Course: MFM2P Gr. 10 Applied **Lesson: 10**

Unit: Right Triangle Trigonometry **Topic: Sine and Cosine Ratio in Right Triangles**

- ***homework check:*** **FM10 p. 59 #1 – 8, 10 – 12**

- ***note:*** **Sine and Cosine Ratio in Right Triangles**

The sine and cosine ratios in a right triangle allow us to determine any missing angle measures. The sine ratio compares the length of the opposite side to the hypotenuse side

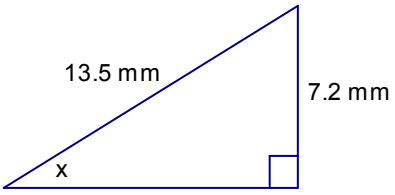
$$\sin x = \frac{length\ of\ opposite\ side}{length\ of\ hypotenuse\ side}$$

The cosine ratio compares the length of the adjacent side to the hypotenuse side.

$$\cos x = \frac{length\ of\ adjacent\ side}{length\ of\ hypotenuse\ side}$$

Whenever we use the ratios to find an angle, we rely on our scientific calculator and the inverse operation. For example, find the unknown angle:

a)



Step 1: identify sides
Step 2: identify ratio
Step3: solve for unknown angle

$$\sin x = \frac{opposite}{hypotenuse}$$

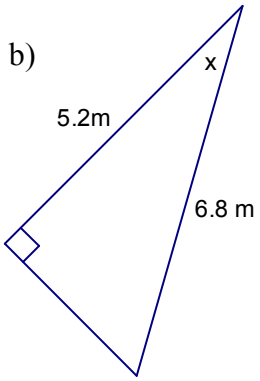
$$\sin x = \frac{7.2}{13.5}$$

$$\sin x = 0.5333$$

$$x = \sin^{-1} 0.5333$$

$$x = 32.2°$$

b)



Step 1: identify sides
Step 2: identify ratio
Step3: solve for unknown angle

$$\cos x = \frac{adjacent}{hyporenuse}$$

$$\cos x = \frac{5.2}{6.8}$$

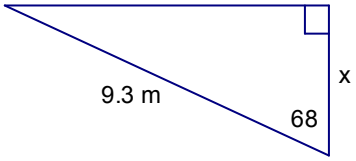
$$\cos x = 0.7647$$

$$x = \cos^{-1} 0.7647$$

$$x = 40.1°$$

These same ratios can also be used with an angle to find a missing side. For example,

a)



Step 1: identify sides
Step 2: identify ratio
Step3: solve for unknown side

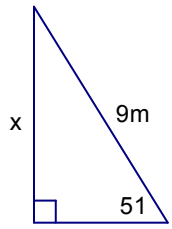
$$\cos x = \frac{adjacent}{hypotenuse}$$

$$\cos 68 = \frac{x}{9.3}$$

$$9.3 \cos 68 = x$$

$$x = 3.5m$$

b)



Step 1: identify sides
Step 2: identify ratio
Step3: solve for unknown side

$$\sin x = \frac{opposite}{hypotenuse}$$

$$\sin 51 = \frac{x}{9}$$

$$9 \sin 51 = x$$

$$x = 7.0m$$

- ***homework assignment:*** **<u>FM10</u> p. 71 #1 – 6, 8 – 12**

Discuss the Concepts

D1. Explain why the value of the sine ratio depends on the angle and not on the size of the right triangle.

D2. Does the value of the cosine ratio depend on the size of the right triangle? If it does, explain why, and if it does not, explain why not.

D3. Explain how to use the sine ratio to find the length of a side of a right triangle.

D4. Explain how to use the cosine ratio to find the measure of an angle in a right triangle.

Practise the Concepts A

For help with question 1, refer to Example 1.

1. Use a scientific calculator to find each value to four decimal places.

a) sin 42° **b)** sin 33° **c)** cos 19°
d) sin 88° **e)** cos 74° **f)** cos 38°
g) sin 45° **h)** cos 42°

2. Use a scientific calculator to find the measure of each angle A to the nearest degree.

a) $\sin A = 0.6092$ **b)** $\cos A = 0.4067$ **c)** $\sin A = 0.1425$
d) $\sin A = 0.7777$ **e)** $\cos A = 0.3907$ **f)** $\sin A = 0.2861$
g) $\cos A = 0.5736$ **h)** $\cos A = 0.7193$

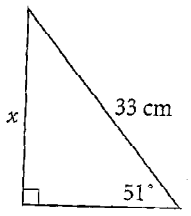
For help with questions 3 and 4, refer to Examples 1 and 2.

