

# Trigonometry and Metric Relations

Name: \_\_\_\_\_

Date: \_\_\_\_\_

## Concepts

- Finding the Area of a Triangle Using Trigonometry
- Metric Relations in a Right Triangle
- The Area of Triangles Using Heron's Formula
- The Law of Cosines
- The Law of Sines
- The Trigonometric Ratio of Cosine
- The Trigonometric Ratio of Sine
- The Trigonometric Ratio of Tangent
- Trigonometric Ratios
- Trigonometry and Metric Relations (theory)

## Finding the Area of a Triangle Using Trigonometry

1. A climbing gym builds a triangular hold panel. Two of its edges measure 8.4 m and 6.5 m, and the angle between those two edges is  $52^\circ$ . Find the area of the panel, to the nearest hundredth of a square metre.

## Metric Relations in a Right Triangle

2. In triangle  $ABC$  the right angle is at  $A$ , and  $AH$  is the altitude drawn from  $A$  to the hypotenuse  $\overline{BC}$ . The foot  $H$  divides the hypotenuse so that  $BH = 4$  cm and  $HC = 9$  cm.

- Find  $AH$ .
- Find  $AB$  and  $AC$ , in exact form and to the nearest hundredth.

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**The Area of Triangles Using Heron's Formula**

- 3.** A city plants a triangular strip of wildflowers between three bike paths. Its sides measure 13 m, 14 m and 15 m. Find the exact area of the strip.

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**The Law of Cosines**

- 4.** Two hiking trails leave the same lodge in straight lines that form an angle of  $68^\circ$ . One trail ends at a waterfall 3.2 km from the lodge, the other at a lookout 4.5 km from the lodge. How far apart are the waterfall and the lookout, to the nearest hundredth of a kilometre?

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**The Law of Sines**

- 5.** A canoe race uses three buoys  $D$ ,  $E$  and  $F$ . At buoy  $D$  the course turns through an interior angle of  $41^\circ$ , and at buoy  $E$  the interior angle is  $76^\circ$ . The leg opposite  $D$  measures 9.0 km. Find the length of the leg opposite  $E$ , to the nearest hundredth of a kilometre.

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**The Trigonometric Ratio of Cosine**

- 6.** A stage-lighting truss is held by a straight cable 6.0 m long, anchored to the floor. The cable makes an angle of  $71^\circ$  with the floor. How far from the foot of the truss is the anchor point, to the nearest hundredth of a metre?

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**The Trigonometric Ratio of Sine**

7. A straight conveyor belt in a grain elevator is 14.5 m long and is inclined at  $23^\circ$  to the horizontal floor. How high above the floor is its upper end, to the nearest hundredth of a metre?

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**The Trigonometric Ratio of Tangent**

8. Standing on level ground 45 m from the base of a grain silo, a farmer measures the angle of elevation of the top of the silo as  $38^\circ$ . Find the height of the silo, to the nearest hundredth of a metre.

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**Trigonometric Ratios**

9. In right triangle  $KLM$  the right angle is at  $L$ ,  $KL = 8$ ,  $LM = 15$  and  $KM = 17$ . Write  $\sin M$ ,  $\cos M$  and  $\tan M$  as fractions in lowest terms.

**Trigonometry and Metric Relations**

**10.** For each situation below, name the single tool from this topic that solves it most directly — a trigonometric ratio, a metric relation in a right triangle, the law of sines, the law of cosines, Heron's formula, or the formula  $A = \frac{1}{2}ab \sin C$  — and justify your choice in one sentence.

- a) The three sides of a triangle are known and one of its angles is wanted.
- b) The three sides of a triangle are known and its area is wanted.
- c) Two angles and one side of a triangle are known and another side is wanted.
- d) In a right triangle, the altitude to the hypotenuse and one of the two segments it creates are known; the other segment is wanted.
- e) Two sides of a triangle and the angle between them are known and the area is wanted.

**Synthesis — drawing on several sheets in this topic**

**11.** A community group is building a triangular outdoor skating rink  $ABC$ . The board along  $\overline{AB}$  measures 26 m, the board along  $\overline{AC}$  measures 34 m, and the corner at  $A$  measures  $58^\circ$ .

- a) Find the length of the third board,  $\overline{BC}$ , to the nearest hundredth of a metre.
- b) Find the ice surface area, to the nearest hundredth of a square metre.
- c) A water hose is mounted at corner  $A$ . Determine the shortest length of hose that reaches the board  $\overline{BC}$ , to the nearest hundredth of a metre.

**Want the harder problems and the worked solutions?**

The *Challenge Problems* set and the *Answer Keys* for Trigonometry and Metric Relations — with the reasoning written out in full — are available at [tutorinmontreal.ca](http://tutorinmontreal.ca).