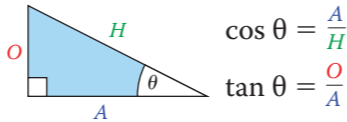


19.3 Trigonometry 2

You can use trigonometric ratios to find angles as well as sides.

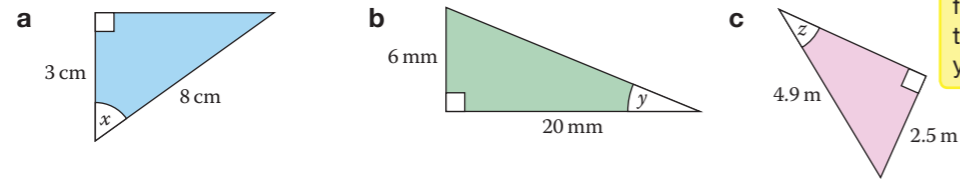
$\sin \theta = \frac{\text{Opposite side}}{\text{Hypotenuse}}$
 $\cos \theta = \frac{\text{Adjacent side}}{\text{Hypotenuse}}$
 $\tan \theta = \frac{\text{Opposite side}}{\text{Adjacent side}}$



$\sin \theta = \frac{O}{H}$
 $\cos \theta = \frac{A}{H}$
 $\tan \theta = \frac{O}{A}$

EXAMPLE

Find the angles marked by letters.



You can subtract from 180° to find the third angle if you need it.

Identify which sides you know.

a $A = 3, H = 8$ **b** $O = 6, A = 20$ **c** $O = 2.5, H = 4.9$

Choose the ratio, substitute values, then write as a decimal.

$\cos x = \frac{3}{8} = 0.375$ $\tan y = \frac{6}{20} = 0.3$ $\sin z = \frac{2.5}{4.9} = 0.5102\dots$

Use the inverse trigonometric function.

$x = \cos^{-1} 0.375 = 68.0^\circ$ (1 dp) $y = \tan^{-1} 0.3 = 16.7^\circ$ (1 dp) $z = \sin^{-1} 0.5102\dots = 30.7^\circ$ (1 dp)

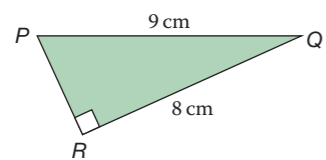
Don't round yet, carry on working on your calculator.



In a right-angled triangle given two sides or one side and one angle you can find all the other sides and angles using trigonometry and Pythagoras theorem.

EXAMPLE

Find the unknown sides and angles in triangle PQR.



If you have time, use the other trigonometric ratios to check your answers.

Use Pythagoras for the third side and trigonometry for an angle.

$PR^2 = 9^2 - 8^2$ $\sin P = \frac{8}{9} = 0.8888\dots$
 $= 81 - 64$ $\angle P = \sin^{-1} 0.8888\dots$
 $= 17$ $= 62.73\dots$
 $PR = \sqrt{17} = 4.123\dots$ $= 62.7^\circ$ (3 sf)
 $= 4.1$ cm (1 dp)

Subtract from 180° to find the third angle.

$\angle Q = 180^\circ - 90^\circ - 62.7^\circ$ Angle sum of a triangle.
 $= 27.3^\circ$ (1 dp)

Check that the smallest angle is opposite the shortest side and the largest angle opposite the longest side.

It is better to use the sides you were given rather than the one you have found.



Exercise 19.3S

- Write these fractions as decimals
 - $\frac{3}{4}$
 - $\frac{9}{10}$
 - $\frac{5}{8}$
 - $\frac{16}{25}$
 - $\frac{6.3}{2.7}$
 - $\frac{120}{290}$
- Find the size of each angle.
 - $\cos A = 0.5$
 - $\sin B = 0.6$
 - $\tan C = 0.43$
 - $\cos D = 0.37$
 - $\sin E = 0.892$
 - $\tan F = 1.645$
- Calculate the size of each angle.
 - $\tan P = \frac{2}{5}$
 - $\sin Q = \frac{37}{50}$
 - $\cos R = \frac{21}{25}$
 - $\sin S = \frac{120}{150}$
 - $\tan T = \frac{7.8}{5.4}$
 - $\cos U = \frac{198}{435}$
- Find the angles marked by letters.
 -
 -
 -
 -
 -
 -
- Calculate all the unknown sides and angles.
 -
 -
 -
 -
- -
- In each part, find the other side and angles of triangle RST.
 - $RS = 7$ cm, $RT = 10$ cm and angle $R = 90^\circ$
 - $RS = 36$ m, $RT = 54$ m and angle $S = 90^\circ$
 - $RS = 3.5$ km, $TS = 1.67$ km and angle $T = 90^\circ$
- PQRS is a rectangle. Calculate
 - QS
 - angle PQS
 - angle PSQ
- The diagonals of kite KLMN intersect at X. $KX = 15$ cm, $XM = 27$ cm and $LN = 24$ cm. Calculate the sides and angles of kite KLMN.
- Calculate
 - all the angles of triangle PQR
 - the distance from P to QR.
- A rhombus has sides of length 10 cm. The length of the longest diagonal is 17 cm. Find
 - the angles of the rhombus
 - the length of the shortest diagonal.
- The 20% on this road sign means the hill down up by 20 metres for every 100 metres in the horizontal direction.
 - Find the angle between the road and the horizontal.
 - How far along the road do you travel as it falls by 20 metres?

