Explore Dividing Multi-Digit Numbers

Learning Target

- Find whole-number quotients of whole numbers with up to four-digit dividends and two-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.

SMP 1, 2, 3, 4, 5, 6, 7, 8

You already know how to divide a multi-digit number by a one-digit divisor. Now you will learn how to divide with two-digit divisors. Use what you know to try to solve the problem below.

There are 92 fifth graders at Wilson Middle School and 23 students in each fifth-grade classroom. How many fifth-grade classrooms are there at Wilson Middle School?

TRY IT

Math Toolkit

- base-ten blocks
- base-ten grid paper
- grid paper
- index cards
- multiplication models

DISCUSS IT

Ask your partner: Can you explain that again?

Tell your partner: I started by . . .

CONNECT IT

1 LOOK BACK

What is 92 ÷ 23? Explain your reasoning.

2 LOOK AHEAD

Multiplication and division are called **inverse operations** because they "undo" each other. For example, the related multiplication and division equations $5 \times 7 = 35$ and $35 \div 5 = 7$ show that if you multiply a number by 5 and then divide the result by 5, you end up with the number you started with.

Think about the related equations $264 \div 12 = ?$ and $12 \times ? = 264$.

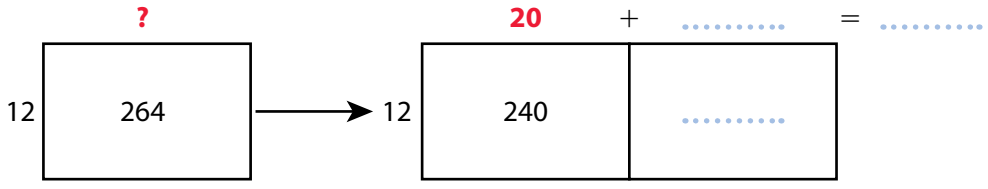
You can use the related multiplication equation to help you divide.

a. Start by listing products of the divisor, 12, and **multiples of 10**.

Multiple of 10	**10**	**20**	**30**	**40**	**50**
12 × Multiple of 10	120				

b. Which row of the table above is related to the dividend in 264 ÷ 12? How could you use the table above to estimate the quotient 264 ÷ 12?

c. Start with 12 × **a multiple of 10** to divide 264 by 12 using an area model. Complete the missing numbers.



3 REFLECT

How can you use the inverse relationship between multiplication and division to check your answer to 264 ÷ 12?

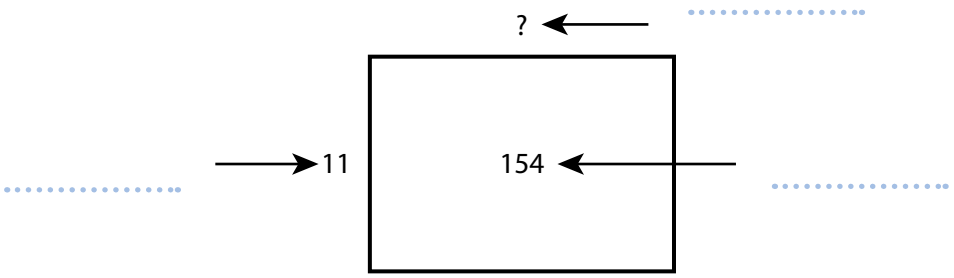
.....

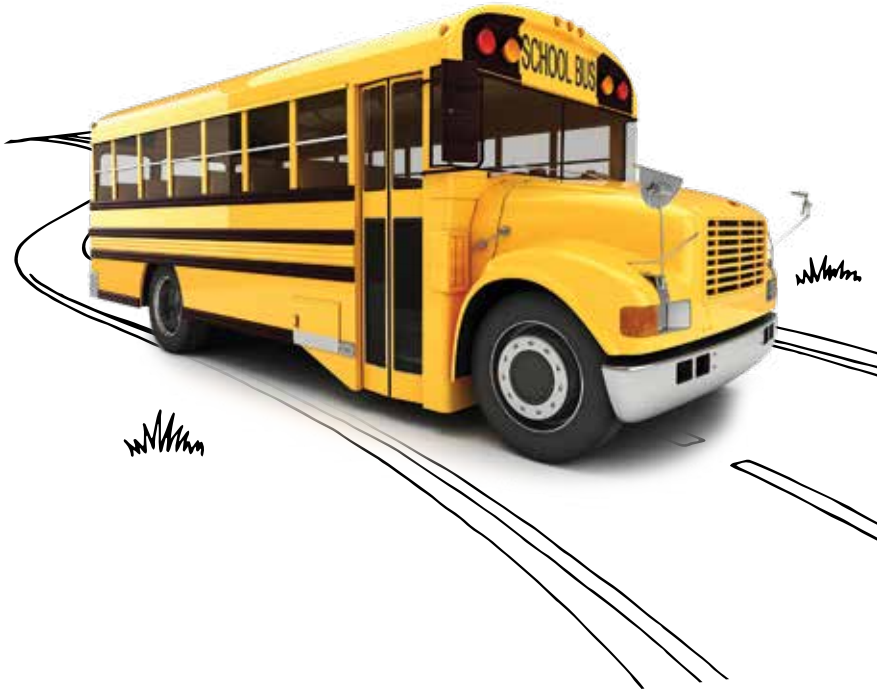
Prepare for Dividing Multi-Digit Numbers

1 Think about what you know about division. Fill in each box. Use words, numbers, and pictures. Show as many ideas as you can.

Word	In My Own Words	Example
dividend		
divisor		
quotient		

2 Label the *dividend*, *divisor*, and *quotient* of the division equation shown by the area model. Then write the division equation.





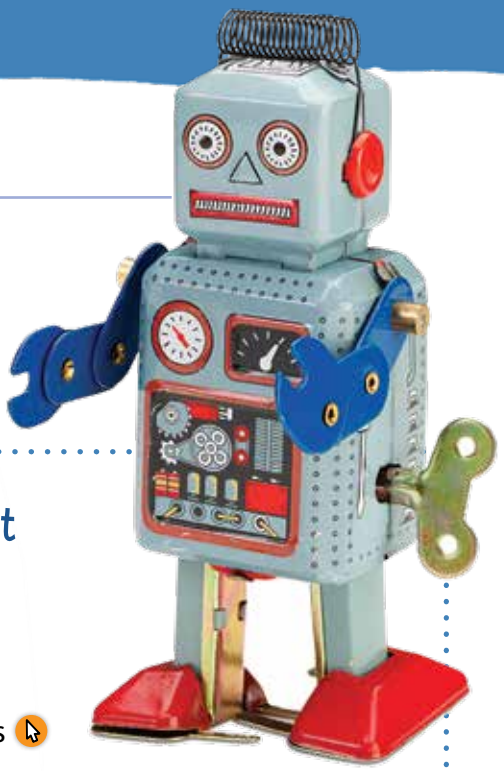
3 Solve the problem. Show your work.

