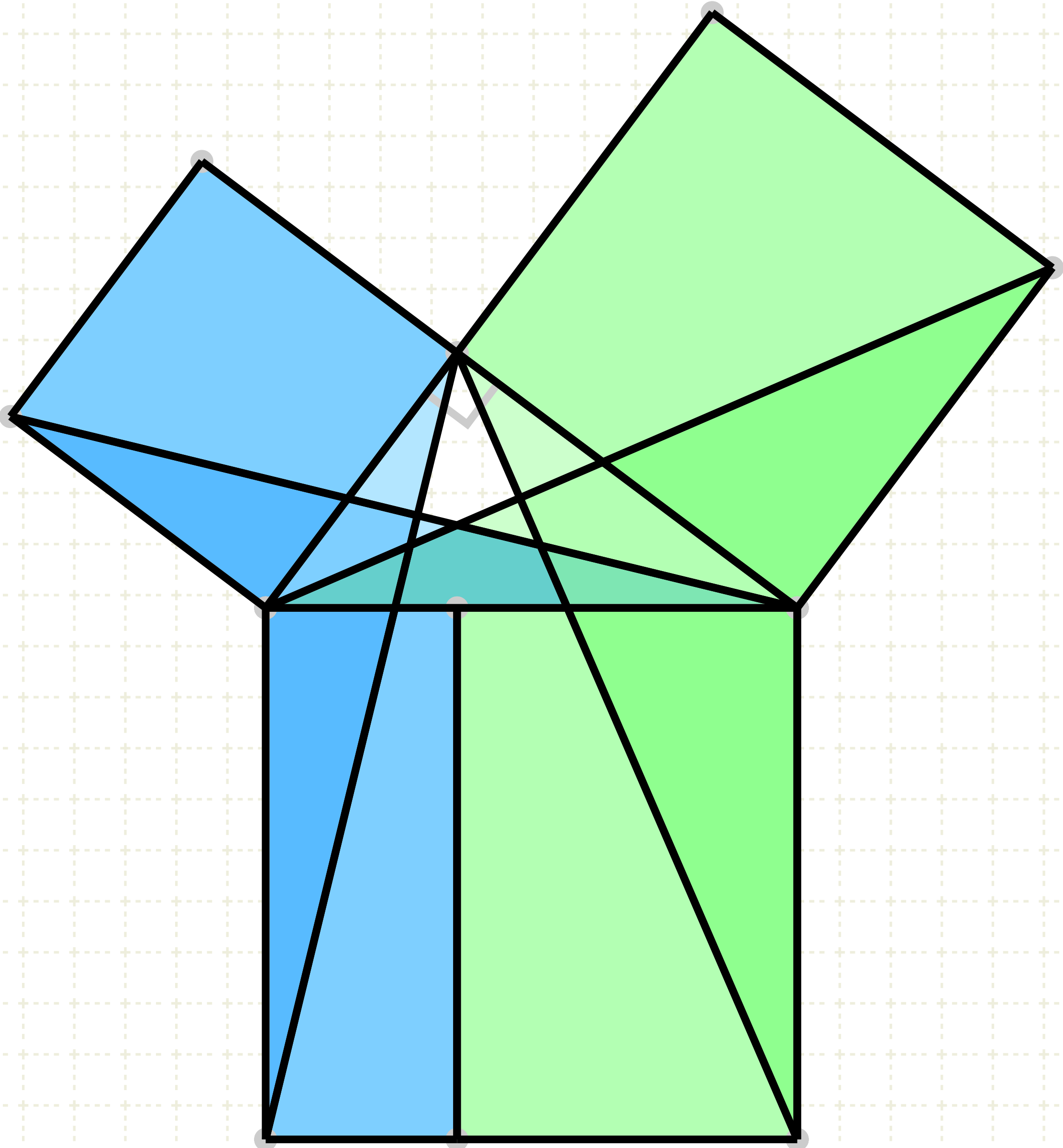
# Euclid's Elements

# Book I



*If Euclid did not kindle your youthful enthusiasm, you were not born to be a scientific thinker.*

Albert Einstein

# Table of Contents, Chapter 1

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# Proposition 26 of Book I

If two triangles have two angles equal to two angles respectively, and one side equal to one side, namely, either the side adjoining the equal angles, or that opposite one of the equal angles, then the remaining sides equal the remaining sides and the remaining angle equals the remaining angle.

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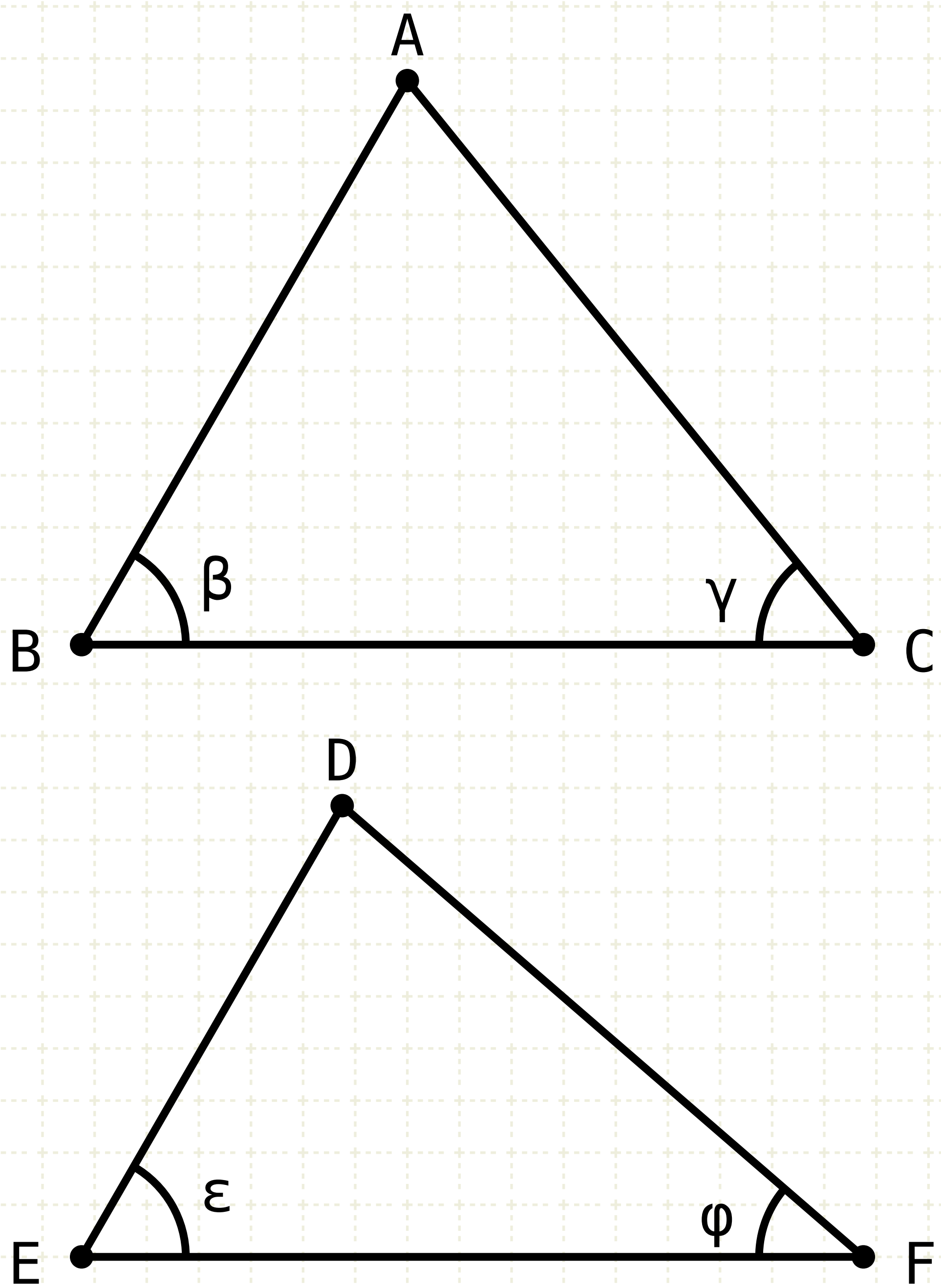


$\varepsilon = \beta$

$\varphi = \gamma$

$EF = BC$

## In other words

Given two triangles ABC and DEF, where BC equals EF, and angles ABC and DEF are equal, and angles BCA and EFD are equal (ASA)

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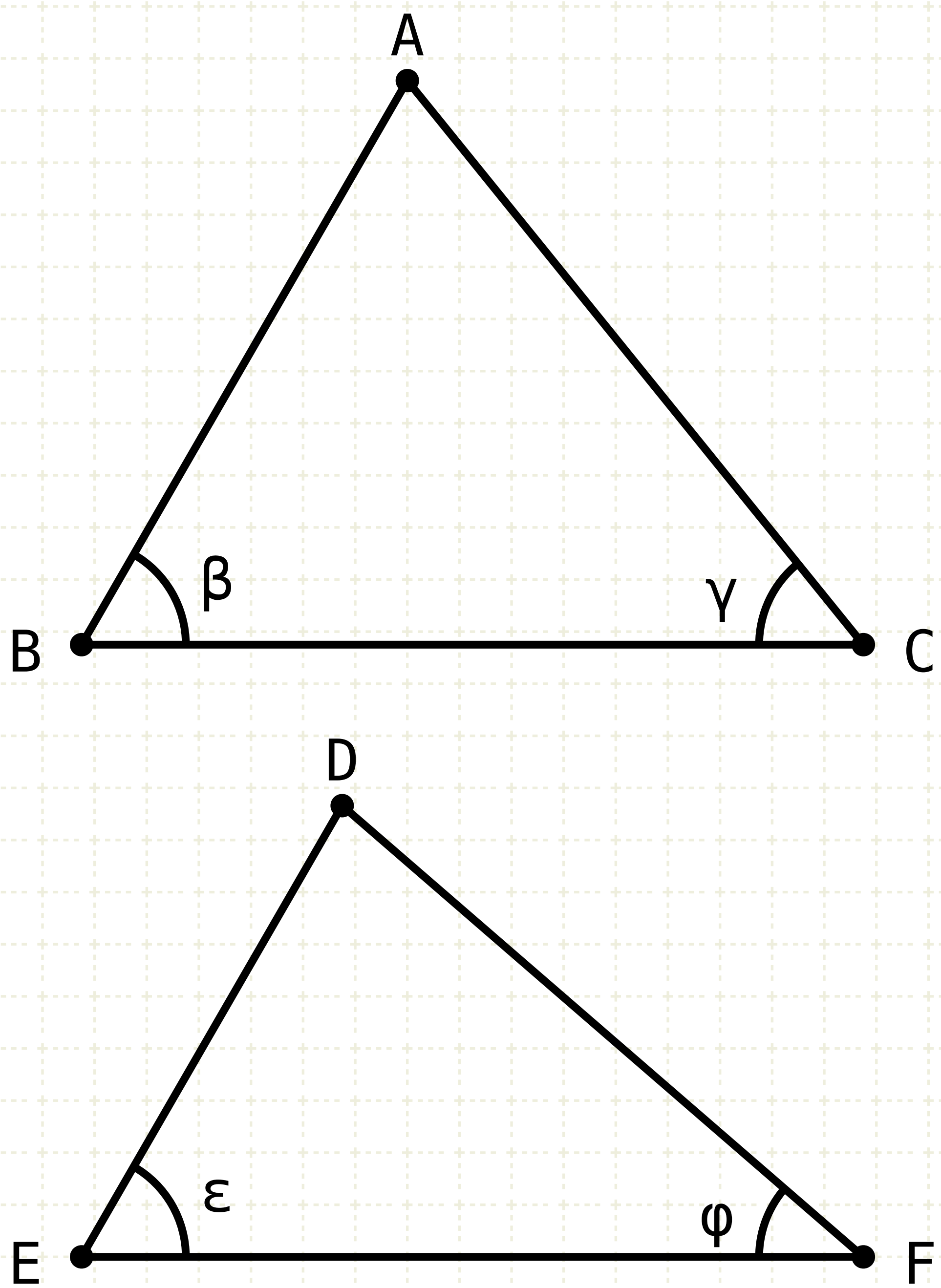


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$\Delta ABC \equiv \Delta DEF$
$DE = AB$
$DF = AC$

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Given two triangles ABC and DEF, where BC equals EF, and angles ABC and DEF are equal, and angles BCA and EFD are equal (ASA)

