Suitable for year 6-10 students

EARTHQUAKE SEISMOLOGY

investigation

Understanding the Earth's shakes, rattles and rolls

Activity 1

You will need:

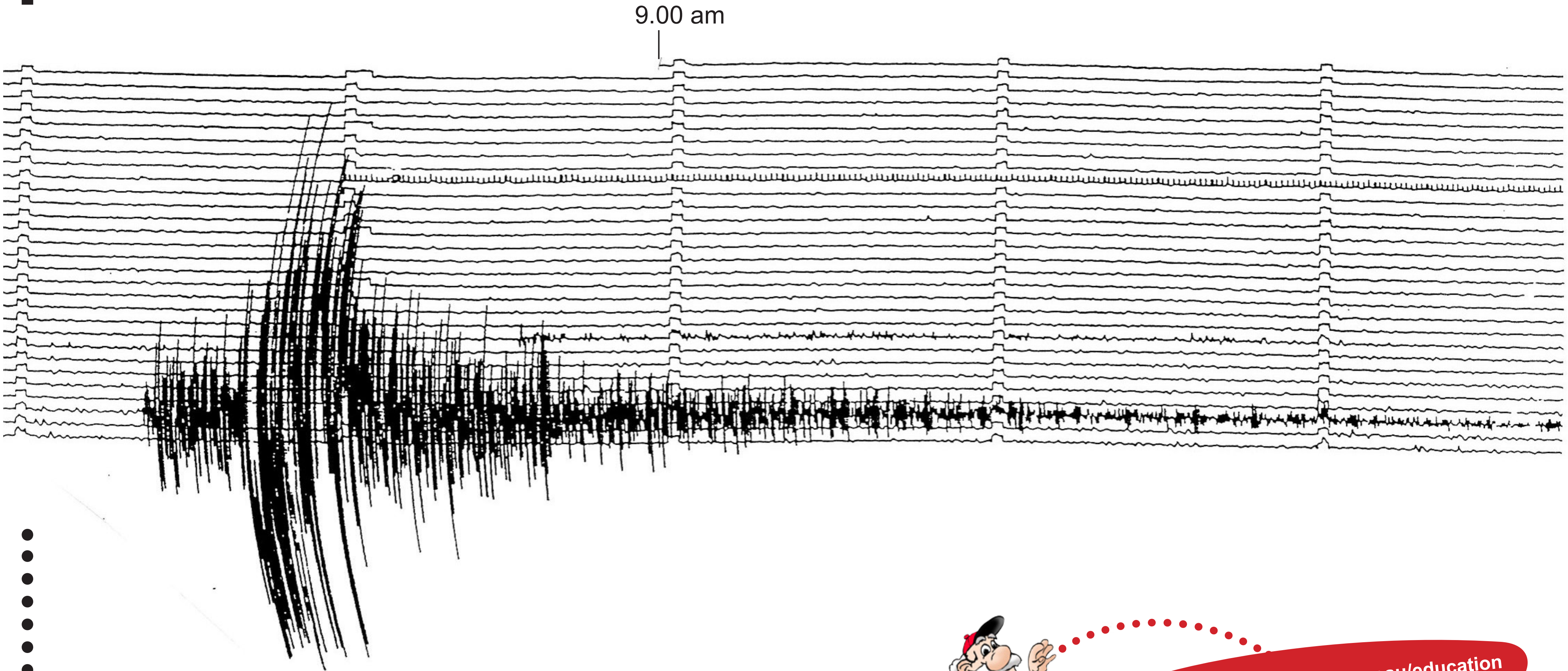
- A pencil
- A ruler with millimetre markings
- A geometric compass for drawing circles

When the Earth's thin crustal rocks are squeezed and buckled too quickly they snap, making the earth shake.

We call this an earthquake, and machines called **seismographs** can record the earth's vibrations, as shown in the example on the next page. This is called a **seismogram**.

The seismogram paper is wrapped around the machine's drum, which turns throughout the day and night with a pen drawing the vibrations picked up by a ground movement sensor, known as a **seismometer**.