There are 95 students on a field trip and 19 students on each bus. How many buses of students are there on the field trip?

Solution

4 Check your answer. Show your work.

Develop Estimating Quotients



Read and try to solve the problem below.

A toy company packs 504 robots into 21 boxes. Each box has the same number of robots. Show how you could estimate the number of robots in each box.

TRY IT

Math Toolkit

- base-ten blocks
- base-ten grid paper
- grid paper
- index cards
- multiplication models

DISCUSS IT

Ask your partner: How did you get started?

Tell your partner: I knew . . . so I . . .

Explore different ways to understand how to estimate quotients when dividing whole numbers.

A toy company packs 504 robots into 21 boxes. Each box has the same number of robots. Show how you could estimate the number of robots in each box.

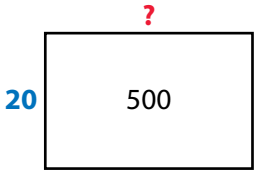
MODEL IT

You can use compatible numbers to estimate a quotient.

Compatible numbers are numbers close to the values of the actual dividend and divisor that allow you to multiply or divide using basic facts.

500 and 20 are compatible numbers that are close to 504 and 21.

You can use them to estimate by thinking 500 ÷ **20** = **?** means **20** × **?** = 500.



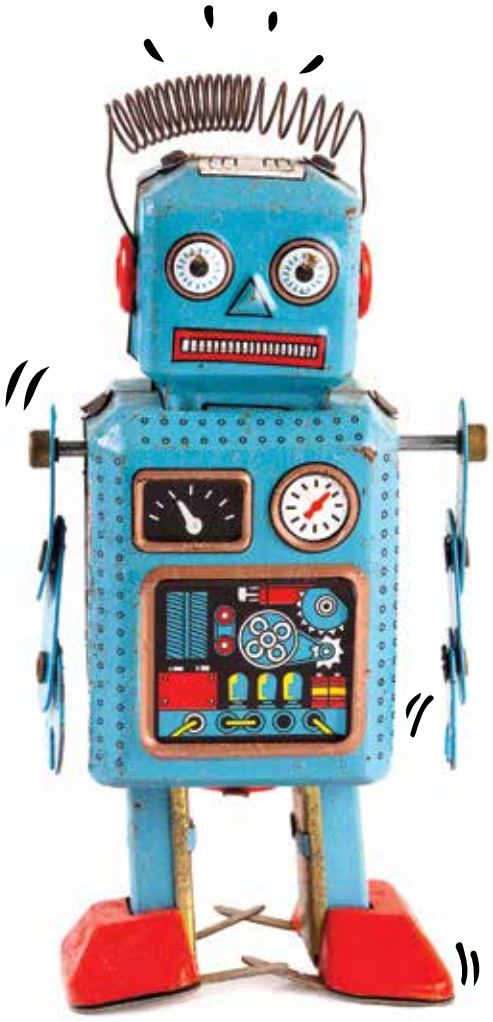
MODEL IT

You can use the inverse relationship between multiplication and division to estimate a quotient.

504 ÷ **21** = **?** or **21** × **?** = 504

Multiply **21** by **multiples of 10**. Make a table.

Number of Robots per Box	Total Number of Robots
10	21 × 10 = 210
20	21 × 20 = 420
30	21 × 30 = 630



CONNECT IT

Now you will use the problem from the previous page to help you understand how to estimate quotients with two-digit divisors.

1. Look at the first **Model It**. Why are 500 and 20 good choices to use for compatible numbers? Why not round to the nearest thousand and use 1,000 and 20 as compatible numbers?

2. How can you find the quotient 500 ÷ 20? What estimate does this give for the number of robots in each box?

3. Look at the second **Model It**. Why do you multiply 21 by multiples of 10? Could you multiply 21 by multiples of 5 instead of by multiples of 10?

4. Look at the table. Between which two numbers is a good estimate for the number of robots packed in each box? Explain how you know.

5. What do the methods of estimating quotients in the **Model Its** have in common?

6 REFLECT

Look back at your **Try It**, strategies by classmates, and **Model Its**. Which models or strategies do you like best for estimating quotients? Explain.

APPLY IT

Use what you just learned to solve these problems.

7 Estimate the quotient 342 ÷ 38. Show your work.

Solution

8 Estimate the quotient 1,103 ÷ 23. Show your work.

Solution

9 Camille arranged 238 chairs into equal rows of 14 chairs. Which of the following is the best estimate for the number of rows she made?

Ⓐ a number close to 30

Ⓑ about 20

Ⓒ a number between 30 and 40

Ⓓ about 10

Practice Estimating Quotients

Study the Example showing how to estimate a quotient with a two-digit divisor. Then solve problems 1–4.

EXAMPLE

Estimate the quotient 1,474 ÷ 22.

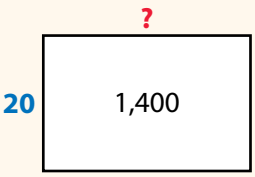
Choose compatible numbers that are close to the actual dividend and divisor and easy to multiply and divide using a basic fact.

1,400 and 20 are close to 1,474 and 22.

$2 \times 7 = 14$, $2 \times 70 = 140$, and $20 \times 70 = 1{,}400$.

$20 \times 70 = 1{,}400$ is the same as $1{,}400 \div 20 = 70$.

So, 70 is the estimated quotient for 1,474 ÷ 22.



1 Look at the Example. You can also multiply 22 by **multiples of 10** to estimate the quotient 1,474 ÷ 22.

a. Complete the table.

Multiple of 10	10	20	30	40	50	60	70	80
22 × Multiple of 10	220	440	660	880	1,100			

b. Complete the statement below with two numbers from the table.

The dividend 1,474 is between _____ and _____.

c. What is a good estimate for the quotient 1,474 ÷ 22?

