Programming in KeTCindy with Combined Use of Cinderella and Maxima

Setsuo Takato

Toho University,Japan

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Producing Class Materials

Printed Materials with KETCindy

- **Math teachers often distribute printed materials to their alumni.**
- For such materials, figures presented as line drawings are better suited.
- Because students can write their own remarks over them on the paper.
- KETCindy can produce fine figures for LaTeX.

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KETCindy=KETpic+Cinderella

- We have developed KETpic, a macro package of mathematical softwares, as an easy drawing tool for LaTeX.
- Cinderella is a dynamic geometry software developed by Gebert and Kortenkamp.
- We had been exploring the possibility of using Cinderella as the GUI of KETpic.
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Contribution of CindyScript

- **CindyScript(CS) is the programming language of Cinderella.**
- Codes of KETCindy are written with CS.
- Cindy(=Cinderella) screen is used :
  - to put geometric elements,
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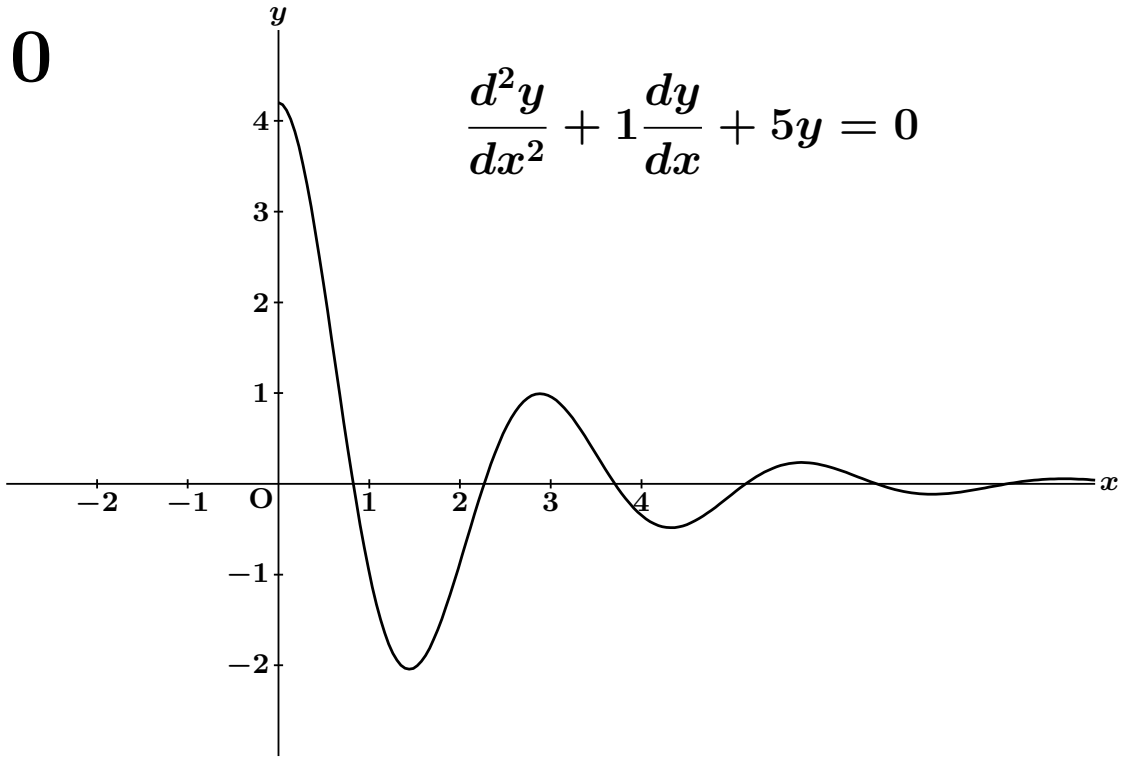
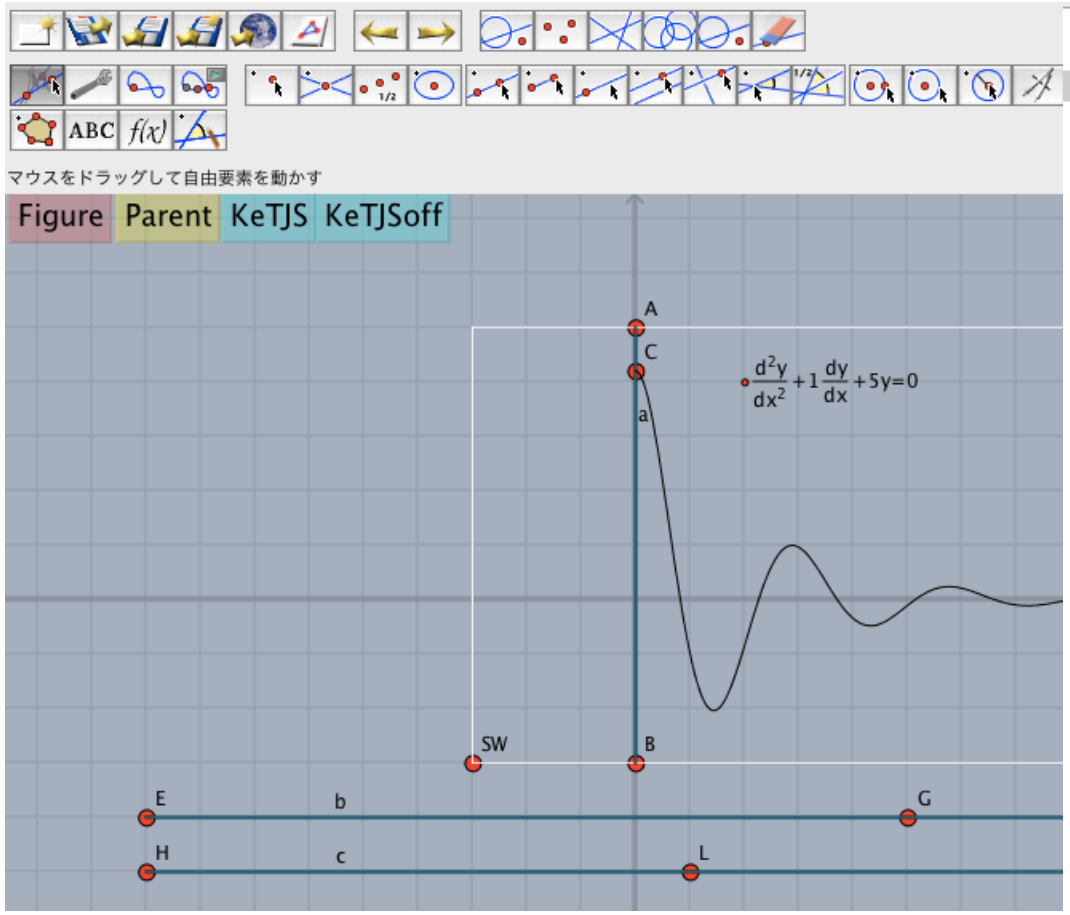
Example of printed materials

Ex) Solve the differential equation

$$\frac{d^2y}{dx^2} + \frac{dy}{dx} + 5y = 0$$



Cindy Screen and Scripts




```
figures   タブ幅 2 16 CindyScript
 1 Ketinit();
 2 Deqplot("2","y''=-L.x*y'-G.x*y",
 3   "t=[0,XMAX]",
 4   0,[C.y,0],["Num=200","dr,1.5"]);
 5 Expr(M,"e","\dfrac{d^2 y}{dx^2}+"
 6   +L.x+"\dfrac{dy}{dx}+"+G.x+"y=0");
 7 Windispg();
 8
 9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
/Users/takatoosetsuo/ketcindy
fig already exists
/kc.sh executable
```

Free Placement of Figures

We can arrange figures at any position on the paper.

```
\begin{layer}{120}{0}

\putnotese{58}{17}{\input{fig/deq1.tex}}

\end{layer}
```

Materials with Presentation Slides

- KETCindy has a function, KeTslide, to produce slides for presentation with LaTeX.
- For math materials, expressions and proper figures are of fundamental importance.
- KeTslide can be handled easily, so will be suitable for usual mathematics teachers.
- Anime and Flip Anime are also available.

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Example 1 of Flip Anime

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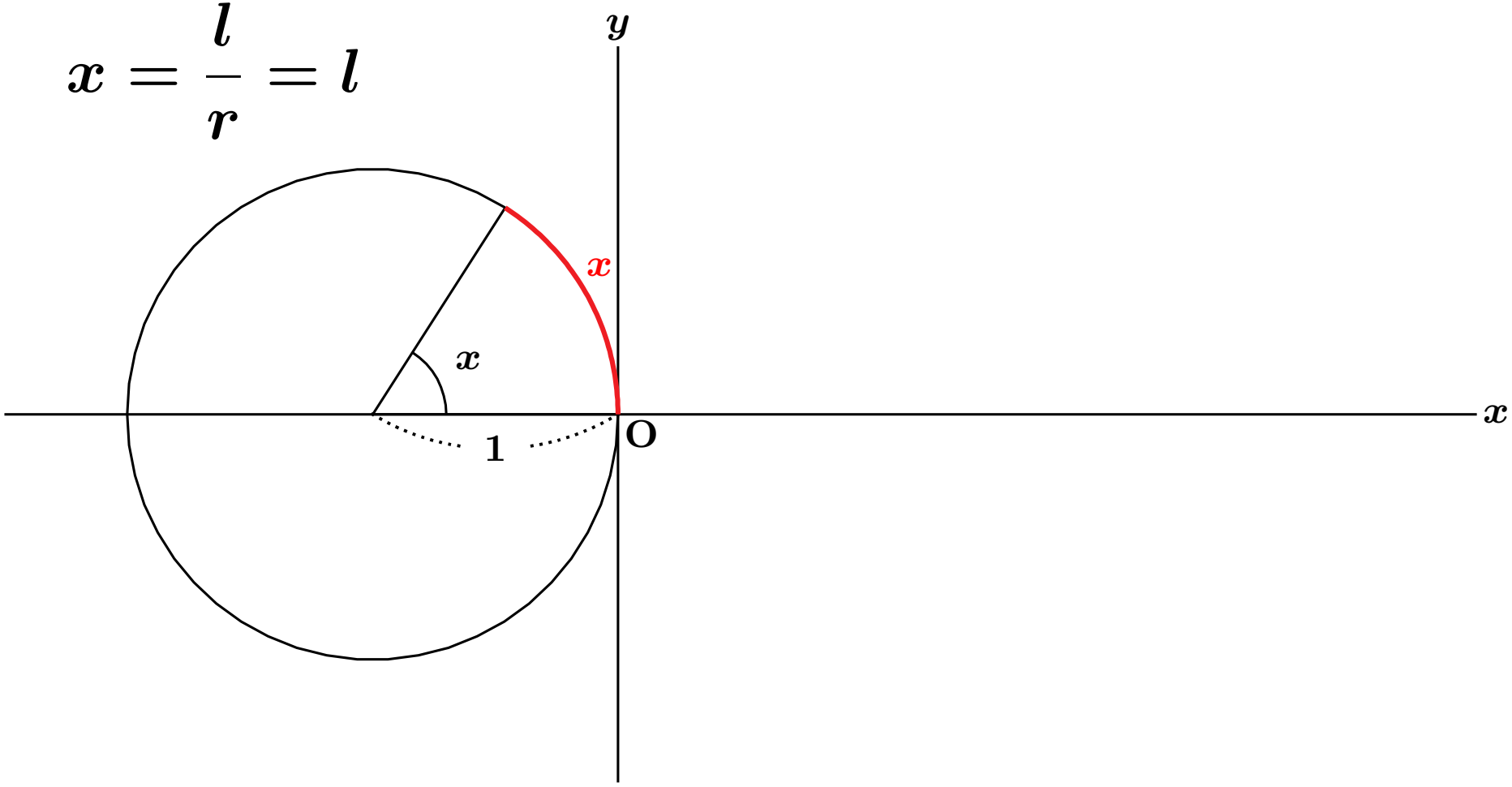

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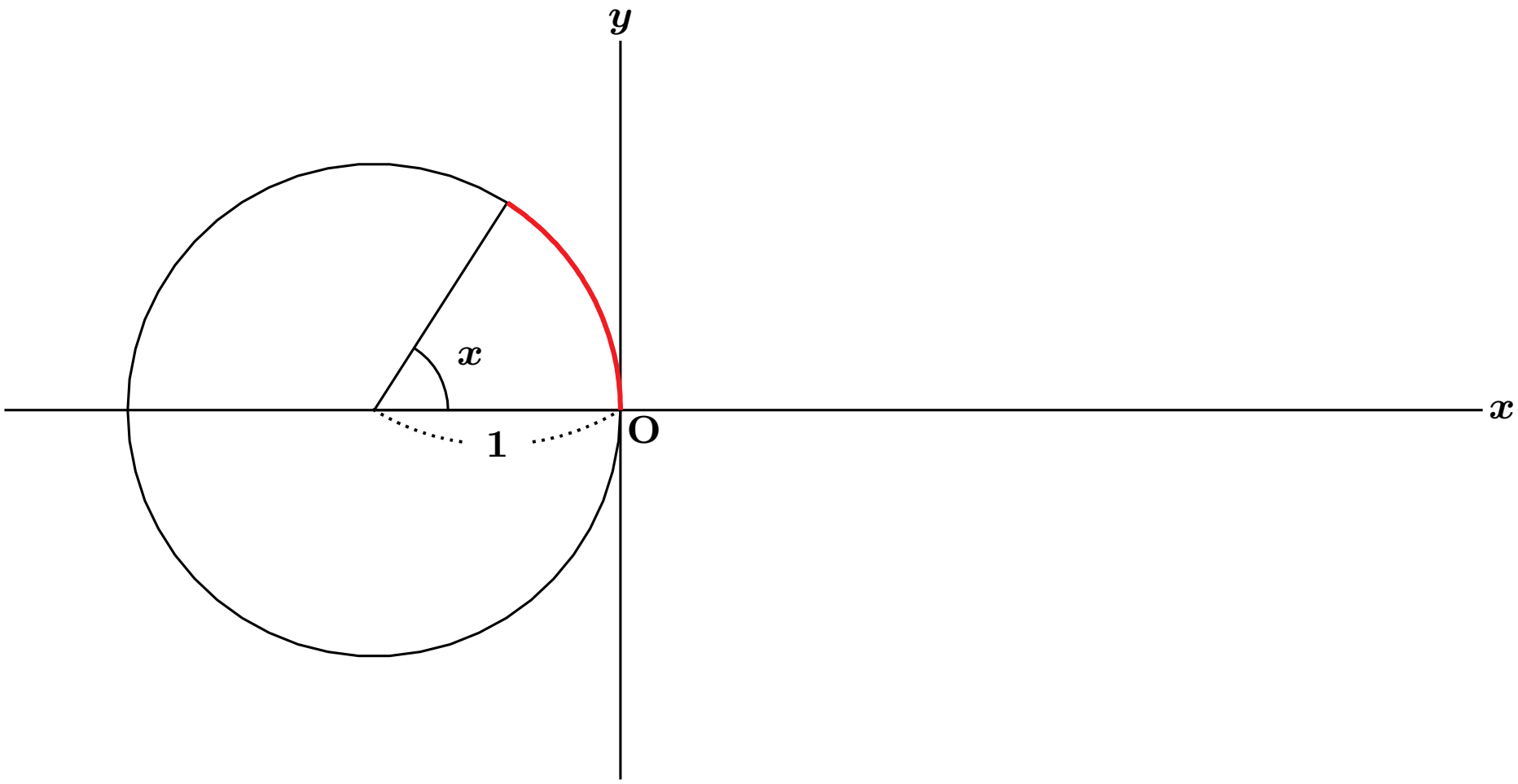

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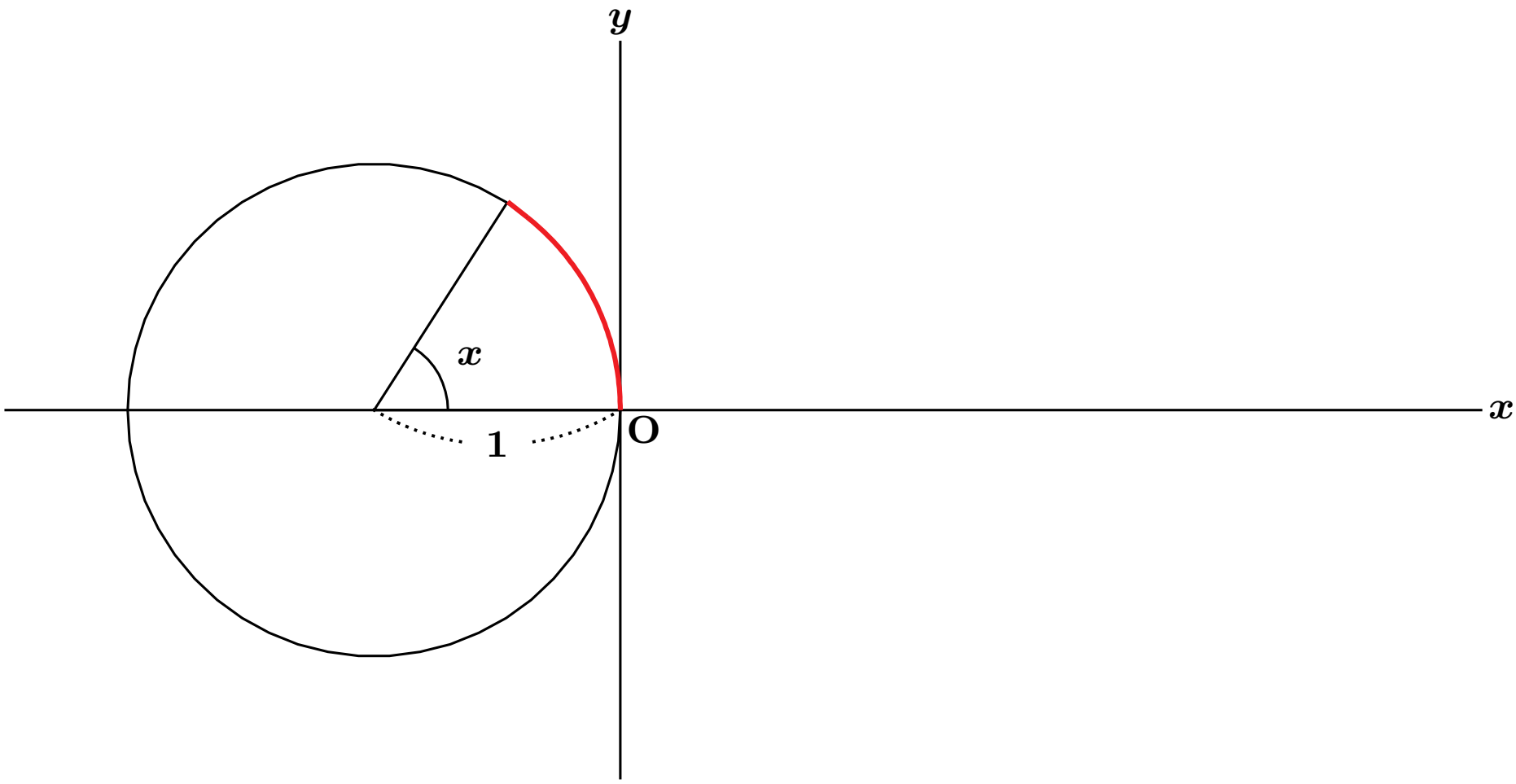

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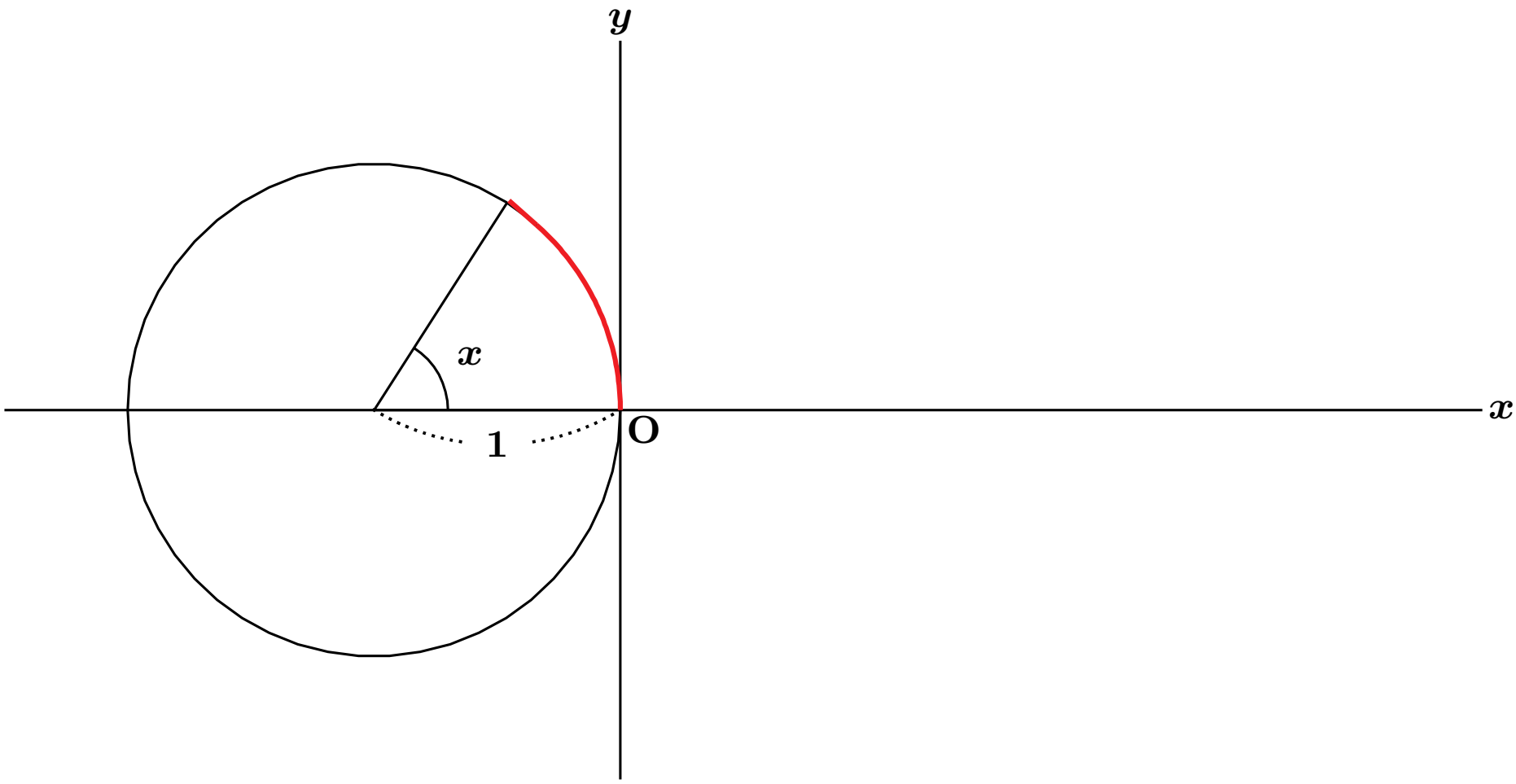

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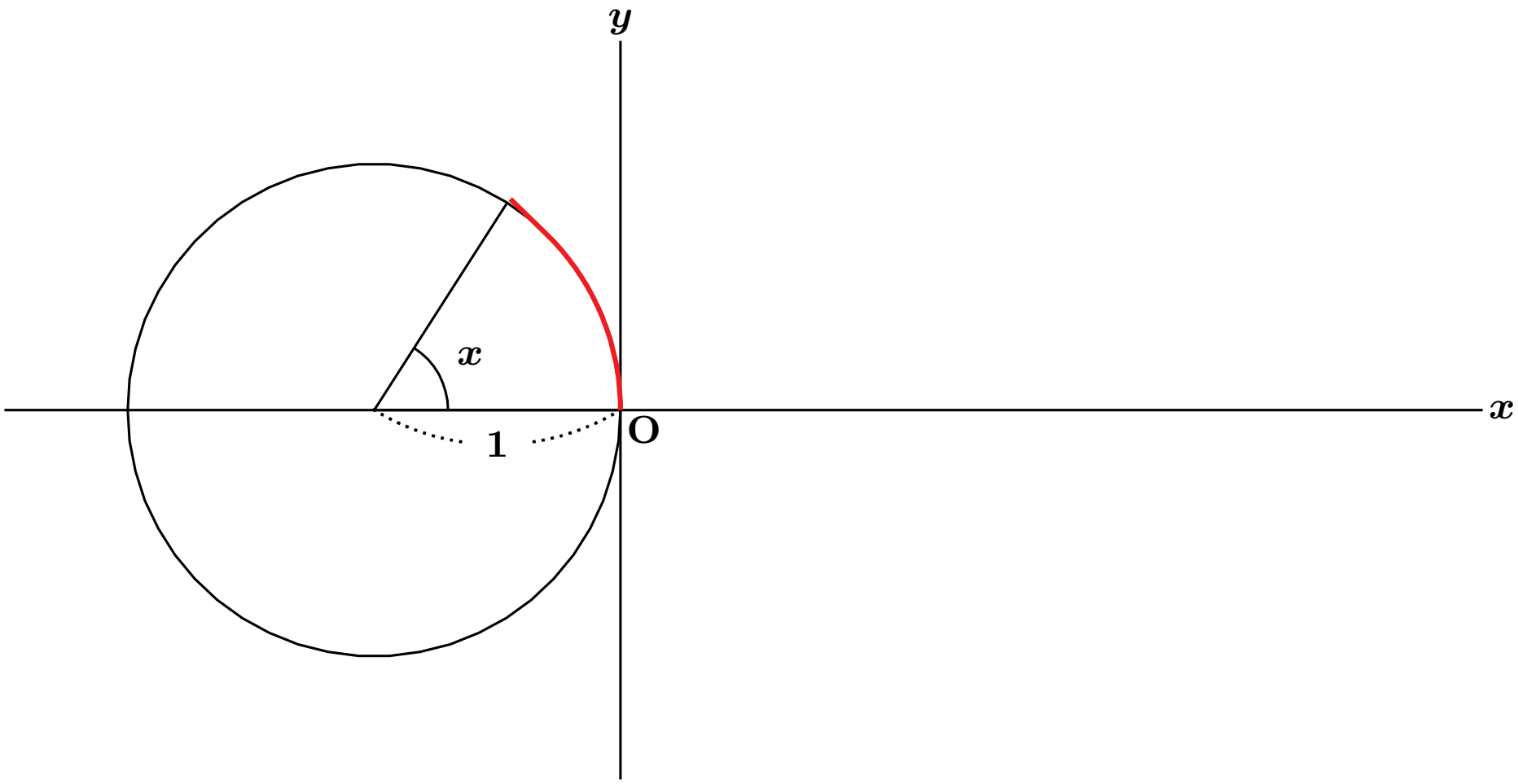

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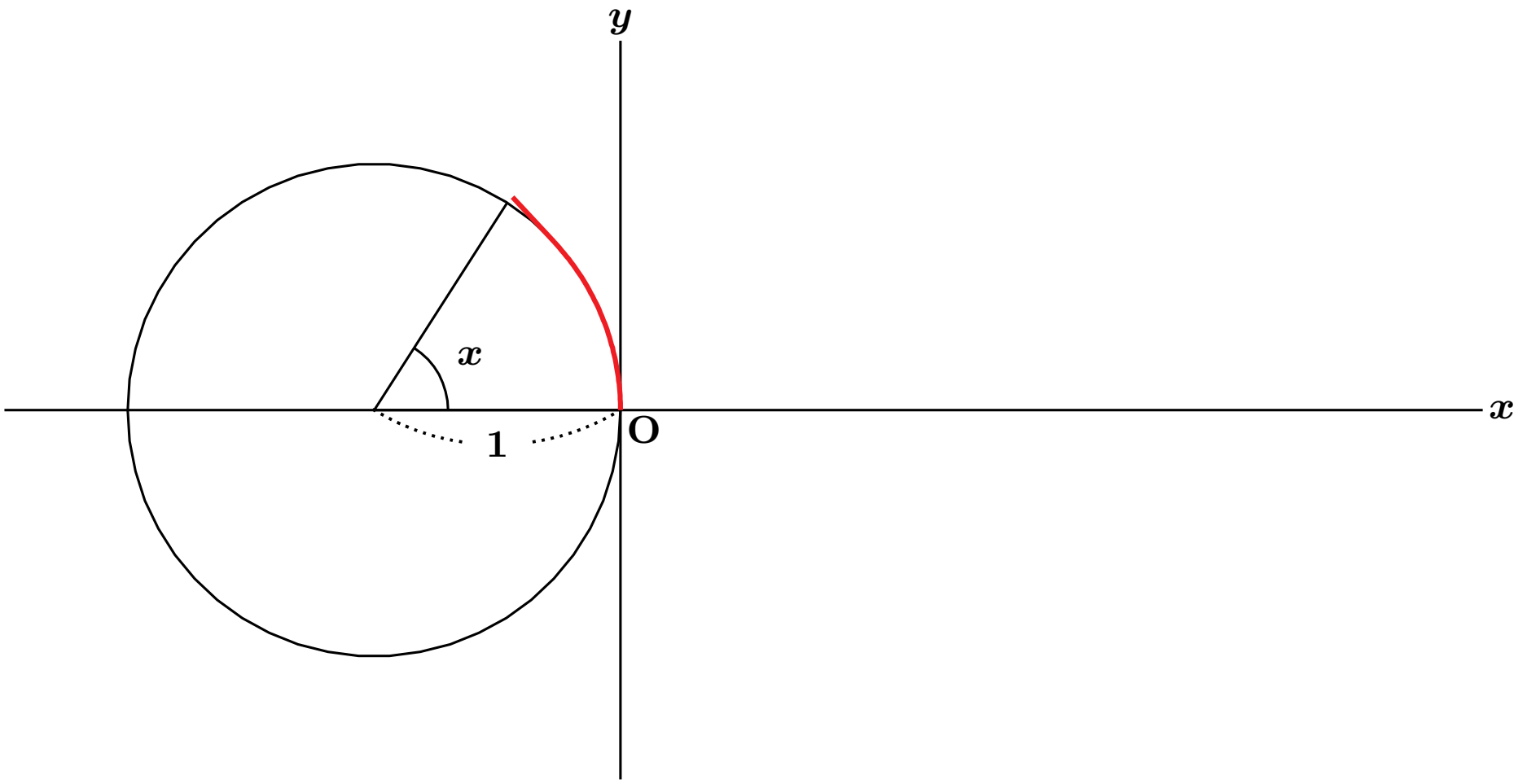

