



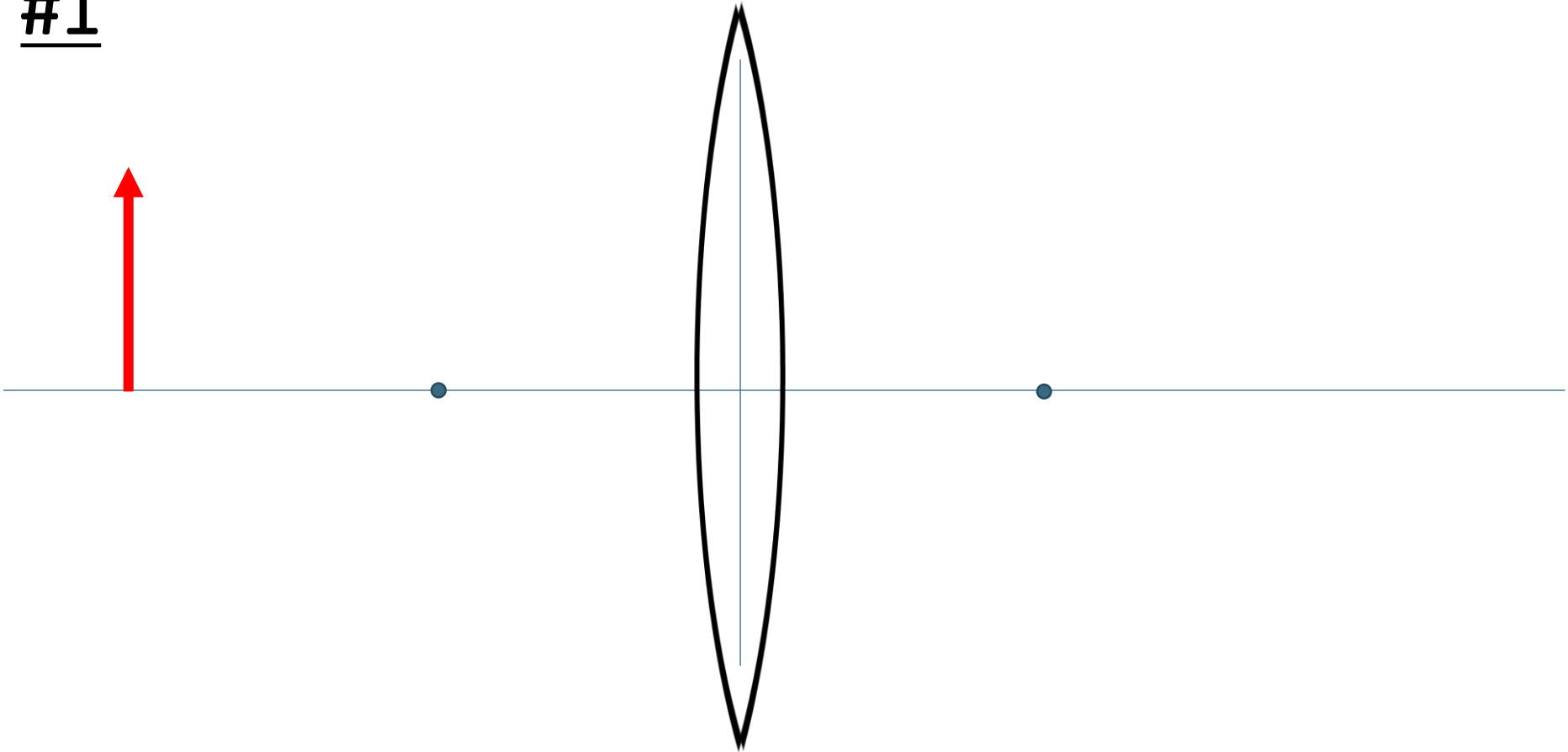
# Electronic and Physical Basics

Lecture 4 – Exercises  
Optics & Acoustics

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[p.nicolay@fh-kaernten.at](mailto:p.nicolay@fh-kaernten.at)

