museum for her sixth grade class. She wants to spend the entire day at the museum and plans to take all twenty-two students with her.

She looks up some information on the internet and finds that a regular price ticket is $12.95 and a student ticket is $10.95. However, when Mrs. Andersen checks out the group rates, she finds that the students can go for $8.95 per ticket at the group student rate.

Because she is a teacher, Mrs. Andersen gets to go for free.

One chaperone receives free admission also. Mrs. Andersen has a total of three chaperones attending the field trip. The other two chaperones will need to pay the regular ticket price. The class has a budget to pay for the chaperones.

Mrs. Andersen assigns Kyle the job of being Field Trip Manager. She hands him her figures and asks him to make up the permission slip. Kyle is glad to do it.

When collection day comes, Kyle collects all of the money for the trip.

Kyle has an idea how much he should collect, what should his estimate be?

Given the student price, how much money does Kyle need to collect if all 22 students attend the field trip?

What is the total cost for all of the students and for the two chaperones?

While Kyle is adding up the money, you have the opportunity to figure out the answers to these two questions.

You will need to use information about multiplying decimals and whole numbers.

Pay close attention during this lesson, see if your answers match Kyle's by the end of the lesson.

What You Will Learn

In this lesson you will learn how to complete the following tasks:

- Multiply decimals by whole numbers
- Use and compare methods of estimation to check for reasonableness in multiplication of decimals by whole numbers
- Identify and apply the commutative and associative properties of multiplication in decimal operations, using numerical and variable expressions.
- Solve real-world problems involving decimal multiplication

Teaching Time

I. **Multiplying Decimals by Whole Numbers**

In this lesson you will be learning about how to multiply decimals and whole numbers together. Let's think about what it means to multiply.

Multiplication is a short-cut for repeated addition. We think about multiplication and we think about groups of numbers. Let's look at an example.

Example

$4 \times 3 = 12$

With this example, we are saying that we have four groups of three that we are counting or we have three groups of four. It doesn't matter which way we say it, because we still end up with twelve.

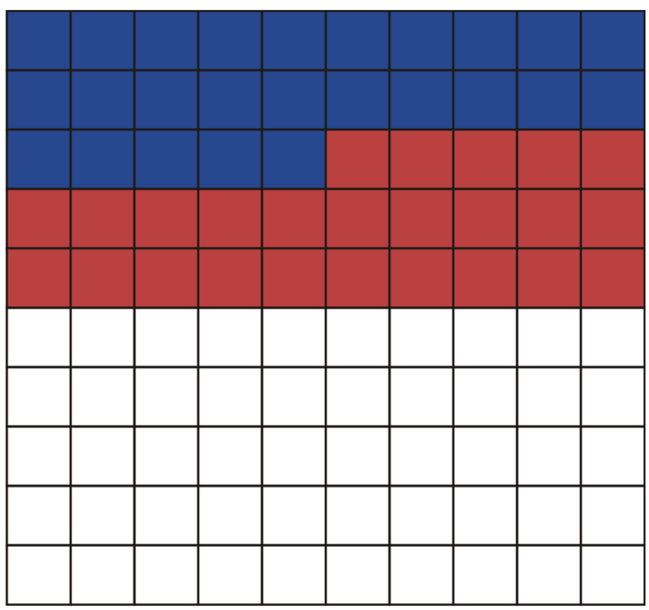
When we multiply decimals and whole numbers, we need to think of it as groups too.

Example

2(.25) = _____

With this example, we are multiplying two times twenty-five hundredths. Remember that when we see a number outside of the parentheses that the operation is multiplication.

We can think of this as two groups of twenty-five hundredths. Let's look at what a picture of this would look like.



Our answer is .50.

This is one way to multiply decimals and whole numbers; however we can't always use a drawing. It just isn't practical.

How can we multiply decimals and whole numbers without using a drawing?

We can multiply a decimal and a whole number just like we would two whole numbers.

First, we ignore the decimal point and just multiply.

Then, we put the decimal point in the ***product*** by counting the correct number of places.

Let's look at an example.

Example

4(1.25) = _____

Let's start by multiplying just like we would if this was two whole numbers. We take the four and multiply it by each digit in the top number.

$$\begin{array}{r} 125 \\ \times \quad 4 \\ \hline 500 \end{array}$$

But wait! Our work isn't finished yet. We need to add the decimal point into the product.

There were two decimal places in our original problem. There should be two decimal places in our product.

5.00

$\nwarrow$

We count in two places from right to left into our product.

This is our final answer.

Here are a few for you to try. Multiply them just as you would whole numbers and then put in the decimal point.

1. **3(4.52)**
2. **5(2.34)**
3. **7(3.56)**

Take a few minutes to check your work with a neighbor. Did you put the decimal point in the correct place?

II. **Use and Compare Methods of Estimation to Check for Reasonableness in Multiplying Decimals by Whole Numbers**

We have learned how to multiply a decimal with a whole number. That is the perfect thing to do if you are looking for an exact answer.

When do we estimate a product?

Remember back to when we were first working with estimation. We can use estimation whenever we don't need to find an exact answer. As long as our answer makes sense, we can estimate.

We can use ***rounding*** to estimate.

How can we estimate a product using rounding?

When we multiply a whole number with a decimal, we can round the decimal that we are multiplying to find a reasonable estimate.

Let's look at an example.

Example

Estimate 5(1.7) = _____

In this example we were told that we could estimate, so we don't need to worry about finding an exact answer.

If we use rounding, we can round the decimal to the nearest whole number.

1.7 is closest to 2.

We round 1.7 up to 2.

Now we can rewrite the problem and multiply.

Example

5(2) = 10

A reasonable estimate for 5(1.7) is 10.

Here is another example.

Example

Estimate 7(4.3) = _____

Here we can estimate by rounding the decimal.

4.3 rounds down to 4

$7 \times 4 = 28$

A reasonable estimate for 7(4.3) = 28

Keep in mind that rounding down means your estimate will be slightly less than the actual one.

Here are a few for you to try. Estimate the following products.

1. **4(3.2) =** _____
2. **6(2.8) =** _____
3. **7(5.3) =** _____

Stop and check your answers with a peer. Are your estimates reasonable?

III. **Identify and Apply the Commutative and Associative Properties of Multiplication in Decimal Operations using Numerical and Variable Expressions**

We have already learned about using the properties of multiplication in numerical and variable expressions. Now we are going to apply these properties to our work with multiplying decimals and whole numbers.

What is a property?

A ***property*** is a rule that makes a statement about the way that numbers interact with each other during certain operations. The key thing to remember about a property is that the statement is true for any numbers.

The Commutative Property of Multiplication

The Commutative Property of Multiplication states that it does not matter which order you multiply numbers in, that you will get the same product.

$$a(b) = b(a)$$

What does this have to do with our work with decimals and whole numbers?

When we apply the Commutative Property of Multiplication to our work with decimals and whole numbers, we can be sure that the product will be the same regardless of whether we multiply the decimal first or the whole number first.

Let's look at an example.

Example

4.5(7) is the same as 7(4.5)

This means that we can multiply them in whichever order we choose. Our product will remain the same.

$$\begin{array}{r} 45 \\ \times \quad 7 \\ \hline 315 \end{array}$$

Add in the decimal point.

Our answer is 31.5.

We can also apply the Commutative Property of Multiplication when we have a problem with a variable in it.

Remember that a ***variable*** is a letter used to represent an unknown.

Let's look at an example.

Example

$$5.6a = a5.6$$

Here we haven't been given a value for a, but that doesn't matter. **The important thing is for you to see that it doesn't matter which order we multiply, the product will be the same.**

If we were given 3 as the value for a, what would our product be?

Example

5.6(3)

$$\begin{array}{r} 56 \\ \times\ 3 \\ \hline 168 \end{array}$$

Add in the decimal point.

Our answer is 16.8.

The Associative Property of Multiplication

We can also apply the Associative Property of Multiplication to our work with decimals and whole numbers.

The Associative Property of Multiplication states that it doesn't matter how you group numbers, that the product will be the same.

Remember that grouping refers to the use of parentheses or brackets.

Let's look at an example of the Associative Property of Multiplication with numbers.

Example

$6(3.4 \times 2) = (6 \times 3.4)2$

We can change the grouping of the numbers and the product will remain the same.

This is also true when we have variable expressions.

Example

$$5(6a) = (5 \times 6)a$$

Once again, we can change the grouping of the numbers and variables, but the product will remain the same.

Look at these examples and determine which property is being illustrated.

1. **4.5(5a) = (4.5 × 5)a**
2. **6.7(4) = 4(6.7)**
3. **5.4a = a5.4**

Take a few minutes to check your work with a peer.

Real life Example Completed

The Science Museum Field Trip

Now that you have learned all about estimating and multiplying whole numbers and decimals, let's look at helping Kyle with the field trip.

Here is the problem once again.

Mrs. Andersen is planning a field trip to the Science Museum for her sixth grade class. She wants to spend the entire day at the museum and plans to take all twenty-two students with her.

She looks up some information on the internet and finds that a regular price ticket is $12.95 and a student ticket is $10.95. However, when Mrs. Andersen checks out the group rates, she finds that the students can go for $8.95 per ticket at the group student rate.

Because she is a teacher, Mrs. Andersen gets to go for free.

One chaperone receives free admission also. Mrs. Andersen has a total of three chaperones attending the field trip. The other two chaperones will need to pay the regular ticket price. The class has a budget to pay for the chaperones.

Mrs. Andersen assigns Kyle the job of being Field Trip Manager. She hands him her figures and asks him to make up the permission slip. Kyle is glad to do it.

When collection day comes, Kyle collects all of the money for the trip.

Kyle has an idea how much he should collect, what should his estimate be?

Given the student price, how much money does Kyle need to collect if all 22 students attend the field trip?

What is the total cost for all of the students and for the two chaperones?

First, let's go back and underline all of the important information.

Now, let's think about the estimate. About how much money should Kyle collect?

The first step in working this out is to write an equation.

22 students at $8.95 per ticket = 22(8.95)

Kyle wants an estimate, so we can round 8.95 to 9

Now let's multiply 22(9) = $198.00

Now that Kyle has an estimate, he can actually work on collecting the money and counting it. Once he has collected and counted all the money, we will be able to see if his original estimate was reasonable or not.

One week before the trip, Kyle collects $8.95 from 22 students.

He multiplies his results, 22(8.95) = $196.90

Kyle can see that his original estimate was reasonable. He is excited-the estimation worked!!

Next, Kyle figures out the cost of the chaperones. There are two chaperones who each pay the regular price which is $12.95.

2(12.95) = 25.90

Finally, Kyle adds up the total.

196.90 + 25.90 = $222.80

He gives his arithmetic and money to Mrs. Andersen. She is very pleased.

The students are off to the Science Museum!!!

Vocabulary

Here are the vocabulary words that can be found in this lesson.

Multiplication
a shortcut for addition, means working with groups of numbers

Product
the answer from a multiplication problem

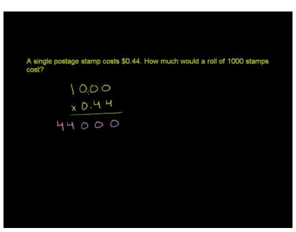
Estimate
an approximate answer-often found through rounding

Properties
rules that are true for all numbers

The Commutative Property of Multiplication
it doesn't matter which order you multiply numbers, the product will be the same.

The Associative Property of Multiplication
it doesn't matter how you group numbers in a multiplication problem, the product will be the same.

Technology Integration



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Khan Academy Multiplying Decimals 2

This video presents multiplying decimals by whole numbers. http://www.youtube.com/watch?v=EZ4KI0pv4Fk

Time to Practice

Directions: Estimate the following products.

1. 4(3.2) = _____

2. 5(1.8) = _____

3. 6(2.3) = _____
4. 9(1.67) = _____
5. 8(4.5) = _____
6. 9(6.7) = _____
7. 4(8.1) = _____
8. 8(3.2) = _____
9. 9(9.7) = _____
10. 7(1.1) = _____
11. 8(3.5) = _____
12. 5(8.4) = _____

Directions: Multiply to find a product.

13. 5(1.24) = _____
14. 6(7.81) = _____
15. 7(9.3) = _____
16. 8(1.45) = _____
17. 9(12.34) = _____
18. 2(3.56) = _____
19. 6(7.12) = _____
20. 3(4.2) = _____
21. 5(2.4) = _____
22. 6(3.521) = _____
23. 2(3.222) = _____
24. 3(4.223) = _____
25. 4(12.34) = _____
26. 5(12.45) = _____
27. 3(143.12) = _____
28. 4(13.672) = _____
29. 2(19.901) = _____
30. 3(67.321) = _____

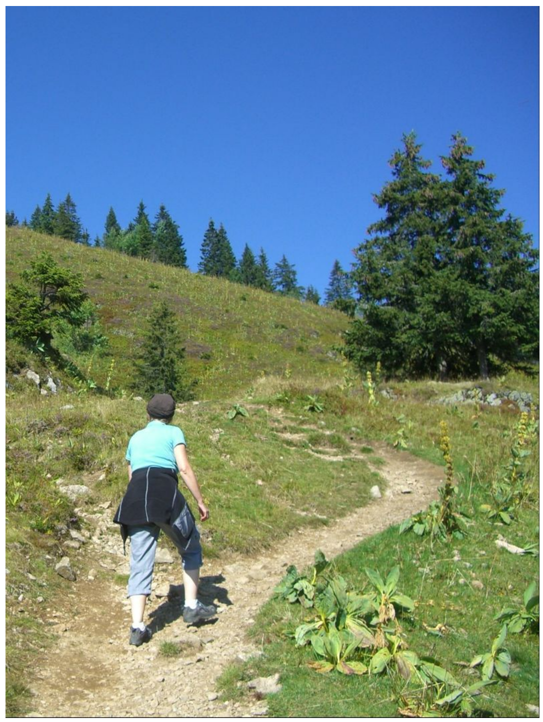
Directions: Identify the property illustrated in each example.

