

Place Value and Decimals: math lesson, Grade 5 – download the PDF

A stopwatch at the track meet, the price at a gas pump, the weight of a science sample: all of them use decimals. In this chapter you will see how place value works on **both sides** of the decimal point, how **powers of 10** make huge and tiny numbers easy to handle, and how to read, write, compare and round decimals like a pro.

1. Place value patterns

D Place value

The value of a digit depends on its **place** in the number. Moving one place to the **left** makes a digit worth **10 times as much**. Moving one place to the **right** makes it worth $\frac{1}{10}$ as much.

Hundreds	Tens	Ones		Tenths	Hundredths	Thousandths
3	5	2	.	6	1	4
300	50	2		0.6	0.01	0.004

In **352.614** the digit **5** is in the tens place, so it is worth **50**. The digit **6** is in the tenths place, so it is worth **0.6**. The decimal point separates the whole-number places from the places smaller than

one.

E Example 1

In **6.666** every digit is a 6, but not every 6 is worth the same.

The 6 in the ones place is worth **6**. The 6 in the tenths place is worth **0.6**, and $6 = 10 \times 0.6$. The 6 in the hundredths place is worth **0.06**, and $0.06 = \frac{1}{10} \times 0.6$.

A Watch out

The place names on the right end in **-ths** (tenths, hundredths, thousandths). There is no “oneths” place: the center of the pattern is the **ones** place.

2. Powers of 10 and exponents

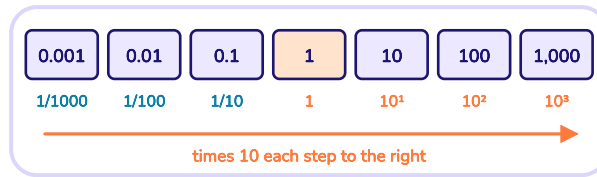
Multiplying by 10 again and again is such a common job that mathematicians invented a shortcut.

D Exponent

An **exponent** tells how many times a number is used as a factor. For example, $10^3 = 10 \times 10 \times 10 = 1,000$. The number **10** is the **base** and **3** is the exponent.

Power	10^1	10^2	10^3	10^4	10^5	10^6
Standard form	10	100	1,000	10,000	100,000	1,000,000
Zeros after the 1	1	2	3	4	5	6

Look at the pattern: the exponent is exactly the **number of zeros** after the 1. Each time the exponent goes up by one, the number becomes 10 times larger, just like moving one place to the left on the place value chart.



Watch out

10^3 does **not** mean 10×3 . It means three tens multiplied together:

$10 \times 10 \times 10 = 1,000$, not 30.



Example 2

(a) Write **100,000** as a power of 10. There are 5 zeros, so $100,000 = 10^5$.

(b) Write 7×10^4 in standard form. $10^4 = 10,000$, so $7 \times 10^4 = 70,000$.

3. Reading and writing decimals to thousandths

Decimals are another way to write fractions whose denominators are 10, 100 or 1,000.

Standard form	Fraction	Words
0.7	$\frac{7}{10}$	seven tenths
0.07	$\frac{7}{100}$	seven hundredths
0.007	$\frac{7}{1000}$	seven thousandths

M How to read a decimal

1. Read the whole-number part.
2. Say “and” for the decimal point.
3. Read the digits after the point as one whole number.
4. Finish with the name of the **last** place.

E Example 3

4.076 is read “four **and** seventy-six thousandths”, because the last digit sits in the thousandths place. In the same way, **0.305** is “three hundred five thousandths”.

Writing goes the other way: “twelve and eight tenths” is **12.8**, and “five hundredths” is **0.05** (the 0 holds the tenths place).

Adding zeros at the **end** of a decimal does not change its value: **$2.5 = 2.50 = 2.500$** . They are called **equivalent decimals**.

4. Expanded form of decimals

D Expanded form

Writing a number as the sum of the values of its digits is called **expanded form**. You can use multiplication to show each digit and its place.