# Plot the image

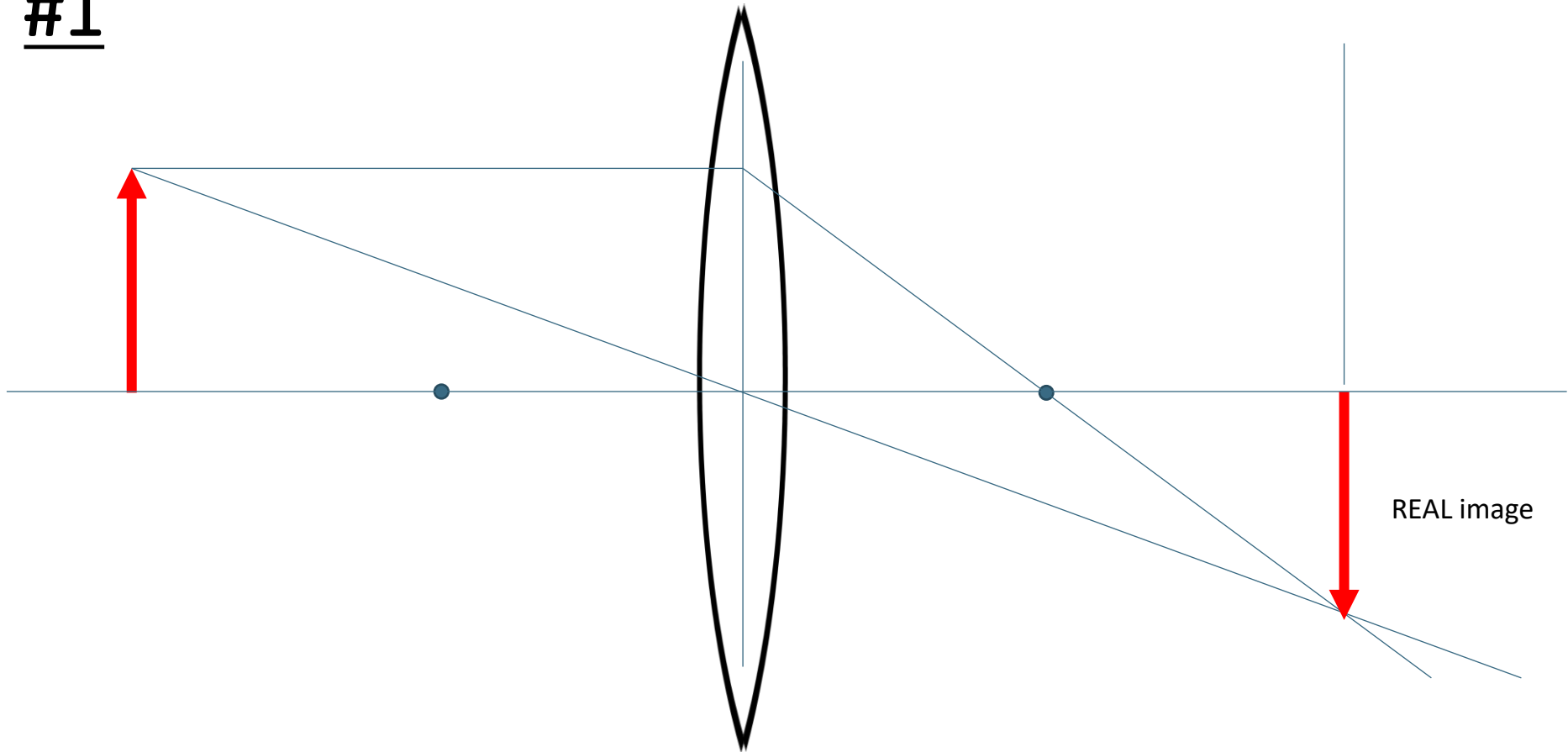
#1



REAL or VIRTUAL?

