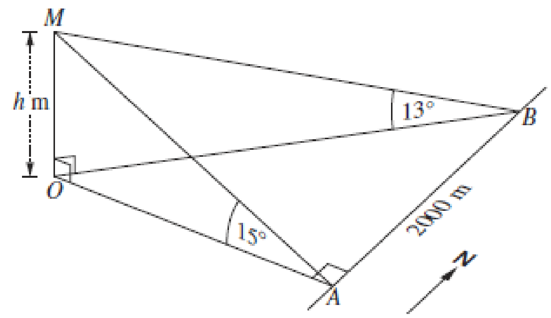
2015 **12 c** A person walks 2000 metres due north along a road from point *A* to point *B*. The point *A* is due east of a mountain *OM*, where *M* is the top of the mountain. The point *O* is directly below point *M* and is on the same horizontal plane as the road. The height of the mountain above point *O* is *h* metres. From point *A*, the angle of elevation to the top of the mountain is 15°. From point *B*, the angle of elevation to the top of the mountain is 13°.



Not to scale

(i) Show that $OA = h\cot 15°$. **1**

(ii) Hence, find the value of *h*. **2**

(i) $\frac{OA}{OM} = \cot 15°$

$\frac{OA}{h} = \cot 15°$

$OA = h\cot 15°$

State Mean: **0.95**

(ii) Similarly, $OB = h\cot 13°$

Using Pythagoras' theorem:

$$(h\cot 13°)^2 = (h\cot 15°)^2 + 2000^2$$

$$h^2(\cot^2 13°) = h^2(\cot^2 15°) + 2000^2$$

$$h^2(\cot^2 13°) - h^2(\cot^2 15°) = 2000^2$$

$$h^2[\cot^2 13° - \cot^2 15°] = 2000^2$$

$$h^2 = \frac{2000^2}{\cot^2 13° - \cot^2 15°}$$

$$h = 909.7038482\ldots$$

$$= 910 \text{ (nearest whole)}$$

State Mean: **1.25**

* These solutions have been provided by *projectmaths* and are not supplied or endorsed by BOSTES.

Board of Studies: Notes from the Marking Centre

(c)(i)
Many candidates were able to show that $OA = h\cot 15°$.

A small number of candidates did not provide a solution to this part, some demonstrating a lack of understanding of the notation by writing expressions such as $15° = \cot\left(\frac{OA}{h}\right)$.

(ii)

This part required the use of Pythagoras's theorem with the substitution of some trigonometric ratios, and candidates with good algebra skills executed a correct solution in a few lines.

Common problems were:

- choosing the incorrect triangle; substituting incorrectly into Pythagoras's theorem; misreading which angle was the right angle (it was marked on the diagram); and both poor calculator skills and poor algebraic manipulation.
- using radian mode although the angles were given in degrees.

It was possible to find the correct answer without the direct use of Pythagoras's theorem via utilising trigonometric ratios with all three triangles. Only a small number of candidates were successful using this approach.