# Answer Key – Road Rage

The data in this answer key is sample data only. Student answers will vary based on personal data.

This activity will explore how to predict where and when two cars will crash into each other based on data you will be collecting in your groups. To begin the activity, assign roles to all the members of your group:

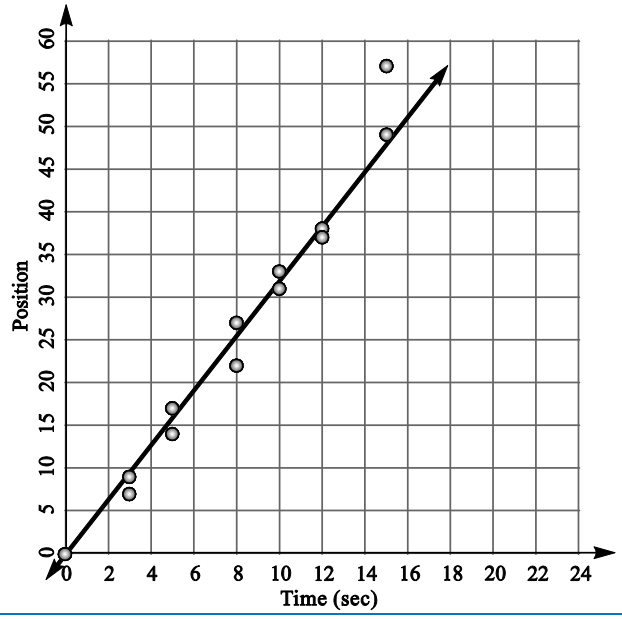
Racer: Operates the remote-controlled car
Timer: Runs the stopwatch
Spotter: Measures the distance traveled
Recorder: Logs data on the activity sheet

**1.** Collect data to determine the velocity (or speed) in units/second for your remote-controlled car. Race your car for the lengths of time indicated in the table. After the given number of seconds has elapsed, measure and record the distance traveled in the second row of the table. Notice you will be racing for each time interval twice. This is to ensure an accurate calculation of velocity. In the final column, race the car for a set time greater than 15 seconds, and record your results.

| TIME (SEC) | 0 | 3 | 3 | 5 | 5 | 8 | 8 | 10 | 10 | 12 | 12 | 15 | 15 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| POSITION | 0 | [9] | [7] | [17] | [14] | [22] | [27] | [33] | [31] | [38] | [37] | [49] | [57] | |

**2.** Create a scatter plot of the data you collected. Determine which axis represents time and which axis represents distance. Remember, the *x*-axis is the independent variable and the *y*-axis is the dependent variable. Your scatter plot should include an appropriate title and labeled axes.

Our Car's Distance vs. Time



**3.** Your data should show an approximate linear relationship between time and distance. Draw a single line that passes through or near all the points on your graph. It may help to use a ruler. This line is called the "line of fit." **Note:** This line may pass through some of the points, none of the points, or all of the points.

**4.** Select two points on the line of fit, and calculate the slope of the line, including units. The slope you found represents the speed of your car. Why?

points selected: (6,20) and (15,50)

slope $= \frac{50-20}{15-6} = \frac{30}{9} = 3.33$ units/second

The slope measures distance divided by time, which is rate of change or speed.

**5. a)** Using a graphing calculator, determine the equation of the line of best fit, which is the line that most closely passes through or near the data points.

| | A time | B blocks | C | D |
|---|---|---|---|---|
| 6 | 8. | 27. | | |
| 7 | 10. | 33. | | |
| 8 | 10. | 31. | | |
| 9 | 12. | 38. | | |
| 10 | 12. | 37. | | |
| 11 | 15. | 49. | | |

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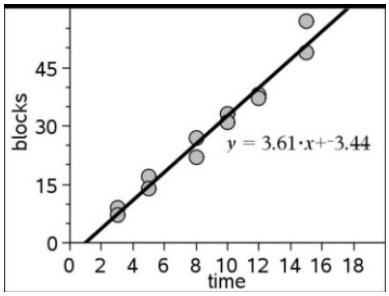



$y = 3.61x - 3.44$

**b)** Which number represents the speed? Why?

3.61

It is the slope of the line, and therefore the rate of change or speed.

**6.** Is the speed the same for the line of fit you drew by hand in Question 4 and the line of best fit drawn by the calculator in Question 5? Why or why not?

No, the calculator is able to determine the line of *best* fit, while the line drawn by hand is just a visual estimation.

**7. a)** Suppose your car starts at position 0 and increases its position as time increases. Given $x$ = time (sec) and $y$ = position, create an equation in slope-intercept form that predicts the position of your car.

$y = 3.61x$

**b)** What do the slope and $y$-intercept represent?

3.61 is the speed.

The $y$-intercept represents the starting position, which is 0 for this equation.