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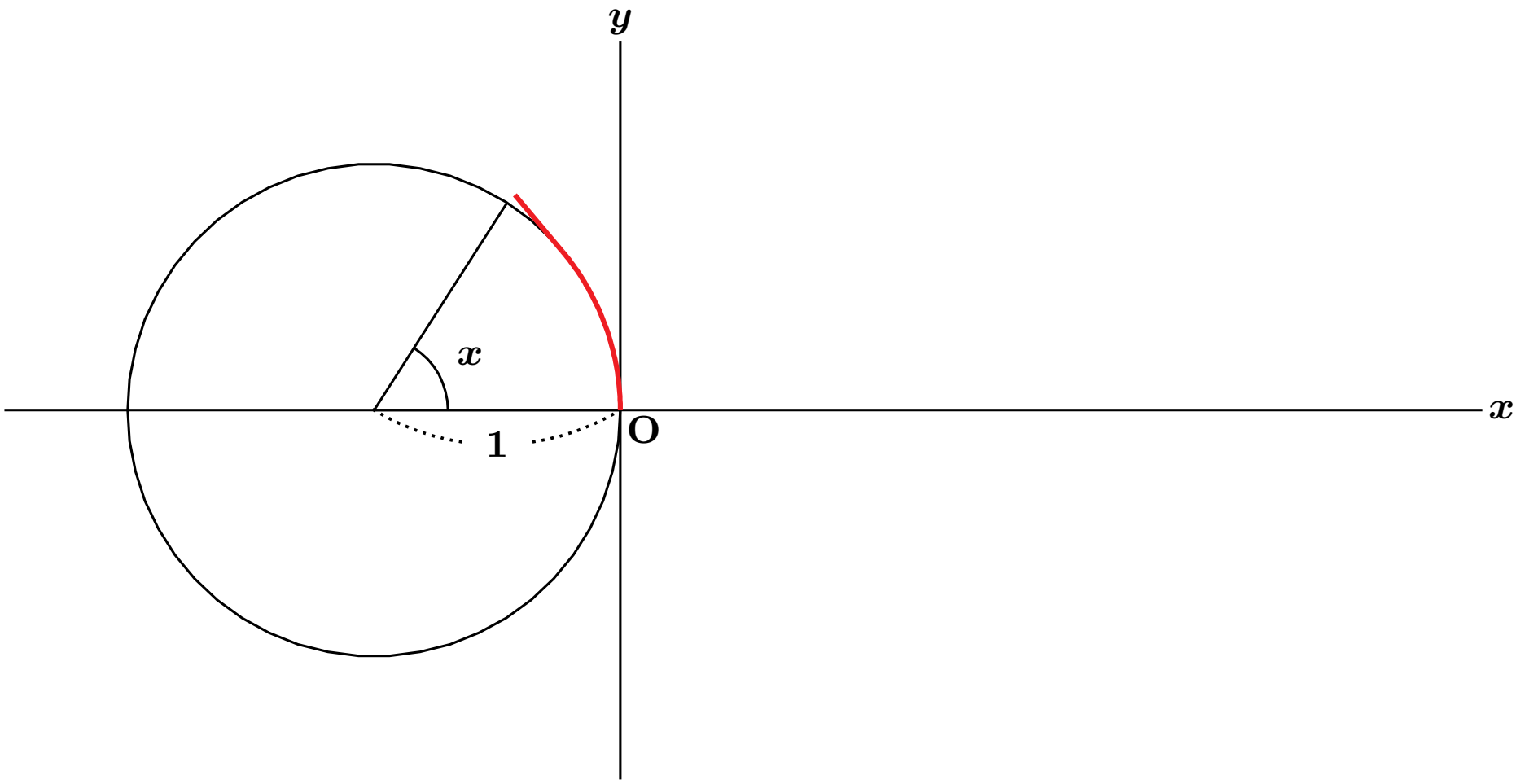

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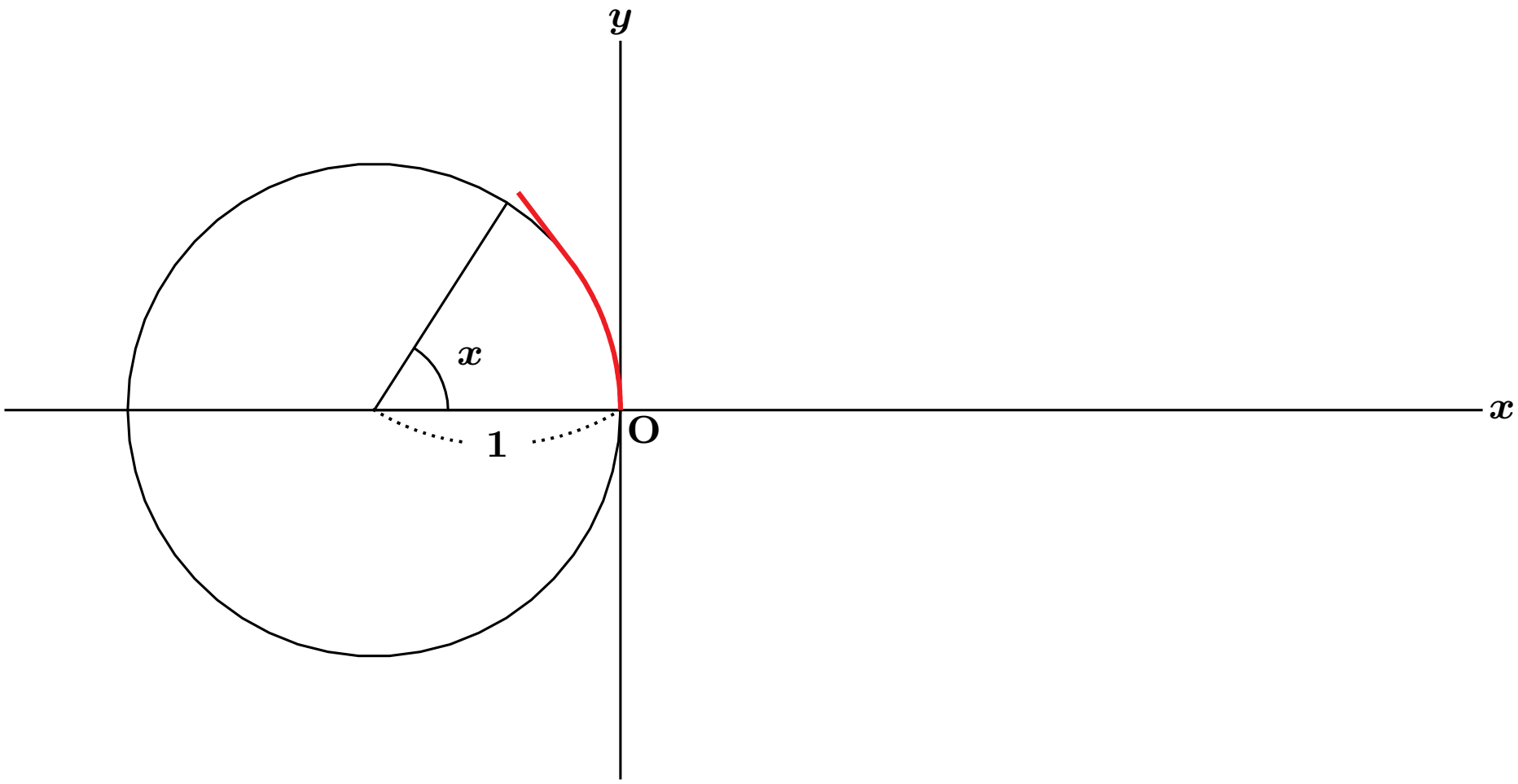

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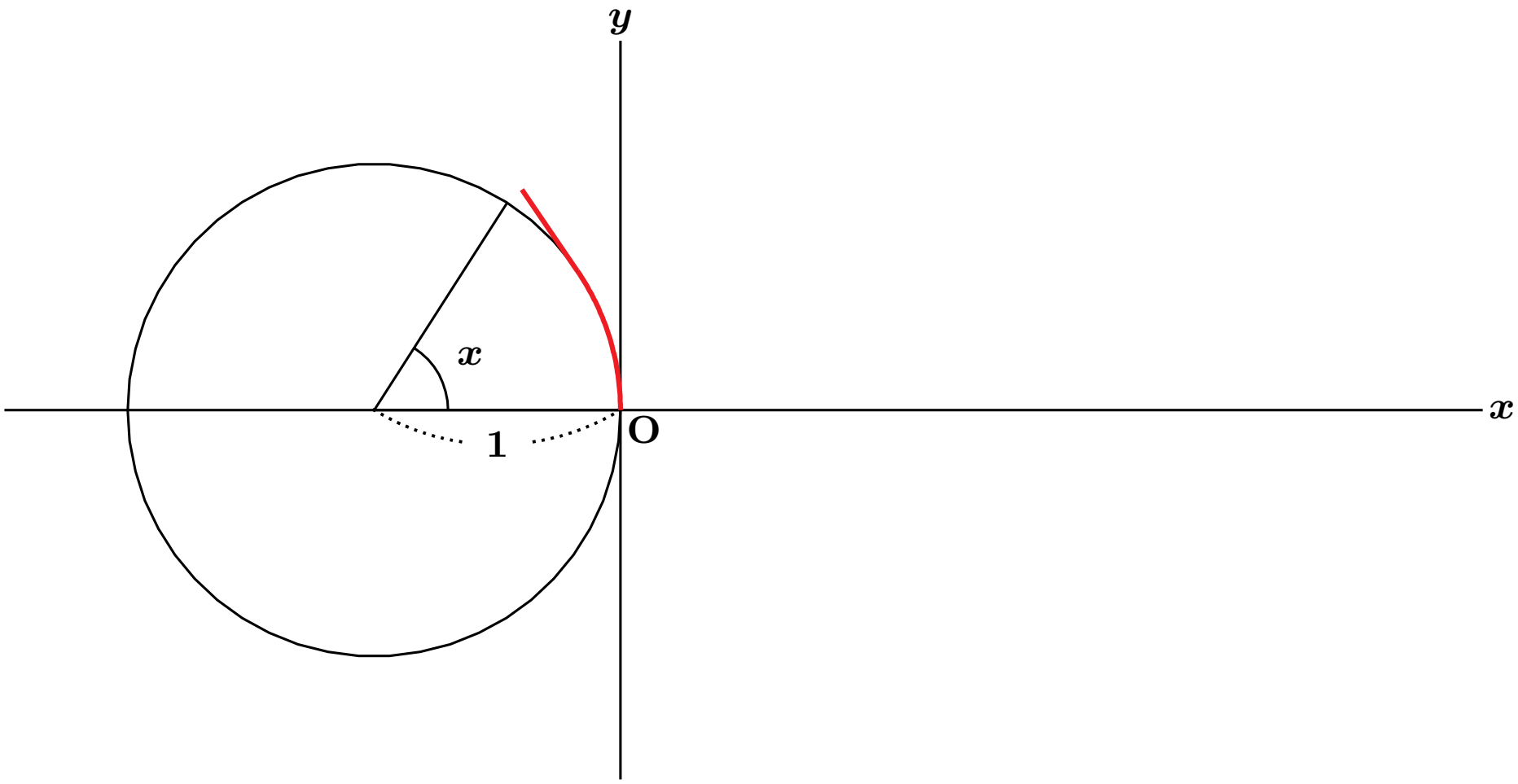

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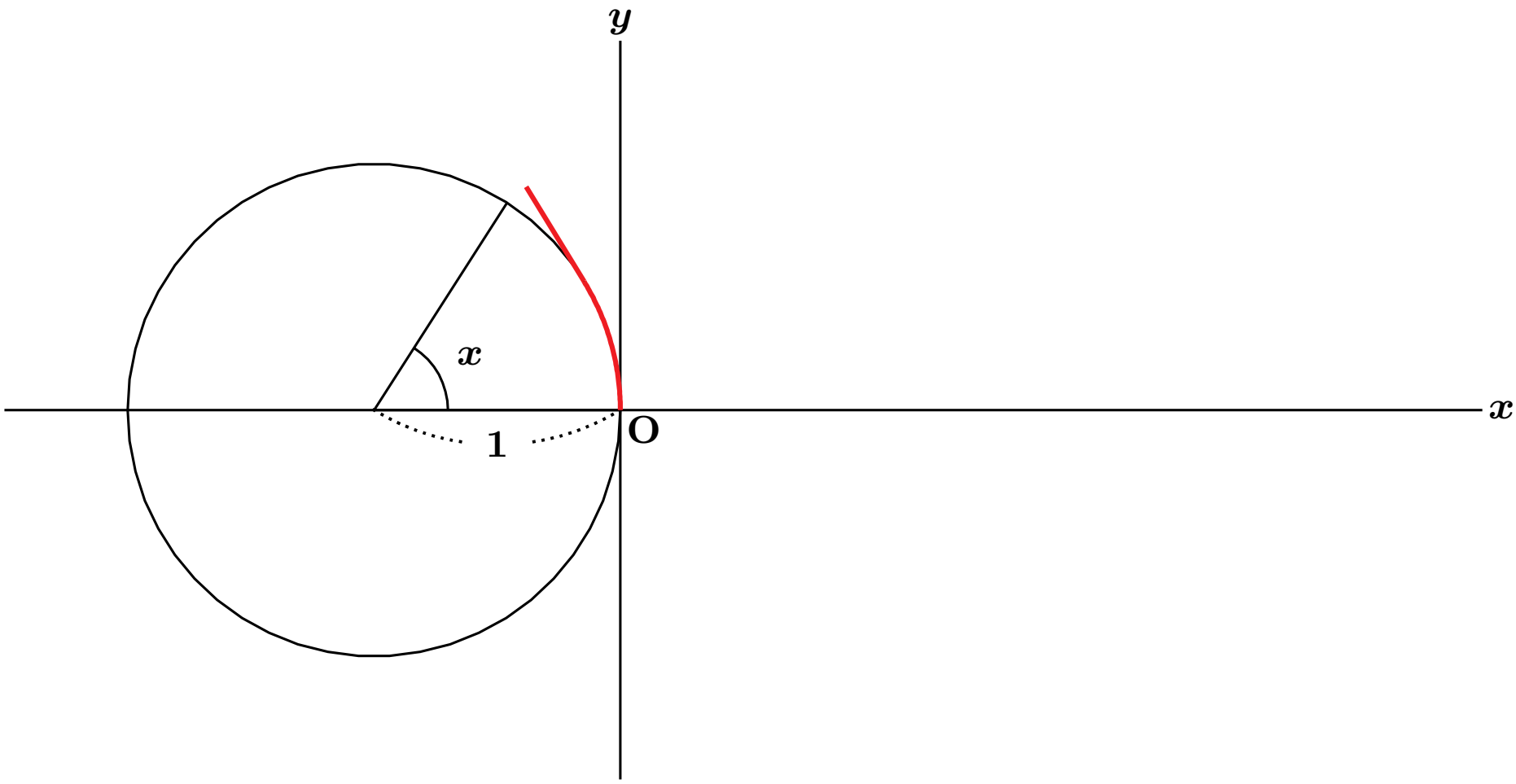

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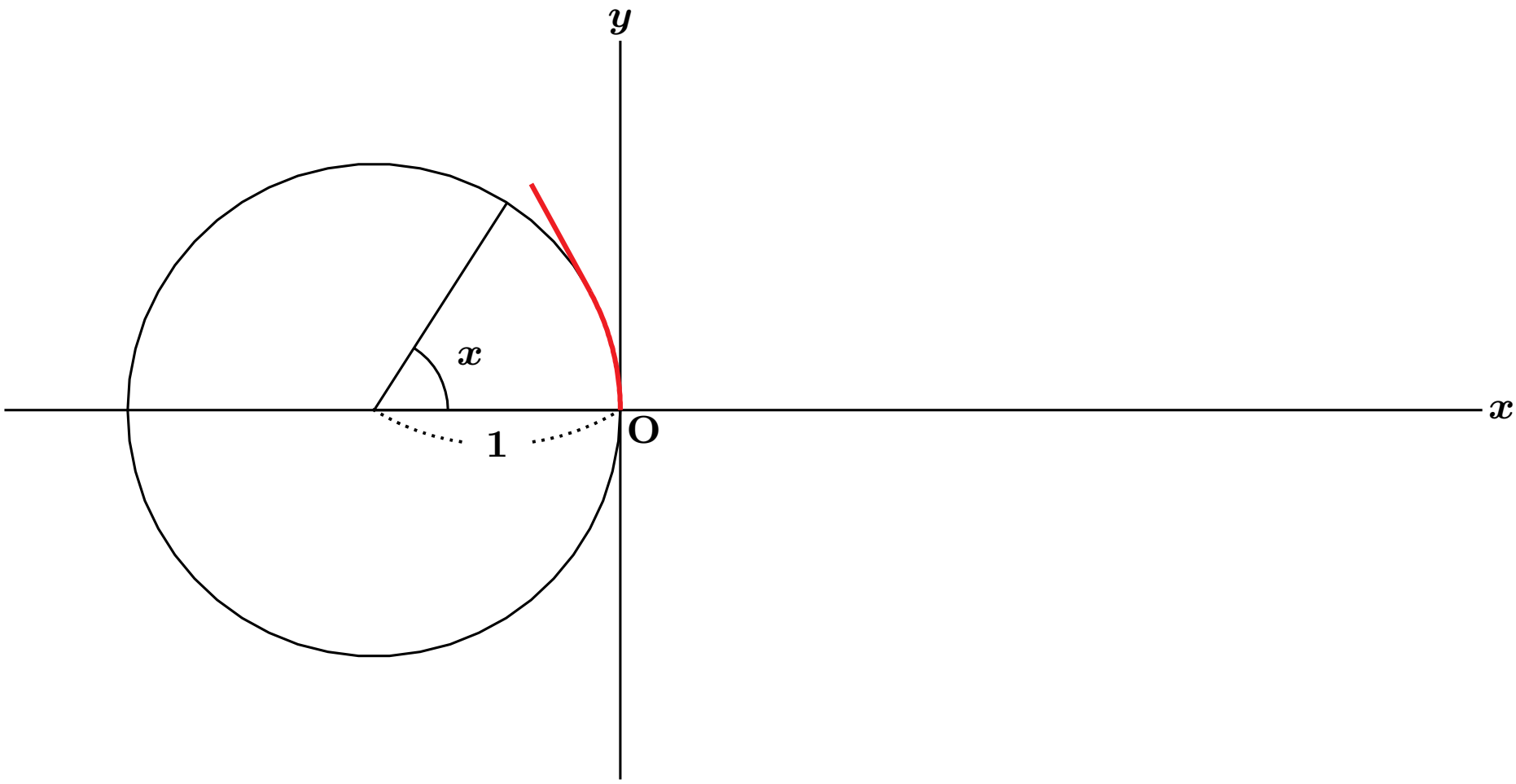

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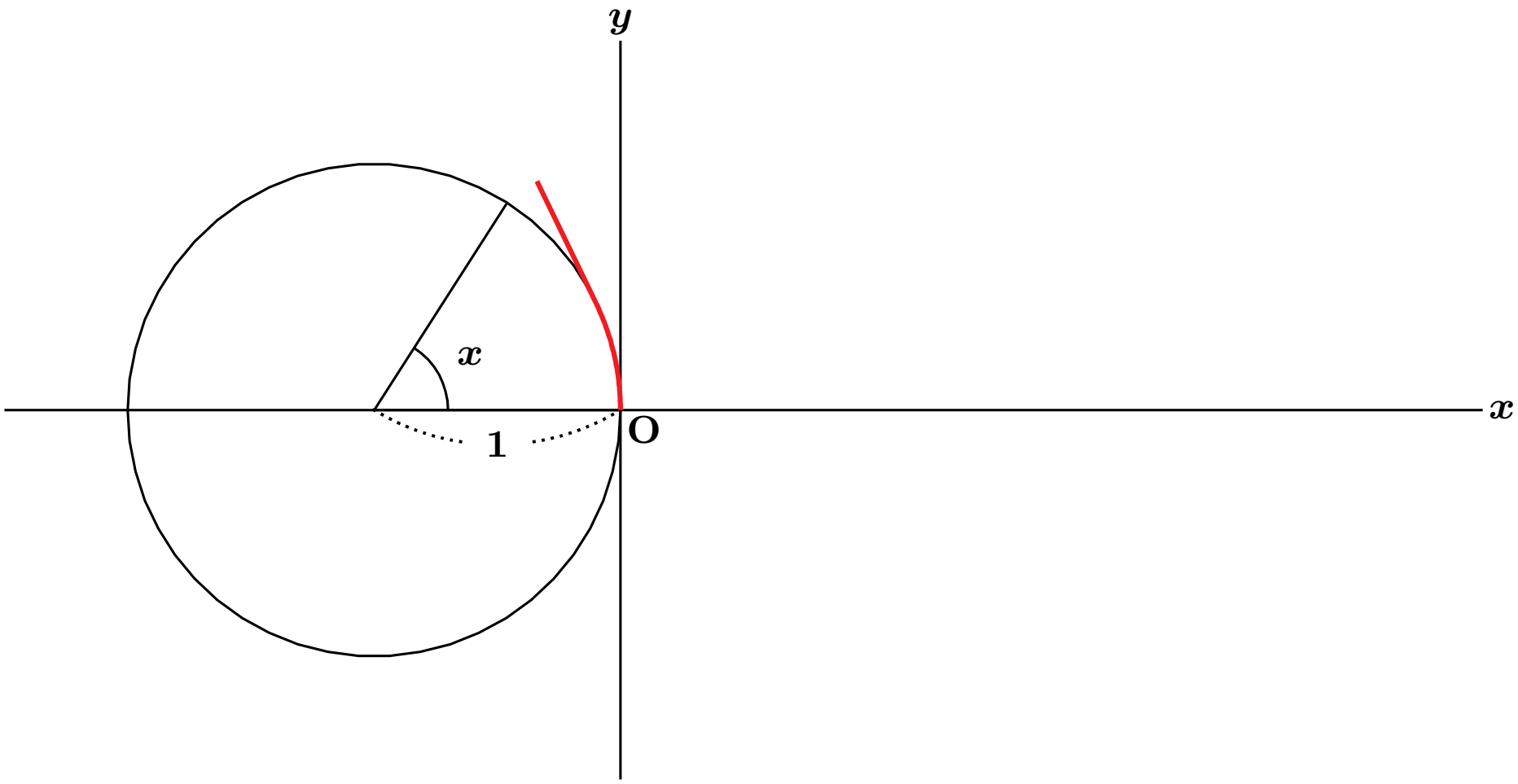

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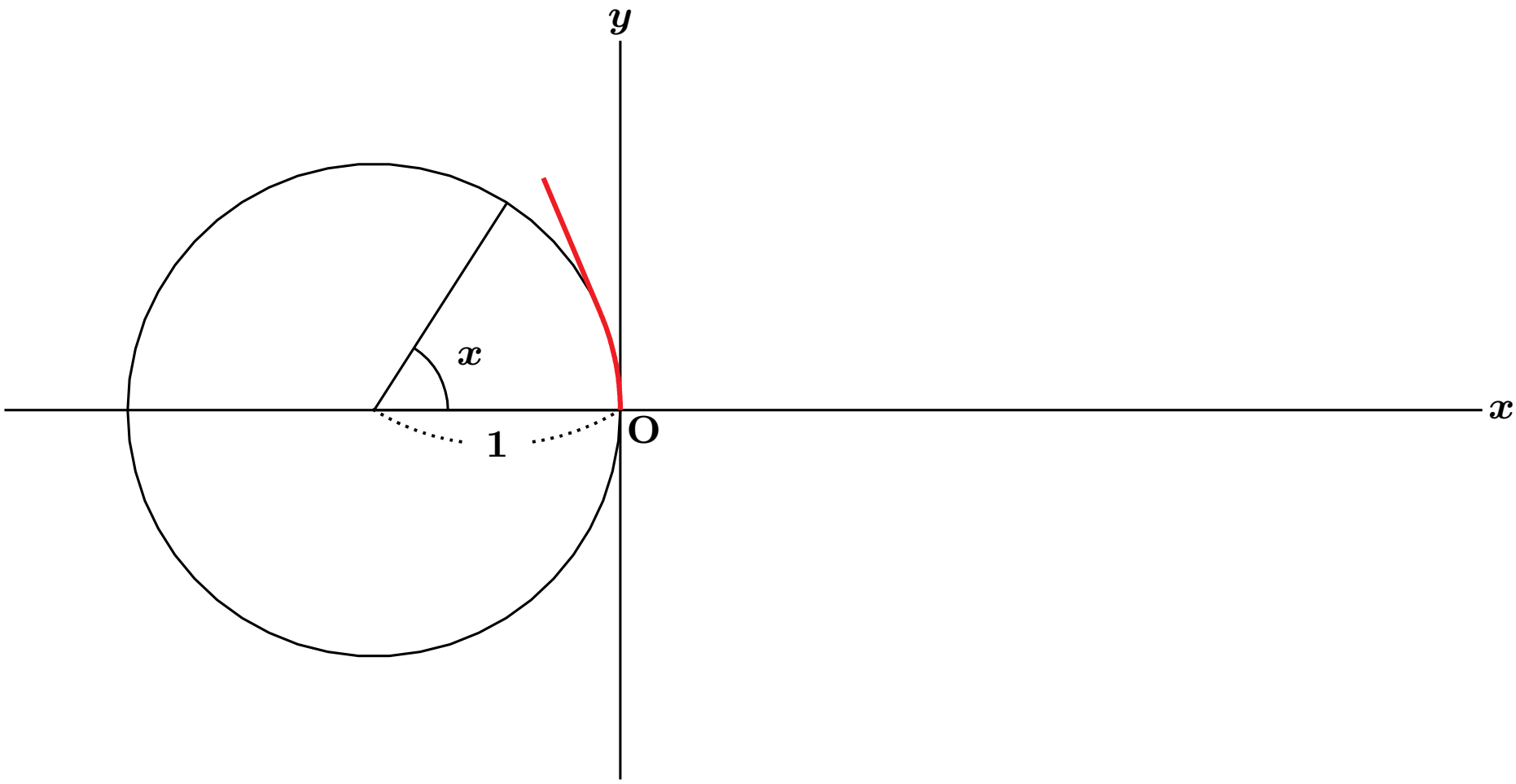

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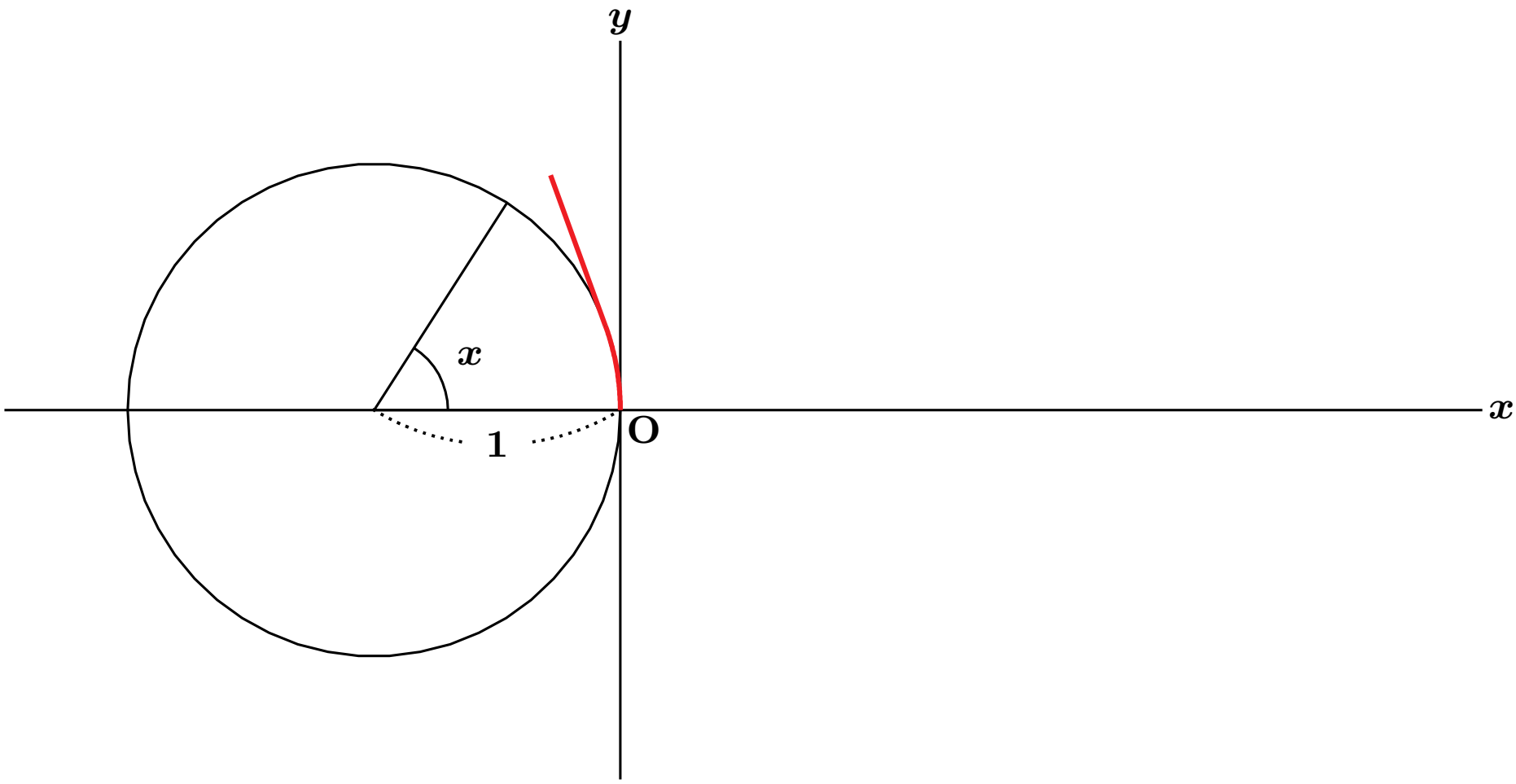