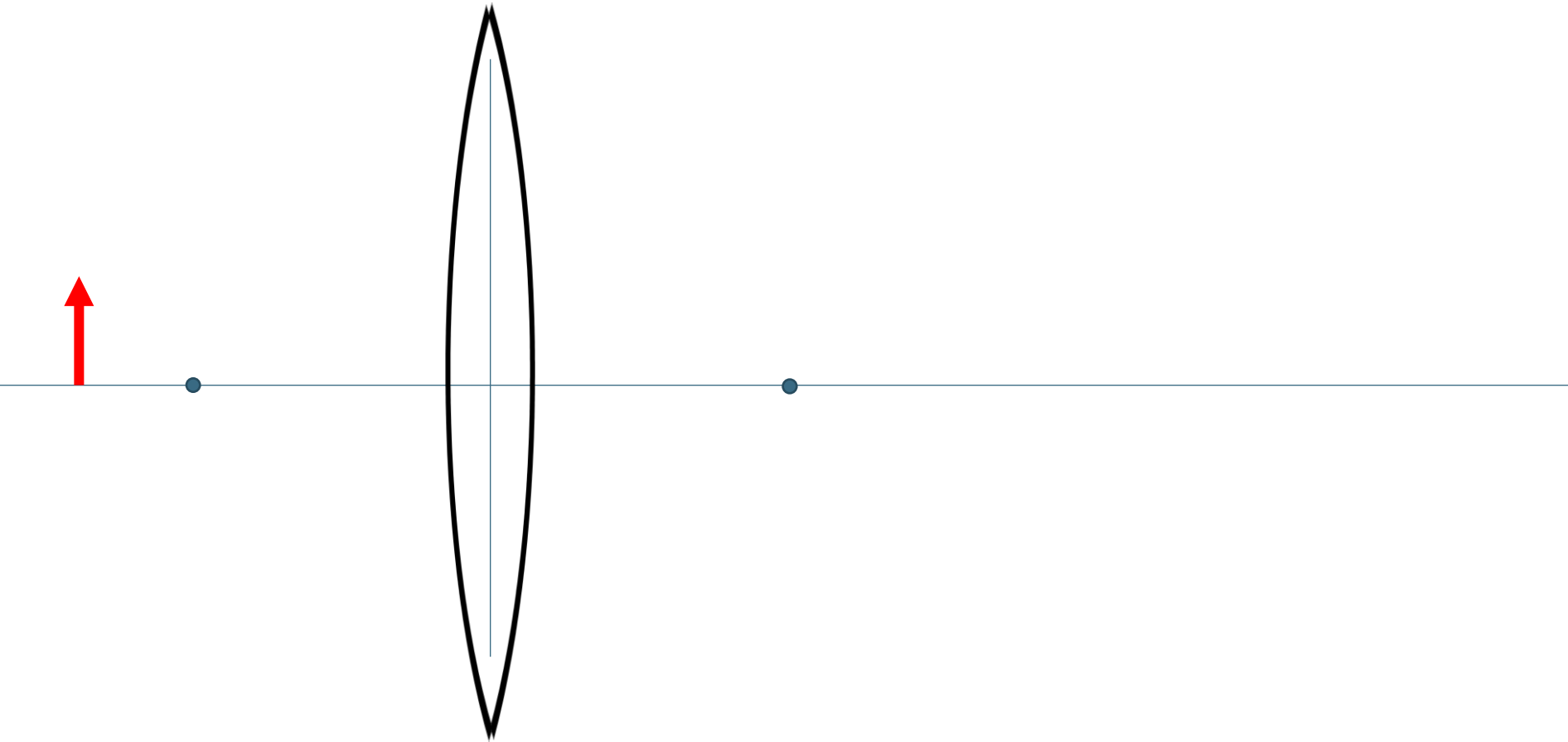
# Plot the image

#1