31. 4.6a = a4.6
32. (4a)(b) = 4(ab)
33. (5.5a)(c) = 5.5(ac)

1.2 The Distributive Property

Introduction

The Omni Theater Dilemma



Three days before the trip, Mrs. Andersen comes running up to Kyle.

She has discovered that there is an Omni Theater at the Science Museum and they are showing a film on the Rainforest. Kyle is thrilled. He loves the Omni Theater.

However, the problem is that it will cost an additional two dollars for each of the students to attend the showing. The Chaperones can all go for free.

"Can you work this out?" Mrs. Andersen asks Kyle. "There are fifty dollars in our class account plus the money that you have already collected from the students. How much money total will we need to go to both the museum and the Omni Theater?"

"I will handle it," Kyle says. "I think we have enough money for everything. Let me figure it out."

Mrs. Andersen smiles and goes back to work.

Kyle takes out a piece of paper and a pencil. He writes down the following information.

22 students with an admission price of $8.95

22 students with an Omni Theater price of $2.00

Ah! Kyle remembers that he can use parentheses to help him out with this problem. Here is what he finally writes.

22(8.95 + 2.00)

Kyle stops. He knows that there is a way to solve this with the Distributive Property, but he can't remember exactly what to do.

This is where you come in.

In this lesson, you will learn how to use the Distributive Property to solve problems where there is a sum being multiplied by a number.

By the end of the lesson, you will be able to help Kyle with his problem.

What You Will Learn

In this lesson, you will learn the following skills:

- Write numerical expressions for the product of a number and a sum
- Identify and apply the Distributive Property to evaluate numerical expressions
- Evaluate products using mental math.
- Apply the Distributive Property to evaluate formulas using decimal quantities.

Teaching Time

I. **Write Numerical Expressions for the Product of a Number and a Sum**

We know that a ***numerical expression*** is a statement that has more than one operation in it.

When we write an expression, we want it to illustrate mathematical information in a correct way.

We can write expressions that contain all kinds of combinations of operations. Today, we are going to learn about how to write an expression that involves the product of a number and a sum.

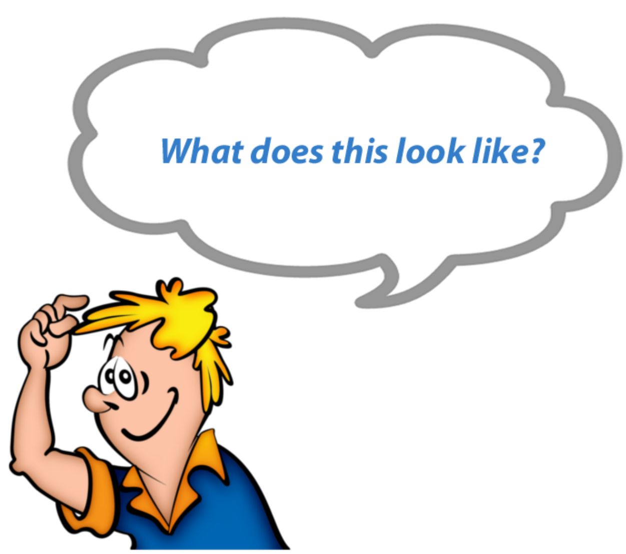
How do we write an expression that involves the product of a number and a sum?

The first thing that we need to do is to decipher these words so that we can understand what we are actually talking about.

The product of a number –we know that product means multiplication. We are going to be multiplying this number.

And a sum –the word sum means addition. We are going to have a sum here. That means that we will have two numbers that are being added together.

The tricky thing about this wording is that it talks about the product of a number AND a sum. That means that we are going to be multiplying a number by an ENTIRE sum.



We can figure out what this looks like by first taking a number.

Let's use 5.

Then we take a sum.

Let's use 4 + 3.

Now because we want to multiply the number times the sum, we need to put the sum into parentheses.

Here is our answer.

5(4 + 3)

This is a numerical expression for the information.

Let's look at another example.

Example

Write a numerical expression for the product of 2 times the sum of 3 and 4.

Here we know that two is going to be outside the parentheses-"the product of 2"

3 plus 4 will be inside the parentheses-this is the sum.

Here is our expression.

Our answer is 2(3 + 4).

Try writing a few of these on your own.

1. **The product of three and the sum of four plus five.**
2. **The product of four and the sum of six plus seven.**
3. **The product of nine and the sum of one plus eight.**

Take a minute to check your work with a friend. Did you write the expression correctly?

II. **Identify and Apply the Distributive Property to Evaluate Numerical Expressions**

We just finished learning how to write a numerical expression that has the product of a number and a sum. Now we are going to work on evaluating those expressions.

What does the word "evaluate" mean?

When we ***evaluate*** an expression, we figure out the value of that expression or the quantity of the expression.

When we evaluate expressions that have a product and a sum, we use a ***property*** called the Distributive Property.

What is the Distributive Property?

The Distributive Property is a property that is a true statement about how to multiply a number with a sum. Multiply the number outside the parentheses with each number inside the parentheses. Then figure out the sum of those products.

In other words, we distribute the number outside the parentheses with both of the values inside the parentheses and find the sum of those numbers.

Let's see how this works.

Example

4(3 + 2)

To use the Distributive Property, we take the four and multiply it by both of the numbers inside the parentheses.

Then we find the sum of those products.

$$4(3)+4(2)$$
$$12+8$$
$$20$$

Our answer is 20.

Here is another one.

Example

8(9 + 4)

Multiply the eight times both of the numbers inside the parentheses.

Then find the sum of the products.

$$8(9)+8(4)$$
$$72+32$$
$$104$$

Our answer is 104.

Now it is your turn. Evaluate these expressions using the Distributive Property. Show all your work.

1. **5(6 + 3)**
2. **2(8 + 1)**
3. **12(3 + 2)**

Now check your work with a peer.

III. **Evaluate Products Using Mental Math**

Some of you may have found that while the Distributive Property is useful, that sometimes it is easier to simply find the products by using mental math.

Some of you may have found that you did not need to write out the distribution of the number outside of the parentheses with the number inside of the parentheses to find the sum of the products.

The Distributive Property is a useful property, especially as you get into higher levels of mathematics like Algebra. There it is essential, but sometimes, you can use mental math to evaluate expressions.

Let's look at this example

Example

2(1 + 4)

Now this is an example where you could probably add and multiply in your head.

You know that you can add what is in parentheses first, so you add one and four and get five.

Then you can multiply five times two and get a product of 10.

Our answer is 10.

When you have larger numbers, you can always use the Distributive Property to evaluate an expression. When you have smaller numbers, you can use mental math.

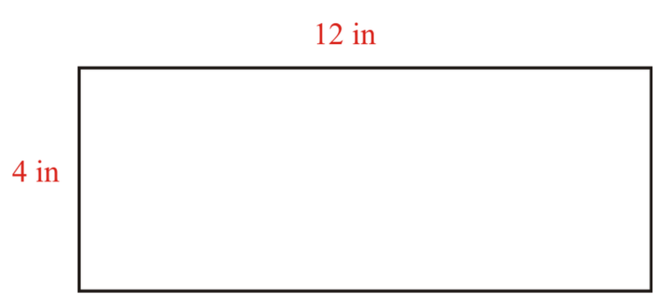
Practice your mental math by evaluating these expressions.

1. **4(2 + 3)**
2. **6(2 + 7)**
3. **5(2 + 6)**

Take a minute to compare your answers with a neighbor's. Were you able to complete the addition and multiplication without a piece of paper?

IV. **Apply the Distributive Property to Evaluate Formulas Using Decimal Quantities**

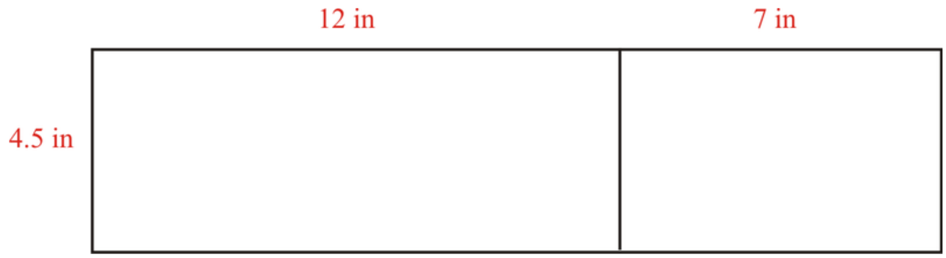
We can also use and apply the Distributive Property when working with a formula. Let's think about the formula for finding the area of a rectangle.



We know that the area of a rectangle can be found by using the formula:

$$A = lw(\text{length} \times \text{width})$$

For this example, we would multiply 12 times 4 and get an area of 48 square inches.



How can we find the area of both of these rectangles?

You can see that they have the same width. The width is four and a half inches.

However, there are two lengths.

We need to find the product of a number and a sum.

Here is our expression.

$$A = 4.5(12+7)$$

Now we can use the Distributive Property to find the area of these two rectangles.

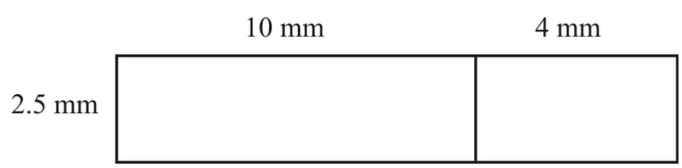
$$\begin{aligned} A &= 4.5(12)+4.5(7) \\ A &= 54+31.5 \\ A &= 85.5 \textit{ square inches} \end{aligned}$$

Notice that we used what we have already learned about multiplying decimals and whole numbers with the Distributive Property.

When we distributed 4.5 with each length, we were able to find the sum of the products.

This gives us the area of the two rectangles.

Here is an example for you to try on your own.

1. 

Check your answer with a friend.

Real Life Example Completed

The Omni Theater Dilemma

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However, the problem is that it will cost an additional two dollars for each of the students to attend the showing. The Chaperones can all go for free.

"Can you work this out?" Mrs. Andersen asks Kyle. "There are fifty dollars in our class account plus the money that you have already collected from the students. How much money total will we need to go to both the museum and the Omni Theater?"

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Mrs. Andersen smiles and goes back to work.

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Ah! Kyle remembers that he can use parentheses to help him out with this problem. Here is what he finally writes.

22(8.95 + 2.00)

Kyle stops. He knows that there is a way to solve this with the Distributive Property, but he can't remember exactly what to do.

First, let's go back and underline all of the important information.

Now we can take the expression that Kyle wrote and use the Distributive Property to figure out the total amount of money needed for the trip.

$$22(8.95+2)$$
$$22(8.95)+22(2)$$

Next, we can multiply 22 by 8.95.

$$\begin{array}{r} 895 \\ \times \quad 22 \\ \hline 1790 \\ +\,1790 \\ \hline 196.90 \end{array}$$ this is the amount of all of the tickets.

Next, we complete the second part of the problem.

2(22) = 44

It will cost the students an additional $44.00 to attend the Omni Theater.

The good news is that there is enough money in the student account to help cover the additional costs. There are fifty dollars in the account and the class only needs $44.00 to help cover the costs.

The total amount of money needed is $240.90.

Kyle gives his information to Mrs. Andersen and she is thrilled!

Now the students are off to the Science Museum and the Omni Theater!

Vocabulary

Here are the vocabulary words that can be found in this lesson.

Numerical expression
: a number sentence that has at least two different operations in it.

Product
: the answer in a multiplication problem

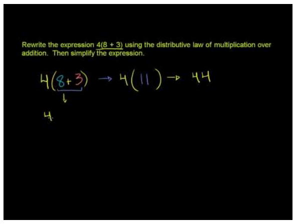
Sum
: the answer in an addition problem

Property
: a rule that works for all numbers

Evaluate
: to find the quantity of values in an expression

The Distributive Property
: the property that involves taking the product of the sum of two numbers. Take the number outside the parentheses and multiply it by each term in the parentheses.

Technology Integration



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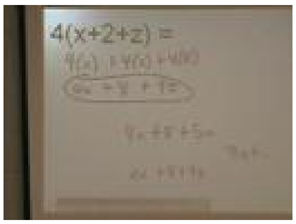
Khan Academy The Distributive Property

This video presents the distributive property from whole numbers to more complicated algebraic expressions.



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The Distributive Property

Time to Practice

Directions: Write a numerical expression for each example.

1. The product of two and the sum of five and six.
2. The product of three and the sum of three and seven.
3. The product of five and the sum of two and three.
4. The product of four and the sum of three and five.
5. The product of seven and the sum of four and five.