Then the two triangles are equivalent

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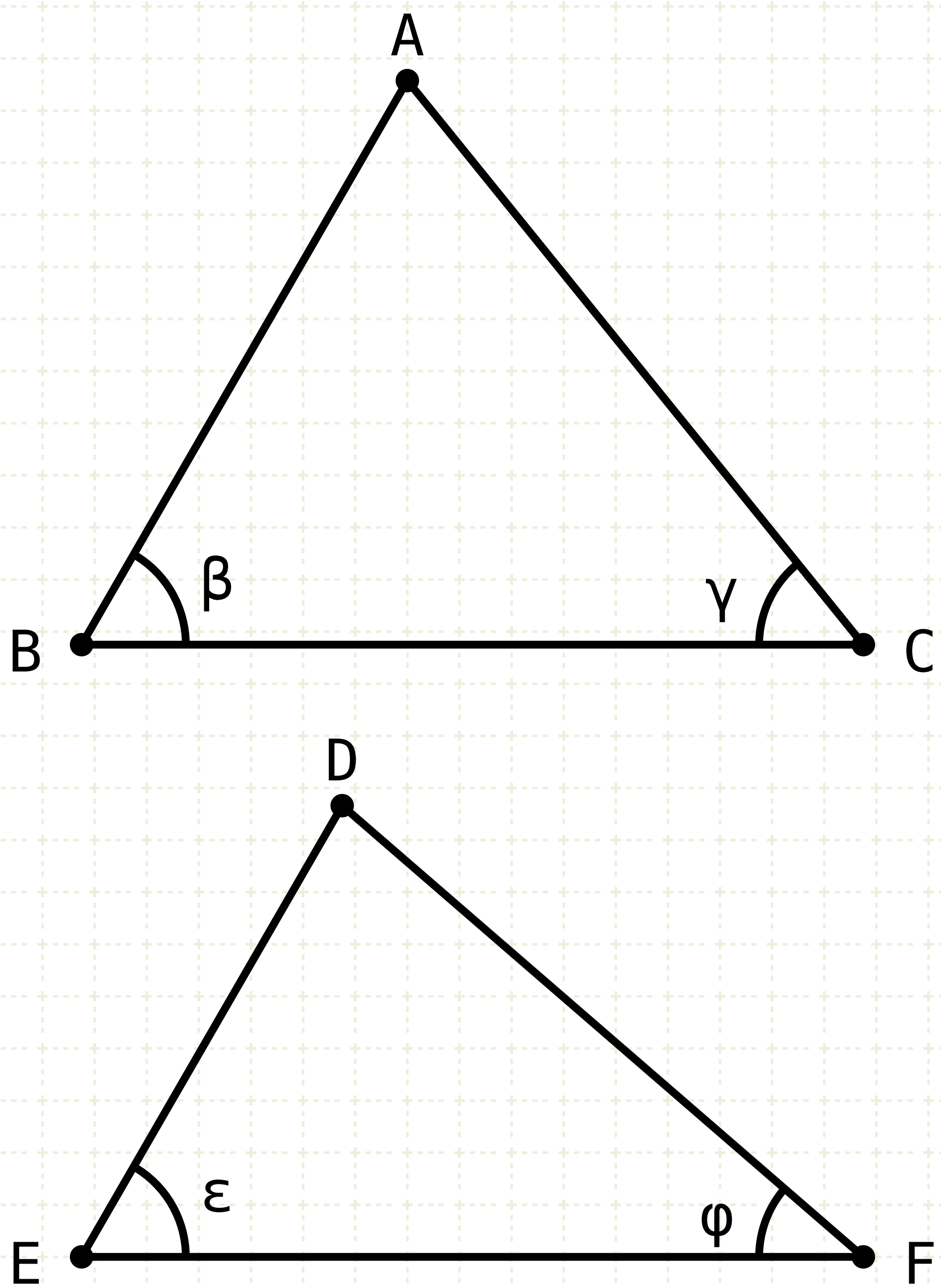


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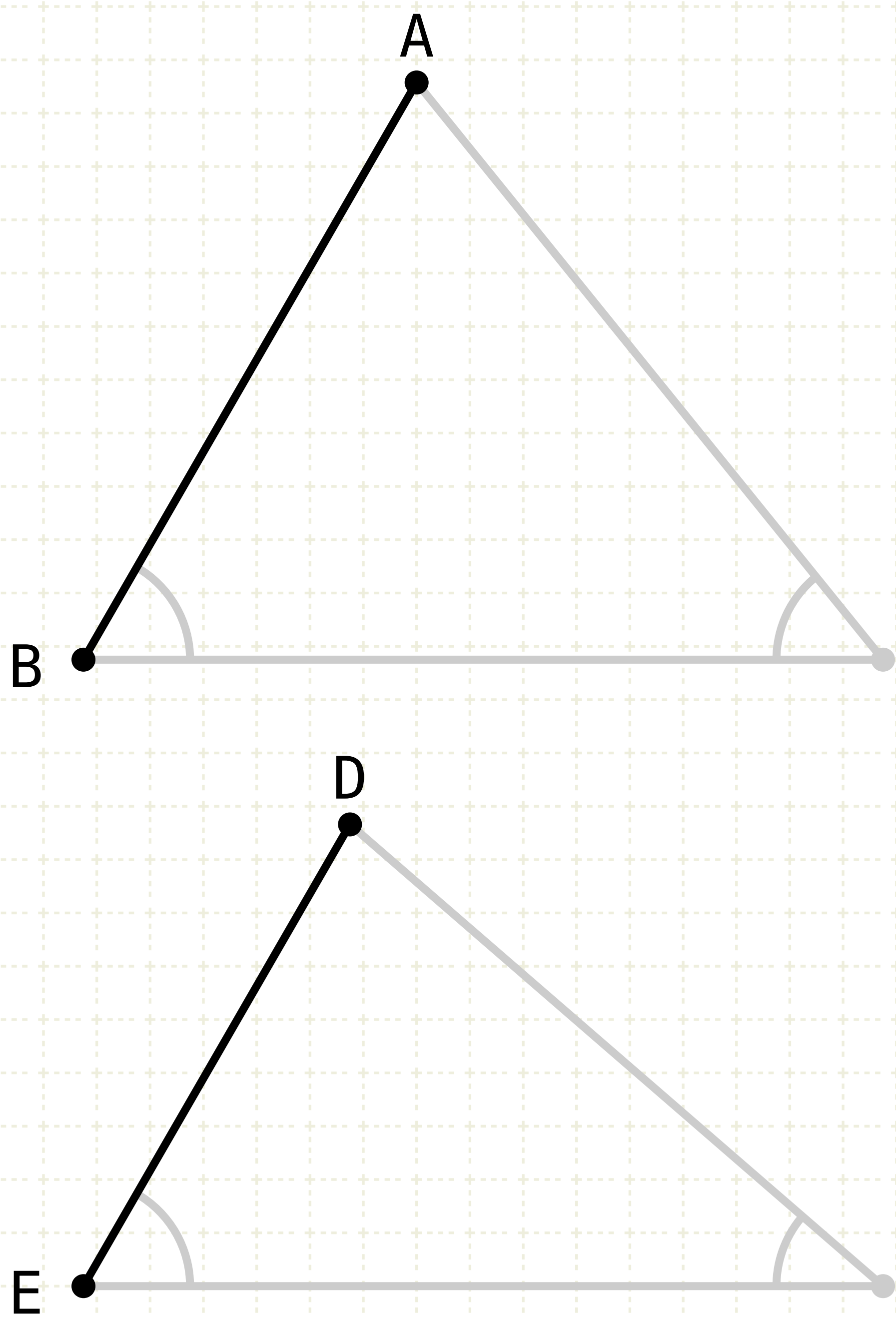


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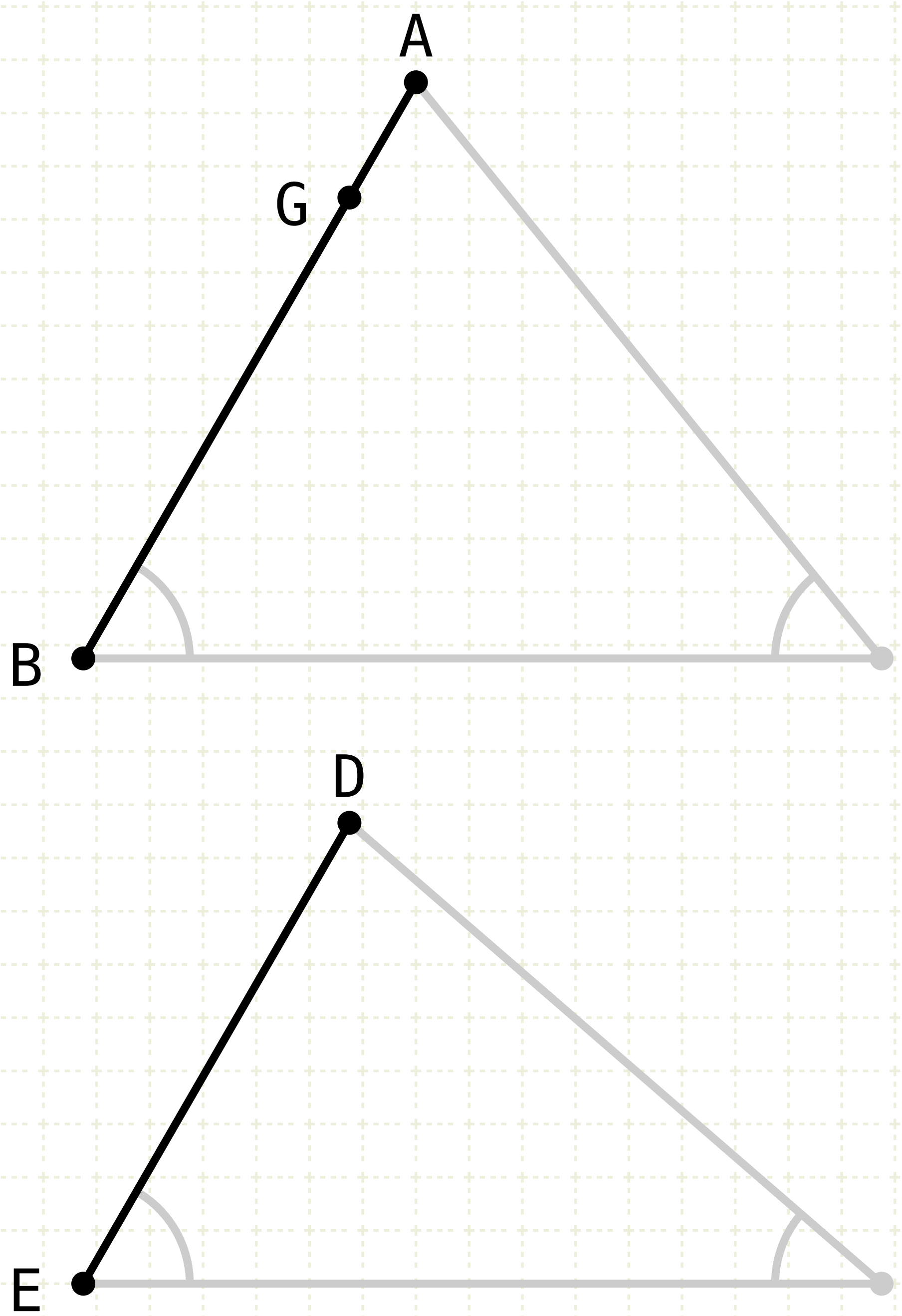


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Assume that AB is greater than DE

Create a point G such that BG equals DE

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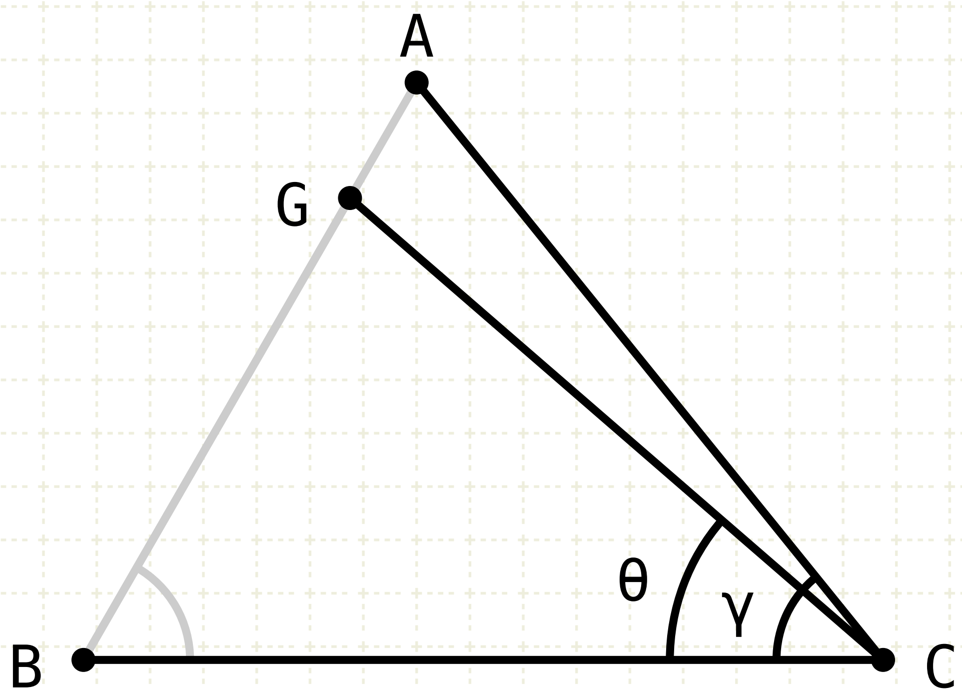




