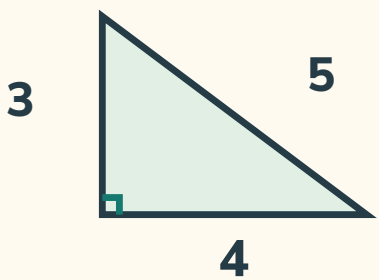
MATHS FIELD GUIDE · GRADE 10

Right-triangle ratios

OPENING PROBLEM

For the acute angle opposite 3, find sine and cosine.



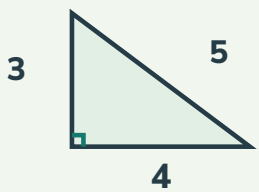
02 Choose the sides for this angle
03 Rules and worked cases
04 From the givens to the answer
05 Rebuild the exact trigonometric values
06 Check your reasoning
07 Check your reasoning

ILLUSTRATED PROBLEM SHEET

Choose the sides for this angle

In a right triangle the hypotenuse stays fixed. Opposite and adjacent swap when the other acute angle is chosen.

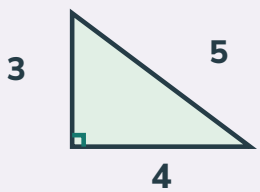
1



For the acute angle opposite 3, find sine and cosine.

sin θ = 3/5 and cos θ = 4/5. The hypotenuse is the denominator in each.

2



Use the angle opposite 4 instead. What happens to tangent?

It becomes 4/3. For the other angle it was 3/4.

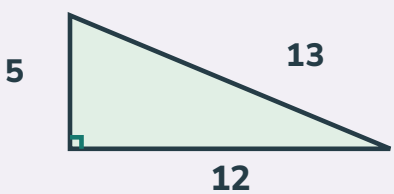
3

$$\sin \theta = 5/13$$
$$\downarrow$$
$$\text{cosec } \theta = 13/5$$

Why does the fraction invert?

Cosecant is hypotenuse over opposite. Its product with sine is one wherever both are defined.

4



Use the triangle to check $\sin^2 \theta + \cos^2 \theta$.

The numerator is 25 + 144 = 169 over 169. The sum is one.

Opposite 5, adjacent 12
tan θ = 5/12.

Same triangle, other acute angle
tan = 12/5.

CHAPTER PROBLEM

A right triangle has opposite 8, adjacent 15, hypotenuse 17 relative to θ. Find sin θ as a fraction.

8/17. Sine is opposite divided by hypotenuse.

MATHS REFERENCE · GRADE 10

Right-triangle ratios

Rules, conditions and worked cases

Recognise the case	Mathematical reasoning
Choose the reference angle	With opposite 5, adjacent 12, hypotenuse 13, sin θ = 5/13 and cos θ = 12/13.
Use tangent	tan θ = 5/12. If a similar triangle has adjacent leg 36, its opposite leg is 15.
Complementary angle	At the other acute angle, opposite and adjacent exchange. Its sine is 12/13.

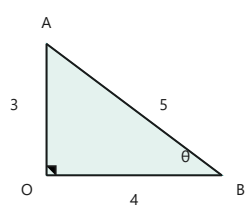
Read the representations

Choose a reference angle before naming the sides

In a right triangle, the hypotenuse is opposite 90°. Relative to acute θ, the opposite leg faces θ and the adjacent leg touches θ.

sin θ = opposite/hypotenuse, cos θ = adjacent/hypotenuse, tan θ = opposite/adjacent.

Right triangles with the same acute angle are similar, so scaling all lengths leaves these ratios unchanged.

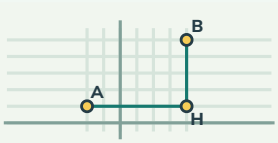


Opposite and adjacent depend on the chosen angle.

A ratio is dimensionless

Convert the lengths to compatible units before dividing. Ratios describe the angle, not the drawing size.

At the other acute angle, opposite and adjacent swap while the hypotenuse stays the same. Do not rename the hypotenuse when the reference angle changes.



A (-2, 1)
H (4, 1)
B (4, 5)

Find the direct distance from A(−2, 1) to B(4, 5).

The legs are 6 and 4. AB = √52 = 2√13. The broken route via H is 10 units.

WORKED EXAMPLES

From the givens to the answer

Find three ratios from legs 9 and 12

1. The hypotenuse is 15 by Pythagoras. For θ opposite 9, sin θ = 9/15 = 3/5.
2. cos θ = 12/15 = 4/5 and tan θ = 9/12 = 3/4.
3. For the complementary angle, sine and cosine exchange their values.

A known ratio determines a missing side

1. For acute θ, sin θ = 5/13 and hypotenuse = 26 cm.
2. Opposite = 26 × 5/13 = 10 cm.
3. The adjacent leg is $\sqrt{(26^2-10^2)}=24$ cm; check cos θ=12/13.

Is the adjacent side always the horizontal one?

