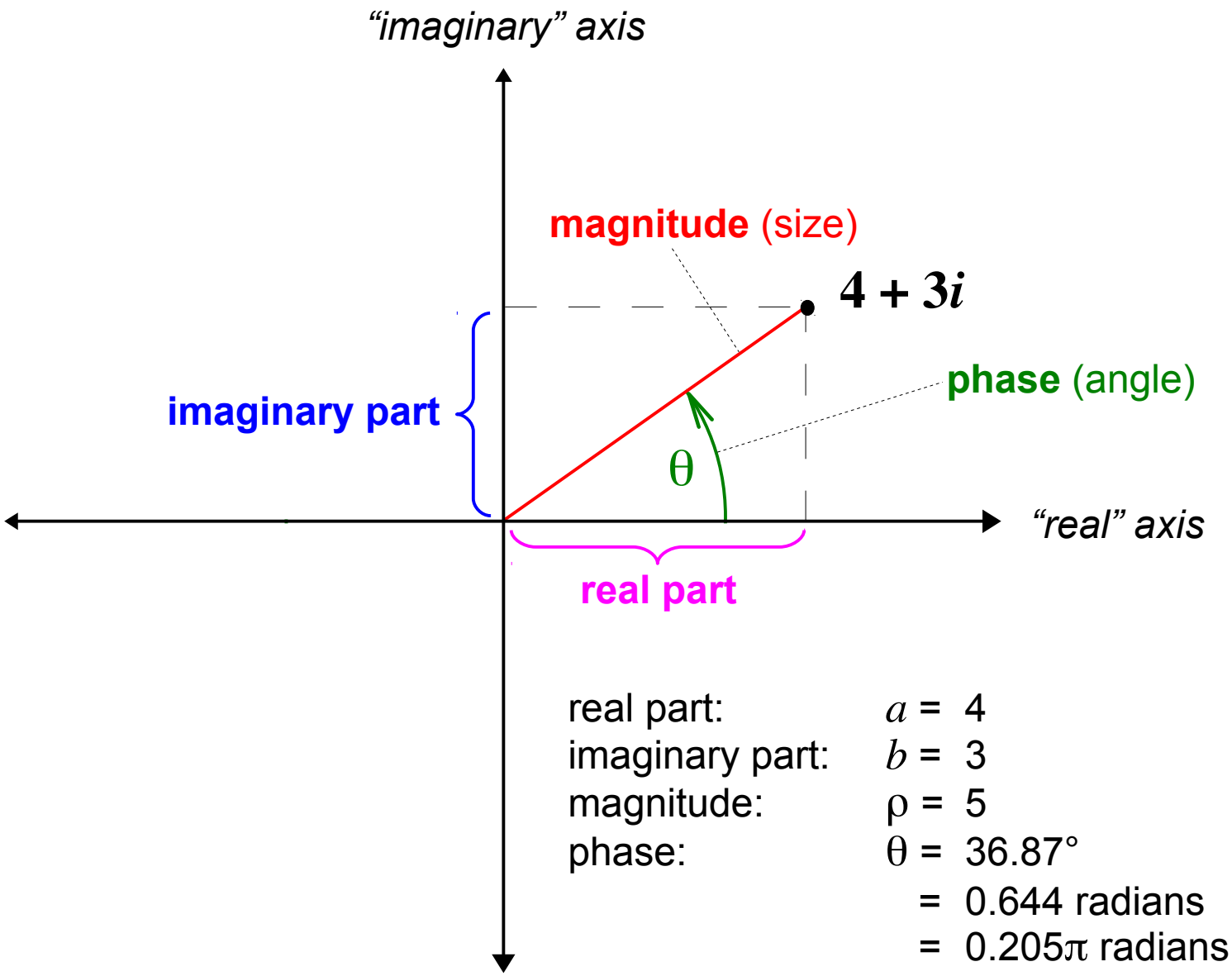
Complex Numbers

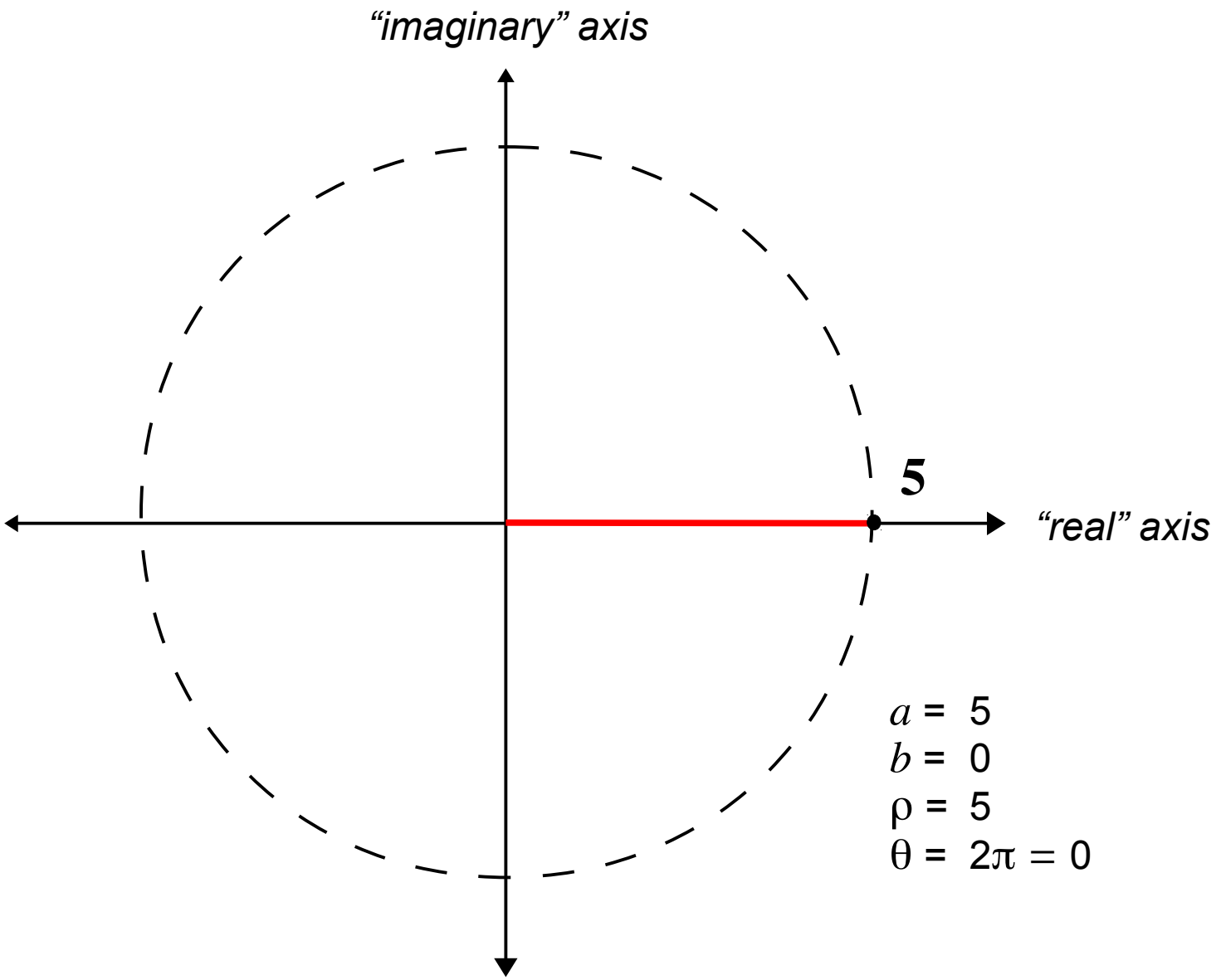


real part: $a = 4$
imaginary part: $b = 3$
magnitude: $\rho = 5$
phase: $\theta = 36.87°$
$= 0.644$ radians
$= 0.205\pi$ radians

Complex Arithmetic

- To **add** two complex numbers, you just:
  - Add their real parts
  - Add their imaginary parts
- To **multiply** two complex numbers, you just:
  - Multiply their magnitudes
  - Add their phases
- To **square** a complex number, you just:
  - Square its magnitude
  - Double its phase