Earthquake Seismogram Event 1



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The parallel lines make a continuous spiral, if you roll the sheet end to end, showing one-minute time pips every 6 centimetres, and these are further divided into 1 second markings each 1 millimetre along.

Earthquakes make similar patterns of smaller vibrations (**P waves**) followed by bigger ones (**S waves**) because there are two types of waves vibrating from the broken rocks. **P or PUSH** waves which are faster, hit the seismograph first followed by the slower **S or SHAKE** waves. These rapid vibrations of P and S waves are only felt by the seismograph, humans feel the larger slower surface waves which follow, which also rock and damage buildings.

Let's imagine you are the Seismologist on duty, you arrive at work and put new paper on the recorder drum and then go about your daily work. An earthquake happens later in the day not too far from Adelaide and you write a report from that seismogram, which answers the following questions.

Reporting seismologist's name:

....

Question 1

At what time was the seismograph started?

Answer ....

Question 2

Find the spot on the seismogram where the earthquake's first ground shaking reached the seismograph, and mark it with a pencil line.

Question 3

Now count how many minutes and seconds had passed from when the seismograph had been started up to when these earthquake waves were detected by it.

Answer ....minutes ....seconds

Question 4

What time of the day was it? Hint: Add the answer from Q3 to the starting time

Answer ....

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Question 5

Was it daytime or night?

Answer ....

Question 6

How long did the earth movements recorded by the seimograph last for?

Answer ....minutes ....seconds

Question 7

Find the spot where the push (P) wave starts and mark it with your pencil then do the same for the shake (S) wave.

Question 8

How many seconds passed between the arrival of the P and S waves. This is called 'separation time' or 'lag time'?

Answer ....seconds

Question 9

Do you think that lag time, increases or decreases as distance from the earthquake centre increases?

Answer ....

Question 10

Someone has worked out all the lag times and corresponding distances from earthquakes, and drawn them into a graph as shown on the next page.

Using your seismogram lag-time and the graph find how far away from the Adelaide seismograph station the earthquake was located.

Answer ....km

Question 11

Does this tell you which direction the earthquake vibrations came from?

Answer ....