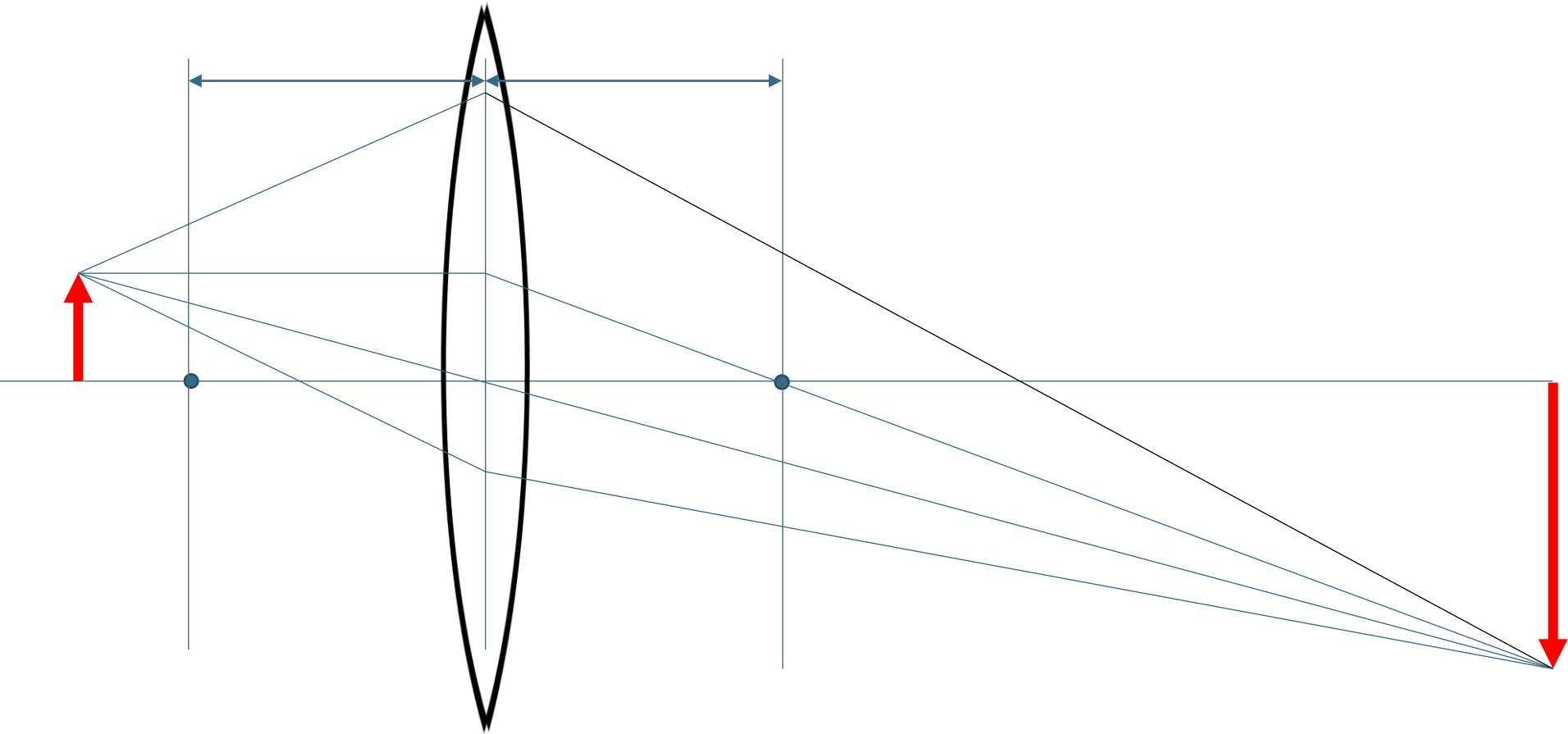
# Plot the image

#2



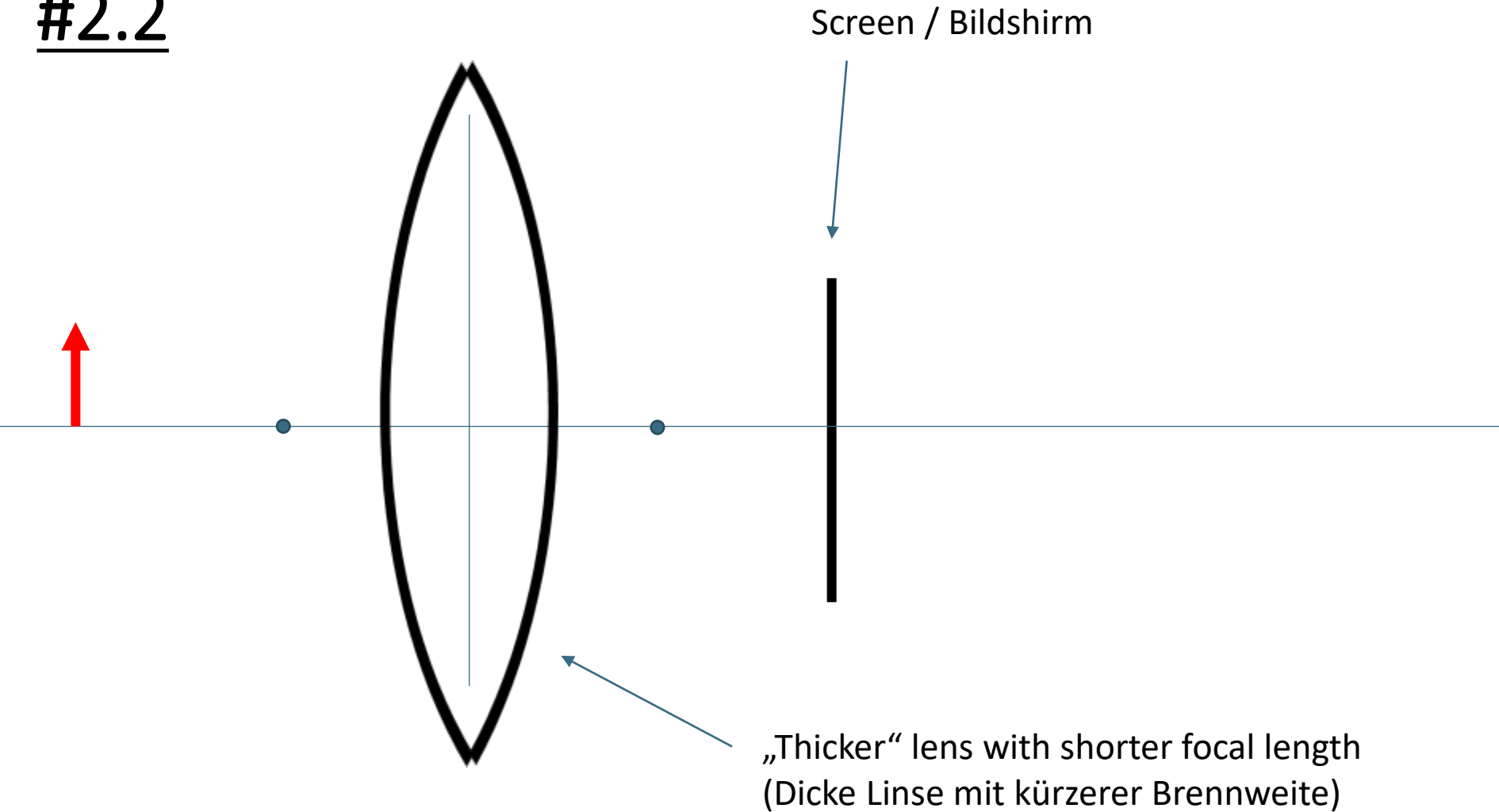