Multiplication By i Adds $\pi/2$ to the Phase



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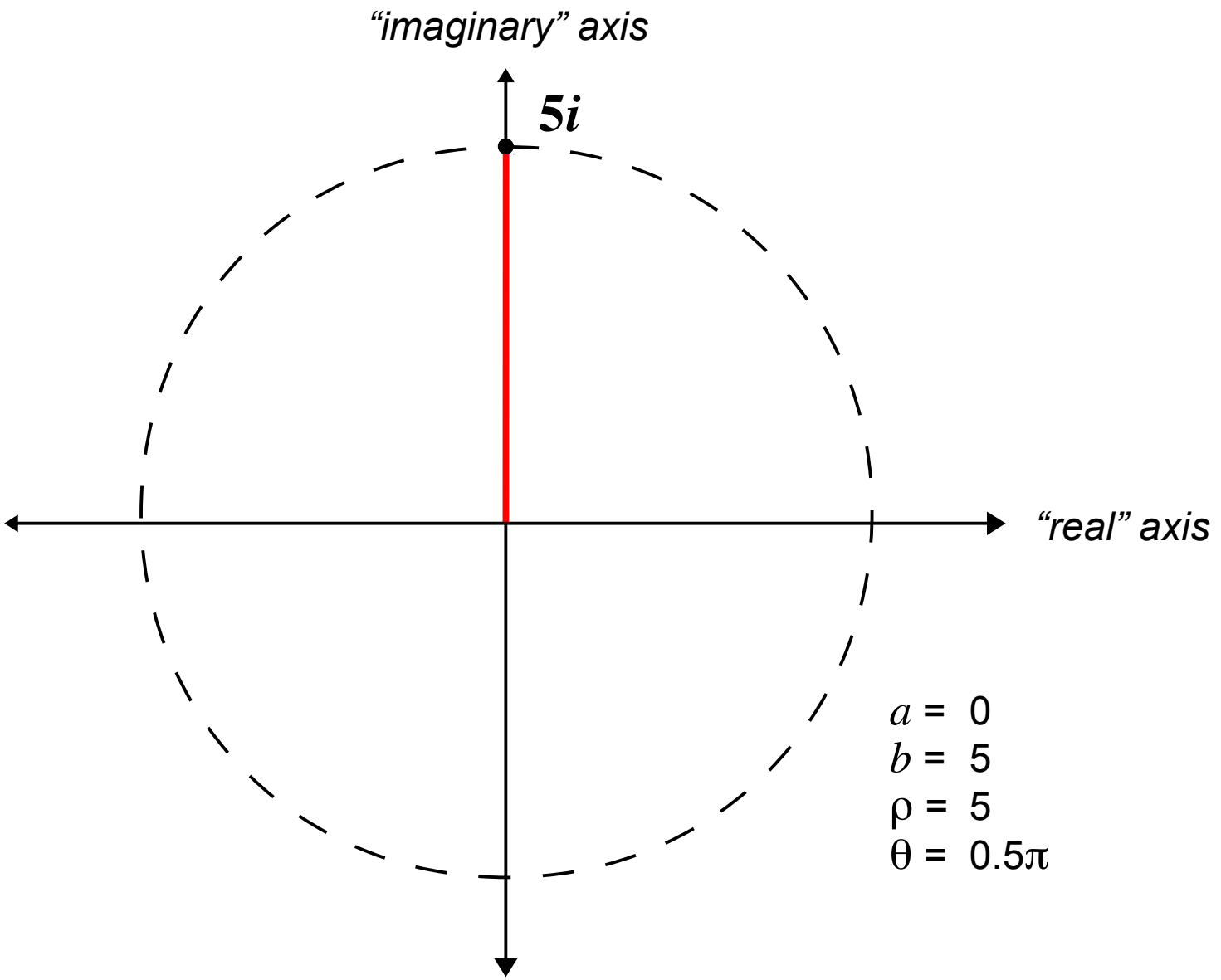