Directions: Evaluate each expression using the Distributive Property.

6. 4(3 + 6)
7. 5(2 + 8)
8. 9(12 + 11)
9. 7(8 + 9)
10. 8(7 + 6)
11. 5(12 + 8)
12. 7(9 + 4)
13. 11(2 + 9)
14. 12(12 + 4)
15. 12(9 + 8)
16. 10(9 + 7)
17. 13(2 + 3)

18. 14(8 + 6)
19. 14(9 + 4)
20. 15(5 + 7)

Directions: Use mental math to evaluate the following expressions.

21. 2(1 + 3)
22. 3(2 + 3)
23. 3(2 + 2)
24. 4(5 + 1)
25. 5(3 + 4)
26. 2(9 + 1)
27. 3(8 + 2)
28. 4(3 + 2)
29. 5(6 + 2)
30. 7(3 + 5)
31. 8(2 + 4)
32. 9(3 + 5)
33. 8(3 + 2)

1.3 Multiplying Decimals

Introduction

The Triceratops Skeleton

When the students in Mrs. Andersen's class arrive at the Science Museum, Kara is very excited to learn that there is a dinosaur exhibit. In fact, it is a famous dinosaur exhibit. A set of dinosaur bones from a triceratops has been reconstructed and is on display.

Kara can't wait to get to see it. She has a feeling that this is going to be her favorite part of the museum. Several other students are equally excited, so Mrs. Andersen and the chaperones decide to go to the exhibit first and the split up into groups.

When Kara walks in, she is delighted. There before her eyes is a huge skeleton of a triceratops. After visiting the exhibit for a while, the students begin to move on. Mrs. Andersen sees Kara hesitate before leaving the exhibit. She walks over to her.

"Imagine, that dinosaur is about 4 and a half times as long as you are!" Mrs. Andersen smiles.

The students exit the exhibit hall, but Kara pauses at the door. She has to think about this. In all of her excitement she forgot to find the information that actually says how long the triceratops actually is.

Mrs. Andersen's words stay with her, "*the dinosaur is* $4\frac{1}{2}$ *times as long as you are.*"

Kara knows that she is $5\frac{1}{4}$ feet tall. If the dinosaur is $4\frac{1}{2}$ times as long as she is, how long is the dinosaur?

While Mrs. Andersen and the chaperones start to split up the students, Kara begins working some quick math on the back of her museum map.

She writes down the following figures.

$5.25 \times 4.5 = \_\_\_\_\_\_$

If Kara multiplies these numbers correctly, she will be able to figure out how long the triceratops is.

How long is he?

In this lesson you will learn all about multiplying decimals. When finished, you will know the length of the triceratops.

What You Will Learn

In this lesson you will learn the following skills:

- Multiply decimals by decimals using area models (hundredths grid).
- Place the decimal point in the product and confirm by estimation.
- Multiply decimals up to a given thousandths place.
- Solve real-world problems involving area of rectangles with decimal dimensions.

Teaching Time

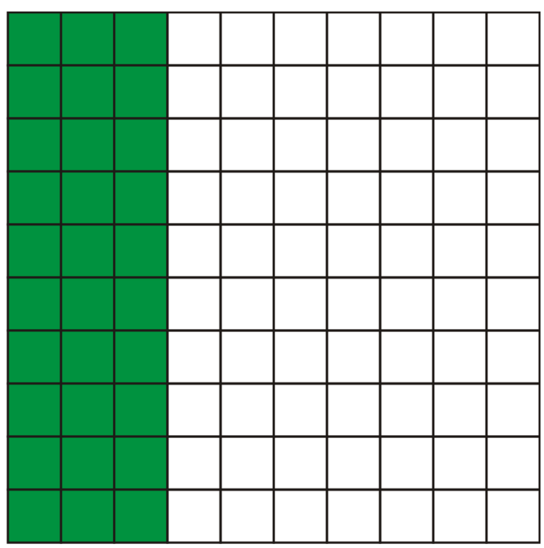
I. **Multiply Decimals by Decimals Using Area Models (hundredths grid)**

Sometimes in life, you will need to multiply a decimal by another decimal. In our last lesson, you learned to multiply a decimal and a whole number. In this lesson, you will learn how to multiply a decimal with another decimal.

Let's start by thinking of a decimal in terms of a picture. We can use a hundreds grid to represent the hundredths of a decimal.

0.3 = 0.30 = 30 hundredths

Shade 30 squares green because we are looking at 30 out of 100 or 30 hundredths.

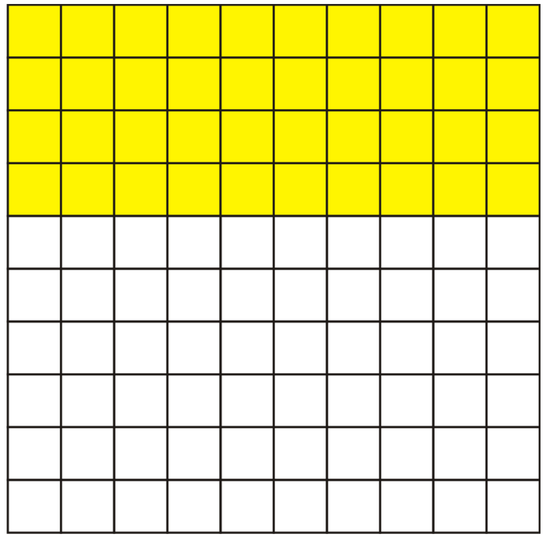


Let's say that that is our first decimal. We are going to multiply it with another decimal. Let's say that we are going to multiply $.30 \times .40$.

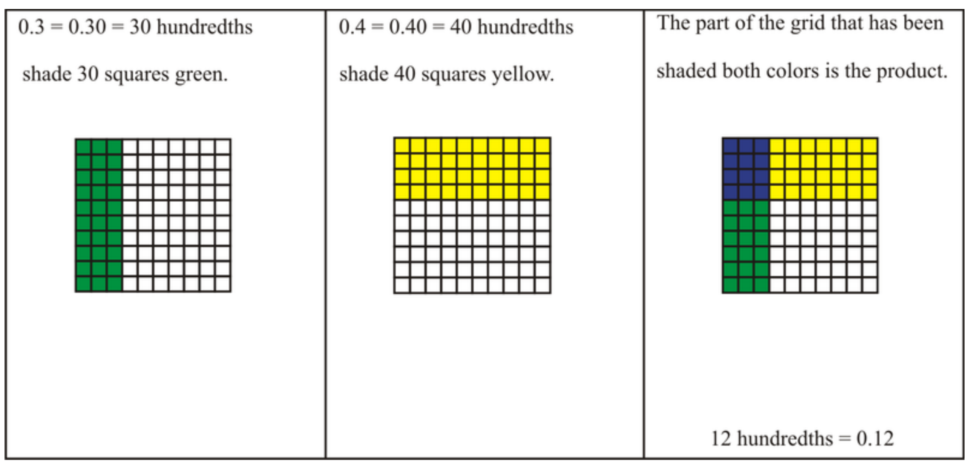
Here is a visual picture of what .40 or 40 hundredths looks like.

0.4 = 0.40 = 40 hundredths

Shade 40 squares yellow.



Now we have two visuals of the decimals that we are multiplying. If we put them both together, then we can see what it would look like to multiply these two decimals together.



Notice that the overlapping part is the product of this problem.

Our answer is .12 or 12 hundredths.

II. **<u>Place Decimal Point in the Product and Confirm by Estimation</u>**

Drawing a couple of hundreds grids each time you wish to multiply isn't really a practical way to go about multiplying.

How can we multiply two decimals without using a hundreds grid?

One of the ways that we can do it is to work on it just like we did when we multiplied decimals and whole numbers together.

First, we ignored the decimal point and multiplied just like it was two whole numbers that we were multiplying.

Second, we counted our decimal places and inserted the decimal into the *product* when we had finished multiplying.

We can approach two decimal multiplication in the same way.

Let's look at an example.

Example

$1.3 \times .24 =$ ______

To work on this problem, let's start by writing it ***vertically*** instead of ***horizontally***. Then we multiply.

Example

$$\begin{array}{r} 1.3 \\ \times \quad .24 \\ \hline 52 \\ + \ 260 \\ \hline 312 \end{array}$$

Now that we have finished the other steps, our final step is to put the decimal point in the correct spot.

To do this, we need to count the decimal places in each number from right to left. The first number has one decimal place.

$1.\underline{3}$

The second number has two decimal places.

$\underline{.24}$

This is a total of three decimal places that need to be placed into the product.

Our final answer is .312.

How can we confirm our answer by using estimation?

When we multiply two decimal, sometimes we can use estimation to check our work.

Let's look at an example.

Example

$4.7 \times 2.1 =$ ______

We can start by rounding each decimal to the nearest whole number.

4.7 rounds to 5.

2.1 rounds to 2.

Next, we multiply $5 \times 2 = 10$.

Our answer is around 10.

Now let's figure out our actual answer and see if our estimate is reasonable.

Example

$$\begin{array}{r} 4.7 \\ \times \quad 2.1 \\ \hline 47 \\ + \quad 940 \\ \hline 9.87 \end{array}$$

Our answer is 9.87.

We can see that our estimate is reasonable because 9.87 is very close to 10.

Now it is your turn. Write an estimate for each example and then multiply for the actual answer.

1. $\mathbf{3.1} \times \mathbf{4.9} =$ _____
2. $\mathbf{1.2} \times \mathbf{5.1} =$ _____
3. $\mathbf{3.2} \times \mathbf{6.7} =$ _____

Take a minute to check your work with a peer. Is your estimate reasonable? Is your multiplication accurate?

III. **Multiply Decimals Up to a Given Thousandths Place**

We can use what we have learned to multiply decimals that have many more places too. These are small decimals. Remember that the greater the number of decimal places after the decimal point, the smaller the decimal actually is.

Let's look at an example.

Example

$.134 \times .567 =$ ______

This problem is going to have several steps to it because we are multiplying decimals that are in the thousandths place.

That is alright though. We can do the same thing that we did with larger decimals. We can multiply the numbers as if they were whole numbers and then insert the decimal point at the end into the final product.

Let's start by rewriting the problem vertically instead of horizontally.

Example

$$\begin{array}{r} .134 \\ \times \quad .567 \\ \hline 938 \\ 8040 \\ +\ 67000 \\ \hline 75978 \end{array}$$

Wow! There are a lot of digits in that number-now we need to put the decimal point into the product.

There are three decimal places in the first number .134.

There are three decimal places in the second number .567.

We need to count six decimal places from right to left in the product.

When this happens, we can add a zero in front of the digits to create the sixth place.

.075978

Our final answer is .075978.

Sometimes, we only need to multiply to a specific place. Let's say that we only wanted to multiply to the ten-thousandths place.

If we were using this example, we would count to the ten-thousandths place in our product and round to the nearest place.

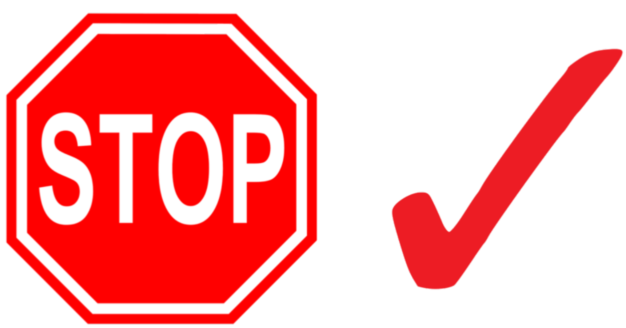
.075<u>9</u>78 - the 9 is in the ten-thousandths place

There is a 7 after the nine, so we can round up.

Our final answer is .0760.

Now it is your turn to practice. Multiply each pair of decimals.

1. **.56** $\times$ **3.24**
2. **.27** $\times$ **.456**
3. **.18** $\times$ **.320**



Stop and check your work.

IV. **<u>Solve Real-World Problems Involving Area of Rectangles with Decimal Dimensions</u>**

In our last lesson we looked at how to find the ***area*** of a rectangle composed of two rectangles using the Distributive Property. This section looks at how to find the area of a rectangle when there are decimal dimensions.

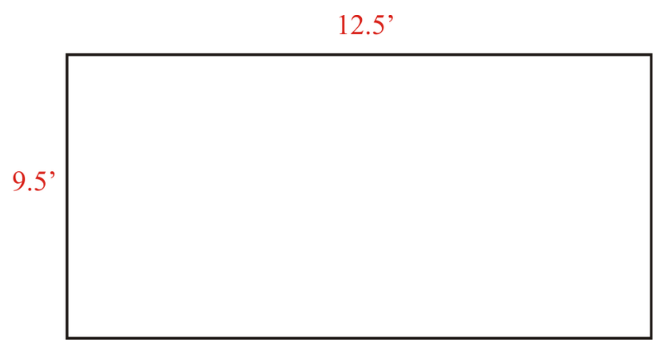
Let's look at an example.

Example

Jesus wants to put new carpeting down in his bedroom. He measured out the length of the room and found that it was $12\frac{1}{2}$ feet long. The width of the room is $9\frac{1}{2}$ feet long. Given these dimensions, how many square feet of carpet will Jesus need?