# Plot the image

#2



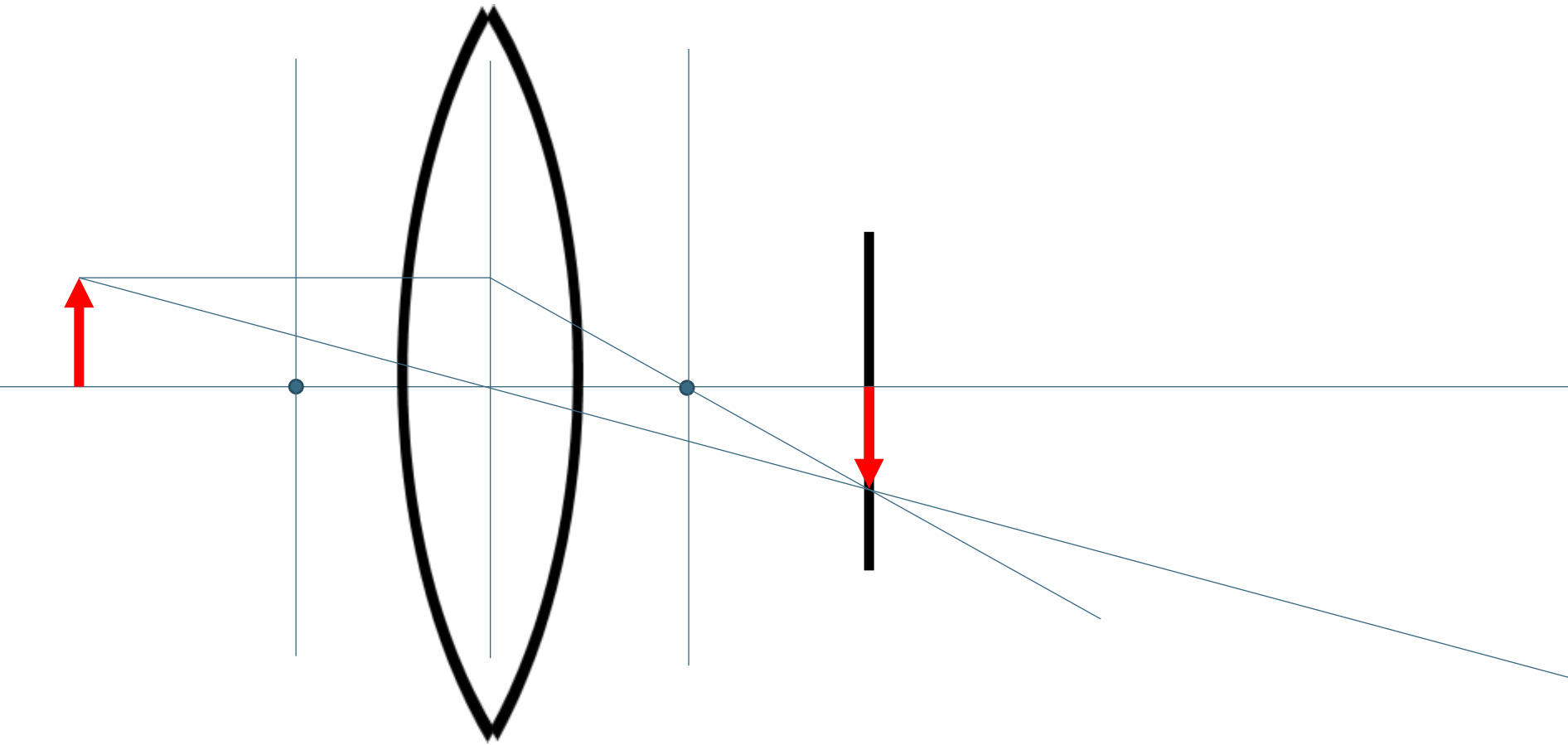