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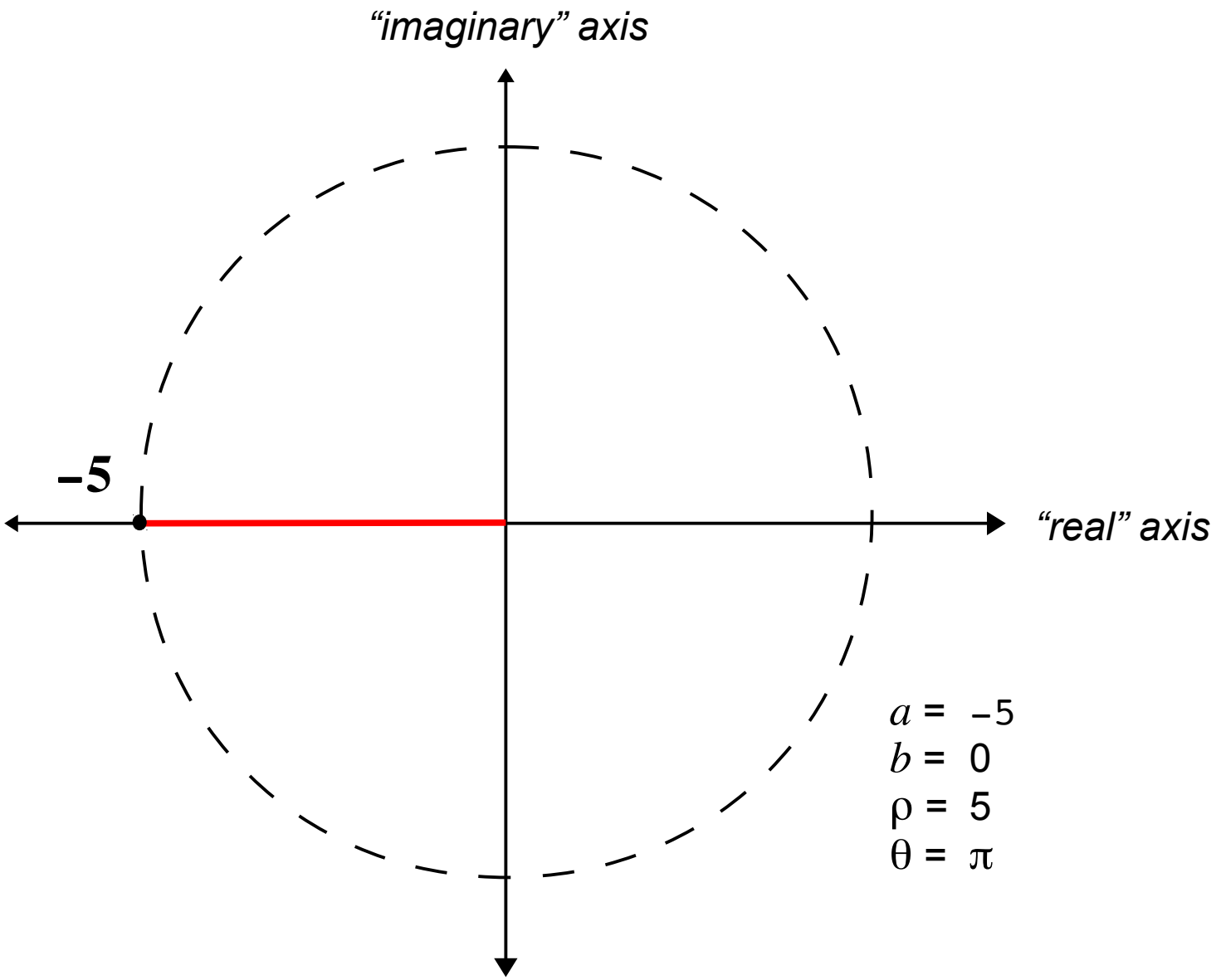

