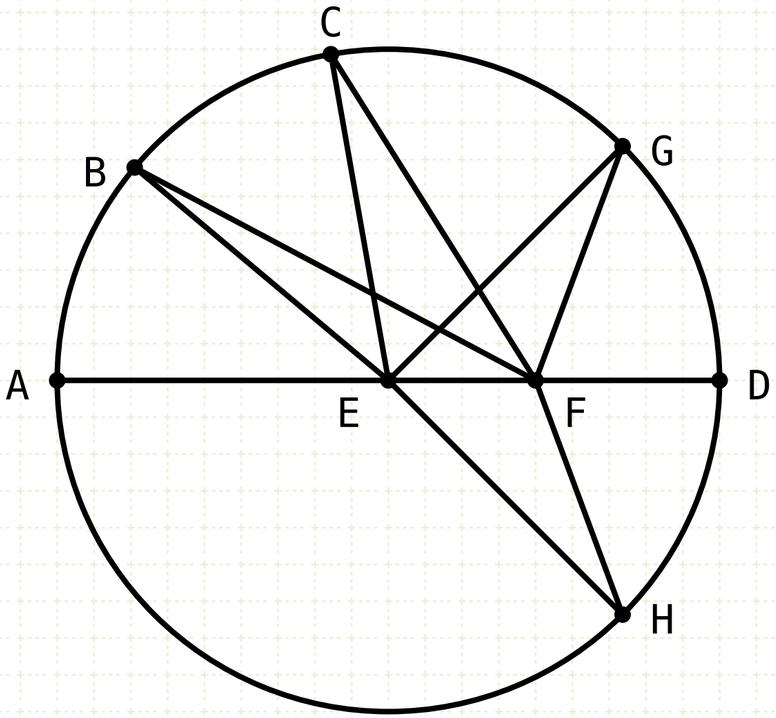
Euclid's Elements

Book III



A circle is a round straight line with a hole in the middle.

Mark Twain

quoting a schoolchild in "-English as She Is Taught-"

If people stand in a circle long enough, they'll eventually begin to dance.

George Carlin, Napalm and Silly Putty (2001)

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Proposition 33 of Book III

On a given straight line to describe a segment of a circle admitting an angle equal to a given rectilineal angle.

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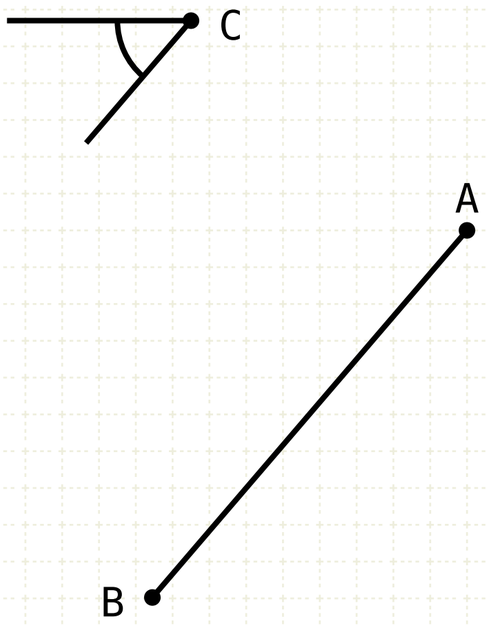
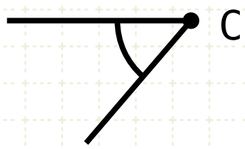


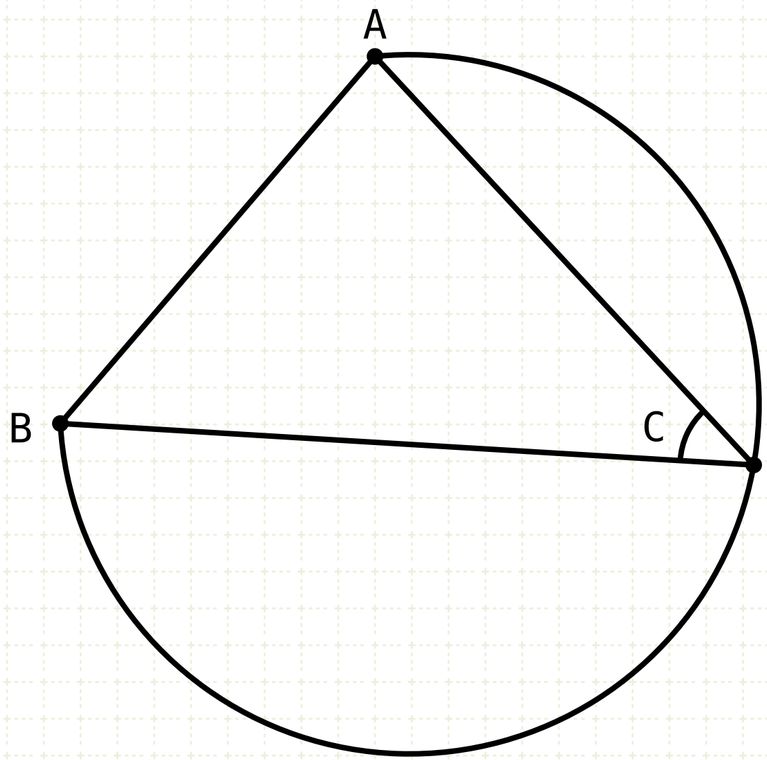
In other words

Given an angle C, and a line segment AB…

Proposition 33 of Book III

On a given straight line to describe a segment of a circle admitting an angle equal to a given rectilineal angle.





In other words

Given an angle C, and a line segment AB…

… construct a circle segment such that the angle within the segment is equal to C

Proposition 33 of Book III

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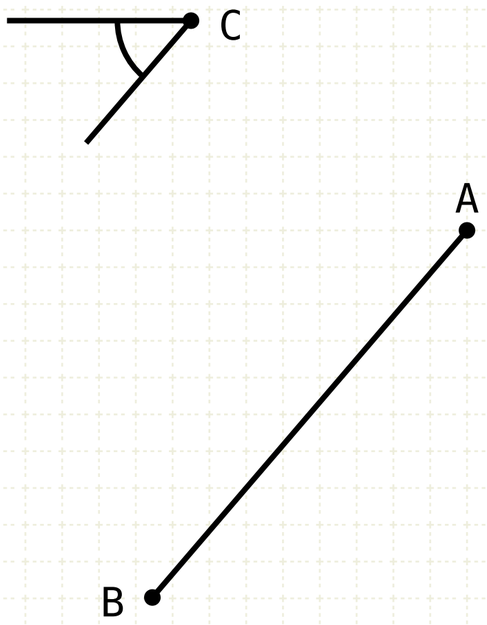

Construction (Acute Angle)

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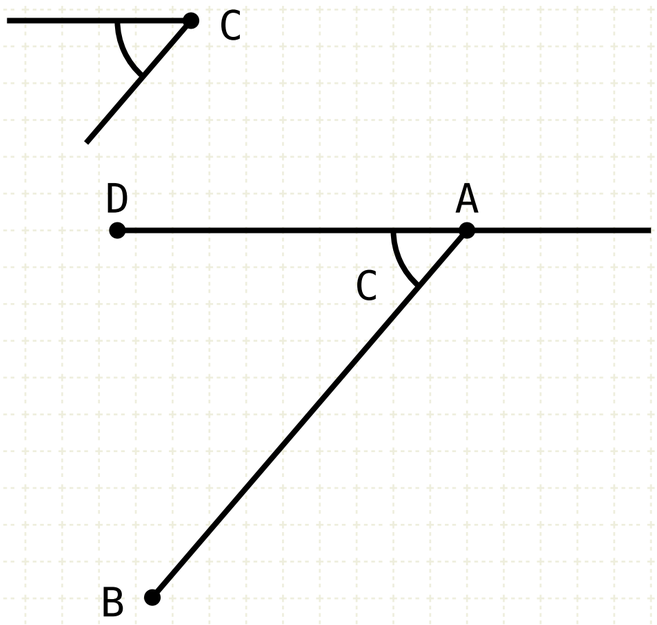

Construction (Acute Angle)

Copy the angle C to the line AB, at point A

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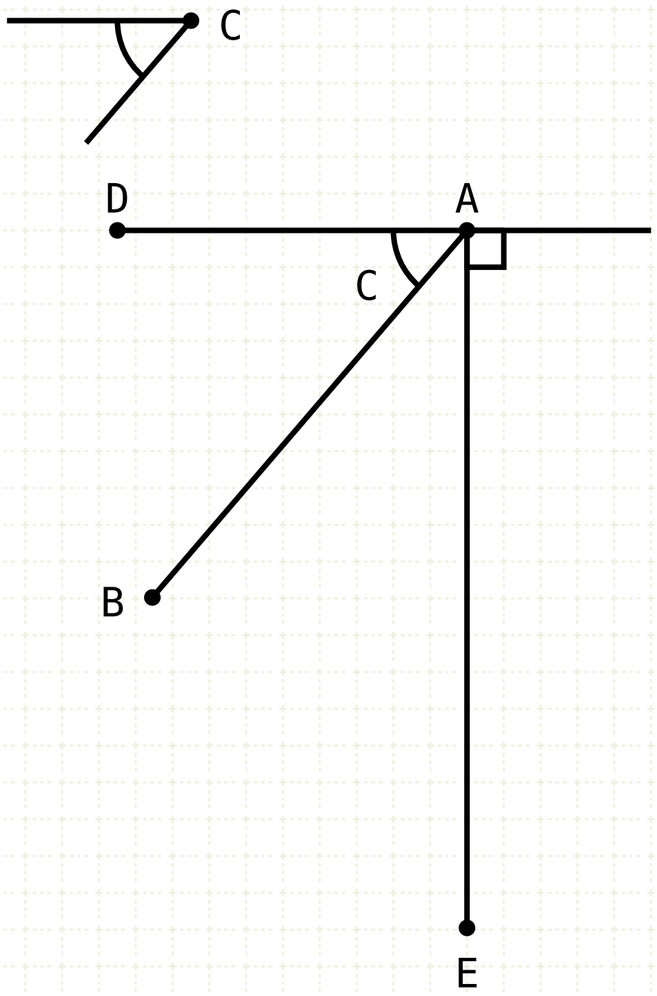

