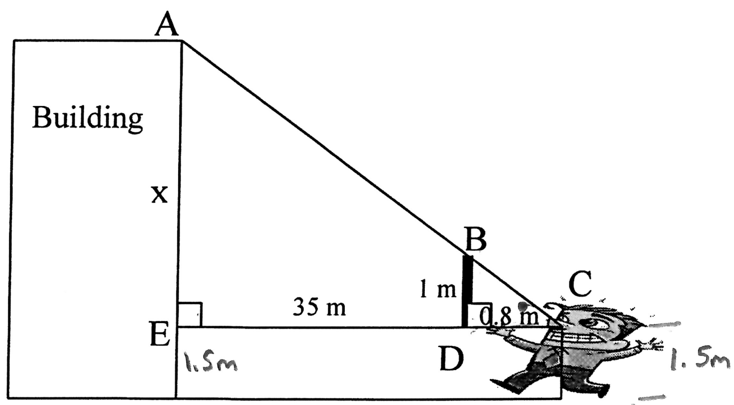
Estimating the Height of Tall Objects Using Similar Triangles

Similar triangles can be used to measure the height of objects without climbing them by using any of these three methods:

1. The Ruler Stick Method
2. The Shadow Method
3. The Mirror Method

1. A Lourdes student holds a metre stick 0.8 m in front of his eyes and walks backwards away from a building until the top of the metre stick lines up with the top of the building. The metre stick is 35 m from the front wall of the building. What is the height of the building if the student's eye level is 1.5 m above the ground?



Since $\angle CDB = \angle CEA$ (90°)

$\angle ACE = \angle BCD$ (common)

then $\triangle AEC \sim \triangle BDC$ (AA~)

Since $\triangle AEC \sim \triangle BDC$

then $AE : EC : CA = BD : DC : CB$

$x : 35.8 : CA = 1 : 0.8 : CB$

$$\frac{x}{1} = \frac{35.8}{0.8} = \frac{\cancel{C}A}{\cancel{C}B}$$

$$\frac{0.8x}{0.8} = \frac{35.8}{0.8}$$

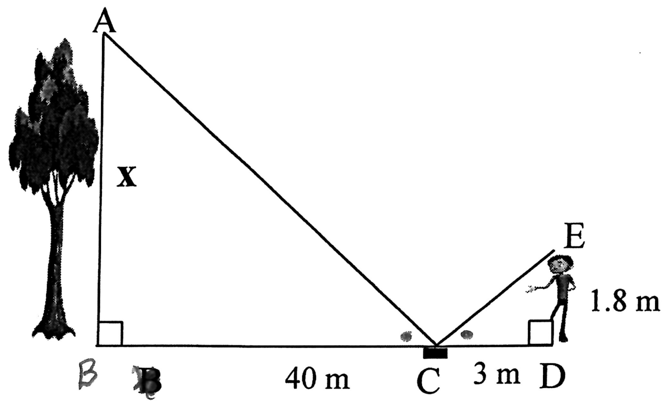
$x = 44.75\text{m}$

height $= x + 1.5$

$= 44.75 + 1.5$

$= 46.25\text{m}$

2. Maxwell walks backwards 40 m from the base of a tree and places a mirror on the ground. He then continues to walk backwards looking down towards the mirror until he can see the top of the tree. Maxwell's eye level is 1.8 m above the ground and his feet are 3 m from the mirror. How tall is the tree?



Since $\angle ACB = \angle ECD$ (reflection)

$\angle ABC = \angle EDC$ ($90°$)

then $\triangle ABC \sim \triangle EDC$ (AA~)

Since $\triangle ABC \sim \triangle EDC$

then $AB : BC : CA = ED : DC : CE$

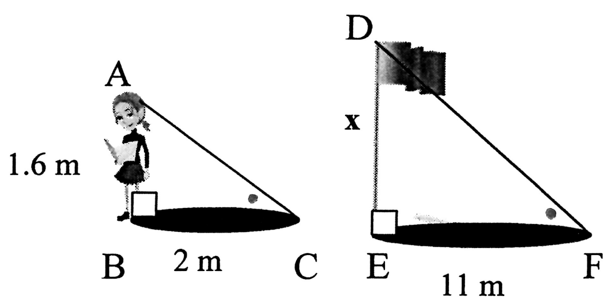
$x : 40 : CA = 1.8 : 3 : CE$

$\frac{x}{1.8} = \frac{40}{3} = \cancel{\frac{CA}{CE}}$

$\frac{3x}{3} = \frac{72}{3}$

$x = 24m$

3. When shadows are produced by sunlight, similar triangles are formed using the shadow, the object and the sunray. Vanessa is 1.6 m tall. On a sunny day, she notices that her shadow extends 2 m. The flagpole casts a shadow that is 11 m long. What is the height of the flagpole?



