

Calculating the Speed of Tsunami Waves

Name: KEY

Adapted from The Wave that Shook the World (PBS Nova)

In the following exercise, you will consider several scenarios where tsunamis are generated. You will calculate the speed of the tsunami wave and estimate the amount of time that it will take for the tsunami to arrive at a number of locations. Please insert your answers into the tables. Please be careful with units.

The speed of a tsunami may be estimated by the following equation

$$\text{speed} = \sqrt{(g \cdot d)} = (g \cdot d)^{1/2}$$

where g is the acceleration due to gravity ($g = 9.81$ meters/second²) and d is the water depth (in meters). To convert the solution from meters/second to kilometers/hour, use the following equalities:

$$1 \text{ hour} = 60 \text{ minutes} = 3,600 \text{ seconds}$$

$$1 \text{ kilometer} = 1,000 \text{ meters}$$

To convert your units to meters/hour, multiply your initial answer by 3,600. Divide the result by 1,000 to convert from meters/hour to kilometers/hour. Round your final answer to the nearest whole number.

To determine the distances between locations, you may use an online calculator such as

<http://www.distancefromto.net/>

Scenario 1. Seismologists have just registered an earthquake in Seward, Alaska, that is big enough to produce a tsunami. The ocean depth is 4,000 meters. Use the wave speed formula to approximate the tsunami's speed. Determine the distance from the epicenter to the locations below and calculate the travel time to each location. Please insert your answers into the table below.

	Speed (km/hour)	Distance (km)	Travel Time (hours)
Kodiak, AK	713	309	0.4
Kauai, HI	713	4304	6
Kwajalein, Marshall Islands	713	6697	9.4

Scenario 2. A tsunami has just been detected off of Ka Lae, HI. The ocean depth is 4,500 m. Use the wave speed formula to approximate the tsunami's speed. Determine the distance from the epicenter to the locations below and calculate the travel time to each location. Please insert your answers into the table below.

	Speed (km/hour)	Distance (km)	Travel Time (hours)
Dutch Island, AK	756	4384	5.8
San Francisco, CA	756	3932	5.2
Tokyo, Japan	756	6020	8.0

Scenario 3. A large part of a volcano in the Gran Canaria, Canary Islands, has just fallen into the ocean that is 3,500 meters deep. Use the wave speed formula to approximate the tsunami's speed. Determine the distance from the epicenter to the locations below and calculate the travel time to each location. Please insert your answers into the table below.

	Speed (km/hour)	Distance (km)	Travel Time (hours)
Terceira, Azores	667	1617	2.4
Galway, Ireland	667	2872	4.3
New York, New York	667	5457	8.2