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## Proof by Contradiction

Assume that AB is greater than DE

Create a point G such that BG equals DE

Create line GC, angle BCA is greater than BCG

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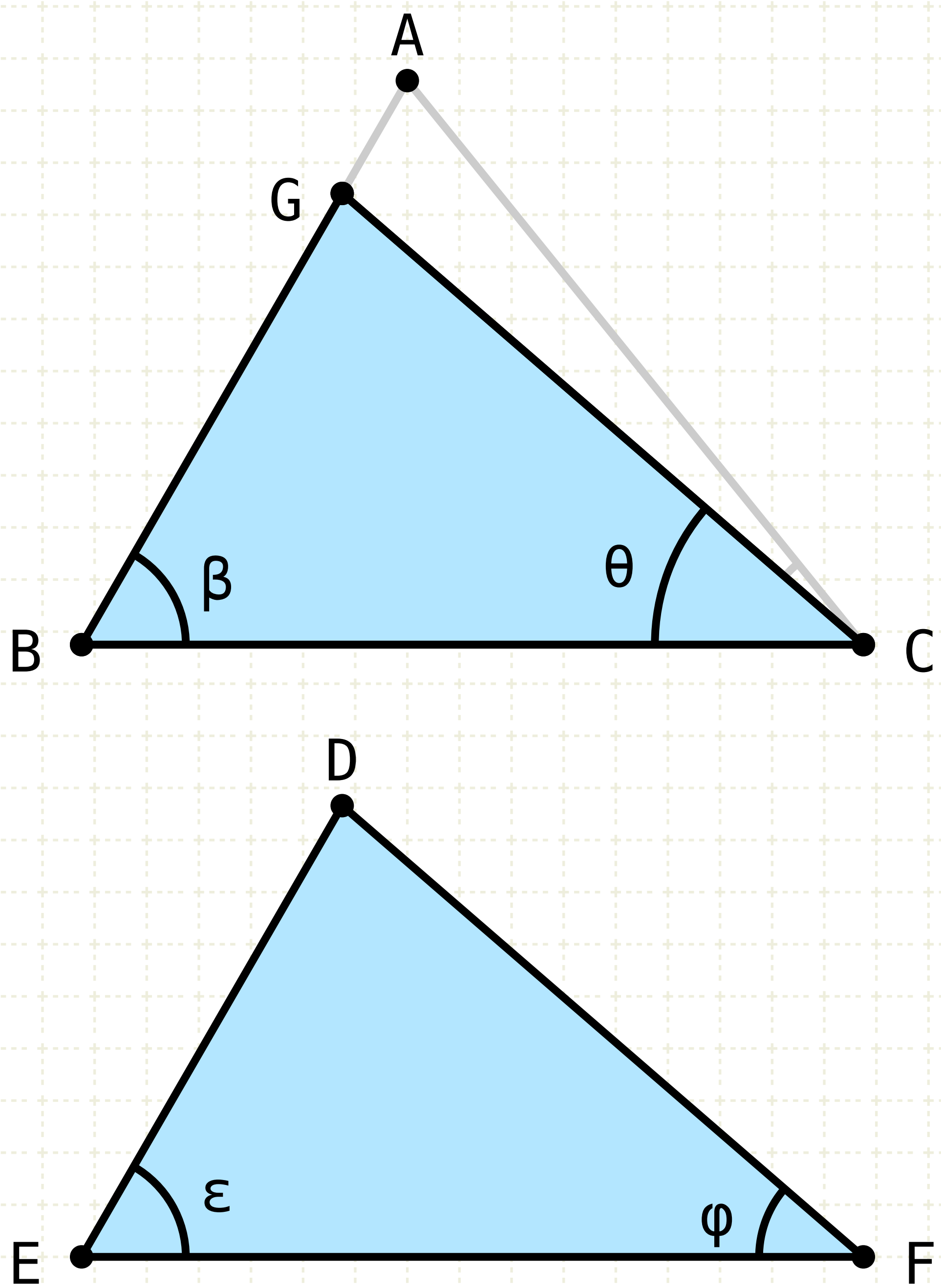


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Given two triangles ABC and DEF, where BC equals EF, and angles ABC and DEF are equal, and angles BCA and EFD are equal (ASA)

Then the two triangles are equivalent

## Proof by Contradiction

Assume that AB is greater than DE

Create a point G such that BG equals DE

Create line GC, angle BCA is greater than BCG

Triangle GBC has two sides and an angle that is equivalent in triangle DEF, hence they are equal in all respects (I·4)

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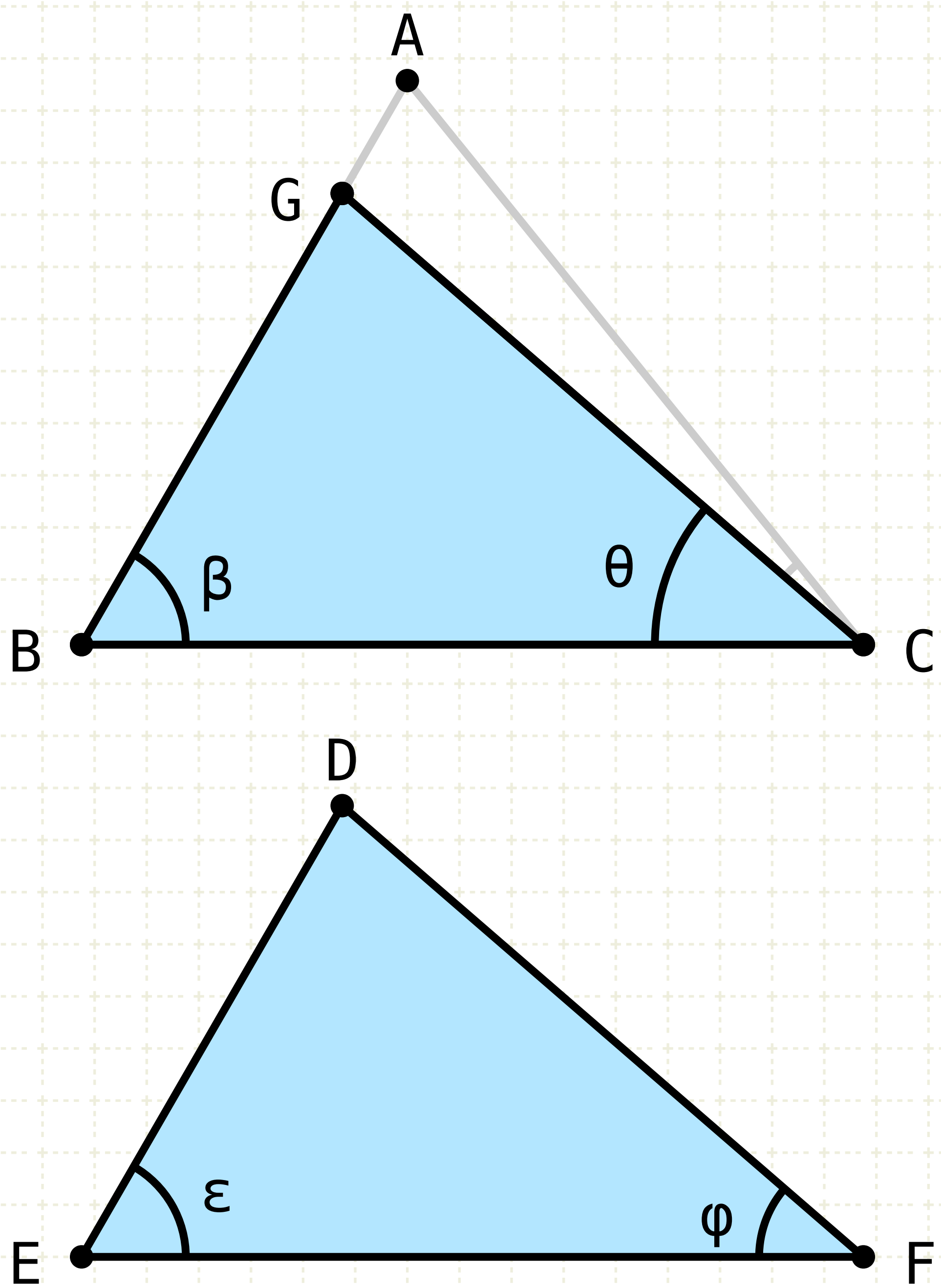


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## Proof by Contradiction

Assume that AB is greater than DE

Create a point G such that BG equals DE

Create line GC, angle BCA is greater than BCG

Triangle GBC has two sides and an angle that is equivalent in triangle DEF, hence they are equal in all respects (I·4)

Thus, angle BCG is equal to angle DFE, which is defined as equal to angle BCA

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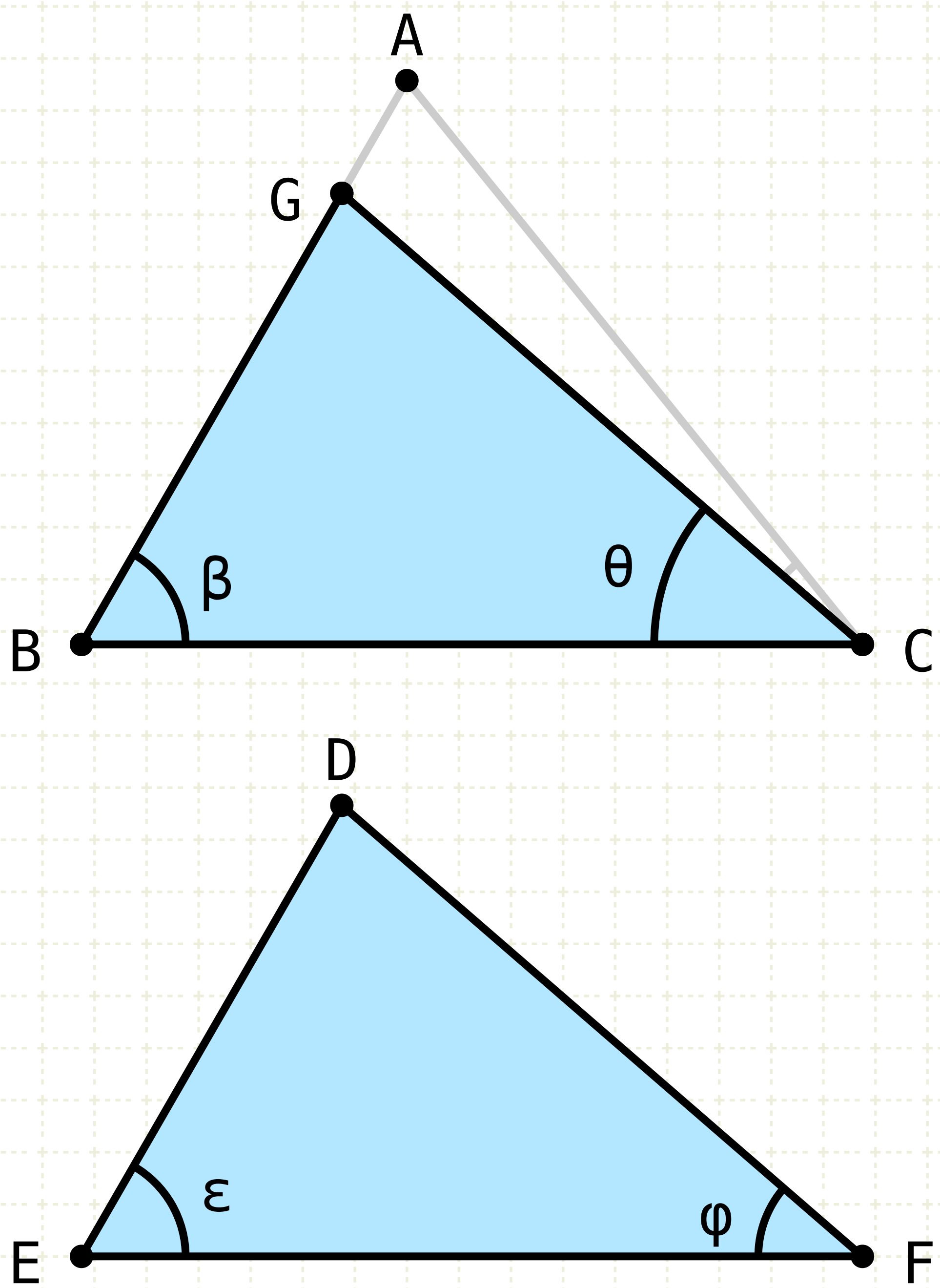


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Given two triangles ABC and DEF, where BC equals EF, and angles ABC and DEF are equal, and angles BCA and EFD are equal (ASA)

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## Proof by Contradiction

Assume that AB is greater than DE

Create a point G such that BG equals DE

Create line GC, angle BCA is greater than BCG

Triangle GBC has two sides and an angle that is equivalent in triangle DEF, hence they are equal in all respects (I·4)

Thus, angle BCG is equal to angle DFE, which is defined as equal to angle BCA

Angle BCG cannot be both less than AND equal to BCA

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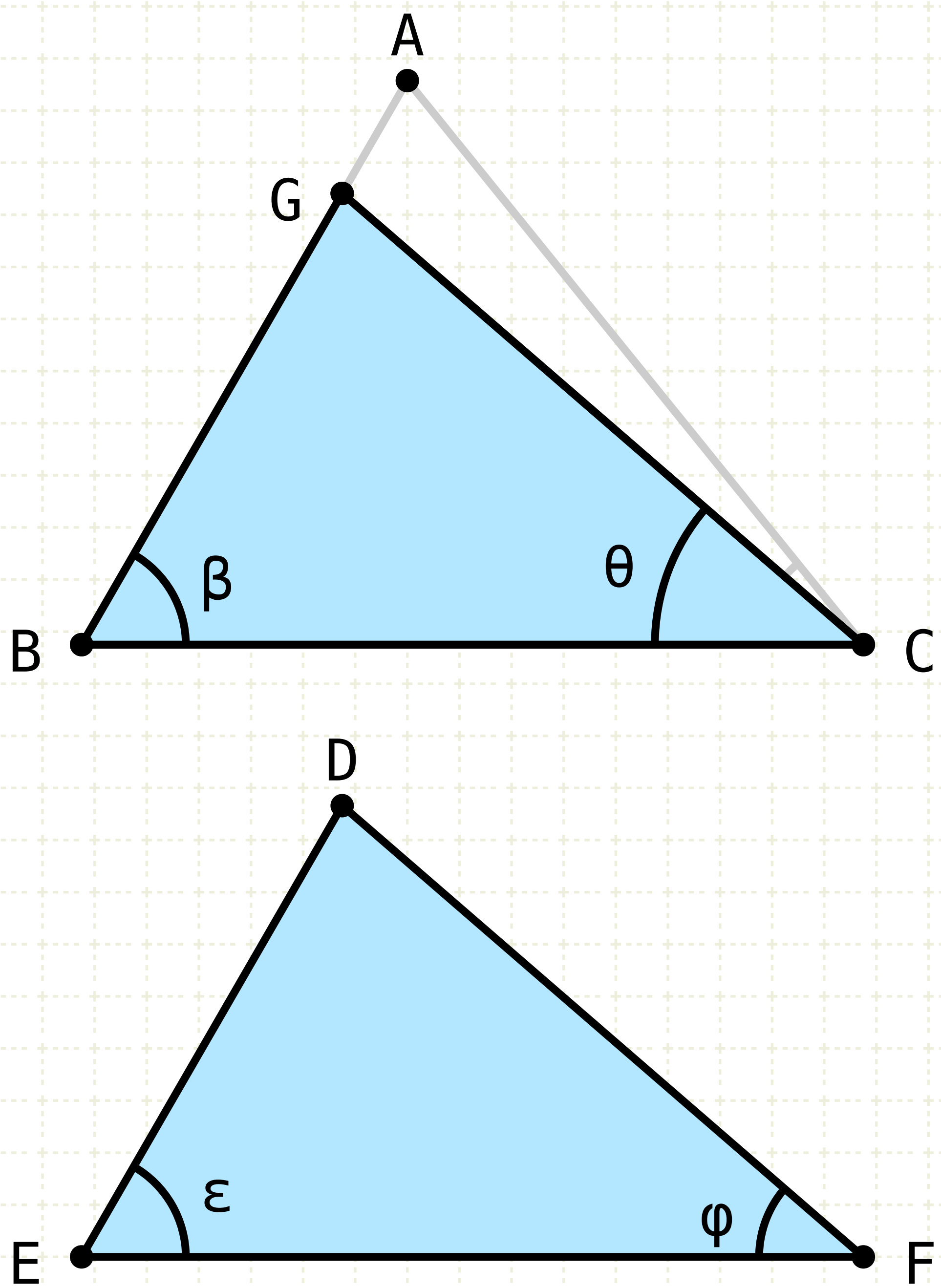


