

3 Solving Unit Rate Problems

What Is a Rate and a Unit Rate?

A rate is a comparison or relationship between two terms with different units.

A unit rate is a rate that has at least one term that is 1 unit.

For example, if the rate is 4 cans of soup for \$2, the unit rate might be 2 cans for \$1.

- Unit rates are often written with a slash and read using the word “per.”

For example, the unit rate for 45 text messages in 3 hours is 15 texts/1 hour and is read as “15 texts per hour.”

- Here are some examples of unit rates:

2 cans/\$1 (“2 cans per dollar”)

50¢/1 can (“50 cents per can”)

90 km/1 h (“90 kilometres per hour”)

\$4/1 box (“4 dollars per box”)

\$1/1 L (“1 dollar per litre”)

- The number 1 in the single-unit term is usually dropped because it’s assumed.

For example, you could write 50¢/can, 90 km/h, \$4/box, and \$1/L.

- When you write a unit rate, the single-unit term is often the second term, although both are correct.

For example, you could write “1 can for 50¢” or “50¢/can.”

- Sometimes there are two unit rates for a given rate that make sense. Other times, only one unit rate makes sense or is useful.

For example:

- For 4 cans of soup for \$2, both 2 cans for \$1 and 50¢ for 1 can make sense.

- For 270 km in 3 hours, 90 km/h would be useful, while 0.67 minutes/km might not be.

Calculating a Unit Rate

There are different ways to calculate a unit rate.

- Often we divide to determine a unit rate.

For example, if you drive 270 km in 3 hours, you get the unit rate 90 km/h by dividing $270 \div 3 = 90$.

This model shows why division makes sense:

270 km		
3 hours		
1 h	1 h	1 h
90 km	90 km	90 km

- You might multiply to get a unit rate if the rate has a term less than 1.

For example, if you drove 45 km in $\frac{1}{2}$ hour, you'd get the unit rate 90 km/h by multiplying $2 \times 45 = 90$.

This model shows why multiplying makes sense:

45 km	45 km
$\frac{1}{2}$ hour	$\frac{1}{2}$ hour
1 hour	
90 km	

- Sometimes you use both operations.

For example, suppose you ran 12 km in 90 minutes.

You might divide $12 \div 3 = 4$ km to figure out far you ran in 30 minutes.

Then you'd multiply $2 \times 4 = 8$ km to figure out how far you ran in 60 minutes, or 1 hour.

So, the unit rate is 8 km/hour, or 8 km/h.

This model shows the thinking:

12 km		
90 minutes		
30 min	30 min	30 min
4 km	4 km	4 km
60 min, or 1 hour		

Notes

- We usually write a unit rate using a slash, use symbols for the units (e.g., h for hour and km for kilometres), drop the numeral 1 for the single-unit term, and place the single-unit term last (e.g., 80 kilometres in 1 hour is 80 km/h). However, these are just conventions that students should be aware of, but they are not required for a rate to be correct.
 - It must be clear what is being measured and compared. For example, using symbols for the units might be more concise, but being clear about what those units mean is more important. Students might be comfortable with km for kilometres, but they may not be as familiar with min for minutes or h for hours.
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Definitions

convention: a usual or agreed-upon way of doing something

numeral: a symbol that uses one or more digits (0 to 9) to name a number; for example, the numeral 15 would describe the number of items in a set of 15 items

rate: a comparison of quantities that are in different units, for example, \$2 for 6 items or 80 km/hour

term (rate): each part of a rate; for example, if the rate is 80 km/h, the two terms are 80 km and 1 h

unit rate: when two quantities are compared in a rate, the unit rate tells how one quantity matches a unit of 1 of the other; for example, if it takes 60 minutes to walk 5 km, the unit rate is 12 min for 1 km