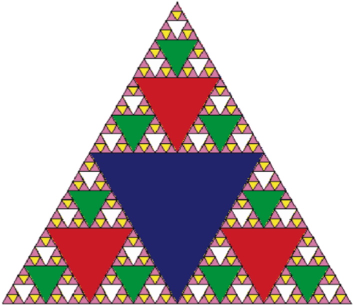
MPM2D: Principles of Mathematics

Properties of Similar Triangles

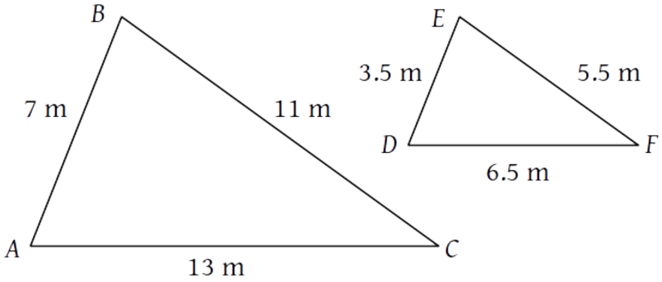
J. Garvin



Solving Proportions

Recap

Explain why $\Delta ABC \sim \Delta DEF$.



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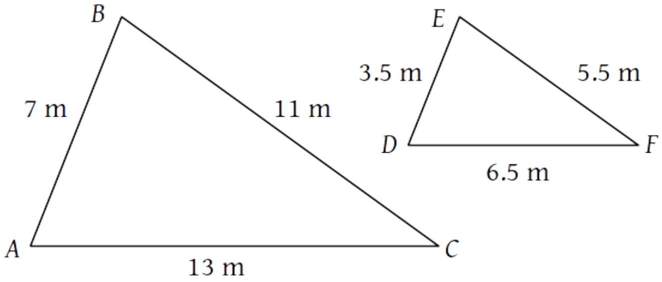

Each side in ΔABC is twice as long as that in ΔDEF.
Therefore, $\Delta ABC \sim \Delta DEF$ by SSS$\sim$.

Solving Proportions

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If we know the ratio $\frac{|AB|}{|DE|}$, and we know one of $|AC|$ or $|DF|$, then we can solve for the other value using the proportion $\frac{|AB|}{|DE|} = \frac{|AC|}{|DF|}$.

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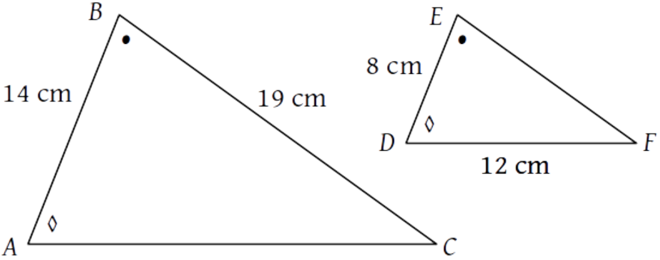
This can be done by inspection, or by using cross-multiplication.

Solving Similar Triangles

Example

$\Delta ABC \sim \Delta DEF$. Determine $|AC|$ and $|EF|$.



Solving Similar Triangles

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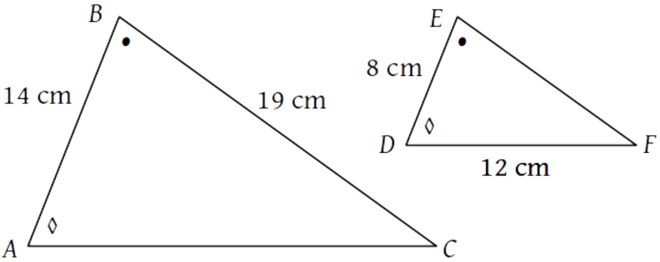

Since we know the values of the corresponding sides AB and DE, we can use their ratio to create proportions involving the unknown sides.

Solving Similar Triangles

AC corresponds to DF, whose value is known.

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$$168 = 8|AC|$$

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AC corresponds to DF, whose value is known.

$$\begin{aligned}\frac{|AB|}{|DE|} &= \frac{|AC|}{|DF|}\\ \frac{14}{8} &= \frac{|AC|}{12}\\ 168 &= 8|AC|\\ |AC| &= 21\end{aligned}$$

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$$\begin{aligned} \frac{|AB|}{|DE|} &= \frac{|BC|}{|EF|} \\ \frac{14}{8} &= \frac{19}{|EF|} \end{aligned}$$

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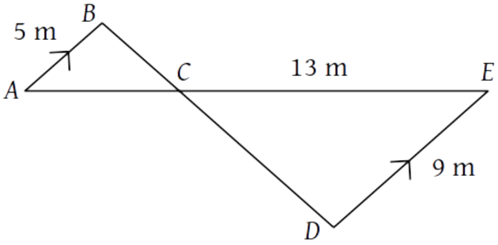
$$\frac{14}{8} = \frac{19}{|EF|}$$
$$14|EF| = 152$$
$$|EF| = \tfrac{76}{7}$$

Solving Similar Triangles

Example

Determine $|AE|$.



