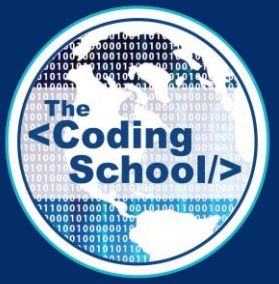

INTRO TO QUANTUM COMPUTING

Lab #2

TRIGONOMETRY AND COORDINATE SYSTEMS

Akshay Agarwal

10/31/2020

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PROGRAM FOR TODAY

- Ground rules
- Pre-lab student feedback
- Popular questions from last week
- Lab content
- Post-lab student feedback

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GROUND RULES

- We want to ensure that every student participating in this lab feels welcome and included

- We ask that you:
  - **Do not** spam the chat or Q&A with repeated questions or messages
  - **Do not** put answers to problems in the chat or Q&A, **unless your TA asks you to**
  - **Keep your questions relevant** to the topics being discussed. We have Piazza for other content-related questions, and Discord for questions on logistics
  - Only raise your hand if the TAs ask students to

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GROUND RULES

- As instructors and TAs, we want to hear from diverse voices
  - **Step up, step back**

- We will not be able to address all content-questions in lecture or lab
  - Look at answers to similar questions on Piazza or Discord
  - Post your question in the relevant folder **in Piazza** (e.g. week 1)
  - We will continue to explore new content each week, and will likely answer your question in future weeks! Hold on ☺

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PRE-LAB CANVAS FEEDBACK

- Please log into Canvas and answer your lab section's quiz (using the password posted below and in the chat).
  - This is lab number <insert lab number>
  - Password:
- On a scale of 1 to 5, how would you rate your understanding of this week's content?
  - 1 –Did not understand anything
  - 2 – Understood some parts
  - 3 – Understood most of the content
  - 4 – Understood all of the content
  - 5 – The content was easy for me/I already knew all of the content
- **This quiz is also your lab attendance!**

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QUESTIONS FROM PAST WEEK

- Combinations of logic expressions: (A NAND B) XOR C

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QUESTIONS FROM PAST WEEK

- How are logic gates made? What's inside them?

- Transistors!
  - A transistor is a switch that can electronically turn a current ON (1) or OFF (0)
  - Gates are made using one or more such switches
  - Many gates are combined to make larger logic circuits
  - Many such logic circuits are combined to make a (classical) computer

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LEARNING OBJECTIVES FOR LAB 2

- Analyze trigonometric functions at various angles
  - Finding values of sin, cos, tan
- Solidify understanding of coordinate systems
  - Cartesian coordinates
  - Polar coordinates
  - Conversion between the two systems
- Summation notation*

*Optional content

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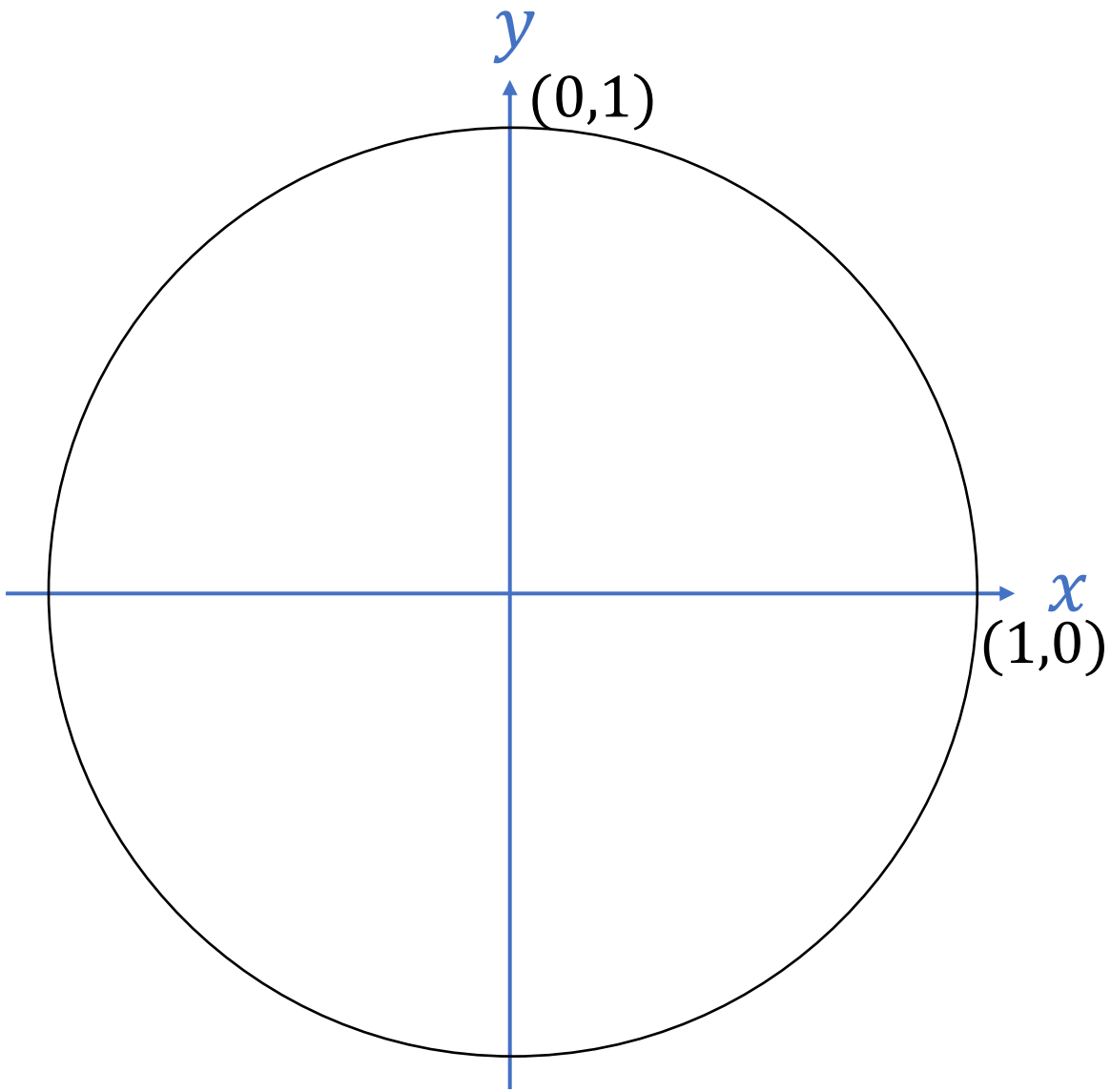
TRIGONOMETRIC FUNCTIONS

Unit circle: Circle of radius 1



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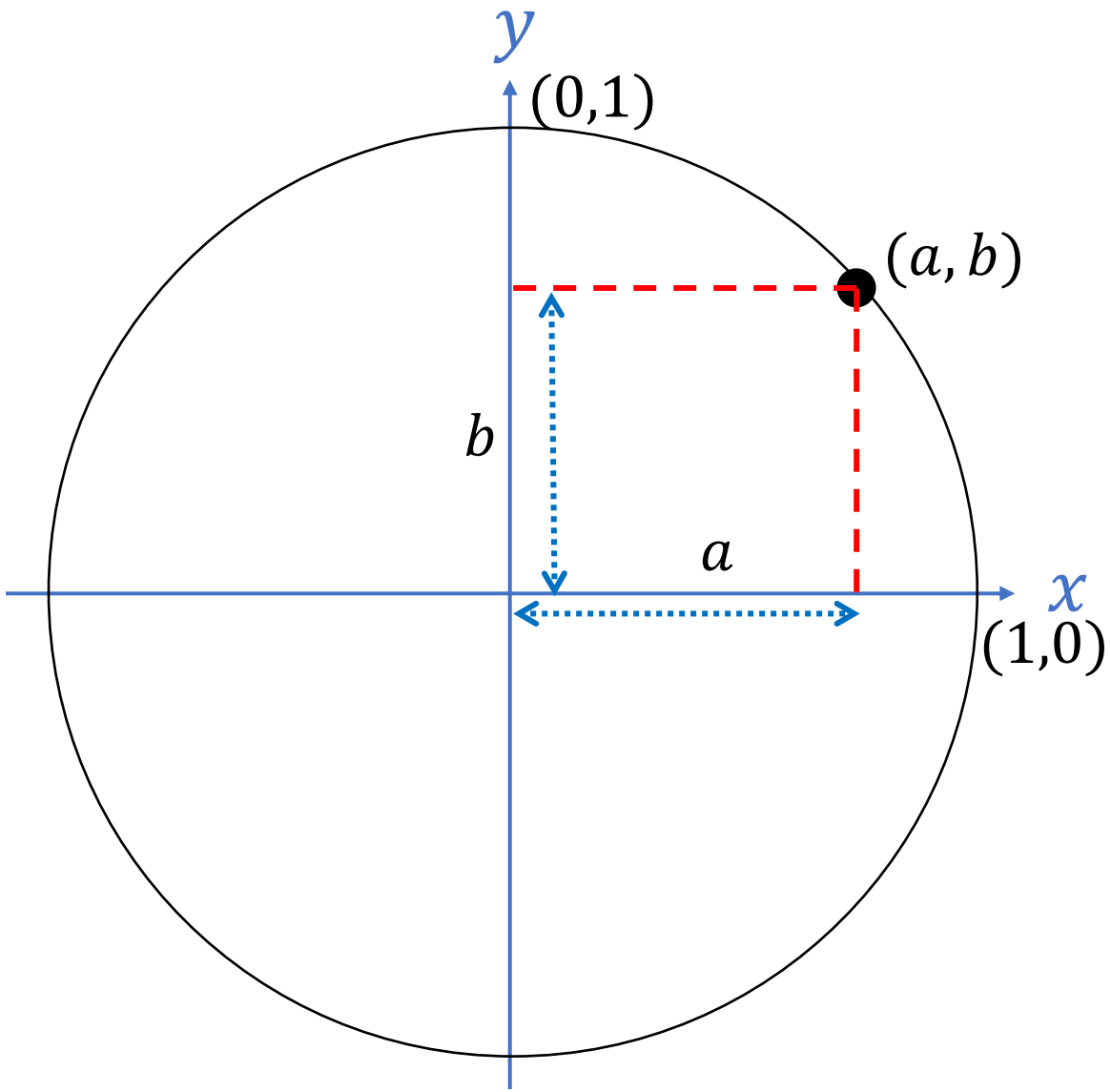
TRIGONOMETRIC FUNCTIONS