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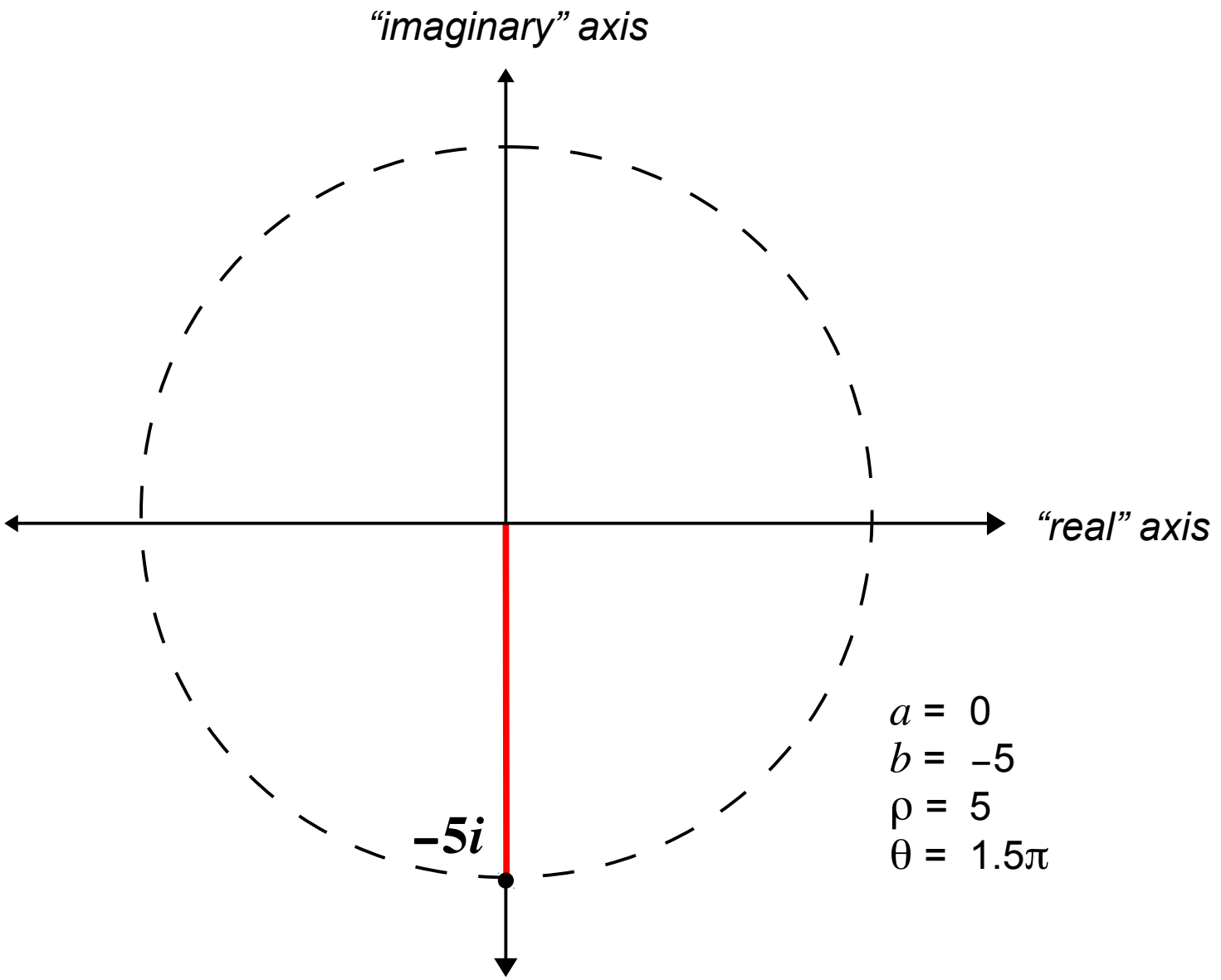
