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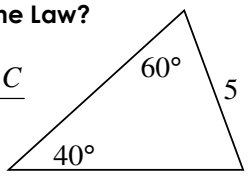
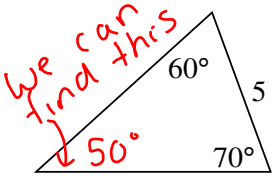
Lesson 1.7 – Applications of Trigonometry

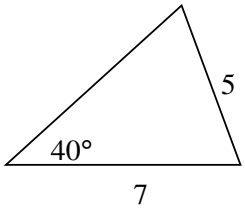
- Learning Goal: I can solve problems involving non-right triangles

- **When can we use Sine Law?**

$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$





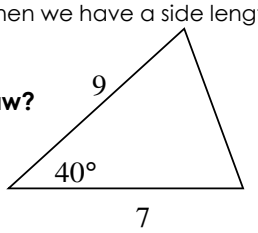


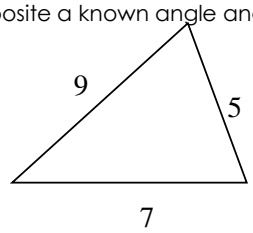
The Sine Law can be used when we have a side length opposite a known angle and another side length or angle

- **When can we use Cosine Law?**

$$a^2 = b^2 + c^2 - 2bc\cos A$$

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$$



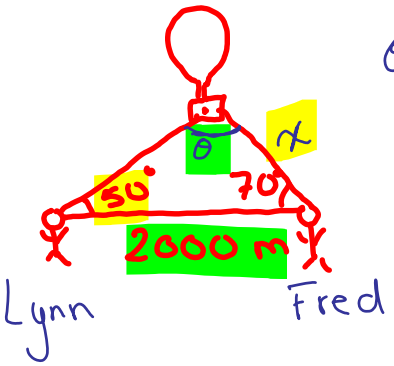


The Cosine Law can be used when we have a contained angle or all three side lengths

Keys to solving word problems

1) Read the problem carefully
2) **Sketch a diagram** and record your known measurements in the appropriate places.
3) Identify unknown.
4) Use triangle relationships to determine the unknown measures.

Example 1: Lynn and Fred, standing 2 000 metres apart, spotted a hot air balloon at angles of elevation of 50° and 70° respectively. The hot air balloon is located between them. What is the distance from Fred directly to the hot air balloon? Show your work.



$\theta = 180° - 50° - 70°$
$= 60°$

$$\frac{\sin A}{a} = \frac{\sin B}{b} \quad \text{or} \quad \frac{a}{\sin A} = \frac{b}{\sin B}$$

$$\frac{x}{\sin 50°} = \frac{2000\text{m}}{\sin 60°}$$

$$x \sin 60° = 2000 \sin 50°$$

$$x = \frac{2000 \sin 50°}{\sin 60°}$$

$$= 1769\text{ m}$$

∴ Fred is 1769 m away from the hot air balloon.

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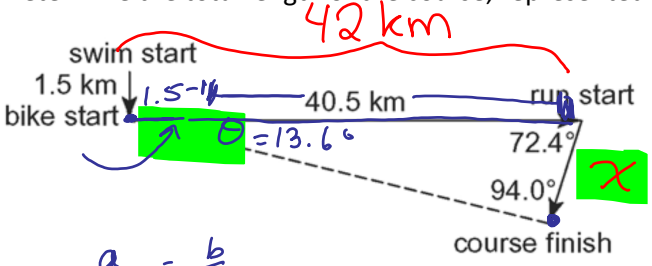
Example 2: A triathlon is an event that has competitors swim, run, and bicycle over a set course. The organizers of a triathlon wish to know the total length of the course and took the measurements shown. Determine the total length of the course, represented in the diagram by the arrows.



$\theta = 180° - 72.4° - 94.0°$

$= 13.6°$

$\frac{a}{\sin A} = \frac{b}{\sin B}$

$\frac{x}{\sin 13.6°} = \frac{42}{\sin 94.0°}$

$x \sin 94.0° = 42 \sin 13.6°$

$x = \frac{42 \sin 13.6}{\sin 94.0°}$

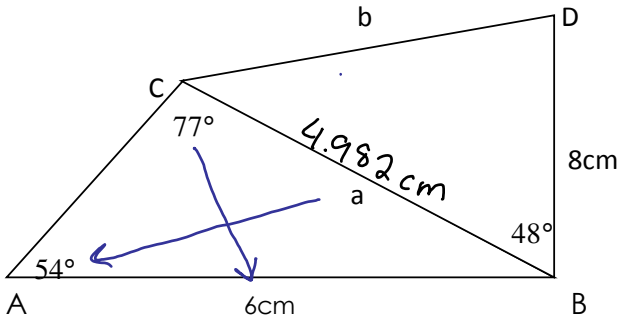
$= 9.9 \text{ km}$

Total length $= 1.5 \text{km} + 40.5 \text{km} + 9.9 \text{km}$

$= 51.9 \text{ km}$

∴ The course is 51.9 km long.

Example 3: Determine lengths a and b



$\frac{a}{\sin 54°} = \frac{6}{\sin 77°}$

$a \sin 77° = 6 \sin 54°$

$a = \frac{6 \sin 54°}{\sin 77°}$

$a = 4.982 \text{ cm}$

$a^2 = b^2 + c^2 - 2bc \cos A$

$b^2 = 4.982^2 + 8^2 - 2(4.982)(8) \cos 48°$

$b^2 = 88.8203 - 53.3377$

$b^2 = 35.48256$

$b = \sqrt{35.48256}$

$= 5.957 \text{ cm}$