Solving Similar Triangles

Example

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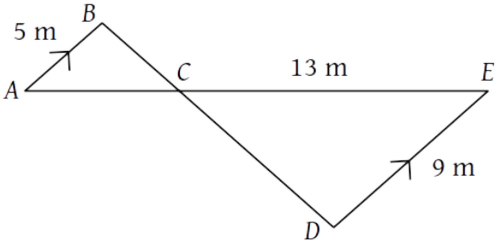

Since $|AE| = |AC| + |CE|$, we can find $|AC|$ and add it to $|CE|$, which is known.

Solving Similar Triangles

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$$65 = 9|AC|$$

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Solving Similar Triangles

AB corresponds with DE, while AC corresponds with CE.

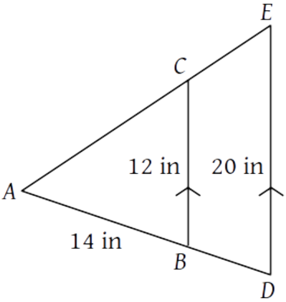
$$\frac{|AB|}{|DE|} = \frac{|AC|}{|CE|}$$
$$\frac{5}{9} = \frac{|AC|}{13}$$
$$65 = 9|AC|$$
$$|AC| = \tfrac{65}{9}$$

Therefore, $|AE| = 13 + \frac{65}{9} = \frac{182}{9}$ m.

Solving Similar Triangles

Example

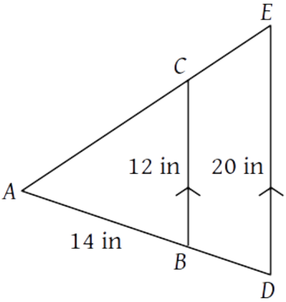
Determine $|BD|$.



Solving Similar Triangles

Example

Determine $|BD|$.



Since BD is part of a trapezoid rather than a triangle, we cannot use it directly in a proportion.

Solving Similar Triangles

Since $|BD| = |AD| - |AB|$, we can first find $|AD|$ and subtract $|AB|$, which is known.

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$$\frac{|AD|}{|AB|} = \frac{|DE|}{|BC|}$$
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$$3|AD| = 70$$

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Since $|BD| = |AD| - |AB|$, we can first find $|AD|$ and subtract $|AB|$, which is known.

$$\begin{aligned} \frac{|AD|}{|AB|} &= \frac{|DE|}{|BC|} \\ \frac{|AD|}{14} &= \frac{20}{12} \\ \frac{|AD|}{14} &= \frac{5}{3} \\ 3|AD| &= 70 \\ |AD| &= \tfrac{70}{3} \end{aligned}$$

Therefore, $|BD| = \frac{70}{3} - 14 = \frac{28}{3}$ in.

Areas of Similar Triangles

What happens to the area of a triangle when its dimensions are doubled?

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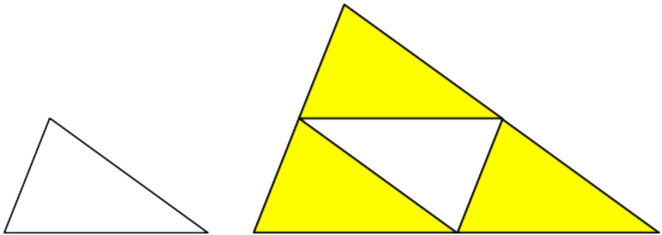

When the dimensions are doubled, the area is quadrupled.

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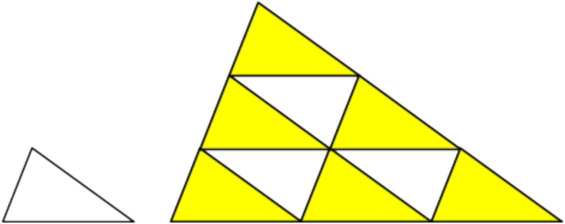

When the dimensions are tripled, the area increases by a factor of nine.

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In general, a triangle whose dimensions are enlarged by a factor of k will have an area k^2 times greater.

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Areas of Similar Triangles

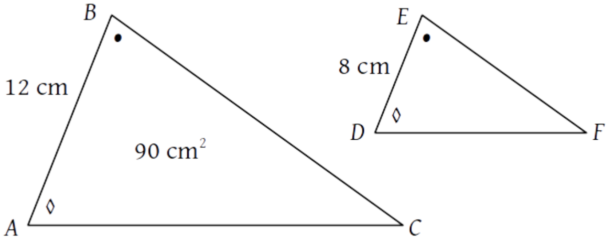
If $\Delta ABC \sim \Delta DEF$, and if $|AB| = k|DE|$, then $\text{Area}_{ABC} = k^2 \cdot \text{Area}_{DEF}$.

Any ratio of corresponding sides can be used, so choose the one that is easiest to work with.

Areas of Similar Triangles

Example

$\Delta ABC \sim \Delta DEF$. Determine Area_{DEF}.



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The area of ΔDEF will be $k^2 = \left(\frac{2}{3}\right)^2 = \frac{4}{9}$ the size of ΔABC.

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Determine the scale factor, k, of ΔDEF.

$$12k = 8$$
$$k = \frac{2}{3}$$

The area of ΔDEF will be $k^2 = \left(\frac{2}{3}\right)^2 = \frac{4}{9}$ the size of ΔABC.

Therefore, the area of ΔDEF is $90 \times \frac{4}{9} = 40$ cm^2.

Questions?