This is a problem that almost everyone will need to solve at one time or another. Whether you are a student redecorating, a college student fixing up a dorm room or an adult remodeling or redesigning a home.

To start with, let's draw a picture of Jesus' room.



We use the formula for finding the area of a rectangle when solving this problem.

$$A = lw \text{ (length} \times \text{width)}$$

Next, we can substitute our given dimensions into this formula.

$$A = (12.5)(9.5)$$

We multiply as if these measurements were whole numbers and then add in the decimal point.

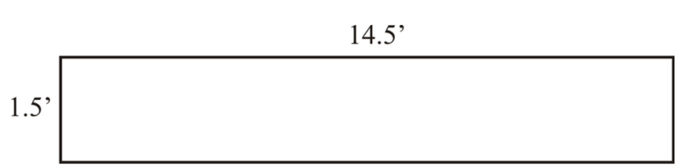
$$\begin{array}{rr} & 12.5 \\ \times & 9.5 \\ \hline & 625 \\ + & 11250 \\ \hline & 11875 \end{array}$$

Our final step is to insert the decimal point two decimal places.

Our answer is 118.75 square feet.

Now it's time for a little practice. Find the area of each rectangle.

1.



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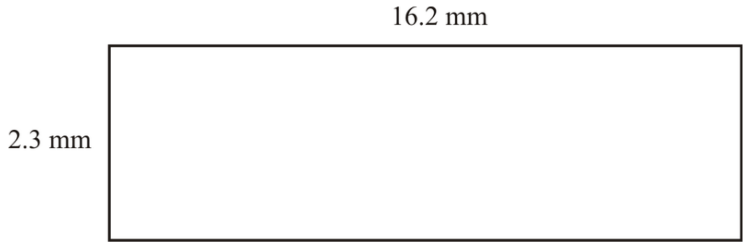

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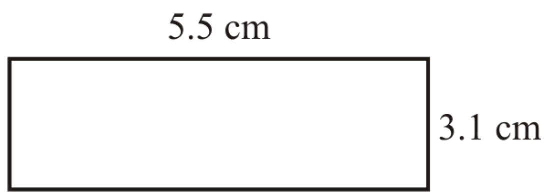
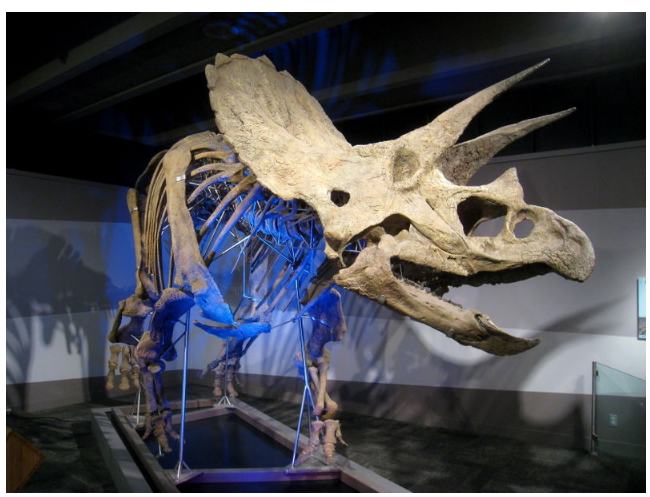


Stop and check your work for accuracy. Did you remember to label the measurements correctly?

Real Life Example Completed

The Triceratops Skeleton



Now that you have learned all about multiplying decimals, let's help Kara figure out the height of the triceratops.

Here is the problem once again.

When the students in Mrs. Andersen's class arrive at the Science Museum, Kara is very excited to learn that there is a dinosaur exhibit. In fact, it is a famous dinosaur exhibit. A set of dinosaur bones from a triceratops has been reconstructed and is on display.

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"Imagine, <u>that dinosaur is about 4 and a half times as long as you are</u>!" Mrs. Andersen smiles.

The students exit the exhibit hall, but Kara pauses at the door. She has to think about this. In all of her excitement she forgot to find the information that actually says how tall the triceratops actually is.

Mrs. Andersen's words stay with her, <u>*"the dinosaur is* $4\frac{1}{2}$ *times as long as you are."*</u>

<u>Kara knows that she is $5\frac{1}{4}$ feet tall</u>. If the <u>dinosaur is $4\frac{1}{2}$ times as long as she is</u>, how long is the dinosaur?

While Mrs. Andersen and the chaperones start to split up the students, Kara begins working some quick math on the back of her museum map.

She writes down the following figures.

<u>$5.25 \times 4.5 =$ ______</u>

First, let's go back and underline all of the important information.

Now let's work on figuring out the height of the triceratops.

First, let's estimate the product.

5.25 rounds down to 5.

4.5 rounds up to 5

5×5 is 25 feet tall.

The triceratops is approximately 25 feet long.

Now let's figure out its actual height.

$$\begin{array}{r} 5.25 \\ \times \quad 4.5 \\ \hline 2625 \\ +\ 21000 \\ \hline 23625 \end{array}$$

Next, we add in the decimal point.

The triceratops is 23.6 feet long. He is a little longer than 23 and one-half feet.

Wow! That is one big dinosaur!!

Vocabulary

Here are the vocabulary words that can be found in this lesson.

Hundreds grid
a grid of one hundred boxes used to show hundredths when working with decimals.

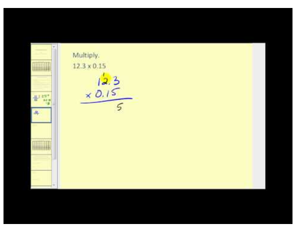
Product
the answer in a multiplication problem.

Vertically
written up and down in columns

Horizontally
written across

Area
the surface or space inside a perimeter

Technology Integration



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James Sousa Multiplying Decimals

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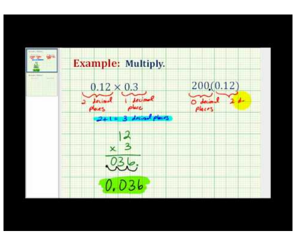
Khan Academy Multiplication 8



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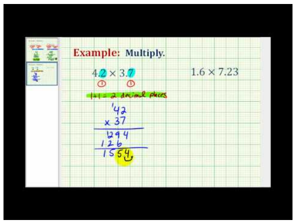
James Sousa Example of Multiplying Decimals



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James Sousa Another Example of Multiplying Decimals

Other Videos:

http://www.mathplayground.com/howto_multiplydecimals.html –A good basic video on multiplying decimals

Time to Practice

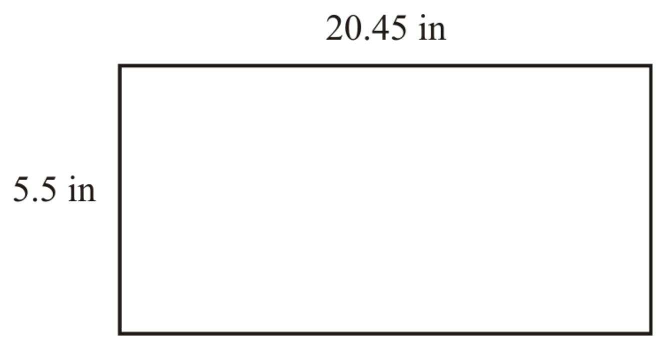
Directions: Multiply the following decimals.

1. $4.3 \times .12 =$ ______
2. $2.3 \times 3.4 =$ ______
3. $.34 \times .56 =$ ______
4. $2.7 \times 3.2 =$ ______
5. $6.5 \times 2.7 =$ ______
6. $.23 \times .56 =$ ______
7. $1.23 \times .4 =$ ______
8. $.5 \times .76 =$ ______
9. $.23 \times .8 =$ ______
10. $3.45 \times 1.23 =$ ______
11. $1.45 \times .23 =$ ______
12. $.89 \times .9 =$ ______
13. $.245 \times .8 =$ ______
14. $34.5 \times .7 =$ ______
15. $18.7 \times .9 =$ ______
16. $22.3 \times .76 =$ ______
17. $21.7 \times .4 =$ ______
18. $14.5 \times .68 =$ ______
19. $20.1 \times .3 =$ ______
20. $34.23 \times .18 =$ ______
21. $.189 \times .9 =$ ______
22. $.341 \times .123 =$ ______
23. $.451 \times .12 =$ ______
24. $.768 \times .123 =$ ______

25. $.76 \times .899 =$ ______

Directions: Find the area of the following rectangles. You may round to the nearest hundredth.

26.



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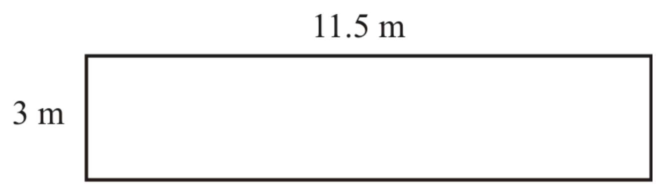

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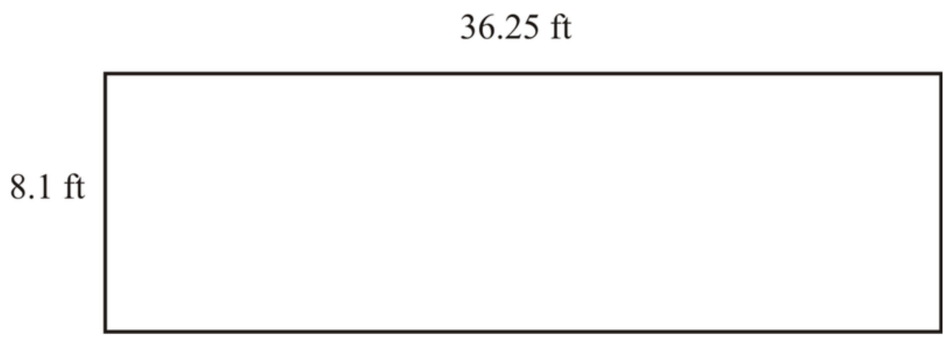

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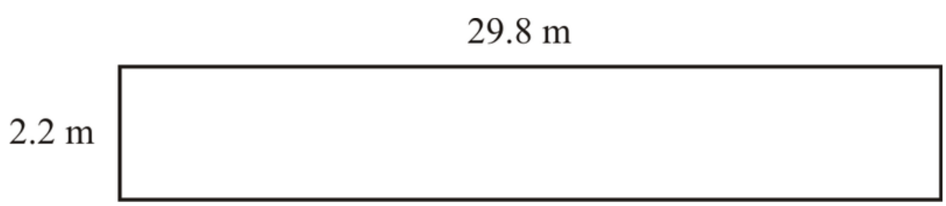

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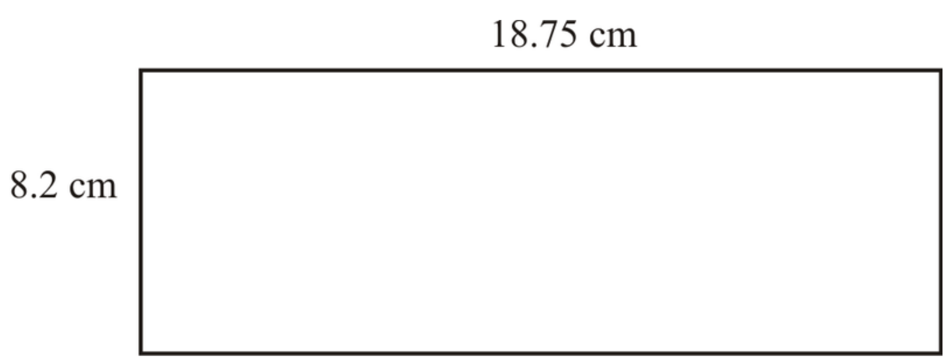


1.4 Dividing by Whole Numbers

Introduction

The Discount Dilemma

When the students in Mrs. Andersen's class came out of the dinosaur exhibit, Sara, one of the people who works at the museum, came rushing up to her.

"Hello Mrs. Andersen, we have some change for you. You gave us too much money, because today we have a discount for all students. Here is $35.20 for your change," Sara handed Mrs. Andersen the money and walked away.

Mrs. Andersen looked at the change in her hand.

Each student is due to receive some change given the student discount. Mrs. Andersen tells Kyle about the change. Kyle takes out a piece of paper and begins to work.

If 22 students are on the trip, how much change should each student receive?

In this lesson you will learn about dividing decimals by whole numbers. When finished with this lesson, you will know how much change each student should receive.

What You Will Learn

In this lesson you will learn how to:

- Divide decimals by whole numbers.
- Find decimal quotients of whole numbers using additional zero placeholders.
- Divide decimals by whole numbers and round to a given place.
- Solve real-world problems involving the division of decimals by whole numbers.

Teaching Time

I. **Divide Decimals By Whole Numbers**

To ***divide*** means to split up into equal parts. You have learned how to divide whole numbers in an earlier lesson. Now we are going to learn how to divide decimals by whole numbers.

When we divide a decimal by a whole number, we are looking at taking that decimal and splitting it up into sections.

Let's look at an example.

Example

$4.64 \div 2 =$ ______

The first thing that we need to figure out when working with a problem like this is which number is being divided by which number. In this problem, the two is the ***divisor***. Remember that the divisor goes outside of the division box. The ***dividend*** is the value that goes inside the division box. It is the number that you are actually dividing.

$$2\overline{)4.64}$$

We want to divide this decimal into two parts. We can complete this division by thinking of this problem as whole number division.