E Example 4

Write **36.082** in expanded form.

$$36.082 = 3 \times 10 + 6 \times 1 + 0 \times 0.1 + 8 \times 0.01 + 2 \times 0.001$$

Without the zero term: **36.082 = 30 + 6 + 0.08 + 0.002**. With fractions:

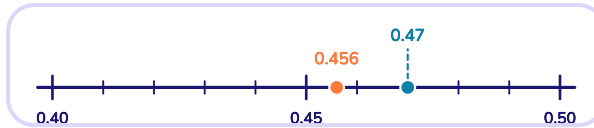
$$8 \times \frac{1}{100} + 2 \times \frac{1}{1000} \text{ for the decimal part.}$$

To go back, add the pieces: **400 + 7 + 0.2 + 0.005 = 407.205**. Zeros in the expanded form tell you which place must hold a placeholder 0.

5. Comparing decimals

M Comparing two decimals

1. Line up the decimal points (add zeros at the end if it helps).
2. Start on the left and compare digits place by place.
3. The first place where the digits differ decides which number is greater.



E Example 5

Compare **0.47** and **0.456**. The ones and tenths match (0 and 4). In the hundredths place, **7 > 5**. So **0.47 > 0.456**, exactly as the number line shows: **0.47** is farther to the right.

Compare **3.09** and **3.1**. Write **3.1** as **3.10**. The tenths place gives **0 < 1**, so **3.09 < 3.1**.



Watch out

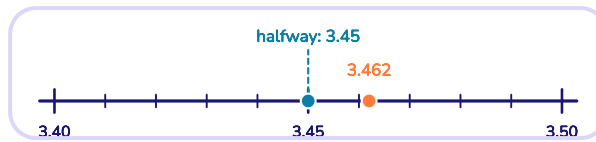
A decimal with more digits is **not** automatically greater. **0.456** has three digits after the point, but it is smaller than **0.47**.

6. Rounding decimals



Rounding to a place

1. Underline the digit in the place you are rounding to.
2. Look at the digit just to its **right**.
3. If it is 5 or more, round **up** (add 1 to the underlined digit). If it is 4 or less, keep the digit.
4. Drop the digits to the right.



E Example 6

Round **3.462**. To the nearest tenth: the hundredths digit is 6, so round up: **3.5**. The number line agrees, since **3.462** lies past the halfway mark **3.45**.

To the nearest hundredth: the thousandths digit is 2, so keep: **3.46**. To the nearest whole number: the tenths digit is 4, so **3**.

Carrying happens too: **9.96** to the nearest tenth is **10.0**, because **9 + 1** carries into the ones place.

7. Multiplying and dividing by powers of 10

Because each place is 10 times the one to its right, multiplying by 10 slides every digit **one place to the left**. Dividing by 10 slides every digit **one place to the right**.

P Rule

To multiply by 10^n , move the decimal point **n** places to the **right**. To divide by 10^n , move it **n** places to the **left**. Use zeros as placeholders when you run out of digits.

Start	$\times 10$	$\times 10^2$	$\times 10^3$	$\div 10$	$\div 10^2$
4.35	43.5	435	4,350	0.435	0.0435

E**Example 7**

0.0638×10^3 : move the point 3 places right, so $0.0638 \times 1,000 = 63.8$.

$5.9 \div 10^2$: move the point 2 places left and add a zero placeholder, so
 $5.9 \div 100 = 0.059$.

!**Zyro's tip**

The decimal point never really moves: the **digits** slide through the places. Picture the place value chart and push each digit one box left or right for every power of 10.

This is how metric conversions work. Since **1 meter = 100 centimeters**, $3.5 \text{ m} = 3.5 \times 100 = 350$ cm. And since **1 liter = 1,000 milliliters**, $2,450 \text{ mL} = 2,450 \div 1,000 = 2.45 \text{ L}$.

Key takeaways

- One place to the left is worth 10 times as much; one place to the right is worth $\frac{1}{10}$ as much.
- 10^n is a 1 followed by n zeros; the exponent counts the factors of 10.
- Read a decimal by saying the whole part, “and”, then the digits and the name of the last place.
- Expanded form adds the value of each digit: $36.082 = 30 + 6 + 0.08 + 0.002$.
- To compare, line up the points and find the first place where the digits differ.
- To round, look at the digit to the right: 5 or more rounds up, 4 or less stays.
- Multiplying by 10^n moves the point n places right; dividing moves it n places left.



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