Unit 5, Lesson 9

# Multiplying Rational Numbers (Part 2)

Let's multiply signed numbers.

## 9.1 Before and After

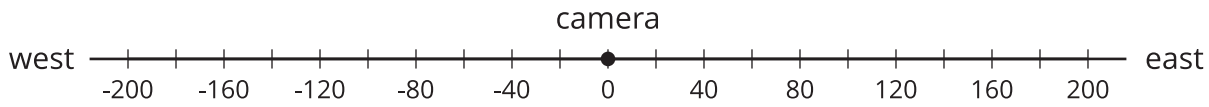


1. Where was the person 5 seconds *after* this picture was taken?

2. Where was the person 5 seconds *before* this picture was taken?

# 9.2 Backwards in Time

A traffic safety engineer was studying traffic patterns. She set up a camera to record the speed and direction of cars and trucks that passed by. She decided to represent positions to the east of the camera with positive numbers and positions to the west of the camera with negative numbers.




1. A car was traveling east at 12 meters per second. Where was the car 10 seconds *before* it passed the camera?

2. A car was traveling west at -14 meters per second. Where was the car 10 seconds *before* it passed the camera?

3. Complete the table to show the position of each vehicle after traveling at a constant velocity for the given amount of time.

| | velocity (meters per second) | time after passing the camera (seconds) | position (meters) | equation |
|---|---|---|---|---|
| **car A** | +12 | -10 | -120 | $12 \cdot -10 = -120$ |
| **car B** | -14 | -10 | | |
| **car C** | +9 | -6 | | |
| **car D** | -11 | -9 | | |
| **car E** | -15 | -4 | | |
| **car F** | +8 | -13 | | |

4. Complete the sentences. Be prepared to explain your reasoning.
   - A positive number times a negative number equals a _____.
   - A negative number times a negative number equals a _____.

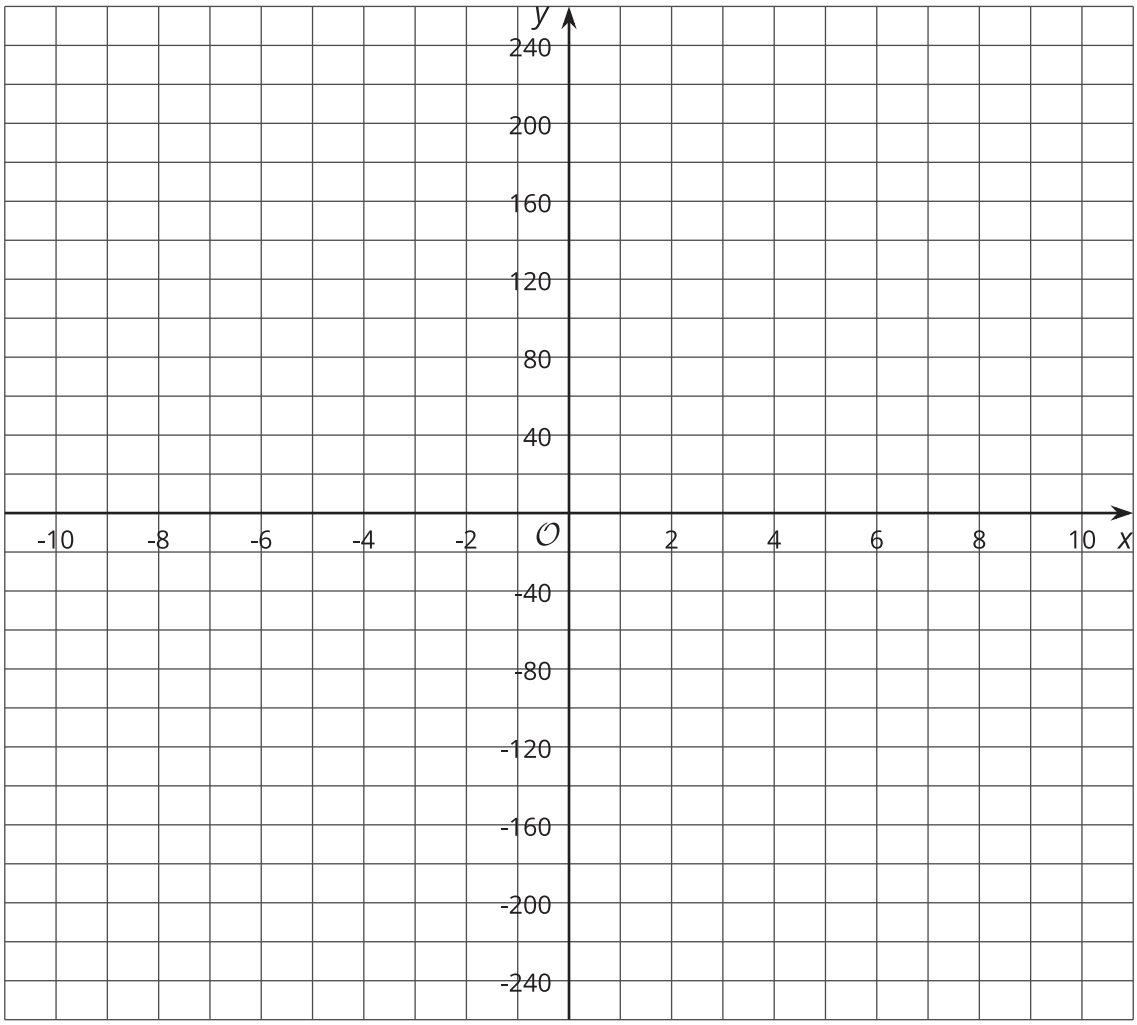
# 9.3 Cruising

Around noon, a car was traveling -25 meters per second down a highway. Use the position of the car at exactly noon as the reference point.

