

Kinetic Energy of Meteors

TEACHER GUIDE AND KEY

Name: _____

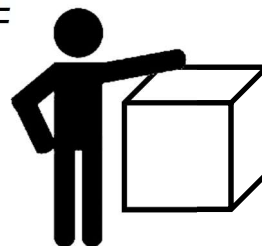
Period: _____ Date: _____

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:

$$KE = \frac{1}{2} (\text{mass}) \times (\text{velocity})^2 \text{ -or- } KE = \frac{1}{2} mv^2$$

$$KE = 0.5 * m * v * v$$



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 10 ¹¹ joules = 136.851 gigajoules	KE = (0.5) *(2,262 kg) *(30,000 m/s) *(30,000 m/s) = 1.0179 x 10 ¹² joules = 1,017.9 gigajoules	KE = (0.5) *(2,262 kg) *(72,000 m/s) *(72,000 m/s) = 5.863104 x 10 ¹² joules = 5,863.104 gigajoules
Leave this row blank for now.	# of 1m ³ granite cubes this would melt:	# of 1m ³ granite cubes this would melt:	# of 1m ³ granite cubes this would melt:
Later they will add this note: "Divide by 5.45"	= 136.851 gigajoules /5.45 gigajoules/m ³ granite	= 1,017.9 gigajoules /5.45 gigajoules/m ³ granite	= 5,863.104 gigajoules /5.45 gigajoules/m ³ granite
# of 1m ³ granite cubes this would melt:	= ~25.1 m ³ granite → A bit more than 25.	= ~186.8 m ³ granite → Almost 187.	= ~1,075.8 m ³ granite → Well over 1,000!

(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.*