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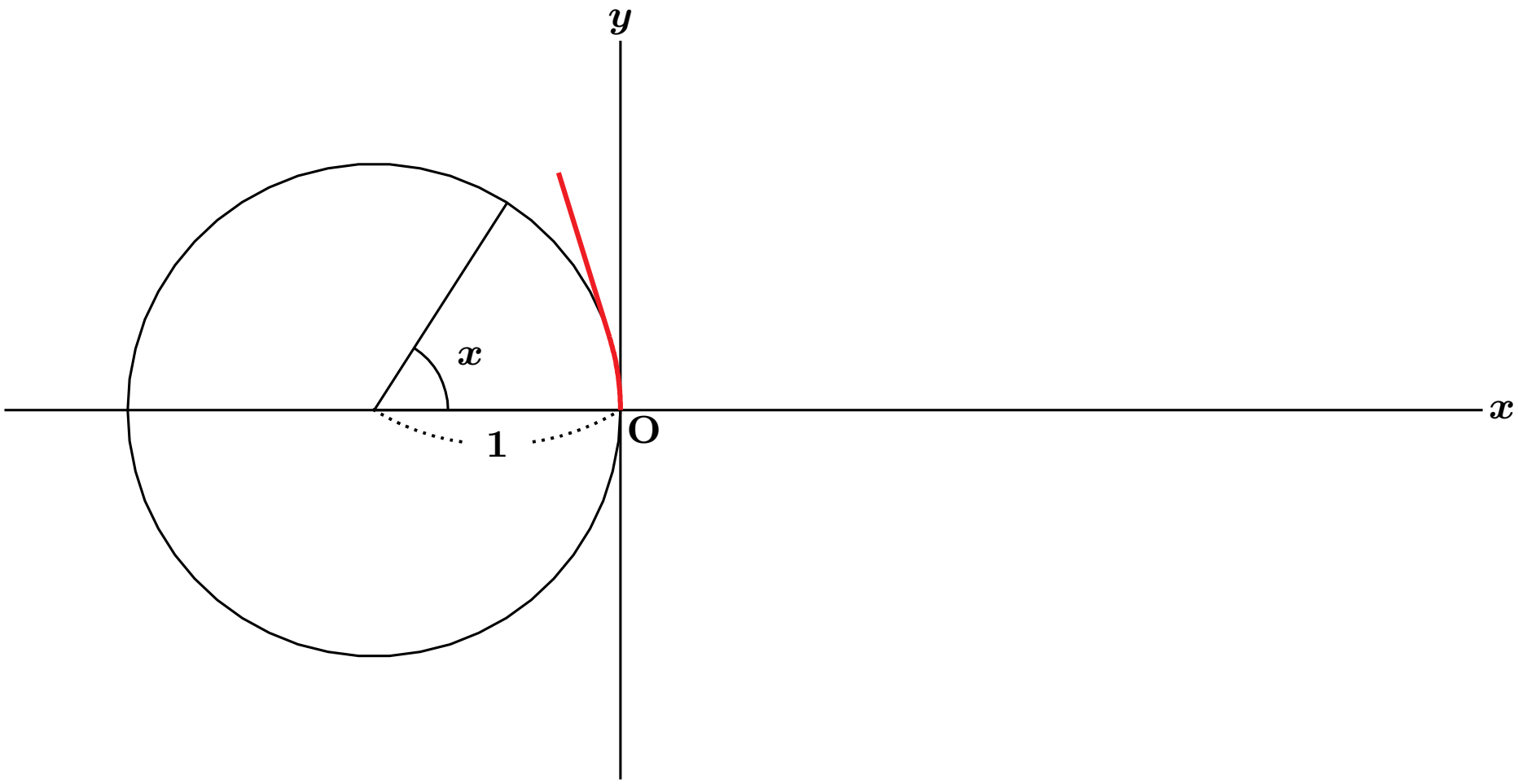

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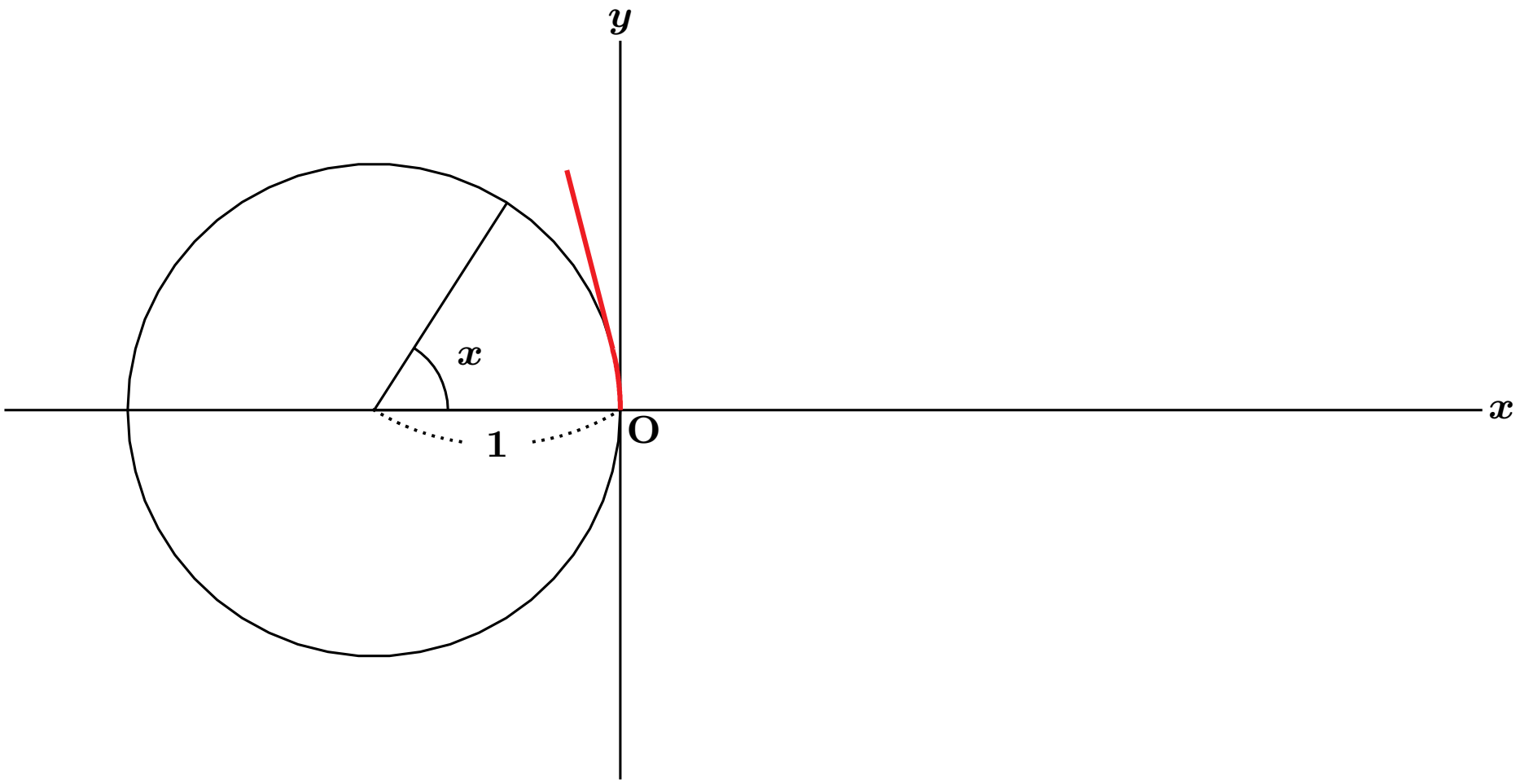

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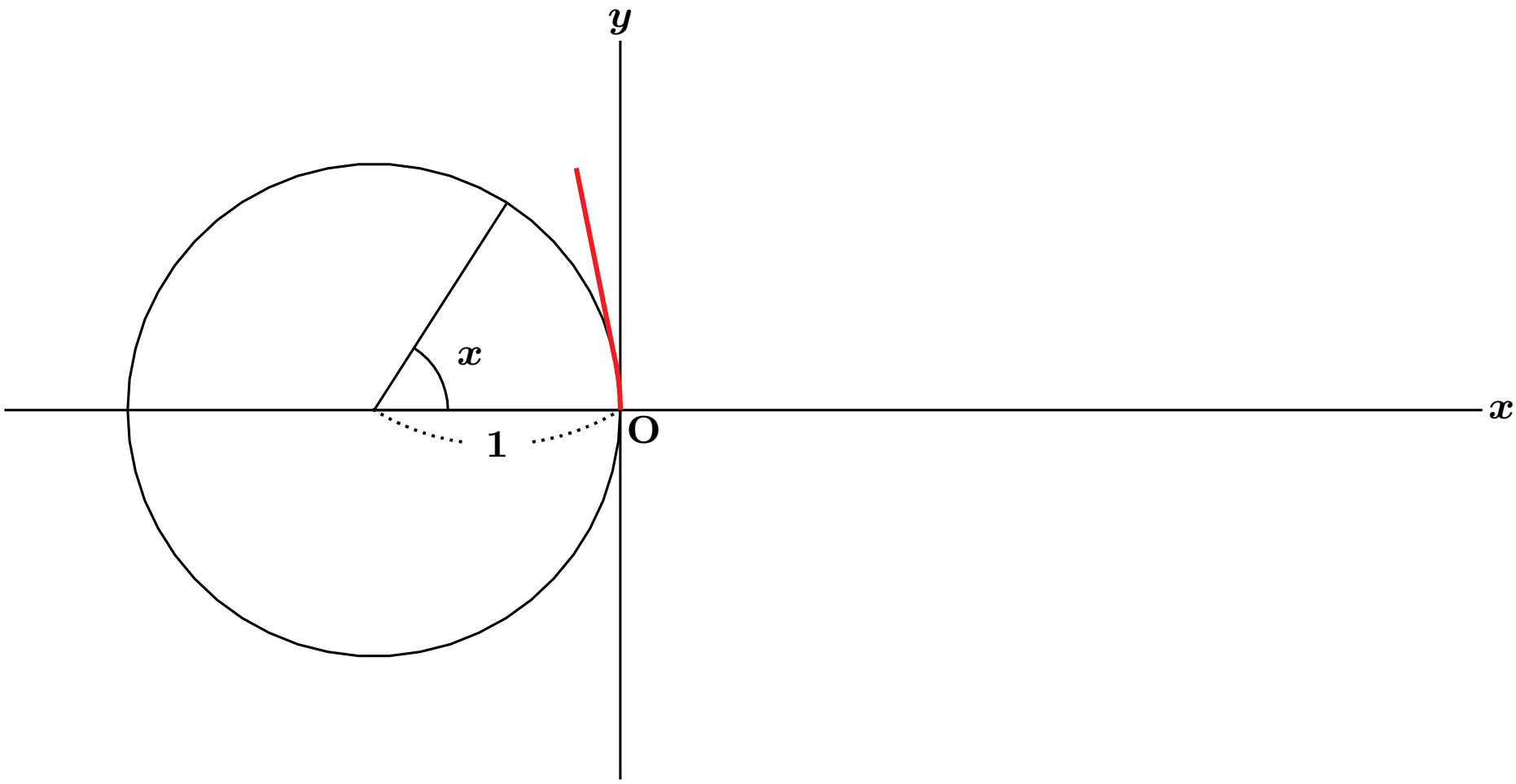

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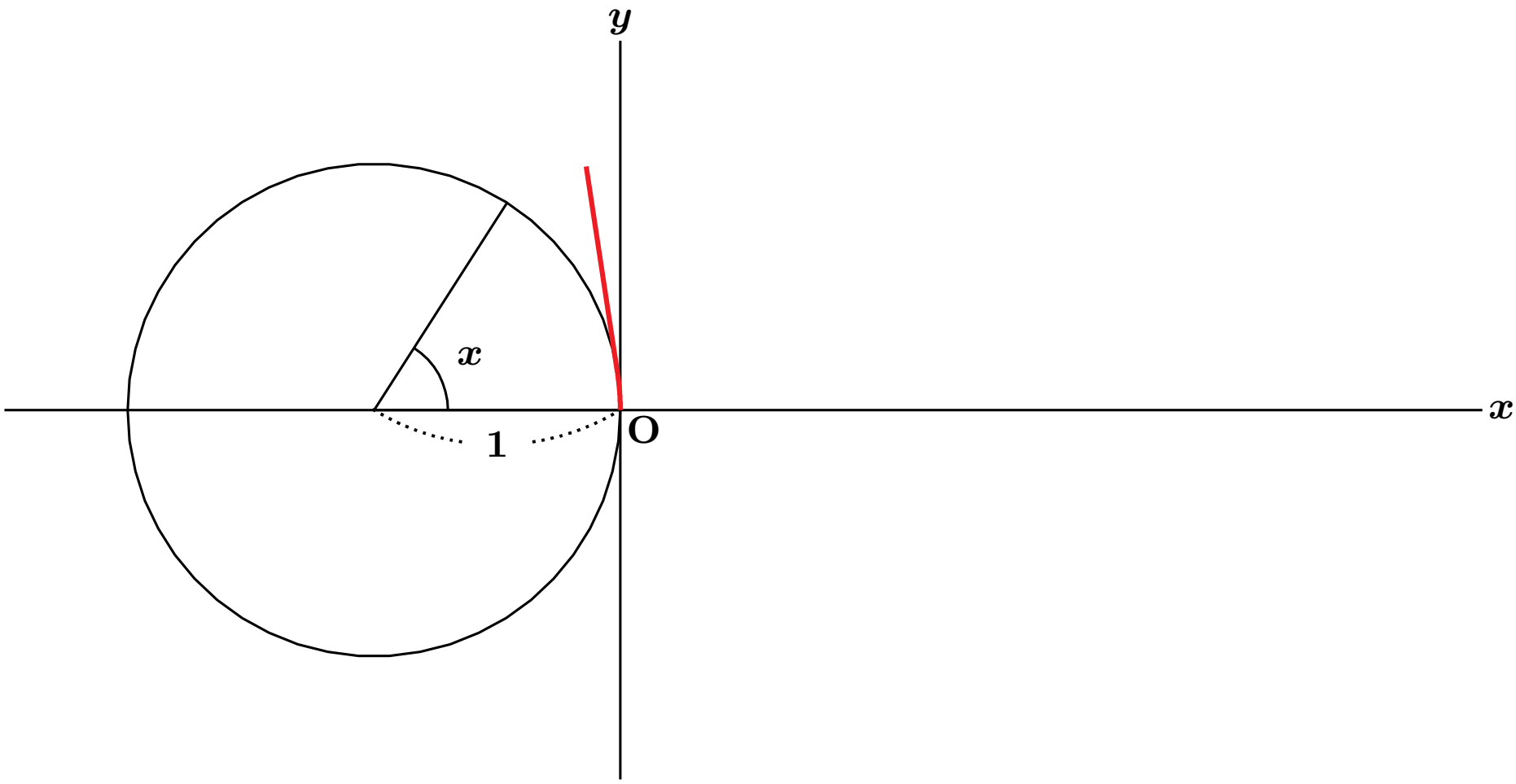

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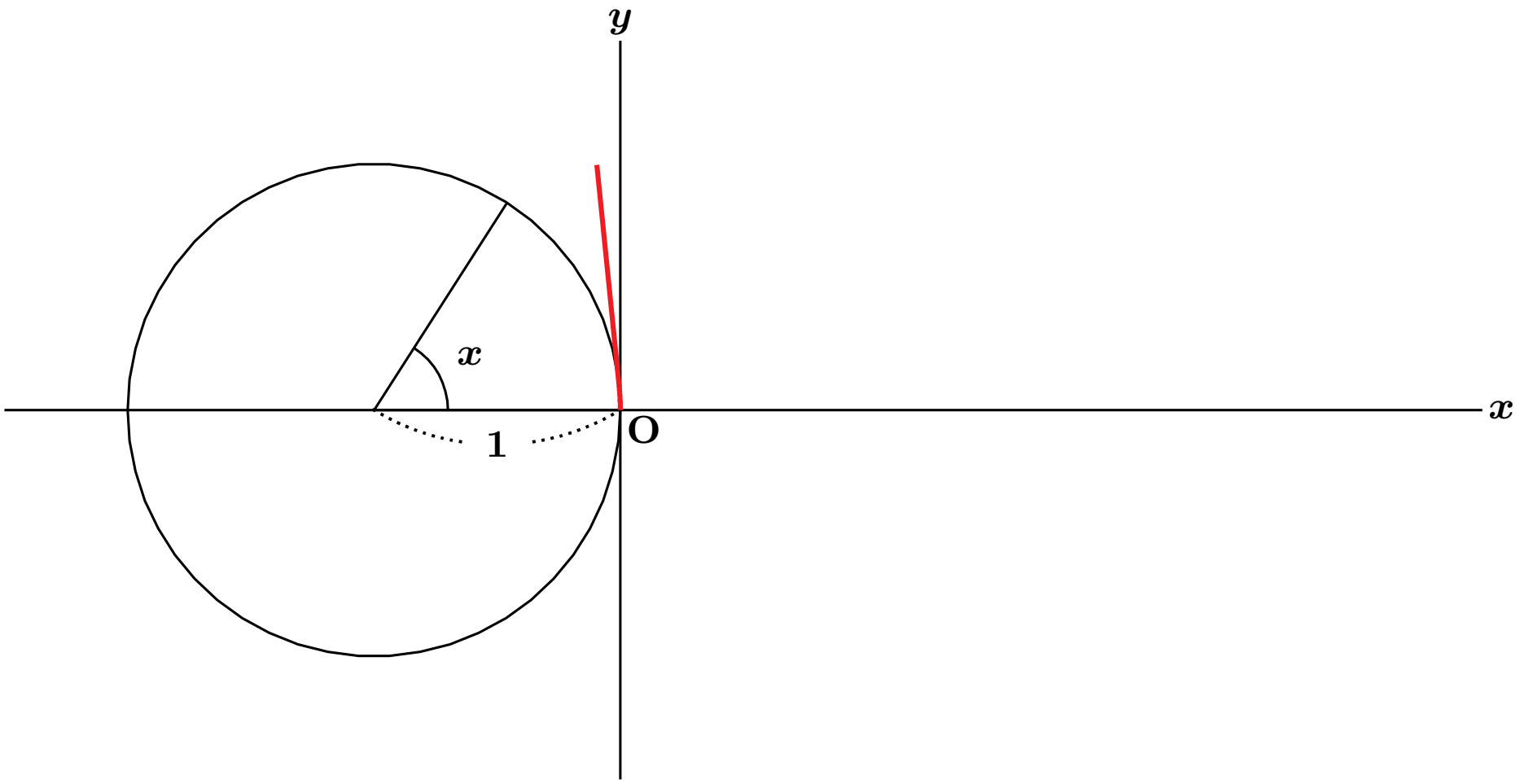

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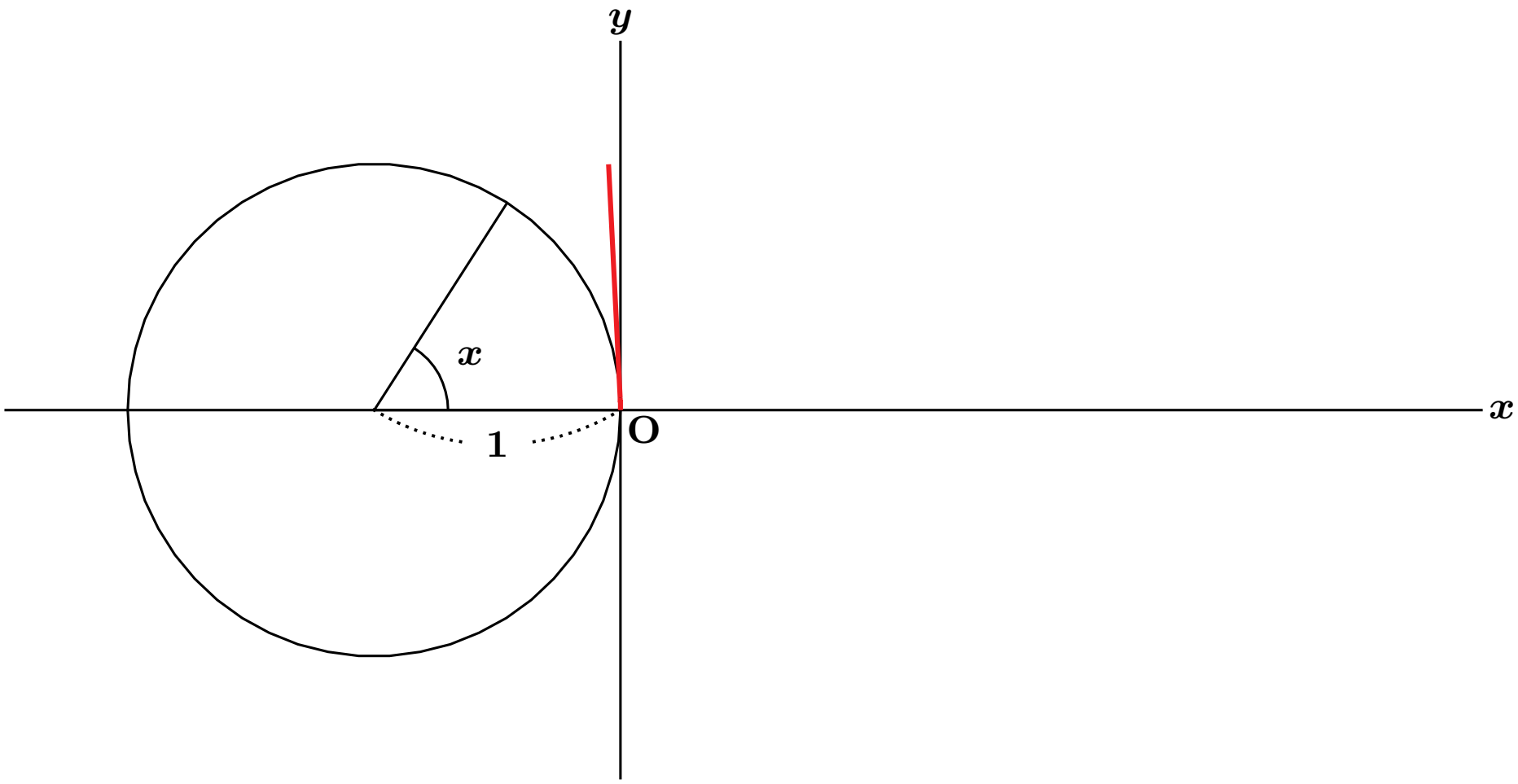

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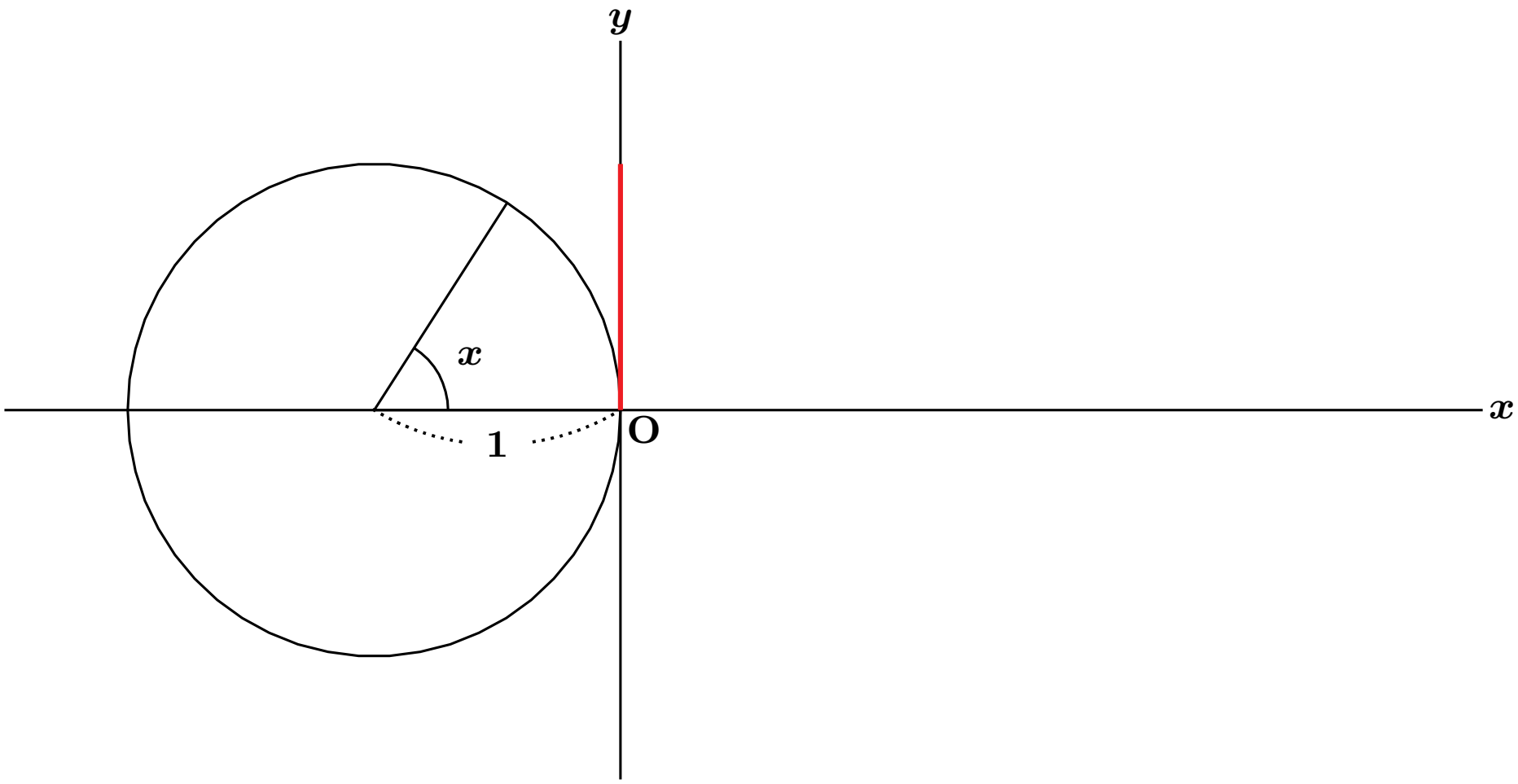

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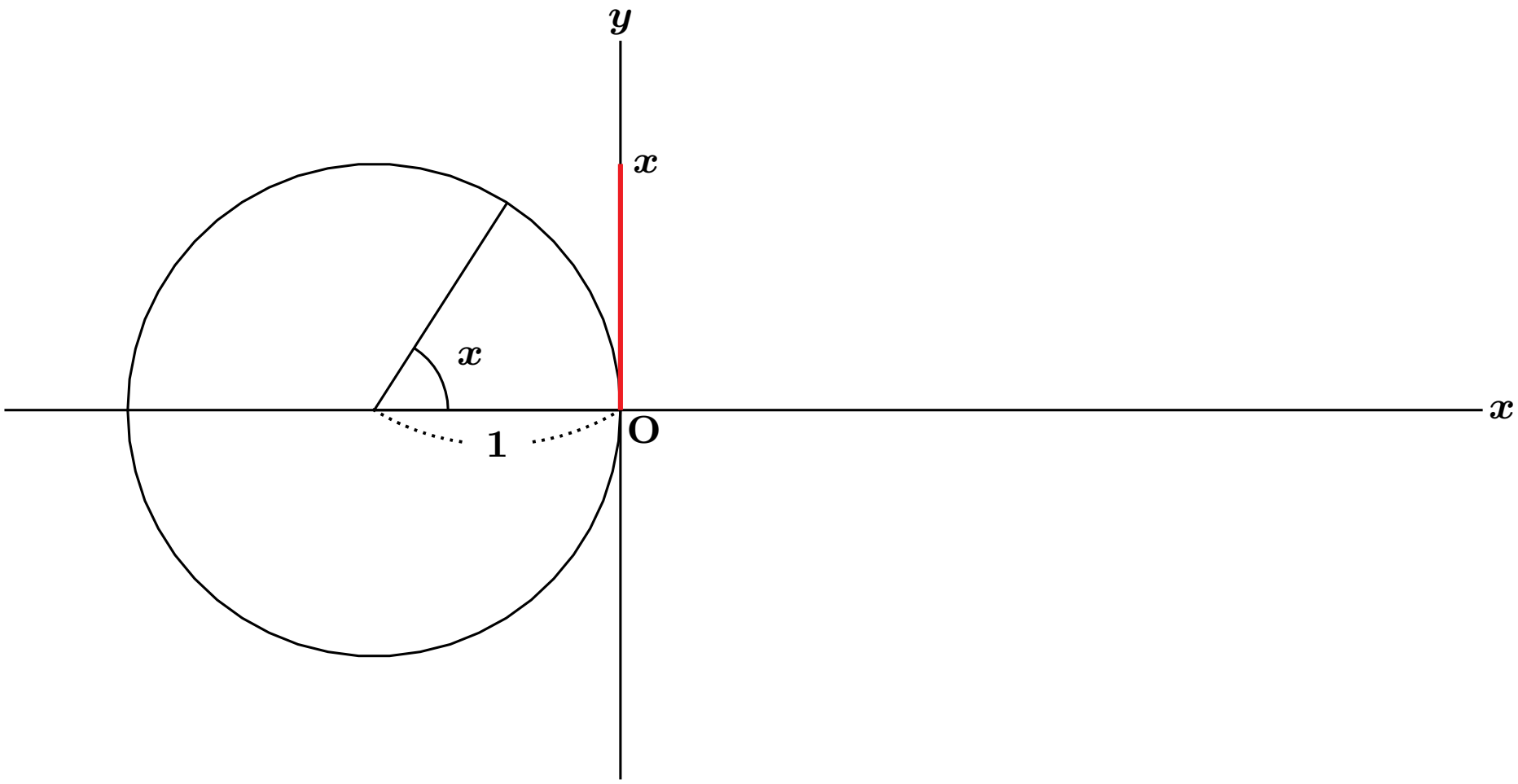

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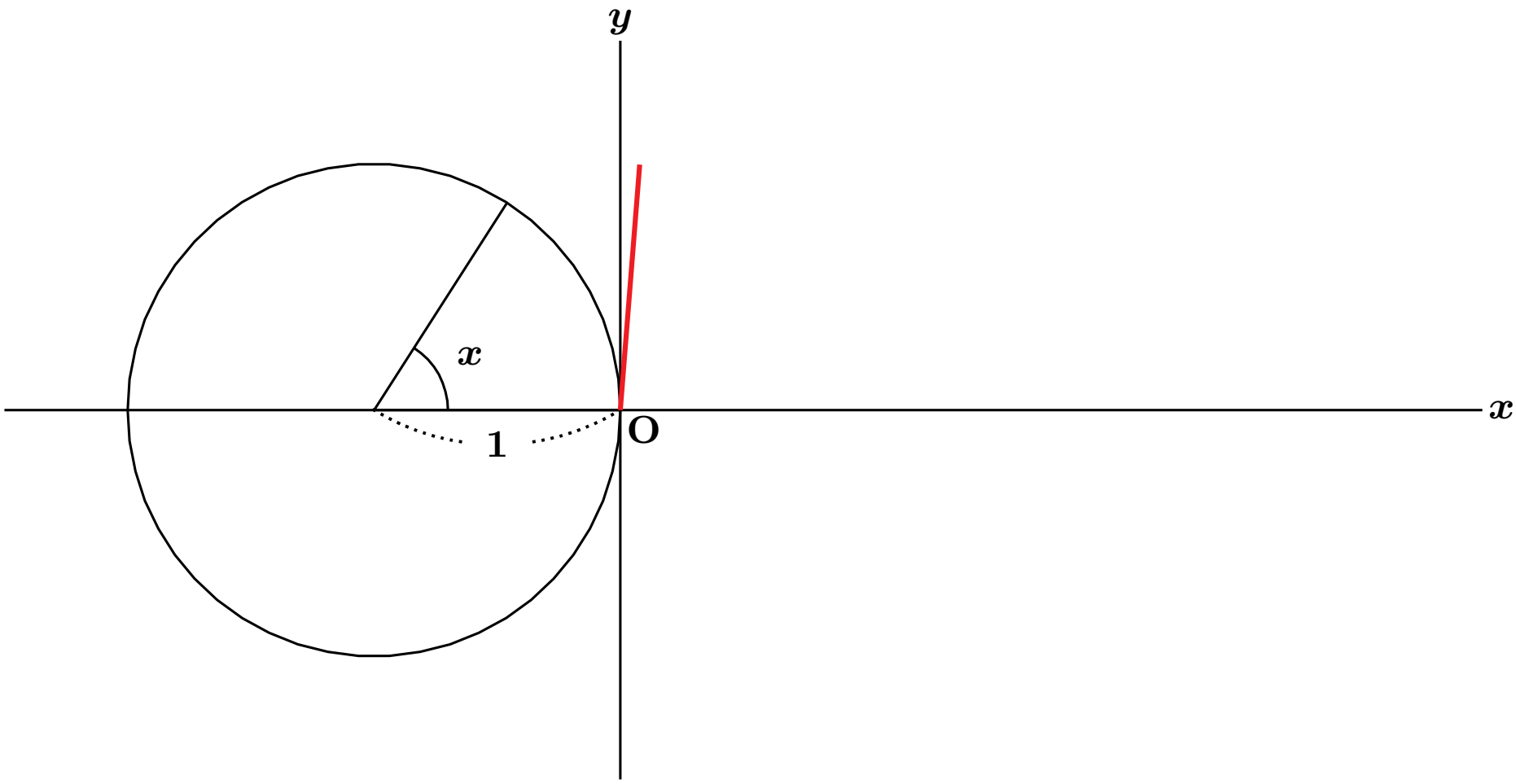