# Plot the image

## #2.2



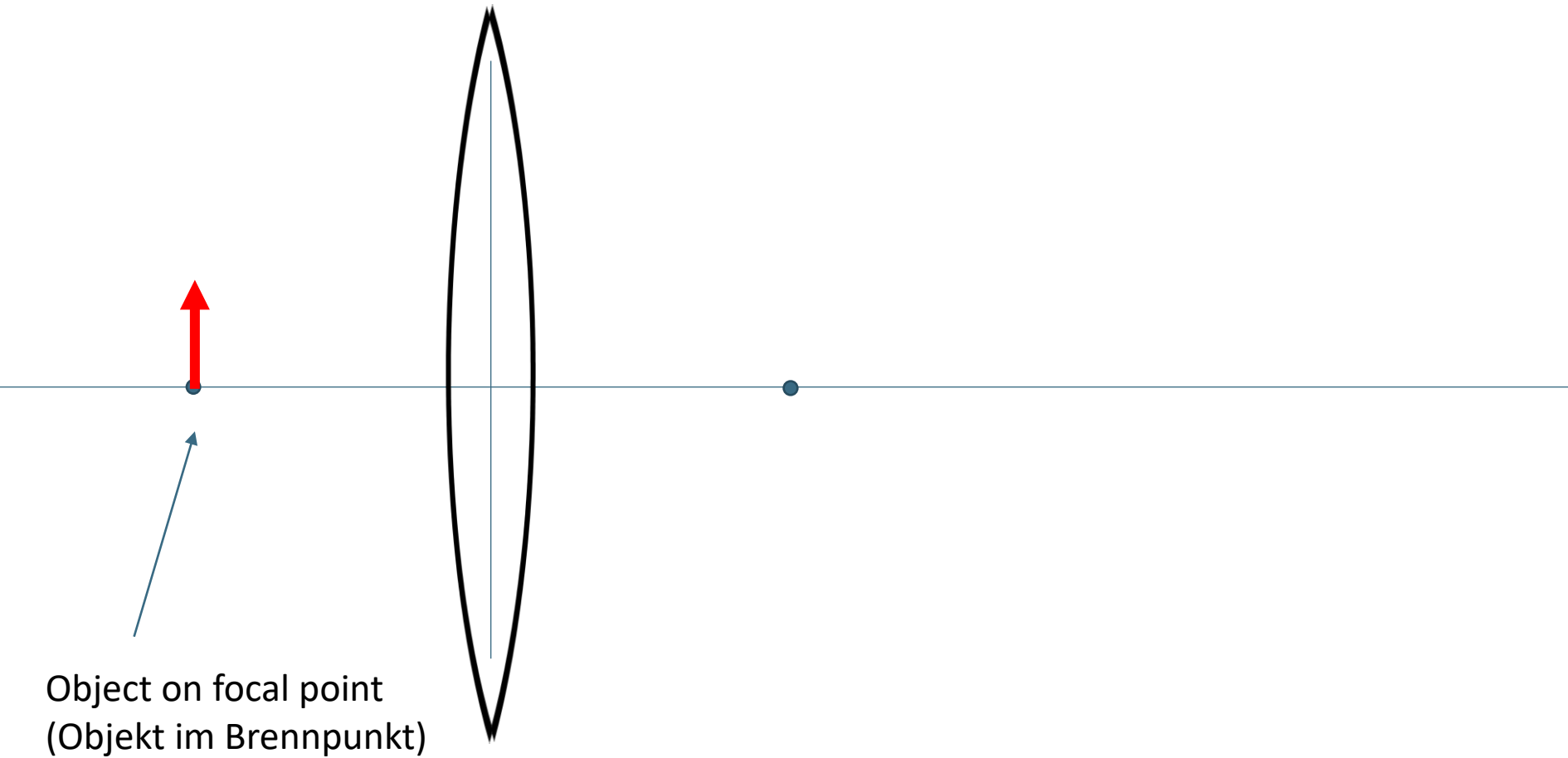
# Plot the image

#2.2



