

Similar Triangles and Trigonometry Review

Try each problem first. You don't need to finish everything.

Core path ~55 min · Full sheet ~1 h 45 min

Recommended: K1-K5, then one A and one T problem

K = Knowledge & Understanding · A = Application · T = Thinking · Boss = Challenge



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QUICK REFERENCE

Similar triangles: equal corresponding angles and proportional corresponding sides. Match sides by vertex order: in $\triangle ABC \sim \triangle DEF$, AB goes with DE , whatever the triangles' positions on the page.

SOH CAH TOA: $\sin \theta = \frac{\text{opp}}{\text{hyp}}$, $\cos \theta = \frac{\text{adj}}{\text{hyp}}$, $\tan \theta = \frac{\text{opp}}{\text{adj}}$. Opposite and adjacent depend on which angle you use. Angles of elevation and depression are measured from the **horizontal**.

Calculator in **degree** mode. Round lengths to one decimal place and angles to the nearest tenth of a degree unless told otherwise.

Show your work on separate paper.

Core Skills (K)

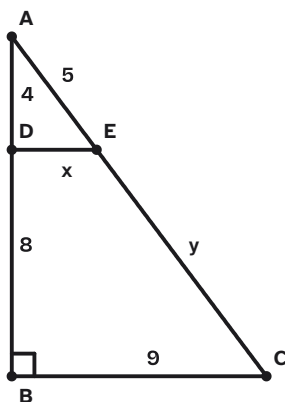
Similarity · Proportions · Trig Ratios · Solving Right Triangles

K1 Similar or Not?

- Two triangles both have angles 30° , 60° and 90° . One has a hypotenuse of 10 cm, the other 14 cm. State whether they are congruent, similar but not congruent, or neither.
- Determine whether a triangle with sides 6, 8 and 10 is similar to a triangle with sides 9, 11 and 13.
- $\triangle ABC \sim \triangle DEF$ with $AB = 6$ cm and $DE = 9$ cm. The area of $\triangle ABC$ is 20 cm^2 . Find the scale factor from $\triangle ABC$ to $\triangle DEF$, and the area of $\triangle DEF$.

K2 Proportions

In the diagram, $DE \parallel BC$. Parts (a) and (b) refer to the diagram.



- Find x .
- Find y .

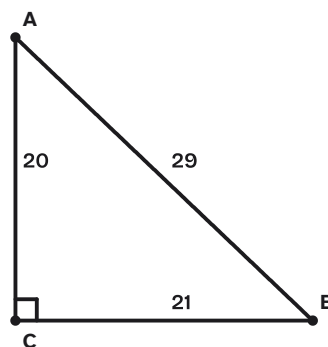
Scale factor k : lengths multiply by k , areas multiply by k^2 .

$\sin^{-1} x$ is the angle whose sine is x . It is **not** $\frac{1}{\sin x}$. If the unknown is in the denominator, $\cos 40^\circ = \frac{12}{x}$ gives $x = \frac{12}{\cos 40^\circ}$.

- $\triangle PQR \sim \triangle STU$ with $PQ = 8$, $QR = 12$, $PR = 14$ and $ST = 6$. Find TU and SU .

K3 Name the Ratios

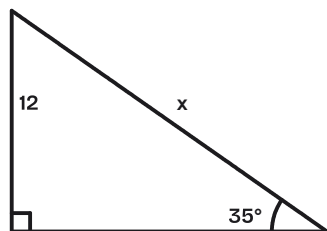
Parts (a) and (b) refer to right triangle ABC .



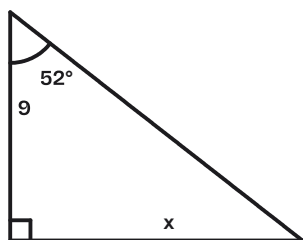
- State $\sin A$, $\cos A$ and $\tan A$ as fractions.
- State $\sin B$, $\cos B$ and $\tan B$ as fractions.
- In another right triangle, the side opposite θ is 9 cm and the hypotenuse is 15 cm. Determine $\tan \theta$ as a fraction in lowest terms.

K4 Missing Sides and Angles

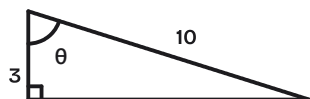
- a) Find
- x
- .