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## In other words

Given two triangles ABC and DEF, where BC equals EF, and angles ABC and DEF are equal, and angles BCA and EFD are equal (ASA)

Then the two triangles are equivalent

## Proof by Contradiction

Assume that AB is greater than DE

Create a point G such that BG equals DE

Create line GC, angle BCA is greater than BCG

Triangle GBC has two sides and an angle that is equivalent in triangle DEF, hence they are equal in all respects (I·4)

Thus, angle BCG is equal to angle DFE, which is defined as equal to angle BCA

Angle BCG cannot be both less than AND equal to BCA

Thus the original assumption must be incorrect

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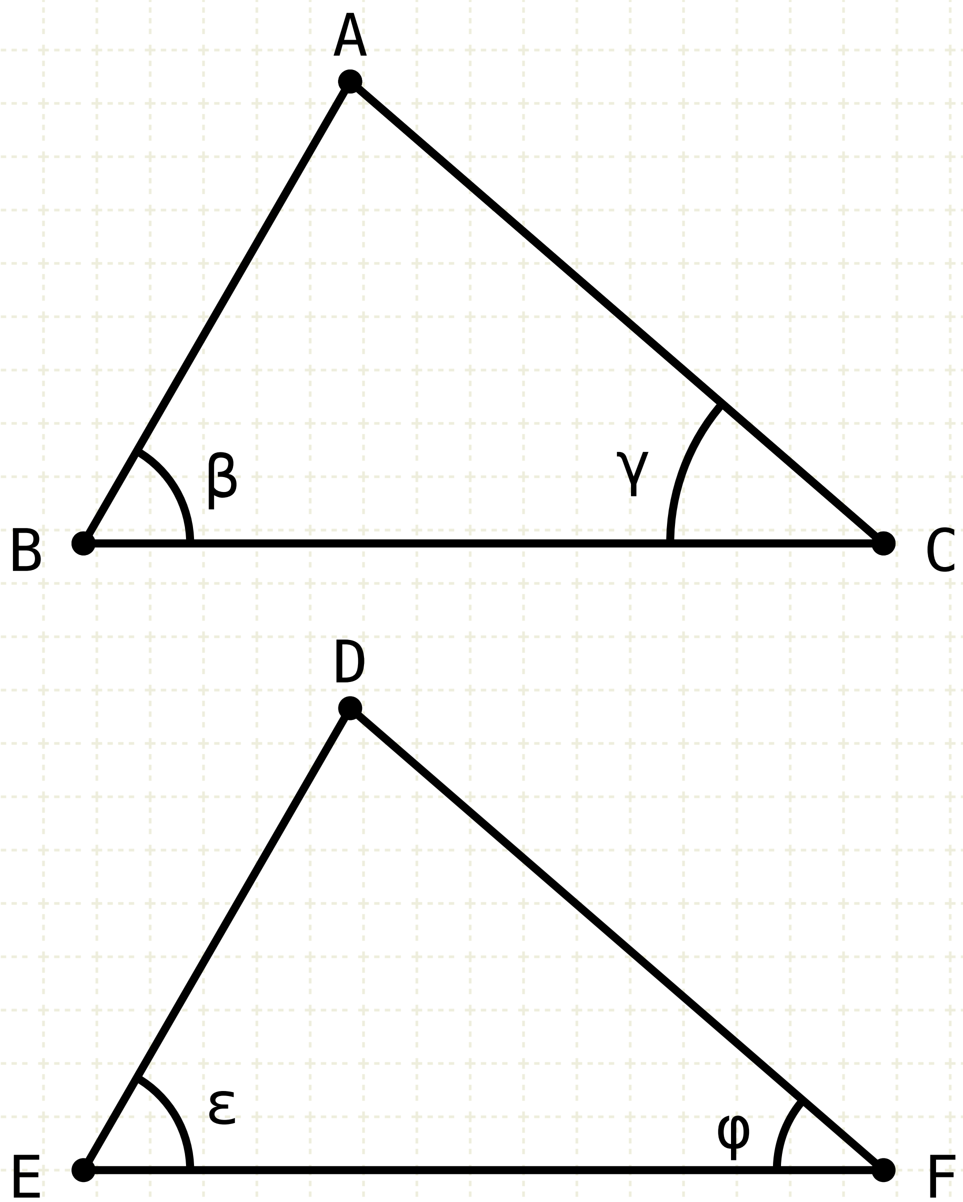


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## In other words

Given two triangles ABC and DEF, where BC equals EF, and angles ABC and DEF are equal, and angles BCA and EFD are equal (ASA)

Then the two triangles are equivalent

## Proof by Contradiction

Assume that AB is greater than DE

Create a point G such that BG equals DE

Create line GC, angle BCA is greater than BCG

Triangle GBC has two sides and an angle that is equivalent in triangle DEF, hence they are equal in all respects (I·4)

Thus, angle BCG is equal to angle DFE, which is defined as equal to angle BCA

Angle BCG cannot be both less than AND equal to BCA

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Therefore AB equals DE

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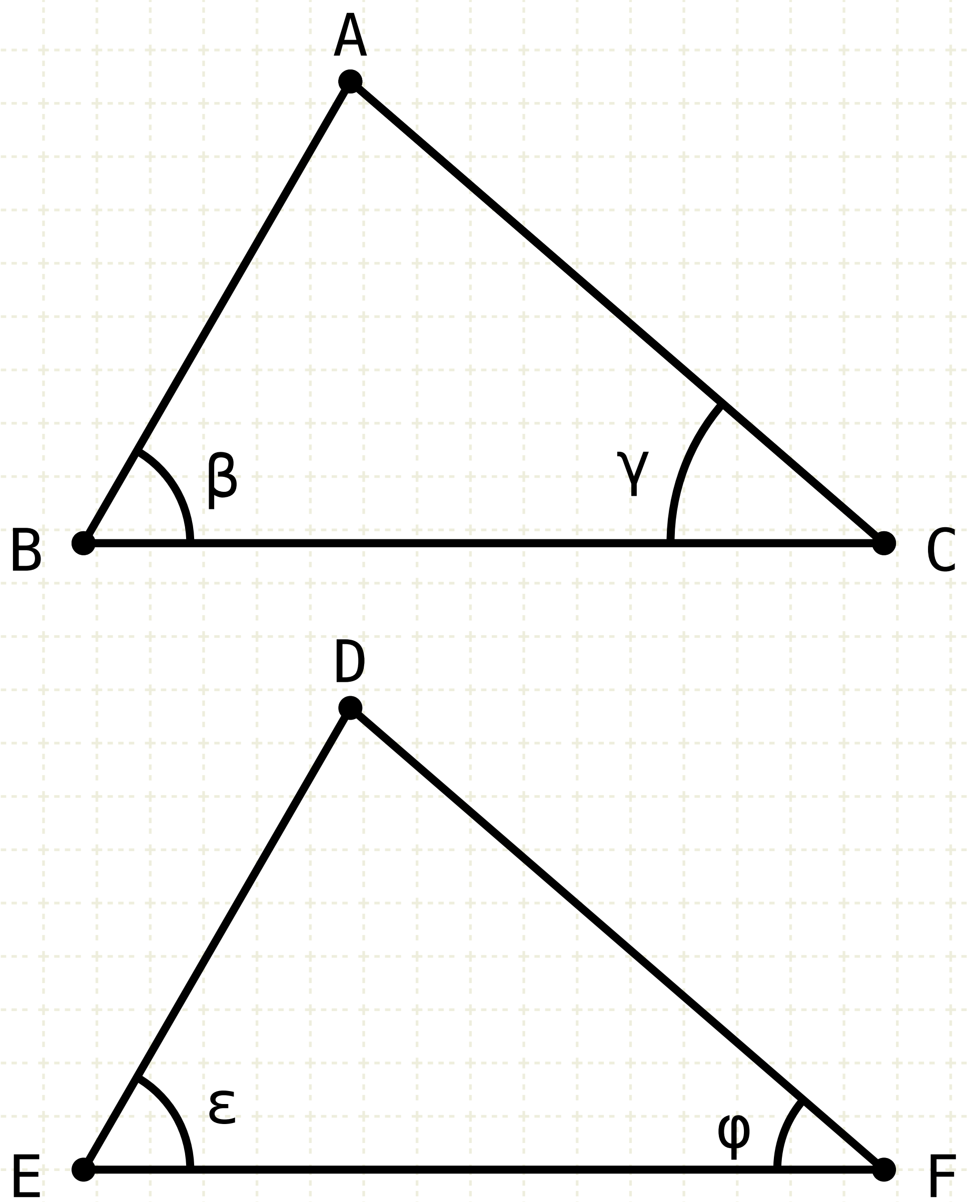


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Given two triangles ABC and DEF, where BC equals EF, and angles ABC and DEF are equal, and angles BCA and EFD are equal (ASA)

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## Proof by Contradiction

Assume that AB is greater than DE

Create a point G such that BG equals DE

Create line GC, angle BCA is greater than BCG

Triangle GBC has two sides and an angle that is equivalent in triangle DEF, hence they are equal in all respects (I·4)

Thus, angle BCG is equal to angle DFE, which is defined as equal to angle BCA

Angle BCG cannot be both less than AND equal to BCA

Thus the original assumption must be incorrect

Therefore AB equals DE

Since we have two triangles, with two equal sides, with equivalent angles, then the two triangles are equal in all respects (I·4)

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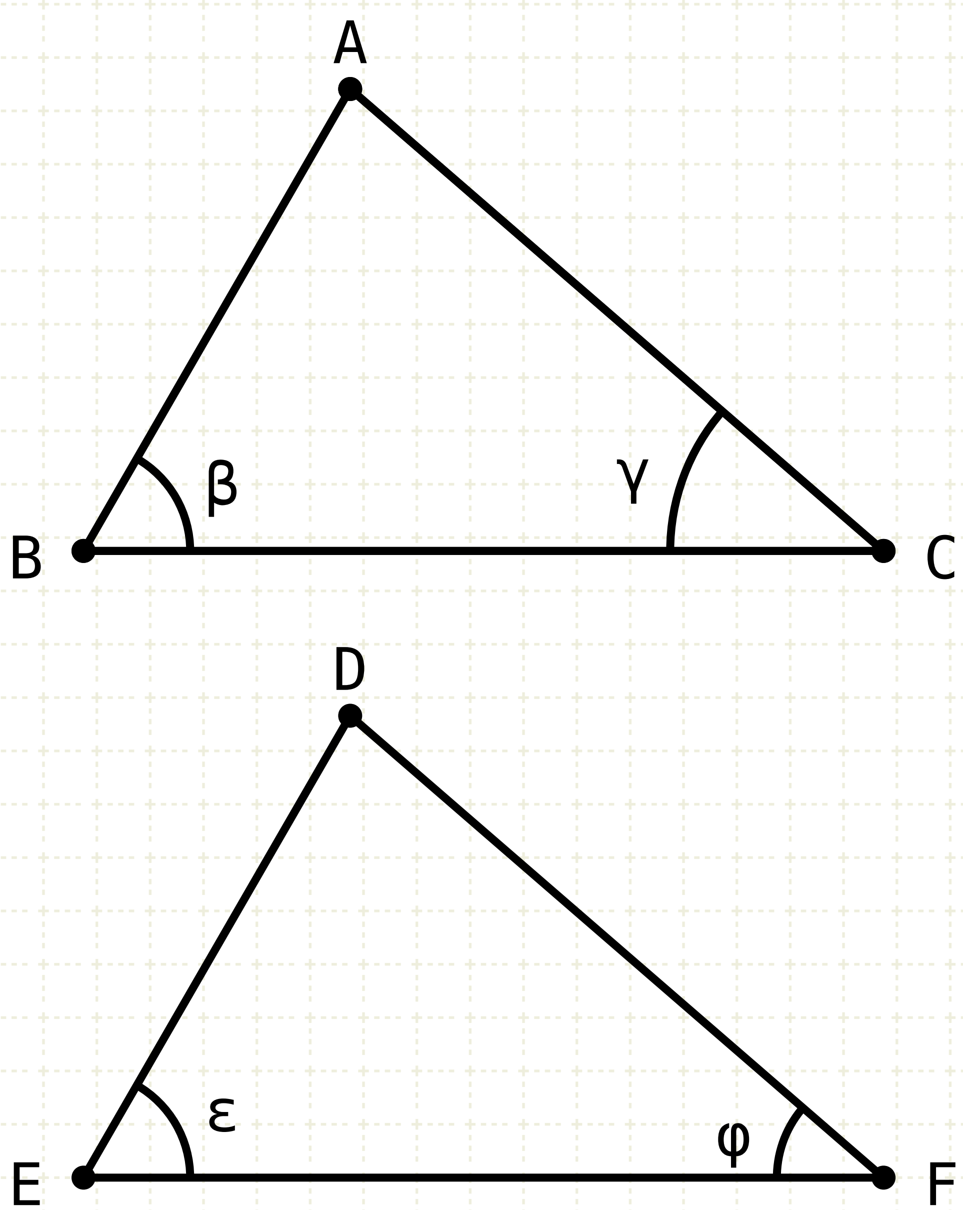


