



Lesson 15: The Division Algorithm—Converting Decimal Division into Whole Number Division Using Mental Math

Student Outcomes

- Students use their knowledge of dividing multi-digit numbers to solve for quotients of multi-digit decimals.
- Students understand the mathematical concept of decimal placement in the divisor and the dividend and its connection to multiplying by powers of 10.

Classwork

Opening Exercises (10 minutes)

This is an optional section for those who would like to include a warm-up exercise in their lessons. Although the Opening Exercises are optional, the 10 minutes provided for these questions are included in the 45 minutes designated for lesson.

These questions can be asked in discussion with the whole group to introduce the students to the idea of multiplying the divisor or dividend by powers of ten.

- Let's take a look at what happens when we change our division problem.

Opening Exercises

Start by finding the quotient of 1,728 and 32.

$$\begin{array}{r} 54 \\ 32 \overline{) 1728} \\ \underline{-160} \\ 128 \\ \underline{-128} \\ 0 \end{array}$$

What would happen if we multiplied the divisor by 10? $1,728 \div 320$

$$\begin{array}{r} 5.4 \\ 320 \overline{) 1728.0} \\ \underline{-1600} \\ 1280 \\ \underline{-1280} \\ 0 \end{array}$$

When the divisor is ten times bigger, the quotient is ten times smaller.

MP.7

What would happen if we multiplied the dividend by 10? $17,280 \div 32$

$$\begin{array}{r} 540 \\ 32 \overline{) 17280} \\ \underline{-160} \\ 128 \\ \underline{-128} \\ 00 \\ \underline{-00} \\ 0 \end{array}$$

When the dividend is ten times bigger, the quotient is ten times bigger.

What would happen if we multiplied both the divisor and dividend by 10? $17,280 \div 320$

$$\begin{array}{r} 54 \\ 320 \overline{) 17280} \\ \underline{-1600} \\ 1280 \\ \underline{-1280} \\ 0 \end{array}$$

When both the divisor and dividend are multiplied by 10, the quotient does not change.

What would happen if we multiplied both the divisor and dividend by 100? $172,800 \div 3,200$

$$\begin{array}{r} 54 \\ 3200 \overline{) 172800} \\ \underline{-16000} \\ 12800 \\ \underline{-12800} \\ 0 \end{array}$$

When both the divisor and dividend are multiplied by 100, the quotient does not change.

What would happen if we multiplied both the divisor and the dividend by 1,000, 10,000, or 100,000? What do you predict would happen?

As long as both the divisor and the dividend are multiplied by the same amount, the quotient will not change.

How can we use this to help us divide when there are decimals in the divisor? For example, how can we use this to help us divide 172.8 and 3.2?

172.8 is the same as 1,728 tenths, and 3.2 is the same as 32 tenths. So, to get the quotient, we could divide 1,728 by 32. If we multiply both the divisor and the dividend by 10, we get the same two numbers that we need to divide, 1,728 and 32. Because we multiplied both numbers by the same amount, the answer will not change.

MP.7

Example 1 (3 minutes)

Example 1

Using our discoveries from the discussion, let's divide 537.1 by 8.2.

How can we rewrite this problem using what we learned in Lesson 14?

We can rewrite this problem as 5,371 tenths $\div$ 82 tenths. These two numbers already have the same unit, so we would divide 5,371 by 82.

How could we use the short cut from our discussion to change the original numbers to 5,371 and 82?

We can multiply both numbers by 10, which changes the divisor from 8.2 to 82. Then, we will have a whole number to divide by. So, the new problem will become 5,371 $\div$ 82.

$$\begin{array}{r} 65.5 \\ 82 \overline{) 5371.0} \\ \underline{-492} \\ 451 \\ \underline{-410} \\ 410 \\ \underline{-410} \\ 0 \end{array}$$

Example 2 (3 minutes)

Example 2

Now let's divide 742.66 by 14.2.

How can we rewrite this division problem so that the divisor is a whole number, but the quotient remains the same?

We can multiply both numbers by 10, which changes the divisor from 14.2 to 142. Then, we will have a whole number to divide by. So, the new problem will become 7,426.6 $\div$ 142.

$$\begin{array}{r} 52.3 \\ 142 \overline{) 7426.6} \\ \underline{-710} \\ 326 \\ \underline{-284} \\ 426 \\ \underline{-426} \\ 0 \end{array}$$

Exercises (21 minutes)

Exercises

Students will participate in a game called Pass the Paper. Students will work in groups of no more than four. There will be a different paper for each player. When the game starts, each student solves the first problem on his paper and passes the paper clockwise to the second student, who uses multiplication to check the work that was done by the previous student. Then, the paper is passed clockwise again to the third student, who solves the second problem. The paper is then passed to the fourth student, who checks the second problem. This process continues until all of the questions on every paper are complete or time runs out.