- b) Find
- x
- .



- c) Find
- θ
- .

**K5 Solve the Triangle**

In $\triangle PQR$, $\angle Q = 90^\circ$, $PQ = 9$ cm and $PR = 41$ cm.

- Determine QR .
- Determine $\angle P$.
- Determine $\angle R$.

Real World (A)

Indirect Measurement · Angles of Depression · Ramps

A1 Shadow Survey

At 3 p.m. on a sunny day in a Kingston park, a student measures heights and shadow lengths.

Object	Student	Flagpole	Lamp post
Height (m)	1.6	?	4.8
Shadow (m)	2.4	13.5	?

- Find the height of the flagpole.
- Find the length of the lamp post's shadow.

- At 5 p.m. the student's shadow is 4.0 m and the flagpole's is 22.5 m. A classmate multiplies 22.5 by the 3 p.m. ratio $\frac{1.6}{2.4}$ and claims the flagpole is 15 m tall. Is the classmate right? Give the flagpole's height.

A2 Lighthouse Watch

From the top of a lighthouse on Georgian Bay, 32 m above the water, a keeper sees a sailboat at an angle of depression of 14° .

- Find the horizontal distance from the base of the lighthouse to the boat, to the nearest metre.
- A few minutes later, the angle of depression is 22° . How far did the boat travel toward the lighthouse, to the nearest metre?
- The keeper wants the distance to a boat seen at an angle of depression of 0° . What happens in your calculation, and what does it mean for the boat?

A3 Accessible Ramp

A school's front door is 0.75 m above the sidewalk. A local accessibility guideline says a wheelchair ramp may rise at most 1 m for every 12 m of horizontal run (a slope of 1:12).

- Find the shortest horizontal run allowed, and the angle of inclination of that ramp.
- A contractor proposes a straight ramp inclined at 8° . Find the length of the ramp surface, and decide whether it meets the guideline.
- Only 6 m of sidewalk lies between the door and the street. Can a straight ramp that meets the guideline fit? What could the builder do instead?

Think It Through (π)

Error Analysis · Counterexample · Explain Why · Build a Triangle

T1 Spot the Flaw

In right triangle ABC , $\angle C = 90^\circ$, $\angle A = 38^\circ$, $AC = 15$ cm and $AB = x$. A student writes:

$$" \cos 38^\circ = \frac{15}{x}, \text{ so } x = 15 \cos 38^\circ \approx 11.8 \text{ cm. } "$$

- Without redoing the calculation, explain how you can tell that 11.8 cm is wrong.
- Identify the error and find x .
- The student then writes: " $\sin \theta = 0.6$, so $\theta = \frac{1}{\sin 0.6}$." Explain the error and find θ .

T2 Same Angle, Same Ratio

- A student claims: "All right triangles are similar, because they all have a 90° angle." Give a counterexample.

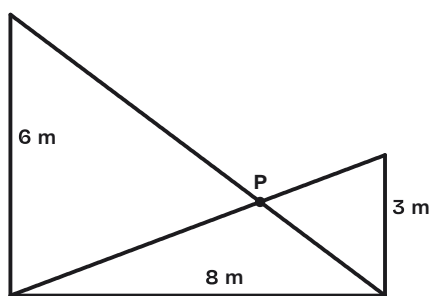
- b) $\triangle ABC$ and $\triangle DEF$ have $\angle C = \angle F = 90^\circ$ and $\angle A = \angle D = 32^\circ$, with $AB = 5$ cm and $DE = 12$ cm. Without a calculator, explain why $\frac{BC}{AB} = \frac{EF}{DE}$, and name this ratio.
- c) Design a right triangle with a hypotenuse of 10 cm in which $\sin A = \cos A$. Give its other two side lengths and $\angle A$.

Boss Level

Optional challenge

Crossed Wires

Two vertical poles stand on level ground. A wire runs from the top of each pole to the base of the other, and the wires cross at P .



- a) The poles are 6 m and 3 m tall and stand 8 m apart. Find the height of P above the ground.
- b) The same poles are moved so they stand 20 m apart. Find the new height of P .
- c) A 10 m pole and a second pole give a crossing height of 4 m. Find the height of the second pole.



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