We divide the two into each number and then we will insert the decimal point when finished. Here is our problem.

$$\begin{array}{r} 232 \\ 2\overline{)4.64} \end{array}$$

Finally, we can insert the decimal point into the ***quotient***. We do this by bringing up the decimal point from its place in the division box right into the quotient. See the arrow in this example to understand it better, and here are the numbers for each step of the division.

$$\begin{array}{l} \quad\;\; 2.32 \\ \quad ?\uparrow \\ 2\overline{)4.64} \\ \quad \underline{4} \\ \quad 06 \\ \quad \underline{\;\;6\;} \\ \quad\;\; 04 \end{array}$$

Our answer is 2.32.

As long as you think of dividing decimals by whole numbers as the same thing as dividing by whole numbers it becomes a lot less complicated.

Always remember to notice the position of the decimal point in the dividend and bring it up into the quotient.

Here are a few for you to try.

1. **36.48 $\div$ 12**
2. **2.46 $\div$ 3**
3. **11.5 $\div$ 5**

Take a minute to check your work with a peer. Did you put the decimal point in the correct spot?

II. **Find Decimal Quotients of Whole Numbers Using Additional Zero Placeholders**

In our last lesson, you learned to divide a decimal by a whole number. Remember here that the divisor is the whole number which goes outside of the division box and the dividend is the decimal that goes inside of the division box.

The examples in the last section were evenly divisible by their divisors. This means that at the end there wasn't a remainder.

How do we divide decimals by whole numbers when there is a remainder?

Let's look at an example.

Example

$14.9 \div 5 =$ ______

The first thing that we can do is to set up this problem in a division box. The five is the divisor and the 14.9 is the dividend.

$$5\overline{)14.9}$$

Next we start our division. Five goes into fourteen twice, with four left over. Then we bring down the 9. Five goes into 49, 9 times with four left over. Before you learned about decimals, that 4 would just be a remainder.

$$\begin{array}{r} 2.9 \\ 5\overline{)14.9}\ r\ 4 \\ \underline{-\ 10} \\ 49 \\ \underline{-\ 45} \\ 4 \end{array}$$

However, when we work with decimals, we don't want to have a remainder. We can use a zero as a placeholder. In this example, we can add a zero to the dividend and then see if we can finish the division. We add a zero and combine that with the four so we have 40. Five divides into forty eight times.

Here is what that would look like.

$$\begin{array}{r} 2.98 \\ 5\overline{)14.90} \\ \underline{-10} \\ 49 \\ \underline{-45} \\ 40 \\ \underline{-40} \\ 0 \end{array}$$

Our final answer is 2.98.

When working with decimals, you always want to add zeros as placeholders so that you can be sure that the decimal is as accurate as it can be. Remember that a decimal shows a part of a whole. We can make that part as specific as necessary.

Try a few of these on your own. Be sure to add zero placeholders as needed.

1. **$13.95 \div 6 =$** _____
2. **$2.5 \div 2 =$** _____

3. **1.66 ÷ 4 =** _____

Take a minute to check your work with a neighbor.

III. **Divide Decimals by Whole Numbers and Round to a Given Place**

You have learned how to divide decimals by whole numbers and how to use zero placeholders to find the most accurate decimal quotient. We can also take a decimal quotient and round it to a specific place.

Let's say we have a decimal like this one.

Example

.3456210

Wow! That is a mighty long decimal. It is so long that it is difficult to decipher the value of the decimal.

If we were to round the decimal to the thousandths place, that would make the size of the decimal a lot easier to understand.

.3456210 Five is in the thousandths place. The number after it is a six, so we round up.

.346

Our answer is .346.

Think about a carpenter, some of those measurements are very tiny, or a scientist looking at microscopic organisms under a microscope.

Now let's try it with an example. Divide and round this decimal quotient to the nearest ten-thousandth.

Example

1.26484 ÷ 4 = ______

Use a piece of paper to complete this division.

Our answer is .31621.

Now we want to round to the nearest ten-thousandth.

.31621 Two is in the ten-thousandths place. The number after this is a one so our two does not round up.

Our answer is .3162.

Divide these decimals and whole numbers and then round each to the nearest thousandth.

1. **.51296 ÷ 2 =** _____
2. **10.0767 ÷ 3 =** _____

Check your work with a peer. Did you round the quotient to the correct place?

Real Life Example Completed

The Discount Dilemma

Now that you have learned about dividing decimals by whole numbers, we are ready to help Kyle figure out the change from the science museum.

When the students in Mrs. Andersen's class came out of the dinosaur exhibit, Sara, one of the people who works at the museum, came rushing up to her.

"Hello Mrs. Andersen, we have some change for you. You gave us too much money because today we have a discount for all students. Here is $35.20 for your change," Sara handed Mrs. Andersen the money and walked away.

Mrs. Andersen looked at the change in her hand.

Each student is due to receive some change given the student discount. Mrs. Andersen tells Kyle about the change. Kyle takes out a piece of paper and begins to work.

If 22 students are on the trip, how much change should each student receive?

First, let's go back and underline the important information.

Now that we know about dividing decimals and whole numbers, this problem becomes a lot easier to solve.

Our divisor is the number of students, that is 22.

Our dividend is the amount of change = 35.20

$$
\begin{array}{r}
1.60 \\
22\overline{)35.20} \\
\underline{-22} \\
132 \\
\underline{-132} \\
0
\end{array}
$$

Our answer is $1.60.

Kyle shows his work to Mrs. Andersen, who then hands out $1.60 to each student.

Vocabulary

Here are the vocabulary words that are found in this lesson.

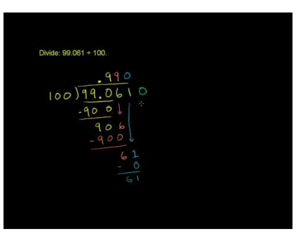
Divide
to split up into groups evenly.

Divisor
a number that is doing the dividing. It is found outside of the division box.

Dividend
the number that is being divided. It is found inside the division box.

Quotient
the answer to a division problem

Technology Integration



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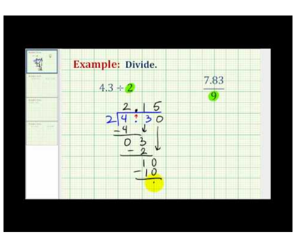
Khan Academy Dividing Decimals 2



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James Sousa Example of Dividing a Decimal by a Whole Number

Other Videos:

http://www.schooltube.com/video/8431c6dd1e794831b100/13-Dividing-Decimals-by-Whole-Numbers-Ex-1 –Blackboard video on dividing decimals by whole numbers

Time to Practice

Directions: Divide each decimal by each whole number. Add zero placeholders when necessary.

1. $5\overline{)17.5}$
2. $8\overline{)20.8}$
3. $4\overline{)12.8}$
4. $2\overline{)11.2}$
5. $4\overline{)14.4}$
6. $5\overline{)27.5}$
7. $6\overline{)13.8}$
8. $7\overline{)16.8}$
9. $7\overline{)23.1}$
10. $6\overline{)54.6}$
11. $8\overline{)41.6}$
12. $9\overline{)86.4}$
13. $10\overline{)52}$
14. $10\overline{)67}$
15. $11\overline{)57.2}$
16. $10\overline{)96}$
17. $8\overline{)75.2}$
18. $9\overline{)32.4}$
19. $12\overline{)38.4}$
20. $12\overline{)78}$

1.5 Multiplying and Dividing by Decimal Powers of Ten

Introduction

The Earth's Diameter

Kailey and Aron are very interested in Astronomy, so they were very excited when their group reached the Astronomy exhibit. Aron is particularly interested in how fast you can travel from the earth to the moon and to other planets. He found an interactive activity on figuring this out and was very excited.

Kailey gravitated over to an interactive exhibit about the earth. In this exhibit, the students are required to figure out what would happen if the size of the earth were increased or decreased.

The diameter of the earth is 12,756.3 km.

As Kailey starts to work on the activity, she is asked specific questions. Here they are:

1. What would the diameter of the earth be if it were ten times as large?
2. What would the diameter of the earth be if it were 100 times smaller?

Kailey is puzzled and stops to think about her answer.

Meantime, Aron is curious about what Kailey is working on. He comes over next to her and begins working on a different activity. In this activity, Aron is asked to think about what would happen to the other planets and celestial bodies if the earth were the size of a marble. He finds out that the asteroid Ceres would only be 2.9×10^{-2}. Here is his question.

1. If the asteroid Ceres were 2.9×10^{-2}, what size would that be as a decimal?

Aron looks at Kailey with a blank stare.

They are both stuck!

This is where you come in. Kailey will need to know how to multiply and divide by multiples of ten to complete her activity. Aron will need to remember how to work with scientific notation to complete his activity.

Pay close attention in this lesson and you will be able to help them by the end!

What You Will Learn

In this lesson you will learn how to complete the following:

- Use mental math to multiply decimals by whole number powers of ten.
- Use mental math to multiply decimals by decimal powers of ten.
- Use mental math to divide decimals by whole number powers of ten.
- Use mental math to divide decimals by decimal powers of ten.
- Write in scientific notation.

Teaching Time

I. **Use Mental Math to Multiply Decimals by Whole Number Powers of Ten**

This lesson involves a lot of mental math, so try to work without a piece of paper and a pencil as we go through this. You have already learned how to multiply decimals by whole numbers, however, there is a pattern that you can follow when you multiply decimals by whole number ***powers of ten.***

What is the pattern when I multiply decimals by whole number powers of ten?

To understand this, let's look at a few examples.

Example

$$3.4 \times 10 = 34$$
$$3.45 \times 100 = 345$$
$$.367 \times 10 = 3.67$$
$$.45 \times 1000 = 450$$

If you look carefully you will see that we move the decimal point to the right when we multiply by multiples of ten.

How many places do we move the decimal point?

That depends on the base ten number. An easy way to think about it is that you move the decimal point the same number of places as there are zeros.

If you look at the first example, ten has one zero and the decimal point moved one place to the **right**. In the second example, one hundred has two zeros and the decimal point moved two places to the **right**.

You get the idea.

Now it is your turn to practice. Use mental math to multiply each decimal and multiple of ten.

1. **.23** $\times$ **10** = _____
2. **34.567** $\times$ **100** = _____
3. **127.3** $\times$ **10** = _____

Now take a minute to check your work with a friend.

II. **Use Mental Math to Multiply Decimals by Decimal Powers of Ten**

How does this change when you multiply a decimal by a decimal power of ten? When multiplying by a power of ten, we moved the decimal point to the right the same number of zeros as there was in the power of ten.

$\times$ 100 = move the decimal to the right two places.

When we have what appears to be a power of ten after a decimal point, we we only move the decimal one place to the left. Why? Let's look at an example to understand why.

.10, .100, .1000 appear to all be powers of ten, but they are actually all the same number. We can keep adding zeros in a decimal, but they still are all the same. They all equal .10. **Therefore, if you see a .1 with zeros after it, you still move the decimal point one place to the left, no matter how many zeros there are.**

Example

$$.10 \times 4.5 = .45$$
$$.100 \times 4.5 = .45$$

Try a few on your own.

1. $\mathbf{.10 \times 6.7} =$ _____
2. $\mathbf{.100 \times .45} =$ _____
3. $\mathbf{.10 \times 213.5} =$ _____

Check your work. Did you complete these problems using mental math?

III. **Use Mental Math to Divide Whole Numbers by Whole Number Powers of Ten**

You just finished using mental math when multiplying, you can use mental math to divide by whole number powers of ten too.

Here are a few examples of 2.5 divided by whole number powers of ten. See if you can see the pattern.

Example

$$2.5 \div 10 = .25$$
$$2.5 \div 100 = .025$$
$$2.5 \div 1000 = .0025$$

What is the pattern?

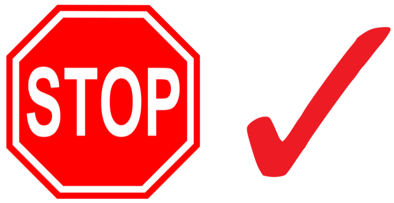
When you divide by a power of ten, you move the decimal point to the left according to the number of zeros that are in the power of ten that you are dividing by.

Once you have learned and memorized this rule, you will be able to divide using mental math.

Notice that division is the opposite of multiplication. When we multiplied by a power of ten we moved the decimal point to the right. When we divide by a power of ten, we move the decimal point to the left.

Use mental math to divide the following decimals.

1. **4.5** $\div$ **10** = _____
2. **.678** $\div$ **1000** = _____
3. **87.4** $\div$ **100** = _____



Double check your work with a friend. Were you able to mentally divide by a power of ten?

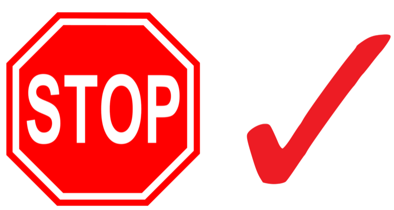
IV. **Use Mental Math to Divide Whole Numbers by Decimal Powers of Ten**

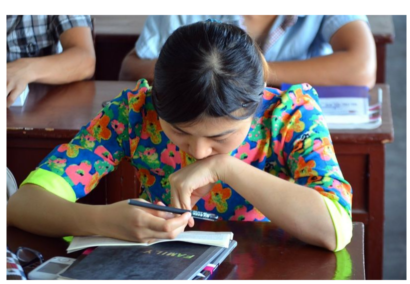
You have already learned how to multiply by what appears to be a power of ten after a decimal place. Remember that all powers of ten that you see written to the right of a decimal point are equal.