2 Which of the following is the best estimate for the quotient 713 ÷ 31?

Ⓐ a number between 10 and 20

Ⓑ a number close to 40

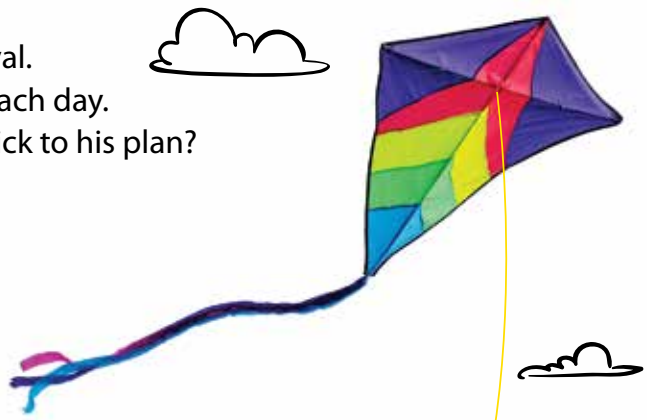
Ⓒ a number close to 35

Ⓓ a number between 20 and 30

3 A beverage company makes 1,008 bottles of water and packs them into boxes. The company packs 24 bottles in each box. Estimate how many boxes of water bottles the company packs. Show your work.

Solution

4 Marcus builds 2,744 kites for a 14-day summer kite festival.
He plans to give away about the same number of kites each day.
He gives away 492 kites the first two days. Did Marcus stick to his plan?
Use estimation to explain. Show your work.



Solution

Develop Using Estimation and Area Models to Divide

Read and try to solve the problem below.

A factory produces 768 buses and puts them in 24 buildings. Each building has the same number of buses. How many buses are in each building? Estimate and then solve.

TRY IT

Math Toolkit

- base-ten blocks
- base-ten grid paper
- grid paper
- index cards
- multiplication models

DISCUSS IT

Ask your partner: Do you agree with me? Why or why not?

Tell your partner: I agree with you about . . . because . . .

Explore different ways to understand how to divide multi-digit numbers using estimation and area models.

A factory produces 768 buses and puts them in 24 buildings. Each building has the same number of buses. How many buses are in each building? Estimate and then solve.

MODEL IT

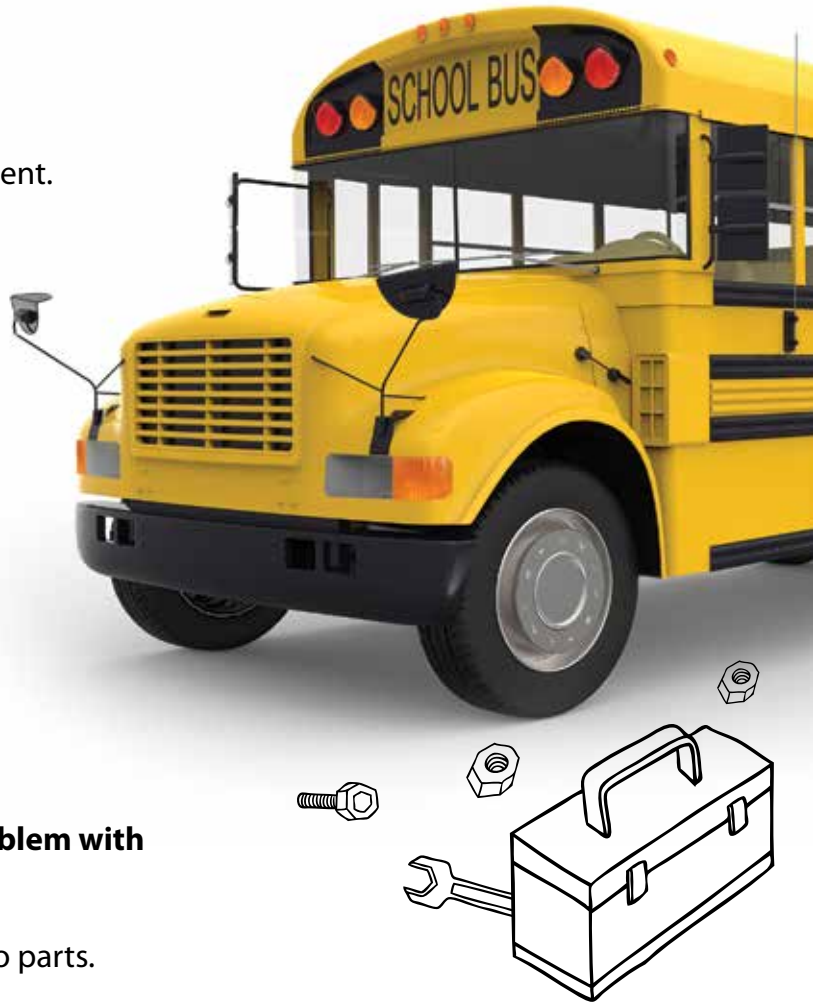
You can use the relationship between multiplication and division to estimate the quotient.

$768 \div 24 = ?$ and $24 \times ? = 768$

Multiply 24 by **multiples of 10** to estimate the quotient. You can organize your work in a table.

Number of Buses in Each Building	Total Number of Buses
10	240
20	480
30	720
40	960

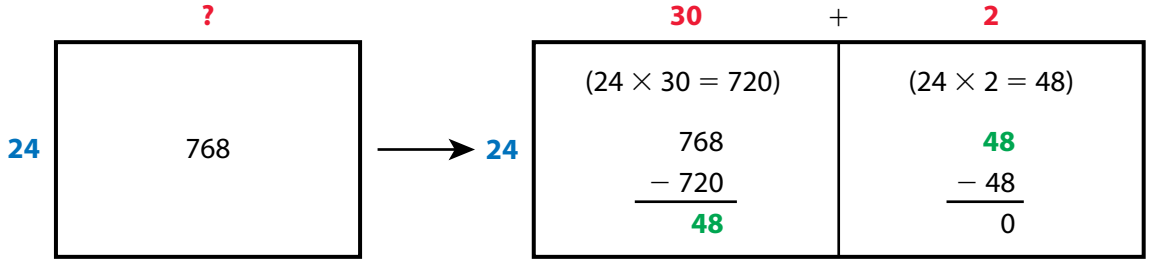
The quotient is between **30** and **40**.



MODEL IT

You can use an area model to solve a division problem with a two-digit divisor.

The area model breaks up the problem 768 ÷ 24 into parts.



CONNECT IT

Now you will use the problem from the previous page to help you understand how to divide multi-digit numbers using estimation and area models.