# Plot the image

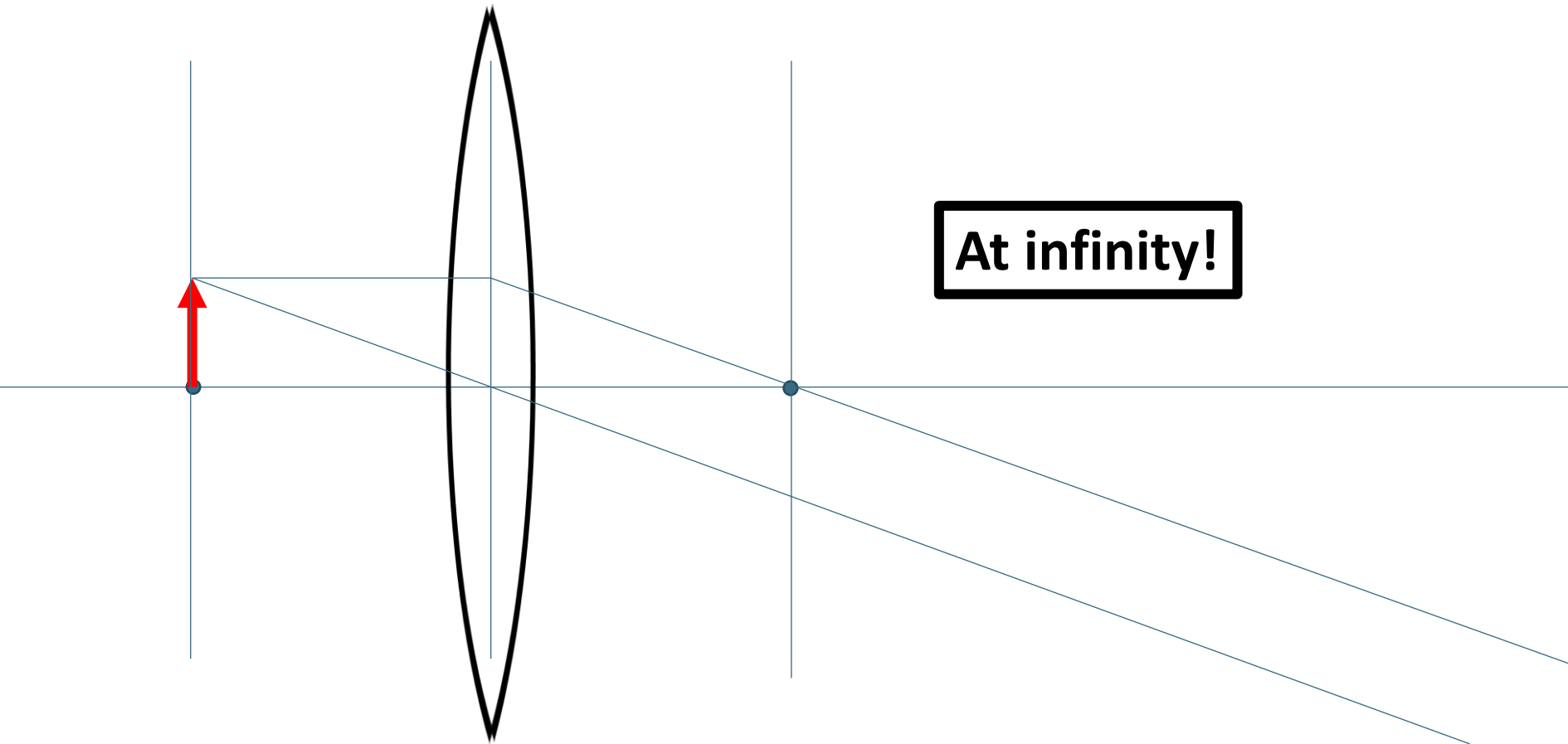
#3