Unit circle: Circle of radius 1



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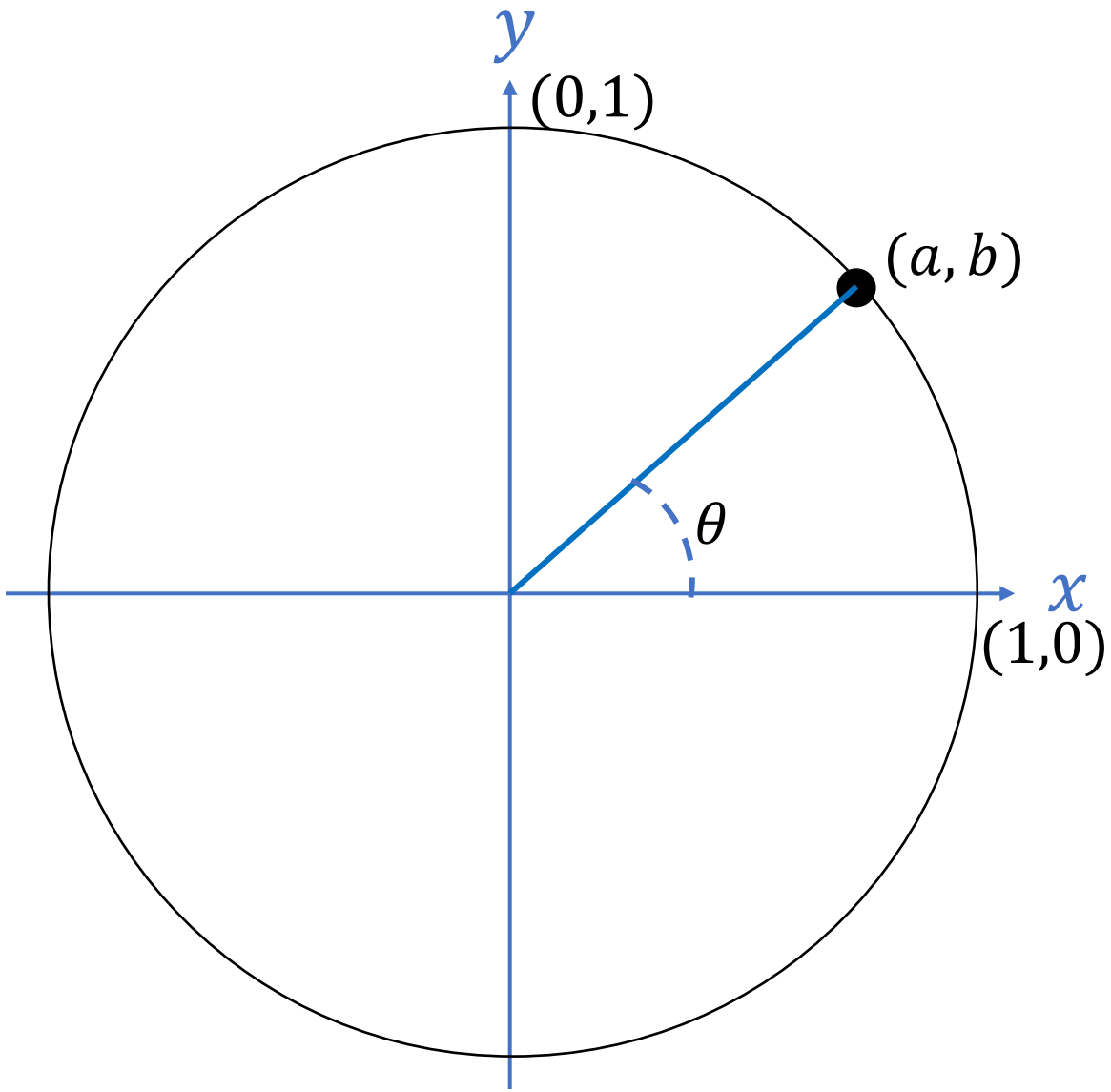
TRIGONOMETRIC FUNCTIONS



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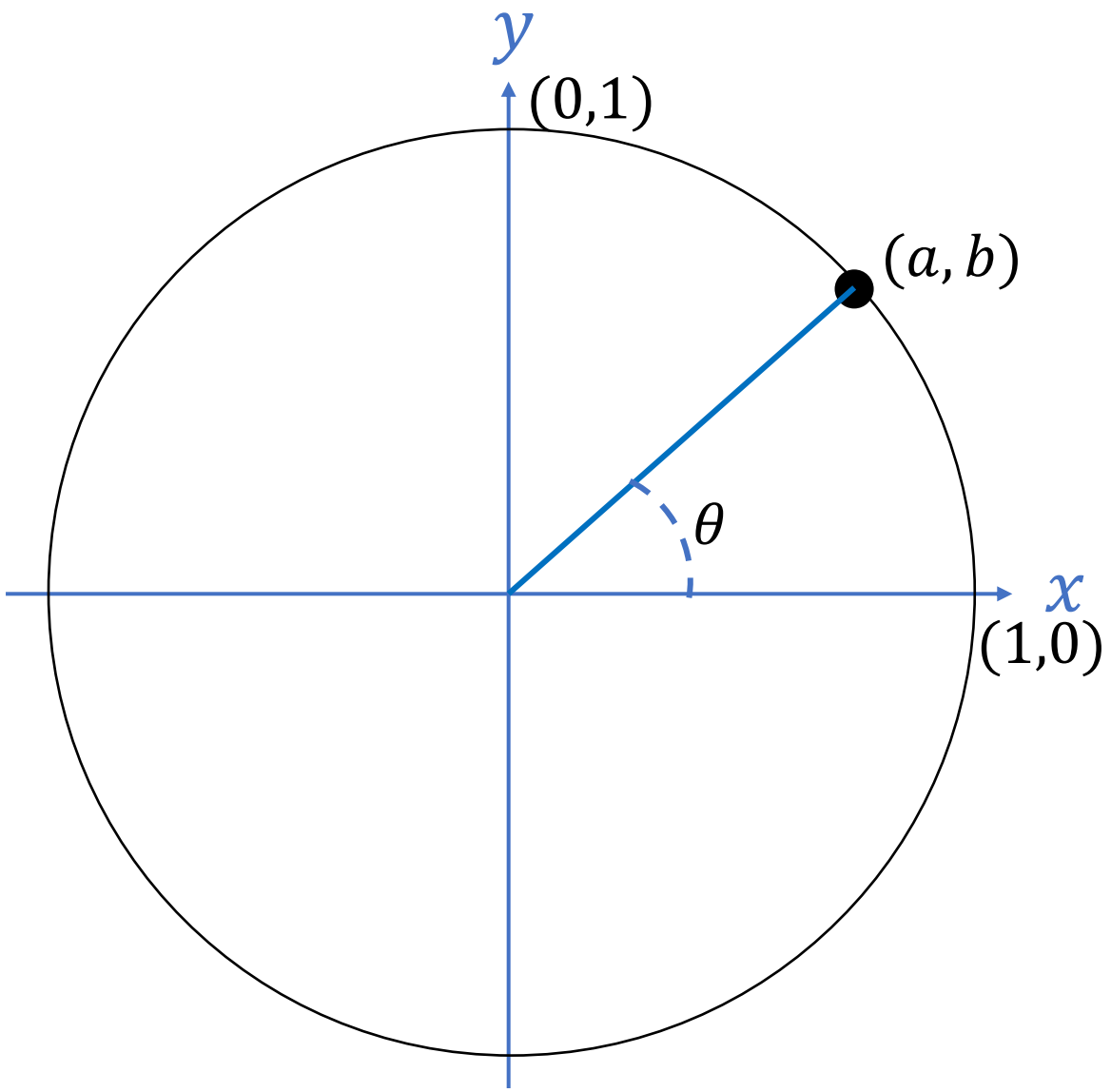
TRIGONOMETRIC FUNCTIONS

$$\sin\theta = b$$



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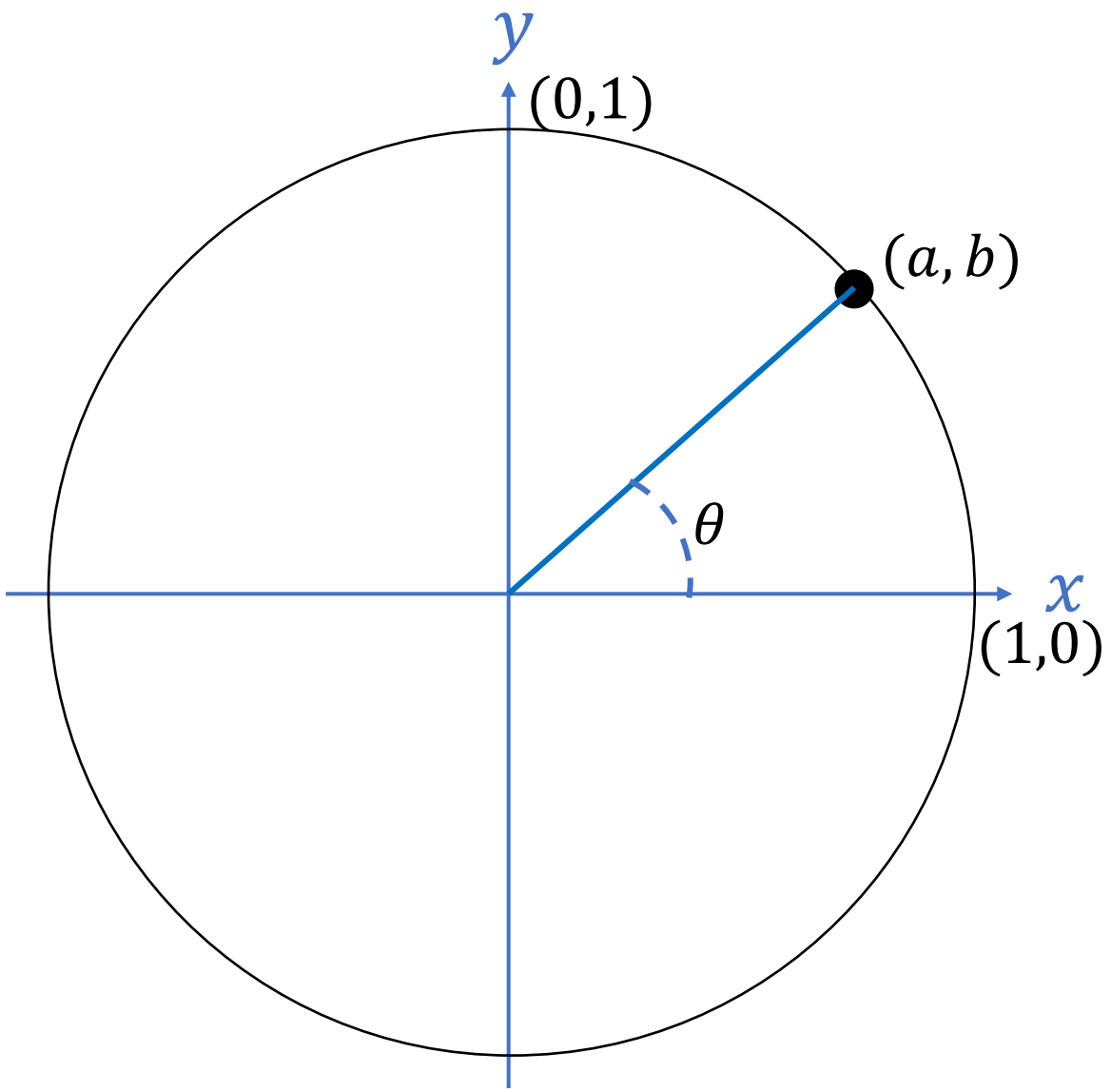
TRIGONOMETRIC FUNCTIONS