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Create a point G such that BG equals DE

Create line GC, angle BCA is greater than BCG

Triangle GBC has two sides and an angle that is equivalent in triangle DEF, hence they are equal in all respects (I·4)

Thus, angle BCG is equal to angle DFE, which is defined as equal to angle BCA

Angle BCG cannot be both less than AND equal to BCA

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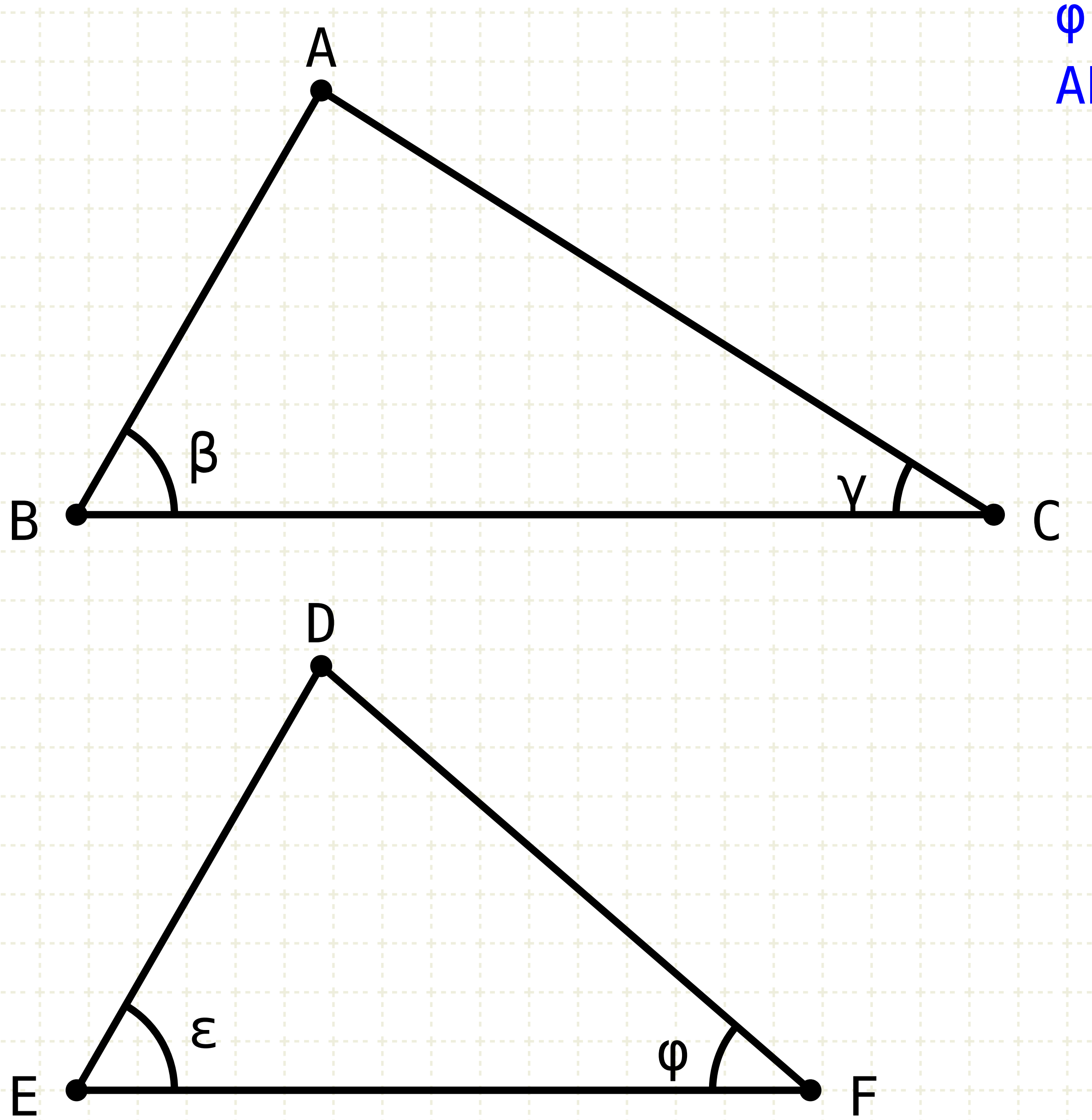


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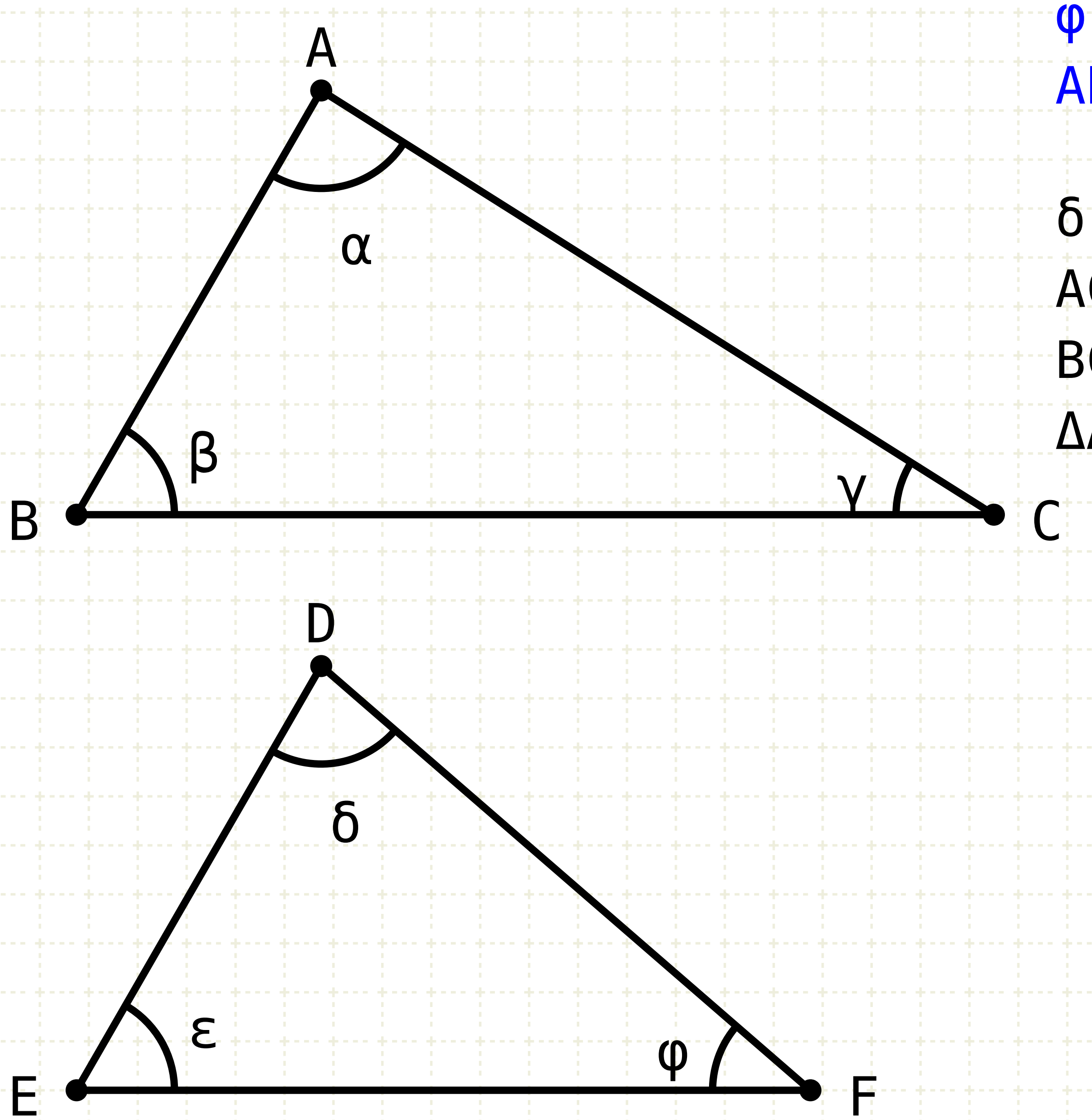


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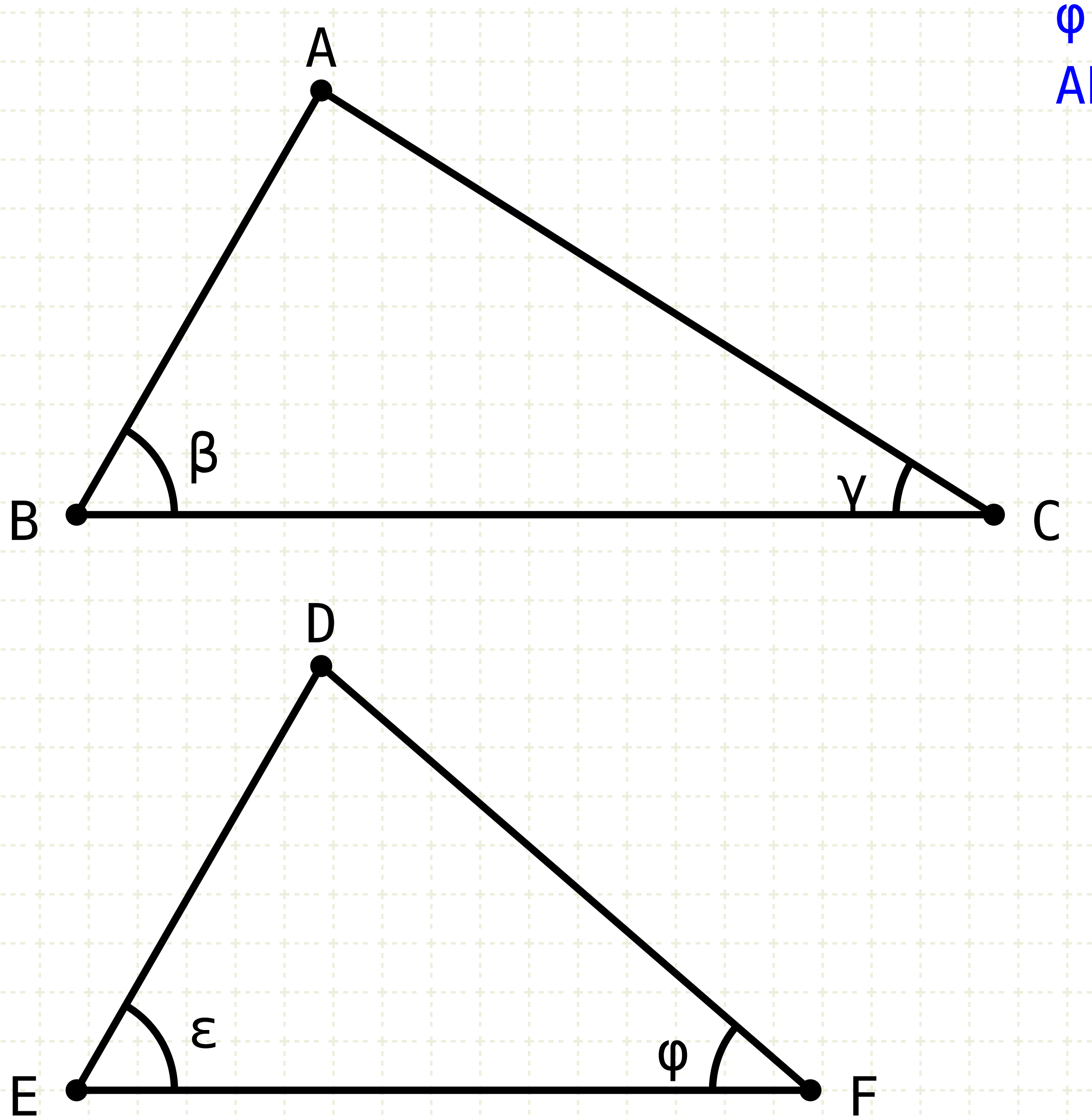