Since $\angle ABC = \angle DEF$ ($90°$)

$\angle ACB = \angle DFE$ (parallel sun rays)

then $\triangle ABC \sim \triangle DEF$ (AA~)

Since $\triangle ABC \sim \triangle DEF$

then $AB : BC : CA = DE : EF : FD$

$1.6 : 2 : CA = x : 11 : FD$

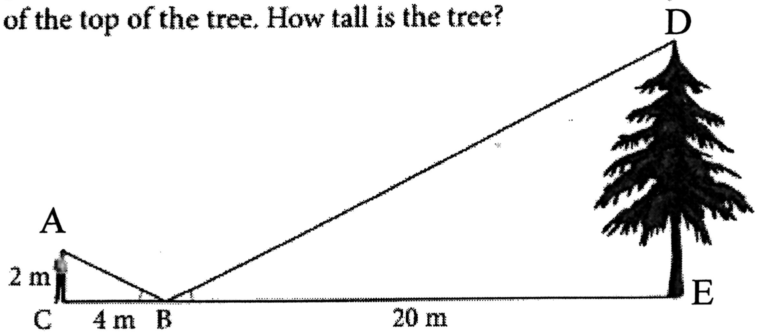
$\frac{1.6}{x} = \frac{2}{11} = \cancel{\frac{CA}{FD}}$

$\frac{2x}{2} = \frac{17.6}{2}$

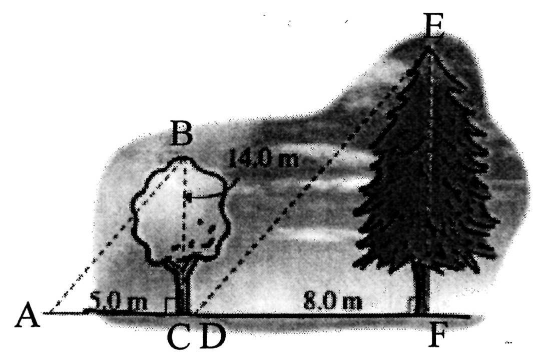
$x = 8.8m$

Similar Triangles - Application Practice

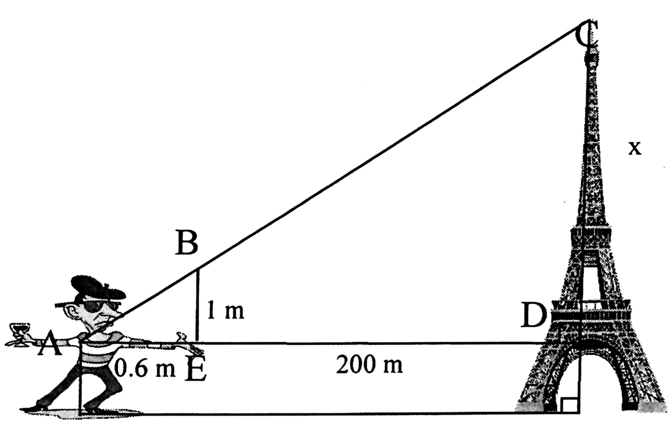
1. A hiker, whose eye level is 2 m above the ground, wants to find the height of a tree. He places a mirror horizontally on the ground 20 m from the base of the tree, and finds that if he stands at a point C, which is 4 m from the mirror B, he can see the reflection of the top of the tree. How tall is the tree?



2. Two trees cast shadows as shown. Determine the height of the evergreen tree.



3. Monsieur Cadieux wishes to determine the height of the Eiffel Tower. He holds a metre stick in front of his eyes and walks back until he can see the top of the tower lined up with the top of his metre stick. Monsieur Cadieux's eyes are 1.7 m above the ground. How tall is the Eiffel Tower?



Answers: 1) 10 m 2) 22.4 m 3) 336 m