# Explosion Math Answer Key

**\*Round all calculations to the nearest hundredth.**

Hawaii Kīlauea volcano lava flow moves at a speed of **25 mph** which is **11.18 meters per second**.

A pyroclastic flow such as Guatemala's Fuego Volcano can move at an average of **220 mph** which is **98.35 meters per second.**

| The World's Fastest Tortoise | Usain Bolt |
|---|---|
| Bertie the world's fastest tortoise travels at .28 meters per second. | Usain Bolt travels 100 meters in 9.58 seconds, which is 10.44 meters per minute. |
| **Average Car On The Freeway** | **Student Speed** |
| An average car travels at 65 miles per hour, which is 29.06 meters per minute. | Results may vary. You may allow the students to run greater than 10m if you have the space to do so. |

| | |
|---|---|
| **Kīlauea Slope-Intercept Form Equation**<br>y=11.18x | **Fuego Slope-Intercept Form Equation**<br>y=98.35x |
| **Tortoise Slope-Intercept Form Equation**<br>y=.28x+1000 | **Usain Bolt Slope-Intercept Form Equation**<br>y=10.44x+1000 |
| **Average Vehicle Slope-Intercept Form Equation**<br>y=29.06x+1000 | **Student Slope-Intercept Form Equation**<br>Results may vary based on the speed of each student |

## Compare the flows:

*Observation: If you were only given the graph of the two equations how would you know which one was moving faster?

**Answer: The linear line that has a steeper slope is traveling at a faster speed. The steeper slope of the line demonstrates a much higher rate that is covering a greater distance over a shorter amount of time.**

*Analyze: If you expanded these graphs to a four quadrant graph the only place they would intersect would be at your point (0,0) as they do on your graph now.  What does the origin in this situation represent?

**Answer: The origin in this graph represents where both of the linear equations that describe the volcano lava flows "started" from in this situation, which would be 0 instead of the 1,000m that each headstart that each character received in our scenario. In this case, it is the starting point for the lava and pyroclastic flow of the volcanoes, the locations of the volcanoes themselves. It can also be characterized as the y-intercept for each of the volcanoes.**

Why is this the only place these two graphs will ever intersect?

**Answer: This is the only place these two lines will intersect because from any point after the starting point the flows will be moving at different speeds. This will cause the lines to have different slopes and to never intersect after starting from the same origin, which in this case is the distance from the start of the lava or pyroclastic flow.**

## Kīlauea

*Observe: Out of the four other equations graphed, which one(s) if any were able to make it to the safety of 5,000m away before the lava flow reached there?

**Answer: Usain Bolt and the car traveling at an average highway speed are able to escape to the safe location 5,000m away before the lava flow reaches them.**

| Time Taken To Reach Safe Distance(in seconds) | | |
|---|---|---|
| Usain Bolt | Average Car | Tortoise |
| 383.14 | 137.65 | 14,285.71 |

**\*Your students may also be able to escape the lava flow depending on how quickly they moved while collecting their data.**

\*Observe: Were there any that make it to the 5,000m mark on your graph paper? If so, what would it mean for that character? Why do you think this was the case? Use evidence from your graph or equation to justify your claim.
**Answer: The world's fastest tortoise didn't make it to the 5,000m mark on the graph paper provided. With the flow from Kīlauea making it to the 5,000m while still on the graph paper it's clear that the tortoise would not have survived. This was the case because even though it was the world's fastest tortoise it wasn't fast enough to make it to the safe distance in time.**

\*Analyze: How were you able to interpret this from the graph?
**Answer: You're able to interpret this from the graph due to the fact that the graph representing Kīlauea made it to the 5,000m mark on the graph before the tortoise was able to.**

**Fuego**
\*Observe: Out of the four other equations graphed, which one(s) if any were able to make it to the safety of 5,000m away before the pyroclastic flow?
**Answer: None of the four characters, including any of your students, would have been able to move fast enough on their own to make it to the safe distance 5,000m away by the time the pyroclastic flow reached them.**

*Analyze: How were you able to interpret this from the graph?

**Answer: The graph for each of the four characters did not make it to the distance of 5,000m before the graph of the rate of speed of the pyroclastic flow did.**

**<u>Fuego Part Two</u>**

**What type of headstart would it take for our 4 characters to survive and make it to the safe distance 5,000m away?**

| World's Fastest Tortoise | Usain Bolt |
|---|---|
| 5000m=_____ * _____+? meters<br><br>↑ Character's speed  ↑ Time it takes Fuego to travel 5000m, in seconds  ↑ Head start needed for character to survive<br><br>**Equation: 5000m=.28 * 50.84 + ?** | 5000m=_____ * _____+? meters<br><br>↑ Character's speed  ↑ Time it takes Fuego to travel 5000m, in seconds  ↑ Head start needed for character to survive<br><br>**Equation: 5000m= 10.44 * 50.84 + ?** |
| Head Start Needed: **4,985.76 meters** | Head Start Needed: **4,469.23 meters** |

| Average Car On The Highway | Student In Class |
|---|---|
| 5000m=_____ * _____+? meters<br><br>↑ Character's speed  ↑ Time it takes Fuego to travel 5000m, in seconds  ↑ Head start needed for character to survive<br><br>**Equation: 5000m = 29.06 *  50.84 + ?** | 5000m=_____ * _____+? meters<br><br>↑ Character's speed  ↑ Time it takes Fuego to travel 5000m, in seconds  ↑ Head start needed for character to survive<br><br>**Equation: 5000m=(the meters per minute of the each student) * 50.84 + ?** |
| Head Start Needed: **3522.59 meters** | Head Start Needed:<br>**(dependent upon each student)** |