How far did the earth move?

Teacher notes

Why use this resource?

This is an example of how logarithms are used in a real world situation. The initial problem gets students to think about how the logarithmic magnitude scale works and to practise doing some calculations. The second part combines that with some empirical data, giving an opportunity to use logarithms to linearise a power law relationship.

Preparation

Calculators will be required for the numerical work and either graph paper or graphing software for the *Energy* section.

Possible approach

Students should be encouraged to work together in pairs or small groups and to explain their understanding of the magnitude scale to one another.

In the *Magnitudes* section, students should be discouraged from using calculators to answer the first two questions. Instead they should try to understand the effect of the logarithm in the formula. The results of the displacement calculations should be related back to the real world context.

In the *Energy* section, students could use different approaches, but a graph fitting method that takes account of the entire data set is probably better than an algebraic one based on individual data points.

Key questions

- If we increase the magnitude by one, how much does the amplitude increase?
- Does that value seem reasonable / realistic?

Possible extension

The magnitude scale discussed here, M_L, is just one among several common scales that are based on different ways of measuring earthquakes. Students could be encouraged to explore the different scales, their strengths and weaknesses. This one, for instance, doesn't work at all well for very large earthquakes.

The magnitude scale extends the other way, to small and negative values of M_L. Using the energy relationship, students could work out the magnitude of "earthquake" created by, say, dropping a book on the floor.