.10 = .100 = .1000 = .10000

When we multiply by this power of ten to the right a decimal point, we move the decimal point one place to the left. When we divide by a power of ten to the right a decimal point, we are going to move the decimal point one place to the right. If you think about this it makes perfect sense. The powers of ten written to the right of a decimal point are all equal. It doesn't matter if you are multiplying or dividing by .10 or .100 or .1000. Division is the opposite of multiplication so you move the decimal point one place to the right.

$$5.2 \div .10 = 52$$
$$5.2 \div .100 = 52$$
$$5.2 \div .1000 = 52$$





Once you have learned the rule, you can use mental math to complete the division of decimals by a power of ten.

Practice using mental math to divide these decimals.

1. **.67** $\div$ **.10** = _____
2. **12.3** $\div$ **.100** = _____
3. **4.567** $\div$ **.1000** = _____

Stop and check your work.

V. **Write in Scientific Notation**

What is scientific notation?

Scientific Notation is a shortcut for writing very small and very large numbers.

When you write in scientific notation, you write a number between 1 and 10 multiplied by a power of ten. Here is an example of a number and the same number written in scientific notation:

$$450,000 = 4.5 \times 10 \times 10 \times 10 \times 10 \times 10 = 4.5 \times 10^5$$

4.5×10^5 is scientific notation. Large numbers written using scientific notation will use positive exponents. Note that to change 450,000 into 4.5, you must move the decimal point five spaces to the left. This is why when the number is written in scientific notation the exponent is 5.

What about very small numbers written using scientific notation?

$$.0023 = 2.3 \div 10 \div 10 \div 10 = 2.3 \times 10^{-3}$$

2.3×10^{-3} is scientific notation. Multiplying by 10^{-3} is like dividing by 10 three times. When writing small numbers between 0 and 1 using scientific notation, we will use negative exponents. Note that to change .0023 into 2.3, you must move the decimal point three spaces to the right. This is why when the number is written in scientific notation the exponent is -3.

.00056

If we want to write this in scientific notation, we first start with the number between 1 and 10. This number is 5.6.

5.6 $\times$ _____

We want to multiply 5.6 by a power of ten. Since .00056 is a number less than 1, we know that it will be a negative power of ten. Notice that to go from .00056 to 5.6, you must move the decimal point four places to the right. This means the exponent will be -4**.**

$$5.6 \times 10^{-4}$$

We can work the other way around too. If we have the scientific notation, we can write the original number by moving the decimal point. If the exponent is negative, work backwards and move the decimal point to the

left. If the exponent is positive, work backwards and move the decimal point to the right. Move the decimal point the number of times indicated by the exponent.

$$3.2 \times 10^{-5} = .000032$$

Notice that to determine the original number, we moved the decimal point five times to the left.

Scientific notation is very useful for scientists, mathematicians and engineers. It is useful in careers where people work with very large or very small numbers.

Practice writing a few of these numbers in scientific notation.

1. **.0012 = _____**
2. **78,000,000 = _____**
3. **.0000023 = _____**

Take a few minutes to check your work.

Real Life Example Completed

The Earth's Diameter

You have finished learning about division by powers of ten. Astronomers use scientific notation, multiplication and division by powers of ten all the time. Think about it, they work with very large and very small decimals.

Now you are ready to help Kailey and Aron with their work. Here is the problem once again.

Kailey and Aron are very interested in Astronomy, so they were very excited when their group reached the Astronomy exhibit. Aron is particularly interested in how fast you can travel from the earth to the moon and to other planets. He found an interactive activity on figuring this out and was very excited.

Kailey gravitated over to an interactive exhibit about the earth. In this exhibit, the students are required to figure out what would happen if the size of the earth were increased or decreased.

The diameter of the earth is 12,756.3 km.

As Kailey starts to work on the activity, she is asked specific questions. Here they are:

1. What would the diameter of the earth be if it were ten times as large?
2. What would the diameter of the earth be if it were 100 times smaller?

Kailey is puzzled and stops to think about her answer.

Meantime, Aron is curious about what Kailey is working on. He comes over next to her and begins working on a different activity. In this activity, Aron is asked to think about what would happen to the other planets and celestial bodies if the earth were the size of a marble. He finds out that the asteroid Ceres would only be 2.9×10^{-2}. Here is his question.

1. If the asteroid Ceres were 2.9×10^{-2}, what size would that be as a decimal?

Aron looks at Kailey with a blank stare.

They are both stuck!

First, let's take a minute to underline the important information.

Let's start by helping Kailey answer her questions. To figure out the diameter or the distance across the earth, Kailey has to use multiplication and division by powers of ten.

She knows that the diameter of the earth is 12,756.3 km. If it were 10 times as large, she would multiply this number by 10. Remember that when you multiply by a whole number power of ten, you move the decimal point one place to the right.

12,756.3 $\times$ 10 $=$ 127,563 km

Wow! That is some difference in size!

Kailey's second question asks if what the diameter of the earth would be if it were 100 times smaller. To complete this problem, Kailey needs to divide the diameter of the earth by 100. She will move the decimal point two places to the left.

12,756.3 $\div$ 100 $=$ 127.563

Wow! The earth went from being in the ten-thousands to being in the hundreds. Think about how much smaller that is!

Let's not forget about Aron. His problem involves scientific notation. If the asteroid Ceres were 2.9×10^{-2} **, what size would that be as a decimal?**

Remember that the negative 2 exponent tells us how many places to move the decimal point to the left.

$$2.9 \times 10^{-2} = .029$$

Aron is excited to understand scientific notation. Here is another fact that he discovers at his work station.

If a Neutron Star was 6.17×10^{-4} inches that would mean that it was .000617 inches. That is a very small star!!!

Vocabulary

Power of 10
$10^1, 10^2, 10^3, \cdots$ and $10^{-1}, 10^{-2}, 10^{-3}, \cdots$.

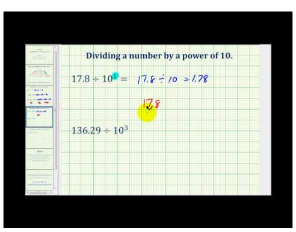
Scientific notation
A means of representing a number as a product of a number between 1 and 10 and a power of 10.

Resources

If you found the information on Astronomy useful, you can go to the following websites for more information.

1. www.wikianswers.com –this site will answer any question that you may have about the solar system.
2. www.janus.astro.umd.edu/AW/awtools –this is a website for the Astronomy Workshop which has great interactive activities using mathematics and astronomy.

Technology Integration



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James Sousa Dividing by Powers of Ten

Other Videos:

http://www.mathplayground.com/howto_dividedecimalspower10.html –Good basic video on how to divide decimals by a power of ten

Time to Practice

Directions: Use mental math to multiply each decimal by a whole number power of ten.

1. $3.4 \times 10 =$ ______

2. $3.45 \times 100 =$ ______

3. $.56 \times 10 =$ ______

4. $1.234 \times 1000 =$ ______

5. $87.9 \times 100 =$ ______

6. $98.32 \times 10 =$ ______

7. $7.2 \times 1000 =$ ______

Directions: Use mental math to multiply each decimal by a decimal power of ten.

8. $3.2 \times .10 =$ ______

9. $.678 \times .100 =$ ______

10. $2.123 \times .10 =$ ______

11. $.890 \times .1000 =$ ______

12. $5 \times .10 =$ ______

13. $7.7 \times .100 =$ ______

14. $12 \times .10 =$ ______

15. $456.8 \times .100 =$ ______

Directions: Use mental math to divide each decimal by a power of ten.

16. $3.4 \div 10 =$ ______

17. $67.89 \div 100 =$ ______

18. $32.10 \div 10 =$ ______

19. $.567 \div 100 =$ ______

20. $.87 \div 1000 =$ ______

Directions: Use mental math to divide each decimal by a decimal power of ten.

21. $6.7 \div .10 =$ ______

22. $.654 \div .100 =$ ______

23. $2.1 \div .10 =$ ______

24. $4.32 \div .1000 =$ ______

25. $.98765 \div .10 =$ ______

Directions: Write each decimal in scientific notation.

26. .00056

27. 98,000

28. .024

29. 2,340,000,000

30. .00000045

1.6 Dividing by Decimals

Introduction

The Sand Experiment

Most students love to participate in hands-on projects, and the students in Mrs. Andersen's class aren't any exception. At the science museum there is a whole section that is a Discovery Center. In the Discovery Center, students can use real objects to work on experiments.

Mrs. Andersen has asked her students to bring a notebook and a pencil into the Discovery Center. The students need to keep track of the experiments that they work on. They will each have an opportunity to share their discoveries when they return to the classroom.

When Miles enters the Discovery Center he is immediately overwhelmed with all of the options. After looking around, he finally decides to work on an experiment that involves an hour glass. To complete the experiment, Miles needs to figure out how long it takes 1.25 pounds of sand to go through the hour glass. There is bucket of sand that is 6.25 pounds in front of Miles. He has a scale and another bucket to hold the sand he needs for his experiment.

Miles needs to complete the experiment as many times as he can with the 6.25 pound bucket of sand. Miles picks up the scoop and begins to sort out the sand. Remember he needs 1.25 pounds of sand each time he does the experiment.

If Miles needs 1.25 pounds of sand, how many times can he complete the experiment if he has a 6.25 pound bucket?

Pretend you are Miles. If you were completing this experiment, how many times could you do it given the amount of sand you have been given and the amount of sand that you need?

In this lesson, you will find all of the information that you need. Dividing decimals by other decimals will help you with this experiment.

What You Will Learn

In this lesson you will learn to:

- Divide decimals by decimals by rewriting divisors as whole numbers.
- Find quotients of decimals by using additional zero placeholders.
- Solve real-world problems involving division by decimals.

Time to Practice

I. **Divide Decimals by Decimals by Rewriting Divisors as Whole Numbers**

In our introductory problem, Miles is working on dividing up sand. If you were going to complete this problem yourself, you would need to know how to divide decimals by decimals.

How can we divide a decimal by a decimal?

To divide a decimal by a decimal, we have to rewrite the ***divisor***. Remember that the divisor is the number that is outside of the division box. The ***dividend*** is the number that is inside the division box.

Let's look at an example.

Example

$$2.6\overline{)10.4}$$

In this problem, 2.6 is our divisor and 10.4 is our dividend. We have a decimal being divided into a decimal. Whew! This seems pretty complicated. We can make our work simpler by rewriting the divisor as a whole number.

How can we do this?

Think back to the work we did in the last section when we multiplied by a power of ten. When we multiply a decimal by a power of ten we move the decimal point one place to the right.

We can do the same thing with our divisor. We can multiply 2.6 times 10 and make it a whole number. It will be a lot easier to divide by a whole number.

$\mathbf{2.6 \times 10 = 26}$

What about the dividend?

Because we multiplied the divisor by 10, we also need to multiply the dividend by 10. This is the only way that it works to rewrite a divisor.

$\mathbf{10.4 \times 10 = 104}$

Now we have a new problem to work with.

$$\begin{array}{r} 4 \\ 26\overline{)104} \end{array}$$

Our answer is 4.

What about if we have two decimal places in the divisor?

Example

$$.45\overline{)1.35}$$

In this example, we want to make our divisor .45 into a whole number by multiplying it by a power of ten. We can multiply it by 100 to make it a whole number. Then we can do the same thing to the dividend.

> Remember, if you multiply the divisor
> by a power of ten
> you must also multiply the dividend
> by the same power of ten.

Here is our new problem and quotient.

$$\begin{array}{r} 3 \\ 45\overline{)135} \end{array}$$

Now it is time for you to practice a few. Rewrite each divisor and dividend by multiplying them by a power of ten. Then find the quotient.

1. $1.2\overline{)4.8}$
2. $5.67\overline{)11.34}$
3. $6.98\overline{)13.96}$

Take a minute to check your rewrite and quotient with a peer. Is your work accurate?

II. **Find Quotients of Decimals by Using Additional Zero Placeholders**

The decimals that we divided in the last section were all evenly divisible. This means that we had whole number quotients. We didn't have any decimal quotients.

What can we do if a decimal is not evenly divisible by another decimal?

If you think back, we worked on some of these when we divided decimals by whole numbers. **When a decimal was not evenly divisible by a whole number, we had to use a zero placeholder to complete the division.**

Here is a blast from the past problem.

Example

$$5\overline{)13.6}$$

When we divided 13.6 by 5, we ended up with a 1 at the end of the division. Then we were able to add a zero placeholder and finish finding a decimal quotient. Here is what this looked like.

$$\begin{array}{r} 2.72 \\ 5\overline{)13.60} \\ \underline{-10} \\ 36 \\ \underline{-35} \\ 1- \\ 10 \\ \underline{-10} \\ 0 \end{array}$$

1 – here is where we added the zero placeholder

We add zero placeholders when we divide decimals by decimals too.