**8. a)** Suppose your car starts at position 100 and moves in the opposite direction, which means it decreases its position as time increases. Given $x$ = time (sec) and $y$ = position, create an equation in slope-intercept form that predicts the position of your car.

$y = 100 - 3.61x$

**b)** What do the slope and $y$-intercept represent?

–3.61 is the speed (or velocity)
The $y$-intercept is 100 because you start at position 100.

**c)** What is different in this equation? What do you think explains this difference?

The slope is negative. This reflects the direction of the car. As time increases, the position of the car decreases.

**9.** Partner with another group for the next part of this activity. Record your roles below.

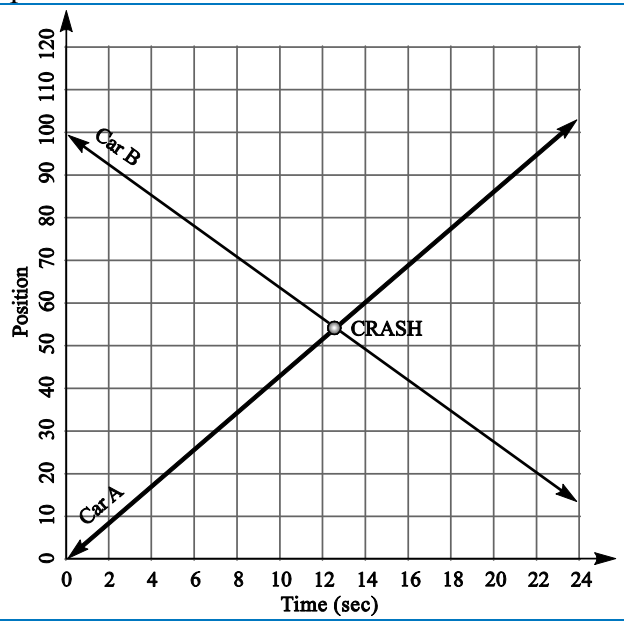
| Car | Starting Position | Equation for Car | Group Members |
|---|---|---|---|
| A | 0 | [$y = 4.32x$] | |
| B | 100 | [$y = 100 - 3.61x$] | |

**10.** Create a function table for each car using your equations.

| Car A | |
|---|---|
| Time ($x$) | Position ($y$) |
| 0 | [0] |
| 5 | [21.6] |
| 10 | [43.2] |
| 15 | [64.8] |
| 20 | [86.4] |
| 25 | [108] |

| Car B | |
|---|---|
| Time ($x$) | Position ($y$) |
| 0 | [100] |
| 5 | [81.95] |
| 10 | [63.9] |
| 15 | [45.85] |
| 20 | [27.8] |
| 25 | [9.75] |

**11.** Graph the points from your function table and draw in the line. Label the lines "Car A" and "Car B," and label the point of intersection "Crash."




**12.** From your graph, find the time and position of the crash for both cars.

Car A: 13 seconds, position 54
Car B: 13 seconds, position 54

**13.** What do you notice about the solution for Car A and the solution for Car B? What do you think explains this result?

They are the same.
The cars must be in the same place at the same time to crash into each other.

**14.** Solve the system of equations algebraically. Show your work.

$$\begin{aligned} y &= 4.32x \\ y &= 100 - 3.61x \\ 100 - 3.61x &= 4.32x \\ 100 &= 7.93x \\ x &\approx 12.6 \text{ seconds} \\ y &\approx 4.32(12.6) \\ y &\approx \text{position } 54.4 \end{aligned}$$

**15.** Is there a relationship between the solution from the systems of equations and the graph? Explain this.

Yes, they are the same point.
They are different representations or methods to solve the same problem.

**16.** Now test your solutions by crashing your cars into each other. Assign roles to the group members as you did before, and collect data on 3 trial runs. In the last row, average the data from your 3 trials. **Note:** Cars may pass by each other instead of crashing. Record the time and position when the cars passed each other if this happens.

| | TIME OF CRASH | POSITION OF CRASH |
|---|---|---|
| TRIAL 1 | | |
| TRIAL 2 | | |
| TRIAL 3 | | |
| AVERAGE RESULT | | |

**17.** What are some of the factors that may have caused your actual results to vary from the predicted result?

The biggest variation may be that the driver has problems controlling the car for longer distances. Usually by the third trial the predictions are more accurate. Also, the batteries can run down (cars go slower) if students drive the cars around too much before the crashes.

**18.** How could you redesign the data collection and the crash test to provide a closer result?

Students can choose the same person to race the car during the data collection and the crash activity. Students could also suggest collecting additional data.

**19.** What does it mean to say that your predicted result is a solution of the system of equations?

Students should understand that a solution to a system of equations is where the lines represented by the equations intersect. For the car crash, the solution is where the cars will be at the same place at the same time. This is why the solution of the system is also the predicted result of crashing the cars.

**20.** Why are the values of time and position the same for both cars when they collide?

The cars must be at the same location at the same time to crash.