Math Connect

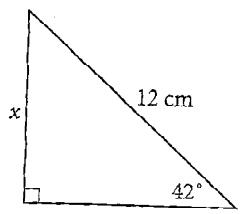
Geoscientists use their understanding of angles and their ability to manipulate trigonometric expressions in coastal geology, mineralogy, and geologic mapping.

3. Find x to the nearest tenth of a centimetre.

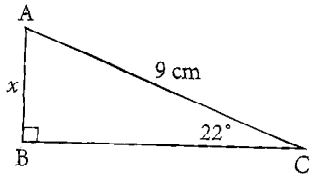
a)



b)



4. Find the length of side AB, to one decimal place, in $\triangle ABC$.

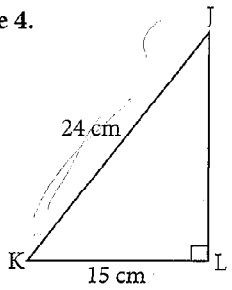


For help with question 5, refer to Example 3.

5. In $\triangle XYZ$, $\angle X = 90°$, $\angle Z = 51°$ and XY = 15 cm. Find the length YZ.

For help with question 6, refer to Example 4.

6. Find the measure of angle K to the nearest degree.

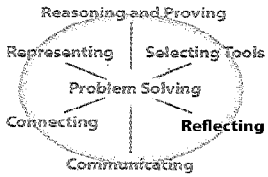


Apply the Concepts B

7. In $\triangle DEF$, $\angle E$ is a right angle and length DF is 13.4 cm. If $\angle F$ is 33°, what is the length of DE, to the nearest tenth of a centimetre?

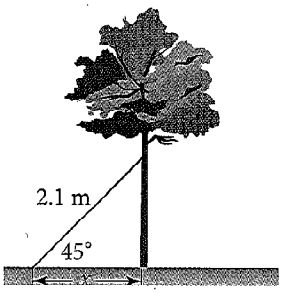
8. A 5-m-long ladder is leaning up against the side of a barn. It reaches 4.2 m up the side of the barn wall. Find the angle the ladder makes with the ground.

9. Ron is building a skateboard ramp for his granddaughter Alexis. Ron wants the ramp to rise at an angle of 12°. If he also wants the ramp to rise vertically 0.5 m how long will the ramp need to be?



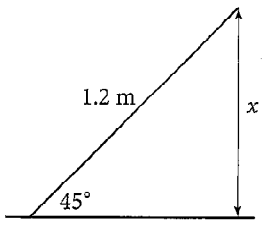
10. A custodian secures a ladder of length 10 m against the side of the school. The ladder makes an angle of 70° with the ground. Will the custodian be able to reach a window that is 7.5 m above the ground? Justify your answer.

11. Hannah wants to make a lean-to shelter against a tree. She starts with a plank that is 2.1 m long. If she wants to have a 45° angle between the ground and the lower end of the plank, how far away from the base of the tree should the lower end of the lean-to be?



Chapter Problem

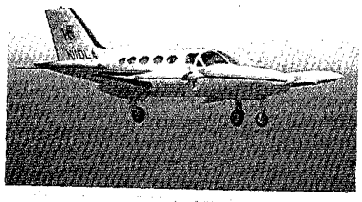
12. Jeff will use right triangles in his design for the elevator to take resort guests down the cliff. He plans to have an angle of 45°, and a diagonal length of 1.2 m. How long will the vertical piece for this part of the elevator be?



Literacy Connect

13. Explain how the sine and cosine ratios are related.

14. Hugo has his own small plane. He is planning his approach to the Kingston airport. He wants to descend at an angle of 22° from horizontal. If he starts his descent at an altitude of 10 000 ft, how long is his glide path to the runway?



Achievement Check

15. The Canadian Standards Association states that the angle between a ladder and the ground must be between 70° and 80° for safety.

a) If you have a 6-m ladder, find the maximum and minimum heights the ladder can reach.

b) A 12-m ladder is leaning against a building so that it reaches a height of 11.5 m. Is this ladder positioned safely according to the Canadian Standards Association? Explain.

c) Compare your answers to parts a) and b). Can you solve part b) without using trigonometry, by using the answer to part a)? Explain.

Extend the Concepts

16. The hypotenuse of a right triangle is 17.9 cm long.

a) How long is the side opposite an angle that measures 27°, to the nearest tenth of a centimetre?

b) What is the measure of the third angle in this triangle?

c) How long is the side opposite the angle found in part b), to the nearest tenth of a centimetre?

17. a) If an isosceles triangle has base angles that measure 50°, and the height of the triangle is 3.2 cm, how long are the equal sides, to the nearest tenth of a centimetre?

b) Confirm your answer to part a) by constructing this isosceles triangle.

18. Construct an isosceles triangle with equal sides 6 cm long and base 9 cm long. What is the measure of each base angle, to the nearest degree?