1. In the first **Model It**, how do you know the quotient is between 30 and 40?

2. Look at the second **Model It**. The number 24 is multiplied by which estimate, 30 or 40, to start the area model work? Why do you think the other number was not used?

3. What does the expression 30 + 2 above the area model represent?

4. Explain why the numbers 30 and 2 can be called *partial quotients*.

5. Explain how an area model can help you break apart a division problem to make it easier to solve.

6 REFLECT

Look back at your **Try It**, strategies by classmates, and **Model Its**. Which models or strategies do you like best for dividing whole numbers? Explain.

APPLY IT

Use what you just learned to solve these problems.

7 In the problem on the previous page, 768 ÷ 24, you first estimated and then used an area model to find the quotient. Describe how can you use multiplication to check that you have the correct quotient.

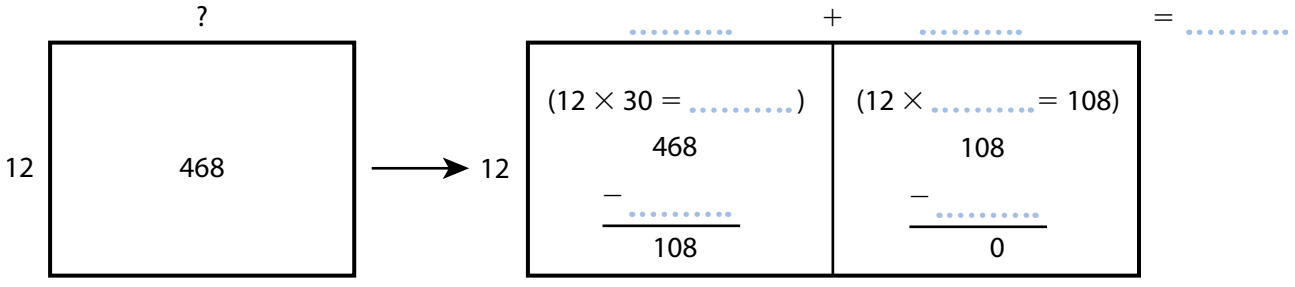
Show your work for the check.

8 Dante has 468 cards in his sports card collection. He buys cards in packages of 12. Complete the table and give an estimate for how many packages of cards Dante has bought.

Number of packages	10	20	30	40	50
Number of sports cards					

Solution

9 Refer to the situation in problem 8. Complete the area model to find the quotient 468 ÷ 12. How many packages of sports cards did Dante buy?



Solution

Practice Using Estimation and Area Models to Divide

Study the Example showing how to estimate and use area models to divide. Then solve problems 1–4.

EXAMPLE

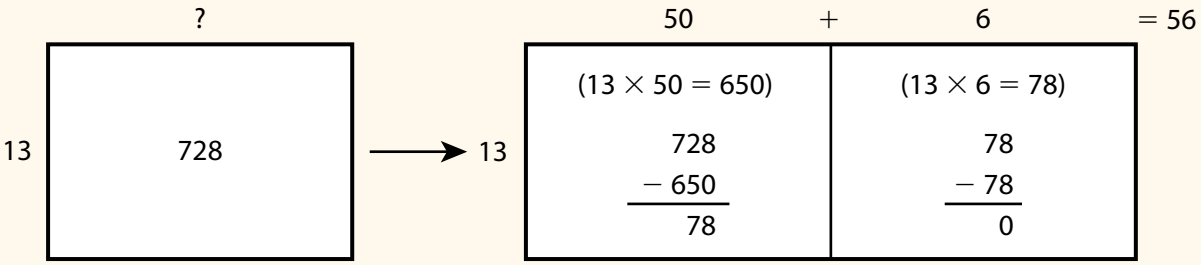
A donut shop sells donuts in boxes that each contain 13 donuts.
If 728 donuts were sold in one day, how many boxes of donuts were sold?

Multiply 13 by multiples of 10 to help you estimate the quotient. Make a table.

Number of boxes	10	20	30	40	50	60
Number of donuts	130	260	390	520	650	780

Because 728 is between 650 and 780, the quotient is between 50 and 60.

Use 50 as the first partial quotient in an area model for 728 ÷ 13.



728 ÷ 13 = 56. The donut shop sold 56 boxes of donuts.

1 The area model in the Example shows how to break apart the problem 728 ÷ 13 into parts.

a. What was 13 multiplied by first? .....

b. What equation in the area model shows this? .....

c. Why do you subtract 650 from 728?

d. What is the second partial quotient? .....

2 The table can be used to estimate the quotient 851 ÷ 37. Which of the following is the best estimate of the quotient?

Multiple of 10	10	20	30	40
37 × Multiple of 10	370	740	1,110	1,480

Ⓐ a number between 30 and 40

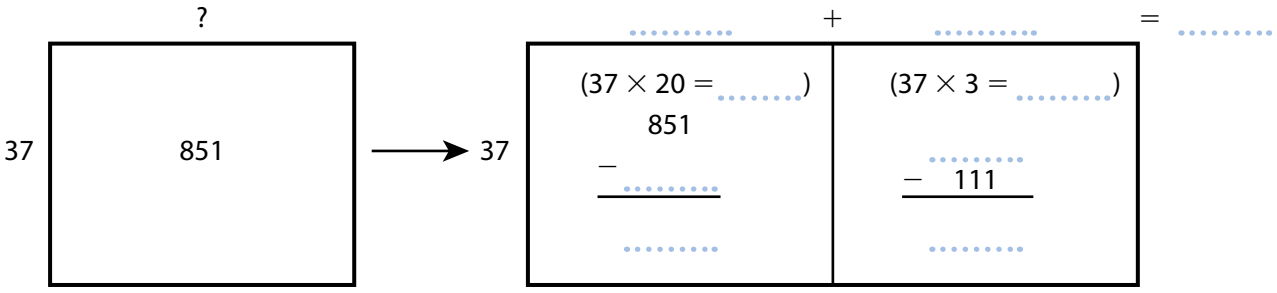
Ⓑ about 15

Ⓒ a number between 20 and 30

Ⓓ about 42

3 Complete the steps for using an area model to find the quotient 851 ÷ 37.

851 ÷ 37 is the same as _____ × ? = _____.



851 ÷ 37 = _____

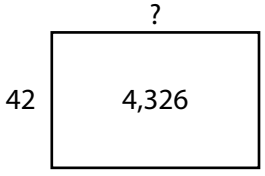
4 Which of the following equations cannot be used to represent the area model?