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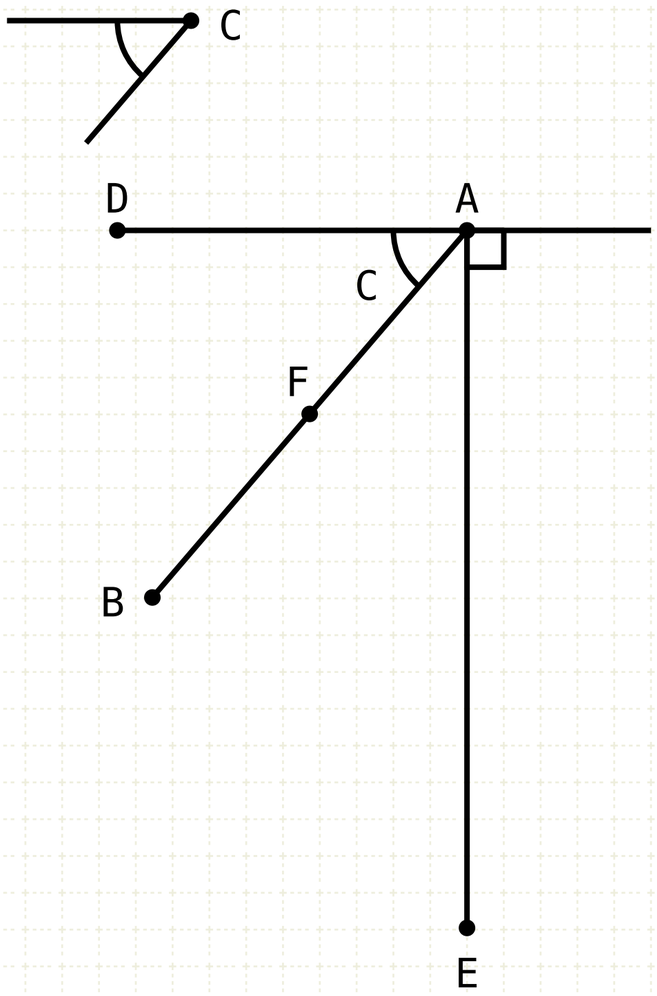

BF = FA

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Bisect line AB at point F

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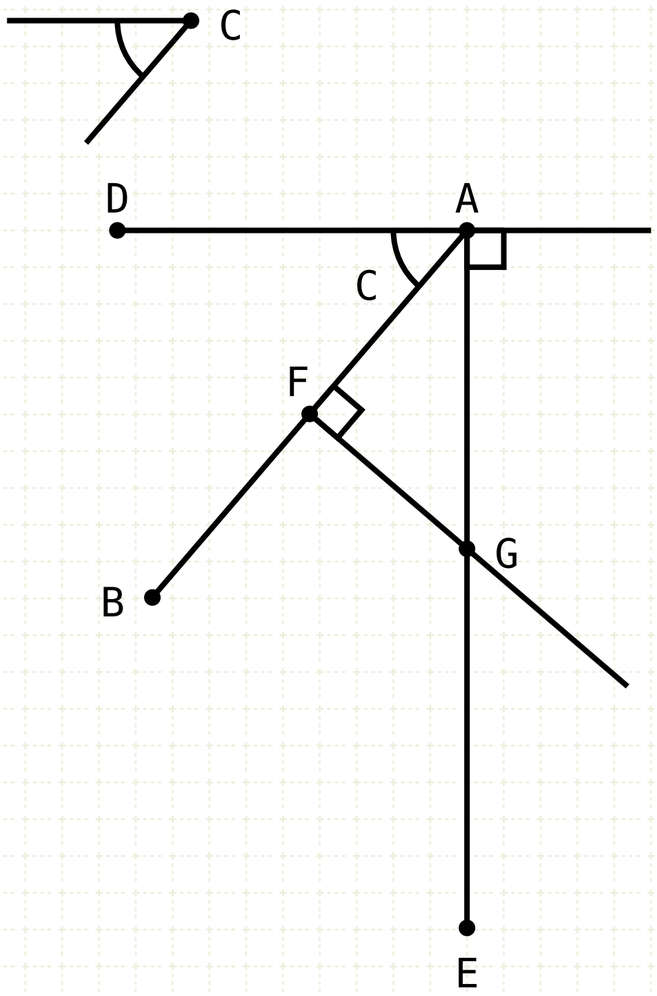

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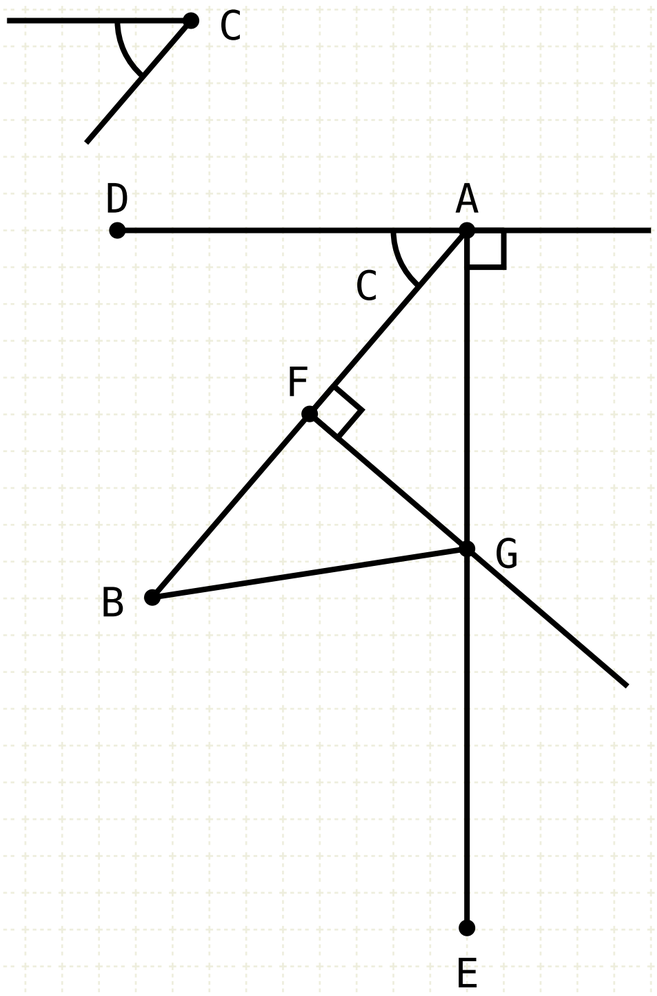

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Draw line BG

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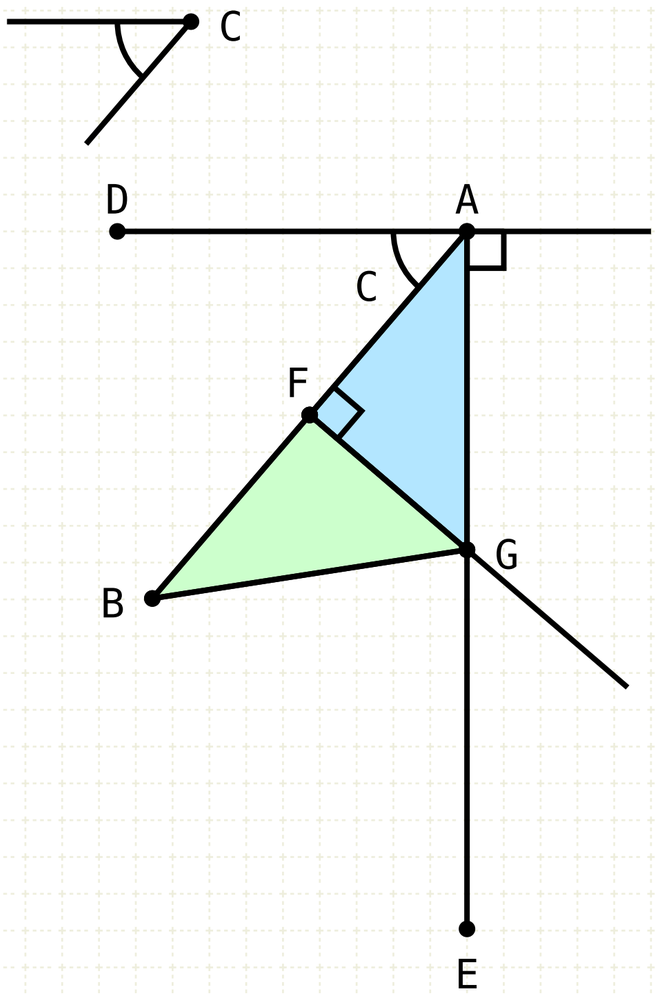

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Since BF equals FA and FG is common, and the angles AFG equals BFG, then the two triangles are equal (I·4), and the lines BG and AG are equal

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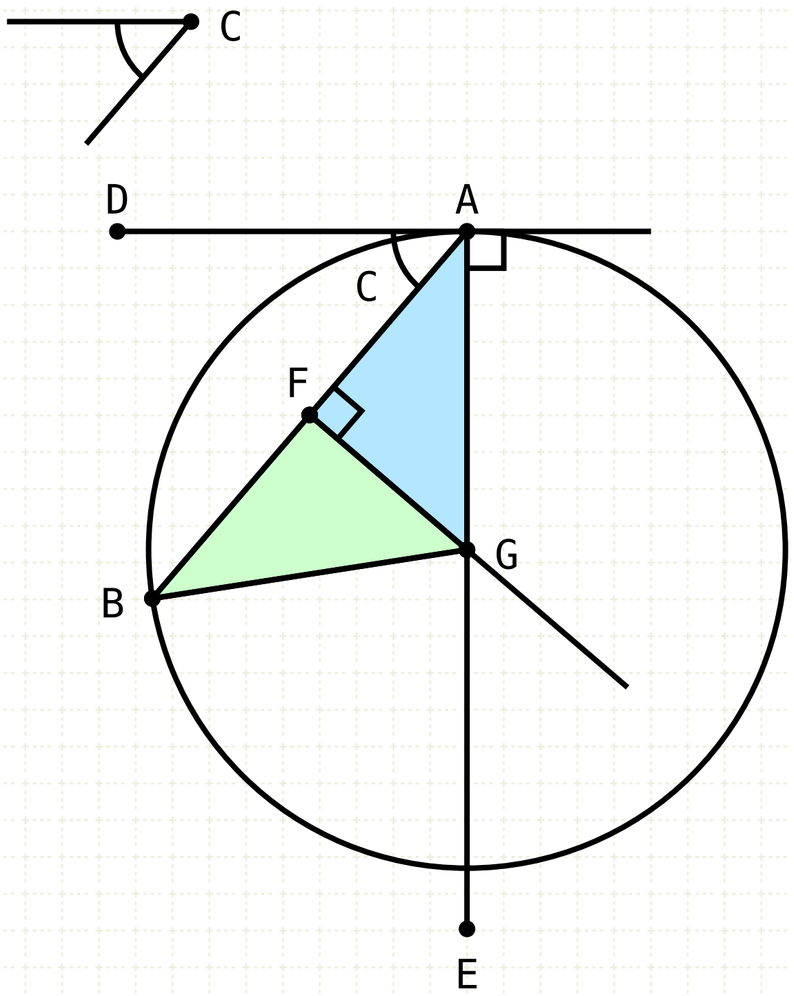