$$\sin\theta = b$$

$$\cos\theta = a$$



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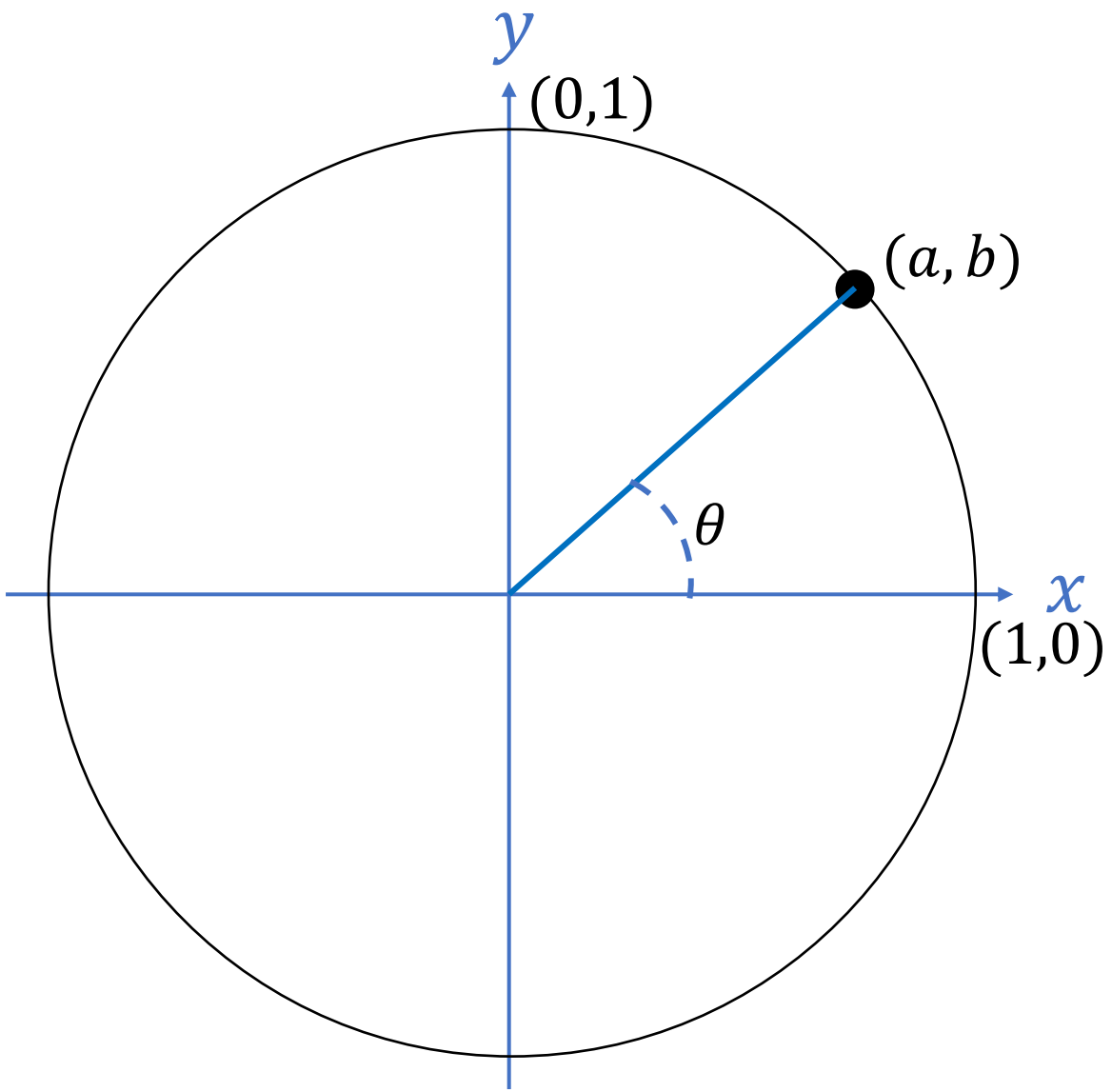
TRIGONOMETRIC FUNCTIONS

$$\sin\theta = b$$

$$\cos\theta = a$$

$$\tan\theta = \frac{b}{a}$$



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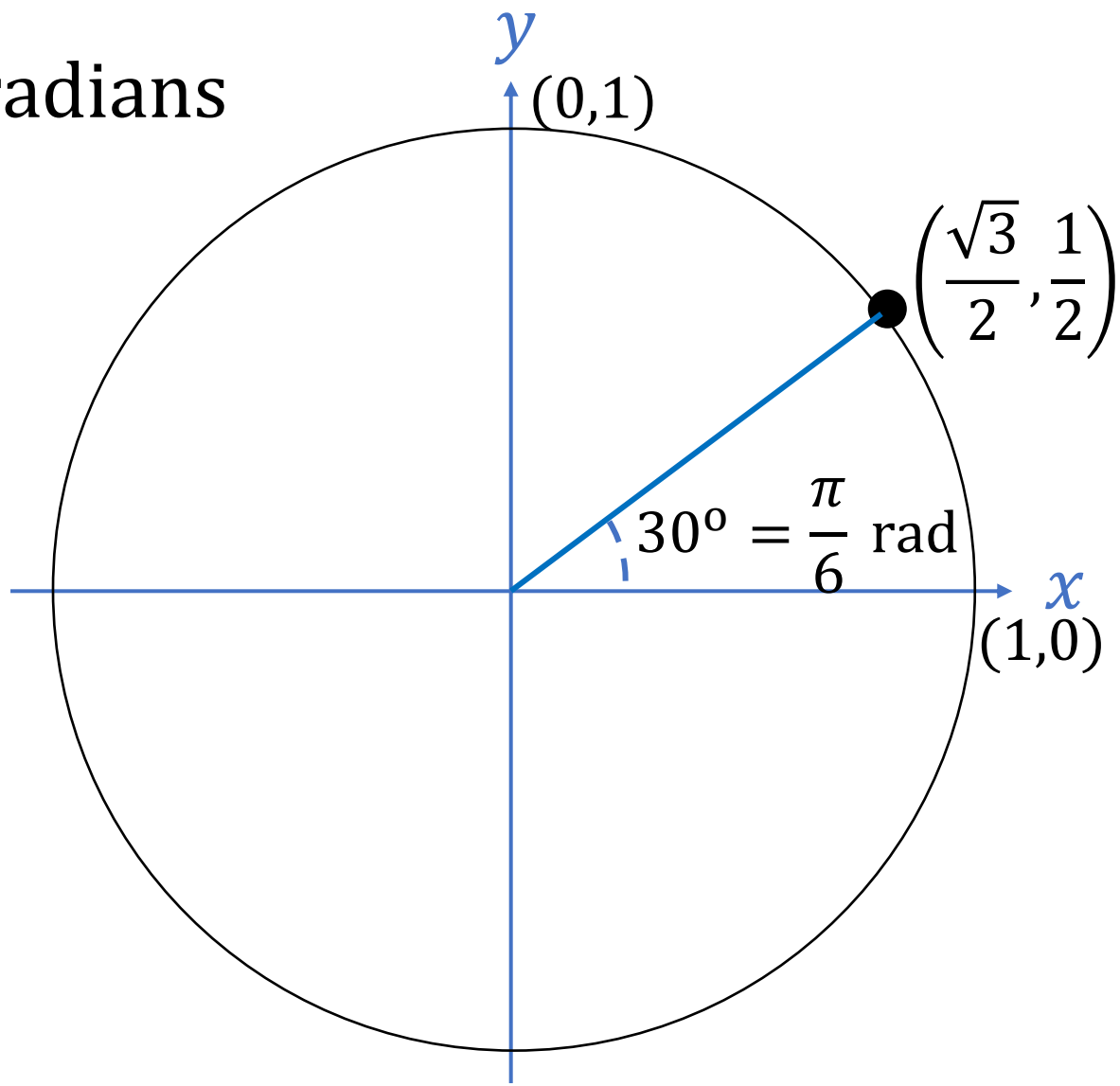
TRIGONOMETRIC FUNCTIONS

$$30^o = \frac{\pi}{6} \text{ radians}$$



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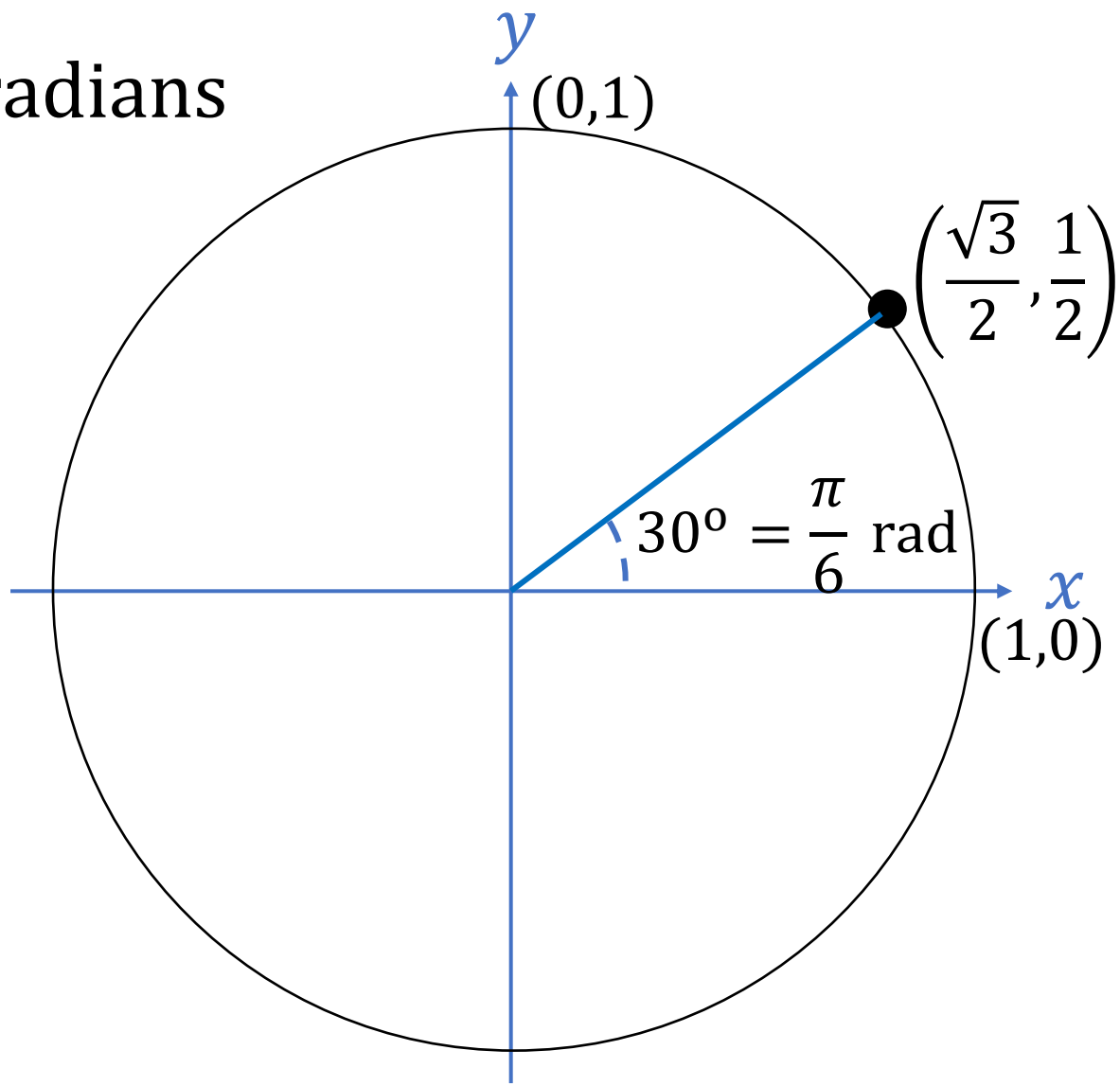
TRIGONOMETRIC FUNCTIONS