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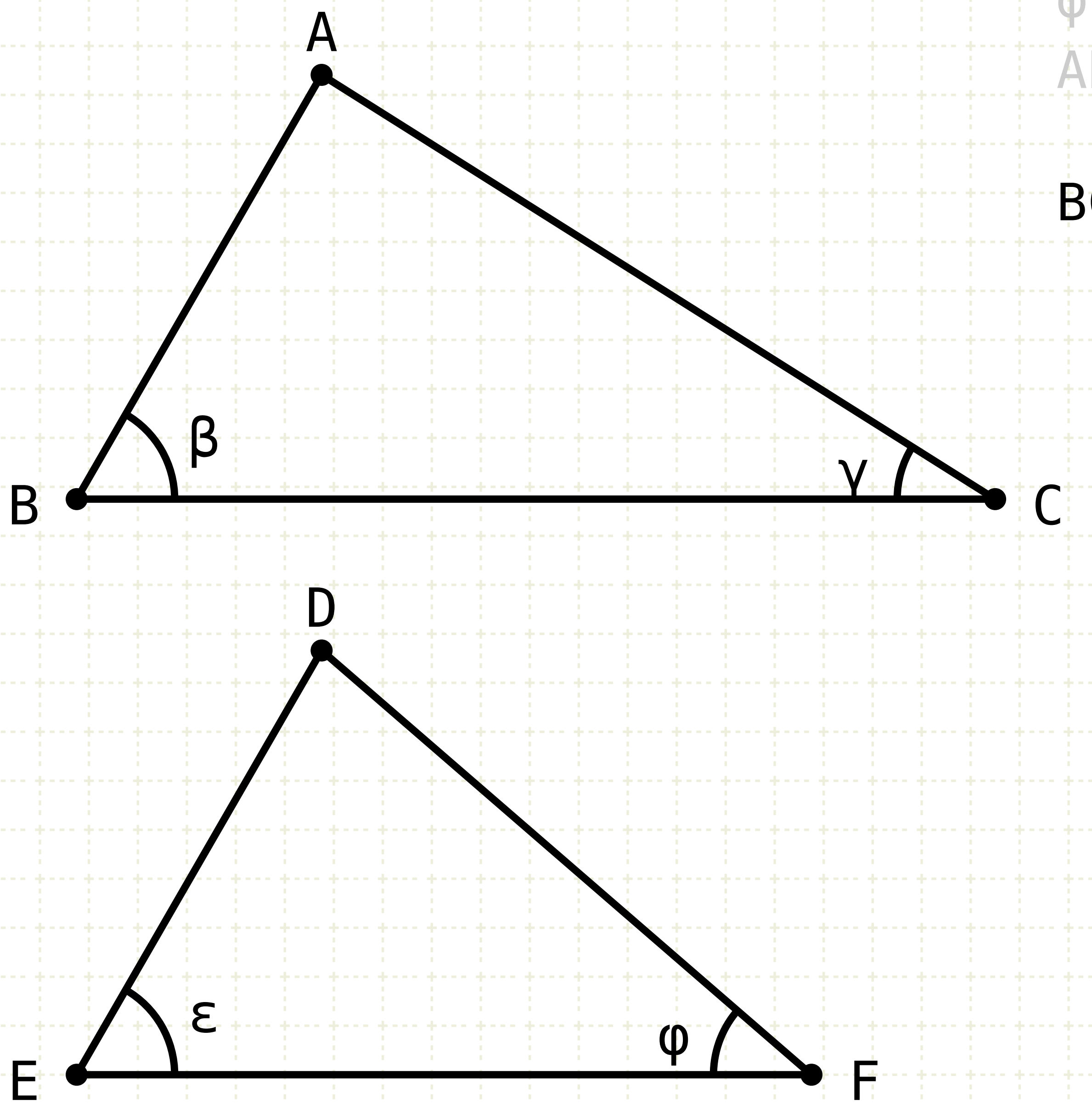


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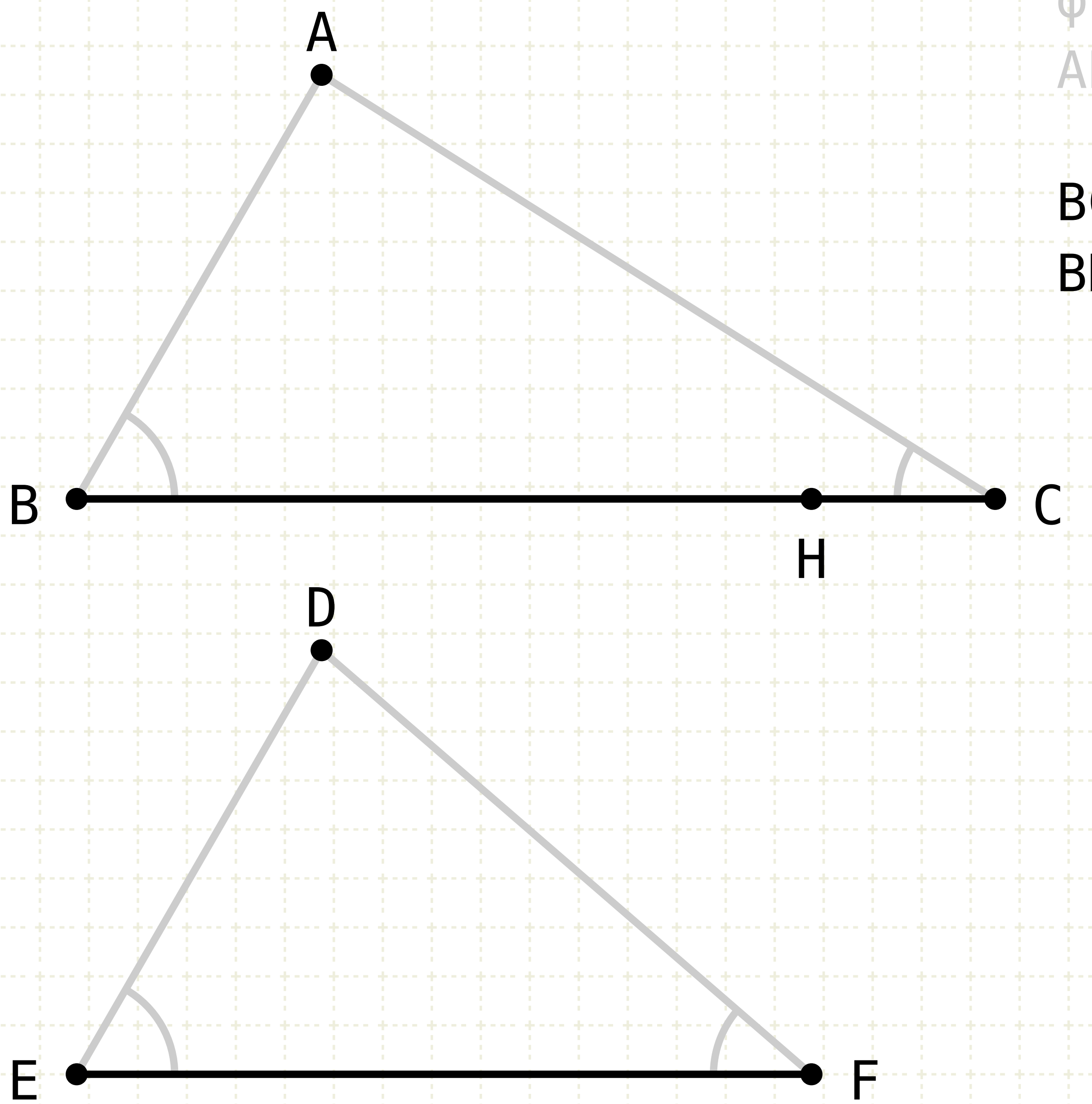


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## In other words

Given two triangles ABC and DEF, where AB equals DE, and angles ABC and DEF are equal, and angles BCA and EFD are equal (SSA)

Then the two triangles are equal in all respects

## Proof by Contradiction

Assume that BC is greater than EF

Create a point H such that BG equals EF (I·2)

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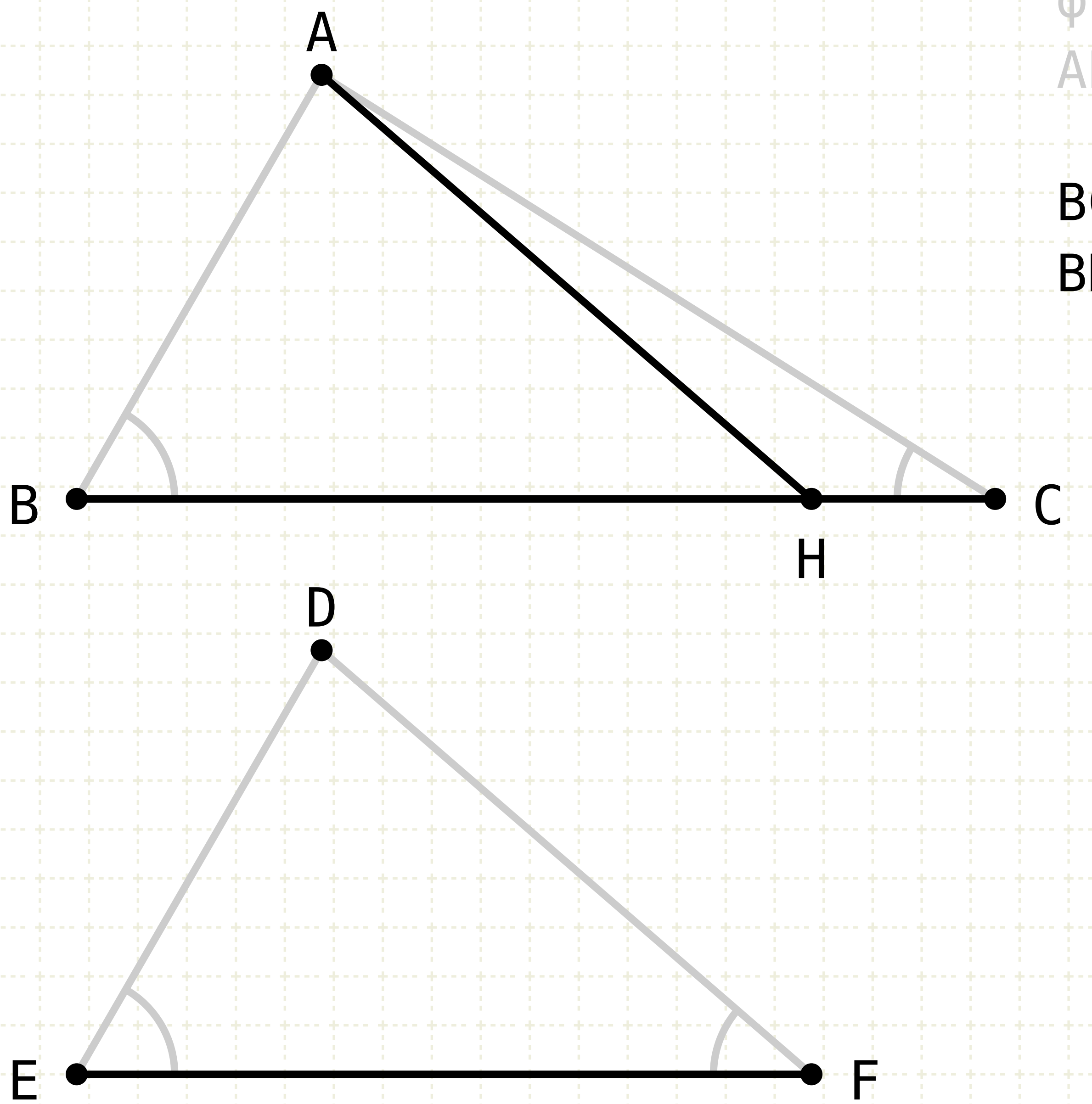


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## Proof by Contradiction

Assume that BC is greater than EF

Create a point H such that BG equals EF (I·2)

Create line HA

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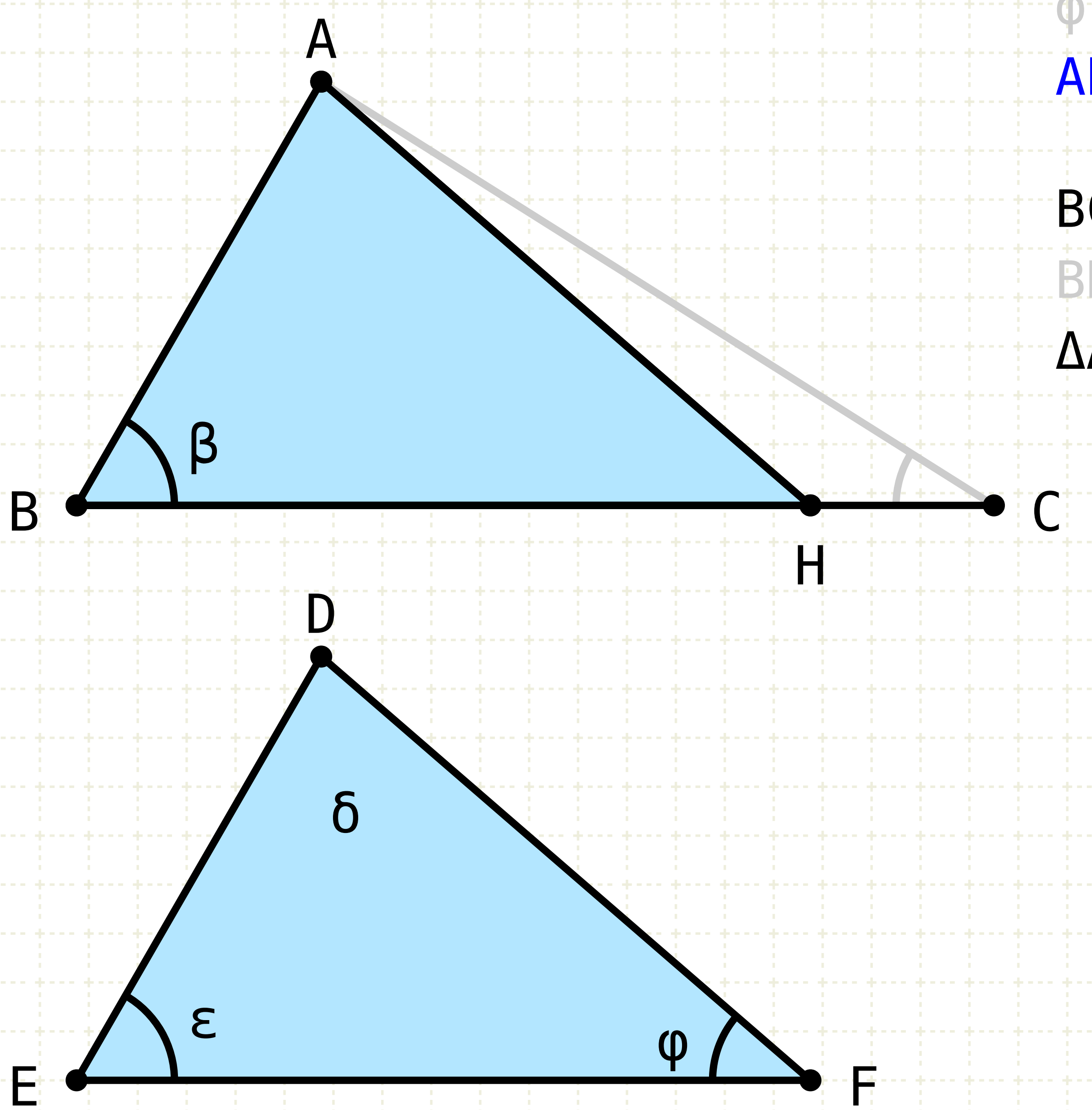


