

Multiplicative Comparison and Factors: math lesson, Grade 4 – download the PDF

There are two ways to compare numbers. You can ask “how many more?” and use addition or subtraction, or you can ask “how many times as many?” and use multiplication or division. In this chapter you will learn to read and write multiplicative comparisons, to find every factor pair of a number up to 100, to list multiples, to tell prime numbers from composite numbers, and to spot patterns in numbers and shapes.

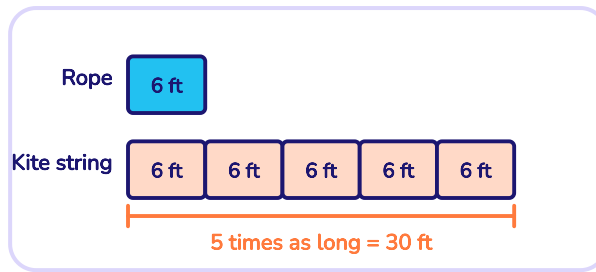
1. Comparing with multiplication

Suppose a snail crawls 4 inches and a beetle crawls 12 inches. You could say the beetle crawled 8 inches farther. That is an additive comparison. But you could also say the beetle crawled **3 times as far** as the snail, because $12 = 3 \times 4$. That is a multiplicative comparison.

D Multiplicative comparison

A multiplicative comparison tells how many times as much one quantity is compared with another. The equation $35 = 5 \times 7$ can be read two ways: “35 is 5 times as many as 7” and “35 is 7 times as many as 5.”

A bar model helps you see it. The small bar is one unit. The big bar is made of several copies of that unit.



E Example 1: finding the larger amount

A rope is 6 feet long. A kite string is 5 times as long as the rope. How long is the kite string?

Multiply: $5 \times 6 = 30$. The kite string is 30 feet long.

E Example 2: finding how many times

A garden hose is 45 feet long. A jump rope is 9 feet long. The hose is how many times as long as the jump rope?

Write an equation with an unknown: $45 = n \times 9$. Use division: $n = 45 \div 9 = 5$. The hose is 5 times as long as the jump rope.

M**Method: solving a multiplicative comparison**

1. Find the small quantity and the big quantity.
2. Write a multiplication equation: big = number of times $\times$ small, with a letter for the unknown.
3. If the big quantity is unknown, multiply. If the number of times (or the small quantity) is unknown, divide.
4. Write a sentence that answers the question, with the unit.

2. Multiplication or addition?

The words “more than” and “times as many” sound alike, but they mean very different things. “3 more than” tells you to add 3. “3 times as many” tells you to multiply by 3.

E**Example 3: two ways to compare**

Maya has 4 stickers. Ben has 3 more stickers than Maya. Cleo has 3 times as many stickers as Maya. How many stickers do Ben and Cleo have?

Ben: $4 + 3 = 7$ stickers. Cleo: $3 \times 4 = 12$ stickers. Cleo has 5 more stickers than Ben, because $12 - 7 = 5$.

⚠**Watch out**

Do not add when you read “times as many.” The statement “Cleo has 3 times as many stickers as Maya” does *not* mean $4 + 3$. Ask yourself: am I adding a group, or making copies of the same group?

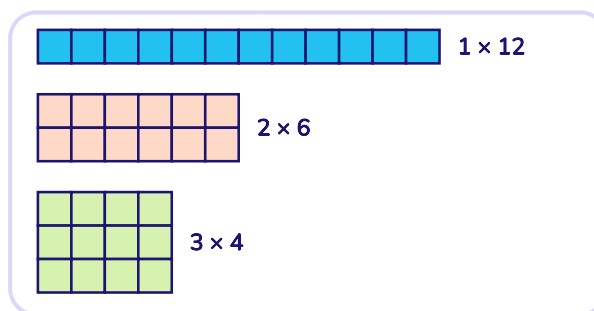
Notice that repeated addition and multiplication are connected. Adding 4 three times gives $4 + 4 + 4 = 12$, which is 3×4 . When the same number is added again and again, multiplication is the shortcut.

3. Factors and factor pairs

D Factor and factor pair

A **factor** of a whole number is a whole number that divides it with no remainder. Two factors that multiply to give the number form a **factor pair**. Since $3 \times 4 = 12$, the numbers 3 and 4 are a factor pair of 12.

Every whole number greater than 1 has at least two factors: 1 and itself. An array of squares shows factor pairs nicely. Each rectangle below has 12 squares, and its number of rows and columns is a factor pair.



M Method: listing all the factor pairs

1. Start with $1 \times$ the number.
2. Test 2, then 3, then 4, and so on. If the number divides evenly, write the pair.
3. Stop when the first factor reaches the second factor, or when they would switch places.
4. Write all the factors in order.

E**Example 4: the factors of 36**

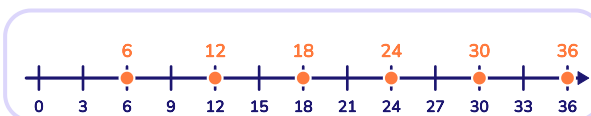
1×36 , 2×18 , 3×12 , 4×9 , 6×6 . Five is not a factor because 36 is not a multiple of 5. The next test, 7, is already bigger than 6, so we stop. The factors of 36 are 1, 2, 3, 4, 6, 9, 12, 18 and 36.