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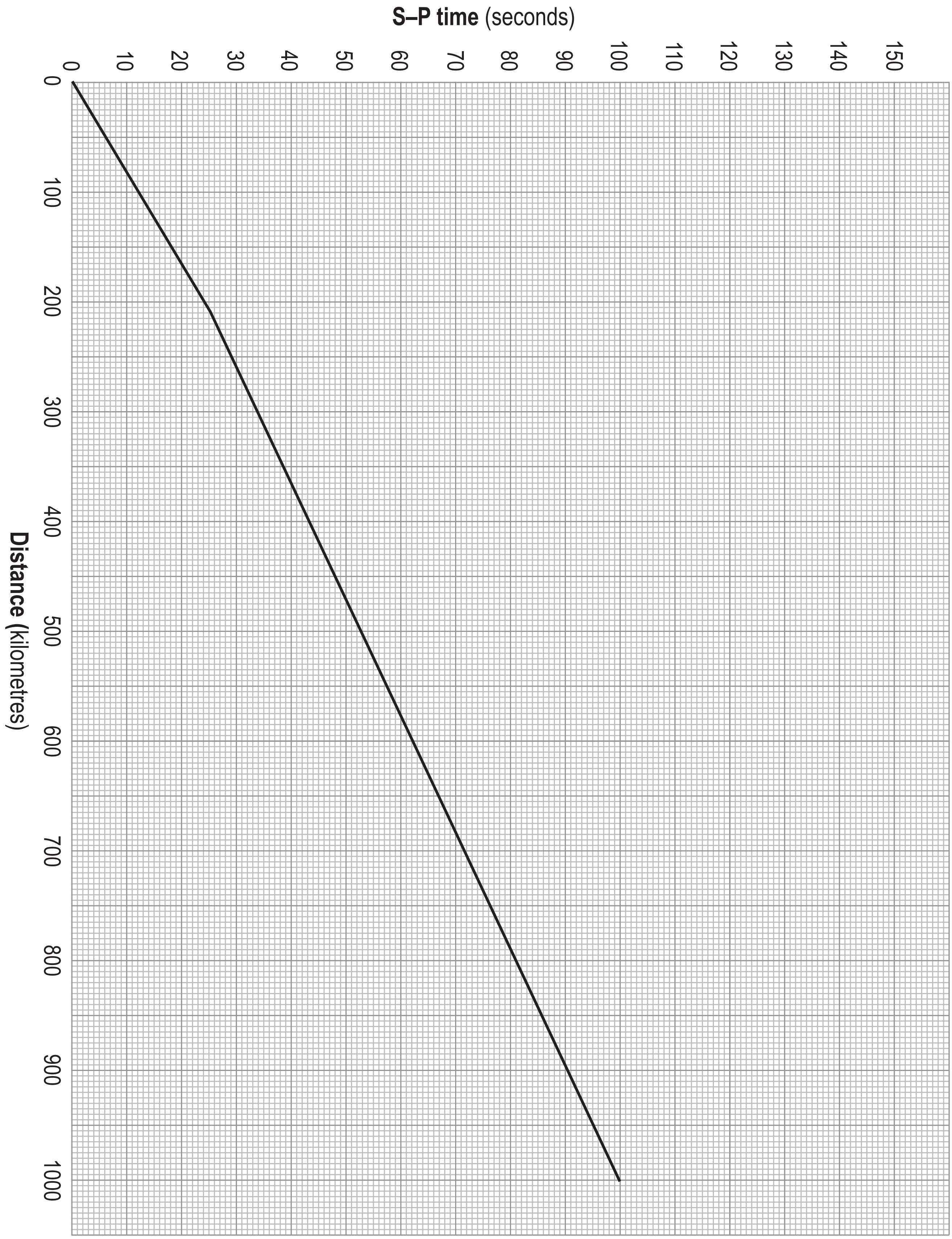
Epicentre distance graphing



Question 12

Use a geometric compass to step out the distance the Adelaide seismograph station is from the earthquake using the scale on the South Australian map. Now draw a circle of that radius around the seismograph station which recorded the earthquake. Your circle shows all the possible places at which the earthquake could have occurred.

How many seismic recording stations would you need to find the exact spot on the circle of the earthquake's origin? This is called the Epicentre.

Answer ....

Question 13

Would you expect the size of ground movements to get bigger or smaller as we go further away from an earthquake epicentre?

Answer ....

Question 14

What part of the seismogram tells how strong the earthquake was?

(Hint: think about how big the pen movements of the seismograph as it records ground movements)

Answer ....