1. Complete the table.

| time ($x$) | -8 | -6 | -4 | -2 | 0 | 2 | 4 | 6 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| position ($y$) | | | | | 0 | | | | |

2. Graph the relationship between the time and the car's position.




3. What was the position of the car at -3 seconds?
4. What was the position of the car at 6.5 seconds?

### Are you ready for more?

Find the value of these expressions without using a calculator.

$(-1)^2$ $(-1)^3$ $(-1)^4$ $(-1)^{99}$

## 9.4 Rational Numbers Multiplication Grid

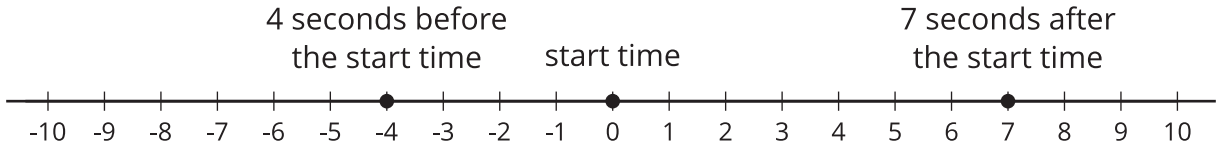
1. Complete the *shaded* boxes in the multiplication square.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 5 | | | | | | 0 | 5 | 10 | 15 | 20 | |
| 4 | | | | | | 0 | 4 | 8 | 12 | 16 | |
| 3 | | | | | | 0 | 3 | 6 | 9 | 12 | |
| 2 | | | | | -2 | 0 | 2 | 4 | 6 | 8 | |
| 1 | | | | | | 0 | 1 | 2 | 3 | 4 | |
| 0 | | | | | | 0 | 0 | 0 | 0 | 0 | |
| -1 | | | | | | | | | | | |
| -2 | | | | | | | | | | | |
| -3 | | | | | | | | | | | |
| -4 | | | | | | | | | | | |
| -5 | | | | | | | | | | | |
| | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |

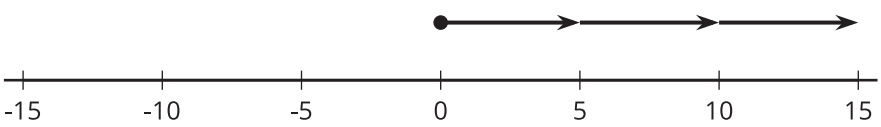
2. Look at the patterns along the rows and columns. Continue those patterns into the unshaded boxes.
3. Complete the whole table.
4. What does this tell you about multiplication with negative numbers?

## Lesson 9 Summary

We can use signed numbers to represent time relative to a chosen point in time. We can think of this as starting a stopwatch. The positive times are after the watch starts, and negative times are times before the watch starts.

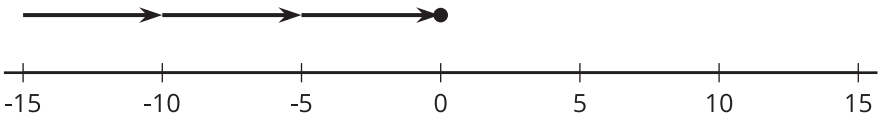



If a car is at position 0 and is moving in a positive direction, then for times after that (positive times), it will have a positive position.



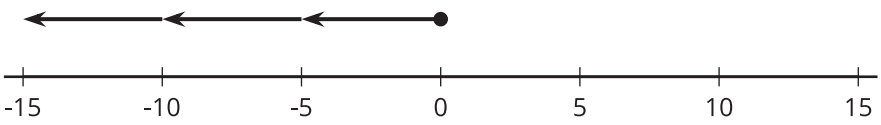

$5 \cdot 3 = 15$

For times *before* that (negative times), it must have had a negative position.



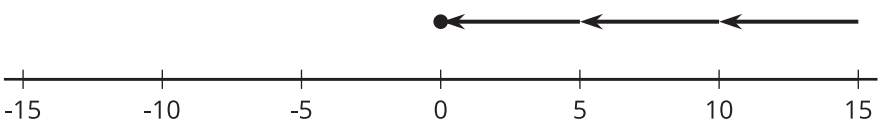

$5 \cdot -3 = -15$

If a car is at position 0 and is moving in a negative direction, then for times after that (positive times), it will have a negative position.




$-5 \cdot 3 = -15$

For times *before* that (negative times), it must have had a positive position.




$-5 \cdot -3 = 15$

Here is another way of seeing this:

- A positive number times a positive number always results in a positive number.
- A negative number times a positive number or a positive number times a negative number always results in a negative number.
- A negative number times a negative number always results in a positive number.


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