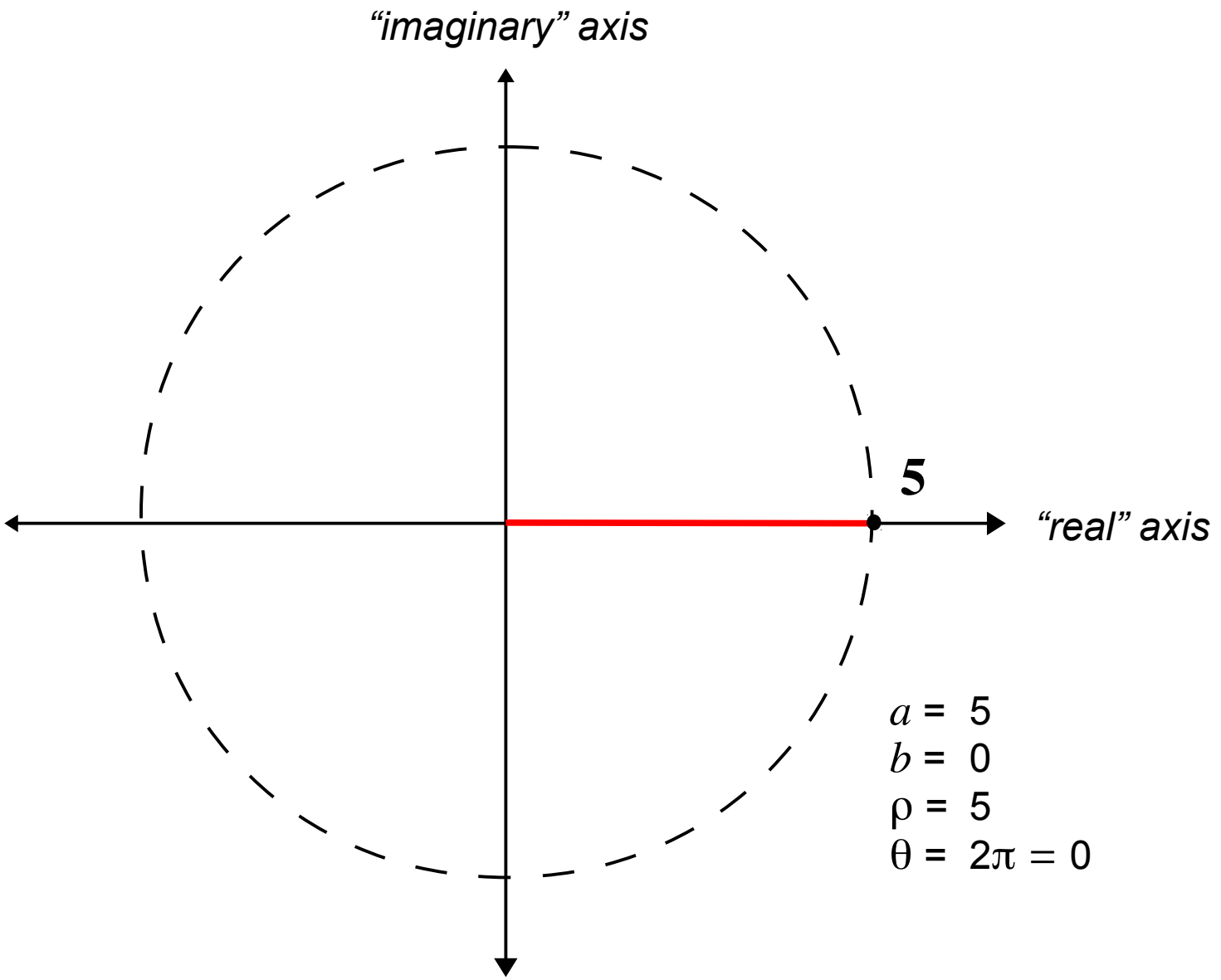
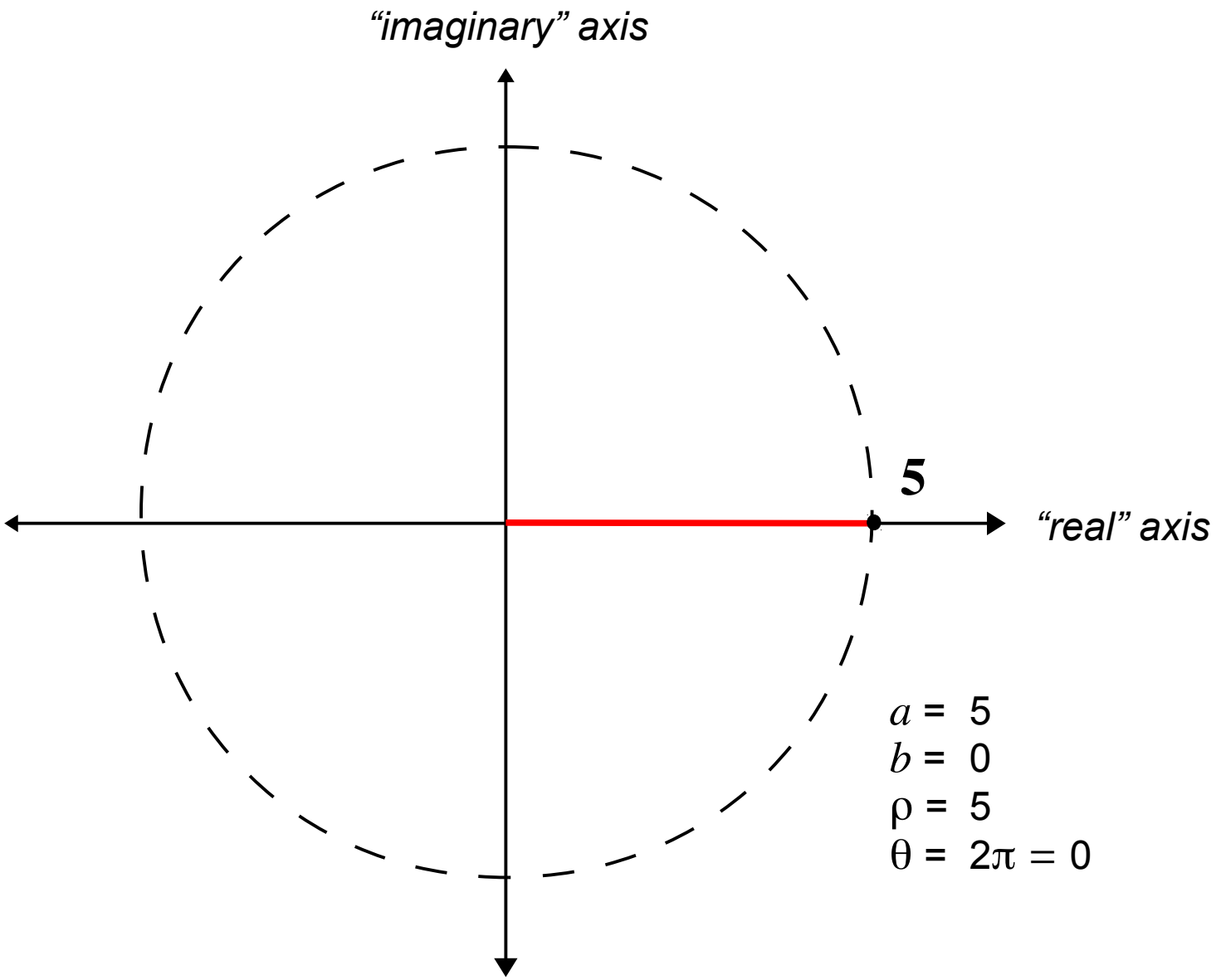