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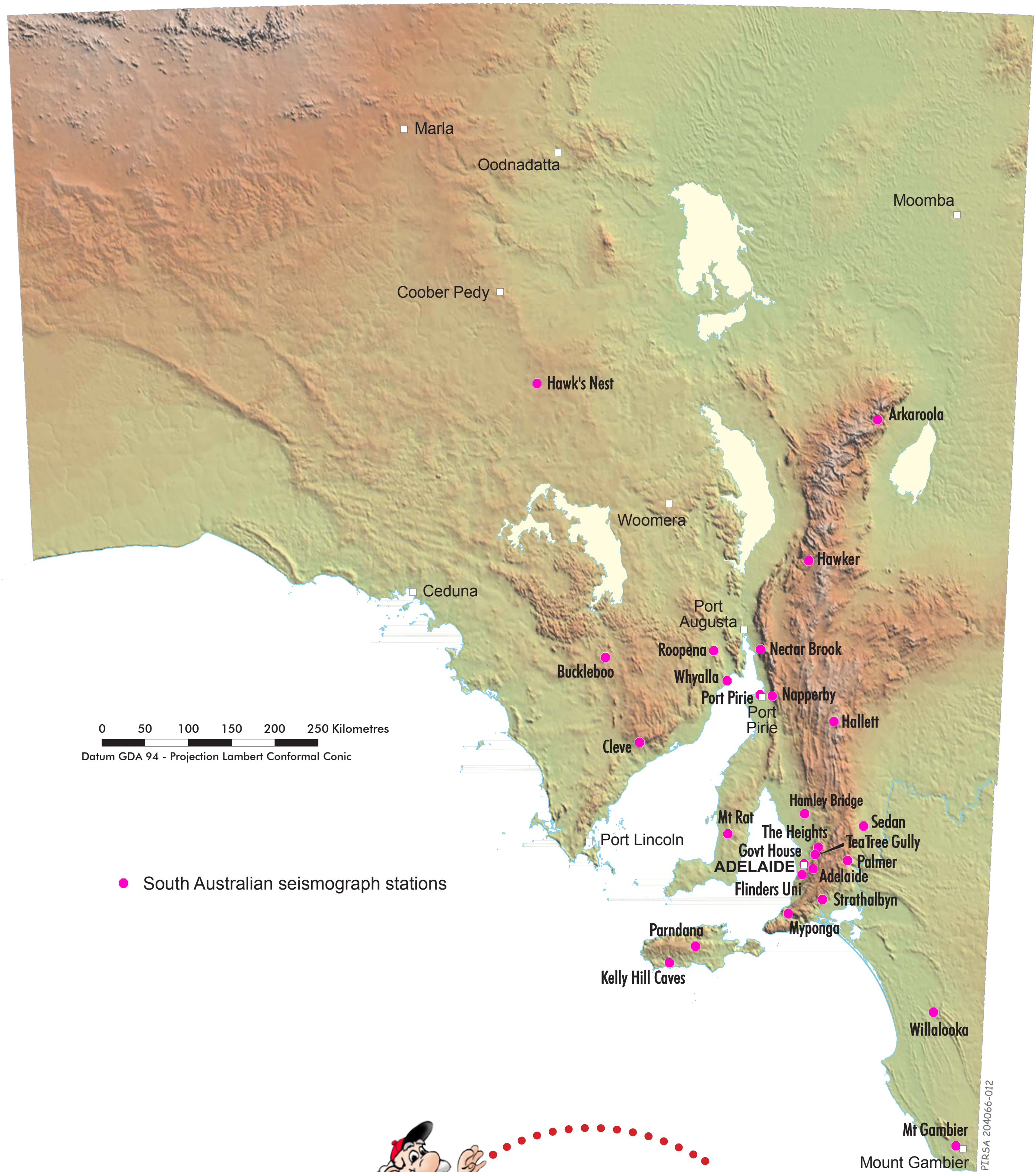


Question 15

To measure the strength of an earthquake (known as its magnitude) we need to take into account how far away from the epicentre we are and the size of the vibrations at the spot where the seismograph is.

These two bits of information carried on the seismogram can be turned into a number value on the Richter scale.

a) Find the P wave to S wave lag time on the left side Time bar.

b) Then measure the size of the vibration's biggest amplitude in millimetres from the vibration's centre line on the seismogram. Locate this value on the amplitude bar.

c) Join the lag time and amplitude point using a ruler and the magnitude will be the number intersected on the centre magnitude bar. This is the Richter scale value you would hear in news reports.

Answer: The earthquake magnitude was .... on the Richter scale.

Question 16

The Richter scale increases by 30 times the energy of earth movements for each unit of increase on the scale.