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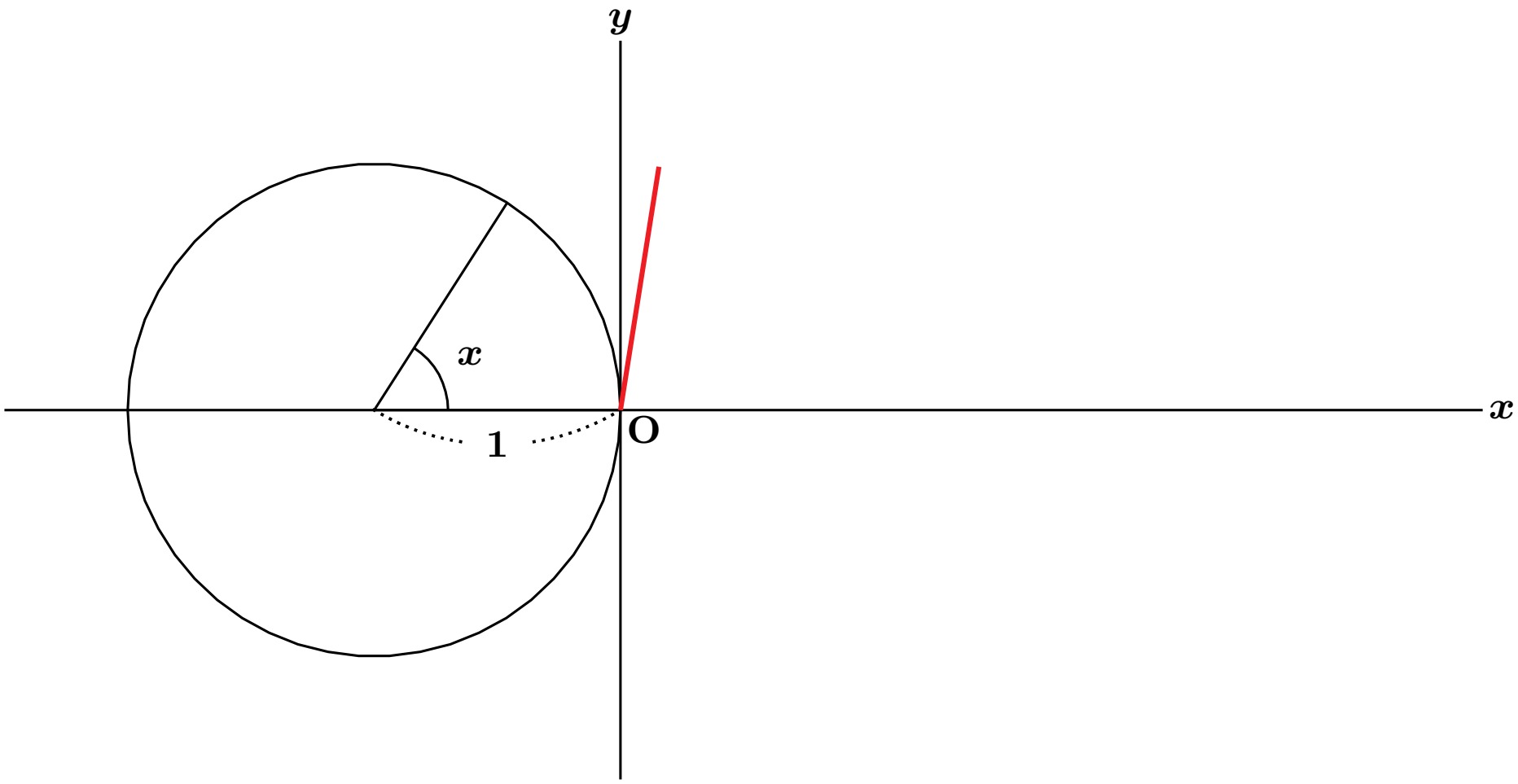

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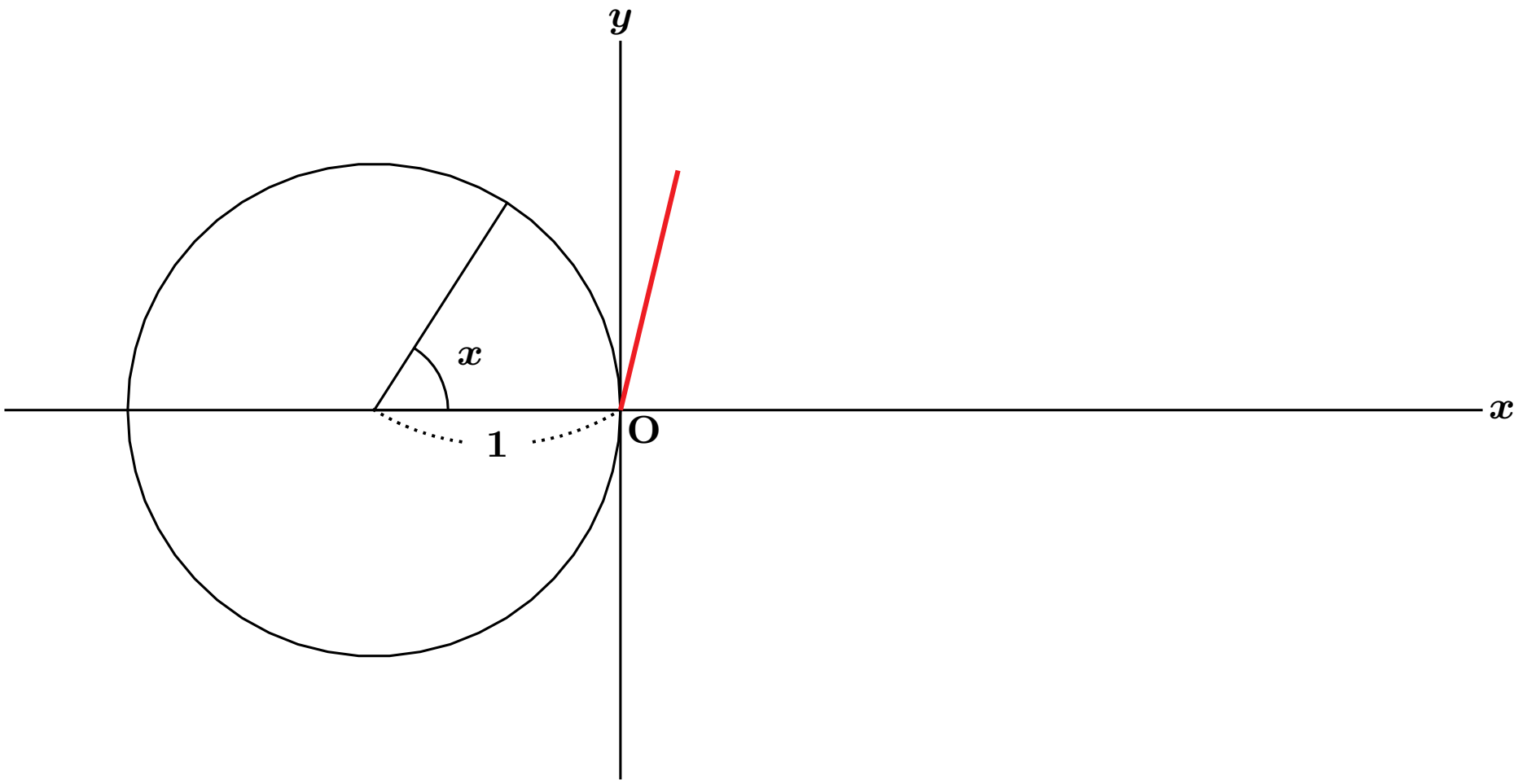

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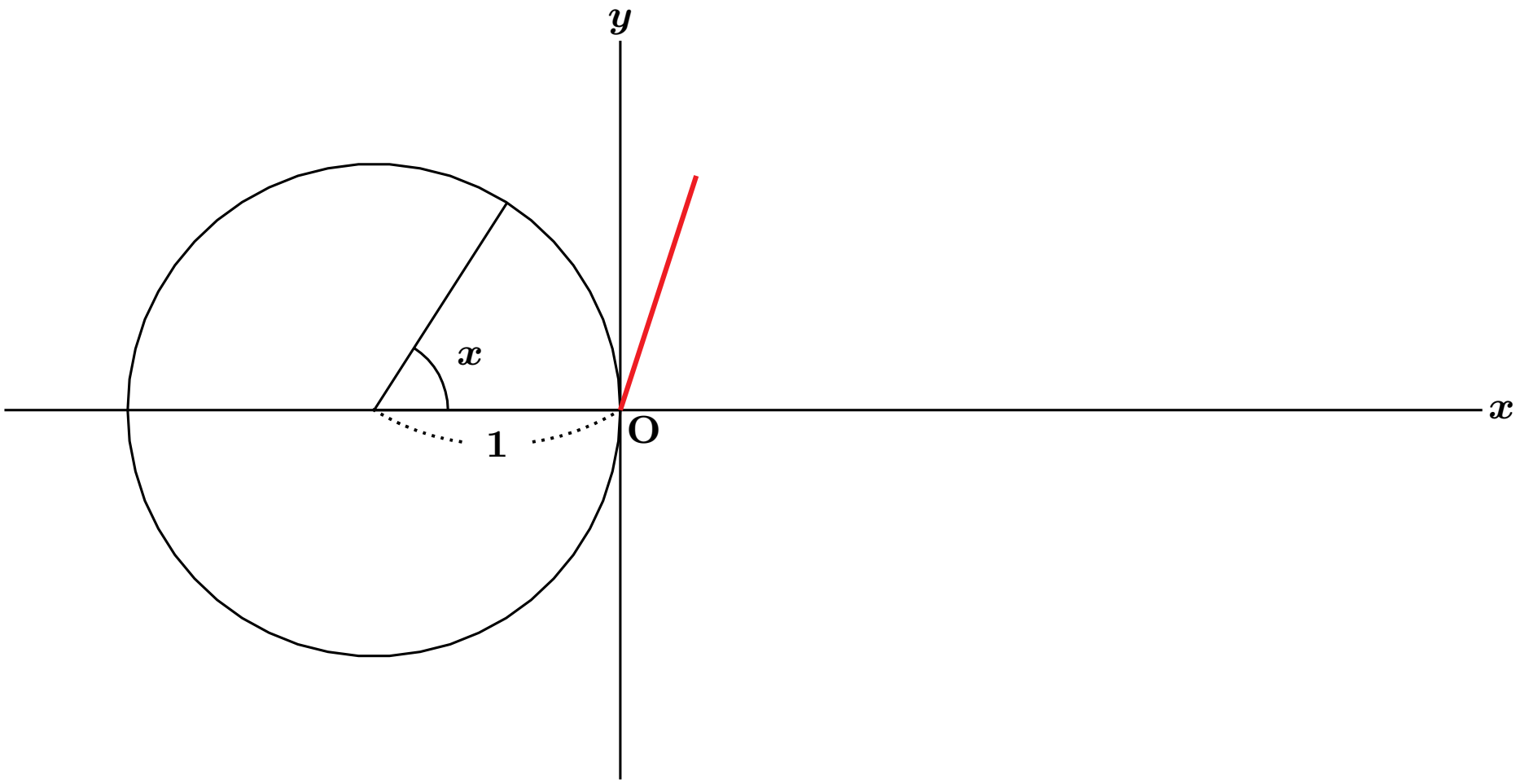

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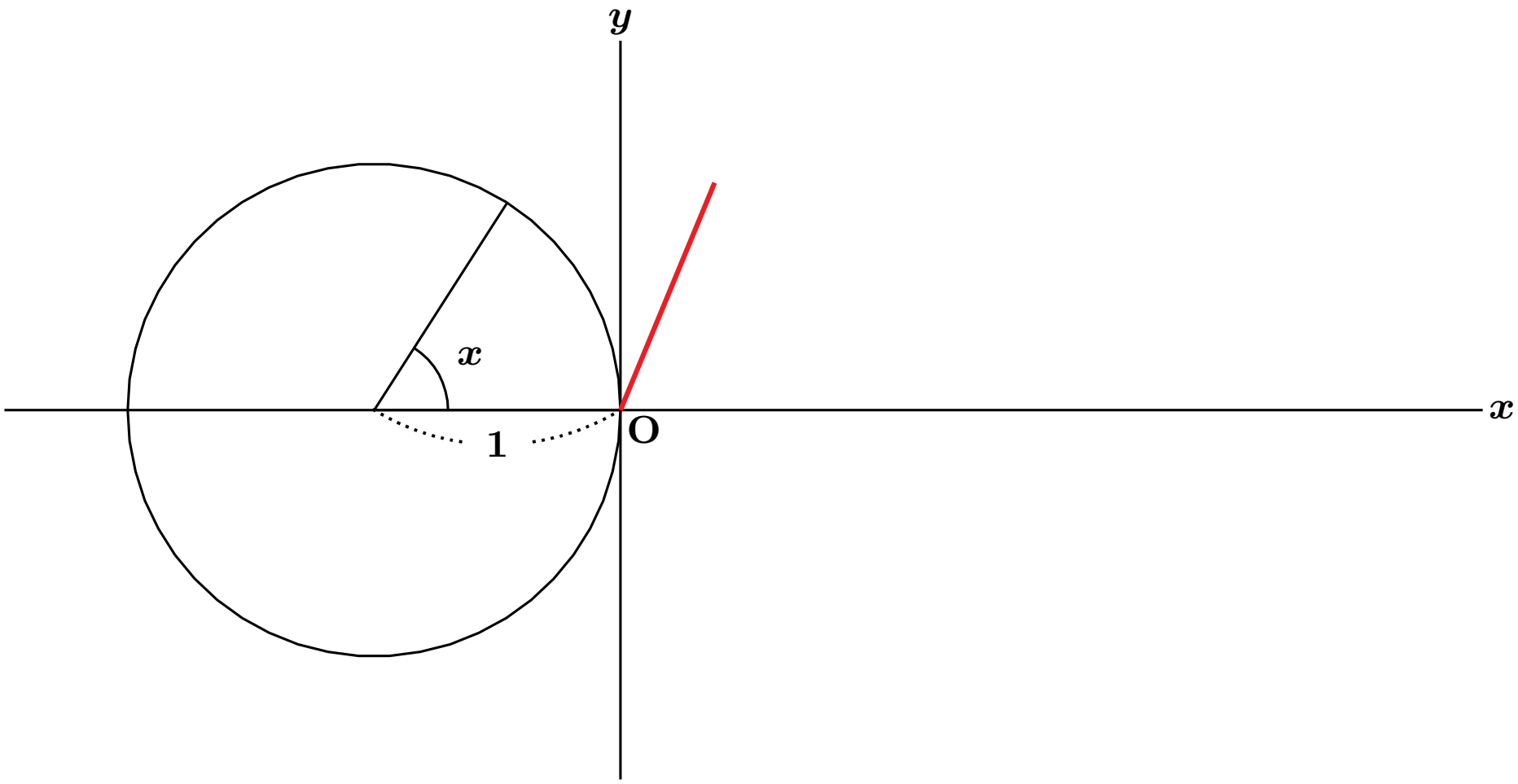

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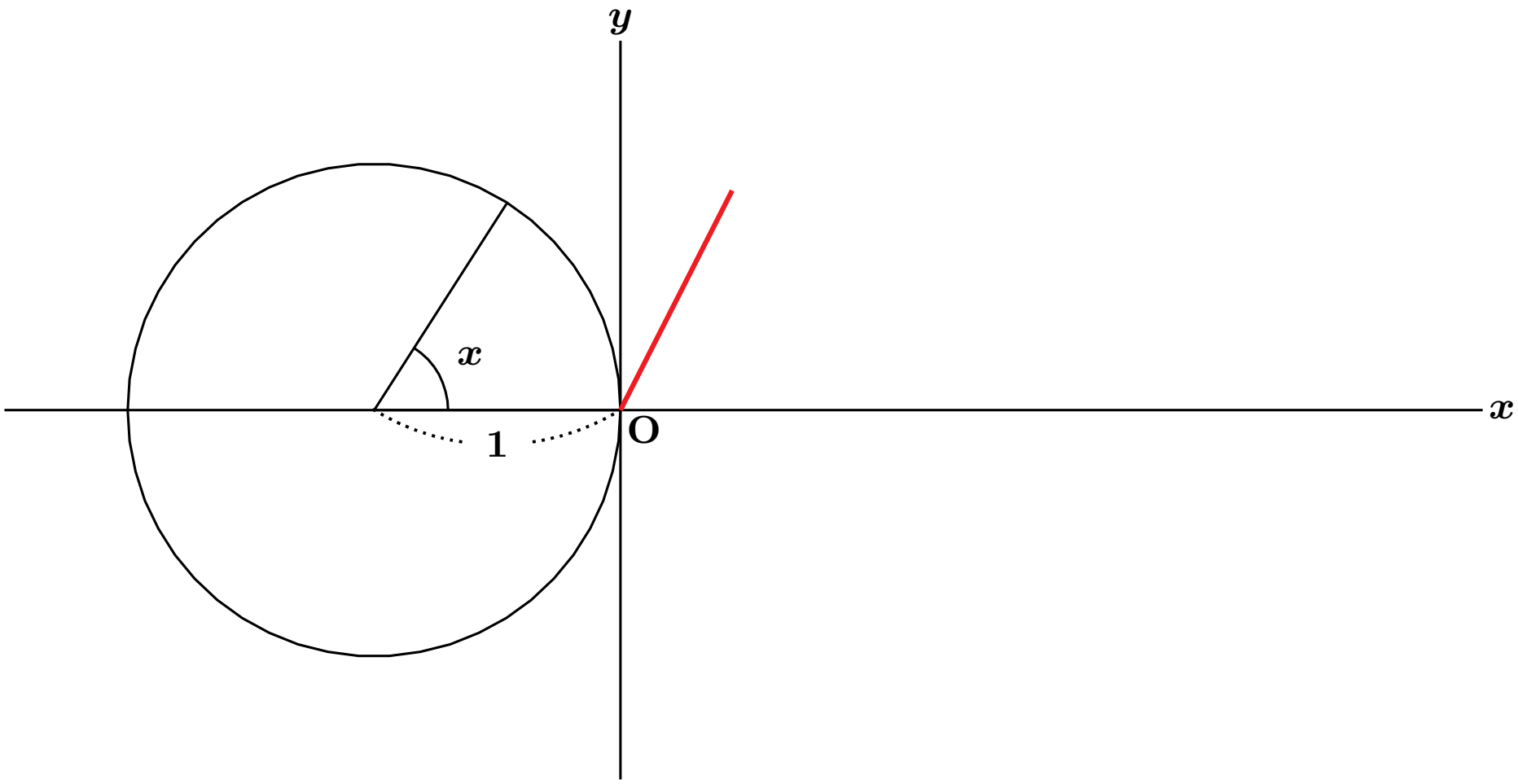

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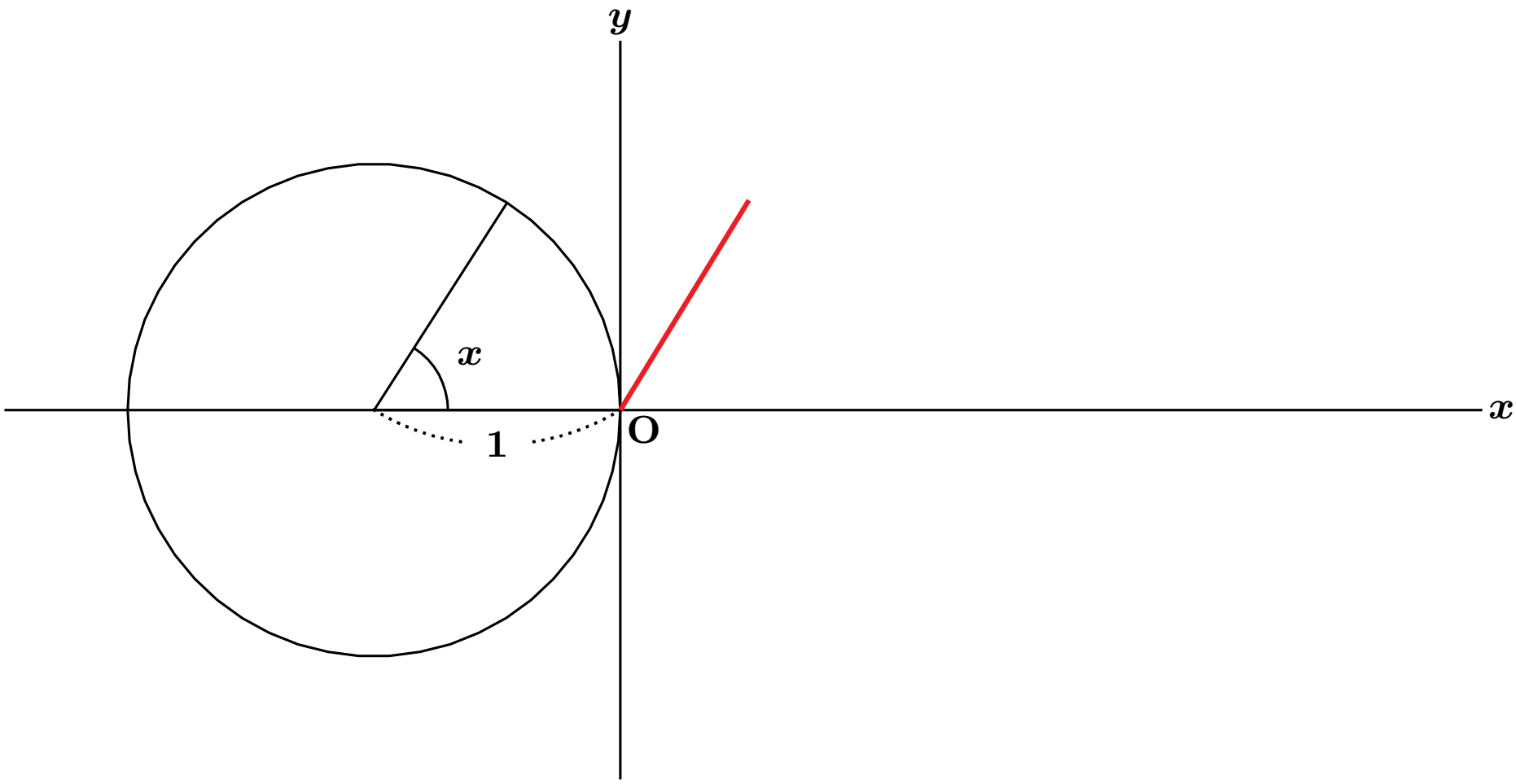

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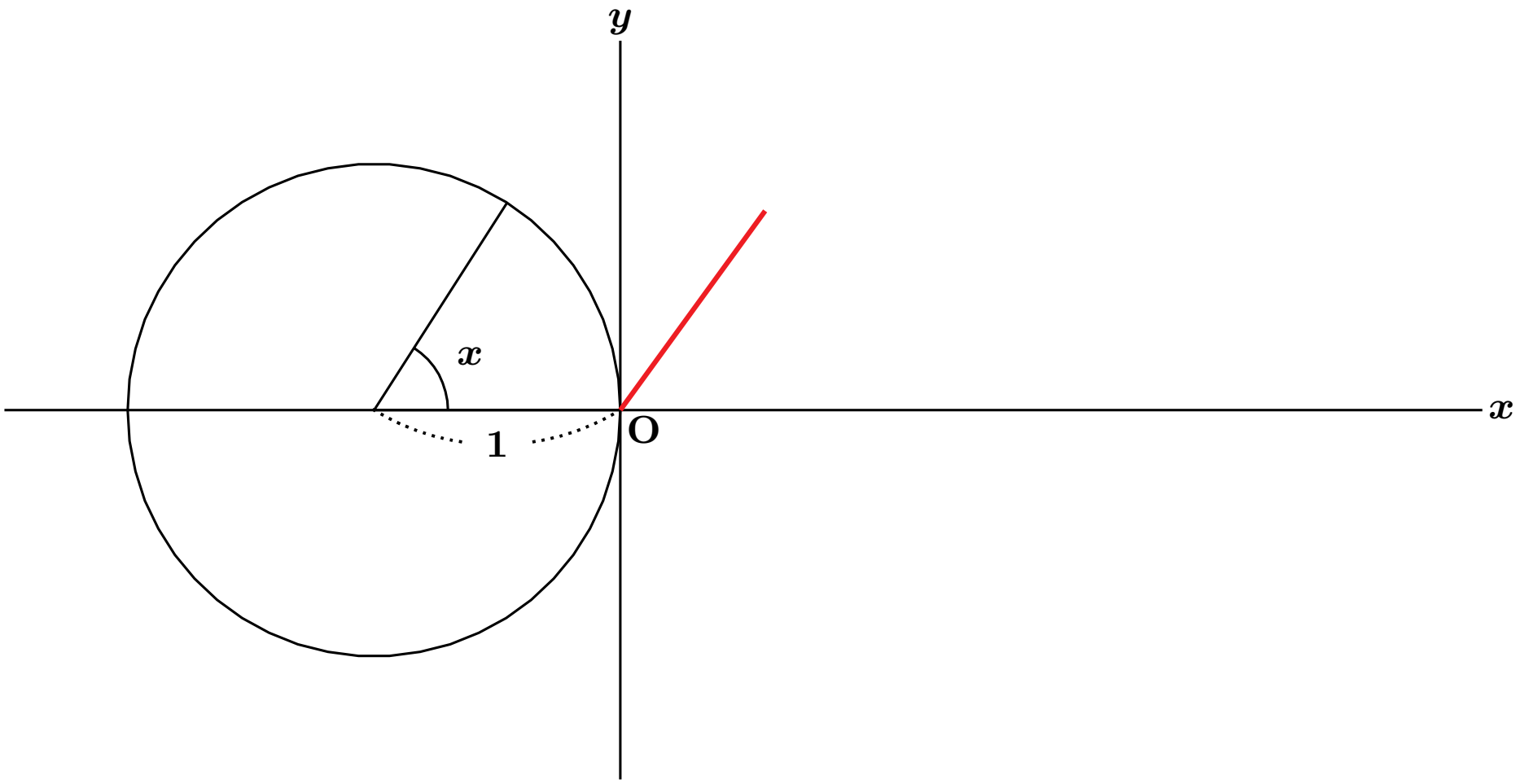

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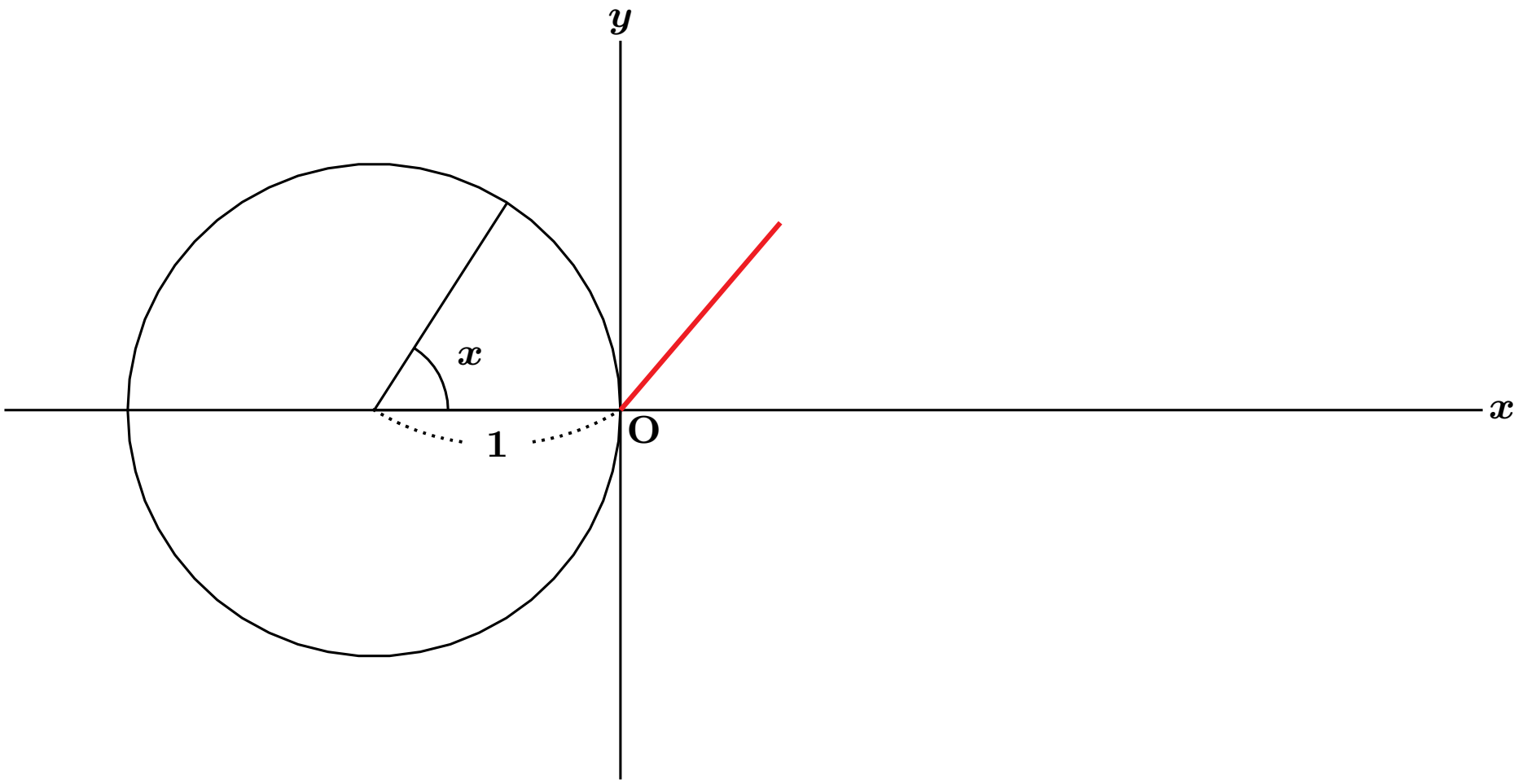