$$30^o = \frac{\pi}{6} \text{ radians}$$

$$\sin\frac{\pi}{6} = \frac{1}{2}$$

$$\cos\frac{\pi}{6} = \frac{\sqrt{3}}{2}$$

$$\tan\frac{\pi}{6} = \frac{1}{\sqrt{3}}$$



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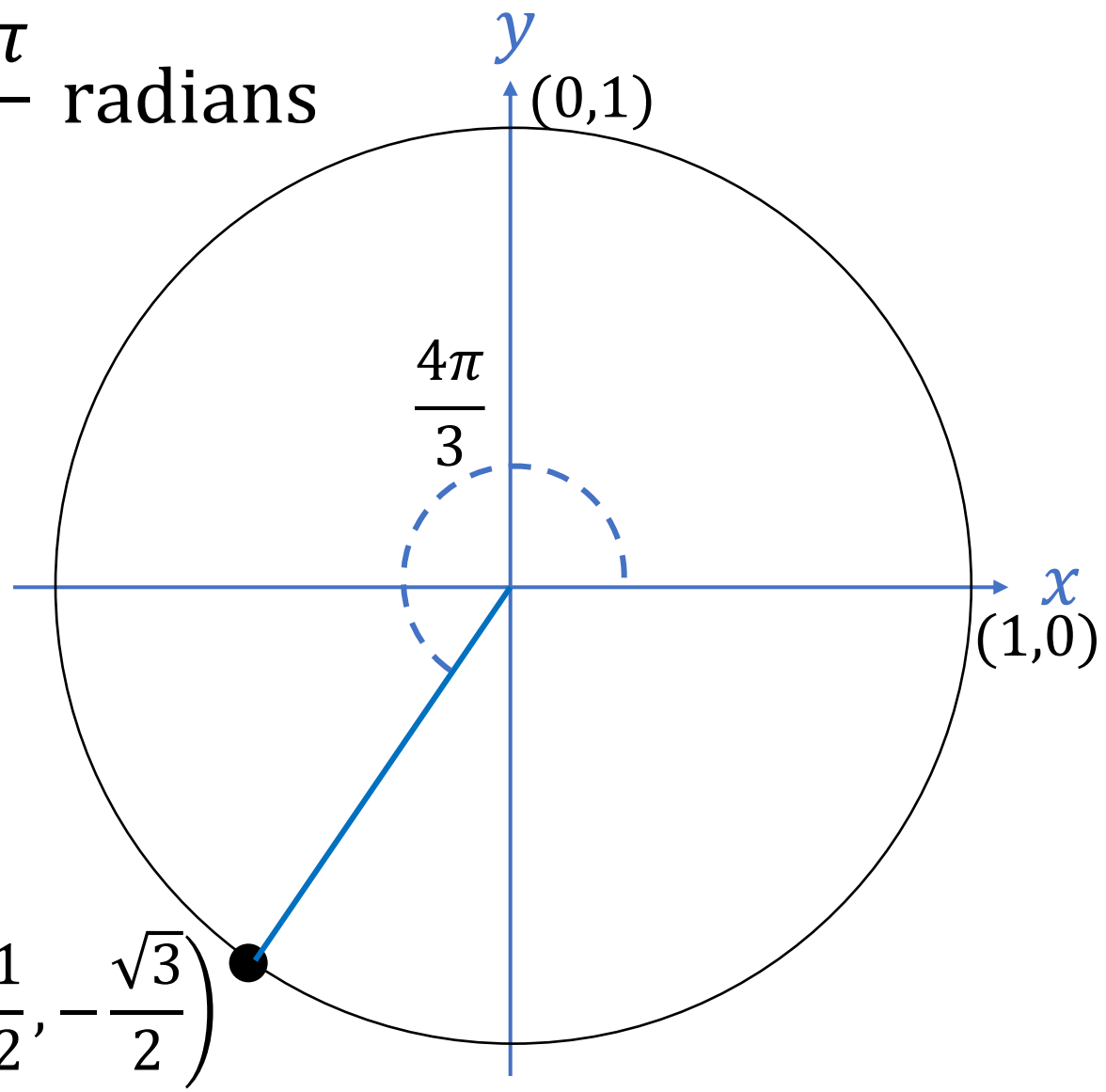
TRIGONOMETRIC FUNCTIONS

$$240^{\circ} = \frac{4\pi}{3} \text{ radians}$$



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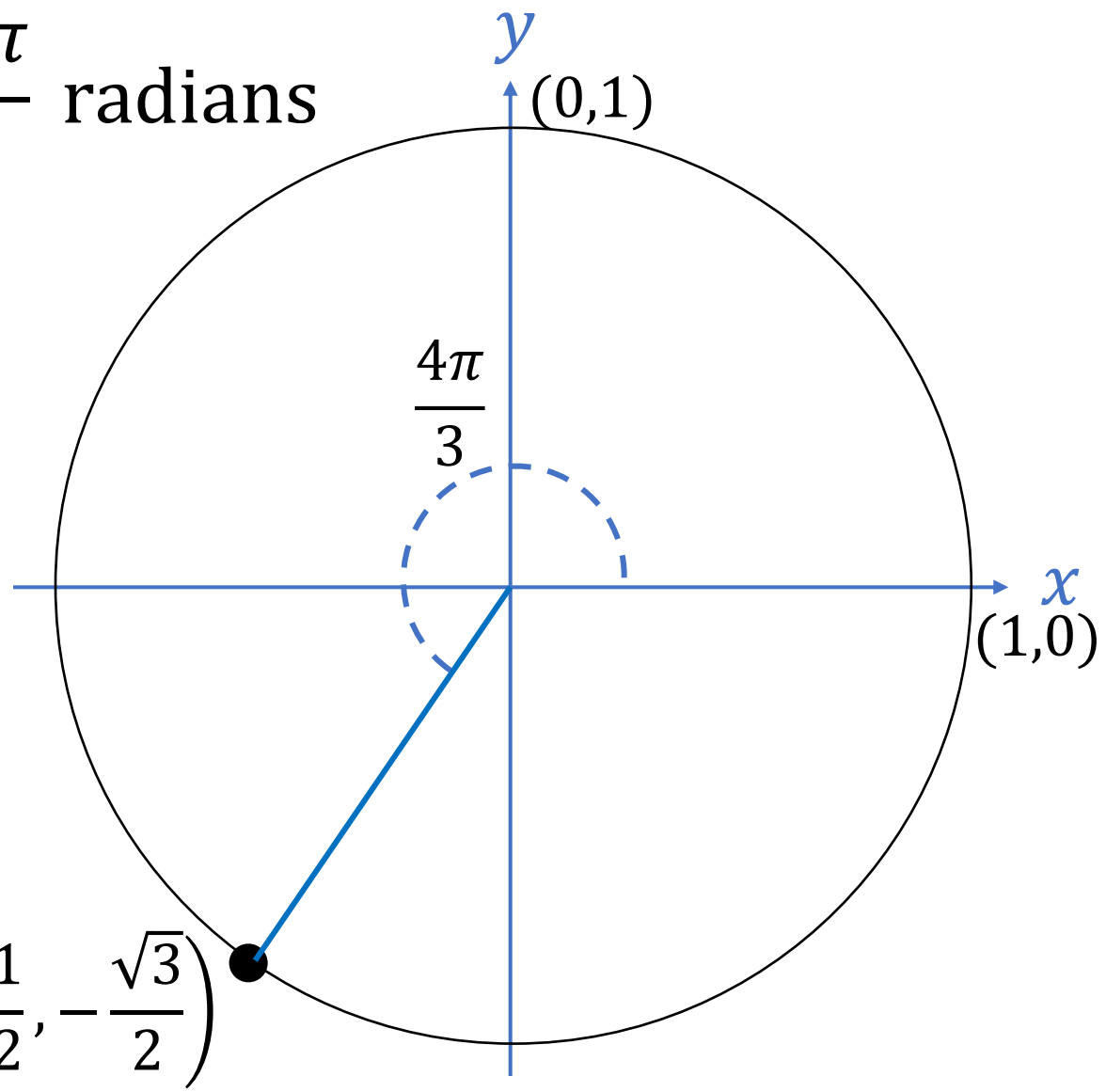
TRIGONOMETRIC FUNCTIONS

$$240° = \frac{4\pi}{3} \text{ radians}$$

$$\sin\frac{4\pi}{3} = -\frac{\sqrt{3}}{2}$$

$$\cos\frac{4\pi}{3} = -\frac{1}{2}$$

$$\tan\frac{4\pi}{3} = \sqrt{3}$$



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QUESTIONS

Questions on content so far?

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COORDINATE SYSTEMS

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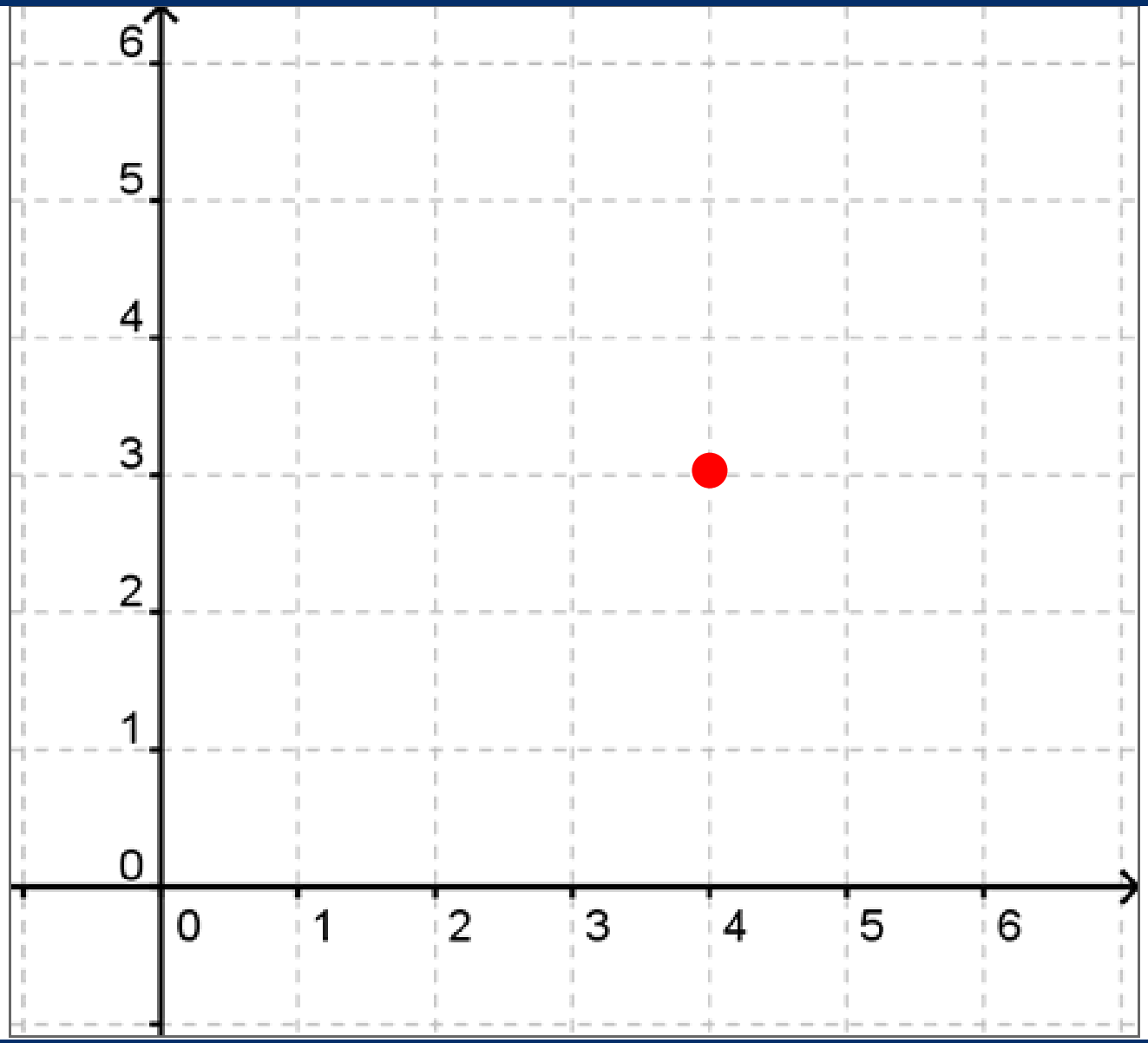
COORDINATE SYSTEMS