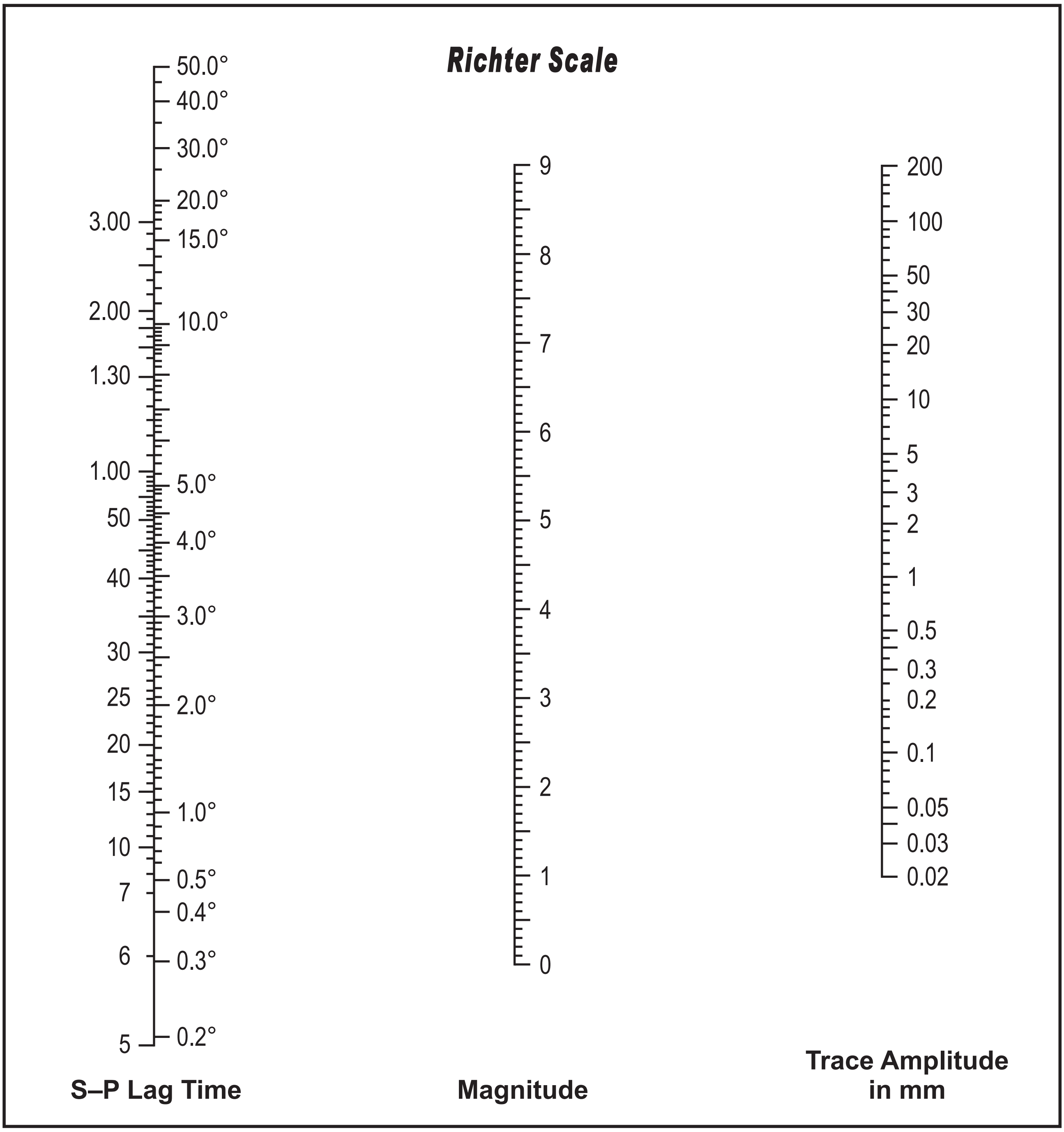
If an earthquake records 3 and another records 6 what is the difference in energy?

a) 3

b) 9

c) 2900

d) 270


Richter Scale
50.0°
40.0°
30.0°
20.0°
15.0°
10.0°
5.0°
4.0°
3.0°
2.0°
1.0°
0.5°
0.4°
0.3°
0.2°
3.00
2.00
1.30
1.00
50
40
30
25
20
15
10
7
6
5
S–P Lag Time
9
8
7
6
5
4
3
2
1
0
Magnitude
200
100
50
30
20
10
5
3
2
1
0.5
0.3
0.2
0.1
0.05
0.03
0.02
Trace Amplitude in mm