Ⓐ 42 × ? = 4,326

Ⓑ 42 + 4,326 = ?

Ⓒ 4,326 ÷ ? = 42

Ⓓ 4,326 ÷ 42 = ?



Develop Using Area Models and Partial Quotients to Divide

Read and try to solve the problem below.

A grocery store only sells eggs by the dozen. There are 12 eggs in 1 dozen. If there are 1,248 eggs in stock, how many dozens of eggs are there?

TRY IT

Math Toolkit

- base-ten blocks
- base-ten grid paper
- grid paper
- index cards
- multiplication models

DISCUSS IT

Ask your partner: Why did you choose that strategy?

Tell your partner: I knew . . . so I . . .

Explore different ways to record partial products when dividing multi-digit whole numbers.

A grocery store only sells eggs by the dozen. There are 12 eggs in 1 dozen. If there are 1,248 eggs in stock, how many dozens of eggs are there?

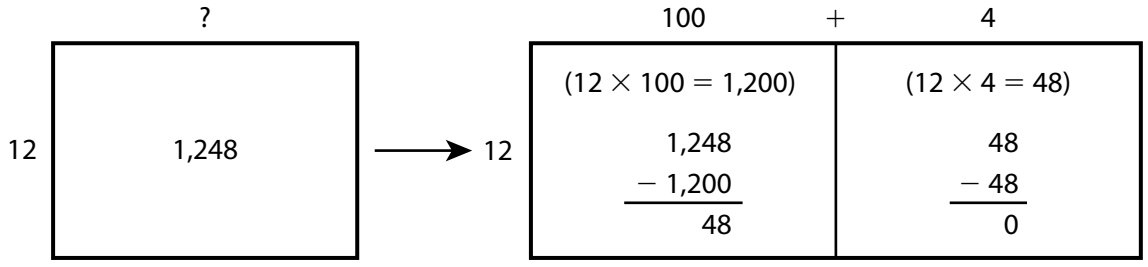
MODEL IT

You can use an area model to record partial quotients.

Estimate to determine the first partial quotient for 1,248 ÷ 12.

1,200 and 12 are compatible numbers close to the dividend and divisor.

12 × 100 = 1,200, so you can use 100 as the first partial quotient in an area model.



MODEL IT

You can use a vertical format to record partial quotients.

4 ← second partial quotient
100 ← first partial quotient

```
12)1,248   ← How many groups of 12 in 1,200?
 − 1,200
      48   ← How many groups of 12 in 48?
   − 48
       0
```

CONNECT IT

Now you will use the problem from the previous page to help you understand how to record partial products in a vertical format.

1. Look at the second **Model It**. How many hundreds are in the dividend? .....

   How many groups of 12 are in 1,200? .....

   Notice that this first partial quotient is written above the bar.

2. After writing the first partial quotient above the bar, you write the number 1,200 under the dividend. What equation in the area model shows where the number 1,200 comes from? .....

3. Why is 1,200 subtracted from 1,248?

4. How does the area model relate to finding the second partial quotient?

5. Explain how to use the partial quotients to find 1,248 ÷ 12. How many dozens of eggs does the grocery store have?

6. Describe how to divide using partial quotients.

7 REFLECT

Look back at your **Try It**, strategies by classmates, and **Model Its**. Which models or strategies do you like best for recording partial products? Explain.

.....

.....

APPLY IT

Use what you just learned to solve these problems.

8 What is the quotient 583 ÷ 11? Show your work.

Solution

9 Carlos has 1,134 pennies. He puts an equal number of pennies into 27 different glass jars. How many pennies are in each jar? Show your work.

Solution

10 Which of the following pairs of numbers are partial quotients for 594 ÷ 18?

Ⓐ 50 and 5

Ⓑ 40 and 4

Ⓒ 30 and 3

Ⓓ 20 and 15

Practice Using Area Models and Partial Quotients to Divide

Study the Example showing division with a two-digit divisor using partial quotients. Then solve problems 1–5.

EXAMPLE

Find 1,386 ÷ 22.

To divide using partial quotients, estimate a number that can be multiplied by the divisor to get a product less than or equal to the dividend. Then subtract the product from the dividend. Repeat these steps until you reach a number less than the divisor.

```
    3
   60
22)1,386  → How many groups of 20 in 1,200? 60
- 1,320   → 22 × 60
------
   66     → How many groups of 22 in 66? 3
-  66     → 22 × 3
------
    0
```

1,386 ÷ 22 = 63

1 Look at the Example. For the first step, Jaime thought: *How many groups of 20 in 1,400? There are 70.* If he continues with the division steps, when will he know that his first estimate of 70 is too high?

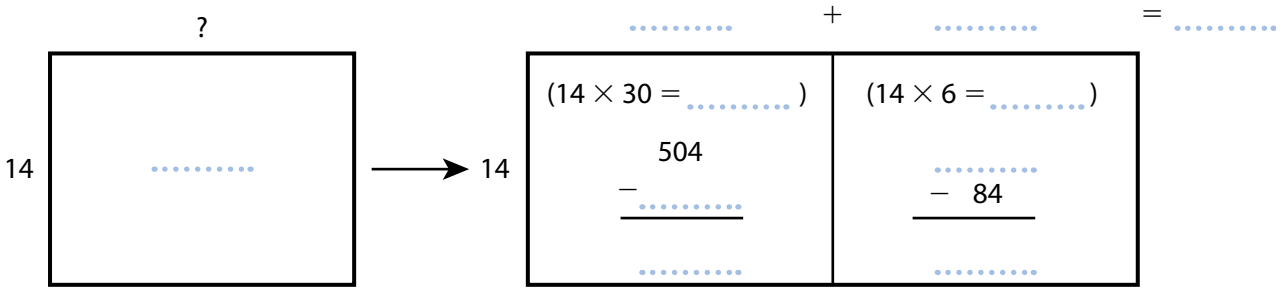
2 Multiply 14 by multiples of 10 to complete the table.

Multiple of 10	10	20	30	40	50	60
14 × Multiple of 10	140	280			700	

Write a multiple of 10 from the table to show the greatest partial quotient to start with for each division problem below.

a. ☐ 14)462 **b.** ☐ 14)350 **c.** ☐ 14)798 **d.** ☐ 14)588

3 Use an area model to find the quotient 504 ÷ 14.



504 ÷ 14 = ...

4 A rectangular box has a volume of 504 cubic inches. The width of the box is 7 inches, and the height of the box is 6 inches. Use the partial quotient method shown in the example to find the length of the box. Show your work.