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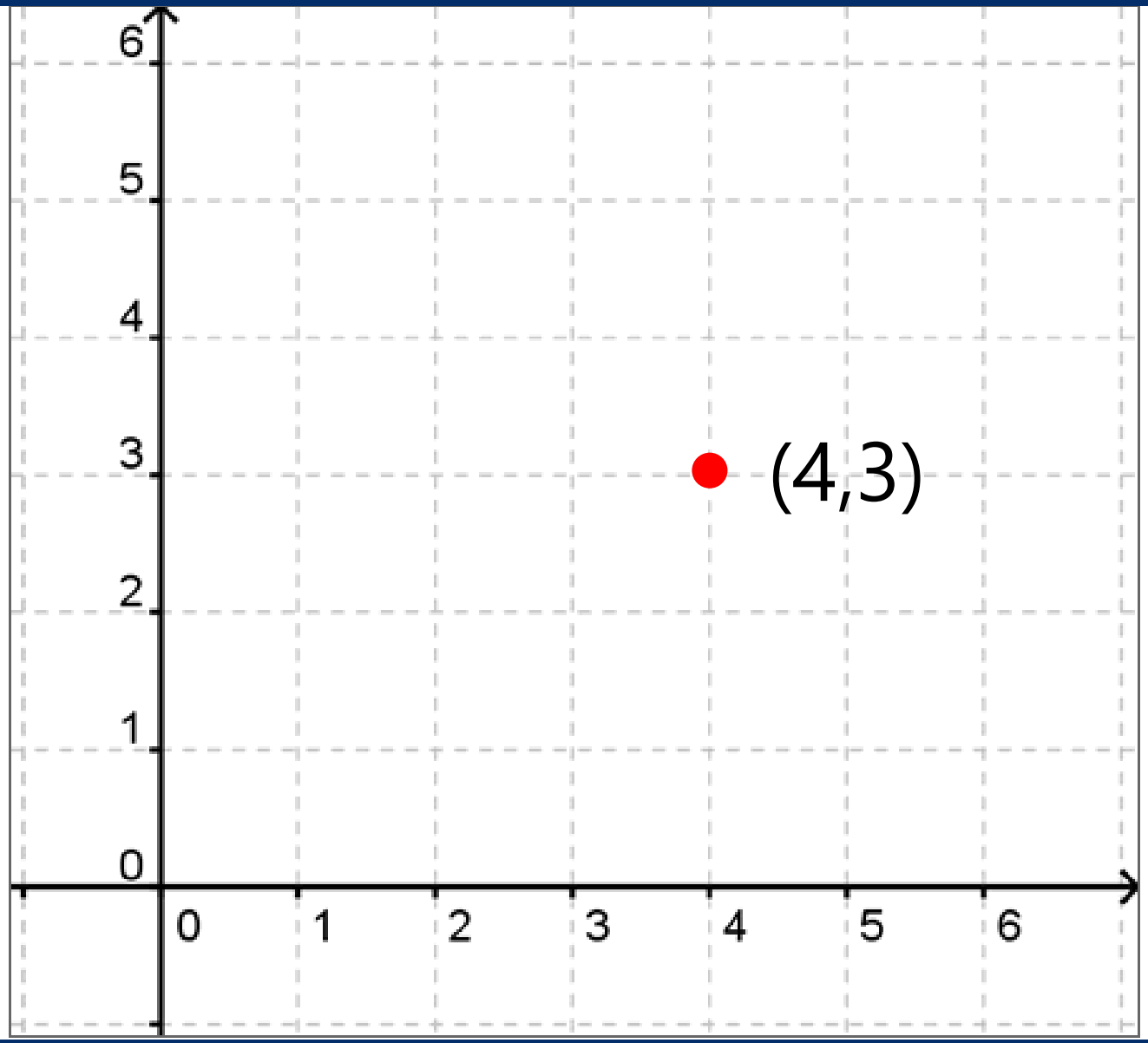
CARTESIAN COORDINATE SYSTEM



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CARTESIAN COORDINATE SYSTEM

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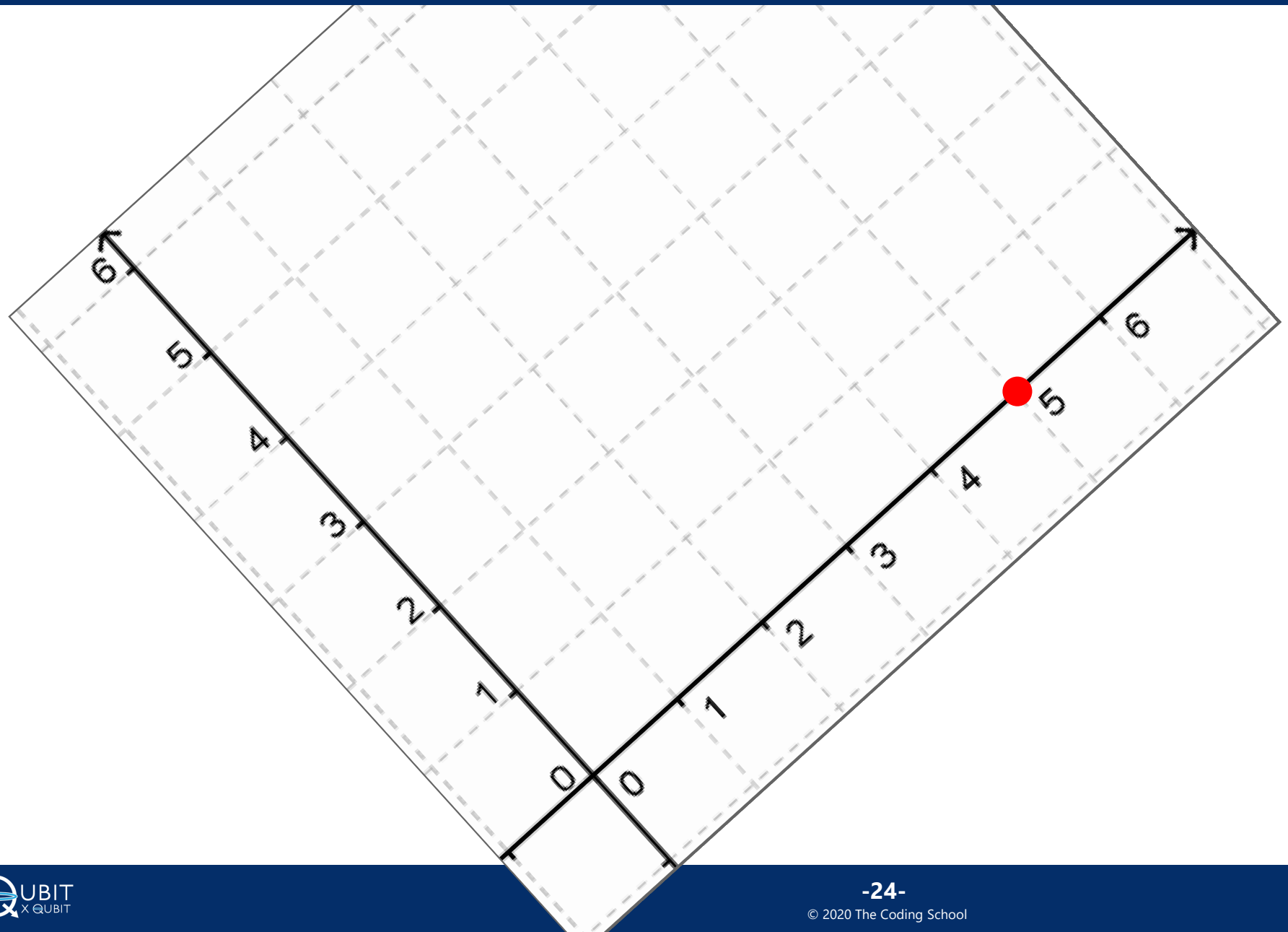
CARTESIAN COORDINATE SYSTEM



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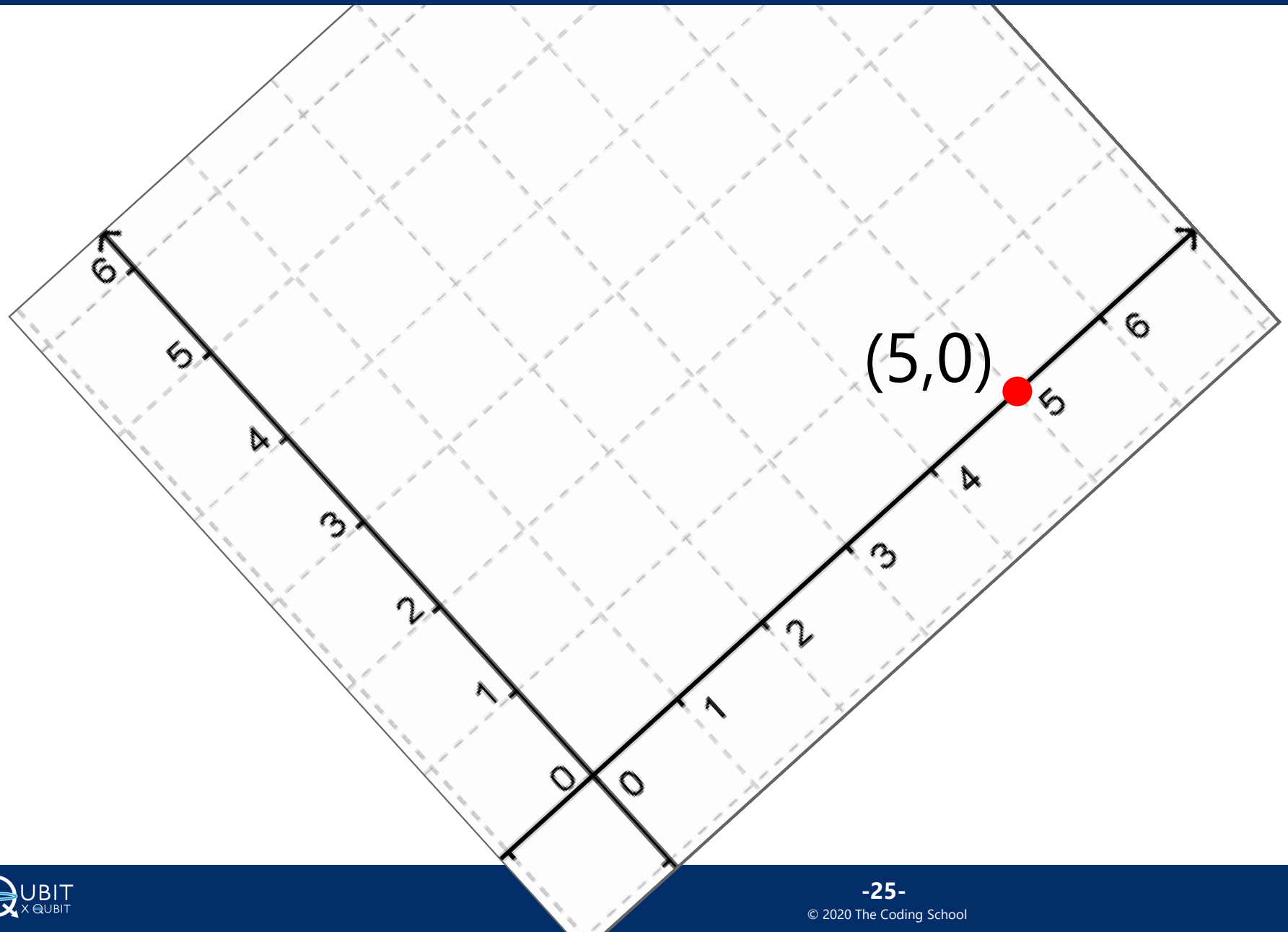
CARTESIAN COORDINATE SYSTEM