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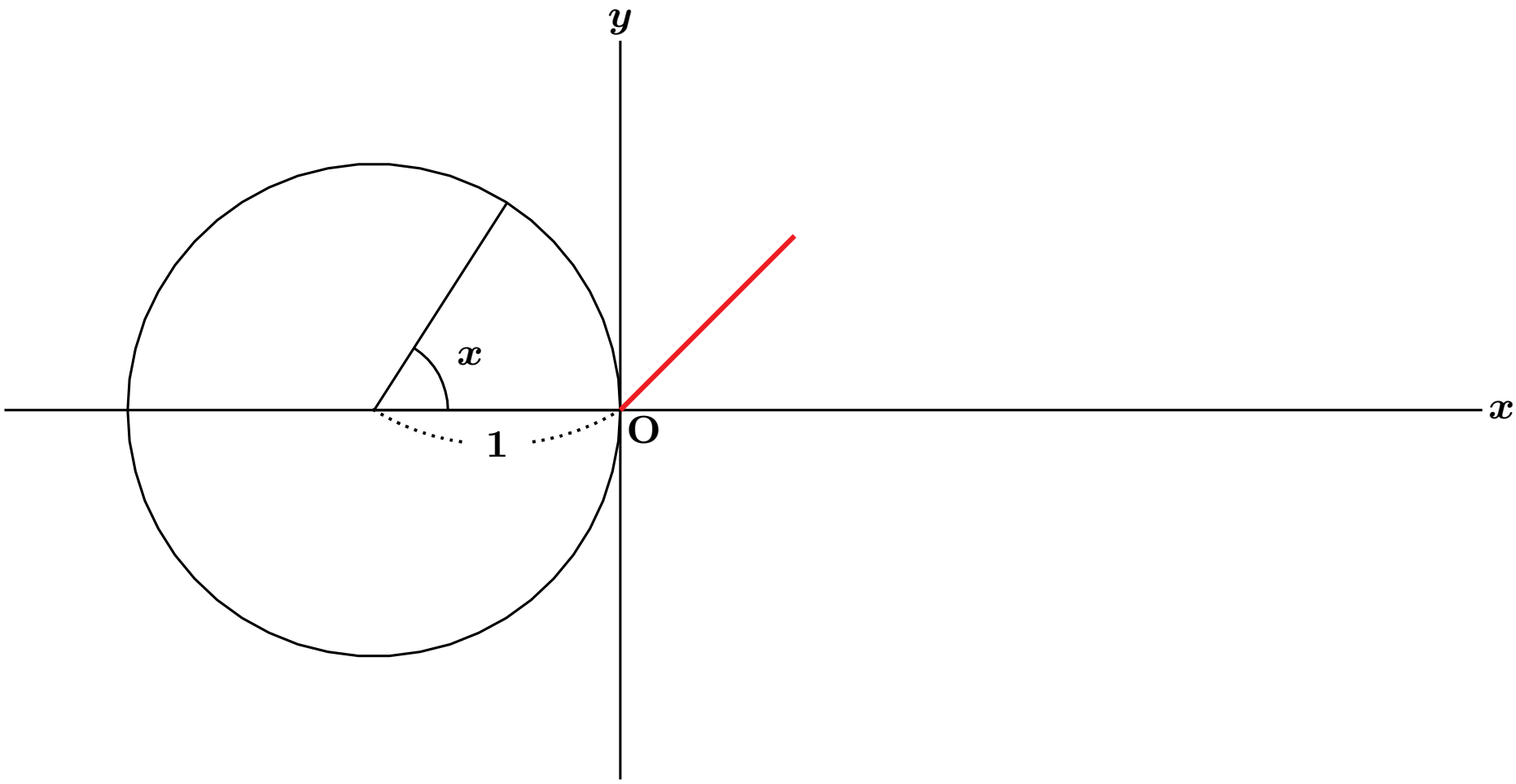

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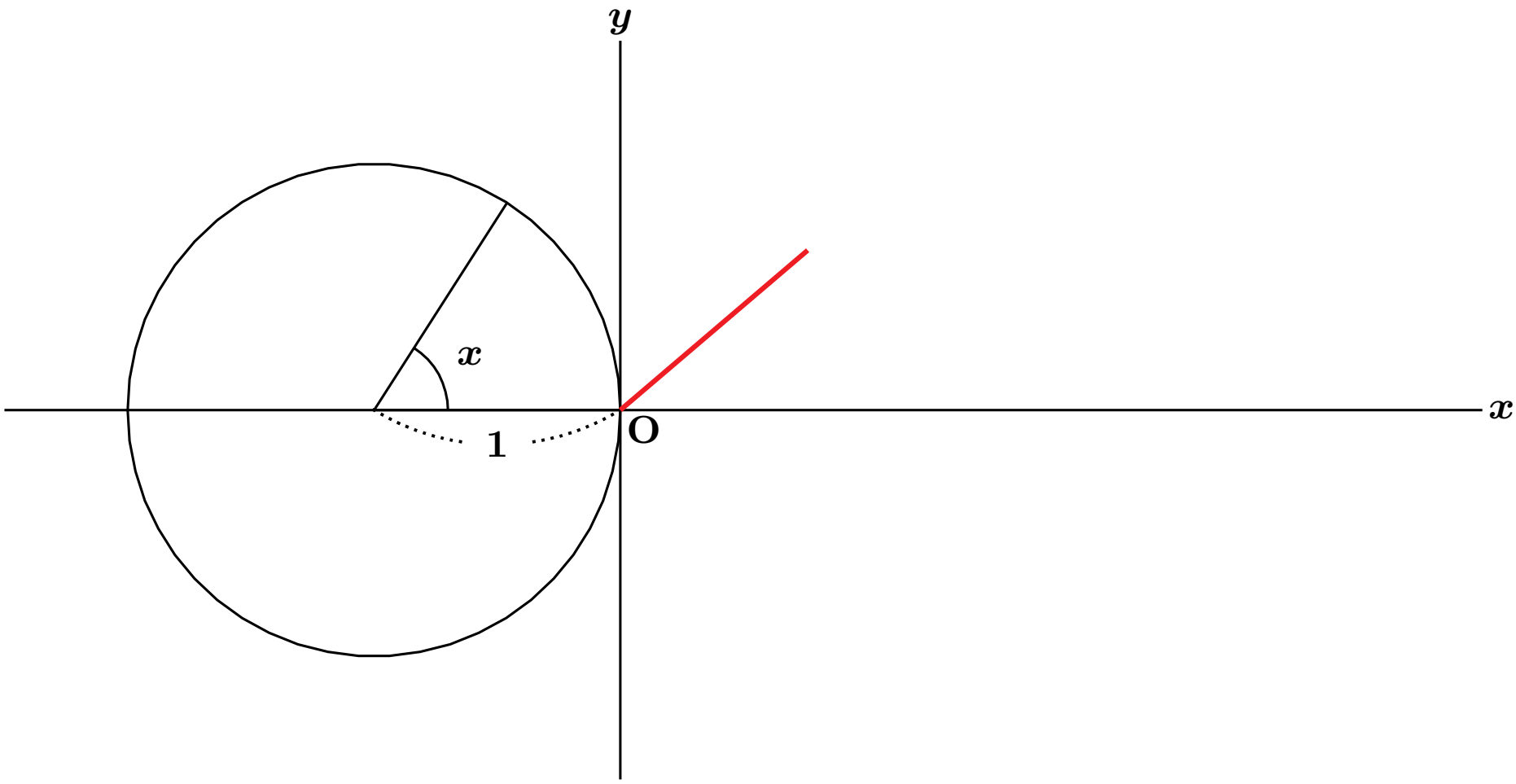

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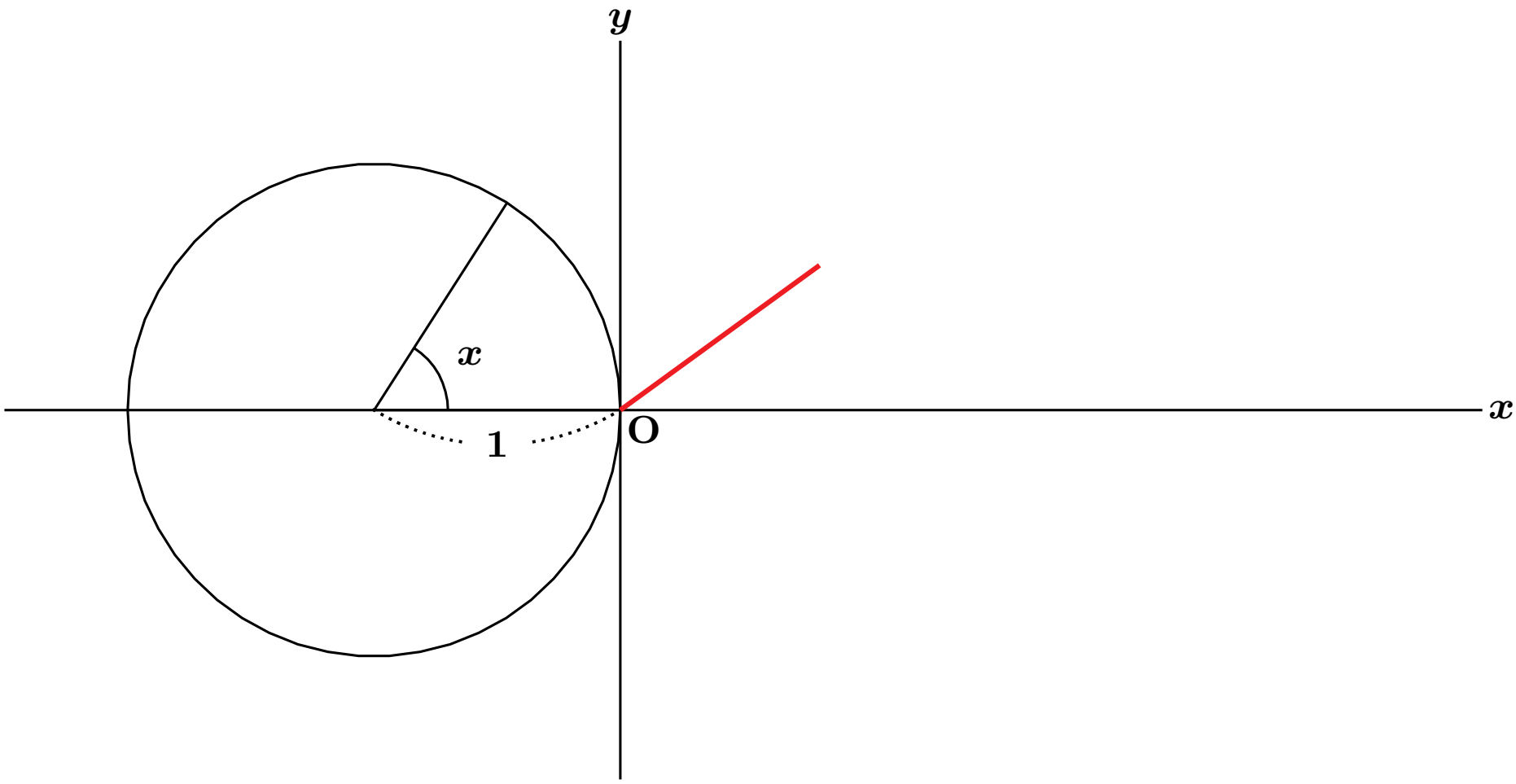

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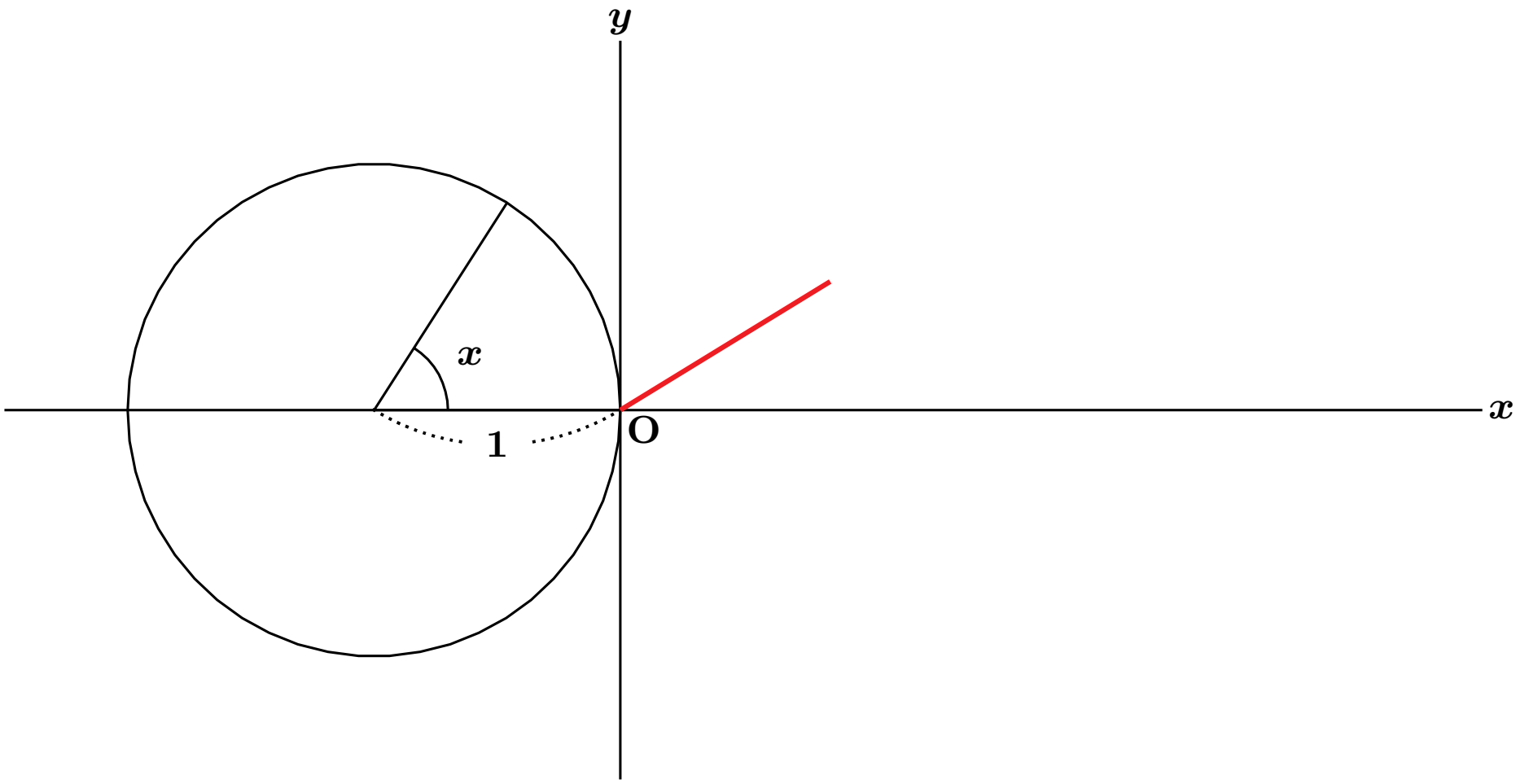

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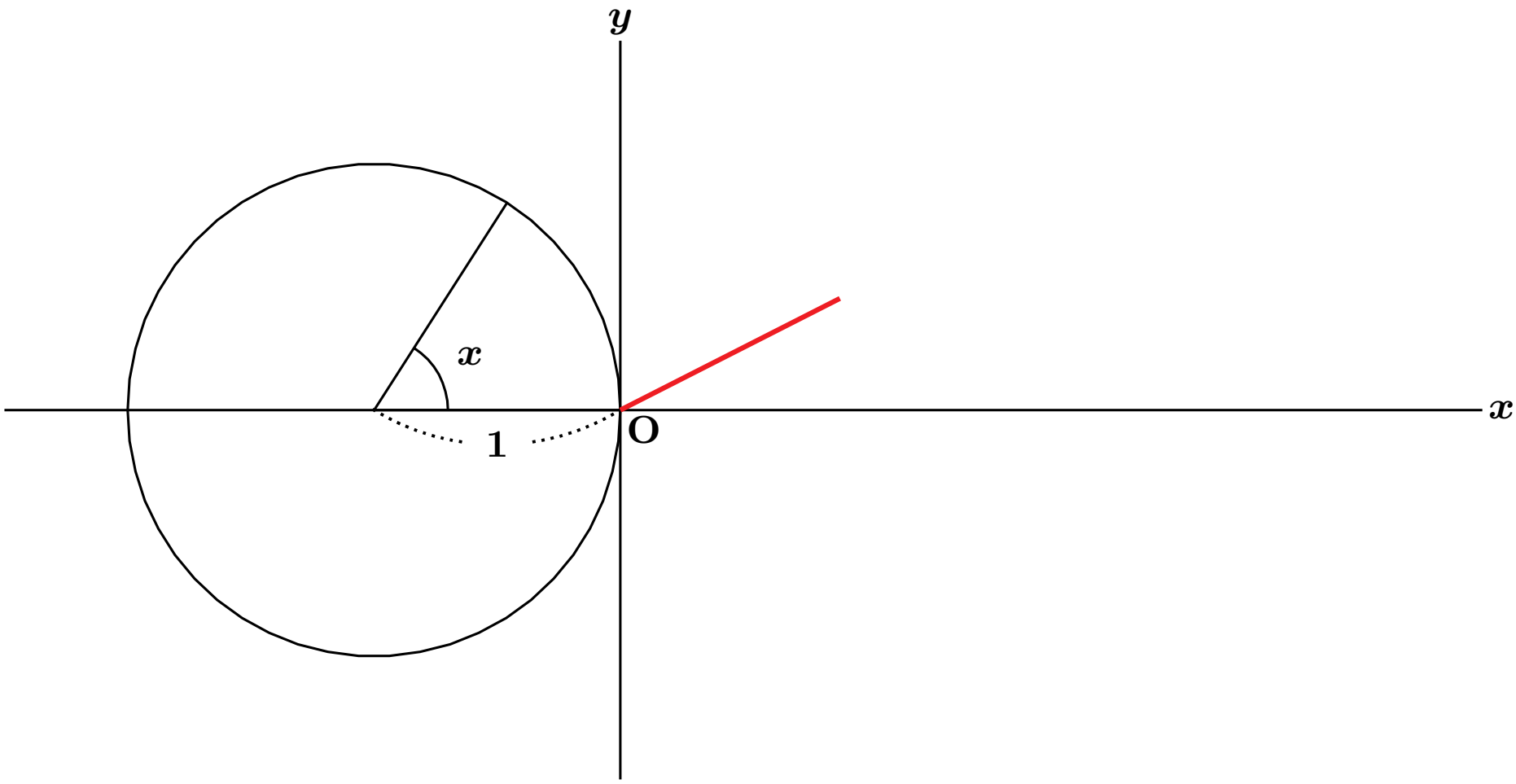

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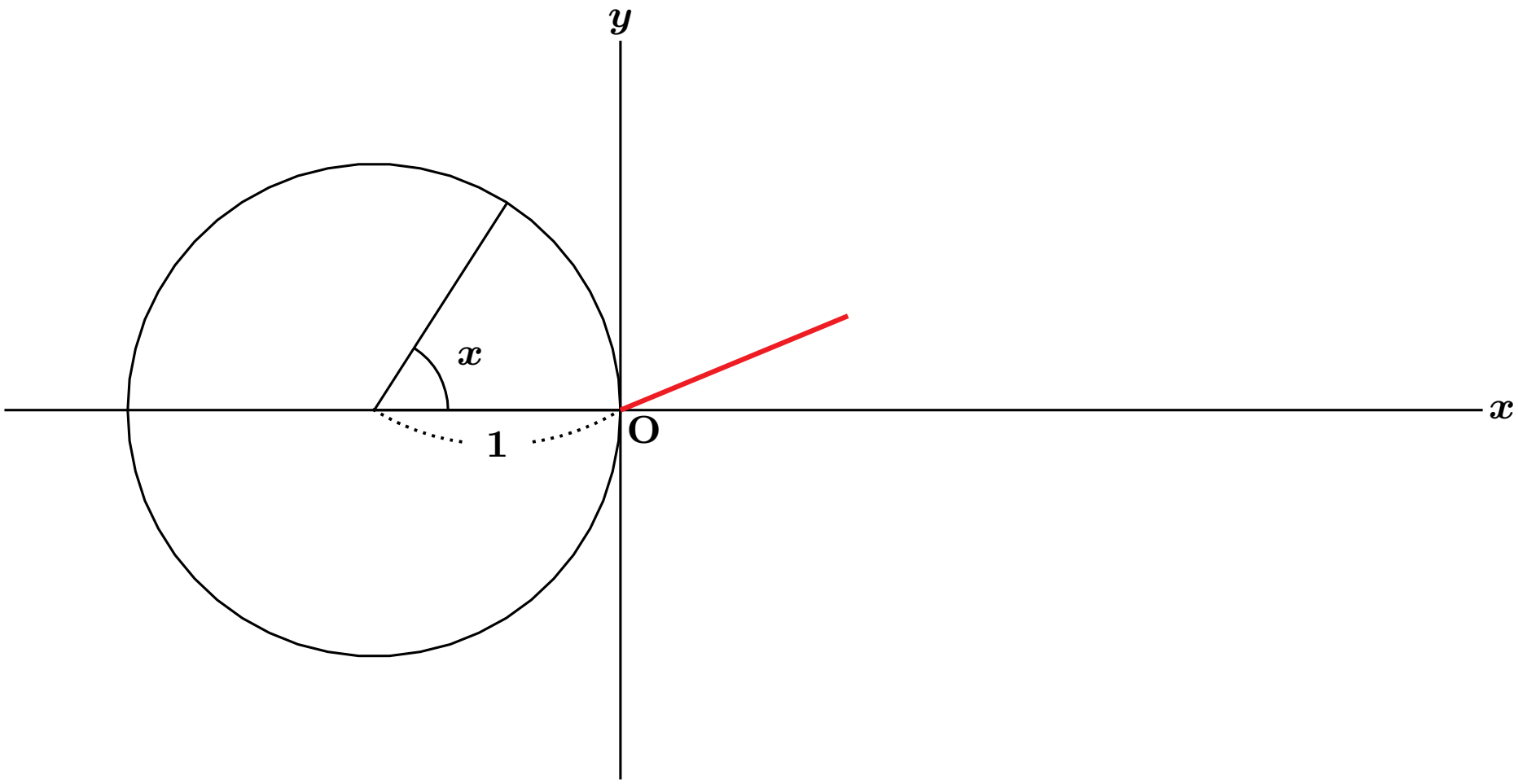

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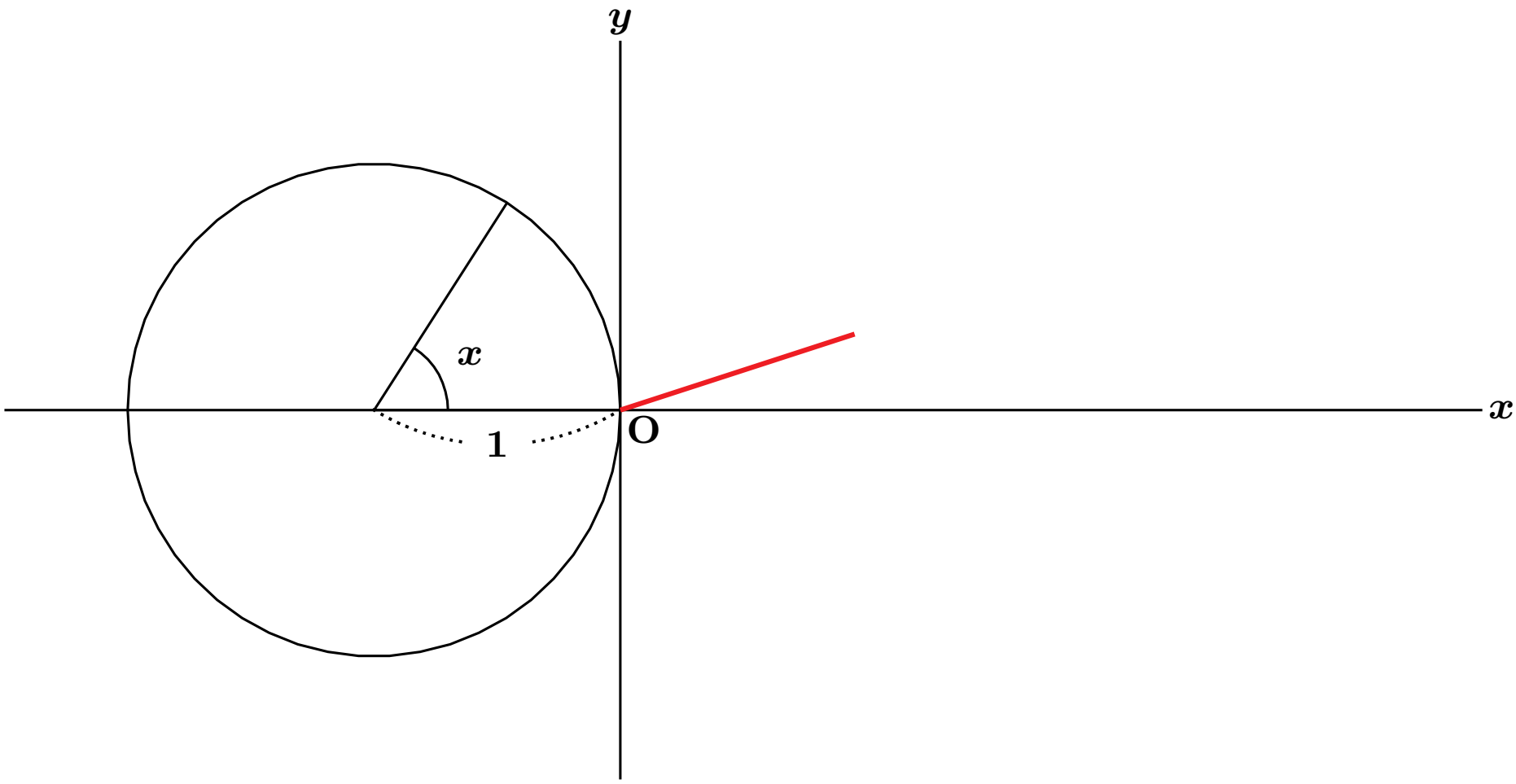

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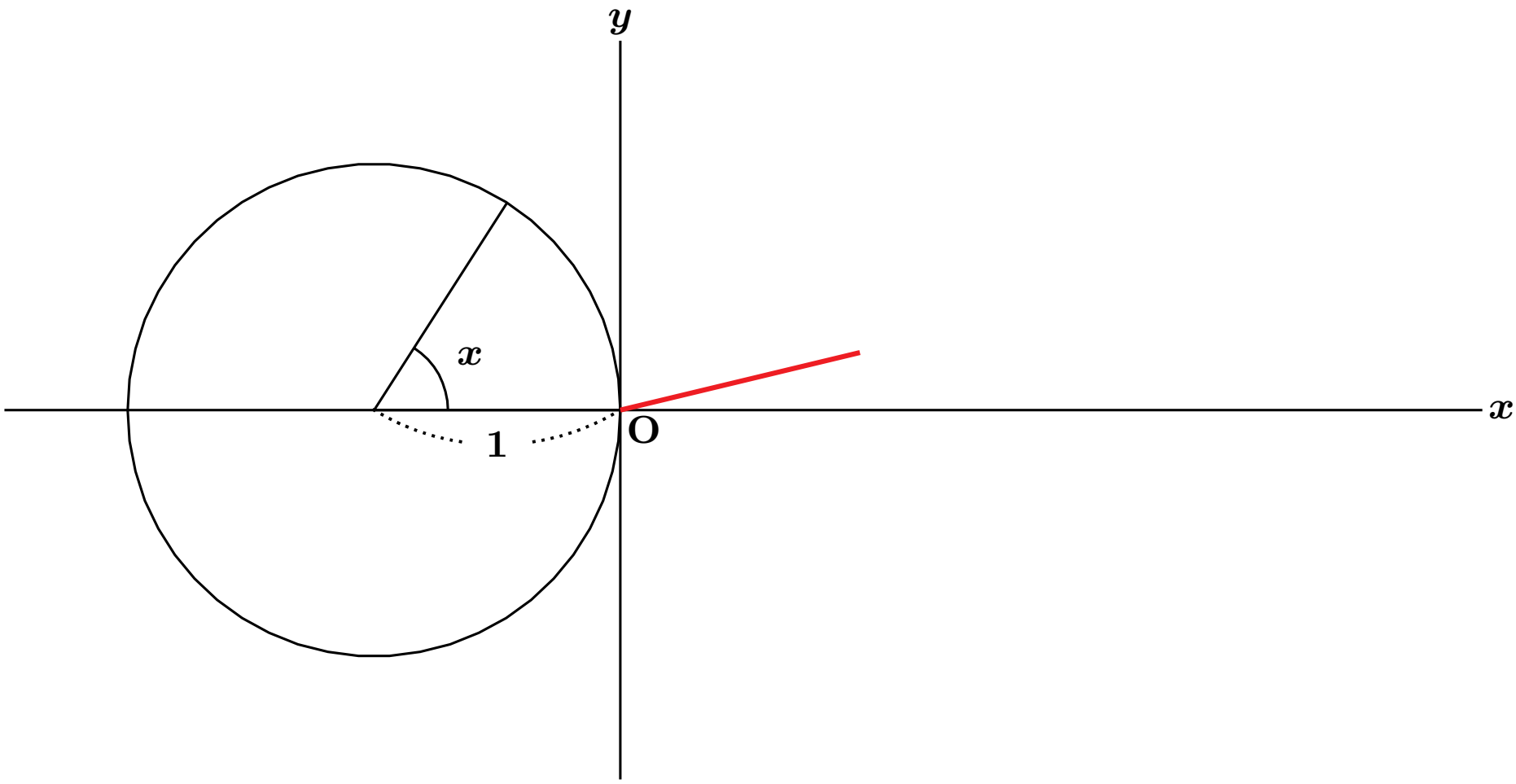