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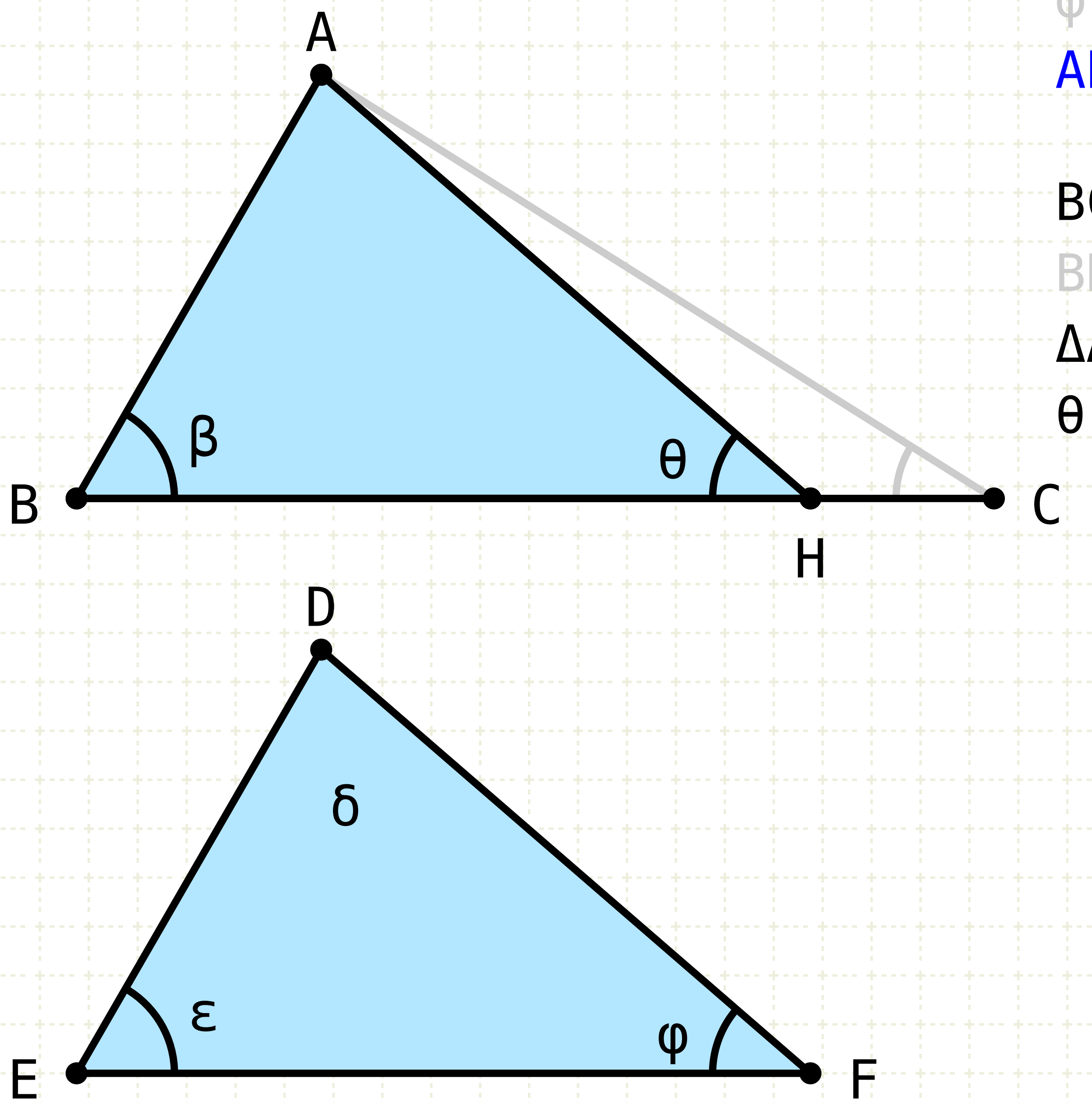


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Assume that BC is greater than EF

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Triangle ABH has two sides and an angle that is equivalent in triangle DEF, hence they are equal in all respects (I·4)

Thus, angle AHB is equal to angle DFE

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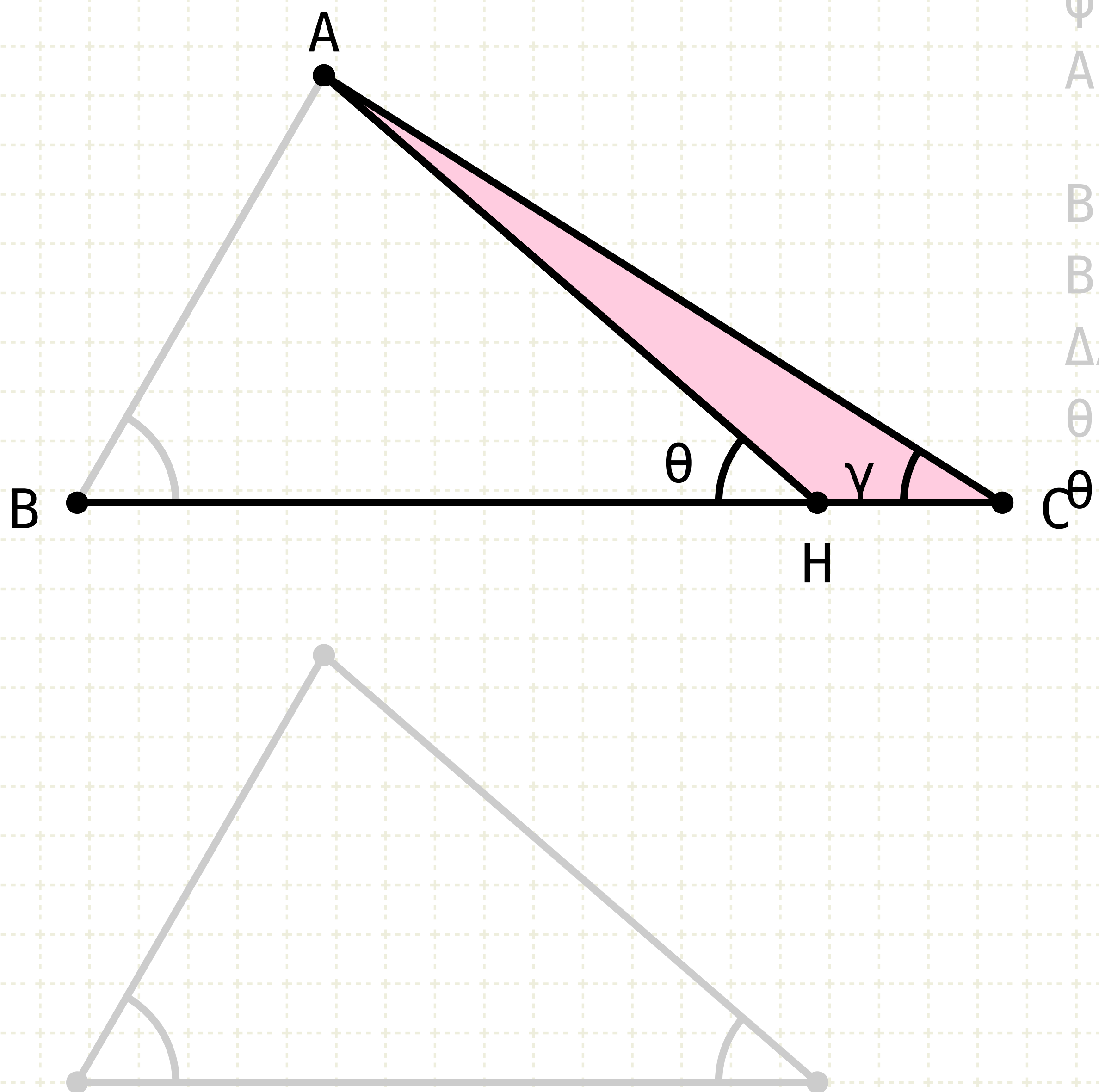


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## Proof by Contradiction

Assume that BC is greater than EF

Create a point H such that BG equals EF (I·2)

Create line HA

Triangle ABH has two sides and an angle that is equivalent in triangle DEF, hence they are equal in all respects (I·4)

Thus, angle AHB is equal to angle DFE

Since angle AHB is an exterior angle to the triangle AHC, it must be larger than angle ACH (I·16)

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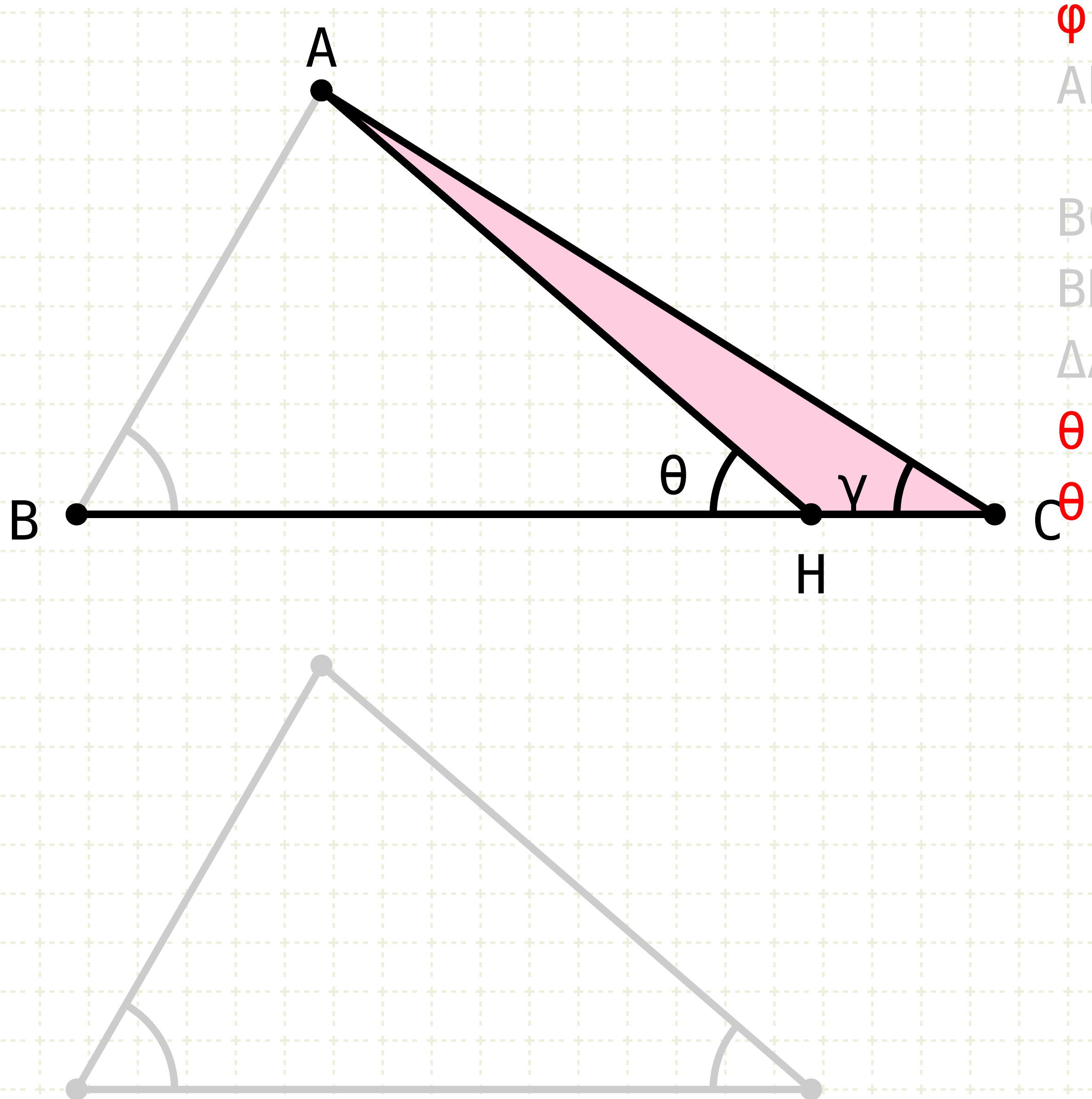


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Angle BHA cannot be both greater than AND equal to BCA

