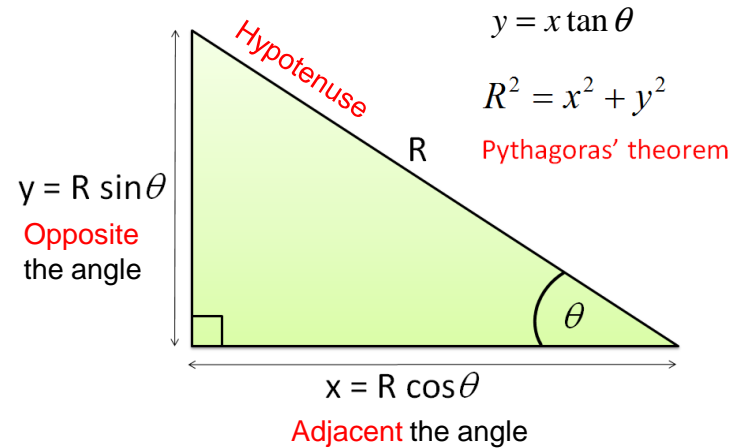


Trigonometry: Sine, Cosine, Tangent as *multipliers*

opposite = hypotenuse $\times \sin \theta$
 adjacent = hypotenuse $\times \cos \theta$
 opposite = adjacent $\times \tan \theta$

Memory aid: **"Opposite goes with SIN"**



Sine, Cosine and Tangent are *functions*. The angle is the *input*, the *output* is the ratio of sides of a right angled triangle.

$$30^\circ \rightarrow \sin \rightarrow \frac{1}{2}$$

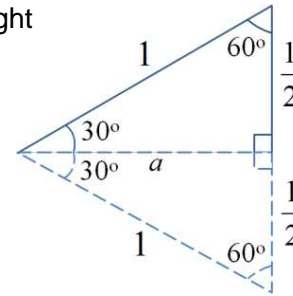
Inverse trigonometric functions

$$\theta = \sin^{-1}\left(\frac{y}{R}\right)$$

$$\theta = \cos^{-1}\left(\frac{x}{R}\right)$$

$$\theta = \tan^{-1}\left(\frac{y}{x}\right)$$

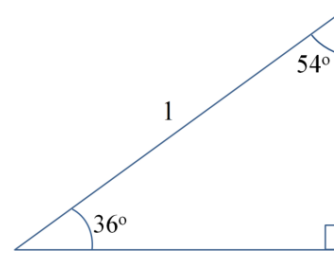
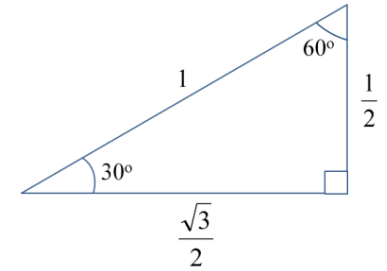
Special triangles



$$1 = a^2 + \left(\frac{1}{2}\right)^2$$

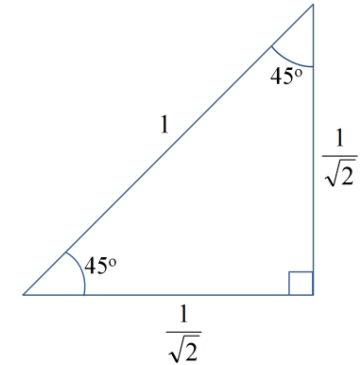
$$\frac{3}{4} = a^2$$

$$\frac{\sqrt{3}}{2} = a$$

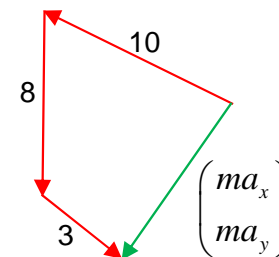
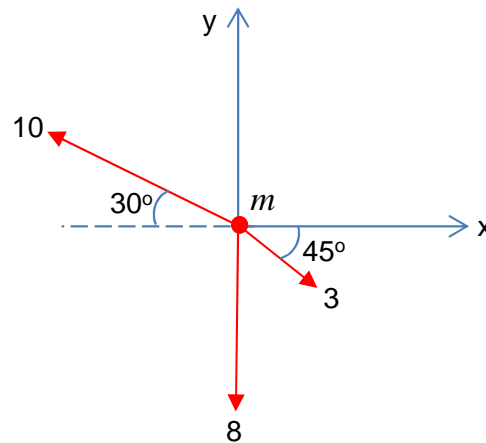