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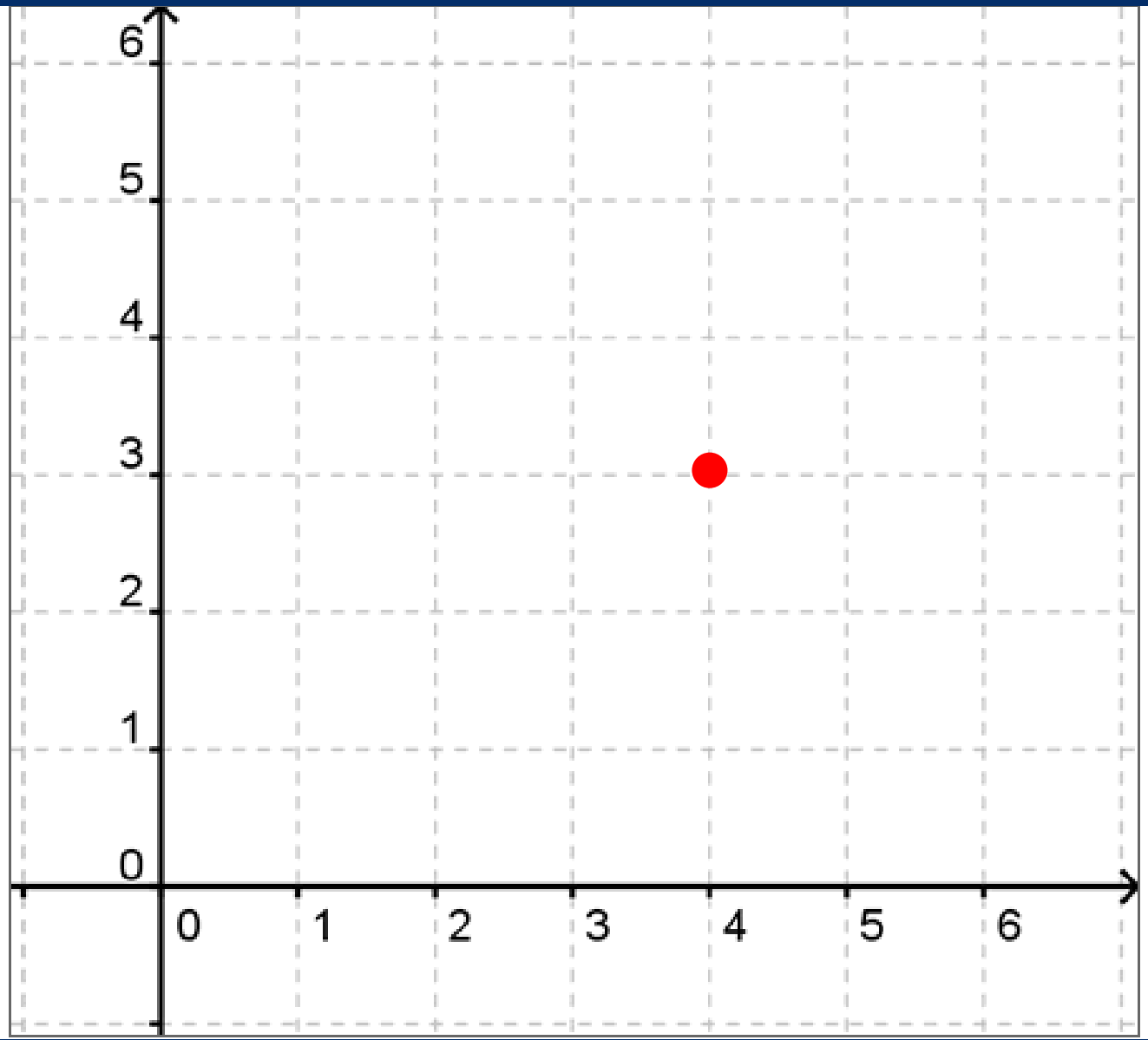
POLAR COORDINATE SYSTEM



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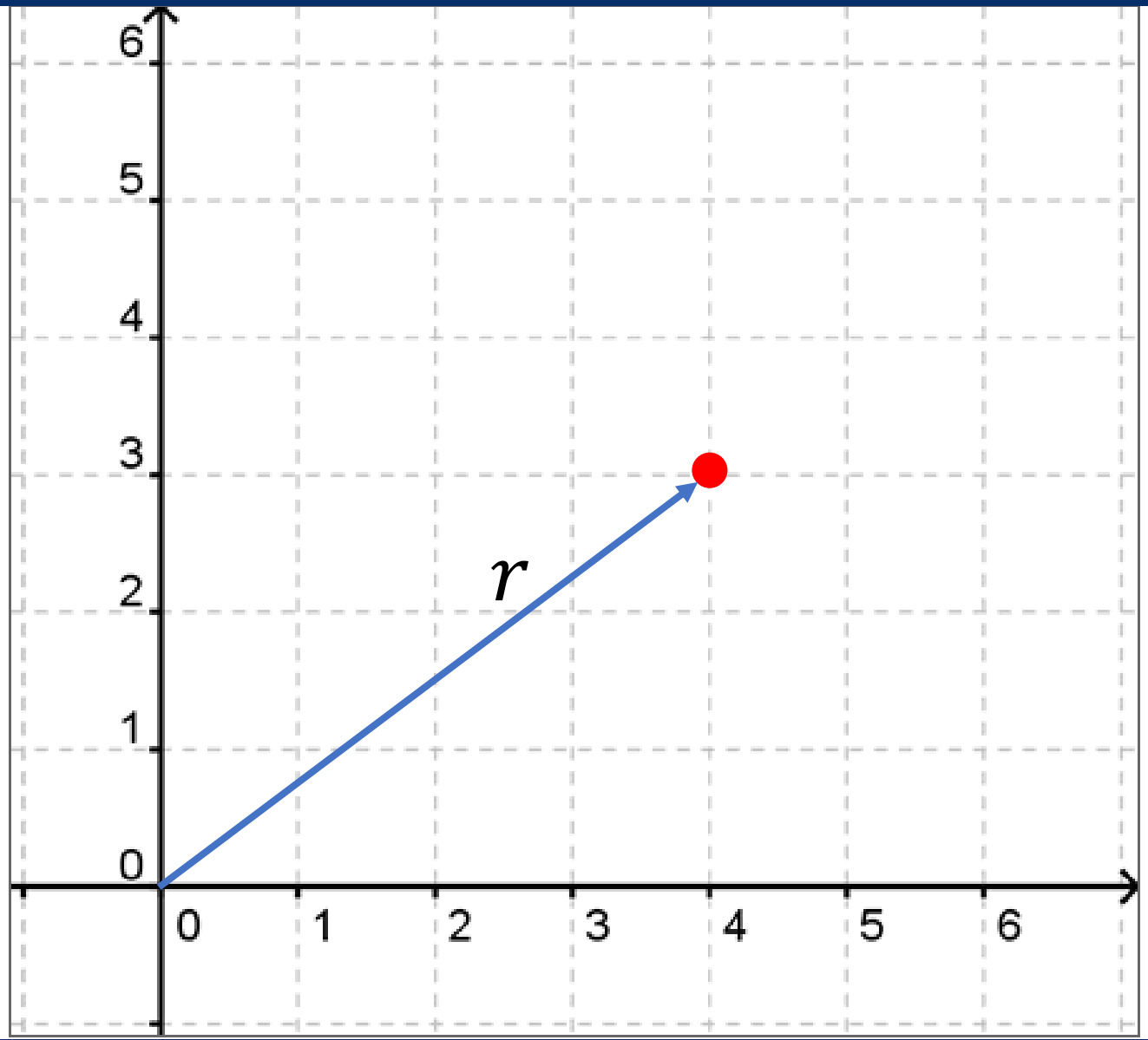
POLAR COORDINATE SYSTEM



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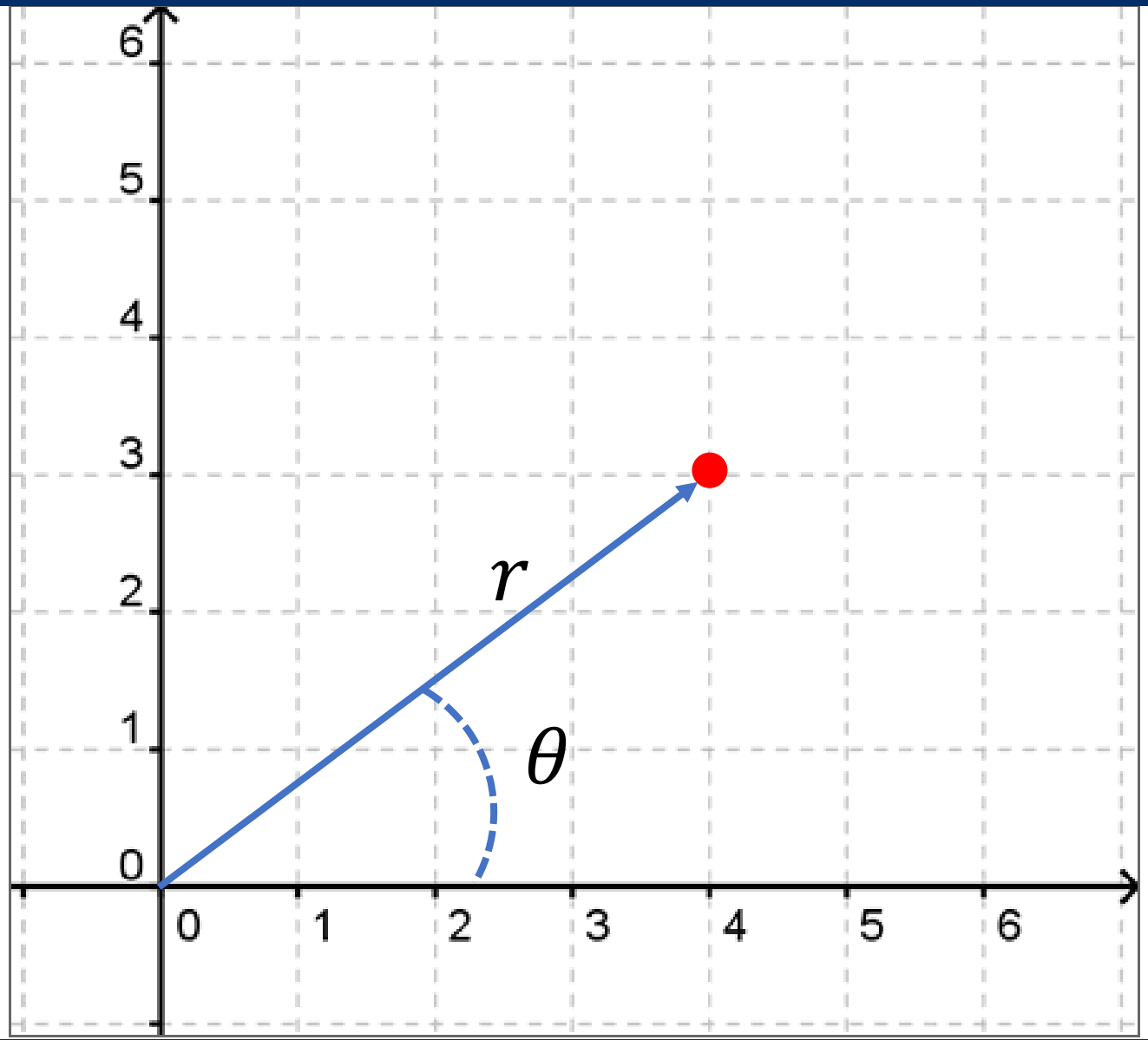
POLAR COORDINATE SYSTEM



