High and Dry

You need: a calculator, a classmate

The seismographs at Counter Catastrophe have picked up an earthquake about 100 kilometres off the east coast. Steve and Lolosea, the tsunami experts, know this spells danger!

> It'll hit at high tide. That's bad timing!

> From the size of the earthquake, we could be dealing with a 10 metre wave.

They send out a warning to the radio stations that cover the area.

1. Lolosea works out how long it will be before the tsunami reaches the shore.
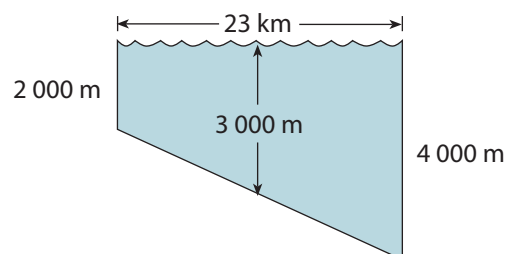   She knows that the speed of the wave, in metres per second, is given by the equation

$$s = \sqrt{9.81 \times \text{ocean depth in metres}}$$

Does the tsunami get faster or slower as it gets near the coast? Explain why.

2. Lolosea works out the ocean depth from her map in this way:

> There are 23 kilometres between where the ocean is 2 000 metres deep and where it is 4 000 metres deep. I'll take the average depth to be 3 000 metres.

23 km

2 000 m

3 000 m

4 000 m

(Diagram is not to scale.)

Using formulae in practical situations and using scale to interpret maps

$$\sqrt{9.81 \times 3\,000} = \sqrt{29\,430}$$

=171.55 metres per second

There are 23 000 metres in 23 kilometres, so the wave will take 23 000 ÷ 171.55 = 134 seconds to cross that 23 kilometre stretch of water. Whew, that's fast!

From the following contour map of the ocean floor, work out how long the tsunami will take to reach the shore from the centre of the earthquake.
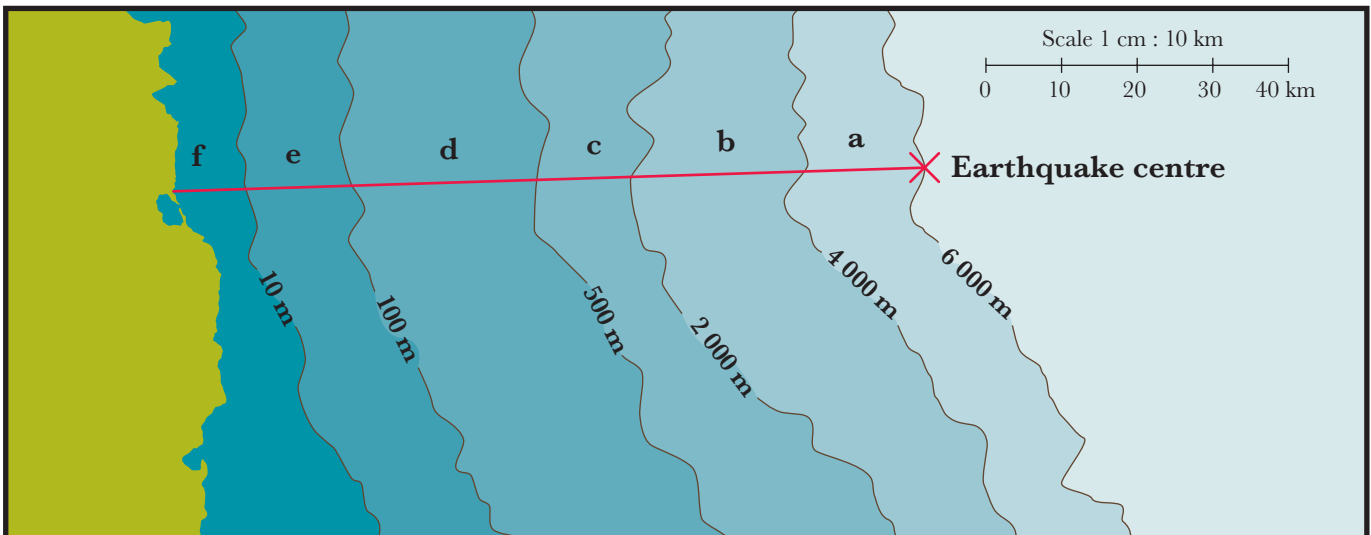
As you work out each part of your answer, put it in a table like this:

Average depth (m)	Speed of wave (m/s)	Distance (m)	Time (s)
5 000		16 000	
3 000	171.55	23 000	134