Solution .....

5 A hunger relief program ships boxes that hold 25 pounds of food. How many boxes will 2,350 pounds of food fill? Show your work.

Solution .....

Refine Dividing Multi-Digit Numbers

Complete the Example below. Then solve problems 1–8.

EXAMPLE

Each package has 21 pieces of chalk. How many packages can be made with 1,701 pieces of chalk?

Look at how you could show your work using partial quotients.

```
      1
     80
21)1,701
 - 1,680  ← 21 × 80
     21
   - 21   ← 21 × 1
      0
```

Solution

Why is 80 a good number to use as a first partial quotient?

PAIR/SHARE
How can you use multiplication to check that the quotient is correct?

APPLY IT

1 A water cooler holds 1,284 ounces of water. How many more 6-ounce glasses than 12-ounce glasses can be filled from a full cooler? Show your work.

You can first estimate how many glasses of each size can be filled.

Solution

PAIR/SHARE
Explain how you found your estimate.

2 Each student needs 35 craft sticks for an art project. The art teacher has 7,140 craft sticks. The art teacher starts a division problem to determine how many students can get craft sticks from him. He was interrupted before he could complete the problem.

His partial work is shown below. Fill in the blanks to complete his work. Write your answers in the blanks.

..... ← quotient
..... ← partial quotient
..... ← partial quotient

```
35)7,140
 − 7,000
     140
   − 140
       0
```

What numbers can I use to estimate the quotient?

PAIR/SHARE
Explain how to check the answer to a division problem.

3 Harrison creates balloon animals for different events. He has 6,440 balloons. He wants to use the same number of balloons for each of 28 events. How many balloons can Harrison use at each event?

Ⓐ 23

Ⓑ 203

Ⓒ 230

Ⓓ 2,030

What will be the greatest place in the quotient?

Tina chose Ⓐ as the correct answer. How did she get that answer?

PAIR/SHARE
Does Tina's answer make sense?

4 Mr. Kovich writes the problem $32 \times \triangle = 1{,}696$ on the board. Write a division equation that can be used to find the value of the triangle. Then find the value of the triangle. Show your work.

Solution

5 Vera makes a table to help her find the area of the base of a rectangular box with a volume of 672 cubic inches and a height of 16 inches.

10	20	30	40	50	60
160	320	480	640	800	960

Choose the correct option to fill in each blank below.

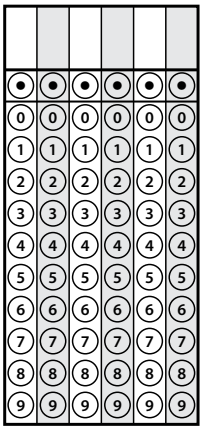
The area of the base is between _____

Ⓐ 20 Ⓑ 30 Ⓒ 40 Ⓓ 60

and _____ square inches.

Ⓐ 30 Ⓑ 40 Ⓒ 50 Ⓓ 60

6 Lisa's camera has 2,048 megabytes of memory for storing pictures. She has already used half this amount. A high-quality picture uses 16 megabytes of memory. How many high-quality pictures can Lisa store with the remaining memory?



7 Mr. Sullivan is organizing teams for the middle school's annual field day. There are 8 classes at the school and 21 students in each class.

Part A What is the total number of students at the school?

..... students

Part B Mr. Sullivan wants to have 12 students on each team. How many teams will there be?

..... teams

Part C How many fewer students will be on each team if he decides to have 24 teams? Explain your answer using diagrams, pictures, mathematical expressions, and/or words.

..... fewer students

8 MATH JOURNAL

Explain what you would do first to divide 1,260 by 28. Tell why it would be your first step.

SELF CHECK Go back to the Unit 1 Opener and see what you can check off.

Explore Powers of 10

What patterns can you find when you multiply or divide by 10, 100, or 1,000?

Learning Target

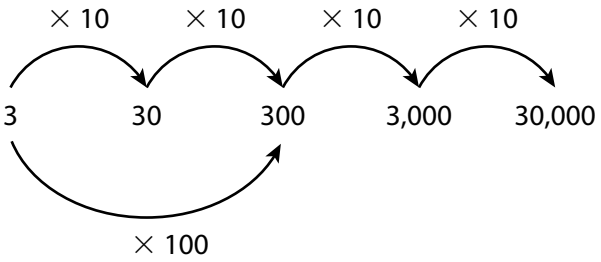
- Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.

SMP 1, 2, 3, 4, 5, 6, 7

MODEL IT

Complete the problems below.

1. Numbers like 10, 100, or 1,000 that can be written as a product of tens are called **powers of 10**. Complete the equations to multiply 3 by a power of 10.



a. $3 \times 10 \times 10 = 3 \times$ .....

$=$ .....

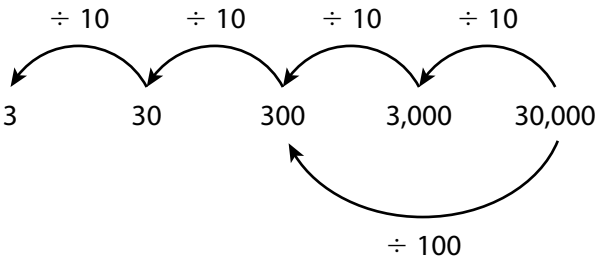
b. $3 \times 10 \times 10 \times 10 = 3 \times$ .....

$=$ .....

c. $3 \times 10 \times 10 \times 10 \times 10 = 3 \times$ .....

$=$ .....

2. Complete the equations to divide 30,000 by a power of 10.



$30{,}000 \div 100 =$ .....

$30{,}000 \div 10{,}000 =$ .....

DISCUSS IT

- How did you and your partner determine the product or quotient in the equations?
- Patterns help me understand how to multiply or divide by numbers like 10, 100, or 1,000 because . . .

MODEL IT

Complete the problems below.

3 You can write a power of 10 using an **exponent**.

The exponent **4** means to use the **base 10** as a factor 4 times.

$$10^4 = 10 \times 10 \times 10 \times 10$$

Complete the table to show different ways to write the first three powers of 10.

Standard Form	Product of Tens	Exponent Form
10	10	10^1
100		10^2
	$10 \times 10 \times 10$	

DISCUSS IT

- What patterns do you notice in multiplying by powers of 10?
- Using exponent form helps me understand place-value relationships because . . .

