7.4 The Tangent Ratio

NEW SKILLS: WORKING WITH THE TANGENT RATIO TO SOLVE TRIANGLES

tangent ratio: in a right triangle, the ratio of the length of the side opposite a given angle to the length of the side adjacent to the angle

(abbreviated as tan)

You have studied two trigonometric ratios, the sine ratio and the cosine ratio. The third trigonometric ratio is the **tangent ratio.**

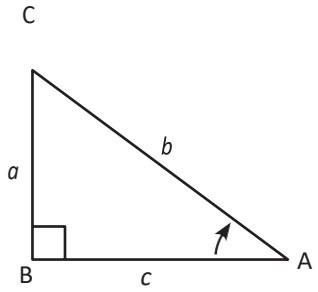
The tangent ratio is defined as the ratio of the side opposite an acute angle of a right triangle to the side adjacent the angle. For angle A, the ratio can be stated as follows.

$$\text{tangent } \angle A = \frac{\text{length of side opposite } \angle A}{\text{length of side adjacent to } \angle A}$$

tangent

This can be abbreviated as the following ratio.

$$\tan A = \frac{\text{opp}}{\text{adj}}$$



For triangle ABC, the tangent of angle A can be stated as follows.

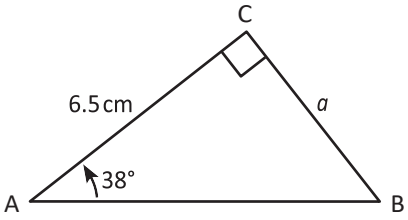
$$\tan A = \frac{a}{c}$$

For more details, see page 301 of *MathWorks 10.*

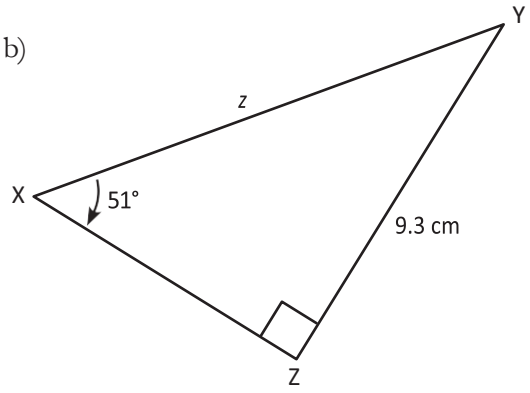
Example 1

Find the indicated side of each triangle.

a)



b)



SOLUTION

a) Use the tangent ratio to solve for a.

$$\tan A = \frac{\text{opp}}{\text{adj}}$$

$$\tan 38° = \frac{a}{6.5}$$ Substitute the known values.

$$6.5 \tan 38° = \frac{a}{6.5} \times 6.5$$ Multiply both sides by tan 6.5 to isolate a.

$$6.5 \tan 38° = a$$

$$5.08 \approx a$$

Side a is approximately 5.1 centimetres long.

b) Use the tangent ratio to solve for z.

$$\tan X = \frac{\text{opp}}{\text{adj}}$$

$$\tan 51° = \frac{9.3}{z}$$ Substitute the known values.

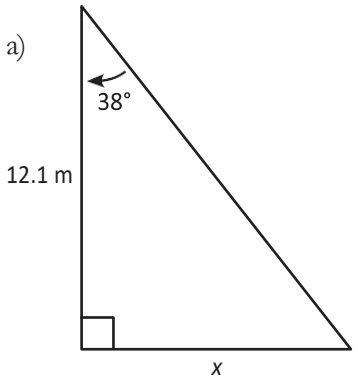
$z \approx$ _____

Side z is approximately _____centimetres long.

BUILD YOUR SKILL

1. Find the length of the indicated sides of the triangles.

a)



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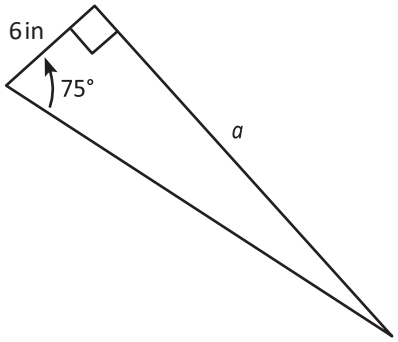
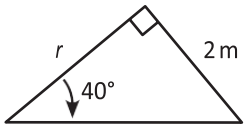
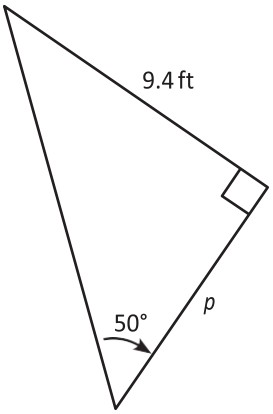


c)

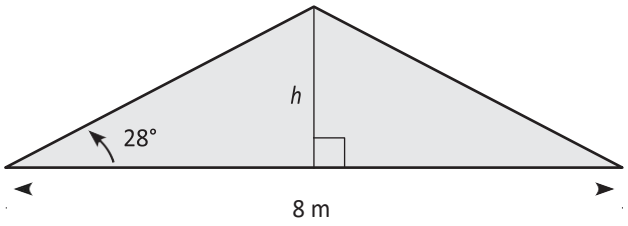


d)



2. The angle of depression to a boat from the top of a 150-metre cliff is 20°. How far is the boat from the base of the cliff?

3. When sand is piled onto a flat surface, it forms a cone. If the pile is 8 m wide, and the angle between the ground and the slope of the pile is 28°, what is the height of the pile?



PRACTISE YOUR NEW SKILLS

1. A 1.7-metre tall man stands 12 m from the base of a tree. He views the top of the tree at an angle of elevation of 58°. How tall is the tree?

2. Two buildings are 18.5 metres apart. The angle of elevation from the top of one building to the top of the other is 18°. If the taller building is 15 metres tall, how tall is the shorter building?

3. How far from the base of the house is the foot of a ladder if the angle of elevation is 70° and it reaches 15 feet up the side of the house?

4. About how tall is a tower if the angle of depression from its top to a point 75 metres from the base is 62°?

5. A rafter's angle of elevation with the horizontal is 25°. How far from the corner could a 6-foot man stand up straight?

6. Determine the distance, AB, across the river, given the following measurements.