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Thus, drawing a circle with centre G and radius AG will pass through points A and B

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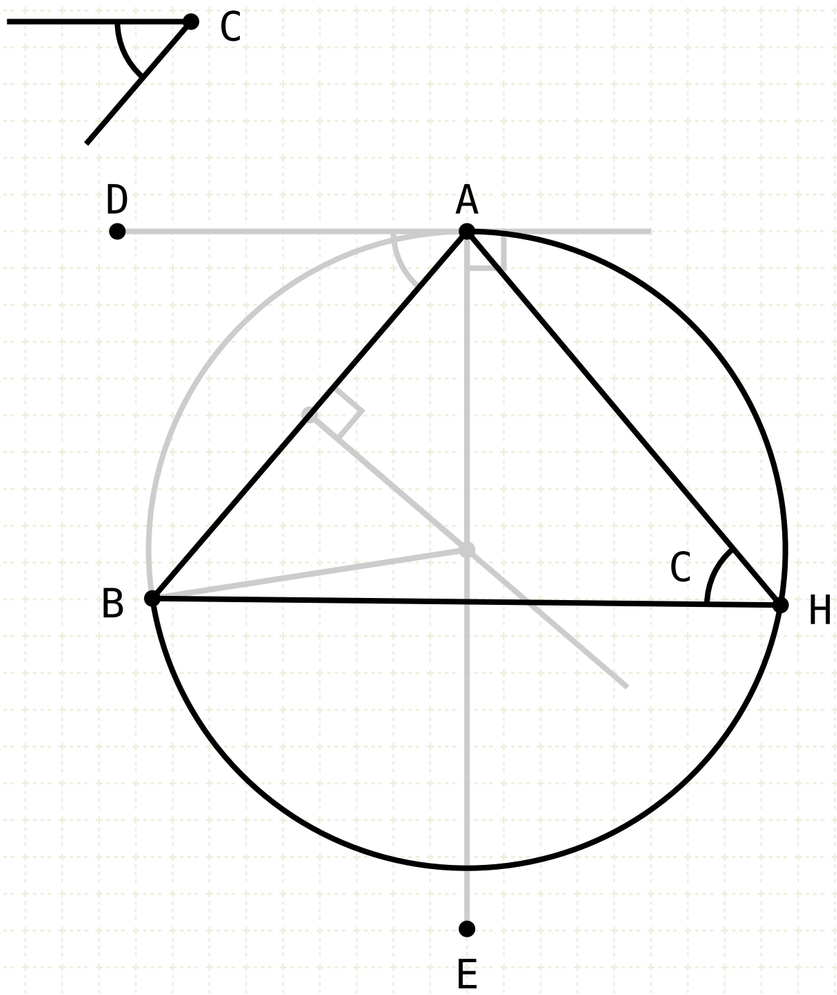

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The circle segment BHA contains the angle C

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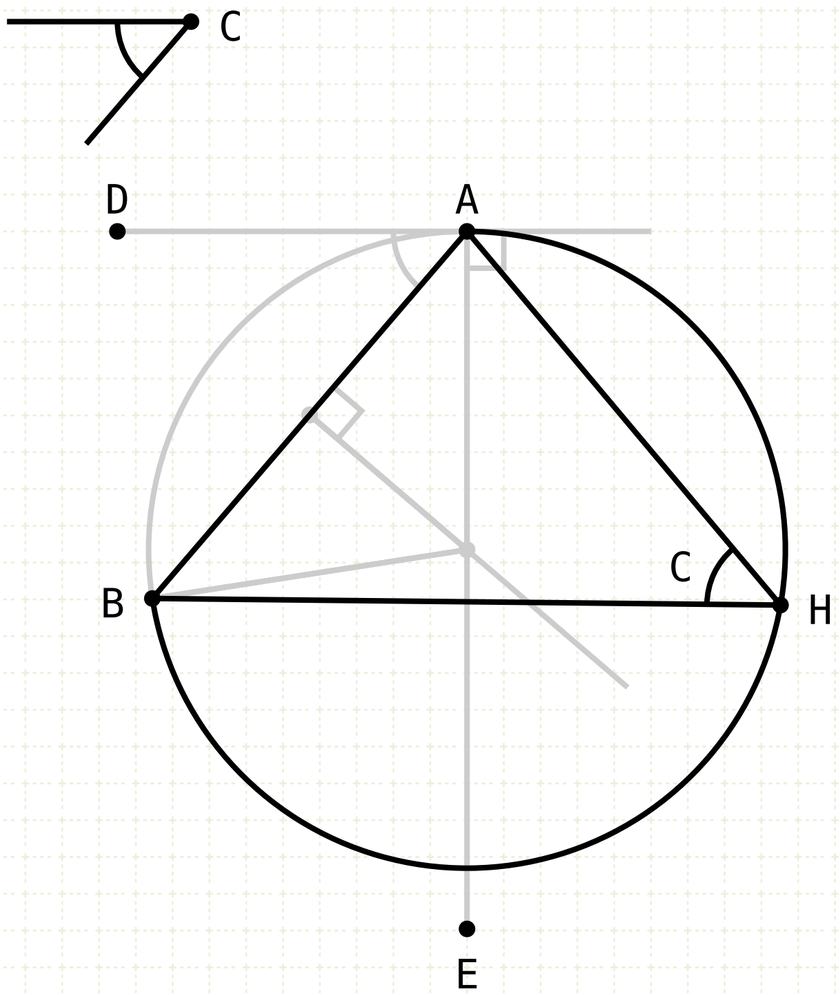

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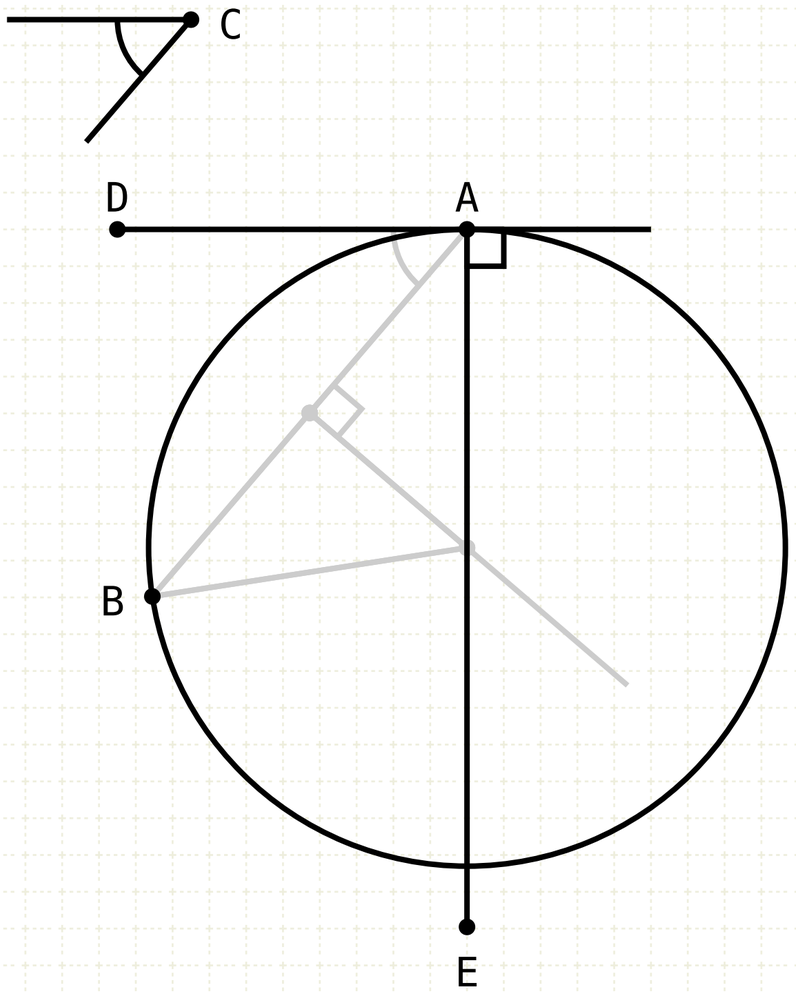

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The line AD is at the extremity of the circle diameter, and is at right angles to the diameter, thus the line AD touches the circle (III·16)

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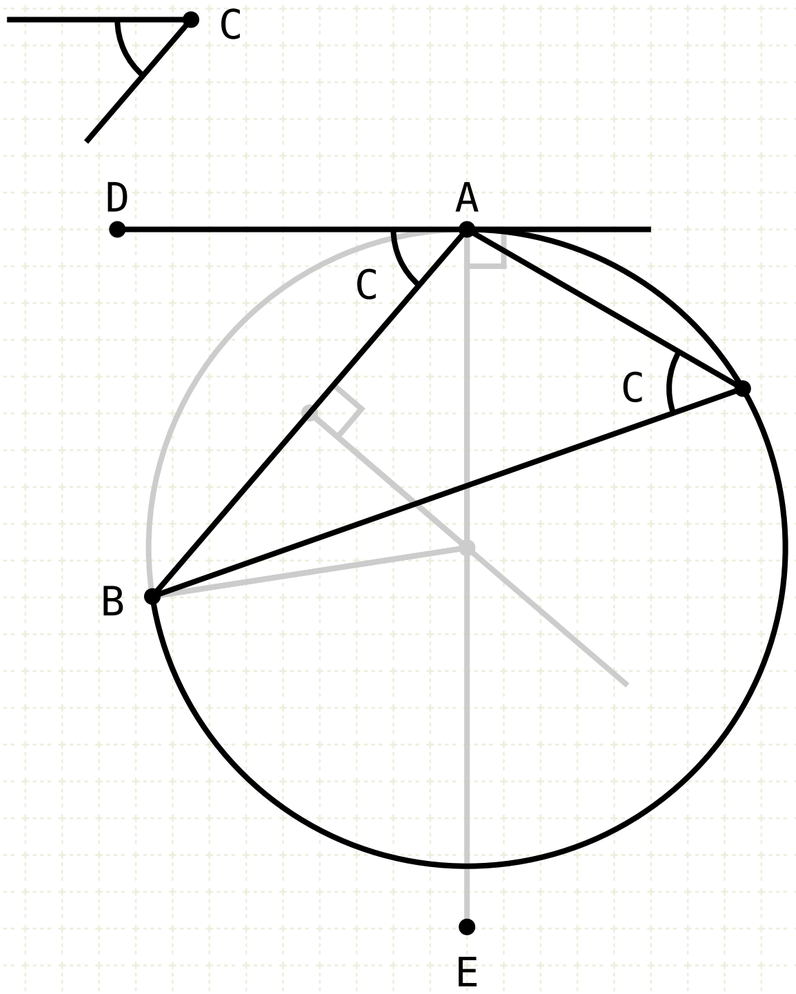