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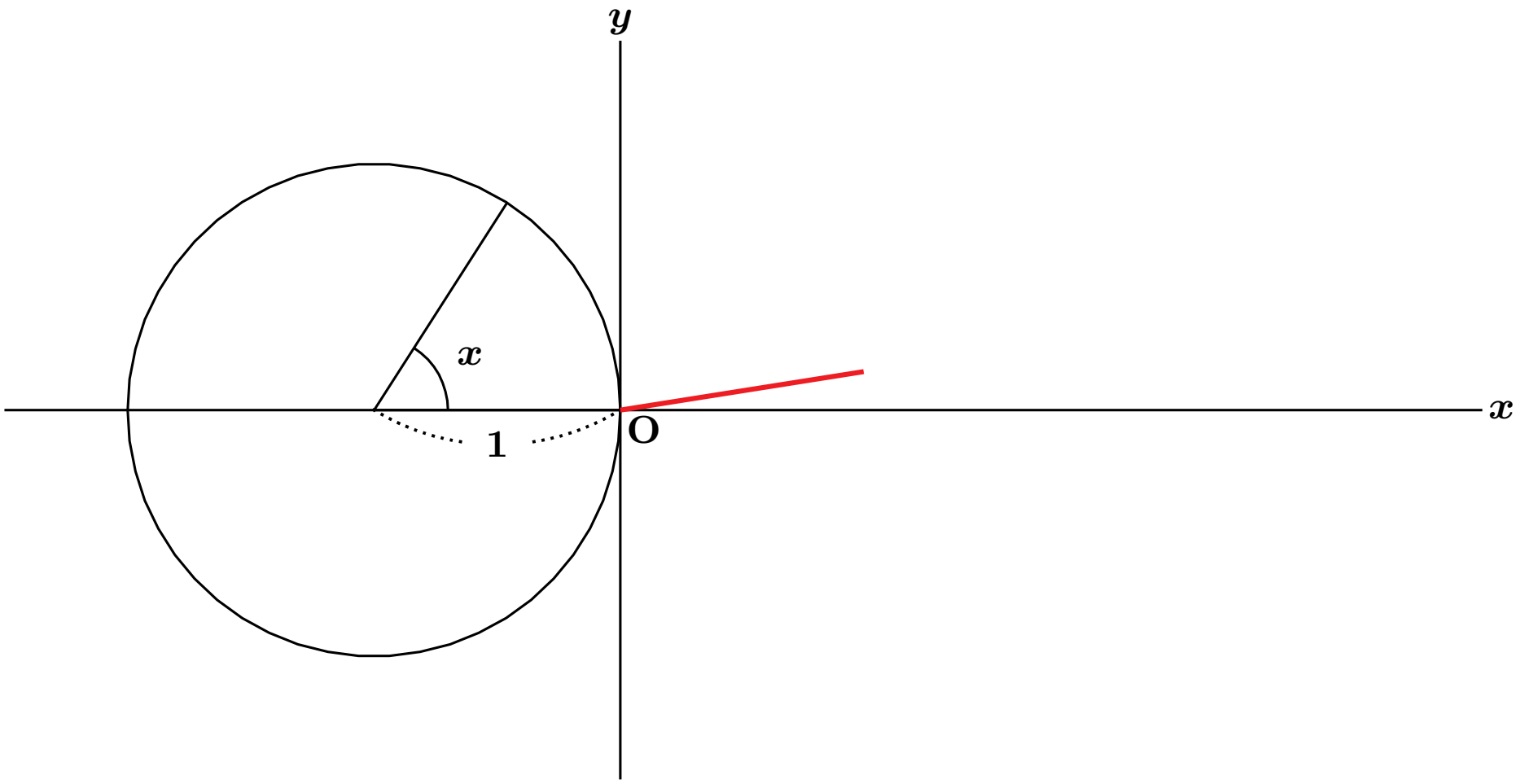

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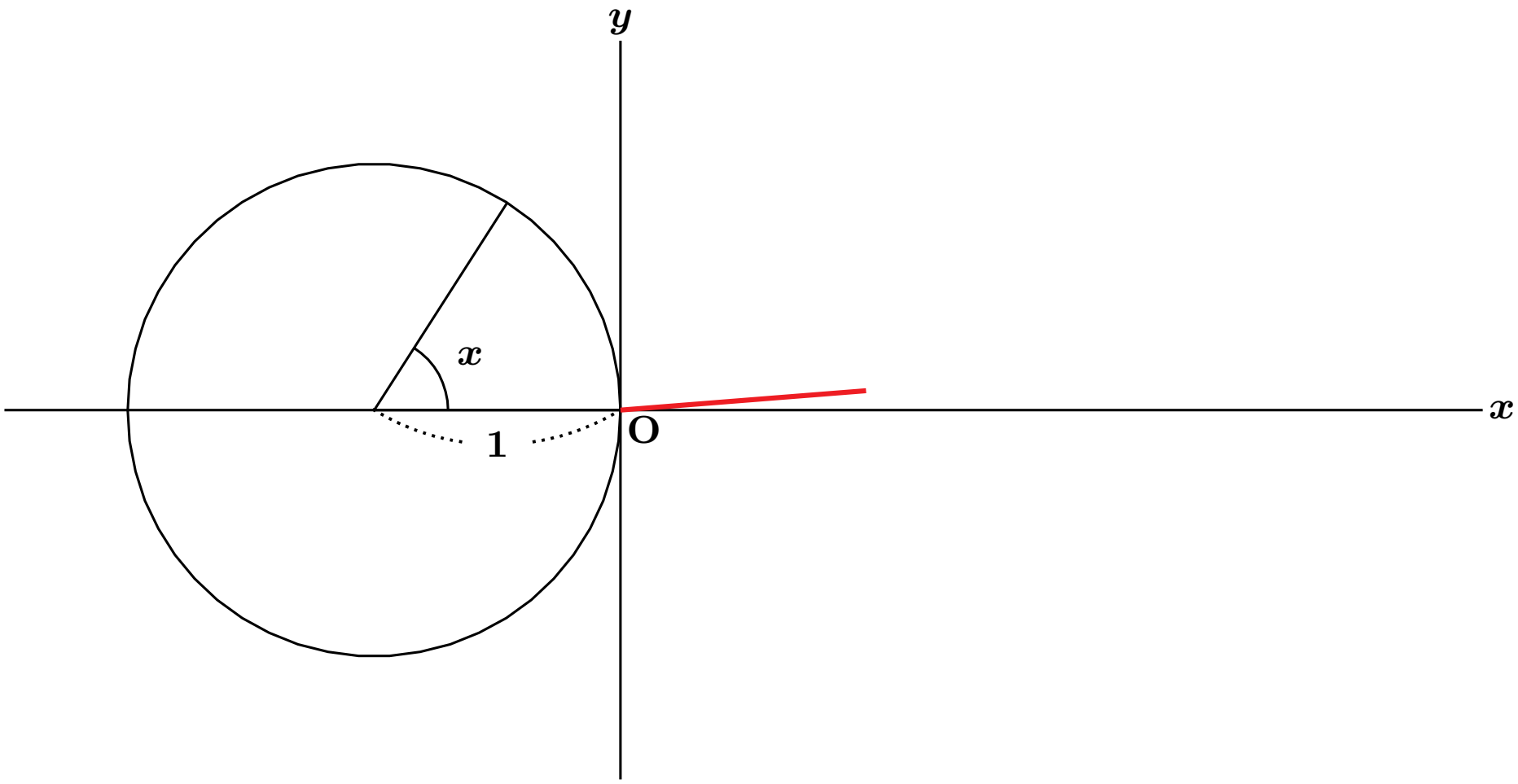

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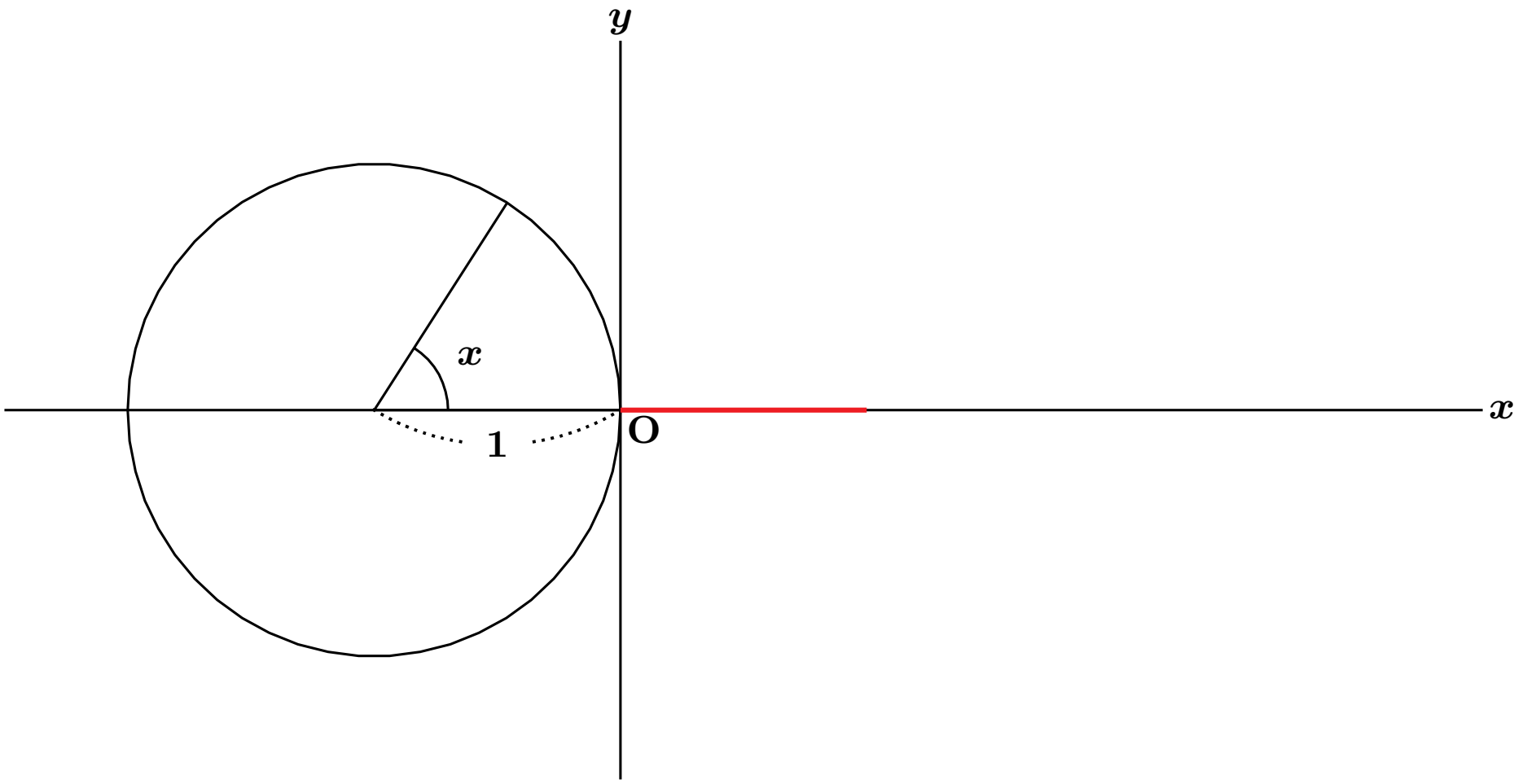

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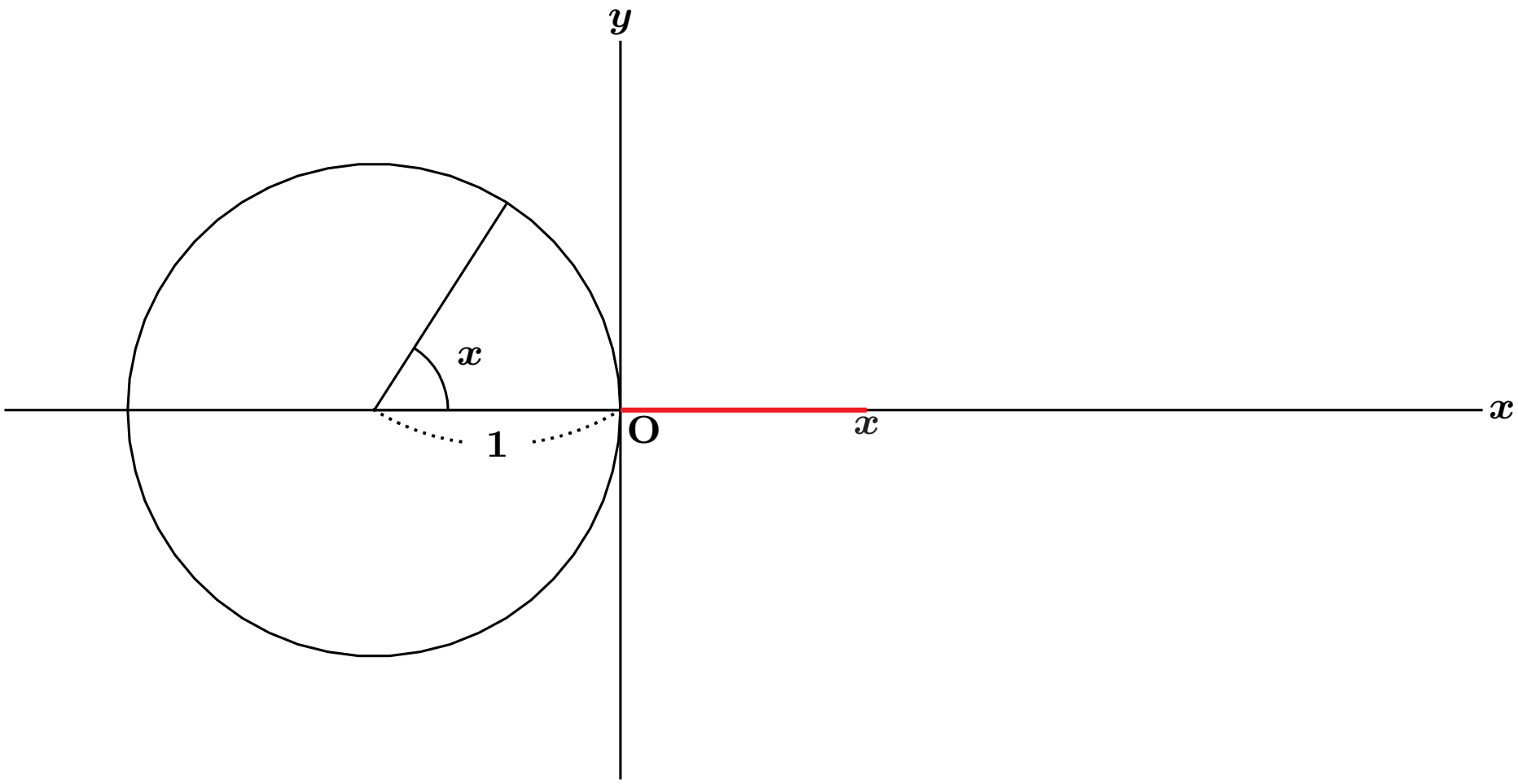

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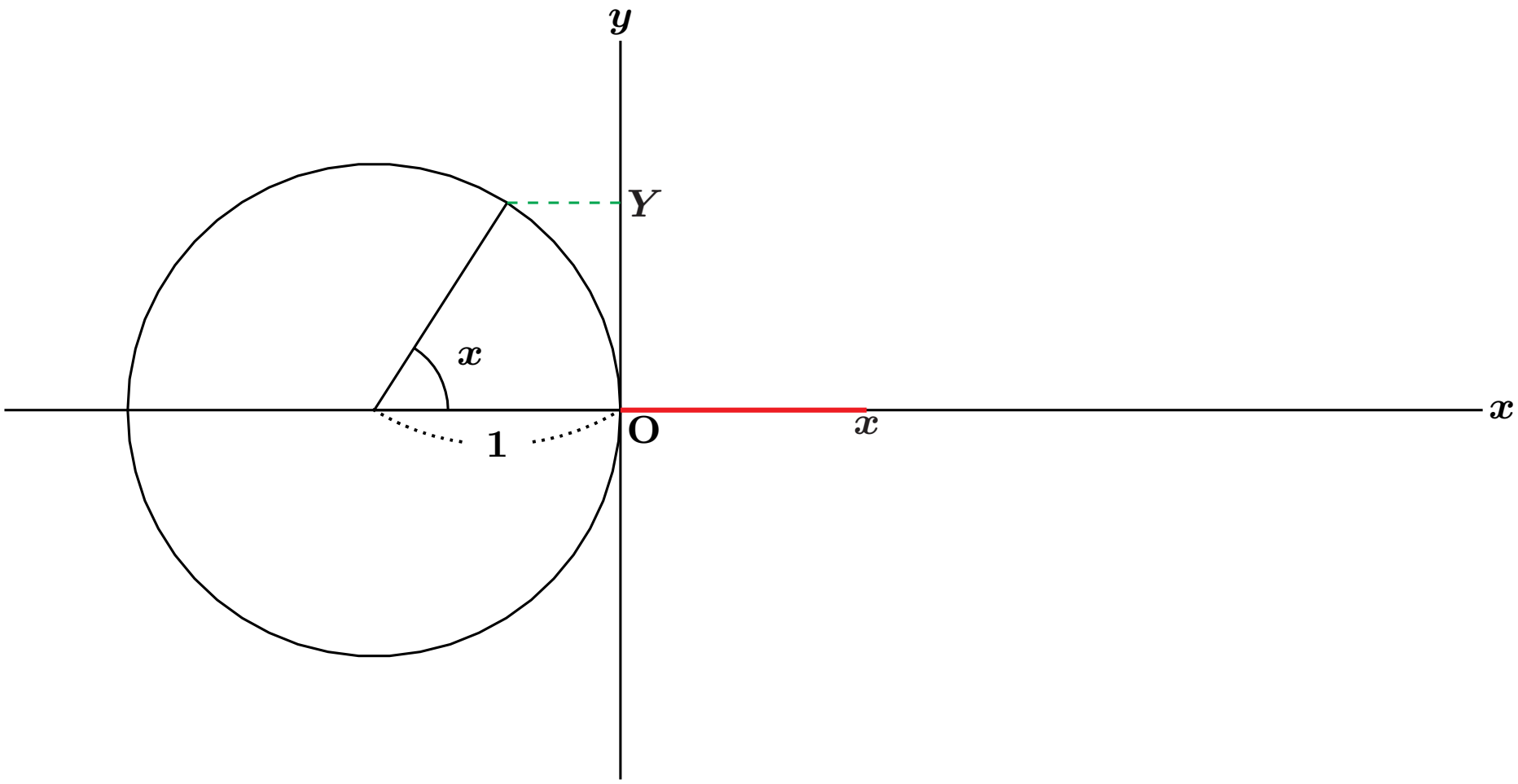

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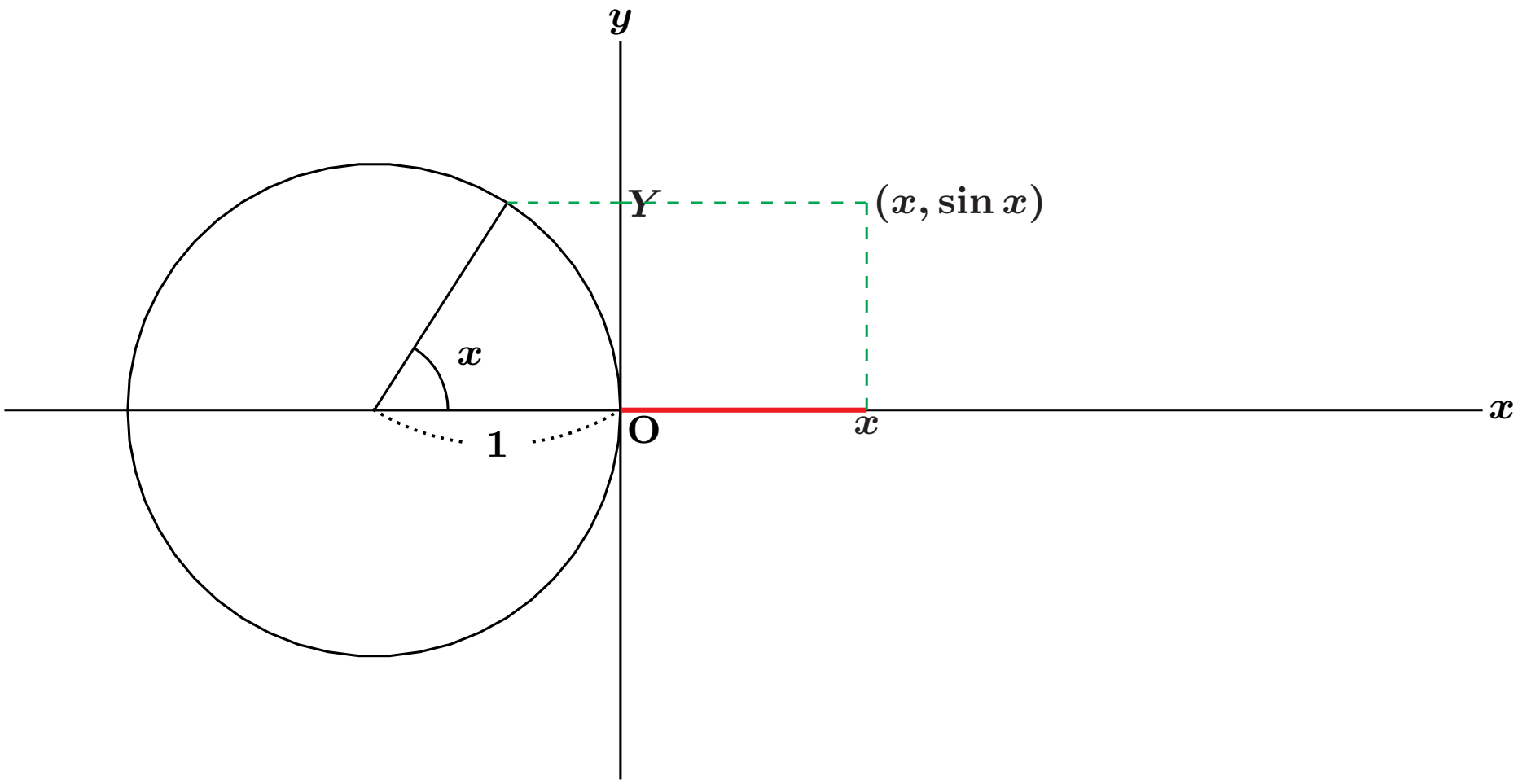

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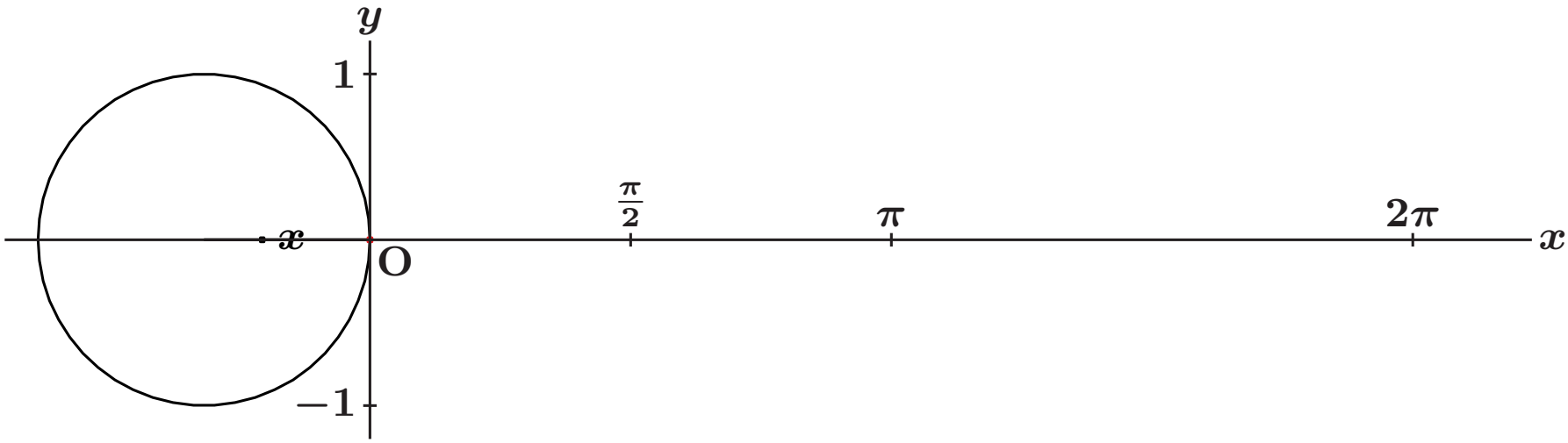

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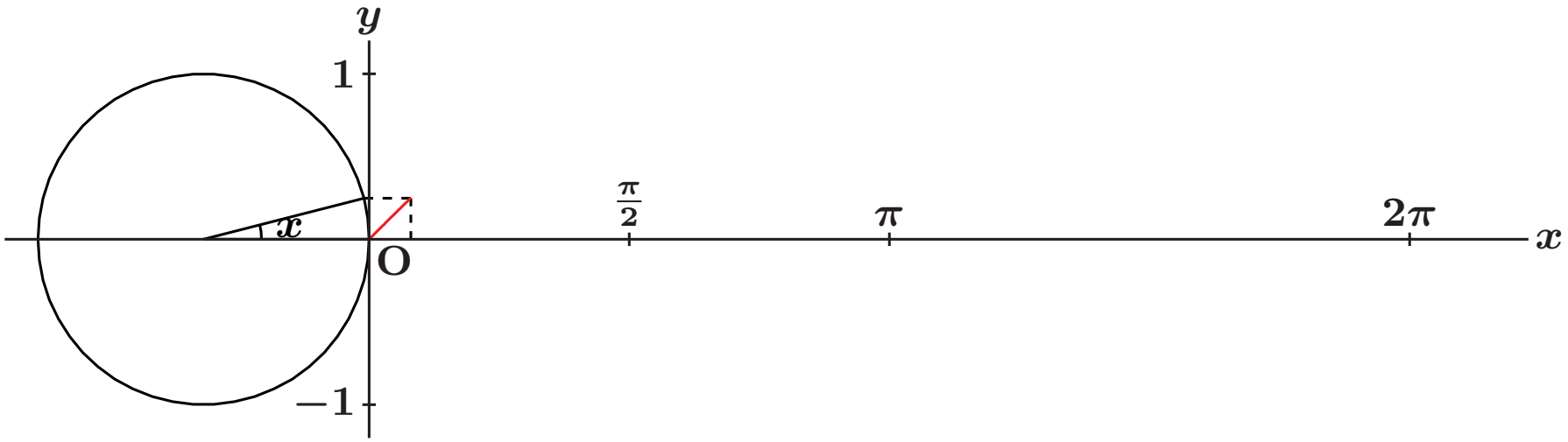

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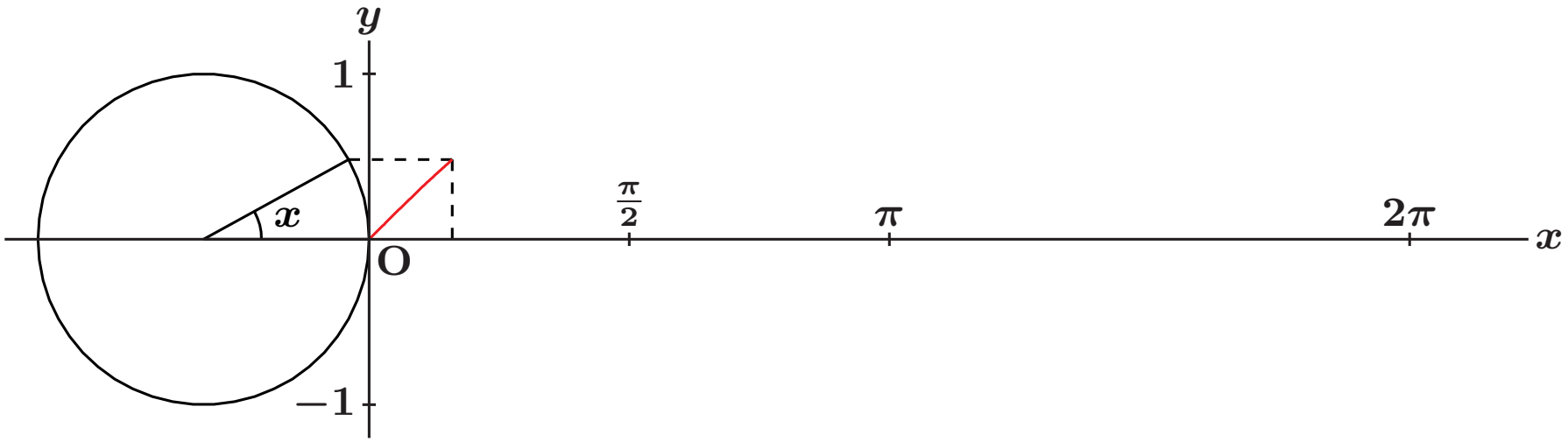

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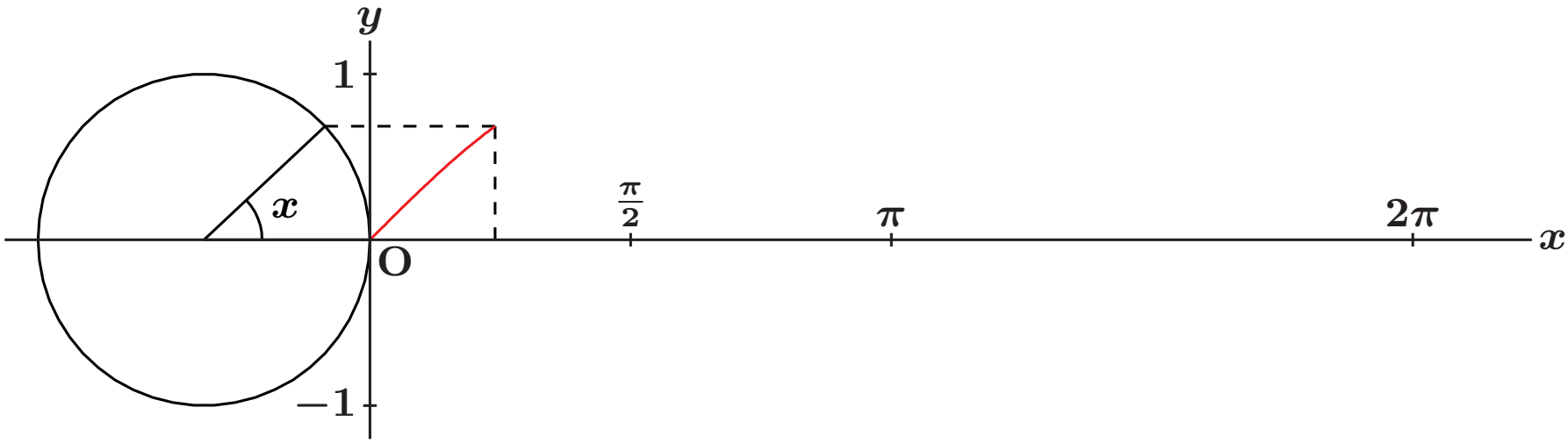