$$\frac{1}{2}\phi = \frac{1 + \sqrt{5}}{4}$$

$$\text{GOLDEN RATIO } \phi = \frac{1 + \sqrt{5}}{2}$$

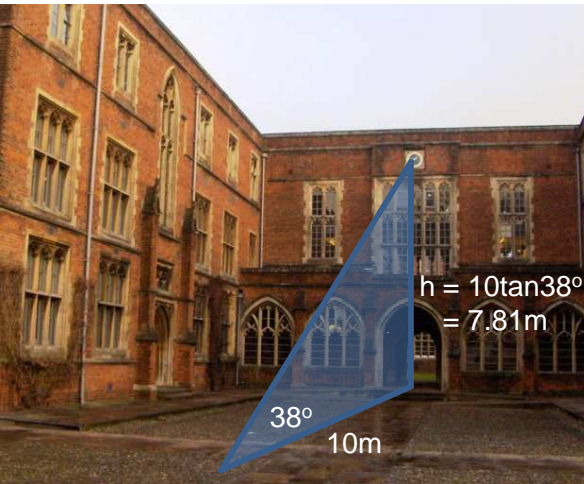


Resolving forces



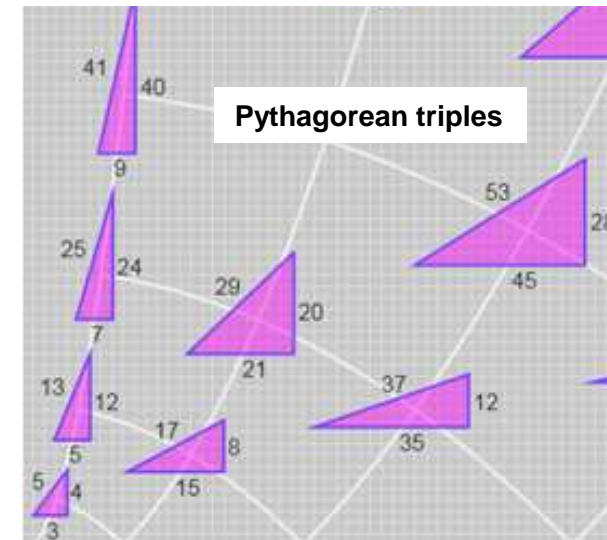
$$\begin{pmatrix} ma_x \\ ma_y \end{pmatrix} = \begin{pmatrix} -10 \cos 30^\circ + 3 \cos 45^\circ \\ 10 \sin 30^\circ - 3 \sin 45^\circ - 8 \end{pmatrix} = \begin{pmatrix} -5\sqrt{3} + \frac{3}{\sqrt{2}} \\ -3 - \frac{3}{\sqrt{2}} \end{pmatrix}$$

Practical applications of trigonometry



Use an angle measuring device, a tape measure and \tan to calculate heights that may be difficult to measure directly

Pythagorean triples



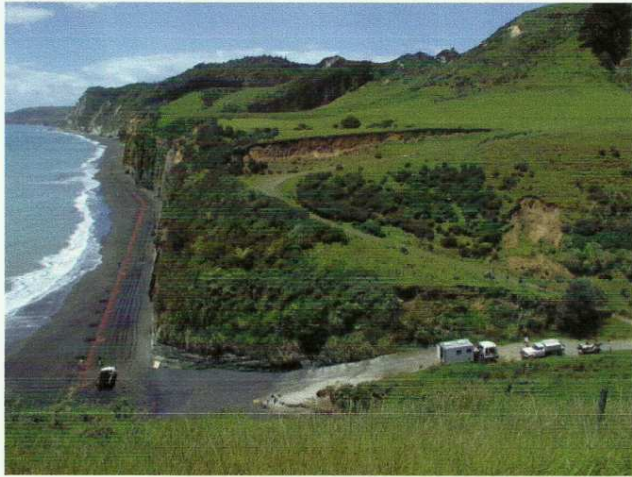


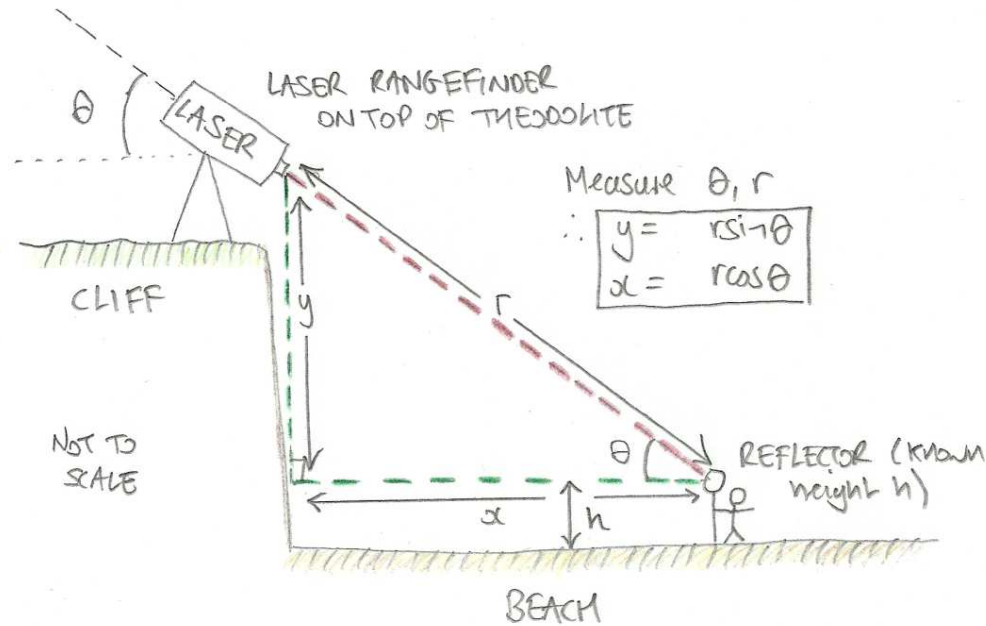
Figure 3.7: Cliff-top view of Pukearuhe beach demonstrating the seismic line and access road along the banks of the Tongaporutu river.



Figure 3.9: Staff mounted prism used to reflect the rangefinding laser.



Figure 3.8: Tripod mounted theodolite and laser rangefinder are used to survey shot and geophone positions.



Height of laser from the beach is $r \sin \theta + h$



Figure 3.10: Global Positioning System (GPS) used to locate a fixed reference point from which all positions were calculated relative to.

Trigonometry was used to determine the positions of *geophones* during a seismic survey of a beach in New Zealand.
(Cambridge University Earth Sciences, 2001).