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The line AD is at the extremity of the circle diameter, and is at right angles to the diameter, thus the line AD touches the circle (III·16)

Since AD touches the circle, the angle DAB equals the angle in the opposite circle segment (III·32)

The angle DAB is equal to C by construction, so thus the angle in the segment BEA equals C

Proposition 33 of Book III

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Construction (Right Angle)

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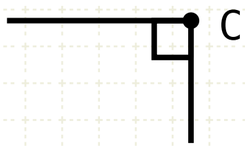

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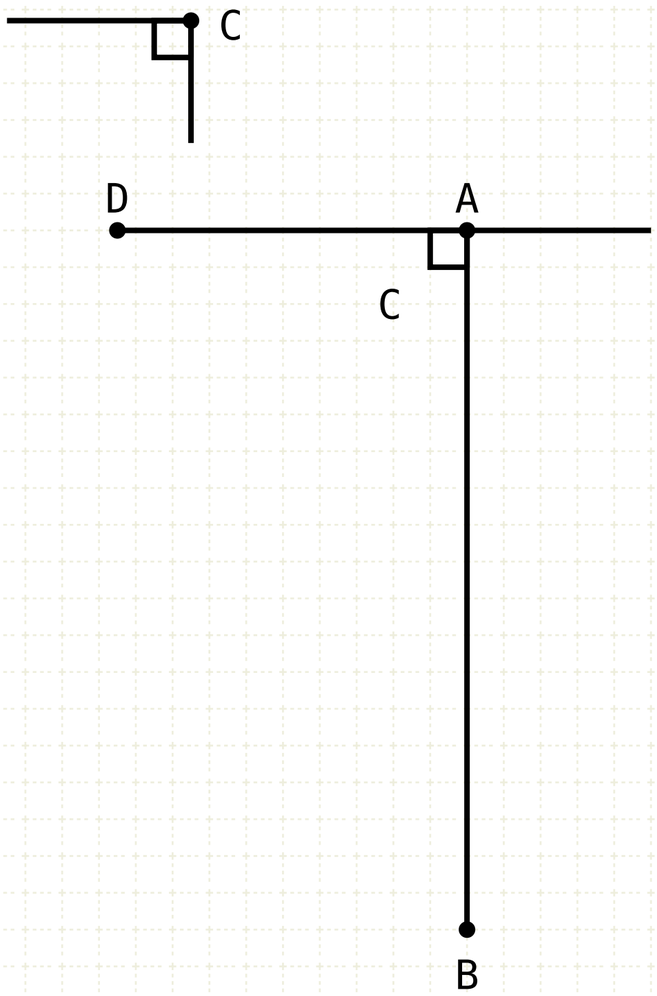

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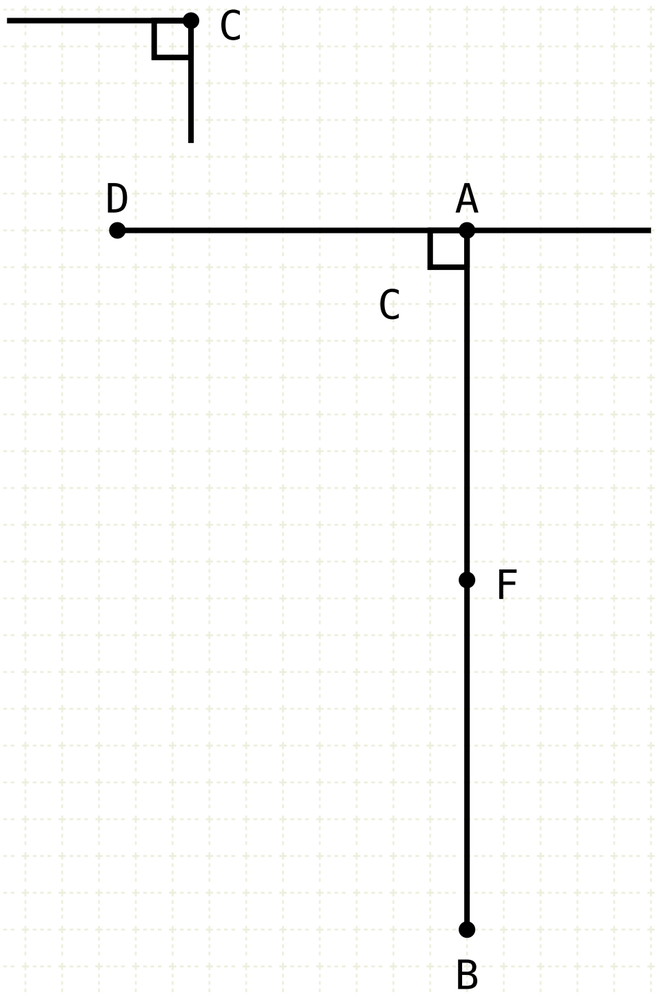

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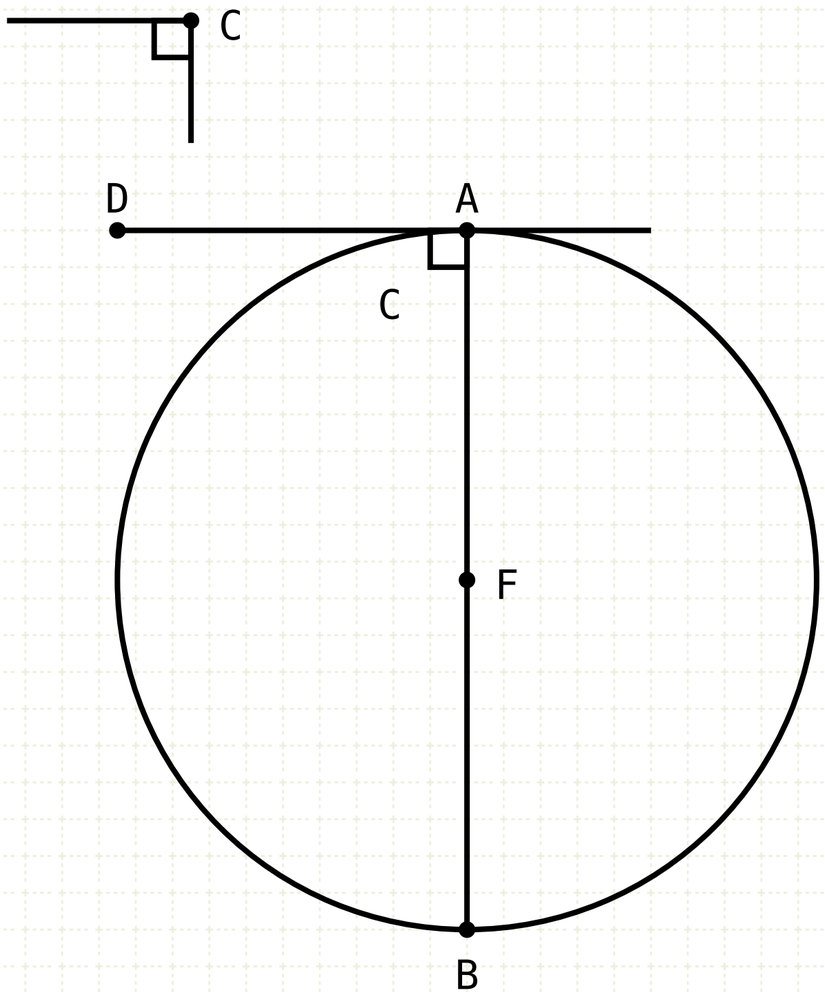

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Construction (Right Angle)

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Drawing a circle with centre F and radius AF will pass through points A and B

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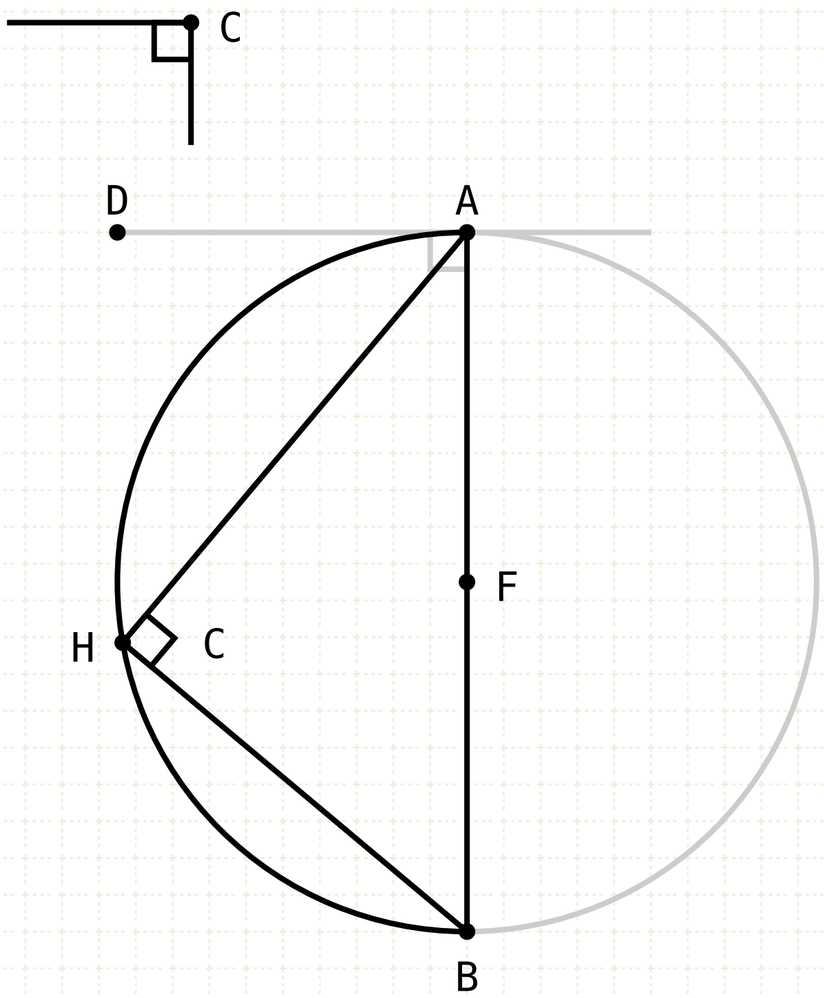