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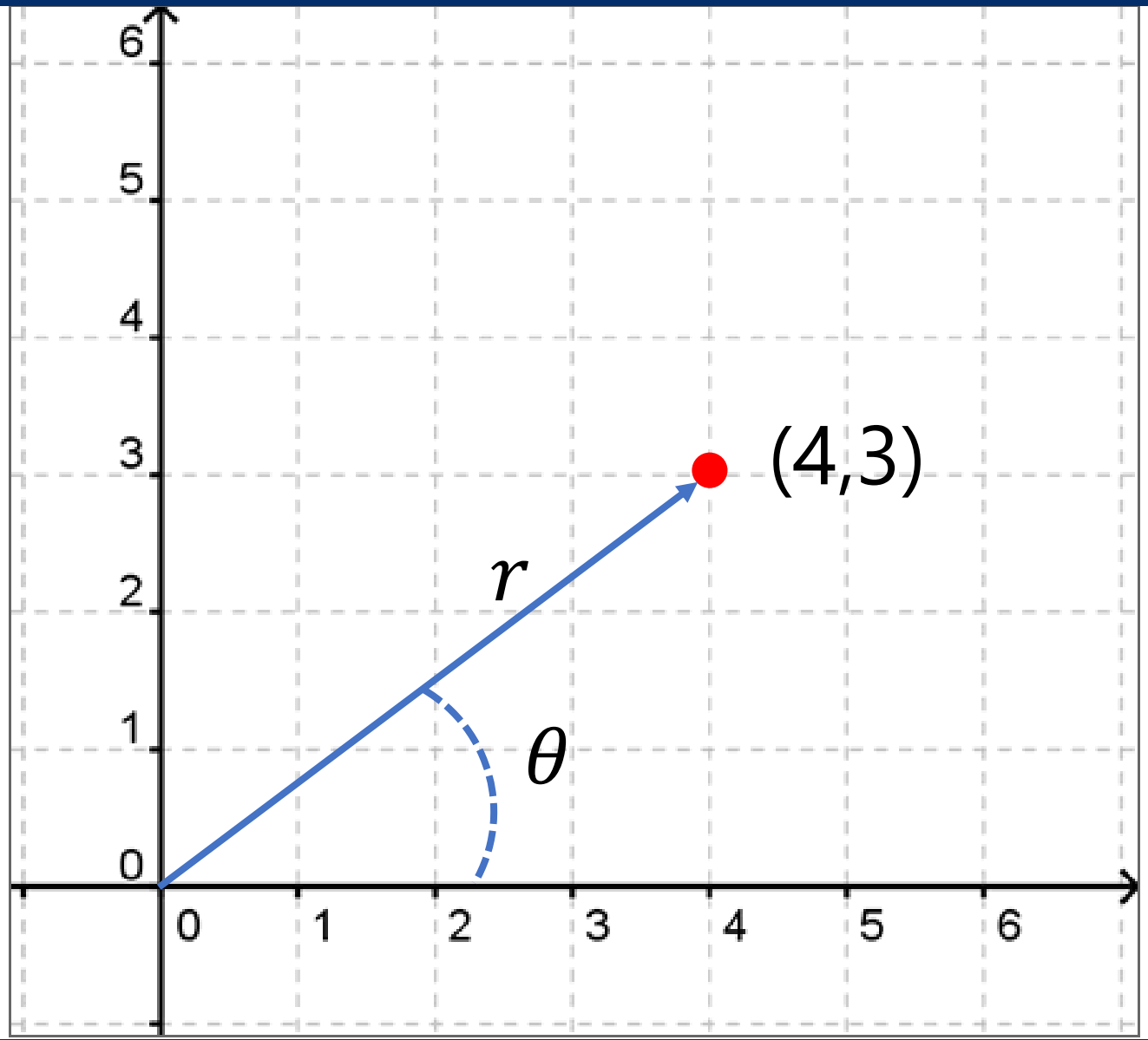
RELATING THE COORDINATE SYSTEMS



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CONVERTING CARTESIAN TO POLAR

$$(x, y) \rightarrow (r, \theta)$$

cartesian polar

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CONVERTING CARTESIAN TO POLAR

$$(x, y) \rightarrow (r, \theta)$$

cartesian polar

$$r = \sqrt{x^2 + y^2}$$

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CONVERTING CARTESIAN TO POLAR

$$(x, y) \rightarrow (r, \theta)$$

cartesian polar

$$r = \sqrt{x^2 + y^2}$$

$$\theta = \tan^{-1} \frac{y}{x}$$

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CONVERTING POLAR TO CARTESIAN

$$(r, \theta) \rightarrow (x, y)$$

polar cartesian

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CONVERTING POLAR TO CARTESIAN

$$\underset{\text{polar}}{(r, \theta)} \rightarrow \underset{\text{cartesian}}{(x, y)}$$

$$x = r \cos \theta$$

$$y = r \sin \theta$$

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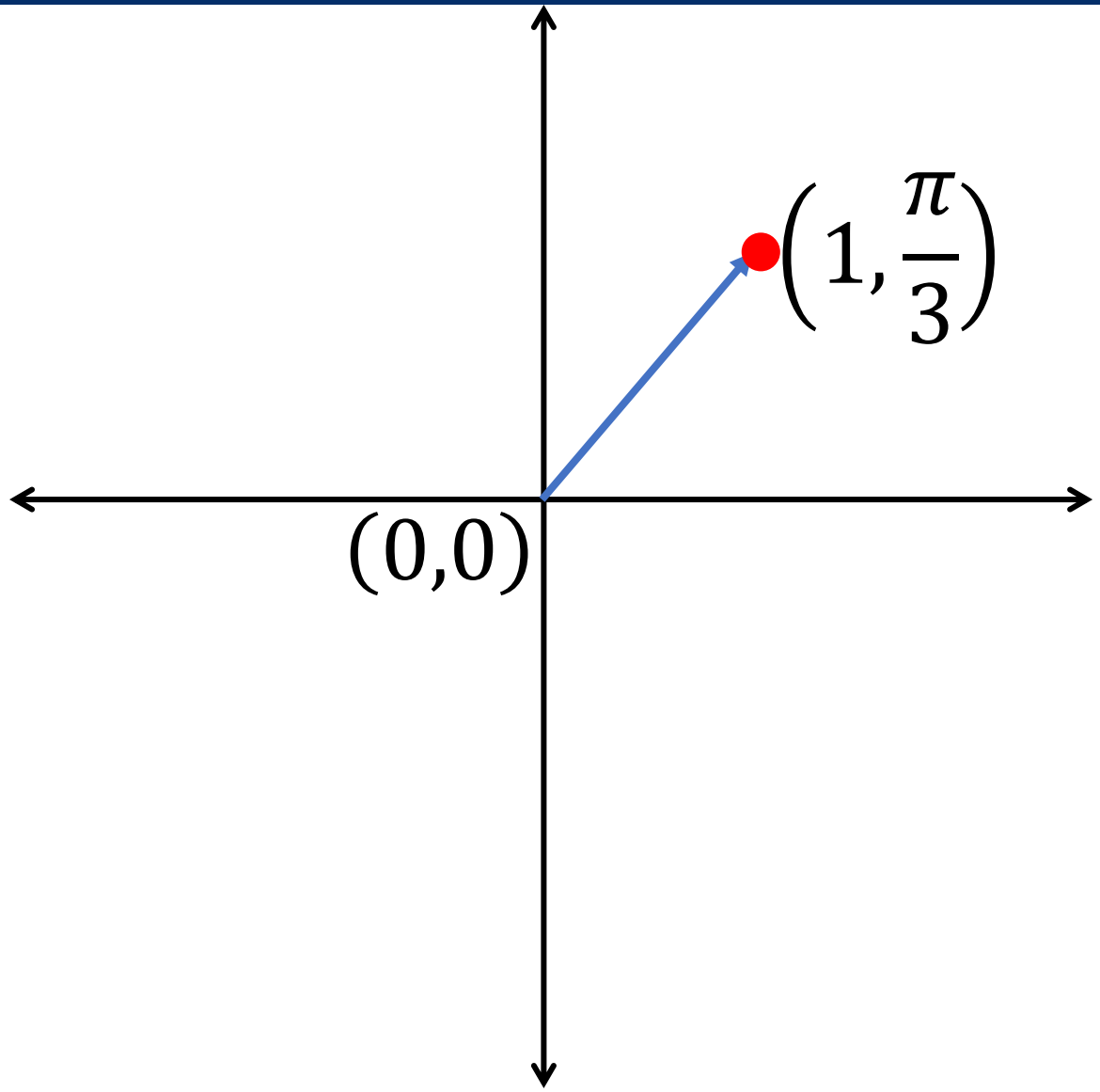
EXAMPLE OF POLAR → CARTESIAN