3. Steve works out that any place less than 10 metres above high tide level is likely to get washed away by the tsunami.
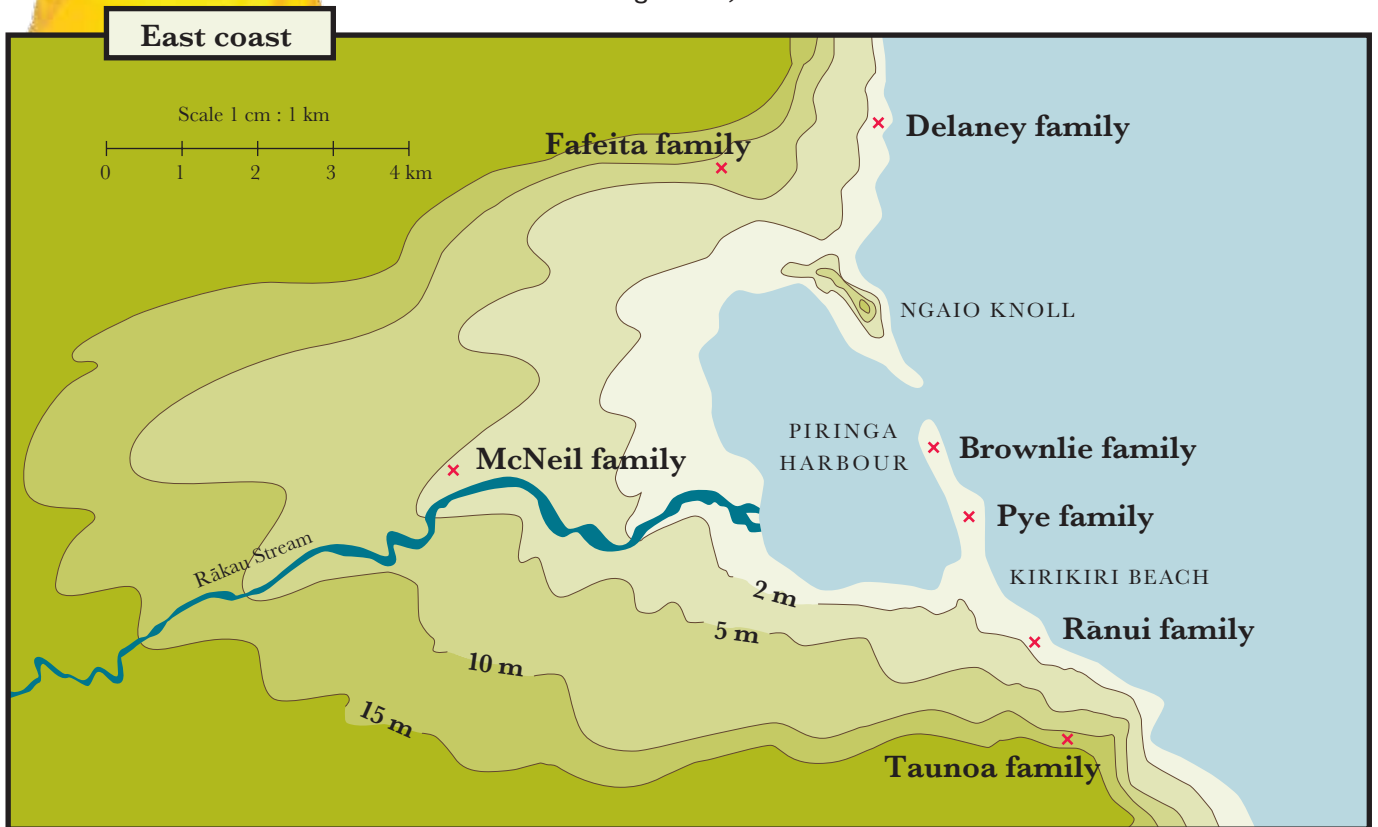
Luckily, very few people live in the low areas.

We need to make sure that everyone can get to safe ground before the tsunami hits.

We may need to rescue some of them in our helicopter.

a. Using this contour map of the area, list the families in order of distance from safety (10 metres or above).
(Once the tsunami hits the shore, it will quickly overtake anyone not on safe ground.)

East coast

Scale 1 cm : 1 km

0   1   2   3   4 km

Delaney family

Fafeita family

NGAIO KNOLL

PIRINGA HARBOUR

McNeil family

Brownlie family

Pye family

KIRIKIRI BEACH

Rānui family

Rākau Stream

2 m

5 m

10 m

15 m

Taunoa family

b. Which families may need helicopter assistance? Discuss this with a classmate.

4. With a classmate, estimate how many people in a particular coastal city in New Zealand live in "at risk" danger areas of less than 10 metres above sea level.