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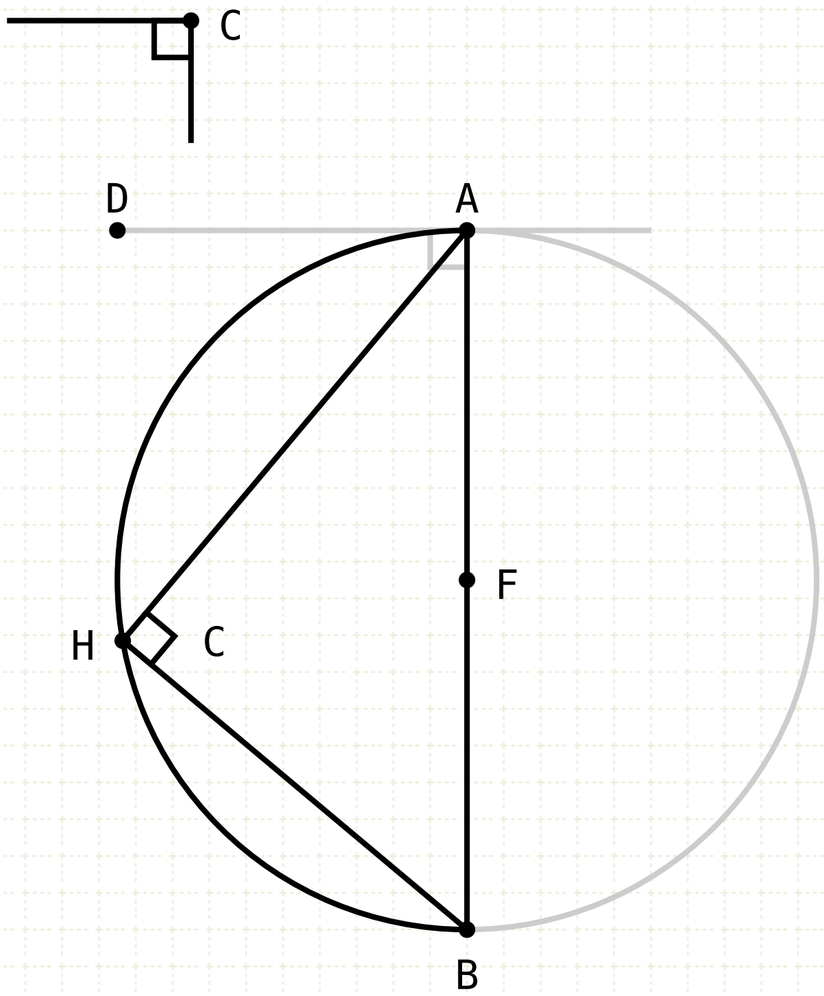

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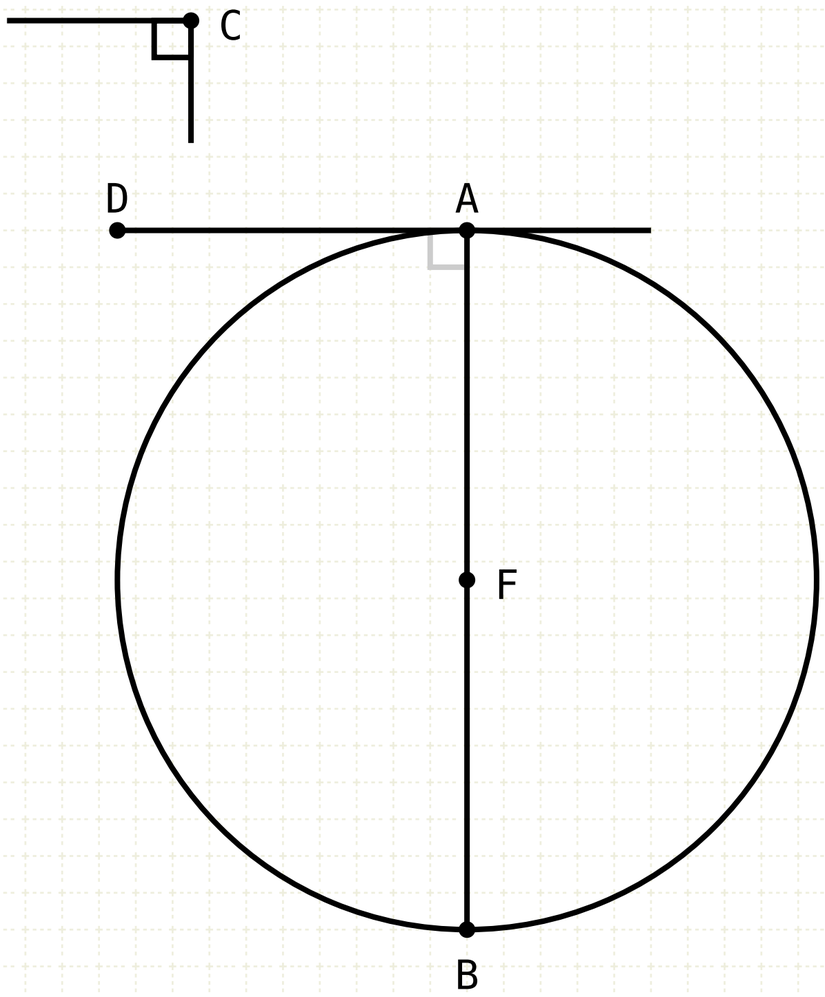

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The line AD is at the extremity of the circle diameter, and is at right angles to the diameter, thus the line AD touches the circle (III·16)

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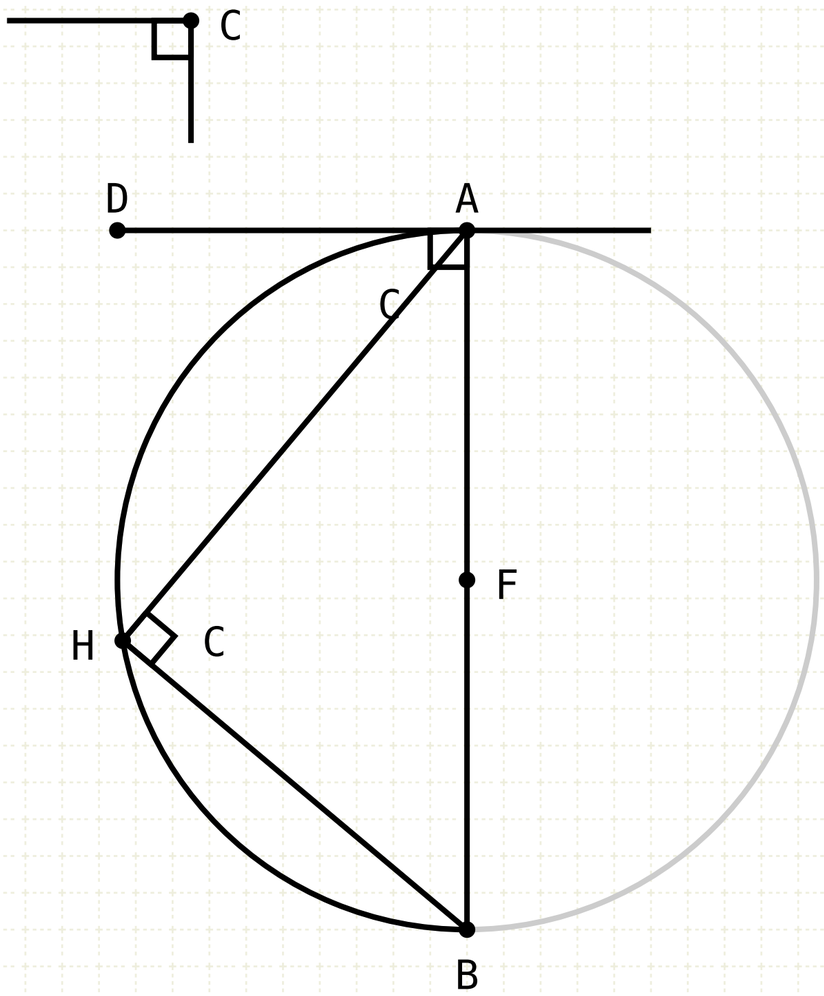

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The circle segment BHA contains the angle C

Proof

The line AD is at the extremity of the circle diameter, and is at right angles to the diameter, thus the line AD touches the circle (III·16)

The angle ACB is right, because it is in a semi-circle (III·31), which is equal to the angle C

Proposition 33 of Book III

On a given straight line to describe a segment of a circle admitting an angle equal to a given rectilineal angle.

Construction (Obtuse Angle)

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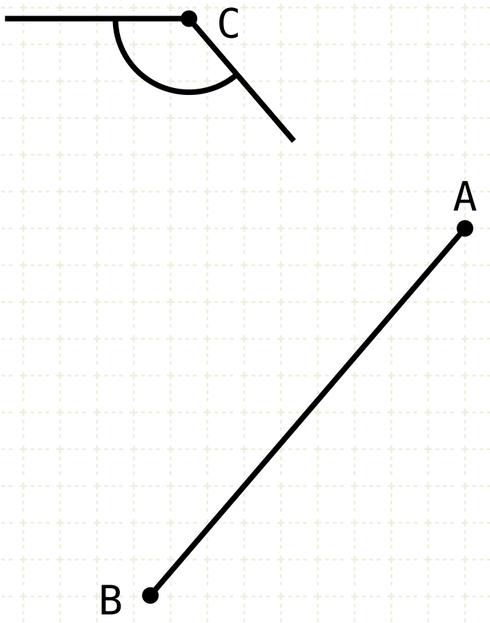

