CHAPTER 3 Number Theory

What You've Learned

- In Chapter 1, you used the order of operations to solve problems.
- In Chapter 2, you wrote and evaluated expressions using variables.
- You solved addition and subtraction equations.

Check Your Readiness

Using Order of Operations

Find the value of each expression.

1. $350 \div 10 + 15$
2. $42 - 3 \times 8$
3. $12 + 45 \div 15$
4. $16 - (5 + 7) \div 3$
5. $(14 + 25) \times 3$
6. $200 \div (65 - 25)$

Check Your Readiness

Evaluating Expressions

Evaluate each expression.

7. $27 \div j$ for $j = 3$

8. $q + 7$ for $q = 5$

9. $4d - 2$ for $d = 22$

10. $14 - 2w$ for $w = 3$

Solving Equations

Solve each equation.

11. $y + 45 = 88$

12. $27 + g = 65$

13. $21 = m + 8$

14. $x - 18 = 75$

15. $d - 88 = 30$

16. $y - 14 = 34$

3-1 Divisibility and Mental Math

CONTENT STANDARDS
Essential for understanding
6.NS.4

What You'll Learn

To check for divisibility using mental math and to use divisibility to solve problems

New Vocabulary divisible, even number, odd number

Why Learn This?

When you plan an event, you can use divisibility rules to find how many tables you will need for your guests.

A whole number is **divisible** by a second whole number if the first number can be divided by the second number with a remainder of 0. You can use multiplication facts to test for divisibility.

EXAMPLE 1 Using Mental Math for Divisibility

a. Is 56 divisible by 7?

Think Since $56 = 8 \times 7$, 56 is divisible by 7.

b. Is 56 divisible by 4?

Think Since $56 = 8 \times 7$, and $4 \times 2 = 8$, 56 is divisible by 4.

Example

1 Using Mental Math for Divisibility

a. Is 46 divisible by 3?

Think Since $3 \times 15 =$ [ ],
and $3 \times 16 =$ [ ],
46 [ ] divisible by 3.

b. Is 63 divisible by 7?

Think Since $7 \times 9 =$ [ ],
63 [ ] divisible by 7.

Quick Check

1. a. Is 64 divisible by 6? [ ]

b. Is 93 divisible by 3? [ ]

You can test for divisibility using the rules below.

KEY CONCEPTS **Divisibility of Whole Numbers**

A whole number is divisible by

- 2, if the number ends in 0, 2, 4, 6, or 8.
- 3, if the sum of the number's digits is divisible by 3.
- 5, if the number ends in 0 or 5.
- 9, if the sum of the number's digits is divisible by 9.
- 10, if the number ends in 0.

An **even number** is a whole number that ends with a 0, 2, 4, 6, or 8.
An **odd number** is a whole number that ends with a 1, 3, 5, 7, or 9.

EXAMPLE 2 Divisibility by 2, 3, 5, and 10

Test 715 for divisibility by 2, 3, 5, and 10.

2: 715 is not an even number. So 715 is not divisible by 2.

3: Find the sum of the digits in 715.

$7 + 1 + 5 = 13$ ← Add the digits.

The sum of the digits of 715 is 13, which is not divisible by 3. So 715 is not divisible by 3.

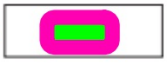
5: 715 ends in a 5. So 715 is divisible by 5.

10: 715 does not end in 0. So 715 is not divisible by 10.

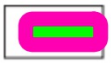
So 715 is divisible by 5, but not by 2, 3, or 10.

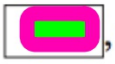
Examples

❷ **Divisibility by 2, 3, 5, and 10** Test 580 for divisibility by 2, 3, 5, and 10.

2: 580 is an  number. So 580  divisible by 2.

3: Find the sum of the digits in 580.

$5 + 8 + 0 =$ 

The sum of the digits is  , which  divisible by 3.

So 580  divisible by 3.

5: 580 ends in  . So 580  divisible by 5.

10: 580 ends in  . So 580  divisible by 10.

EXAMPLE 3 Divisibility by 9

Planning There are 163 people signed up to play softball. Each team will have exactly 9 players. Will everyone who has signed up have a spot on one of the 9-person teams?

If 163 is divisible by 9, then everyone will have a spot on a team.

$1 + 6 + 3 = 10$ ← Find the sum of the digits in 163.

$10 \div 9$ has a remainder of 1. ← The sum is not divisible by 9.

163 is not divisible by 9. Not everyone will have a spot on a team.