Example

$$1.2\overline{)2.79}$$

The first thing that we need to do is to multiply the divisor and the dividend by a multiple of ten to make the divisor a whole number. We can multiply both by 10 to accomplish this goal.

$$12\overline{)27.9}$$

Now we can divide.

$$\begin{array}{r} 2.3 \\ 12\overline{)27.9} \\ \underline{-24} \\ 39 \\ \underline{-36} \\ 3 \end{array}$$

Here is where we have a problem. We have a remainder of 3. We don't want to have a remainder, so we have to add a zero placeholder to the problem so that we can divide it evenly.

$$\begin{array}{r} 2.32 \\ 12\overline{)27.90} \\ \underline{-24} \\ 39 \\ \underline{-36} \\ 30 \\ \underline{-24} \\ 6 \end{array}$$

Uh Oh! We still have a remainder, so we can add another zero placeholder.

$$
\begin{array}{r}
2.325 \\
12\overline{)27.900} \\
-24 \\
\hline
39 \\
-36 \\
\hline
30 \\
-24 \\
\hline
60 \\
-60 \\
\hline
0
\end{array}
$$

Sometimes, you will need to add more than one zero. The key is to use the zero placeholders to find a quotient that is even without a remainder.

Real Life Example Completed

The Sand Experiment

Congratulations you have finished the lesson! Now you are ready for the experiment.

Here is the problem once again.

Most students love to participate in hands-on projects, and the students in Mrs. Andersen's class aren't any exception. At the science museum there is a whole section that is a Discovery Center. In the Discovery Center, students can use real objects to work on experiments.

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Miles needs to complete the experiment as many times as he can with the 6.25 pound bucket of sand. Miles picks up the scoop and begins to sort out the sand. Remember he needs 1.25 pounds of sand each time he does the experiment.

If Miles needs 1.25 pounds of sand, how many times can he complete the experiment if he has a 6.25 pound bucket?

First, underline the important information.

Next, write a division problem.

$$1.25\overline{)6.25}$$

You can start by multiplying the divisor by a power of ten to rewrite it as a whole number. Do this to the dividend too. Since there are two places in the divisor, we can multiply it by 100 to make it a power of ten.

$$125\overline{)625}$$

Next, we divide. Our answer will tell us how many times Miles can complete the hourglass experiment.

$$\begin{array}{r} 5 \\ 125\overline{)625} \\ \underline{-625} \\ 0 \end{array}$$

Miles can complete the experiment 5 times using 1.25 pounds of sand from his 6.25 pound bucket.

Vocabulary

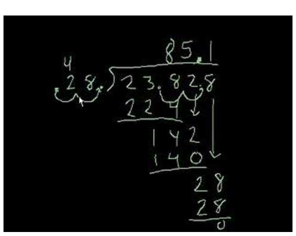
Here are the vocabulary words that are found in this lesson.

Divisor
the number doing the dividing, it is found outside of the division box.

Dividend
the number being divided. It is found inside the division box.

Quotient
the answer in a division problem

Technology Integration



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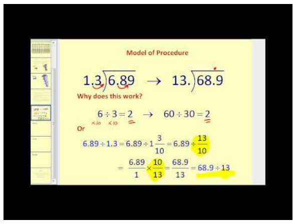
Khan Academy Dividing Decimals



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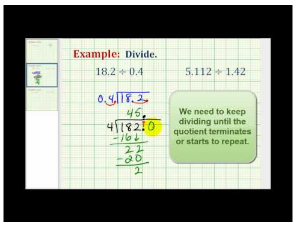
James Sousa Dividing Decimals



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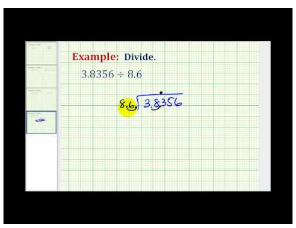
James Sousa Example of Dividing Decimals



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James Sousa Another Example of Dividing Decimals

Other Videos:

http://www.mathplayground.com/howto_dividedecimals.html –Good basic video on dividing decimals

Time to Practice

Directions: Divide the following decimals. Use zero placeholders when necessary.

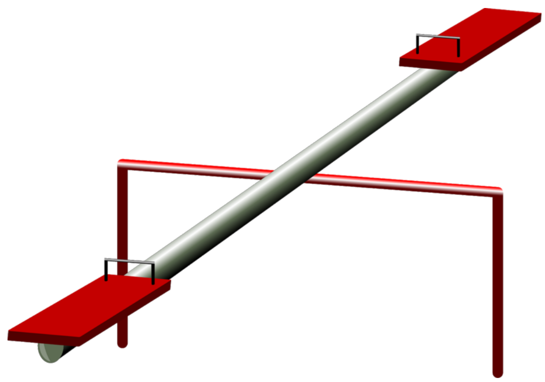
1. $1.3\overline{)5.2}$
2. $6.8\overline{)13.6}$
3. $4.5\overline{)13.5}$
4. $2.5\overline{)10}$
5. $3.3\overline{)19.8}$
6. $8.5\overline{)17}$
7. $9.3\overline{)27.9}$
8. $1.2\overline{)7.2}$
9. $5.3\overline{)26.5}$
10. $6.5\overline{)13}$

11. $1.25\overline{)7.5}$
12. $3.36\overline{)20.16}$
13. $5.87\overline{)52.83}$
14. $2.5\overline{)3}$
15. $3.2\overline{)8}$
16. $4.6\overline{)10.58}$
17. $8.1\overline{)17.82}$
18. $3.1\overline{)28.52}$
19. $8.7\overline{)53.94}$
20. $5.4\overline{)18.9}$

1.7 Metric Units of Mass and Capacity

Introduction

The Metric Park



Mrs. Andersen's class is having a great time at the science museum. Sam and Olivia are very excited when the group comes upon the metric playground. This playground has been built inside the museum and combines playground toys with metrics.

The first one that they try is the metric seesaw. Sam sits on one side of the seesaw and Olivia sits on the other side. Since they weigh about the same, it is easy to keep the seesaw balanced. Under Sam, there is a digital scale. Under Olivia there is the same scale with a key pad. Sam's weight shows up under the scale.

Sam weighs 37 kg.

"Next, we have to convert kilograms to grams and punch it in so both of our scales will have the same reading," Sam tells Olivia.

Olivia pauses, she can't remember how to do this.

"Let's move on to something else, I can't remember," She tells Sam.

The two move on to a birdbath. Together, they need to fill one 4.5 liter birdbath with water using a scoop. Once they have it filled, the sign above the birdbath will light up and tell them how many milliliters are in 4.5 liters.

"I think I can figure this out without filling the birdbath," Olivia says.

Can you figure it out? How many milliliters can be found in that 4.5 liter birdbath?

This lesson is all about metrics, but by the end, you will be able to master the tasks at the metric park.

What You Will Learn

In this lesson you will learn the following skills:

- Identify equivalence of metric units of mass.
- Identify equivalence of metric units of capacity.
- Choose appropriate metric units of mass or capacity for given measurement situations.
- Solve real-world problems involving metric measures of mass or capacity.

Teaching Time

I. **Identify Equivalence of Metric Units of Mass**

In the United States, the most common system of measurement is the ***Customary system*** of measurement. The Customary system of measurement for ***mass*** or weight is measured in pounds and tons. Outside of the United States and when people work with topics in science, people use a system called the ***Metric system***. The metric system measures mass or weight differently from the customary system.

How do we measure mass in the Metric system?

In the metric system we use different standard units to measure mass or weight.

Metric Units of Mass

Kilograms
Grams
Milligrams

This text box lists the units of measuring mass from the largest unit, the kilogram, to the smallest unit, the milligram. If you think back to when you learned about measuring length, the prefix "milli" indicated a very small unit. That is the same here as we measure mass.

How can we find equivalent metric units of mass?

The word ***equivalent*** means equal. We can compare different units of measuring mass with kilograms, grams and milligrams. To do this, we need to know how many grams equal one kilogram, how many milligrams equal one gram, etc. Here is a chart to help us understand equivalent units.

Equivalent Units of Mass - Metrics

1 kilogram (kg) = 1000 grams (g)
1 gram = 1000 milligrams (mg)

Here you can see that when we convert **kilograms to grams you multiply by 1000.**

When you convert **grams to milligrams, you multiply by 1000.**

To convert from a large unit to a small unit, we multiply.

To convert from a small unit to a large unit, we divide.

Example

5 kg = _____ g

When we go from kilograms to grams, we multiply by 1000.

5 kg = 5000 g

These two values are equivalent.

Example

2000 mg = _____ g

When we go from milligrams to grams, we divide.

2000 mg = 2 g

These two values are equivalent.

Now it is your turn to practice. Convert each metric unit of mass to its equivalent.

1. **6 kg = _____ g**
2. **3000 g = _____ kg**
3. **4 g = _____ mg**

Take a few minutes to check your work with a peer.

II. **Identify Equivalence of Metric Units of Capacity**

When we think about ***capacity***, often referred to as volume, we think about measuring liquids. In the Customary system of measurement, we measure liquids using cups, pints, ounces, gallons etc. In the Metric System of measurement, we measure capacity using two different measures, liters and milliliters.

Metric Units of Capacity

1 liter (L) = 1000 milliliters (mL)

Since there are only two common metric units for measuring capacity, this text box shows them and their equivalent measures.

Liters are larger than milliliters. Notice that prefix "milli" again.

When converting from large units to small units, you multiply.

When converting from small units to large units, you divide.

Let's apply this in an example.

Example

4 liters = _____ milliliters

Liters are larger than milliliters, so we multiply by 1000.

4 liters = 4000 milliliters

Use what you have learned to write each equivalent unit of capacity.

1. **5 liters = _____ milliliters**
2. **2000 milliliters = _____ liters**
3. **4500 milliliters = _____ liters**

Take a minute to check your work with a neighbor. Did you divide or multiply when needed?

III. Choose Appropriate Metric Units of Mass or Capacity for Given Measurement Situations

When you think about the metric units for measuring mass, how do you know when to measure things in grams, milligrams or kilograms? To really understand when to use each unit of measurement we have to understand a little more about the size of each unit. If you know measurements in the customary or standard system of measurement, such as ounces and pounds, you can compare them to measurements in the metric system of measurement, such as milligrams, grams, and kilograms. **Grams compare with ounces, which measure really small things like a raisin. Kilograms compare with pounds, which we use pounds to measure lots of things, like a textbook. What about milligrams?**

Milligrams are very, very tiny. Think about how small a raisin is and recognize we would use grams to measure that. Scientists are one group of people who would measure the mass of very tiny items. These things would be measured in milligrams.

If you think about things that would be seen under a microscope, you would measure the mass of those items in milligrams.

A milligram is $\frac{1}{1000}$ of a gram.

Use what you have learned to select the correct metric unit for measuring the mass of each item.

1. **The weight of five pennies**
2. **The weight of a person**
3. **The weight of a car**

Now take a minute to check your answers with your neighbor.

What about capacity? How do we choose the correct unit to measure capacity?

There are two metric units for measuring capacity, milliliters and liters.

This comparison may seem a little more obvious that the units for mass. A milliliter would be used to measure very small amounts of liquid. Milliliters are much smaller even than ounces. A liter would be used to measure much larger volumes of liquid.

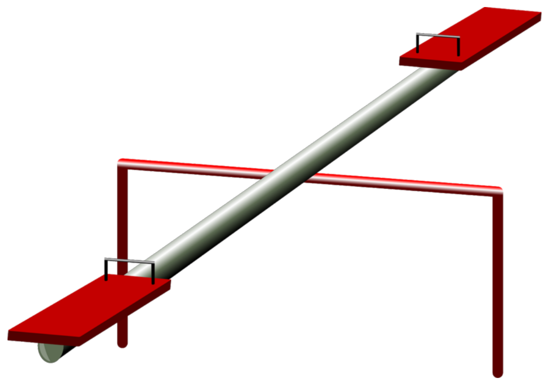
A milliliter is $\frac{1}{1000}$ of a liter.

Would you measure a bottle of soda in liters or milliliters?

You would measure it in liters. A 2 liter bottle of soda is a standard size for soda bottles. Think about milliliters as the amount of liquid in an eyedropper.

Real Life Example Completed

The Metric Park



Remember back to the metric park? Well, now you are ready to help Sam and Olivia with those conversions.

Let's take another look at the problem.

Mrs. Andersen's class is having a great time at the science museum. Sam and Olivia are very excited when the group comes upon the metric playground. This playground has been built inside the museum and combines playground toys with metrics.

The first one that they try is the metric seesaw. Sam sits on one side of the seesaw and Olivia sits on the other side. Since they weigh about the same, it is easy to keep the seesaw balanced. Under Sam, there is a digital scale. Under Olivia there is the same scale with a key pad. Sam's weight shows up under the scale.

Sam weighs 37 kg.

"Next, we have to convert kilograms to grams and punch it in so both of our scales will have the same reading," Sam tells Olivia.

Olivia pauses, she can't remember how to do this.

"Let's move on to something else, I can't remember," She tells Sam.

The two move on to a birdbath. Together, they need to fill one 4.5 liter birdbath with water using a scoop. Once they have it filled, the sign above the birdbath will light up and tell them how many milliliters are in 6 liters.

"I think I can figure this out without filling the birdbath," Olivia says.

