

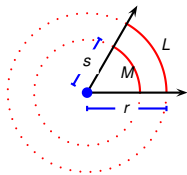
Precalculus

Find circle arclength from radius and angle

Todor Milev

2019

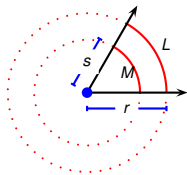
Arc-length of a circle arc



Proposition

Let two circles have common center and radii s and r . Suppose an arbitrary geometric angle with vertex at the common center of the circles cuts off short arcs of length M and L . Then $\frac{s}{r} = \frac{M}{L}$.

Arc-length of a circle arc

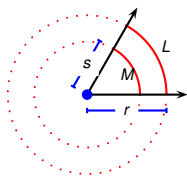


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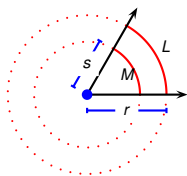
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$$\frac{s}{r} = \frac{M}{L}$$

$$\frac{1}{r} = \frac{\alpha}{L}$$

Choose $s = 1$, relabel $M = \alpha$

Arc-length of a circle arc



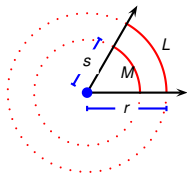
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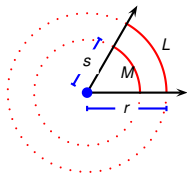
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$$\begin{aligned} \frac{s}{r} &= \frac{M}{L} \\ \frac{1}{r} &= \frac{\alpha}{L} \\ \frac{\textcolor{red}{L}}{r} &= \alpha r \end{aligned}$$

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Arc-length of a circle arc



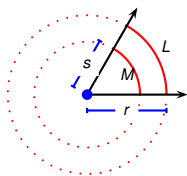
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Arc-length of a circle arc



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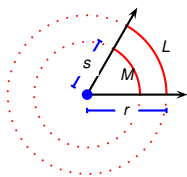
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The angle-measure of a geometric angle is the arc-length cut off from a radius 1 circle, therefore we get the following.

Arc-length of a circle arc



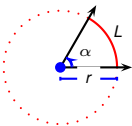
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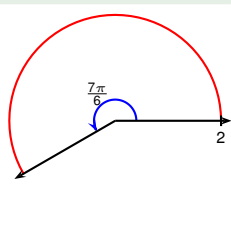
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Corollary

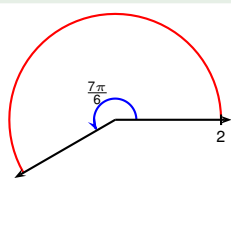
The arc-length cut off by an angle with measure α from a circle of radius r equals αr .

Example



Find the length of an arc of a circle of radius 2 cut off by an angle of measure $\frac{7\pi}{6}$ ($= 210^\circ$).

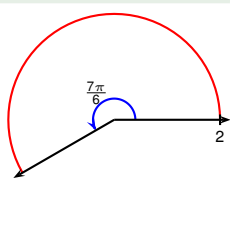
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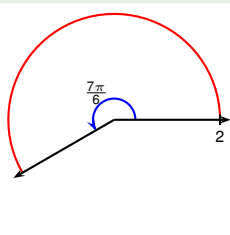
Example



Find the length of an arc of a circle of radius 2 cut off by an **angle of measure** $\frac{7\pi}{6}$ ($= 210^\circ$).

$$\text{arc-length} = \alpha r = \frac{7\pi}{6} \cdot 2$$

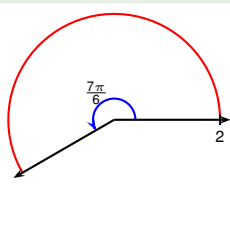
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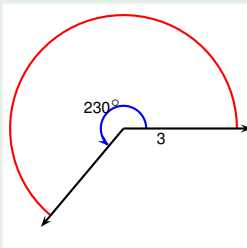
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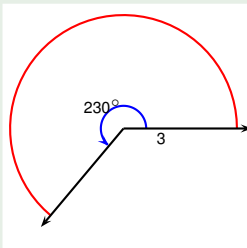
$$\text{arc-length} = \alpha r = \frac{7\pi}{6} \cdot 2 = \frac{7\pi}{3} \approx 7.33038 \text{ (units)}$$

Example



Find the length of an arc of a circle of radius 3 cut off by an angle of measure 230° .

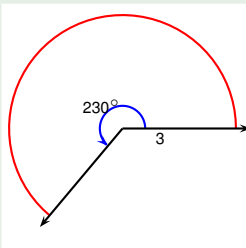
Example



Find the length of an arc of a circle of radius 3 cut off by an angle of measure 230° .

$$\text{arc-length} = ar$$

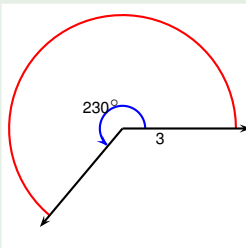
Example



Find the length of an arc of a circle of **radius 3** cut off by an angle of measure 230° .

$$\text{arc-length} = \alpha r = ? \cdot 3$$

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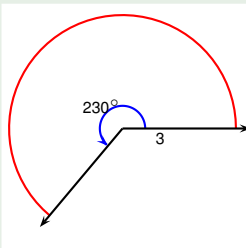


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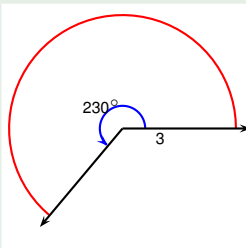
$$\alpha = 230^\circ$$

$$= ?$$

Convert to radians

$$\text{arc-length} = \alpha r = ? \cdot 3$$

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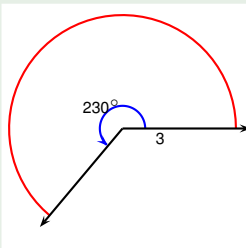
$$\alpha = 230^\circ$$

$$= 230^\circ \frac{\pi \text{ rad}}{180^\circ}$$

Convert to radians

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Example



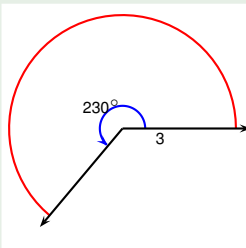
Find the length of an arc of a circle of radius 3 cut off by an angle of measure 230° .

$$\begin{aligned}\alpha &= 230^\circ \\ &= 230^\circ \frac{\pi \text{ rad}}{180^\circ} = \frac{23}{18} \pi \text{ rad}\end{aligned}$$

Convert to radians

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Find the length of an arc of a circle of radius 3 cut off by an angle of measure 230° .

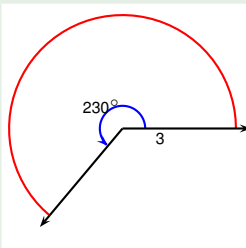
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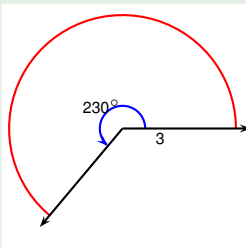
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$$\text{arc-length} = \alpha r = \frac{23\pi}{18} \cdot 3 = \frac{23\pi}{6}$$

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Convert to radians

$$\text{arc-length} = \alpha r = \frac{23\pi}{18} \cdot 3 = \frac{23\pi}{6} \approx 12.043$$