4 Complete the table to show different ways to write 300, 3,000, and 30,000.

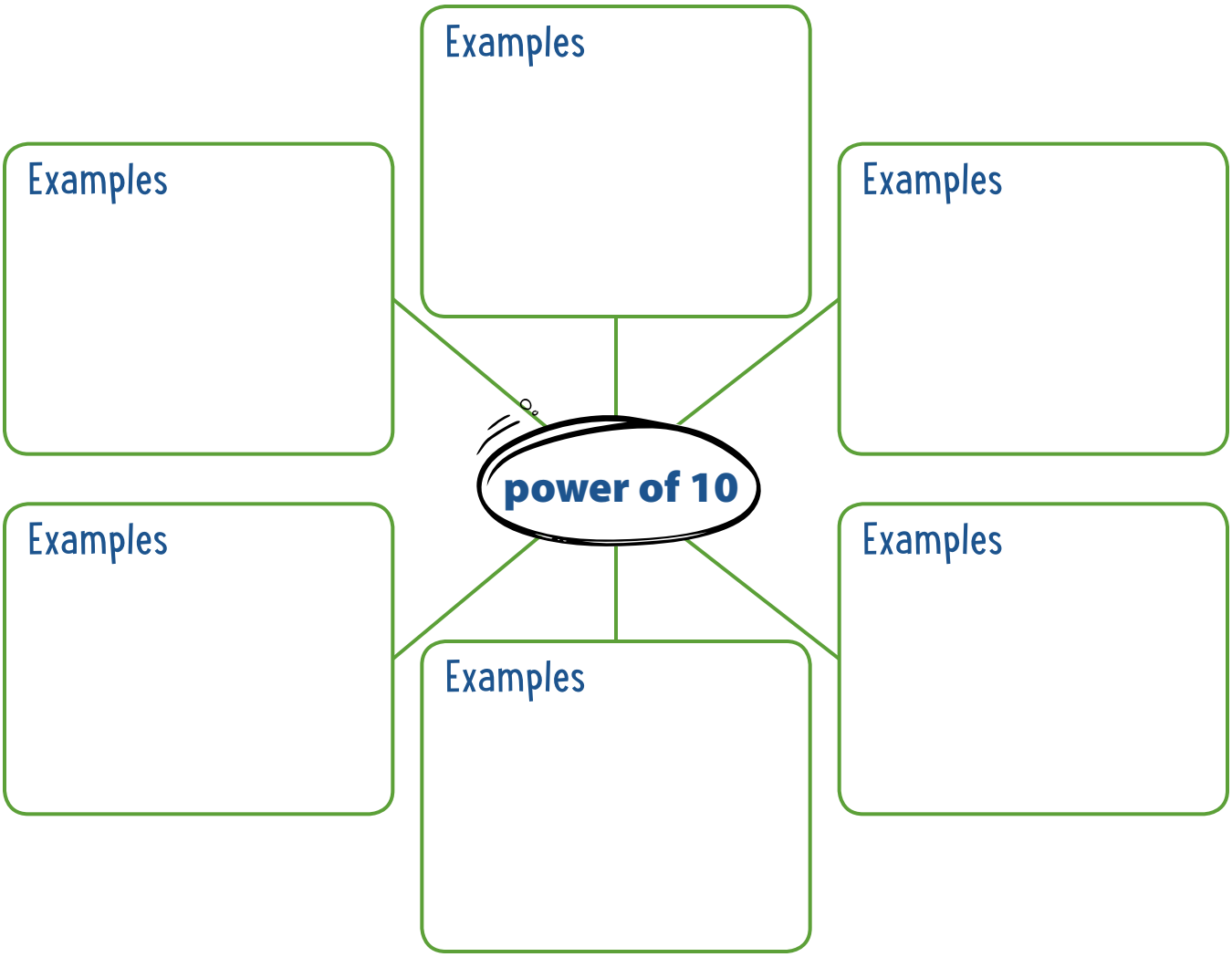
Standard Form	Using a Power of 10	Using Factors of 10	Exponent Form
300	3×100	$3 \times 10 \times 10$	3×10^2
3,000	$3 \times 1{,}000$	$3 \times$	$3 \times$
30,000	$3 \times$	$3 \times 10 \times 10 \times 10 \times 10$	$3 \times$

5 REFLECT

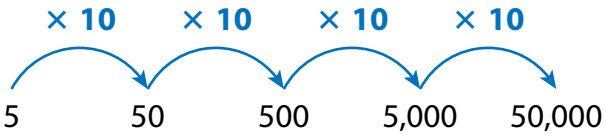
How do you know how many zeros are in the product 5×10^4? What is the product?

Prepare for Powers of 10

1 Think about what you know about powers of 10. Fill in each box.
Use words, numbers, and pictures. Show as many ideas as you can.



2 Use the diagram to help you find each product.



$5 \times 100 =$ .....

$5 \times 10{,}000 =$ .....

Solve.

3 Complete the table showing different ways to write powers of 10.

Standard Form	Product of Tens	Exponent Form
100	10×10	10^2
1,000		10^3
10,000	$10 \times 10 \times 10 \times 10$	
	$10 \times 10 \times 10 \times 10 \times 10$	

4 Complete the table to show different ways to write 500, 5,000, and 50,000.

Standard Form	Using a Power of 10	Using Factors of 10	Exponent Form
500	5×100	$5 \times 10 \times 10$	5×10^2
5,000	$5 \times 1{,}000$	5	$5 \times$
50,000	$5 \times$	$5 \times 10 \times 10 \times 10 \times 10$	$5 \times$

5 Rewrite each division equation to show the power of 10 in exponent form. Use the first pair of equations as an example.

$5{,}000 \div 10 = 500 \longrightarrow 5{,}000 \div 10^1 = 500$

$5{,}000 \div 100 = 50 \longrightarrow 5{,}000 \div$ ..... $= 50$

$5{,}000 \div 1{,}000 = 5 \longrightarrow 5{,}000 \div$ ..... $= 5$

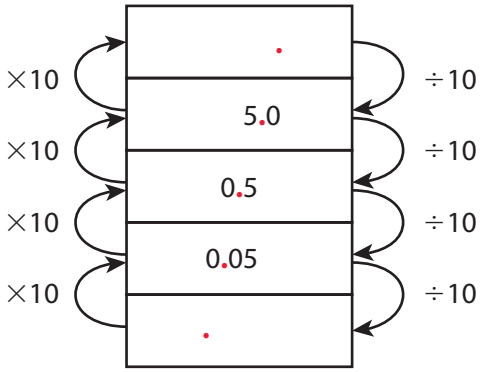
Develop Understanding of Powers of 10

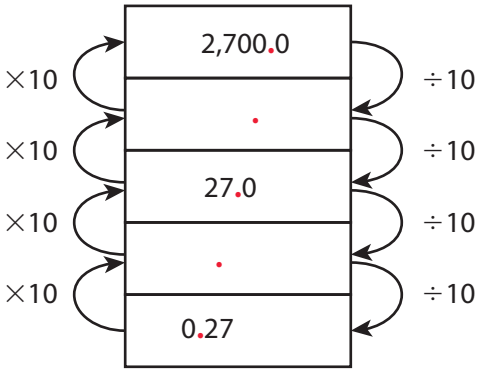
MODEL IT: DECIMAL POINT PATTERNS

Try these two problems.