Can you figure it out? How many milliliters can be found in that 4.5 liter birdbath?

First, let's underline all of the important information.

Next, Sam and Olivia need to convert 37 kg into grams. There are 1000 grams in 1 kilogram, so there are 37,000 grams in 37 kilograms.

You can see why it makes so much more sense to measure someone's weight in kilograms versus grams.

The birdbath holds 4.5 liters of water. Now that you know that there are 1000 milliliters in one liter, you can figure out how many milliliters will fill the birdbath by multiplying 4.5 $\times$ 1000. We move the decimal point three places to the right when we multiply by 1000.

Our answer is 4500 milliliters.

Wow! You can see why it makes much more sense to measure the amount of water in the birdbath in liters versus milliliters.

Vocabulary

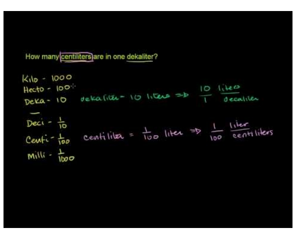
Here are the vocabulary words that are found in this lesson.

Customary System
The system of measurement common in the United States, uses feet, inches, pounds, cups, gallons, etc.

Mass
the weight of an object

Capacity
the amount of liquid an object or item can hold

Technology Integration



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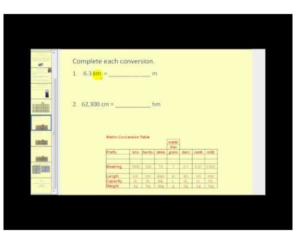
Khan Academy Conversion Between Metric Units



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James Sousa Metric Unit Conversions

Other Videos:

http://www.linkslearning.org/Kids/1_Math/2_Illustrated_Lessons/6_Weight_and_Capacity/index.html –Great animated video on weight and capacity using metric units and customary units

Time to Practice

Directions: Convert to an equivalent unit for each given unit of mass.

1. 5 kg = ______ g
2. 2000 g = ______ kg
3. 2500 g = ______ kg
4. 10 kg = ______ g
5. 2000 mg = ______ g
6. 30 g = ______ mg
7. 4500 mg = ______ g
8. 6.7 g = ______ mg
9. 9 kg = ______ g
10. 1500 g = ______ kg

Directions: Convert to an equivalent unit for each given unit of capacity.

11. 4500 mL = ______ L
12. 6900 mL = ______ L
13. 4400 mL = ______ L
14. 5200 mL = ______ L
15. 1200 mL = ______ L
16. 3 L = ______ mL
17. 5.5 L = ______ mL
18. 8 L = ______ mL
19. 9.3 L = ______ mL
20. 34.5 L = ______ mL

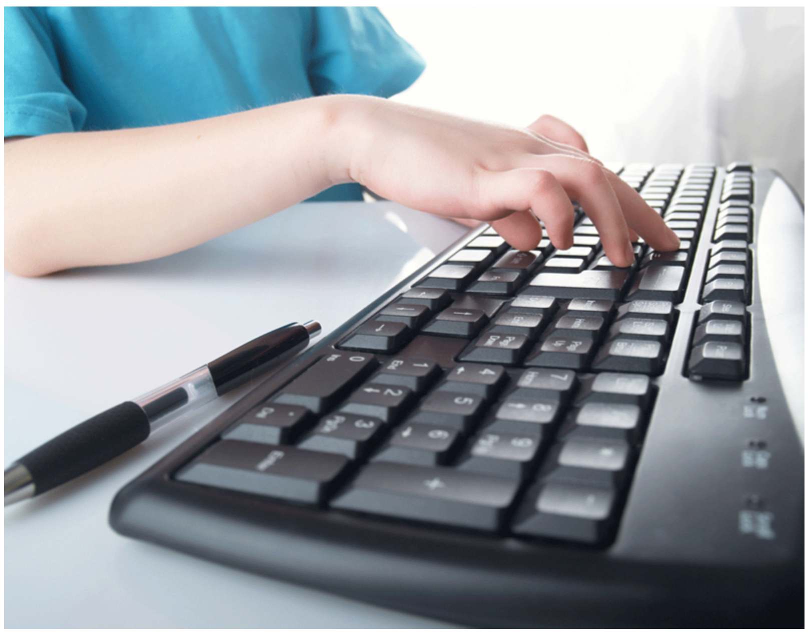
Directions: Choose the best unit of either mass or capacity to measure each item.

21. A dictionary
22. A flea under a microscope
23. A jug of apple cider
24. An almond
25. Drops of water from an eyedropper

1.8 Converting Metric Units

Introduction

The Computer Game



Before leaving the science museum, Caleb found a really cool computer game all about metrics. Caleb had been practicing his metric conversions while playing at the Metric Playground, but now it was time for him to apply what he had learned.

The object of the game is to move the mountain climber up the mountain by solving problems involving metric lengths, weights and liquids. Each time a correct answer is given, the mountain climber moves up the mountain. You keep playing until the climber reaches the top.

At the beginning of the game, Caleb sees this problem on the computer screen. It is a problem that requires Caleb to use greater than or less than symbols to compare values.

5.5 grams _____ 4500 mg

Caleb is unsure of the correct answer. He decides to skip this problem by pushing the NEXT button on the computer.

Here is Caleb's second problem.

6.7 Liters $\times$ 10 = _____

Caleb thought that the answer was 6700 so he entered that answer into the computer.

TRY AGAIN popped up on his screen.

Finally Caleb decided to try one more problem.

______ kilograms is one hundred times lighter than 1550 kilograms

Caleb is stuck again.

You can help Caleb. In this lesson you will learn all about comparing metric units of length, mass and capacity. You will also learn to convert units using powers of ten.

What You Will Learn

In this lesson, you will learn the following skills:

- Convert metric units of length, mass and capacity using powers of ten.
- Compare and order given metric measurements of length, mass or capacity.
- Solve real-world problems involving conversion of metric measures of length, mass and capacity.

Teaching Time

I. **Convert Metric Units of Length, Mass and Capacity Using Powers of Ten**

This section combines a couple of different skills that we have already learned. We have learned all about metrics and about how to convert metric units of length, mass and capacity. We have also learned how to multiply decimals using powers of ten such as 10, 100, 1000.

How can we put these two skills together?

We can put them together by converting metric units using powers of ten. This will require us to move the decimal point as we did in earlier lessons. Let's look at an example.

Example

Convert 150 cm into mm by multiplying by a power of ten.

We know that there are 10 mm in 1 cm. When we go from a larger unit to a smaller unit we multiply. Therefore, we are going to multiply 150 cm by 10.

150 cm $\times$ 10 = _____ mm

We know that when we multiply by 10 we move the decimal point one place to the right. The decimal point in a whole number is after the number. So we need to add a zero placeholder to 150.

150 cm = 1500 mm

We can do this when we convert from a smaller unit to a larger unit too. Let's look at this one involving capacity.

Example

1250 milliliters = _____ L

We know that there are 1000 milliliters in one liter. We need to divide 1250 milliliters by 1000. To do this, we will move the decimal point three places to the left. The decimal point is after the number in a whole number.

1250 milliliters = 1.25 Liters

We can complete this with any unit of measure as long as we know the conversion equivalents and remember how to use powers of ten to move the decimal point to the left or to the right.

Here are a few for you to try.

1. **1340 ml = _____ Liters**
2. **66 grams = _____ mg**
3. **1123 m = _____ km**

Take a few minutes to check your work with a peer.

II. <u>**Compare and Order Given Metric Measurements of Length, Mass or Capacity**</u>

In a previous lesson, we learned that we can have metric units that are equivalents of each other. For example, 100 cm is equal to 1 meter. Because of this, 500 cm is equal to 5 meters. What if we have different metric units and different quantities?

How can we compare metric units?

To compare metric units, we have to use comparisons between the numbers. Let's look at an example.

Example

4.5 m _____ 500 cm

We have two different metric units here. We have centimeters and we have meters. We can compare the units by thinking about the equivalents. If there are 100 centimeters in one meter, then 500 cm is the same as 5 meters. 5 meters is greater than 4.5 meters.

4.5 m <500 cm

We can work this way with metric units of length, mass and capacity.

Example

7.6 kg _____ 7800 g

Which is greater? To figure this out, we need to use the equivalents that we have already learned. There are 1000 grams in 1 kg. Therefore, 7800 grams becomes 7.8 kilograms.

We know from our work with decimals that 7.6 is less than 7.8. Now we can compare them.

7.6 kg <7800 g

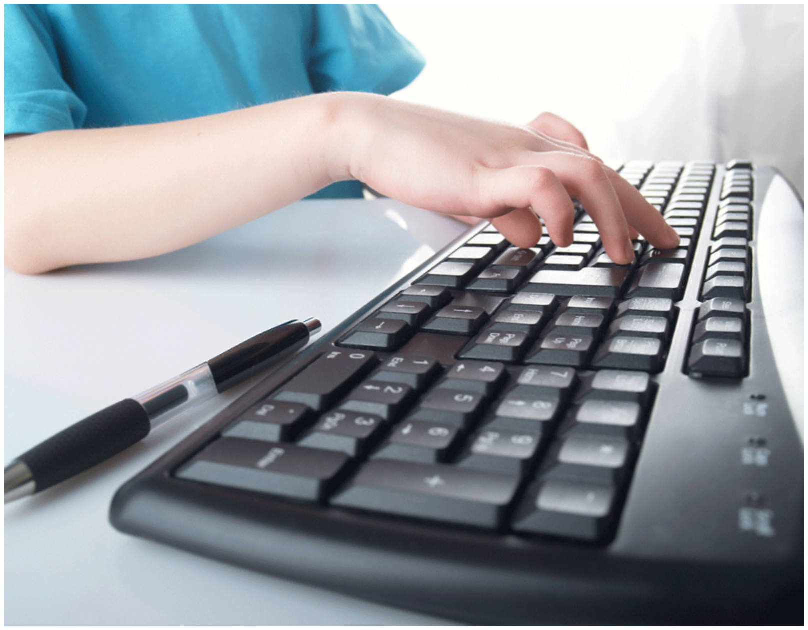
Take a minute to compare a few of these on your own.

1. **6.5 kg _____ 50000 g**
2. **500 mL _____ .5 liters**
3. **7000 m _____ 7.1 km**

Take a few minutes to check your work with a peer.

Real Life Example Completed

The Computer Game



Now we are ready to help Caleb with his computer game. Here is the problem once again.

Before leaving the science museum, Caleb found a really cool computer game all about metrics. Caleb had been practicing his metric conversions while playing at the Metric Playground, but now it was time for him to apply what he had learned.

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Here is Caleb's second problem.

6.7 Liters x 10 = _____

Caleb thought that the answer was 6700 so he entered that answer into the computer.

TRY AGAIN popped up on his screen.

Finally Caleb decided to try one more problem.

______ kilograms is one hundred times lighter than 1550 kilograms

Caleb is stuck again.

We are going to help Caleb answer all three questions. Let's start with the first one.

5.5 grams _____ 4500 mg

There are 1000 mg in 1 gram. Therefore, if we change the 4500 milligrams to grams by moving the decimal

point three places to the left, we end up with 4.5 grams. 5.5 is greater than 4.5.

5.5 grams >4500 mg

The second problem requires multiplying by powers of ten.

6.7 liters $\times$ 10 = _____

To multiply by a power of ten we move the decimal point to the right. Here we are multiplying by 10, so we move the decimal point one place to the right.

6.7 liters $\times$ 10 = 67 liters

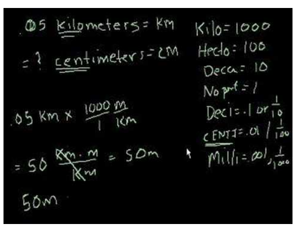
Our final problem involves division by powers of ten.

______ kilograms is one hundred times lighter than 1550 kilograms

We want to make 1550 kg 100 times lighter. To do this, we divide by 100. To divide by 100, a power of 10, we move the decimal point two places to the left.

15.5 kg is our answer.

Technology Integration



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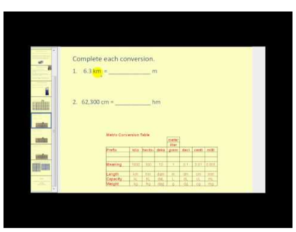
Khan Academy Unit Conversion



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Time to Practice

Directions: Compare the following metric units using >, <, or =.

1. 5 cm ______ 60 mm
2. 105 mm ______ 10 cm
3. 6000 mg ______ 6 kg
4. 7.8 L ______ 780 mL
5. 65 L ______ 65000 mL
6. 102 cm ______ 1000 mm

Directions: Convert each measurement using powers of ten.

7. 5.6 km = ______ m
8. 890 m = ______ km
9. 9230 m = ______ km
10. 40 cm = ______ mm
11. 5000 mm = ______ cm
12. 500 cm = ______ m
13. 7.9 m = ______ cm
14. 99 m = ______ cm
15. 460 cm = ______ m
16. 34 cm = ______ m
17. 4.3 km = ______ m
18. 760 m = ______ km
19. 4300 m = ______ km
20. 5000 g = ______ kg
21. 560 mL = ______ L
22. 6210 mL = ______ L
23. 8900 mL = ______ L
24. 7.5 L = ______ mL
25. .5 L = ______ mL