Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Kinetic Energy of Meteors**

**TEACHER GUIDE AND KEY**

Period: \_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_



*Q. How much energy would be released if a 1m3 CUBE*

*traveling at meteor speeds crashed into the earth?*

You will use the kinetic energy equation to calculate the energy:

KE = ½ (mass) x (velocity)2 -or- KE = ½ mv2

**KE = 0.5 \* m \* v \* v**

The **mass** of a cube of granite 1 meter on each side (volume = 1m3) = **2.262 Mega grams.**

Mega is a million in the SI system.

For reference, 2.262 Mega grams = 4987 lbs, the weight of a large truck.

*Since the SI unit of energy, the joule, is calculated using kilograms (kg), we want to know that 2.262 Mega grams is 2,262 kg. KE (in joules) = 0.5 x mass (in kg) x velocity (in m/s) x velocity (in m/s). You will need to work carefully with your students in tracking units as they complete these calculations. It may be best to go through all of them as a class after only giving students a brief time to struggle with setting up the calculations.*

Meteors travel at a range of velocities, from as low as 11 kilometers/second (km/s) to as high as 72 kilometers/second (km/s). For references, 11 km/s = 24,606 mph, and 72 km/s =161,059 mph.

Since there is a wide range of meteor velocities, you will do three kinetic energy calculations, each at a different speed as shown in the table below.

Do the KE calculation (use a calculator) and fill in boxes 1, 2, and 3 in the data table.

*Notice the kinetic energy goes up by a factor of 5 to 10 between columns. This corresponds to the square of the difference in velocities between columns.*

|  |  |  |  |
| --- | --- | --- | --- |
|  | velocity = 11 km/s  = 11,000 m/s | velocity = 30 km/s  = 30,000 m/s | velocity = 72 km/s  = 72,000 m/s |
| Kinetic Energy  of a granite cube  in **gigajoules**  (giga = 1 billion) | KE = (0.5)  \*(2,262 kg)  \*(11,000 m/s)  \*(11,000 m/s)  = 1.36851 x 1011 joules  = 136.851 gigajoules | KE = (0.5)  \*(2,262 kg)  \*(30,000 m/s)  \*(30,000 m/s)  = 1.0179 x 1012 joules  = 1,017.9 gigajoules | KE = (0.5)  \*(2,262 kg)  \*(72,000 m/s)  \*(72,000 m/s)  = 5.863104 x 1012 joules  = 5,863.104 gigajoules |
| **Leave this row blank for now.**  Later they will add this note:  **“Divide by 5.45”**  # of 1m3 granite cubes this would melt: | # of 1m3 granite cubes this would melt:  = 136.851 gigajoules  /5.45 gigajoules/m3 granite  = ~25.1 m3 granite  🡪 A bit more than 25. | # of 1m3 granite cubes this would melt:  = 1,017.9 gigajoules  /5.45 gigajoules/m3 granite  = ~186.8 m3 granite  🡪 Almost 187. | # of 1m3 granite cubes this would melt:  = 5,863.104 gigajoules  /5.45 gigajoules/m3 granite  = ~1.075.8 m3 granite  🡪 Almost 1,076. |

*(That is a lot of energy!)*

*How much energy does it take to completely melt rock?*

4. *It takes 5.45 gigajoules (5,450,000,000 joules) to melt one cubic meter of granite.*