FINDING POSITIONS AT SEA

One of the main uses of trigonometry is to navigate on the ocean, where there are very few "landmarks" to guide the way. By measuring angles, distances can be calculated and vice versa.

This stamp shows Captain James Cook (the first person to map New Zealand and the east coast of Australia) with his two most important navigation instruments, the compass and sextant. The sextant is used for measuring angles, including the angle of elevation of the sun to work out latitude.

In this project, you have to use your knowledge of trigonometry and Pythagoras' Theorem to find positions and distances at sea. You will need to think about triangles from a bird's eye view (from above) as well as from the side. Draw yourself lots of diagrams.

Imagine you are sailing a boat along a coast that is running directly east-west. You want to travel past Mt Kestrel in an easterly direction, until you are directly opposite Mt Swift. This means that you will then be directly south of it. To avoid the rocks, you must be about 1 kilometre out to sea for this part of the journey.

When you pass Mt Swift, you can change direction and sail directly to your overnight mooring in Jaeger Inlet.

Mt Kestrel and Mt Swift both rise steeply directly out of the sea, with rocky cliffs. The height of Mt Kestrel is known to be 710m above sea level and Mt Swift is 570m above sea level. The distance from the base of Mt Kestrel to the base of Mt Swift is 4850m.

General view from boat to coast – not to scale.
(Dotted line shows planned path of boat)

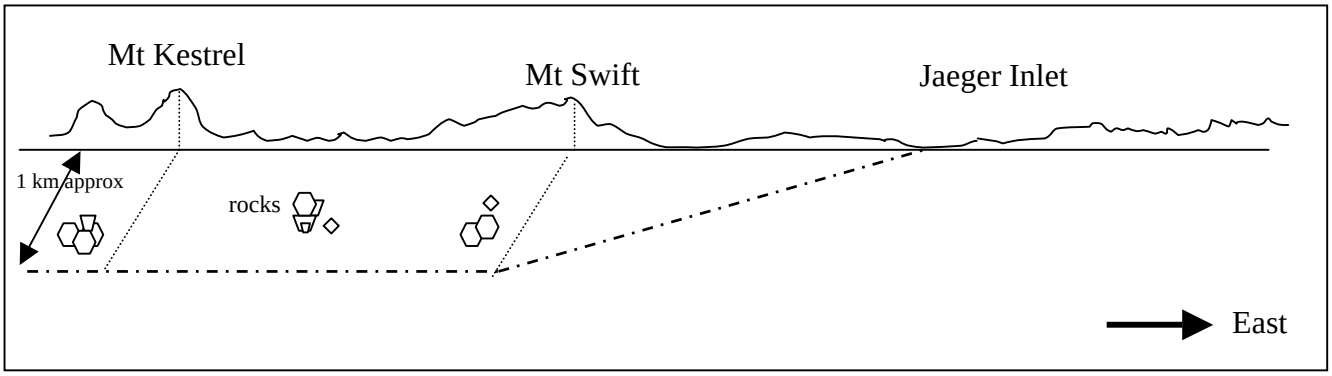
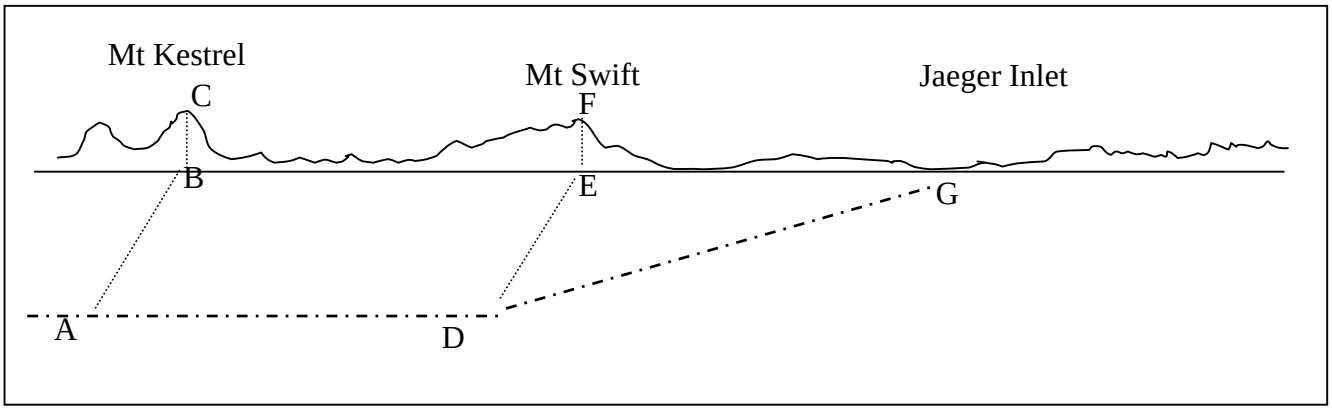


Diagram labelling points

For the calculations following, assume that point C is directly above point B, that point F is directly above point E and the three points along the coast B,E and G are in a straight line going directly west to east.



1. Point A is directly south of both point B (at sea level) and point C (on the top of Mt Kestrel and nearly directly above point B). When the boat is at point A, the angle of elevation of the top of Mt Kestrel is 34.9°.
   (i) How far is the boat from the coast?
   (ii) What is the angle of elevation to the top of Mt Kestrel in degrees, minutes and seconds?

2. What is the distance from A to E?

3. Find the angle of elevation from point A to the top of Mt Swift.

4. (i) What is the angle BAE ?
   (ii) What is the compass direction of point E from the boat at point A?

5. The captain wants the boat to travel directly east from A to D, due south of E.

   (i) If the average speed of the boat travelling from A to D is 15.3 km/hr, how long will it take to travel from A to D?

   (ii) The captain wants to double check when it has reached point D by measuring the angle back to point B. What should the angle ADB then be?

6. Some people are on the top of Mt Swift watching the boat when it reaches point D. What is the angle of depression that they would observe?

7. The boat can now travel directly to Jaeger Inlet. The compass reading from D to Jaeger Inlet is N 75.6° E.

   (i) How far does the boat have to travel to Jaeger Inlet from D?

   (ii) How far east of Mt Swift is Jaeger Inlet?

8. As you arrive at Jaeger Inlet on the boat you can see the top of Mt Swift. Can you also see the top of Mt Kestrel? Explain.

ENJOY YOUR STAY IN JAEGER INLET