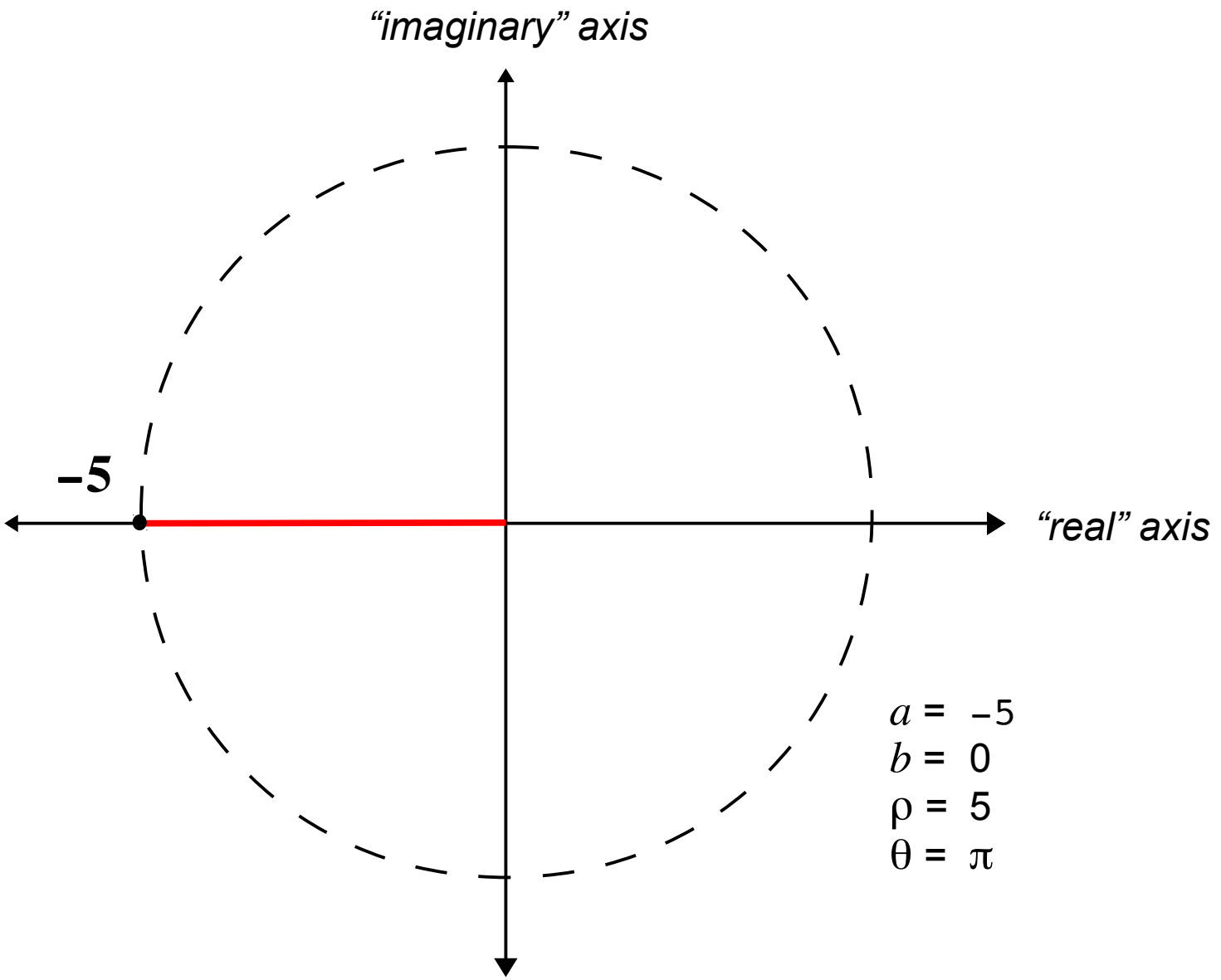
Multiplication By i Adds $\pi/2$ to the Phase