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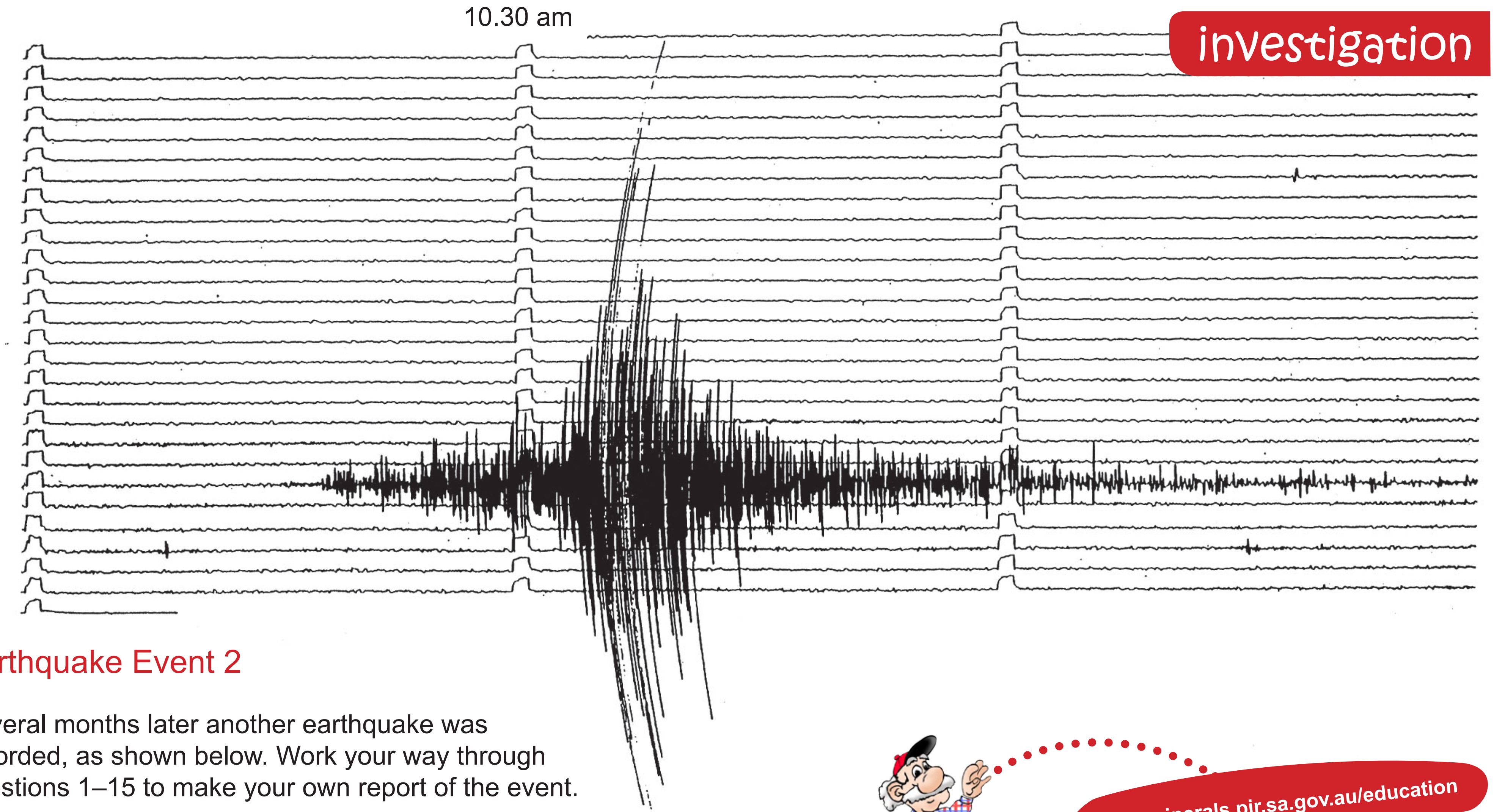

Earthquake Event 2

Several months later another earthquake was recorded, as shown below. Work your way through questions 1–15 to make your own report of the event.

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