1. Adjacent is defined relative to the selected angle.
2. Rotating a triangle changes its page orientation, not its trigonometric ratios.
3. Locate the reference angle and the right angle before labelling sides.

Check another case

Example 1

Relative to θ, the adjacent leg is 48 and hypotenuse 50. Find cos θ.

48/50

Cosine is adjacent divided by hypotenuse.

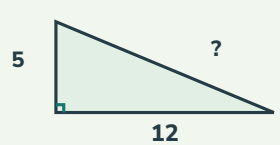
Example 2

With opposite 15 and adjacent 36, which is tan θ?

15/36 · 36/15 · 15/39 · 36/39

15/36

Tangent uses the two legs.



A right triangle has legs 5 and 12. How long is its hypotenuse?

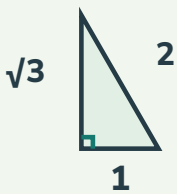
$5^2 + 12^2 = 169$, so the longest side is 13.

ILLUSTRATED PROBLEM SHEET

Rebuild the exact trigonometric values

Use half an equilateral triangle or half a square. At 0° and 90° use unit-circle coordinates.

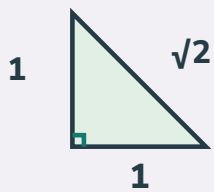
1



Which acute angle faces the short leg?

30°. Thus sin 30° = 1/2 and cos 30° = √3/2.

2



Why is tan 45° exactly one?

The legs match. Sine and cosine each equal 1/√2.

3

θ	0°	90°
cos θ	1	0
sin θ	0	1

At which endpoint does tan θ fail?

At 90°. Cosine is zero, so the quotient sine/cosine is undefined.

4

$$\theta = 60°$$
$$\downarrow$$
$$\sin^2\theta = 3/4$$
$$\downarrow$$
$$\cos^2\theta = 1/4$$

Check the identity at an exact angle.

Three quarters plus one quarter equals one. The individual ratios are square roots of these values.

sin 30° equals cos 60°
both 1/2.

sin 60° equals cos 30°
both √3/2.

CHAPTER PROBLEM

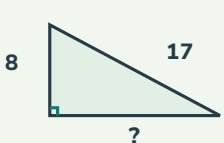
Relative to θ, the adjacent leg is 24 and hypotenuse 25. Find cos θ.

24/25. Cosine is adjacent divided by hypotenuse.

QUESTION BANK · FOLD OR COVER THE RIGHT COLUMN

Check your reasoning

Try the problem	Solution and reasoning
01 Could 7/5 be the sine of an acute angle?	No. Its opposite side would exceed the hypotenuse. A reciprocal ratio such as cosecant can exceed one.
02 Is cosec 0° equal to zero?	No. It is 1/sin 0°, so the denominator is zero and it is undefined.
03 With opposite 16 and adjacent 30, which is tan θ? A) 16/30 B) 30/16 C) 16/34 D) 30/34	16/30 Tangent uses the two legs.
04 In a right triangle with hypotenuse 50, which statement is true? A) The hypotenuse stays the same when the acute reference angle changes B) The hypotenuse becomes adjacent instead C) The hypotenuse is always vertical D) Both legs become hypotenuses	The hypotenuse stays the same when the acute reference angle changes The right angle uniquely identifies the hypotenuse.
05 For sin θ = 15/39, the hypotenuse is 78. Find the opposite side.	30 Multiply the ratio by the hypotenuse.
06 A right triangle has legs 5 and 12. Find its hypotenuse. 	13 Square the legs and add: $5^2 + 12^2 = 169$. The hypotenuse is the positive square root.



The hypotenuse is 17 and one leg is 8. Recover the other leg.

Subtract squares: 289 − 64 = 225. The missing positive length is 15.

QUESTION BANK · FOLD OR COVER THE RIGHT COLUMN

Check your reasoning

Try the problem	Solution and reasoning
07 Explain why doubling sides 8,15,17 leaves sin θ unchanged.	The opposite and hypotenuse both double. Their common factor cancels. Similarity preserves the acute angle and its ratio.
08 A learner writes cos θ = 7/25 when 7 is opposite θ. Correct the side choice.	The given fraction is sine. Cosine needs adjacent 24 over hypotenuse 25. The corrected cosine is 24/25.
09 A right triangle has opposite 7, adjacent 24, hypotenuse 25 relative to θ. Find sin θ as a fraction.	7/25 Sine is opposite divided by hypotenuse.
10 Relative to θ, the adjacent leg is 24 and hypotenuse 26. Find cos θ.	24/26 The cosine is adjacent divided by hypotenuse: 24/26 simplifies to 12/13.
11 A right triangle has opposite 16, adjacent 30, hypotenuse 34 relative to θ. Find sin θ as a fraction.	16/34 Sine is opposite divided by hypotenuse.

$7^2 + 24^2$
↓
$49 + 576 = 625$
↓
25^2

Can sides 7, 24 and 25 make a right triangle?

Yes. The converse places the right angle opposite the longest side, 25.

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