1 The diagrams below show patterns in the placement of the decimal point each time you multiply or divide a decimal by 10.

Complete the missing numbers in each diagram. The decimal point for each missing number is already placed for you.





2 Use the decimal point pattern diagrams above to help you find each product or quotient.

$0.5 \times 100 =$ .....

$0.5 \times 10^2 =$ .....

$5 \div 100 =$ .....

$5 \div 10^2 =$ .....

$0.27 \times 1{,}000 =$ .....

$0.27 \times 10^3 =$ .....

$2{,}700 \div 1{,}000 =$ .....

$2{,}700 \div 10^3 =$ .....

DISCUSS IT

- What happens to the value of a number when you multiply or divide by a power of 10? Why?
- I think patterns in the placement of the decimal point help you multiply by 1,000 because . . .

MODEL IT: PLACE-VALUE CHARTS

Use place-value charts to show multiplying and dividing by powers of 10.

3 Complete each row with the product shown to the right of that row.

Ones	.	Tenths	Hundredths	Thousandths	
0	.	0	0	5	
	.				0.005×10^1
	.				0.005×10^2
	.				0.005×10^3

4 Complete each row with the quotient shown to the right of that row.

Ones	.	Tenths	Hundredths	Thousandths	
5	.	0	0	0	
	.				$5 \div 10^1$
	.				$5 \div 10^2$
	.				$5 \div 10^3$

DISCUSS IT

- How do the values of the digits and the placement of the decimal point change when you multiply or divide any decimal by a power of 10?
- I think place-value charts show the pattern of multiplying and dividing by powers of 10 because . . .

CONNECT IT

Complete the problems below.

5 Look at the first decimal point pattern diagram and the place-value charts. How do the position and the value of the digit 5 change when multiplying and dividing by 10?

6 Show how to find the product 0.19×10^3.

Practice with Powers of 10

Study how the Example shows multiplying a decimal number by a power of 10. Then solve problems 1–7.

EXAMPLE

Find $10^2 \times 0.004$.

Break 10^2 into the product of tens.

$$10^2 \times 0.004 = 10 \times \mathbf{10} \times \mathbf{0.004}$$
$$= 10 \times \mathbf{0.04}$$
$$= 0.4$$

The value of the digit 4 increases by moving one place to the left for each factor of 10.

$$10^2 \times 0.004 = 0.4$$

1 Write the missing power of 10 in exponential form.

a. $0.04 \times$ _____ $= 0.4$ $\quad$ $0.004 \times$ _____ $= 4$

b. _____ $\times 0.006 = 0.6$ $\quad$ _____ $\times 0.006 = 6$

c. $0.007 \times$ _____ $= 7$ $\quad$ $0.07 \times$ _____ $= 7$

2 Complete the equations to find each product.

a. $8 \times 100 = 8 \times 10^2 =$ _____

b. $8 \times 1{,}000 = 8 \times$ _____ $=$ _____

c. $2 \times$ _____ $= 2 \times 10^1 =$ _____

d. $0.02 \times 100 = 0.02 \times$ _____ $=$ _____

3 Complete the equations.

a. $0.03 \times 1{,}000 =$ _____

b. $0.18 \times 100 =$ _____

Vocabulary

power of 10 a number that can be written as a product of tens.

$10 = 10$
$100 = 10 \times 10$
$1{,}000 = 10 \times 10 \times 10$

exponent the number in a power that tells how many times to use the base as a factor.

10^2 ← exponent
↑ base

$10^2 = 10 \times 10$, or 100

4 Use the place-value chart to show dividing 9 by powers of 10. Complete each row with the quotient shown to the right of the row.

Ones	.	Tenths	Hundredths	Thousandths	
9	.	0	0	0	
	.				$9 \div 10$
	.				$9 \div 10^2$
	.				$9 \div 10^3$

5 Match each expression with its quotient.

a. $5.2 \div 10$

b. $520 \div 10^2$

c. $52 \div 10^3$

d. $5{,}200 \div 10^1$

0.052
0.52
5.2
52
520
5,200

6 Describe how the placement of the decimal point changes when you multiply a number by a power of ten. How is this the same and different for division?

7 Is multiplying by 10^3 the same as multiplying by 10 factors of 3? Explain.

Refine Ideas About Powers of 10

APPLY IT

Complete these problems on your own.

1 COMPARE

Complete the place-value chart with the products and quotients shown to the right of the chart. Then write a sentence to compare the value of 0.8×10^2 to the value of $0.8 \div 10^2$.

Tens	Ones	.	Tenths	Hundredths	Thousandths	
		.				0.8×10^2
		.				0.8×10^1
	0	.	8	0	0	
		.				$0.8 \div 10^1$
		.				$0.8 \div 10^2$

2 INSPECT

Max says that the product 30×10^4 has exactly four zeros. Is he correct? Explain.

3 EXPLAIN

How do you determine the value of the unknown exponent in the equation $9{,}700 \div 10^? = 0.97$?

PAIR/SHARE

Discuss your solutions for these three problems with a partner.

Use what you have learned to complete problem 4.

4 Jaime claims that when you multiply a whole number or a decimal by 10^2, the placement of the decimal point in the product is always two places to the right of where it was in the factor.

Salome argues that the placement of the decimal point changes two places to the right only when you multiply a decimal by 10^2. Salome says that when you multiply a whole number by 10^2, you can put two extra zeros after the whole number to find the product.

Part A Explain each student's point of view with examples.

Part B Which student is correct? Justify your answer.

5 MATH JOURNAL

Find the value of $80 \div 10^4$. Explain the change in value between 80 and $80 \div 10^4$.