***Energy vs. Mass vs. Velocity***

***Storyline: Could an asteroid colliding with Earth cause a mass extinction?*** The asteroid will be traveling very fast when it hits the surface of the planet. We must consider:

* *How much energy will be transferred to the asteroid at impact?*
* *How does it change with the size and speed of the asteroid?*
* *Which is the more IMPORTANT factor.*
* *Should we focus on the mass of the asteroid or worry about its VELOCITY?*

In [physics](https://en.wikipedia.org/wiki/Physics), **KINETIC ENERGY** is the energy an object has BECAUSE of its [motion](https://en.wikipedia.org/wiki/Motion_(physics)).  Kinetic energy is also a measure of how much change an object can cause.

* a *larger* moving object will do more damage (cause more change) than a *smaller* moving object.
* a *faster* moving object will do more damage (cause more change) than a *slower* moving object.

**Graphing Data**

You will receive some experimental data that our NASA research scientists determined for the KINETIC ENERGY (measured in kilojoules (kJ) = 1000 Joules) of the impact of an asteroid.

1. Draw and label the axes for your data on the given graph paper
2. Label your axes with a proper SCALE so that your data will FILL the graph
3. Plot the points on your own paper
4. Connect the dots to see the relationship
5. When you are finished, compare the two graphs and answer the “data match” and analysis questions

|  |  |
| --- | --- |
| VELOCITY (m/s)  experimental lander mass = 1000 kg  (about 2200 lbs) | Energy (kJ) |
| 10 m/s | 50 kJ |
| 20 m/s | 200 kJ |
| 30 m/s | 450 kJ |
| 40 m/s | 800 kJ |
| 50 m/s | 1,250 kJ |
| 60 m/s | 1,800 kJ |
| 70 m/s | 2,450 kJ |
| 80 kg | 3,200 kJ |

|  |  |
| --- | --- |
| MASS (kg)  experimental lander velocity = 50 m/s  (about 100 mph) | Energy (kJ) |
| 200 kg | 250 kJ |
| 400 kg | 500 kJ |
| 600 kg | 750 kJ |
| 800 kg | 1,000 kJ |
| 1000 kg | 1,250 kJ |
| 1200 kg | 1,500 kJ |
| 1400 kg | 1,750 kJ |
| 1600 kg | 2,000 kJ |

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**QUESTIONS: Answer in complete sentences in your notebook**

**\*\* you do not need to write the question \*\***

* 1. What happens to the kinetic energy when you increase the mass?
  2. What happens to the kinetic energy when you increase the speed?
  3. How can a small object (small mass) have the same energy as a large object (large mass)?
  4. a) What is the shape of the MASS vs ENERGY graph? Is it a *LINEAR RELATIONSHIP?*

b) What happens when you DOUBLE the mass?

* 1. a) What is the shape of the VELOCITY vs ENERGY graph? Is it a *LINEAR*

*RELATIONSHIP?*

b) What happens when you DOUBLE the velocity?

* 1. Which makes a bigger difference: a 100 kg increase in the mass or a 100 meter/sec rise in

velocity?

**DATA MATCH: WRITE the statements (more than one) that agree with the graphs you made on your *output sheet.***

a. Kinetic energy increases when mass increases.

1. Kinetic energy decreases when speed increases.
2. A small object (small mass) can have the same kinetic energy as a large object (large mass)

IF its velocity is large enough

1. The shape of the MASS vs ENERGY graph has a *NON-LINEAR RELATIONSHIP.*
2. The VELOCITY vs ENERGY graph shows a *NON-LINEAR RELATIONSHIP.*
3. An increase in velocity of 100 m/s leads to a LARGER increase in kinetic energy than an

increase of 100 kg