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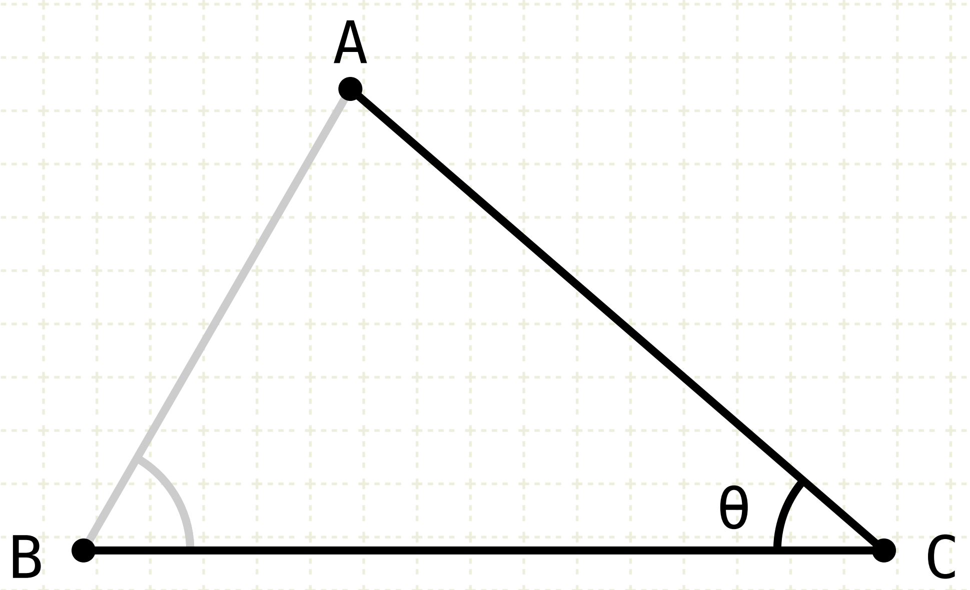




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## In other words

Given two triangles ABC and DEF, where AB equals DE, and angles ABC and DEF are equal, and angles BCA and EFD are equal (SSA)

Then the two triangles are equal in all respects

## Proof by Contradiction

Assume that BC is greater than EF

Create a point H such that BG equals EF (I·2)

Create line HA

Triangle ABH has two sides and an angle that is equivalent in triangle DEF, hence they are equal in all respects (I·4)

Thus, angle AHB is equal to angle DFE

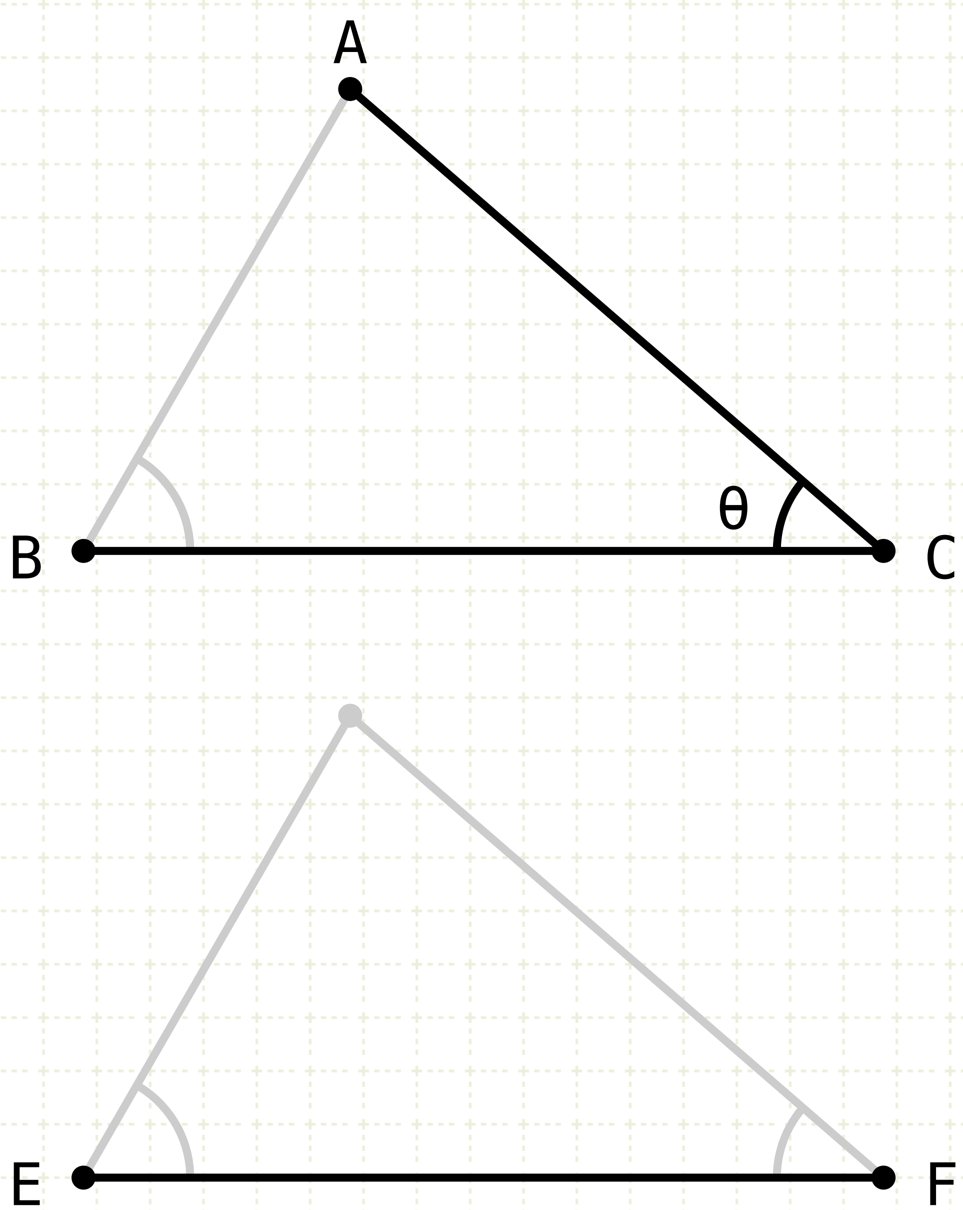
Since angle AHB is an exterior angle to the triangle AHC, it must be larger than angle ACH (I·16)

Angle BHA cannot be both greater than AND equal to BCA

So the initial assumption is incorrect

# Proposition 26 of Book I

If two triangles have two angles equal to two angles respectively, and one side equal to one side, namely, either the side adjoining the equal angles, or that opposite one of the equal angles, then the remaining sides equal the remaining sides and the remaining angle equals the remaining angle.




$\varepsilon = \beta$

$\varphi = \gamma$

$AB = DE$

$BC > EF$ ✗

$BH = EF$

$\Delta ABH \equiv \Delta DEF$

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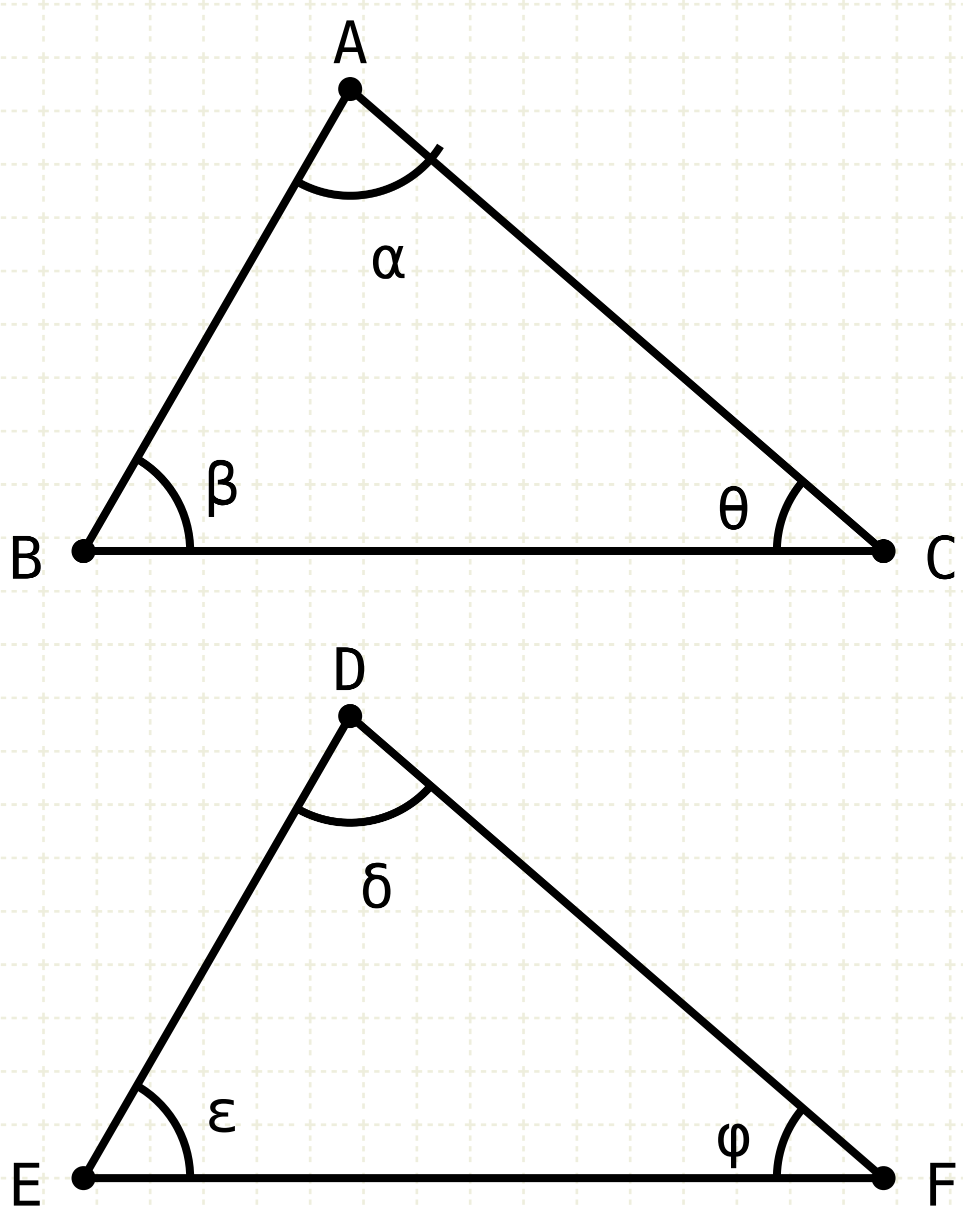


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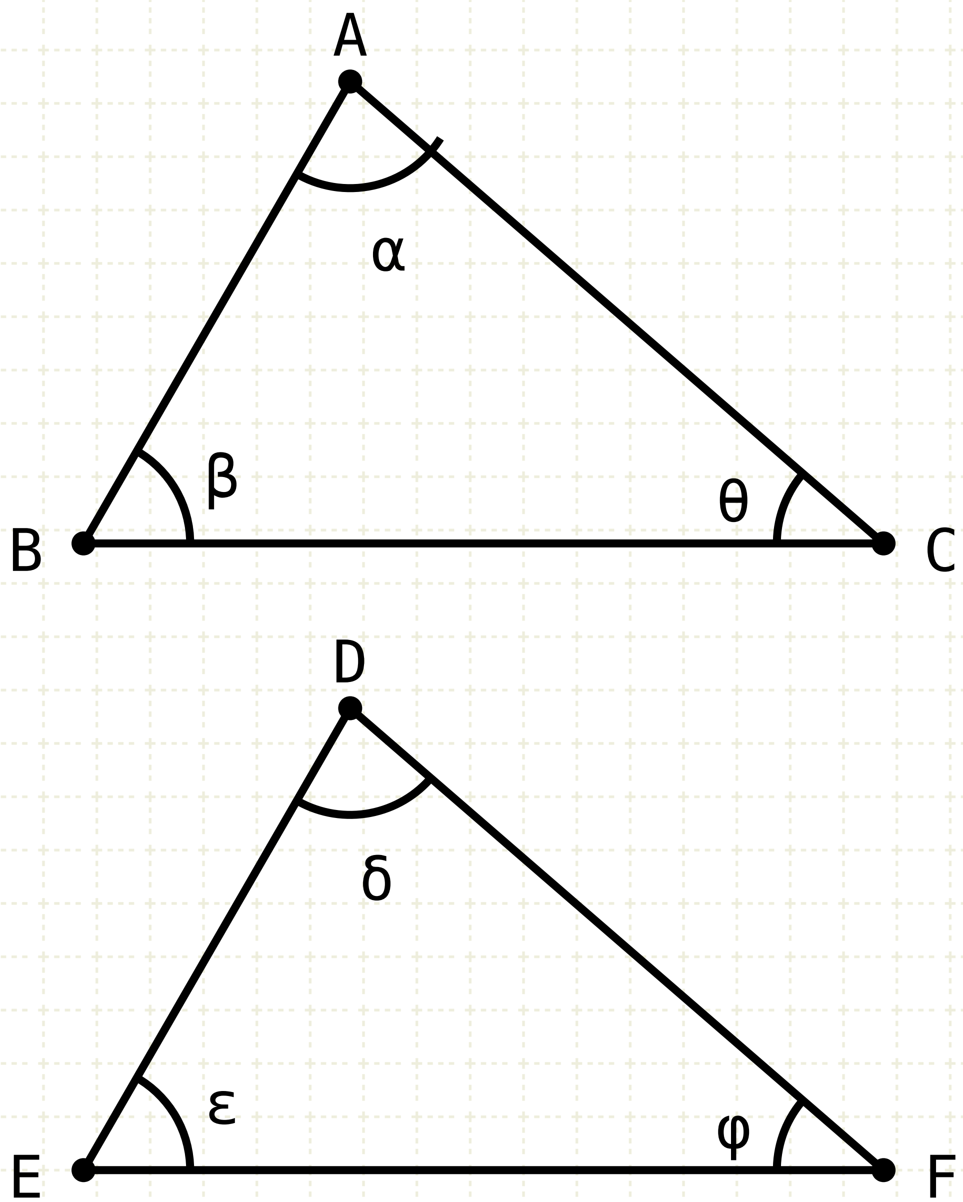


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