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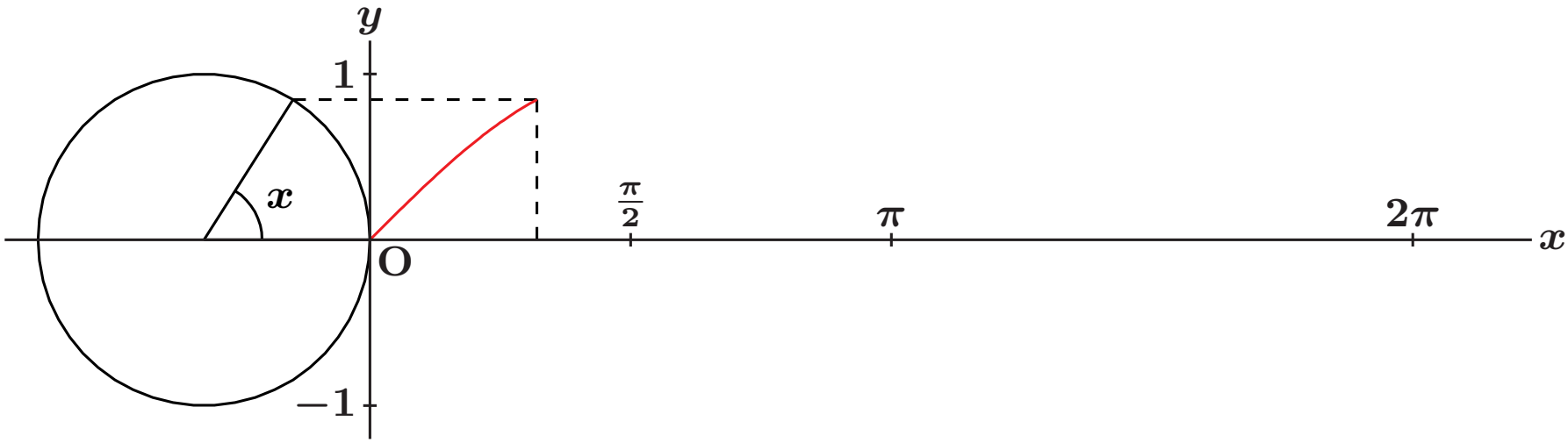

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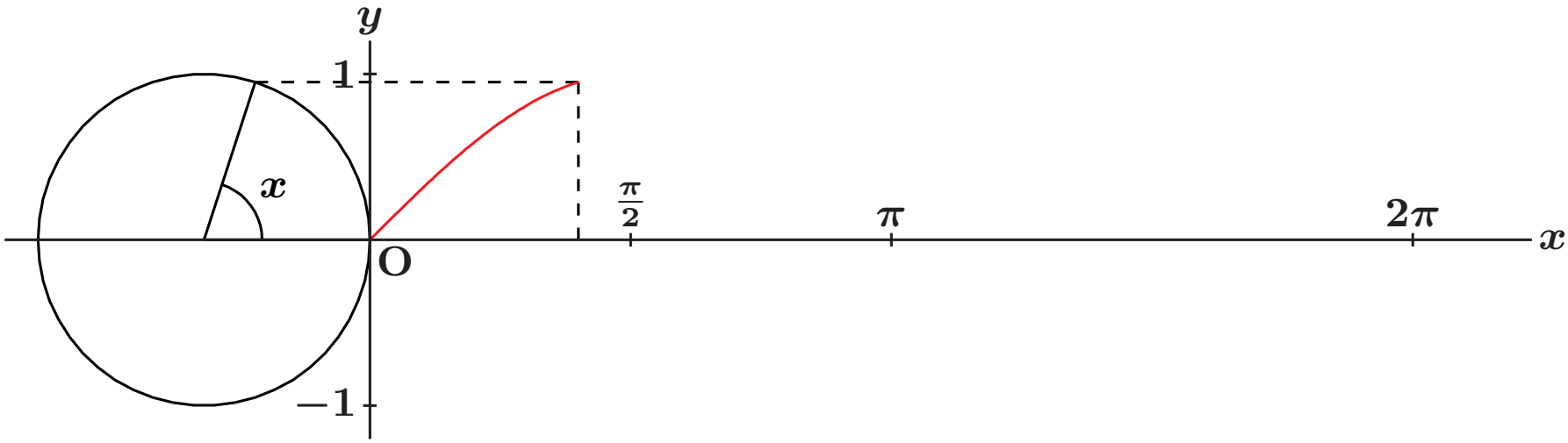

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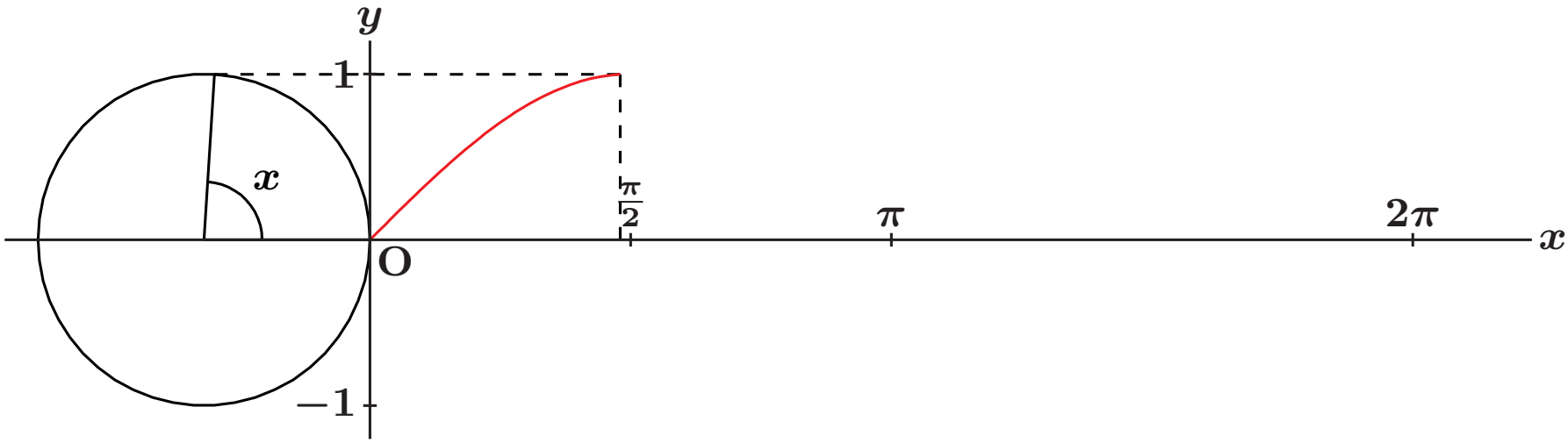

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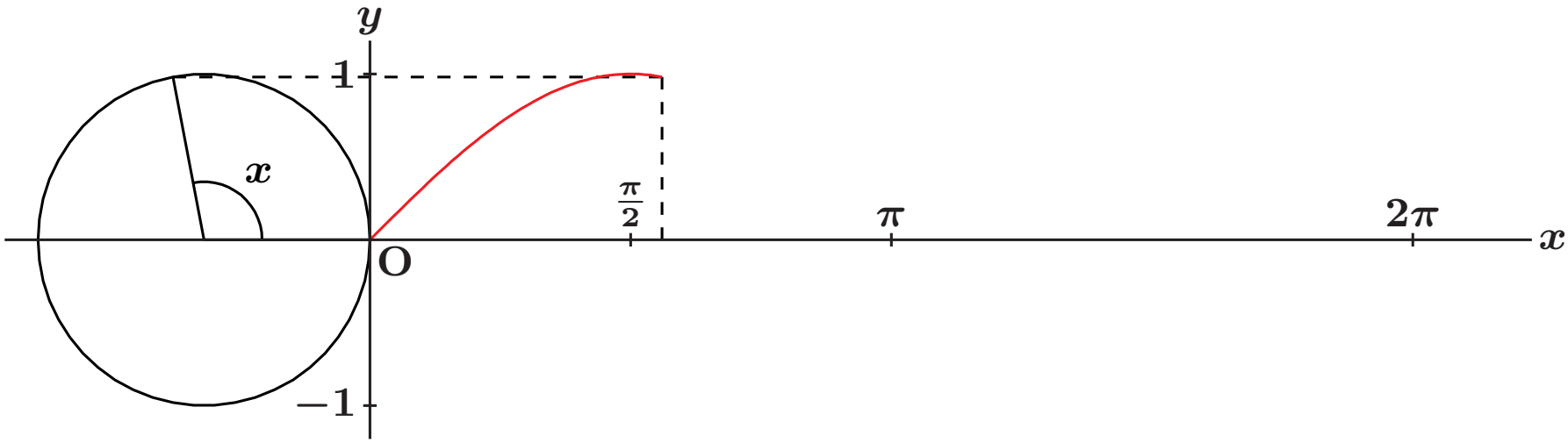

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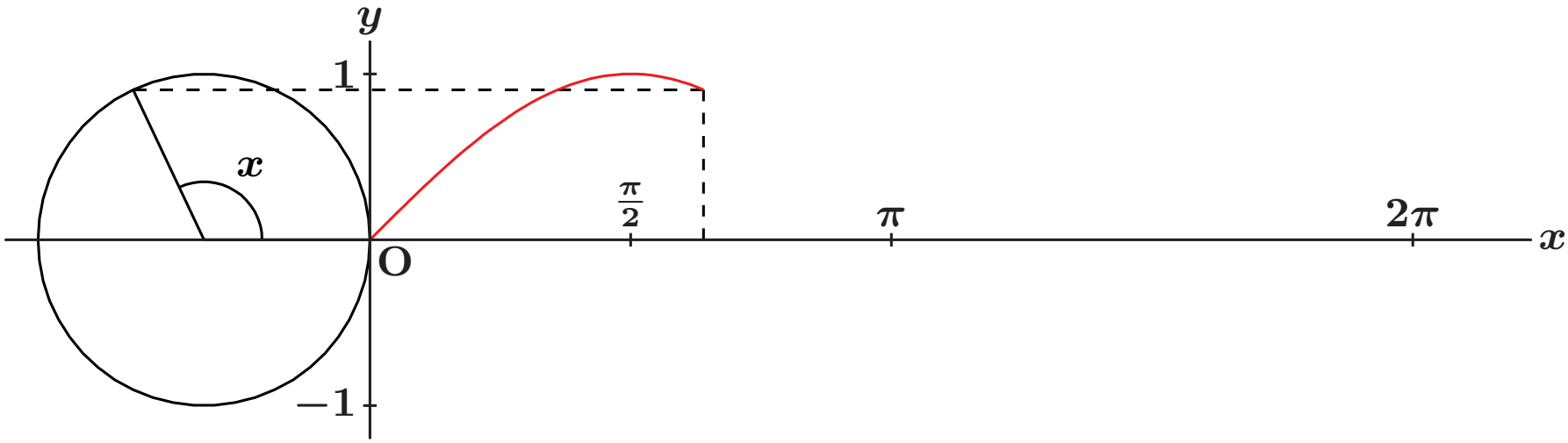

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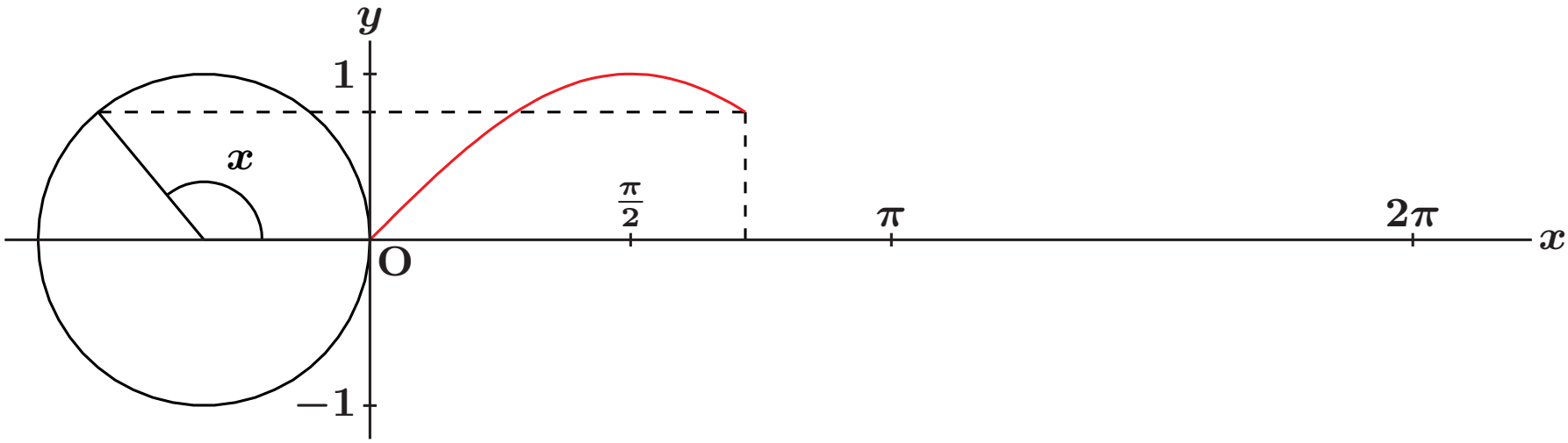

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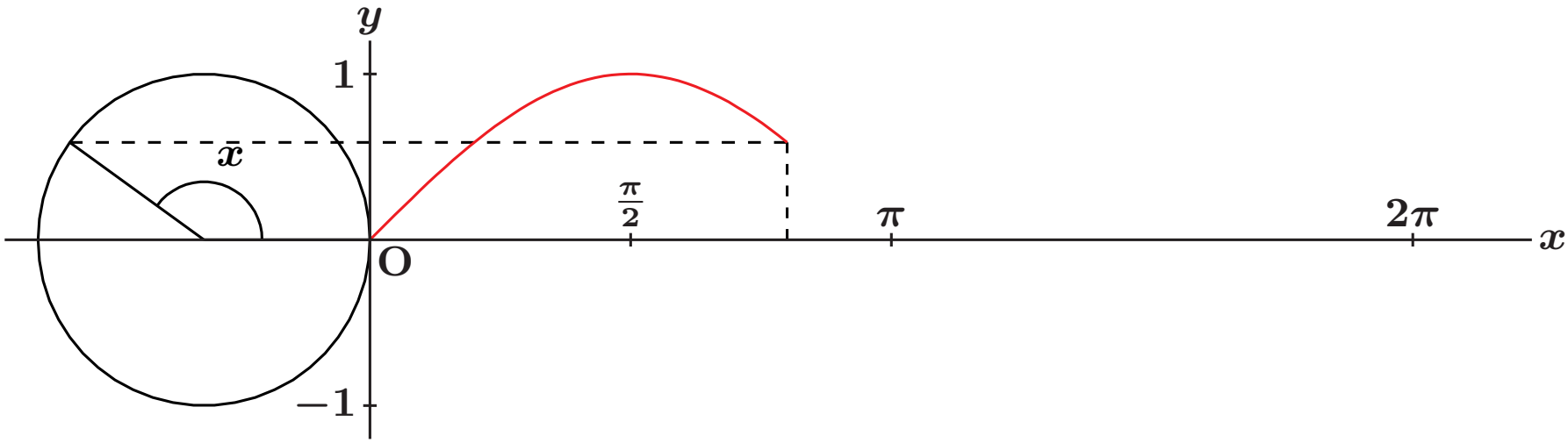

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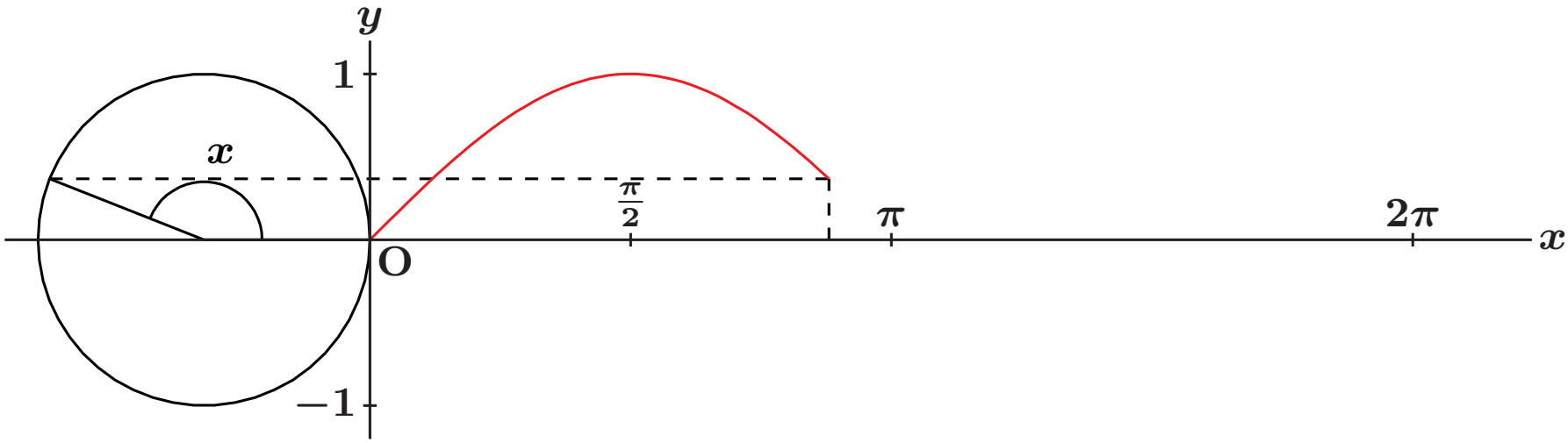

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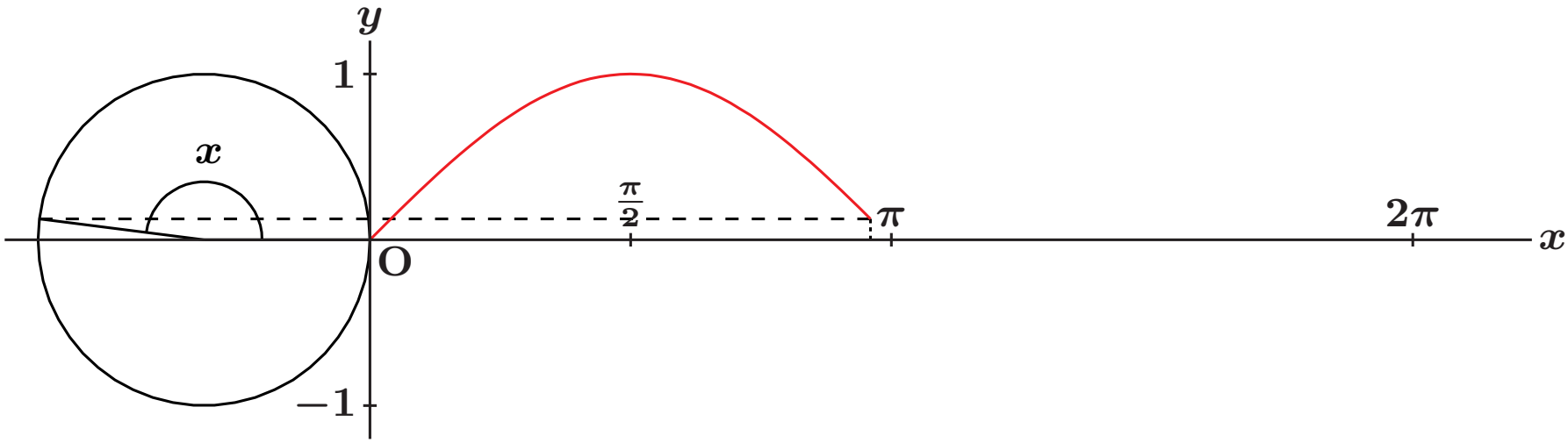

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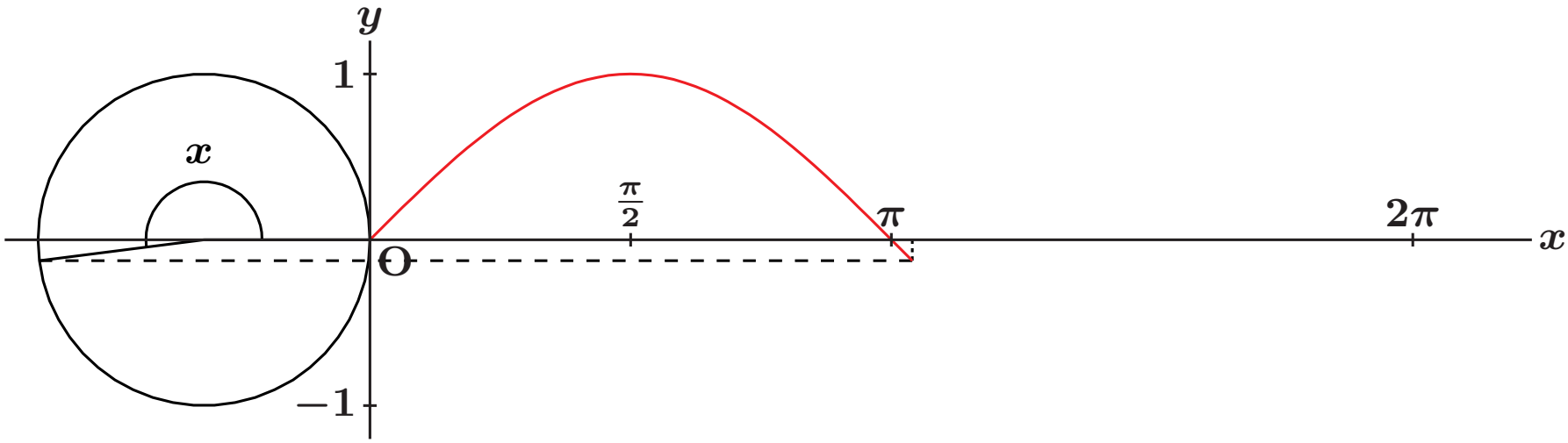

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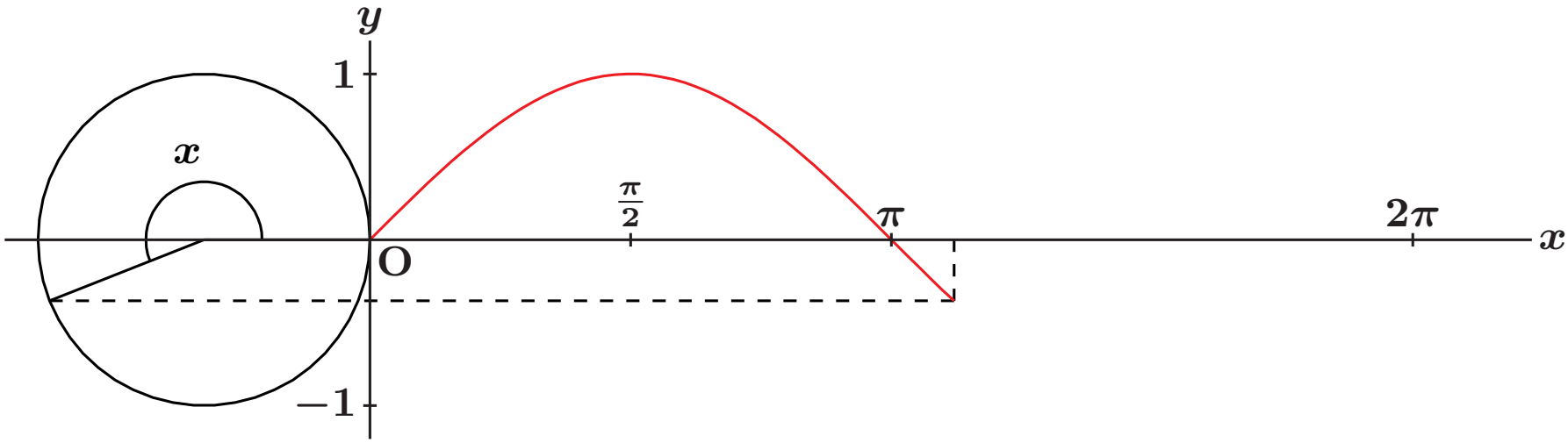

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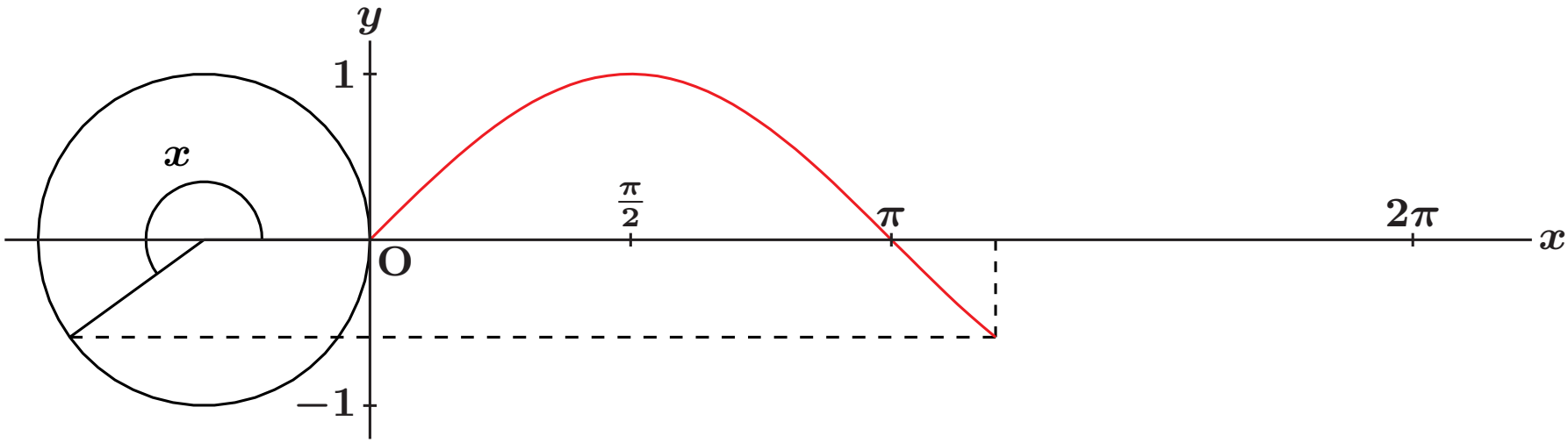

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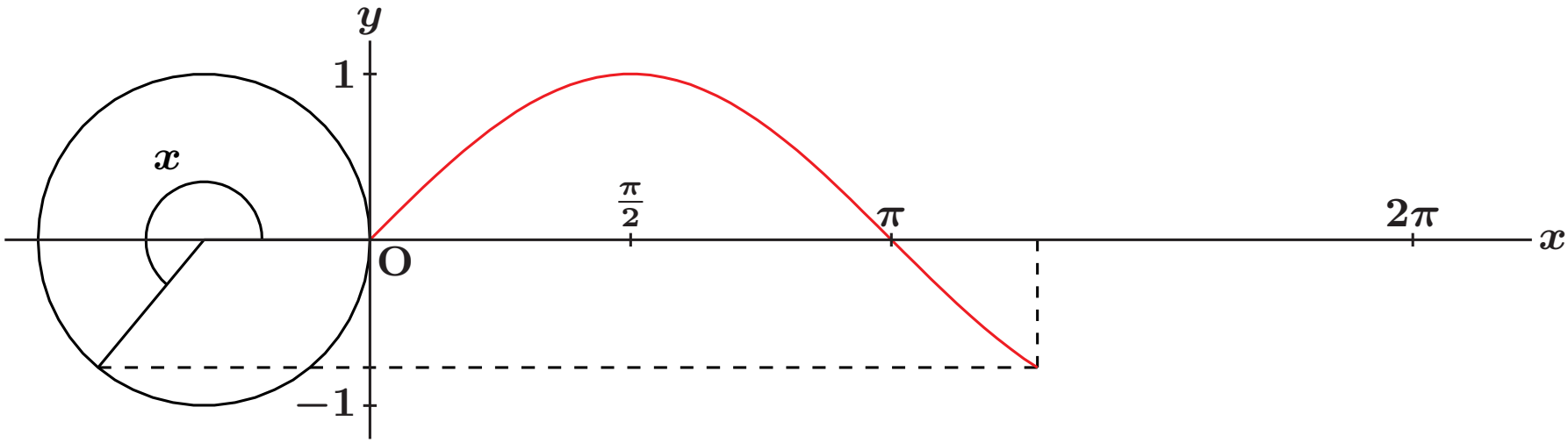

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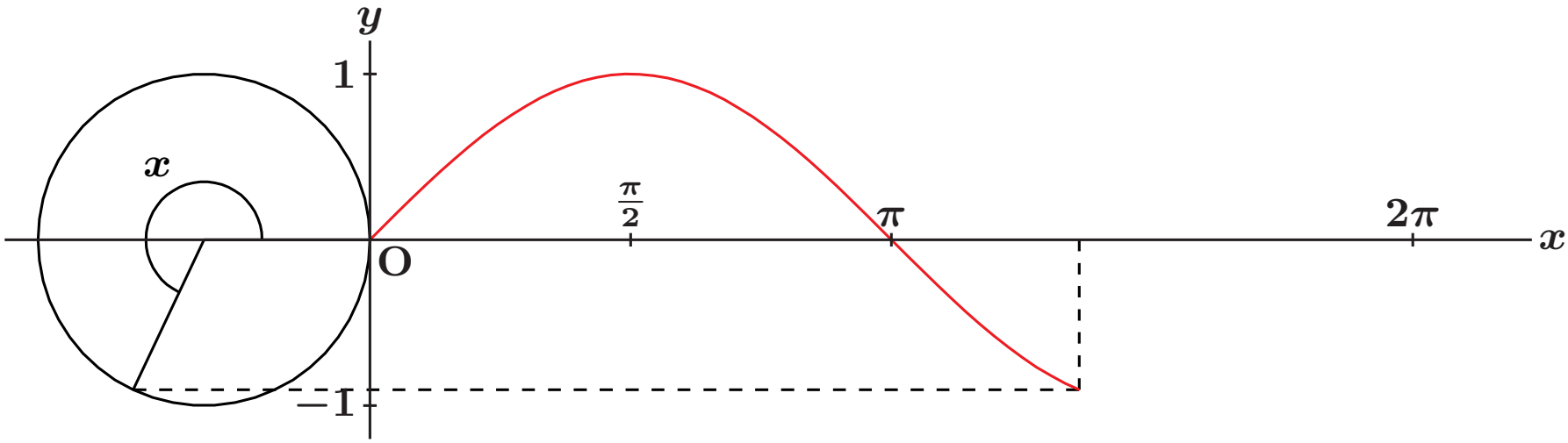