Notice that 6 is paired with itself, so it is written only once in the list. Numbers like 36 and 25 that have a pair with the same factor twice are called square numbers.

4. Multiples

D**Multiple**

A **multiple** of a number is the product of that number and a whole number. The multiples of 7 are 7, 14, 21, 28, 35, 42, and so on. You can find them by skip counting by 7.

**P****Property**

If $a \times b = c$, then a and b are factors of c , and c is a multiple of a and of b .

Factors and multiples are two sides of one fact. Because $3 \times 6 = 18$, you can say “3 is a factor of 18” and also “18 is a multiple of 3.” A number has only a few factors, but it has endless multiples.

E**Example 5: is 56 a multiple of 7?**

Skip count by 7: 7, 14, 21, 28, 35, 42, 49, 56. We land on 56, and $8 \times 7 = 56$. So 56 is a multiple of 7, and 7 is a factor of 56.

!**Zyro's tip**

To check a big multiple, do not skip count all the way. Use a fact you know. For example, $7 \times 9 = 63$, so 63 is a multiple of 7 and of 9.

5. Prime and composite numbers**D****Prime and composite**

A **prime number** is a whole number greater than 1 with exactly two factors: 1 and itself. A **composite number** is a whole number greater than 1 with more than two factors. The number 1 is neither prime nor composite, because it has only one factor.

Number	Factors	Type
1	1	neither
2	1, 2	prime
3	1, 3	prime
4	1, 2, 4	composite
5	1, 5	prime
6	1, 2, 3, 6	composite
7	1, 7	prime
9	1, 3, 9	composite
11	1, 11	prime
12	1, 2, 3, 4, 6, 12	composite

The number 2 is the only even prime, since every other even number has 2 as an extra factor. The prime numbers less than 100 are 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89 and 97.

E Example 6: prime or composite?

Is 91 prime? Try small factors: it is not even, it does not end in 0 or 5, and the digits add to 10, so 3 is not a factor. Try 7: $7 \times 13 = 91$. So 91 is composite.

Is 83 prime? It is not divisible by 2, 3, or 5, and $7 \times 11 = 77$ and $7 \times 12 = 84$, so 7 does not work either. No other test is needed below 100, so 83 is prime.



Watch out

Many people think every odd number is prime. It is false: 9, 15, 21, 25, 27 and 91 are all odd and composite.

6. Divisibility patterns

A number is **divisible** by another when the division leaves no remainder. You do not always need to divide. The digits give you a shortcut.

Divisible by	Test	Example
2	The ones digit is 0, 2, 4, 6, or 8.	78
5	The ones digit is 0 or 5.	65
10	The ones digit is 0.	90
3	The sum of the digits is a multiple of 3.	$5 + 1 = 6$, so 51
9	The sum of the digits is a multiple of 9.	$8 + 1 = 9$, so 81



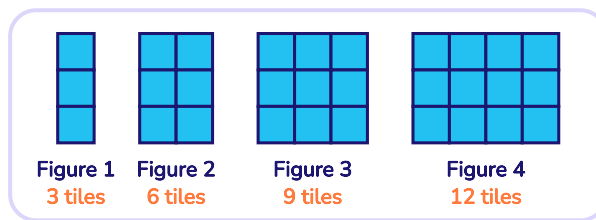
Example 7: testing 456

The ones digit is 6, so 456 is divisible by 2, but not by 5 or 10. The digits add up to $4 + 5 + 6 = 15$. Since 15 is a multiple of 3 but not of 9, 456 is divisible by 3 but not by 9. Check: $456 \div 3 = 152$.

7. Number and shape patterns

A pattern follows a rule. Look at the numbers 5, 9, 13, 17, 21. The rule is “start at 5 and add 4.” Patterns often have features the rule does not show. The ones digits here go 5, 9, 3, 7, 1 and then repeat, and the numbers are all odd, because adding the even number 4 to an odd number always gives an odd number.

Shape patterns grow in a steady way too. In the tile pattern below, each figure has one more column of 3 tiles, so the number of tiles is a multiple of 3.



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Example 8: predicting a figure

How many tiles are in Figure 10? Figure n has n columns of 3 tiles, so the count is $n \times 3$. For Figure 10: $10 \times 3 = 30$ tiles. Figure 10 has 30 tiles, and 30 is a multiple of 3.

Skip counting, multiples and patterns are the same idea: starting at a number and adding the same amount again and again.

Key takeaways

- “ a is n times as many as b ” means $a = n \times b$. “More than” means add.
- To solve a comparison, write an equation with a letter, then multiply or divide.
- Factor pairs multiply to give the number. Test 1, 2, 3, ... and stop when the pairs meet.
- Multiples come from skip counting. If $a \times b = c$, then a and b are factors of c , and c is a multiple of both.
- A prime number has exactly two factors. A composite number has more. The number 1 is neither, and 2 is the only even prime.
- Divisibility: by 2 if the ones digit is even; by 5 or 10 by the ones digit; by 3 or 9 when the digit sum is a multiple of 3 or 9.
- A pattern follows a rule. Check the rule against the terms, and look for extra features.



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