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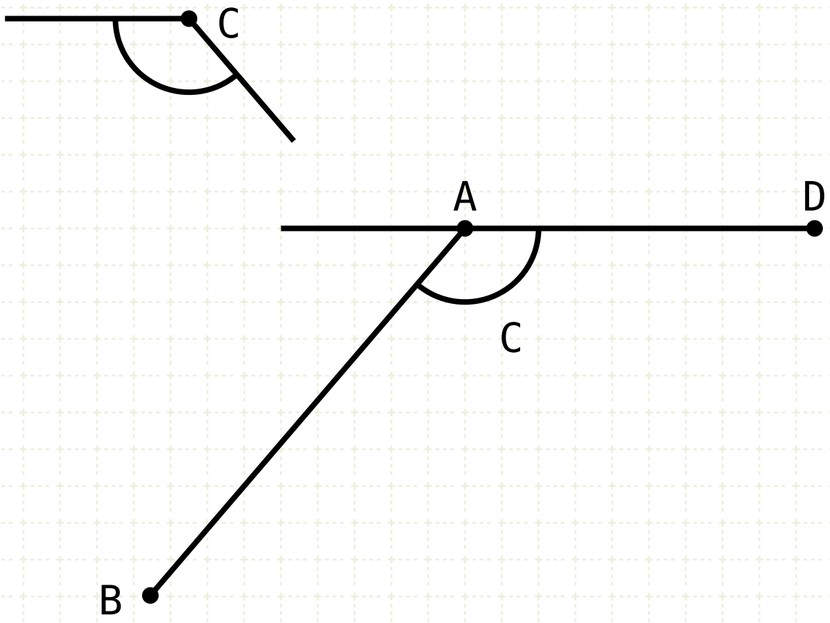

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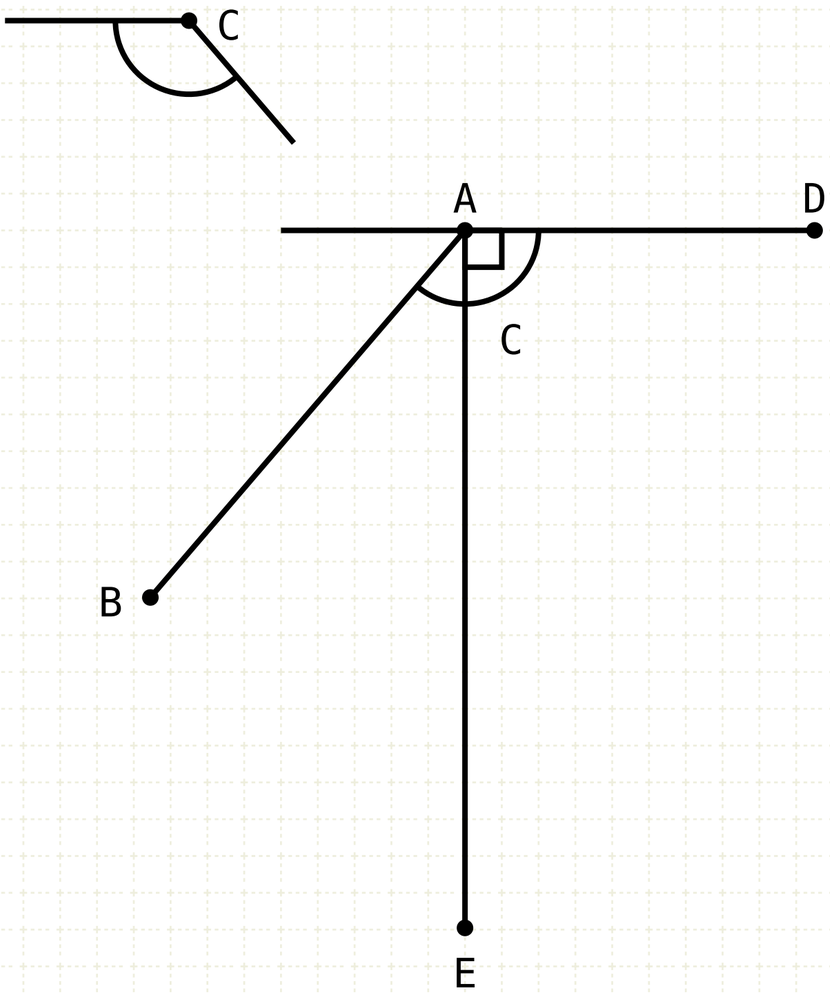

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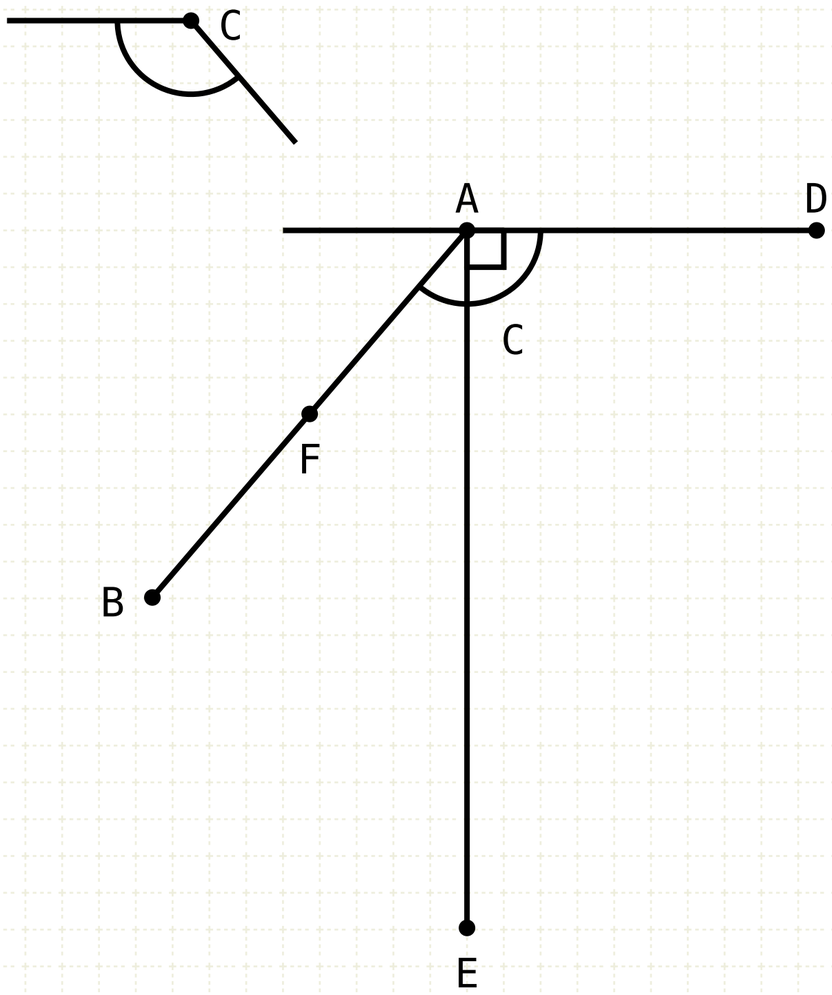

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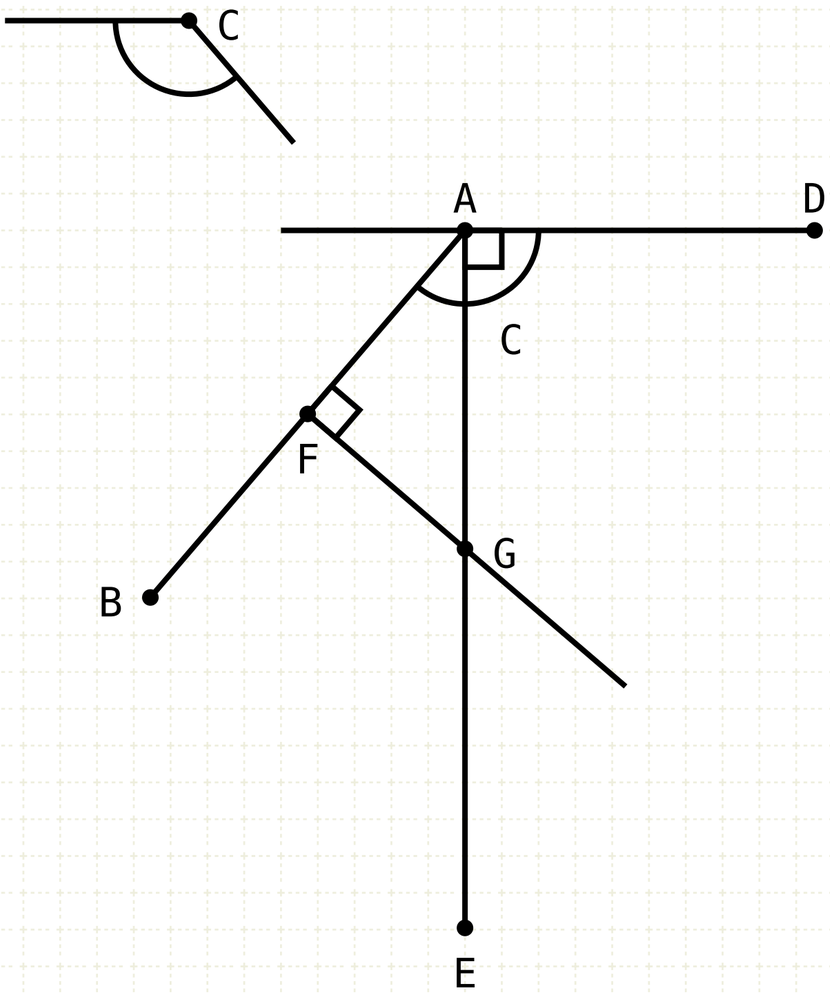

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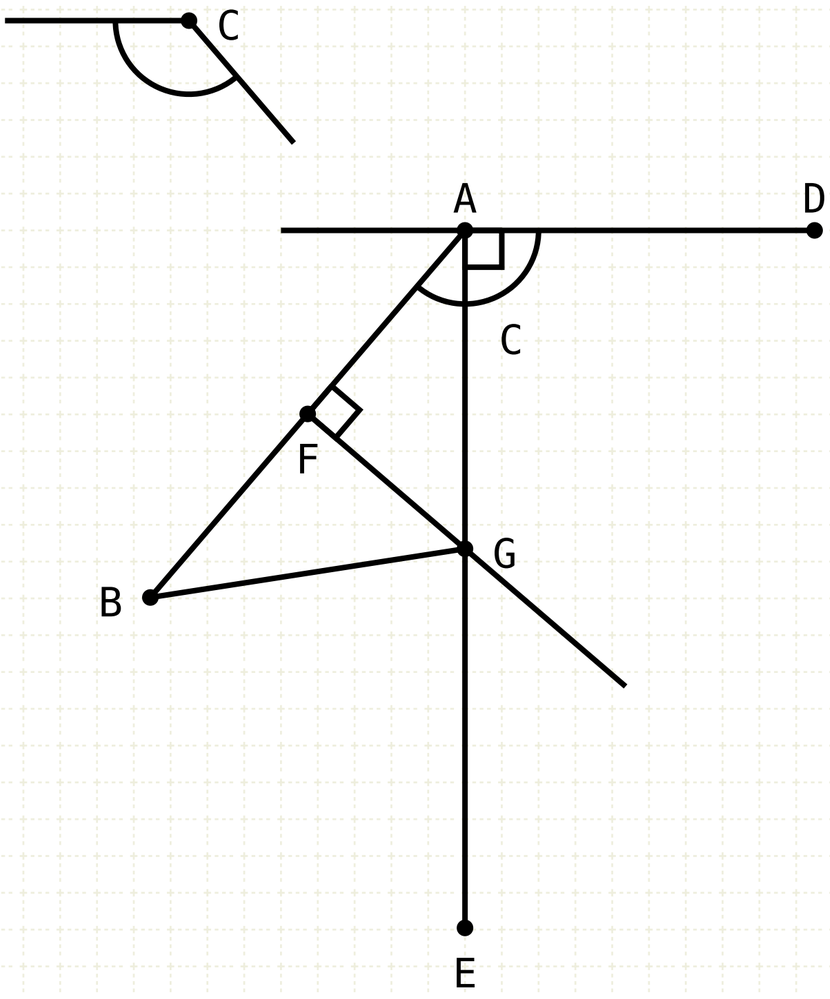