Four pages, one for each player, are attached at the end of the lesson. Answers are provided below.

Player A Answers

1. $15.5 \div 6.2 = 2.5$
2. $28.08 \div 7.8 = 3.6$
3. $44.888 \div 3.62 = 12.4$
4. $3,912.99 \div 15.9 = 246.1$
5. $865.1475 \div 47.25 = 18.31$

Player B Answers

1. $32.4 \div 7.2 = 4.5$
2. $49.14 \div 6.3 = 7.8$
3. $39.321 \div 2.57 = 15.3$
4. $8,578.02 \div 24.6 = 348.7$
5. $439.0464 \div 35.18 = 12.48$

Player C Answers

1. $25.9 \div 7.4 = 3.5$
2. $25.48 \div 5.2 = 4.9$
3. $61.962 \div 4.49 = 13.8$
4. $16,437.42 \div 31.8 = 516.9$
5. $1,238.8048 \div 52.76 = 23.48$

Player D Answers

1. $63.7 \div 9.8 = 6.5$
2. $32.68 \div 8.6 = 3.8$
3. $142.912 \div 8.12 = 17.6$
4. $23,344.58 \div 57.4 = 406.7$
5. $2,498.743 \div 39.65 = 63.02$

Closing (3 minutes)

- Based upon our work today, discuss ways you would alter the problem $4,509 \div 0.03$ to make it easier to use the long division algorithm yet yield the same answer.
 - *As long as I multiply both dividend and divisor by the same number, the quotient will not change. If I multiply by powers of 10, I will be able to ultimately get to a point where both dividend and divisor are whole numbers. In this case, if I multiply by 10^2 , the problem will become $450,900 \div 3$.*

Exit Ticket (5 minutes)

Name _____

Date _____

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Exit Ticket

State the power of 10 you would use to convert the given decimal division to whole number division. Then, complete the multiplication on the dividend and divisor.

1. $133.84 \div 5.6$

2. $12.4 \div 1.036$

3. $38.9 \div 2.91$

4. $45 \div 1.5$

Exit Ticket Sample Solutions

State the power of 10 you would use to convert the given decimal division to whole number division. Then, complete the multiplication on the dividend and divisor.

1. $133.84 \div 5.6$

10, 1338.4 and 56

2. $12.4 \div 1.036$

1,000 or 10^3 , 12,400 and 1,036

3. $38.9 \div 2.91$

100 or 10^2 , 3,890 and 291

4. $45 \div 1.5$

10 or 10^1 , 450 and 15

Problem Set Sample Solutions

1. $118.4 \div 6.4$

1,184 $\div$ 64

$$\begin{array}{r} 18.5 \\ 64 \overline{) 1184.0} \\ \underline{- 64} \\ 544 \\ \underline{- 512} \\ 320 \\ \underline{- 320} \\ 0 \end{array}$$

2. $314.944 \div 3.7$

3,149.44 $\div$ 37

$$\begin{array}{r} 85.12 \\ 37 \overline{) 3149.44} \\ \underline{- 296} \\ 189 \\ \underline{- 185} \\ 44 \\ \underline{- 37} \\ 74 \\ \underline{- 74} \\ 0 \end{array}$$

3. $1,840.5072 \div 23.56$

$184,050.72 \div 2,356$

$$\begin{array}{r} 78.12 \\ 2356 \overline{) 184050.72} \\ \underline{- 16492} \\ 19130 \\ \underline{- 18848} \\ 2827 \\ \underline{- 2356} \\ 4712 \\ \underline{- 4712} \\ 0 \end{array}$$

Player A

1. $15.5 \div 6.2$	Check:
2. $28.08 \div 7.8$	Check:
3. $44.888 \div 3.62$	Check:
4. $3,912.99 \div 15.9$	Check:
5. $865.1475 \div 47.25$	Check:

Player B

1. $32.4 \div 7.2$	Check:
2. $49.14 \div 6.3$	Check:
3. $39.321 \div 2.57$	Check:
4. $8,578.02 \div 24.6$	Check:
5. $439.0464 \div 35.18$	Check:

Player C

1. $25.9 \div 7.4$	Check:
2. $25.48 \div 5.2$	Check:
3. $61.962 \div 4.49$	Check:
4. $16,437.42 \div 31.8$	Check:
5. $1,238.8048 \div 52.76$	Check:

Player D

1. $63.7 \div 9.8$	Check:
2. $32.68 \div 8.6$	Check:
3. $142.912 \div 8.12$	Check:
4. $23,344.58 \div 57.4$	Check:
5. $2,498.743 \div 39.65$	Check: