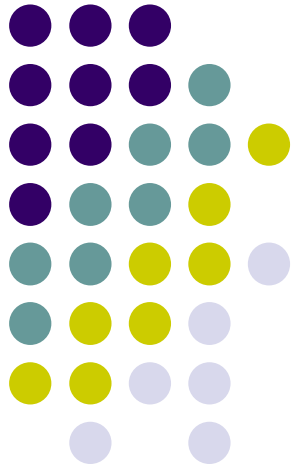
Vergence: Basics

Basic Optics, Chapter 1



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- Why? Because the wave model allows us to describe the behavior of light in terms of ***rays***

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BTW, per the BCSC *Optics* book, the answer to this question is "Light is made of particles, [but] not in the ordinary sense…".

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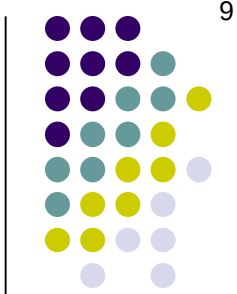
  - via reflection off a surface



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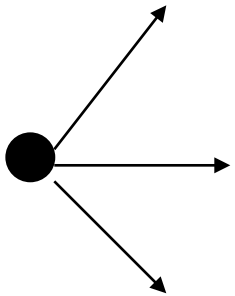
  - spread out (**diverge**)



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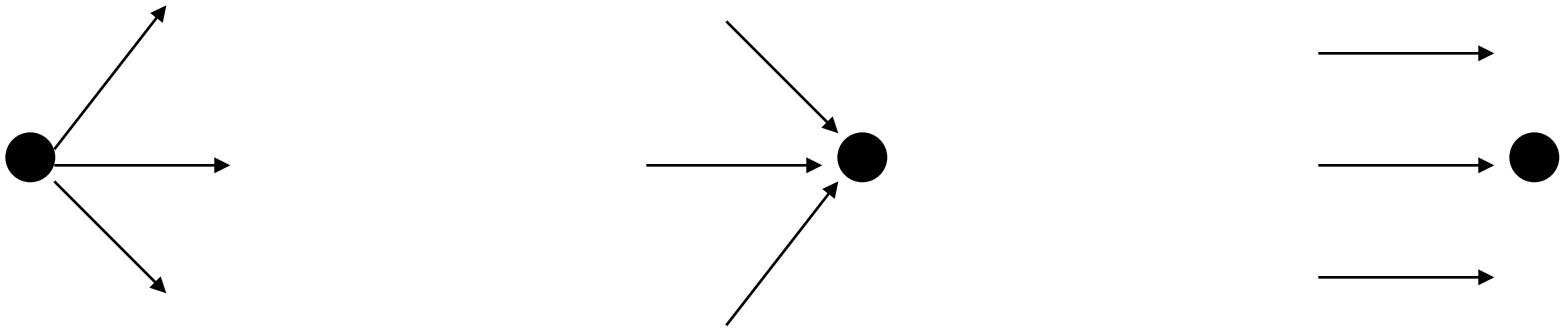
- With respect to a given point, light rays can:
  - spread out (**diverge**)
  - come together (**converge**)
  - run parallel (**vergence = zero**)



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- Vergence is measured in *diopters (D)*
- Dioptric power is defined as the reciprocal of the distance (in meters) to the point where light rays would intersect

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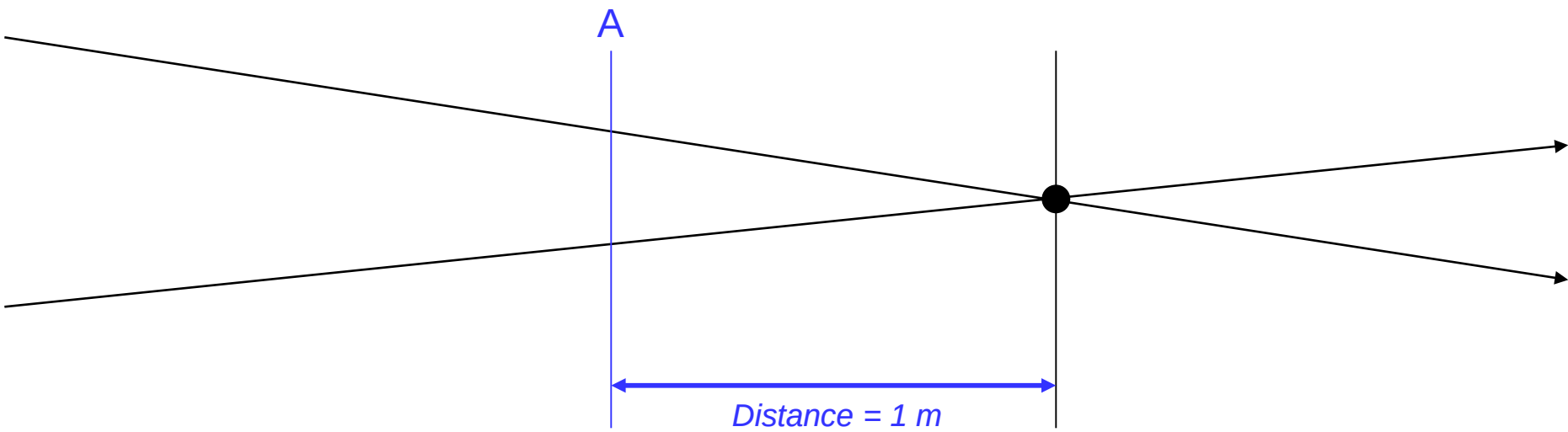
What is the vergence at point A?



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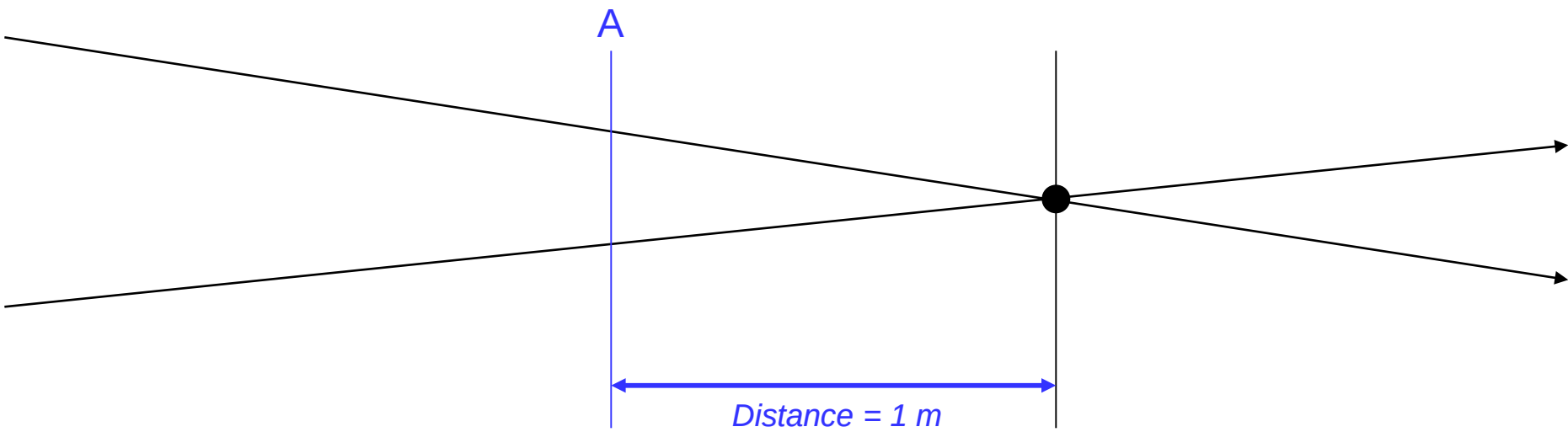

The distance until the rays intersect is 1 m. Therefore, the dioptric power at this location is 1/1 or +1D.

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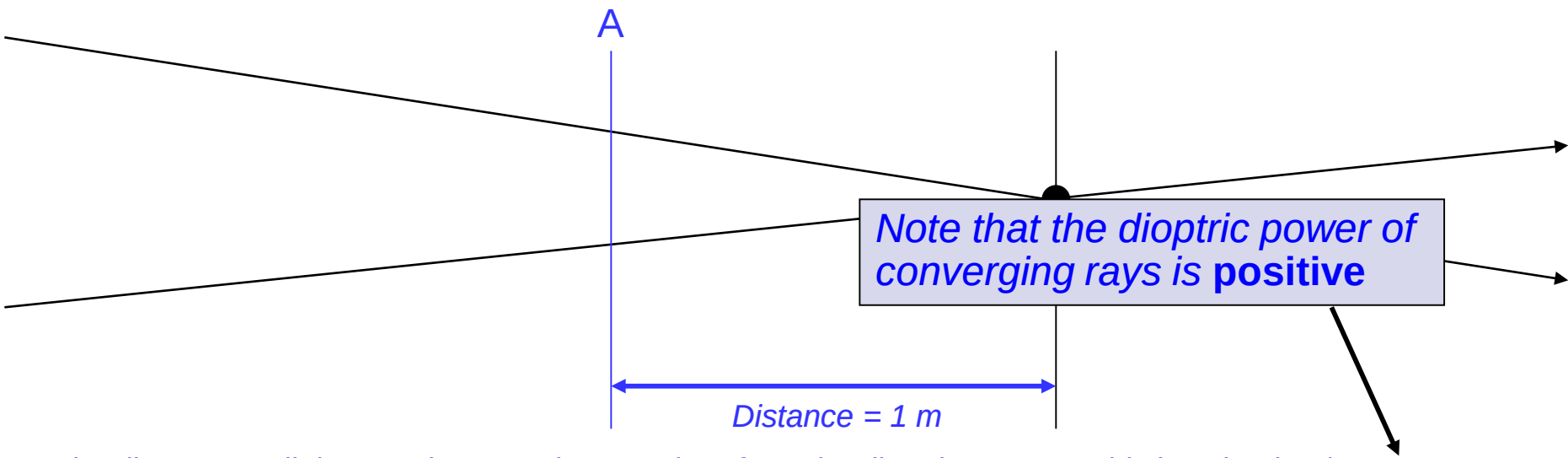

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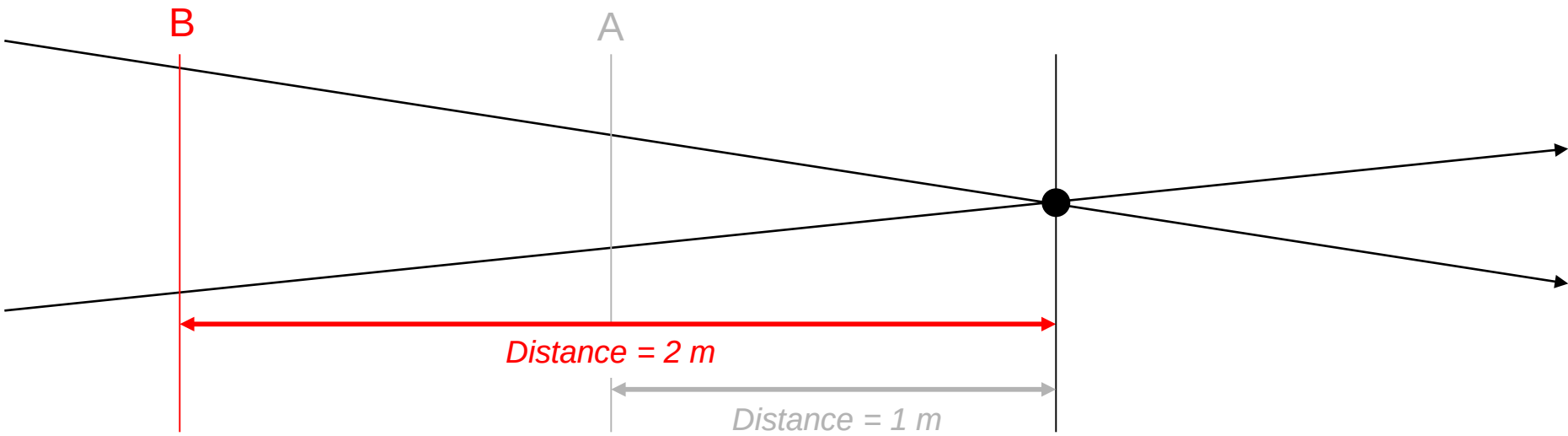

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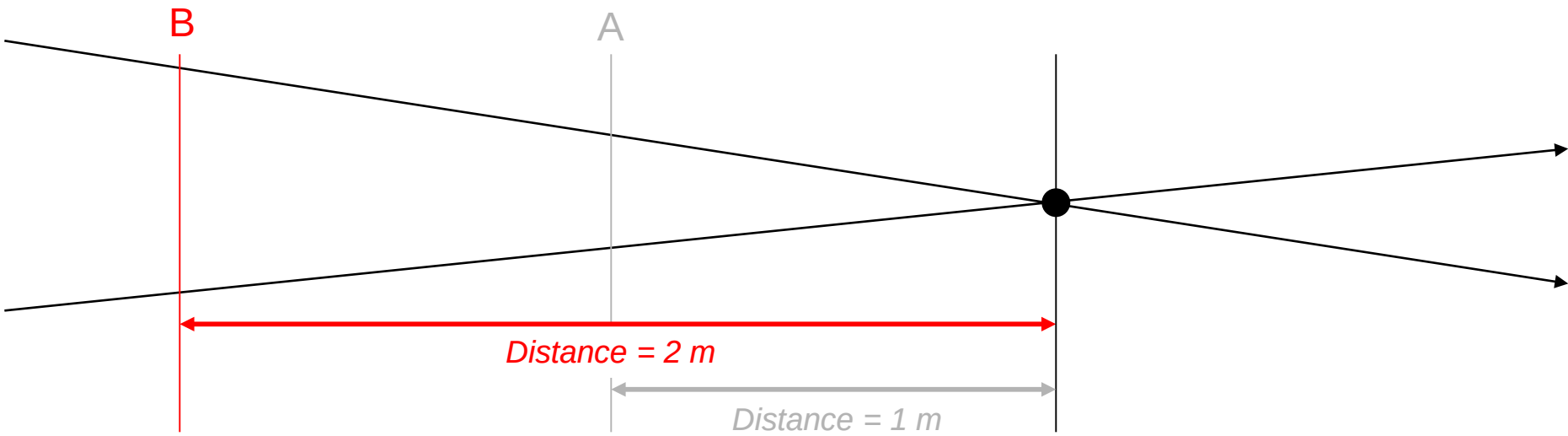

The distance until the rays intersect is 2 m. Therefore, the dioptric power at this location is 1/2 or +0.5D.

*What if the distance to point B was **2000** m instead of 2?*

light rays would intersect

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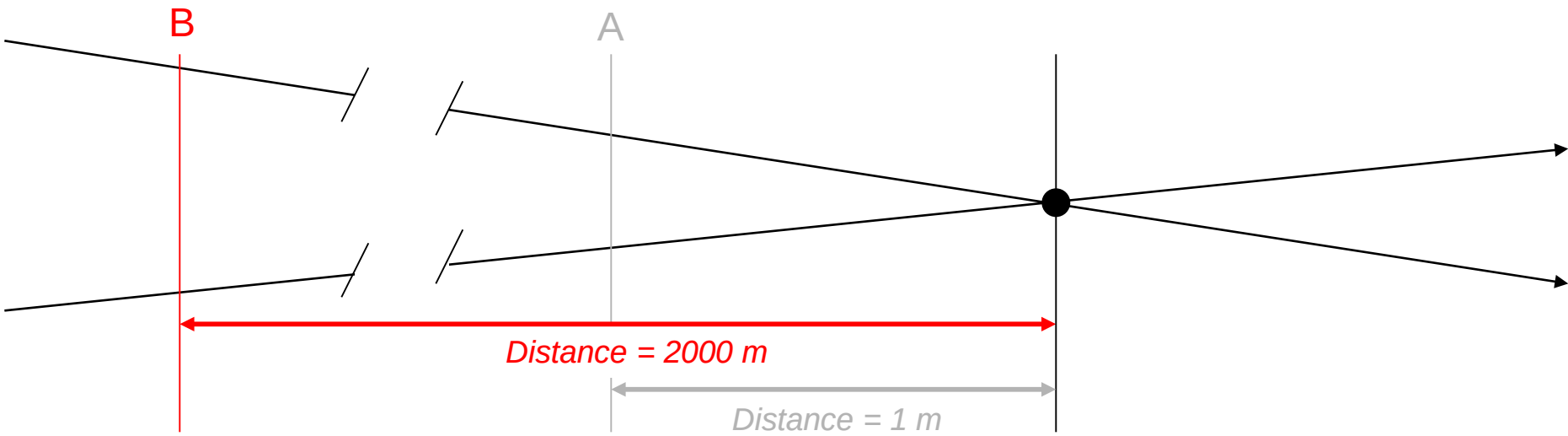

*What if the distance to point B was **2000** m instead of 2?*
The vergence would be 1/2000 = 0.0005D—a value not meaningfully different from zero for most purposes.

The point: As distance approaches infinity, the vergence of light approaches **zero.**

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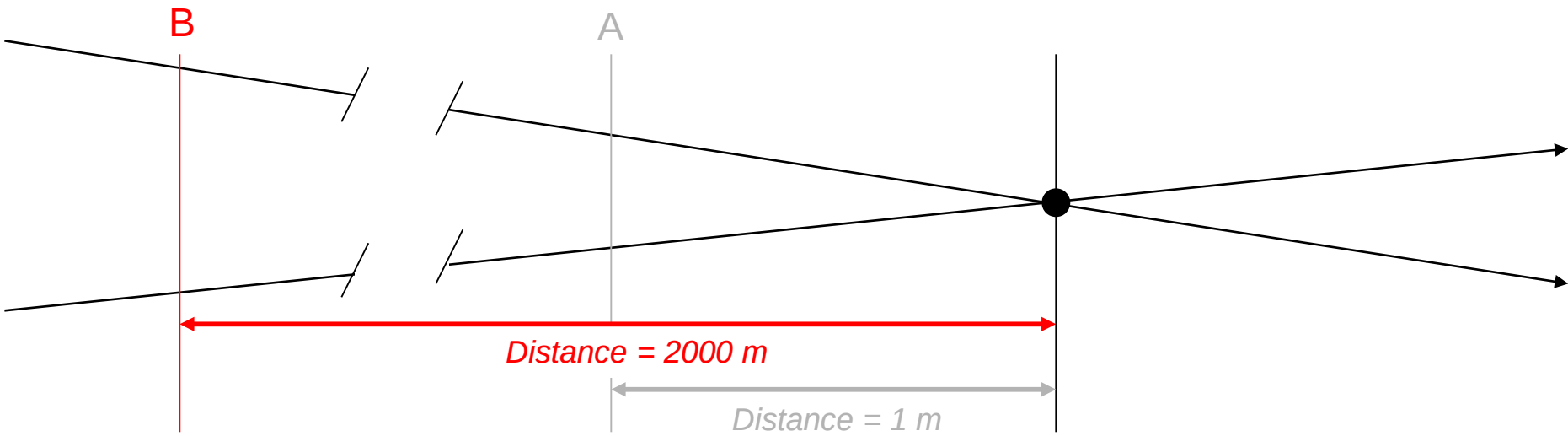

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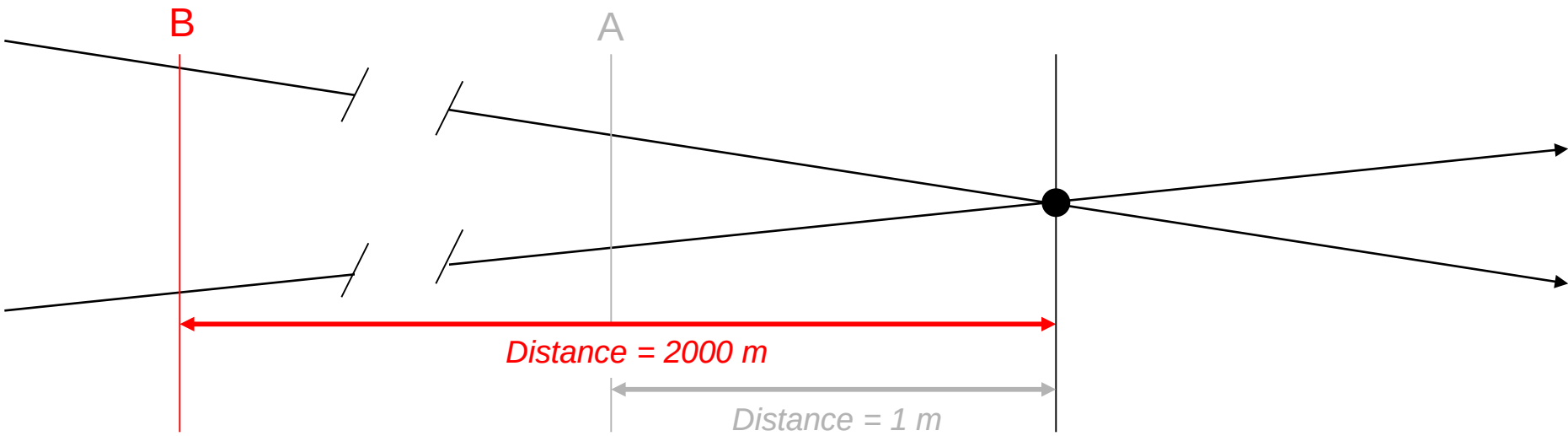

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For the purposes of clinical optics, at what distance can we consider the vergence to be zero?
There's no definitive answer to this. However, consider that we refract patients at 6 m (20 feet) for their distance prescription. In essence, we are treating 6 m as if it equals infinity. The vergence at 6 m is 1/6 = 0.17D. This means that a patient with a perfect 'lane refraction' is actually overplussed by 0.17D (i.e., at a distance of 6 meters the light from the acuity chart is diverging to the tune of -0.17D, which must be neutralized by an extra +0.17D in the phoropter). This overcorrection is usually—but not always!--of no consequence. (More on this in a later chapter.)

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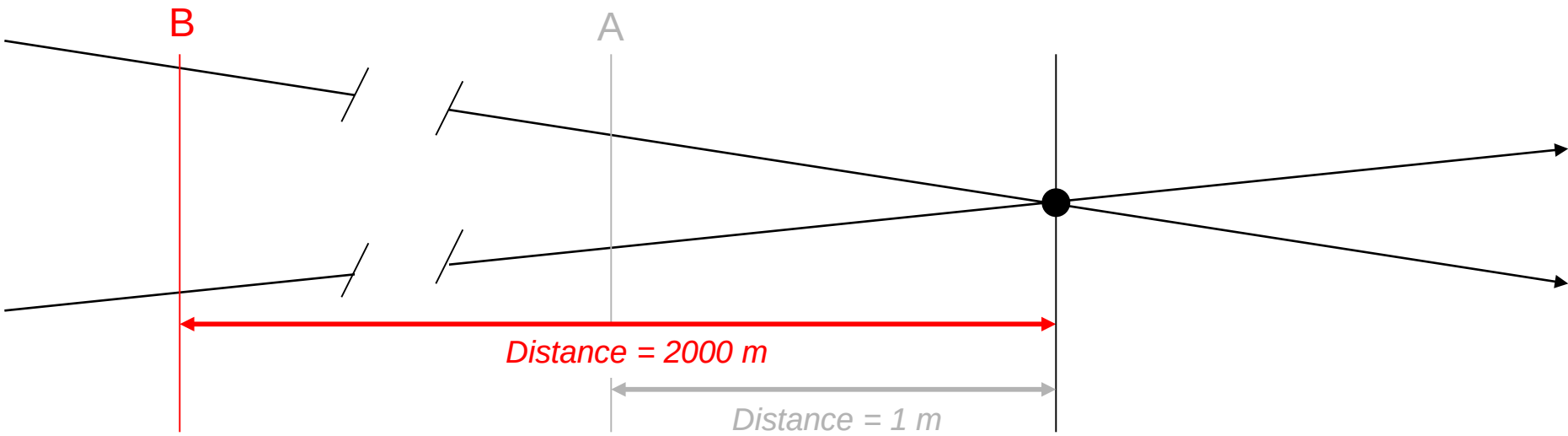

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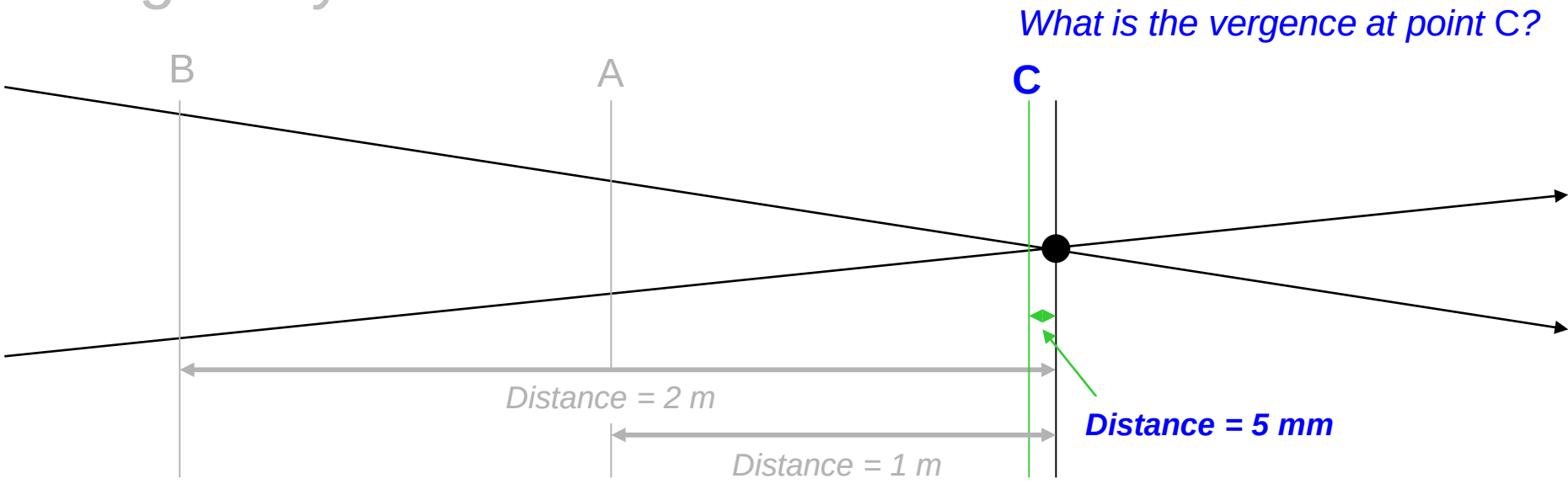

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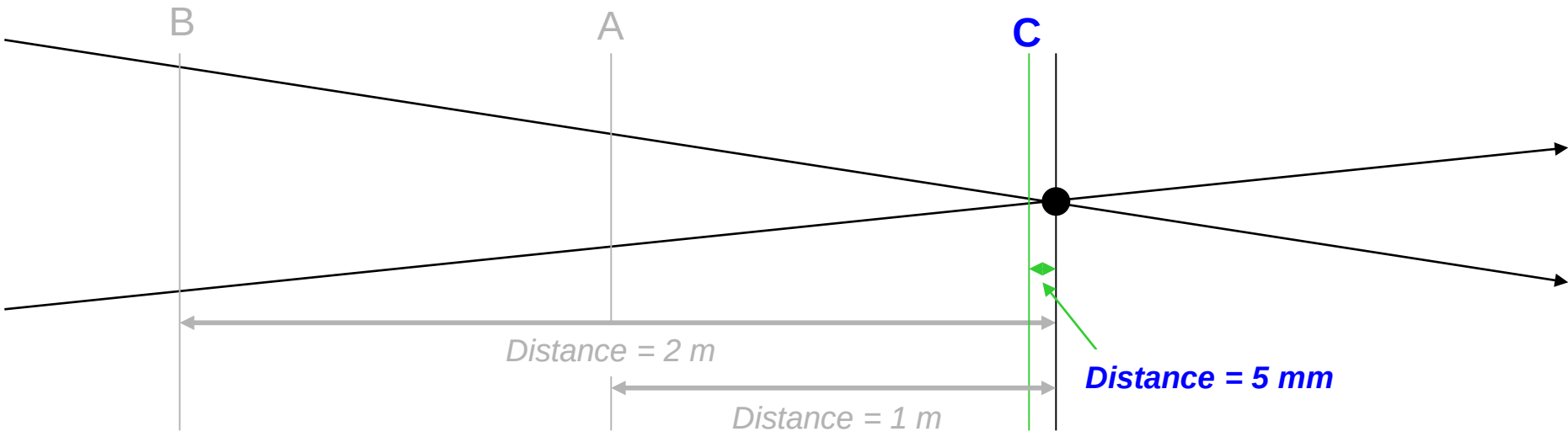

The distance until the rays intersect is 5 mm. Therefore, the dioptric power at this location is 1/.005 or +200D.

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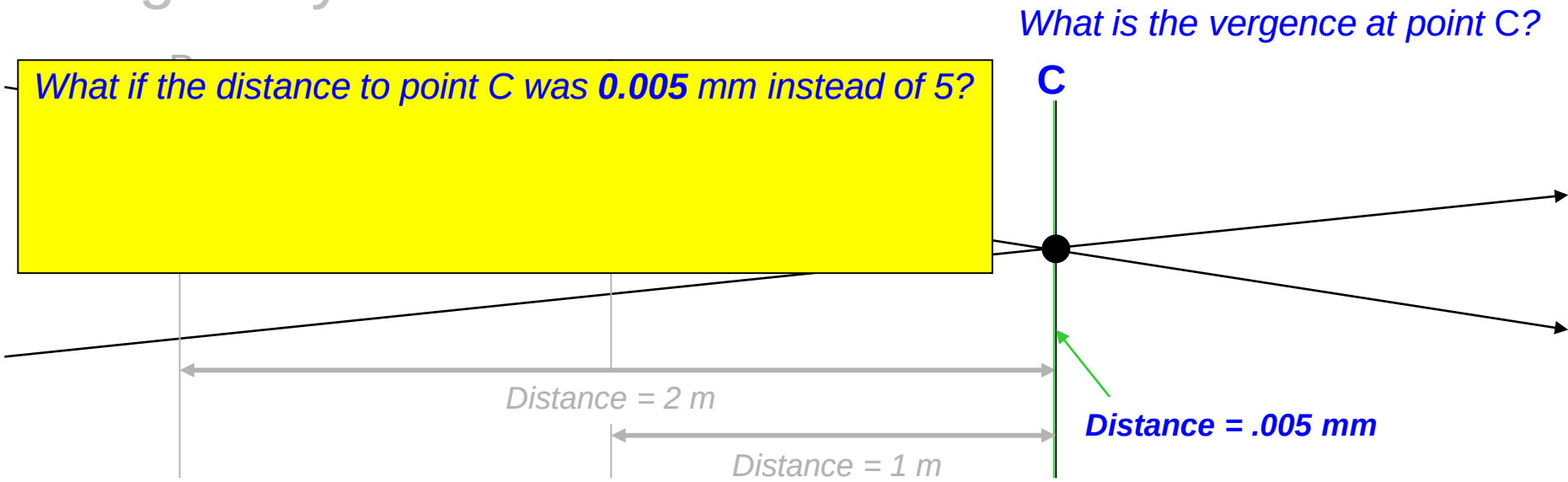

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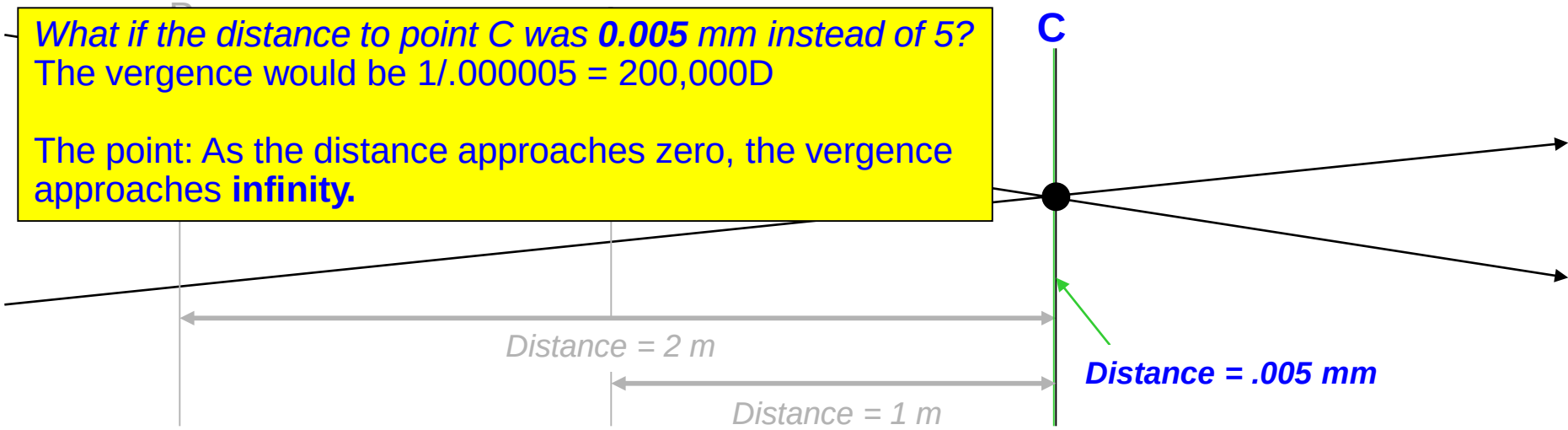
What is the vergence at point C?

*What if the distance to point C was **0.005** mm instead of 5?*
The vergence would be 1/.000005 = 200,000D

The point: As the distance approaches zero, the vergence approaches **infinity.**



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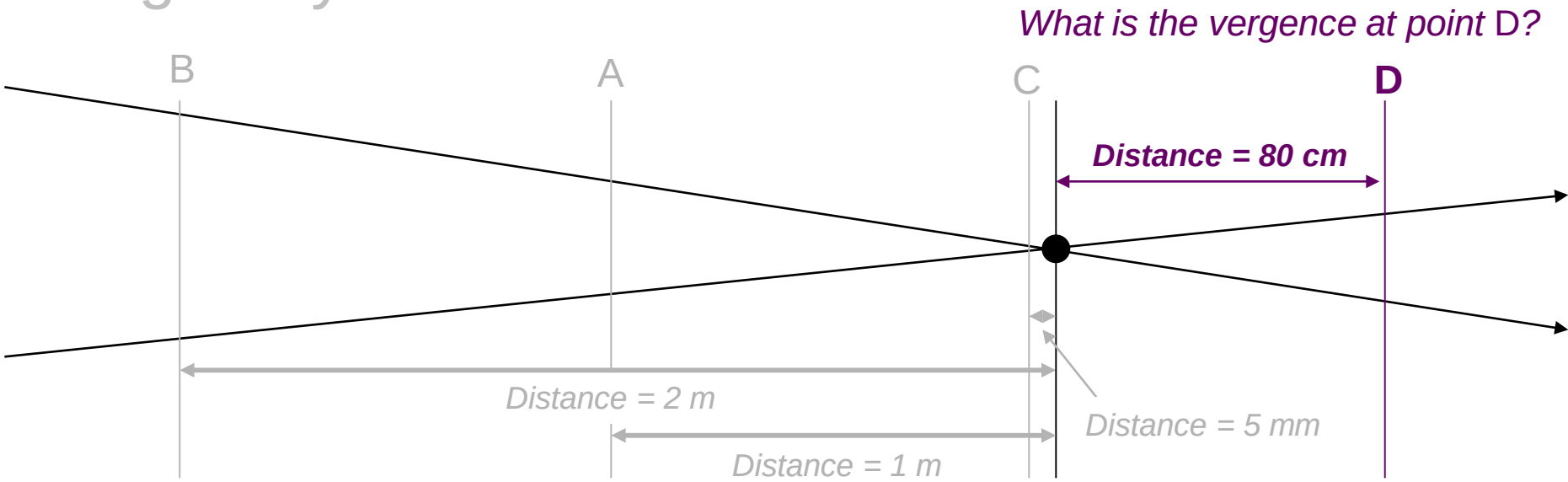

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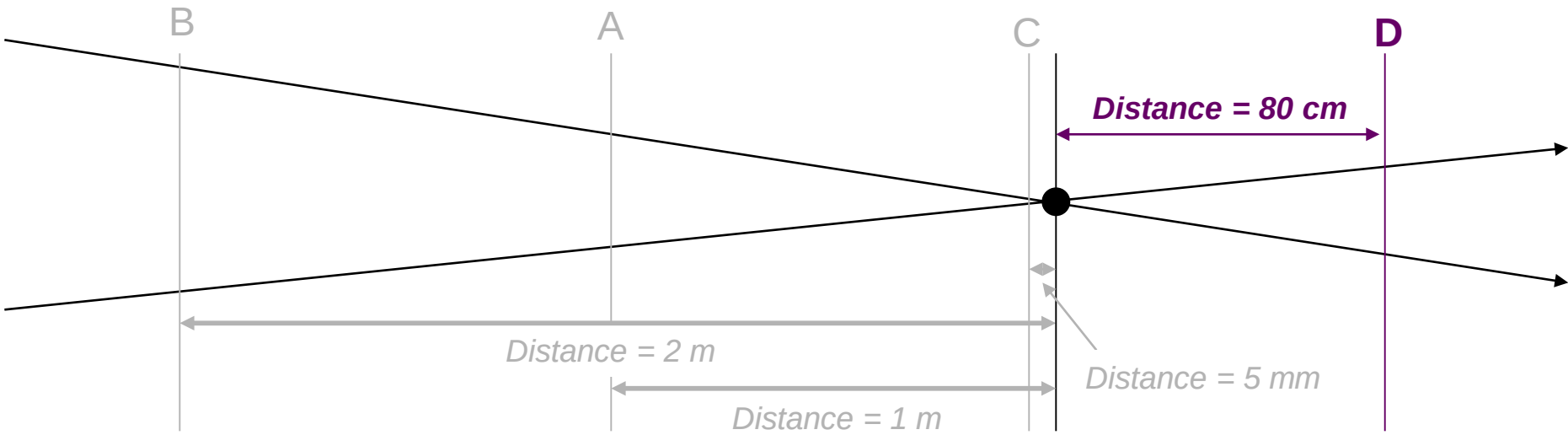

The distance **since** the rays intersected is 80 cm. Therefore, the dioptric power at this location is 1/-.8 or -1.25D.

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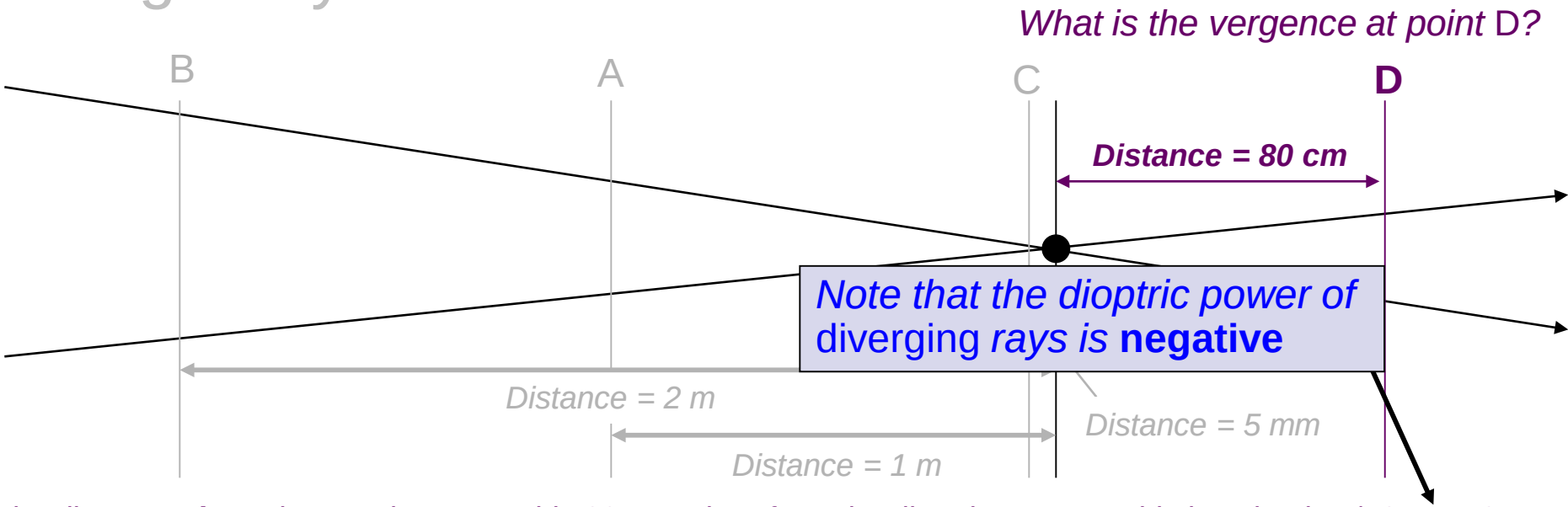

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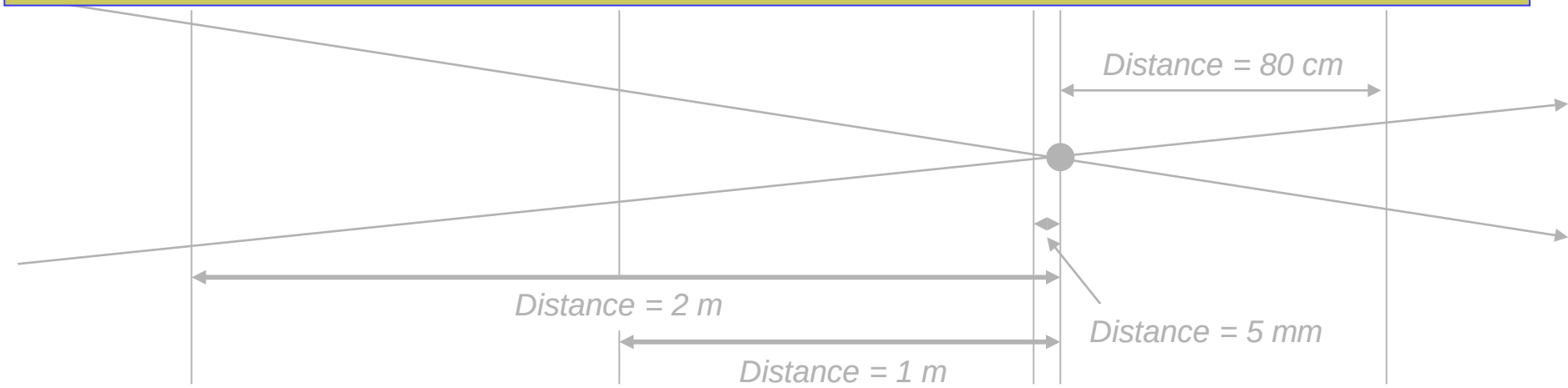
Note also what was missing from this discussion of dioptric power—LENSES. When we think of diopters, we usually think of lens power. It's true of course that lens power is expressed in diopters (more on this very shortly), but it is equally true that diopters are used to describe the vergence of light in general, not just as it is influenced by lenses!



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