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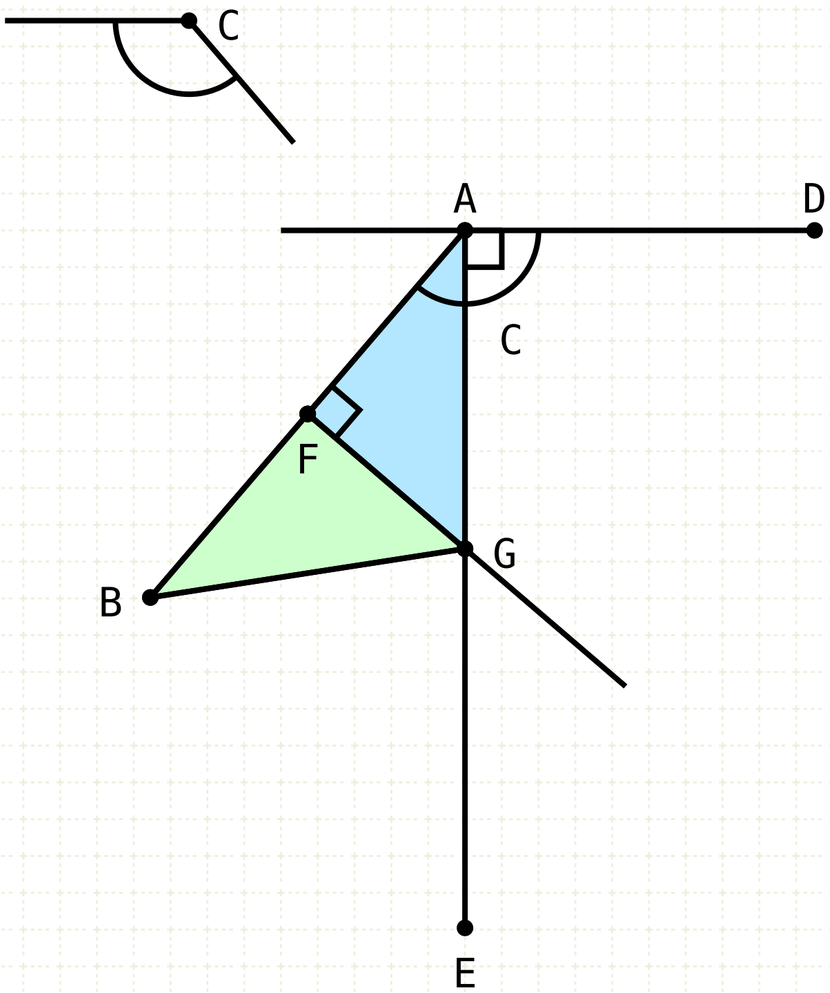

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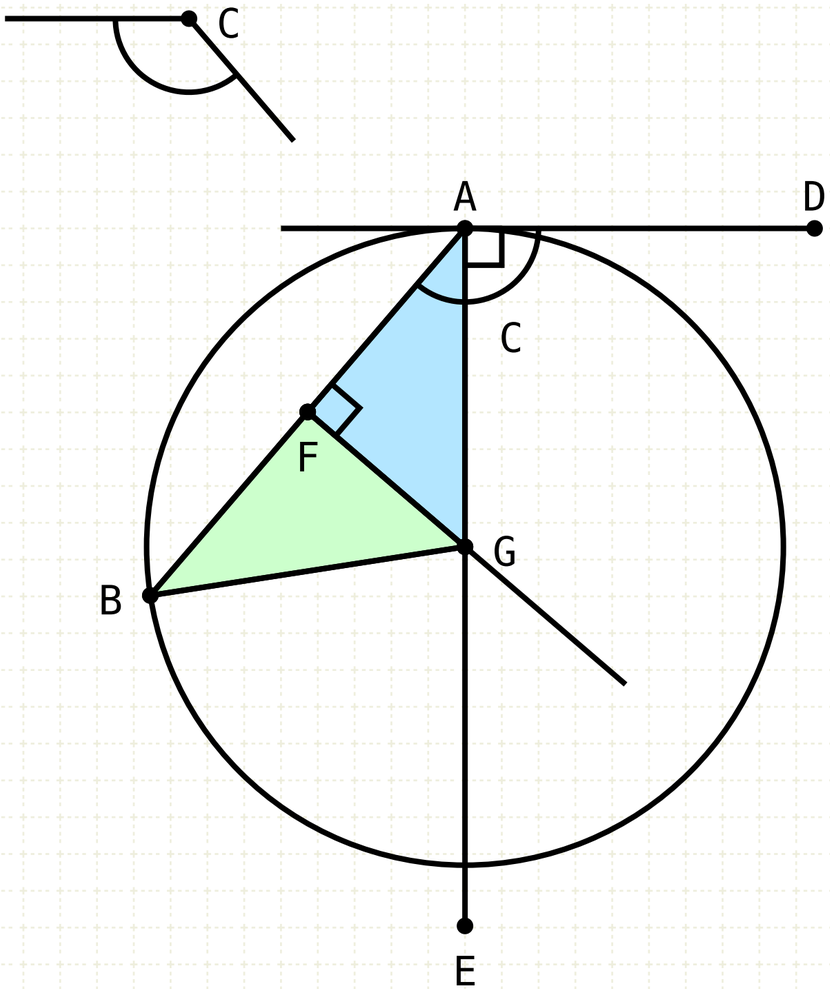
Since BF equals FA and FG is common, and the angles AFG equals BFG, then the two triangles are equal (I·4), and the lines BG and AG are equal

Proposition 33 of Book III

On a given straight line to describe a segment of a circle admitting an angle equal to a given rectilineal angle.



BF = FA
BG = AG

Construction (Obtuse Angle)

Copy the angle C to the line AB, at point A

Draw a line perpendicular to AD, from point A

Bisect line AB at point F

Draw a line FG perpendicular to AB from point F, where G is the intersection between this line and AE

Draw line BG

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Thus, drawing a circle with centre G and radius AG will pass through points A and B

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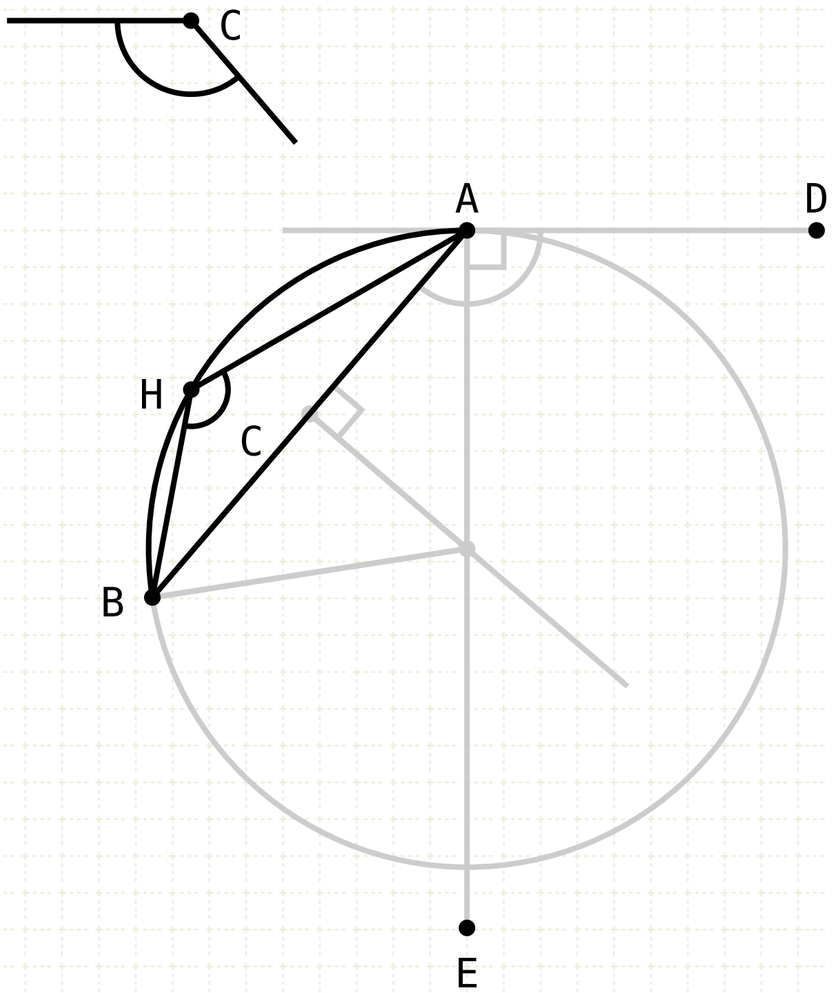

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The circle segment BHA contains the angle C