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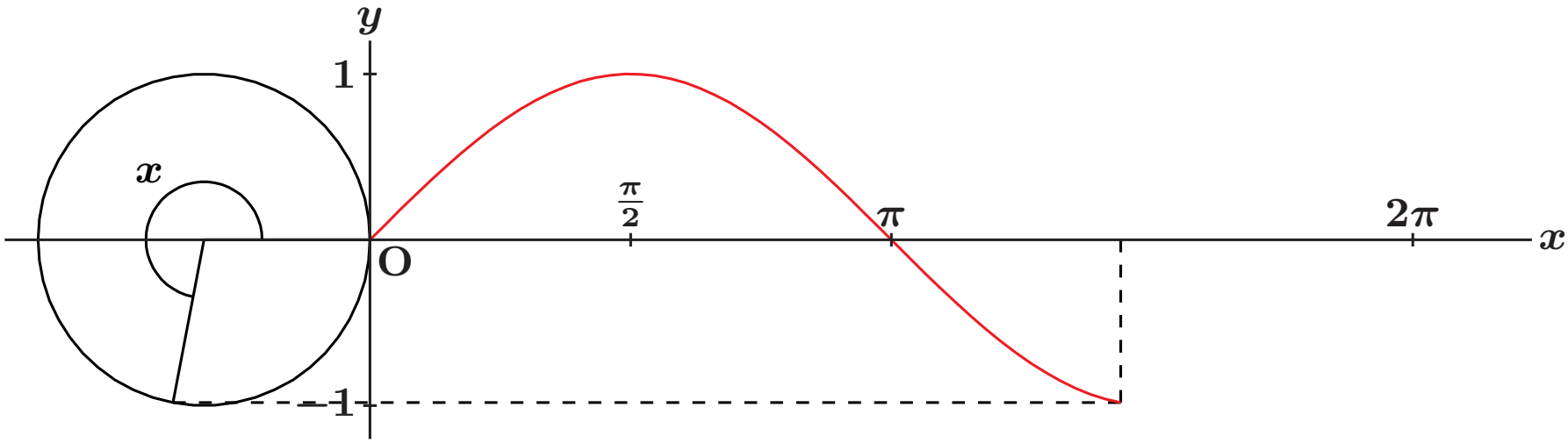

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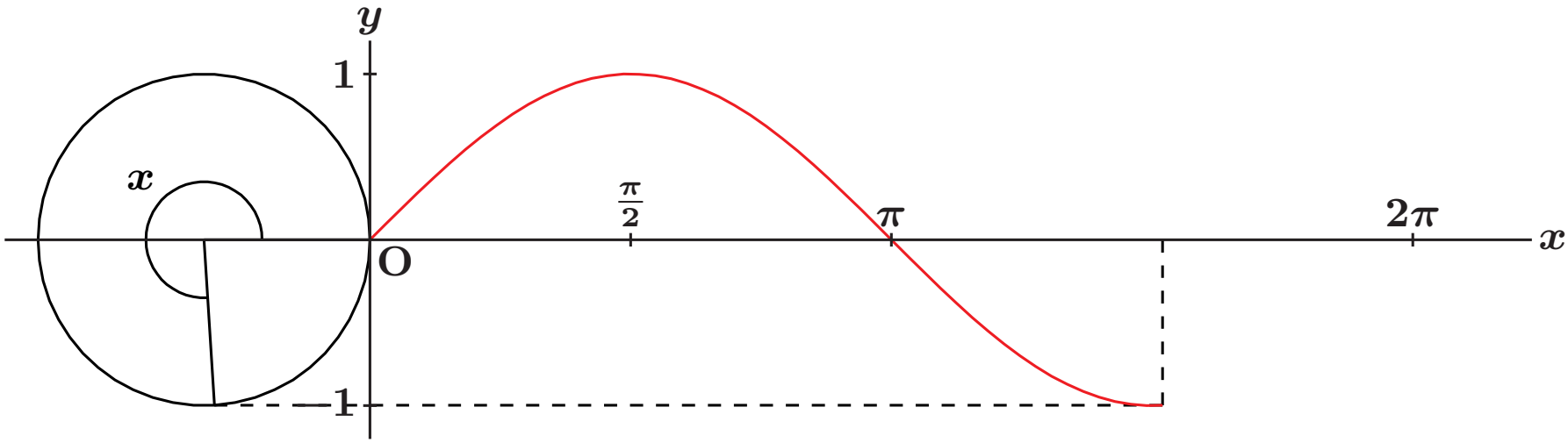

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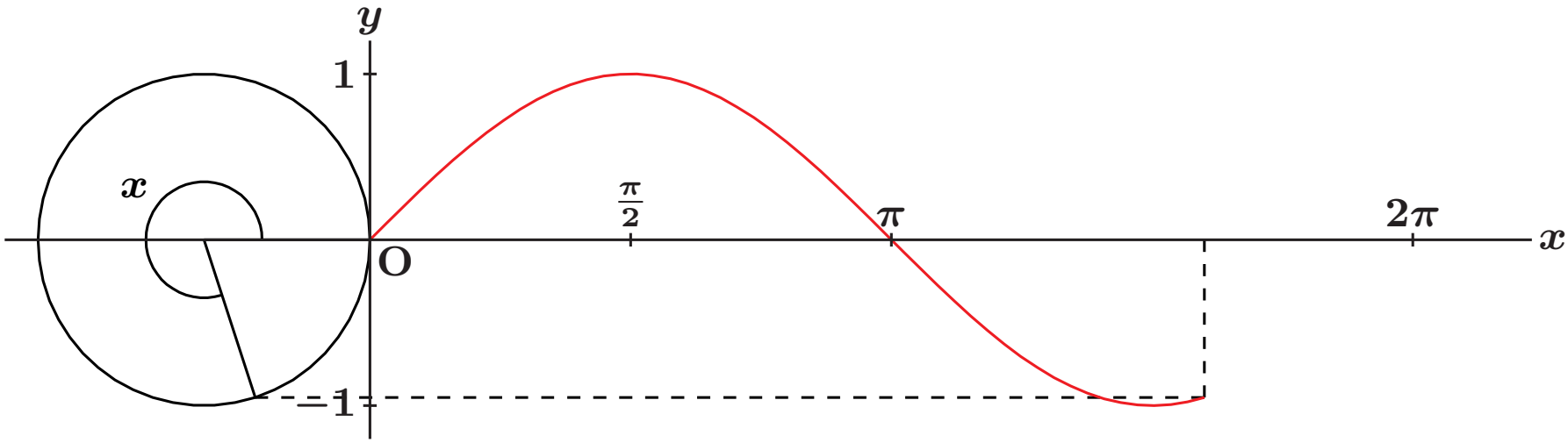

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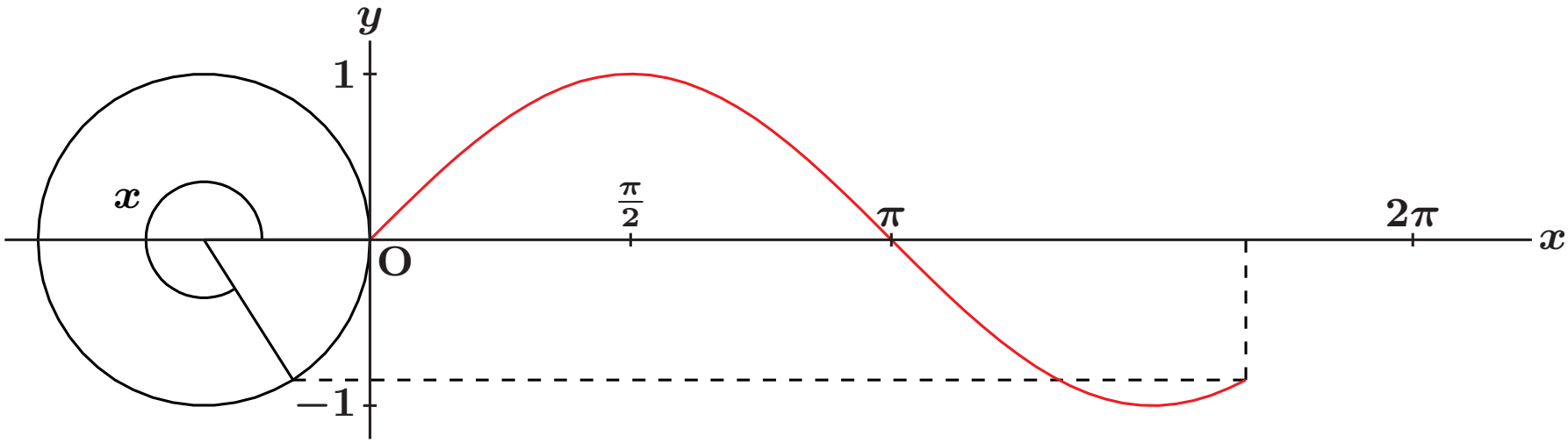

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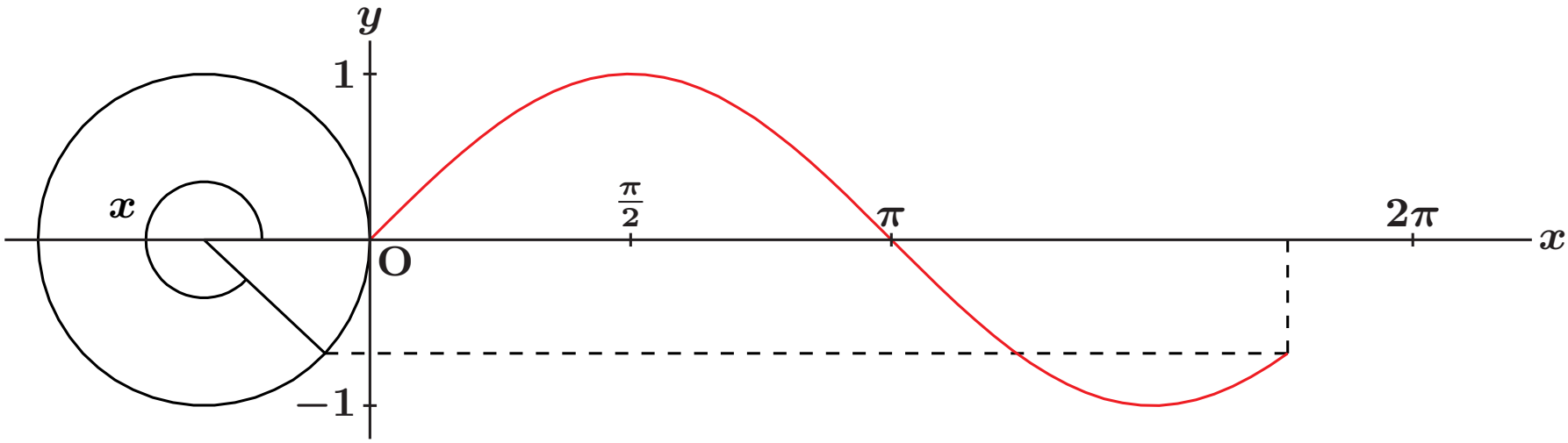

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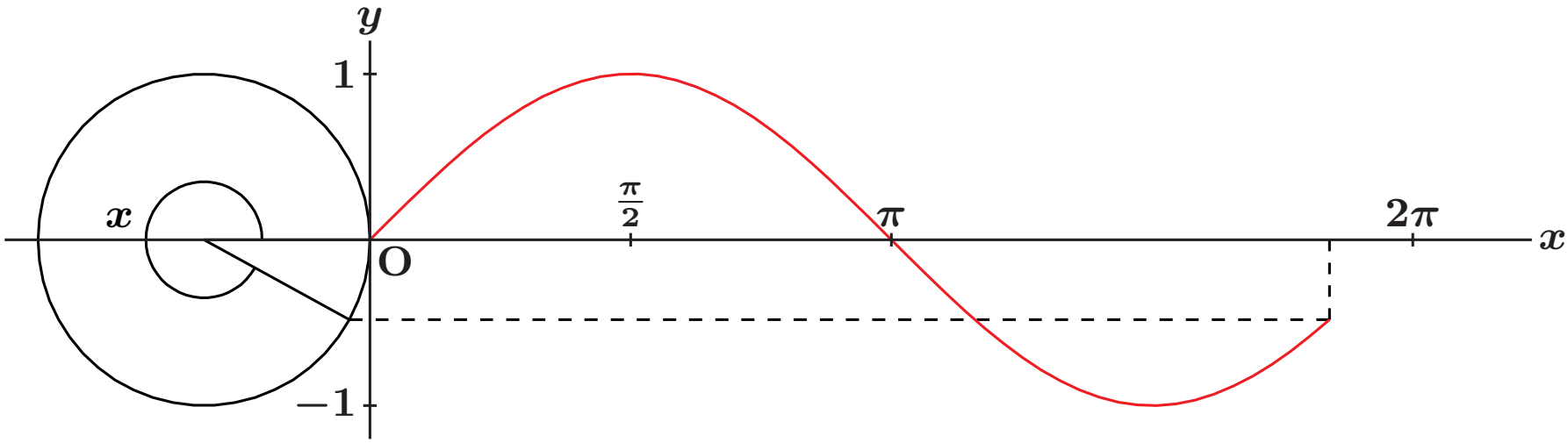

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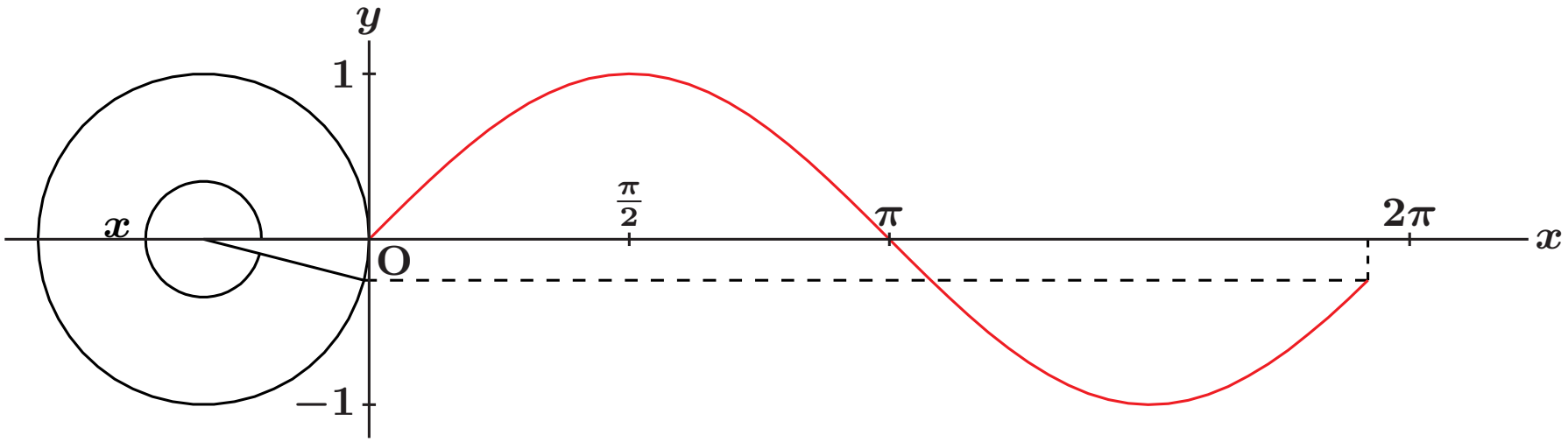

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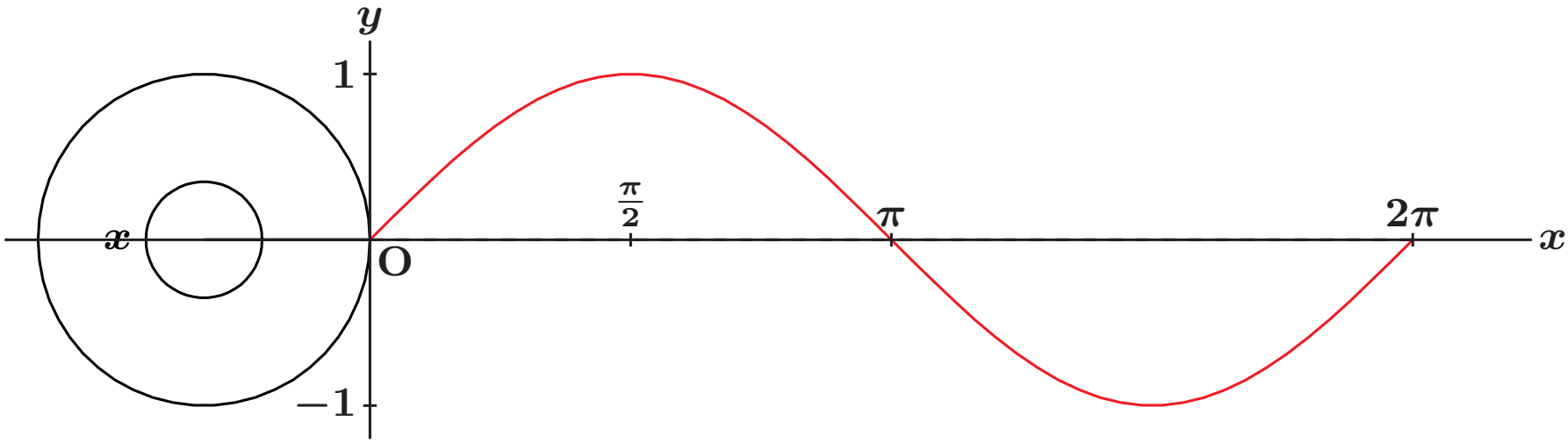

Usage of JS files

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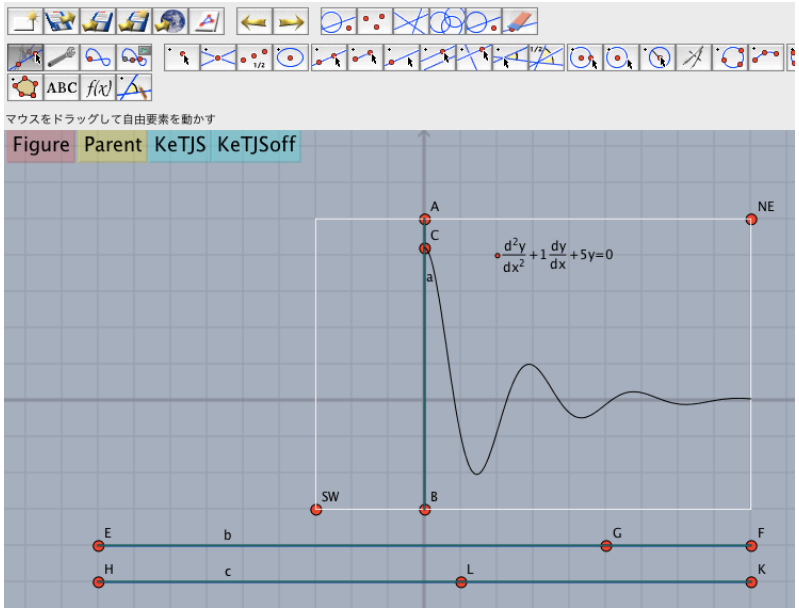
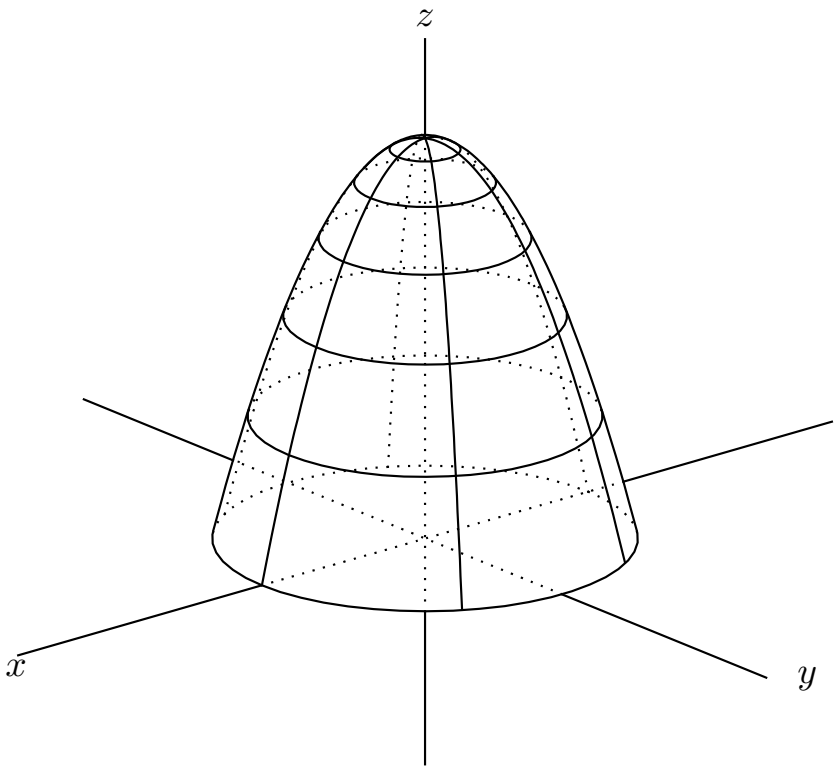
Example of Interactive Materials



Materials with 3D figures

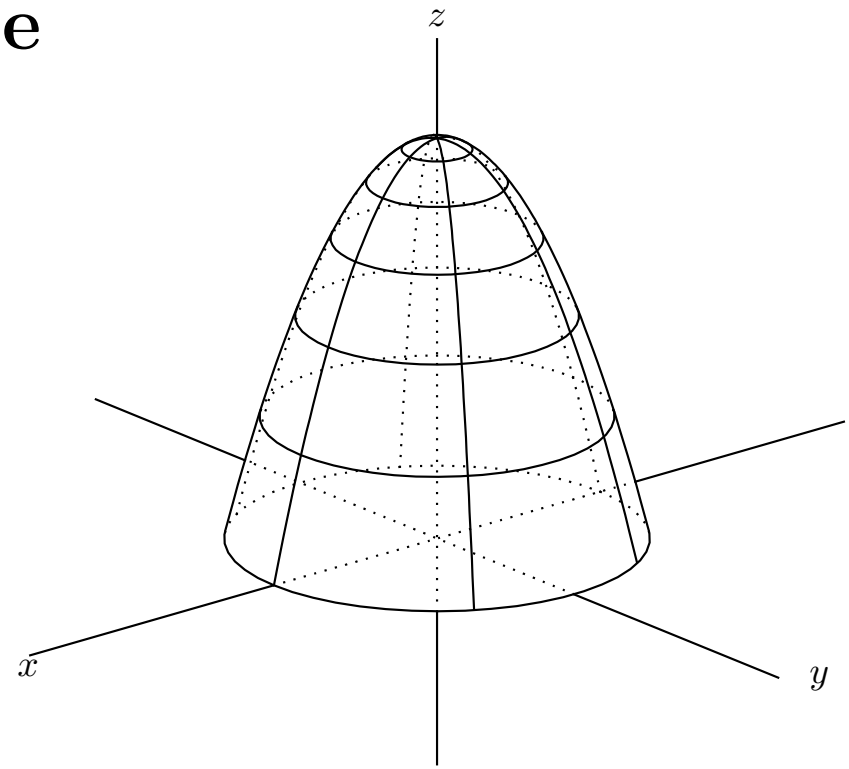
3D Figures by KETCindy

- KETCindy supports line drawing of 3D figures.



3D Figures by KETCindy

- KETCindy supports line drawing of 3D figures.
- These figures are suitable for printed materials



Steps of Producing 3D Figures

Step1. To find silhouette lines of the surface.

Step2. To find the intersections of silhouette lines and a projection curve.

Step3. To divide the curve by these intersects, and to decide whether each separation is hidden by the surface or not.

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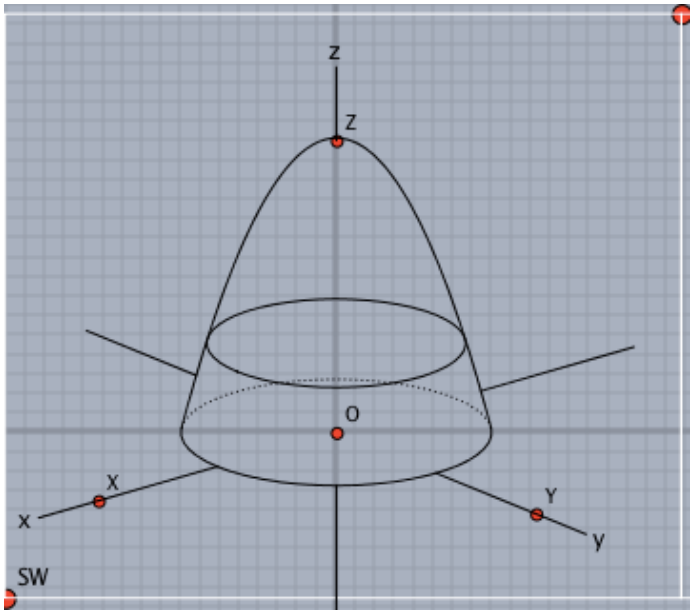
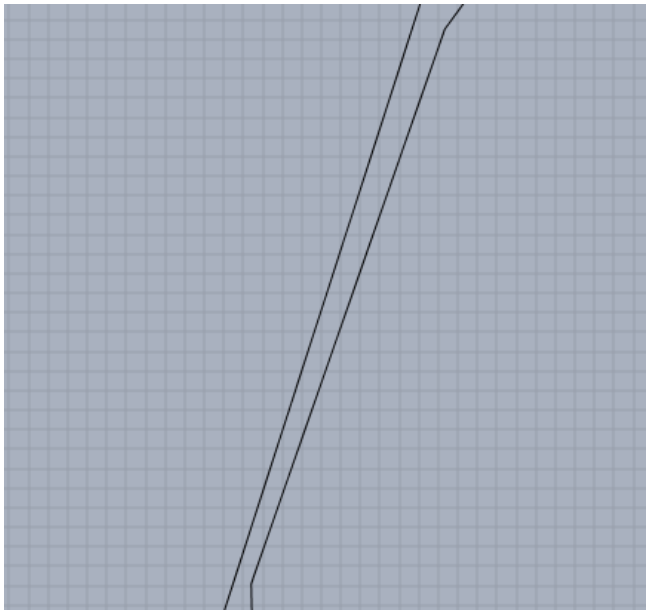
- Of these steps, step 2 represents a difficult task in the case of contacting curves because curves are numerically polygonal lines.





Refinement of Step 2

- We have adopted an interpolatory scheme using Bézier curves near the contact point.
- Then we use a formula developed by Oshima to decide the control points.

Drawing Curves, Mathematical Progress in Expressive Image Synthesis III, edited by Y. Dobashi and H. Ochiai, Mathematics for Industry, 24 (2016), 95-106, Springer, ISBN : 9789811010750

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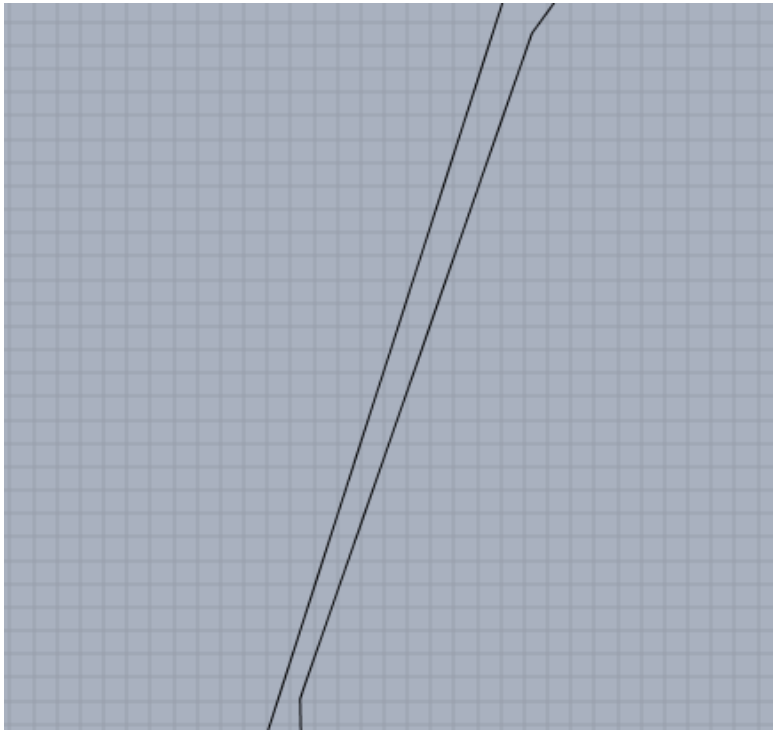
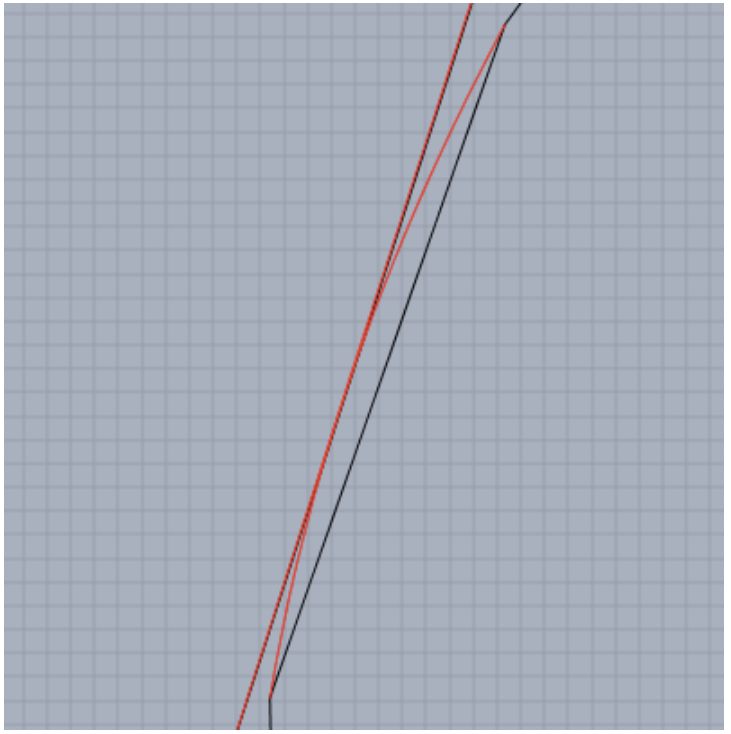
- In many cases, Oshima spline gives better interpolation than Catmull-Rom spline.





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- **The intersect is represented by a cluster of points near each others.**
- One of them is $(-1.65827, 1.20578)$
- KETCindy can also call Maxima from Cinderella and return a result back to Cinderella.
- The result is $(-1.65670129924, 1.21075577903)$

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Calling C from KETCindy

- KETCindy can call C to speed up the calculation of 3D drawing.
- We will demonstrate that it is very effective to call C with an example.

Conclusions

- The combined use of KETCindy, Cinderella, Maxima, C is an effective tool to develop programs for surface drawing.
- It is often necessary to write a program for producing desirable materials.
- These programming becomes easier through the help of visualisation on the screen.