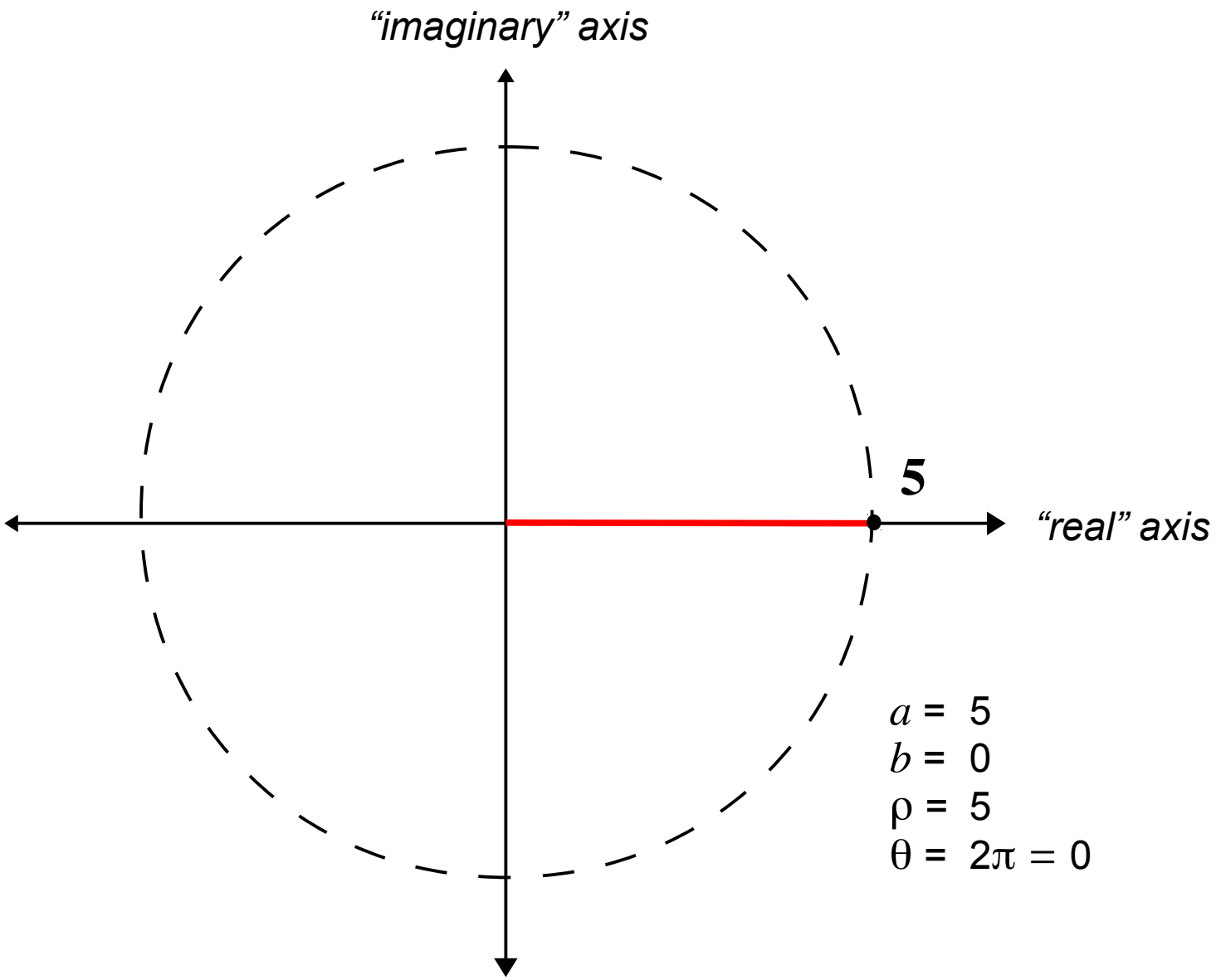
Multiplication By –1 Adds π to the Phase



Multiplication By –1 Adds π to the Phase



Multiplication By –1 Adds π to the Phase



Complex Arithmetic

- Why does a **positive times a positive** give a **positive**?

  Because we add their phases: $0 + 0 = 0$

- Why does a **negative times a positive** give a **negative**?

  Because we add their phases: $\pi + 0 = \pi$

- Why does a **negative times a negative** give a **positive**?

  Because we add their phases: $\pi + \pi = 2\pi = 0$