$(r, \theta) \rightarrow (x, y)$

polar cartesian

$$x = r\cos\theta$$

$$y = r\sin\theta$$



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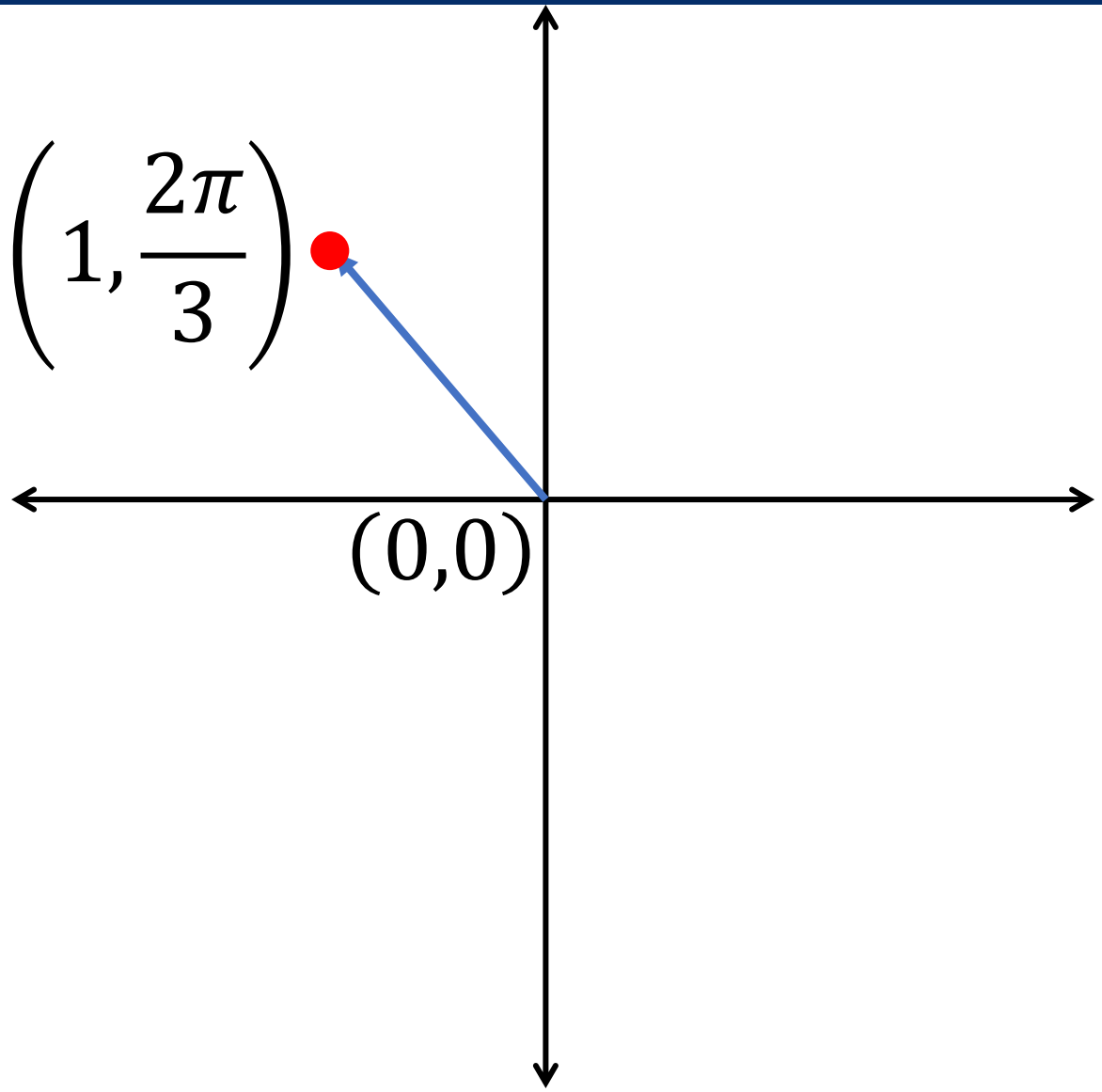
EXAMPLE OF POLAR → CARTESIAN

$$(r, \theta) \rightarrow (x, y)$$

polar cartesian

$$x = r\cos\theta$$

$$y = r\sin\theta$$



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QUESTIONS

Questions on content so far?

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POST-LAB ZOOM FEEDBACK

- Please answer the Zoom poll
- On a scale of 1 to 5, how would you rate your understanding of this week's content?
  - 1 –Did not understand anything
  - 2 – Understood some parts
  - 3 – Understood most of the content
  - 4 – Understood all of the content
  - 5 – The content was easy for me/I already knew all of the content

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ADDITIONAL OPTIONAL CONENT

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SUMMATION NOTATION

Notation to make writing long sums easier!

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SUMMATION NOTATION

Notation to make writing long sums easier!

$$\text{Sum} = 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10$$

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SUMMATION NOTATION

Notation to make writing long sums easier!

$$\text{Sum} = 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10$$

$$\text{Sum} = \sum_{i=1}^{10} i$$

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SUMMATION NOTATION

Notation to make writing long sums easier!

$$\text{Sum} = 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10$$

$$\text{Sum} = \sum_{i=1}^{10} i$$

$$a_1 + a_2 + a_3 + a_4 + a_5 = \sum_{k=1}^{5} a_k$$

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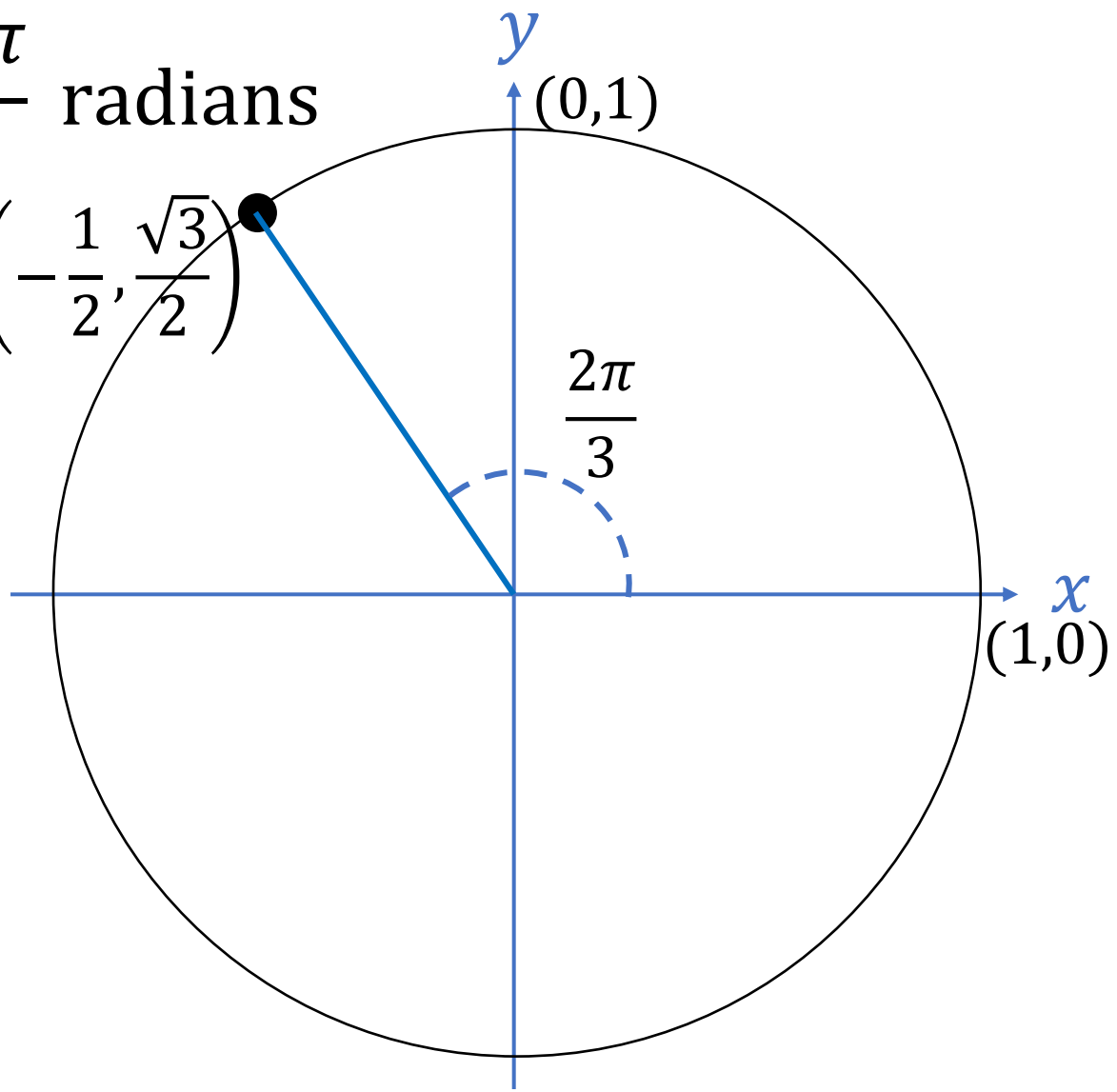
TRIGONOMETRIC FUNCTIONS

$$120^{\circ} = \frac{2\pi}{3} \text{ radians}$$



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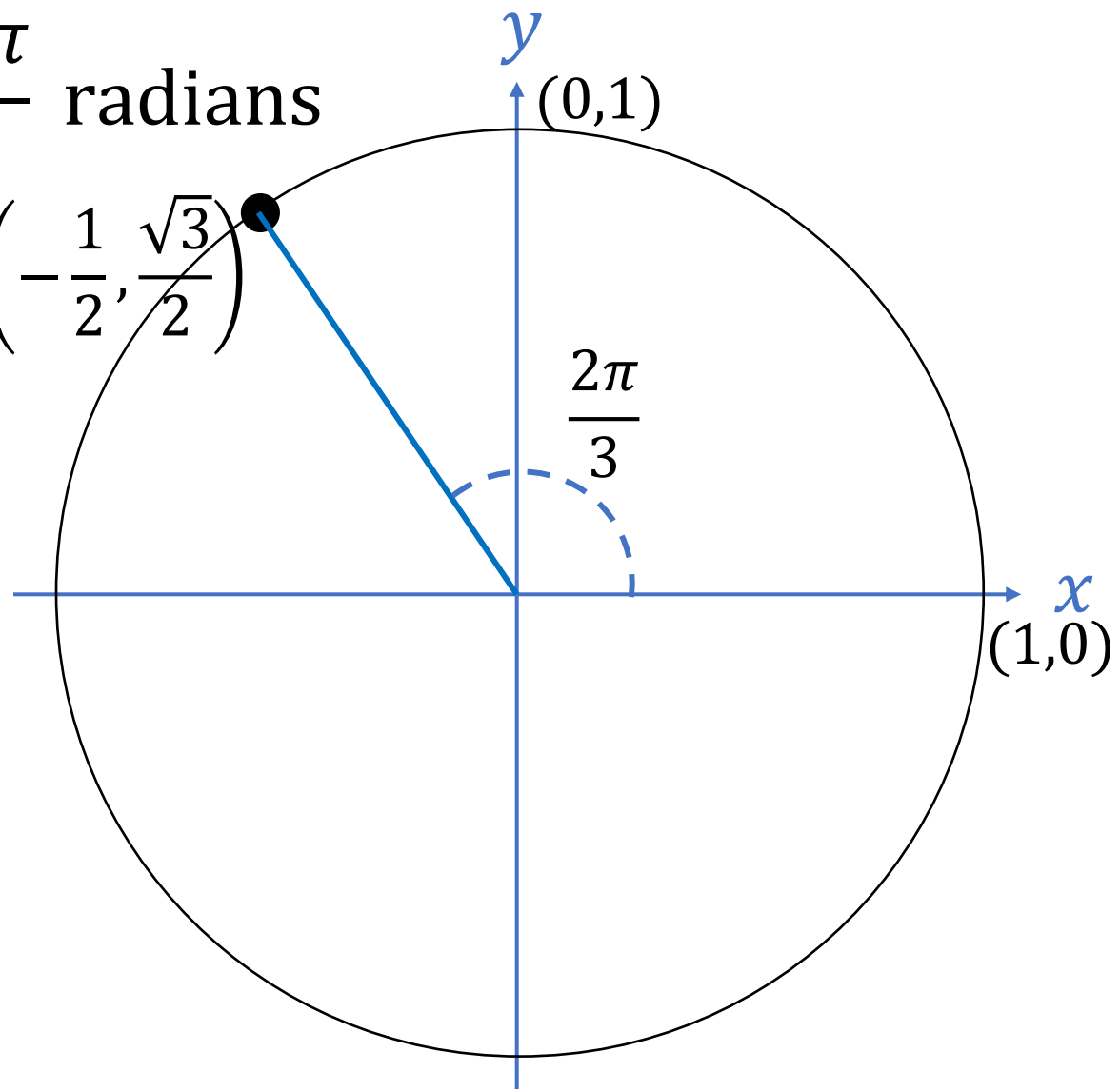
TRIGONOMETRIC FUNCTIONS

$$120^\circ = \frac{2\pi}{3} \text{ radians}$$

$$\sin\frac{2\pi}{3} = \frac{\sqrt{3}}{2}$$

$$\cos\frac{2\pi}{3} = -\frac{1}{2}$$

$$\tan\frac{2\pi}{3} = -\frac{1}{\sqrt{3}}$$



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