3 **Divisibility by 9** A baker sells muffins in boxes that contain exactly 9 muffins each. Can the baker place 576 muffins in boxes of 9 with none left over?

If 576 is divisible by 9, then there will be no muffins left over.

$5 + 7 + 6 =$ [redacted] ¬ **Find the sum of the digits in 576.**

$18 \div 9 =$ [redacted] ¬ **The sum** [redacted] **divisible by 9.**

So, 576 [redacted] divisible by 9. There [redacted] muffins left over.

Quick Check

2. Test each number for divisibility by 2, 3, 5, and 10.

a. 150

b. 1,021

c. 2,112

3. Music A high school marching band has 126 members. Each row in the band formation on the field has 9 musicians. Will everyone in the band fit in a nine-person row?

Check Your Understanding

1. [redacted]

1. **Vocabulary** How can you tell whether a number is odd or even?

2. **Number Sense** Since 54 is divisible by 6, 54 is also divisible by 2 and 3. Explain. [redacted]

Match each number with its divisibility numbers.

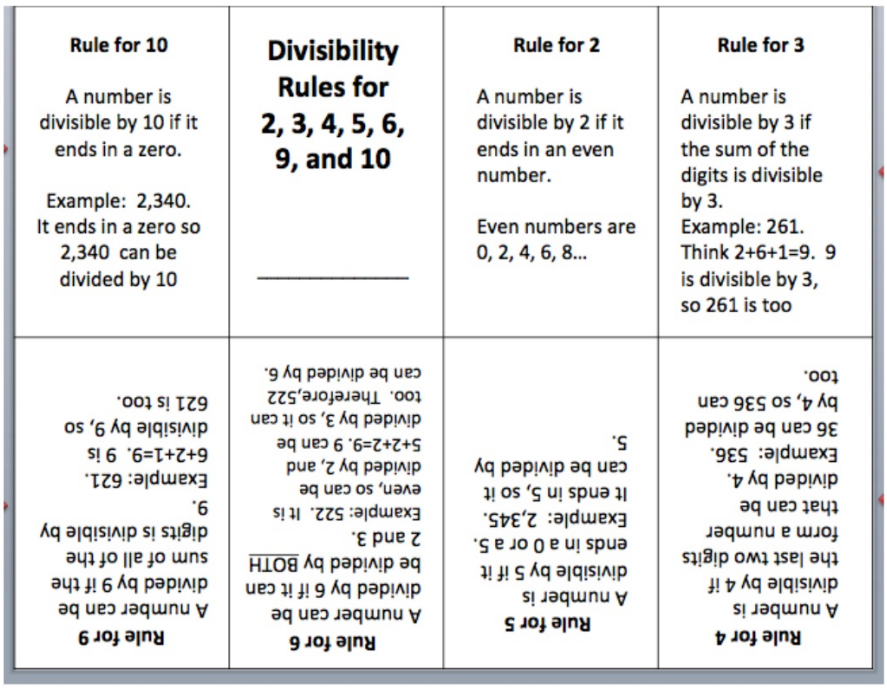
3. 60 [redacted]
4. 48 [redacted]
5. 81 [redacted]

A. 3, 9

B. 2, 3

C. 2, 3, 5, 10

Now we are going to make an 8 page book.



Rule for 10

A number is divisible by 10 if it ends in a zero.

Example: 2,340. It ends in a zero so 2,340 can be divided by 10

Divisibility Rules for 2, 3, 4, 5, 6, 9, and 10

Rule for 2

A number is divisible by 2 if it ends in an even number.

Even numbers are 0, 2, 4, 6, 8...

Rule for 3

A number is divisible by 3 if the sum of the digits is divisible by 3.
Example: 261. Think 2+6+1=9. 9 is divisible by 3, so 261 is too

Rule for 9

A number can be divided by 9 if the sum of all of the digits is divisible by 9.
Example: 621. 6+2+1=9. 9 is divisible by 9, so 621 is too.

Rule for 6

A number can be divided by 6 if it can be divided by BOTH 2 and 3.
Example: 522. It is even, so can be divided by 2, and 5+2+2=9. 9 can be divided by 3, so it can too. Therefore,522 can be divided by 6.

Rule for 5

A number is divisible by 5 if it ends in a 0 or a 5.
Example: 2,345. It ends in 5, so it can be divided by 5.

Rule for 4

A number is divisible by 4 if the last two digits form a number that can be divided by 4.
Example: 536. 36 can be divided by 4, so 536 can too.