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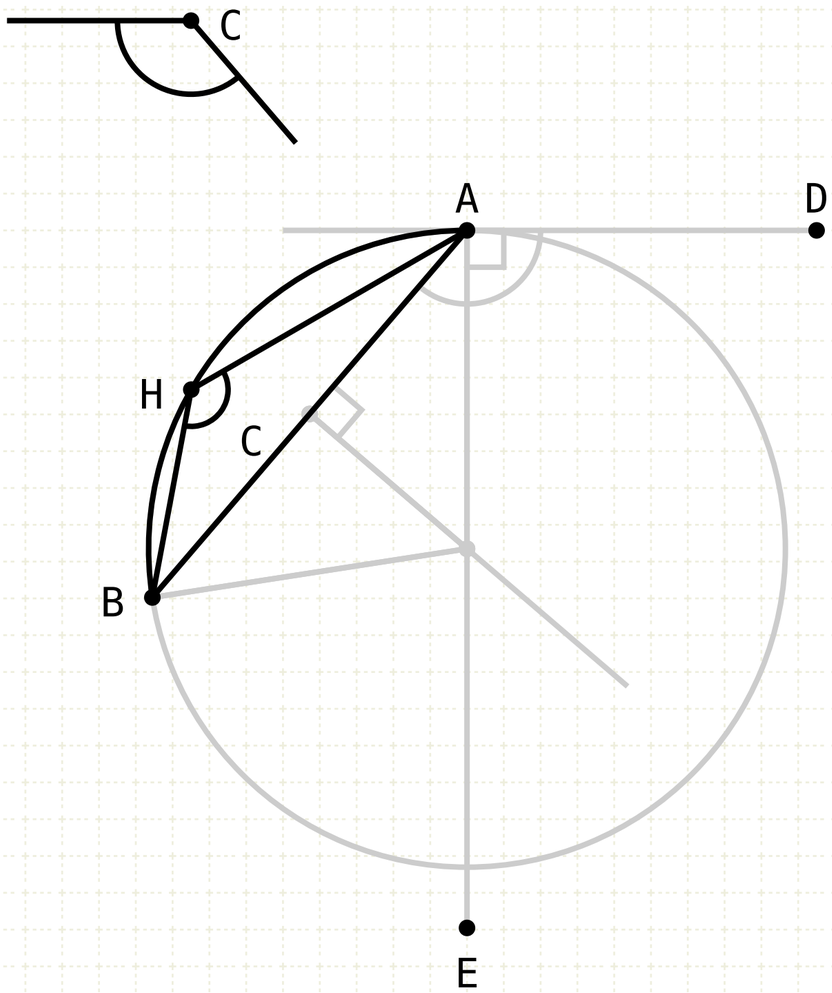

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Proof

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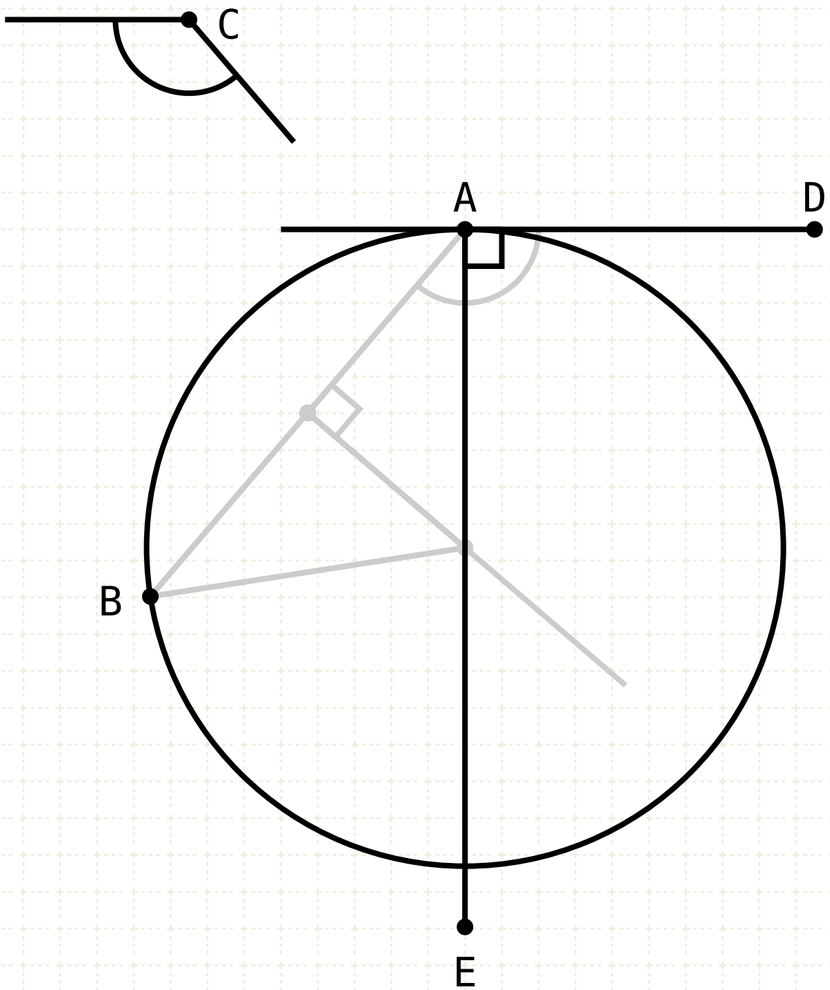

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BG = AG

Proof

The line AD is at the extremity of the circle diameter, and is at right angles to the diameter, thus the line AD touches the circle (III·16)

Proposition 33 of Book III

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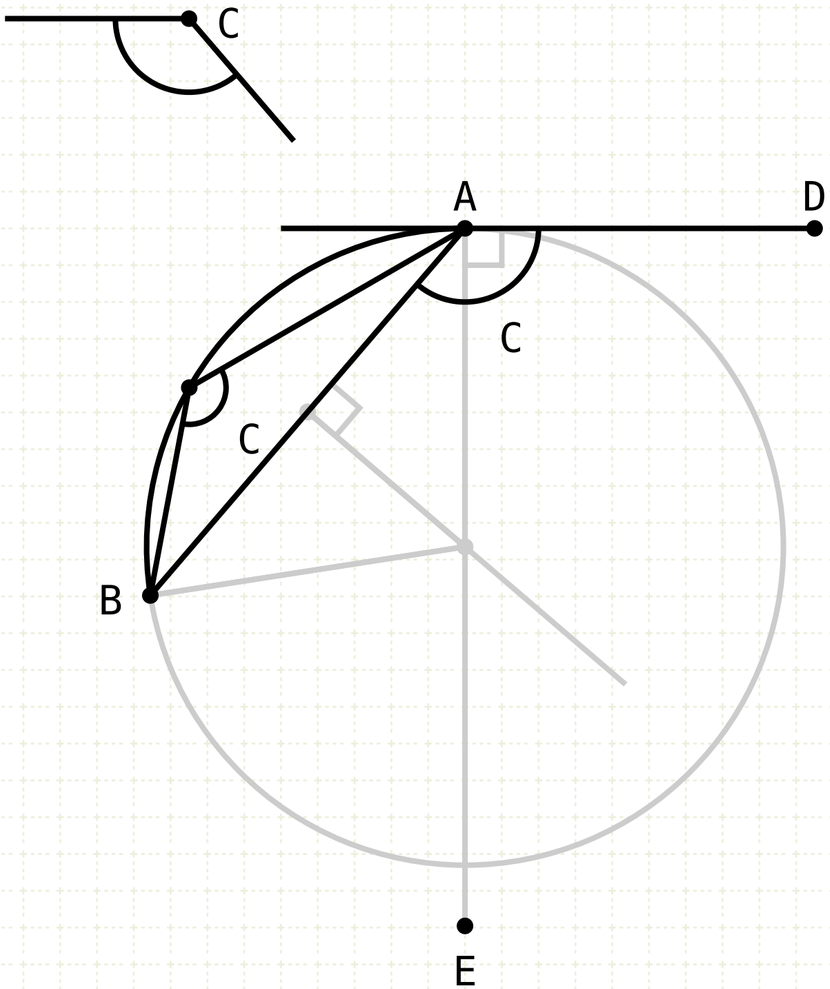

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Proof

The line AD is at the extremity of the circle diameter, and is at right angles to the diameter, thus the line AD touches the circle (III·16)

Since AD touches the circle, the angle DAB equals the angle in the opposite circle segment (III·32)

The angle DAB is equal to C by construction, so thus the angle in the segment BEA equals C

Proposition 33 of Book III

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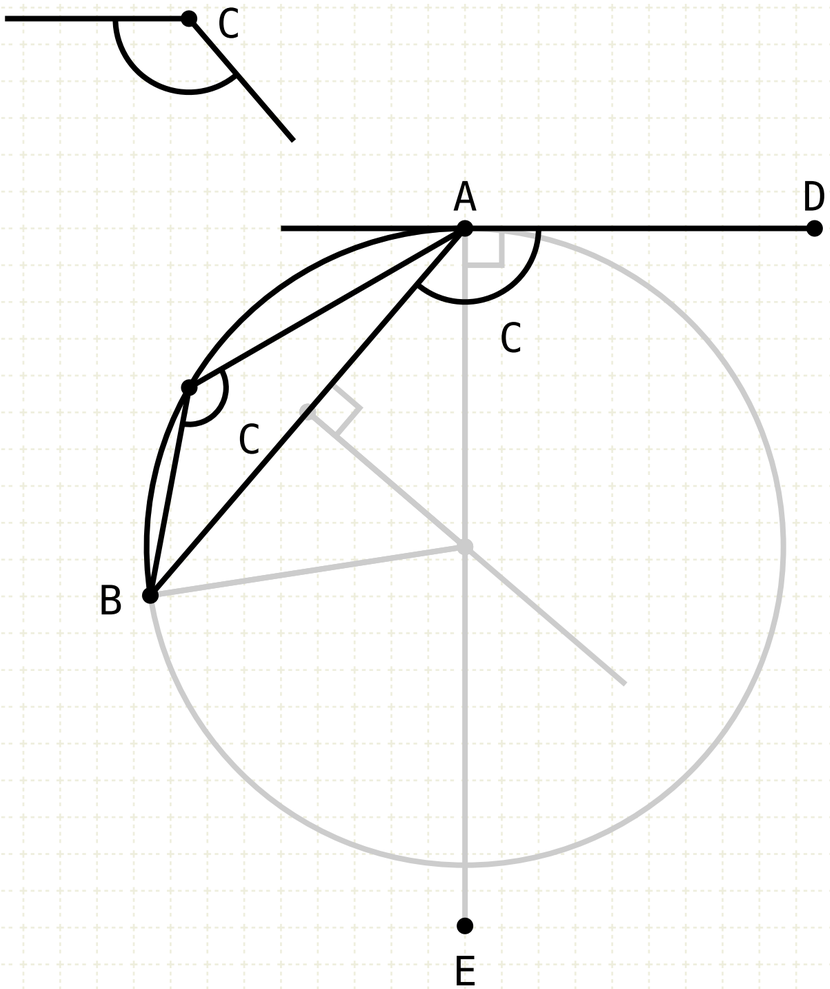

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