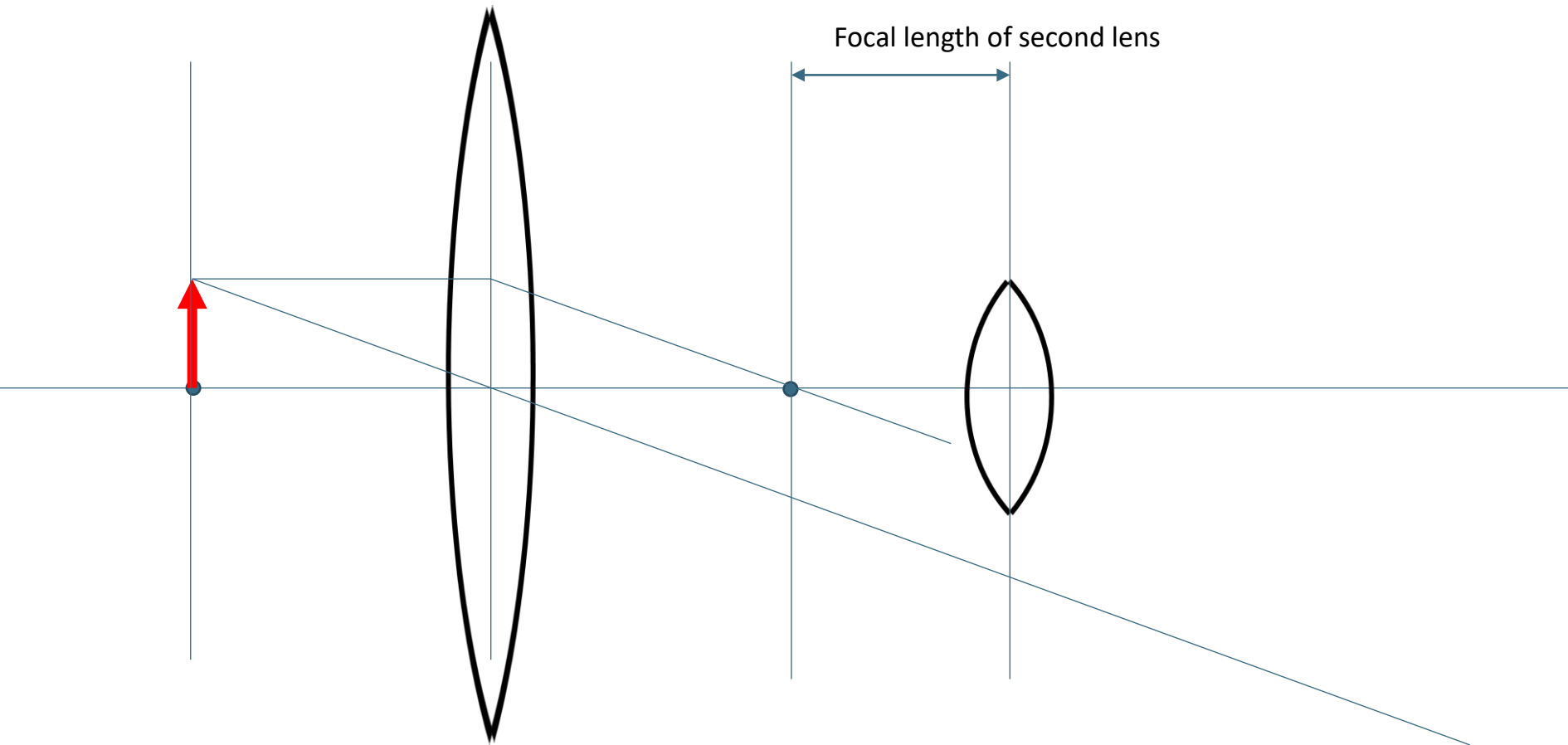
# Plot the image

#3



# Plot the image

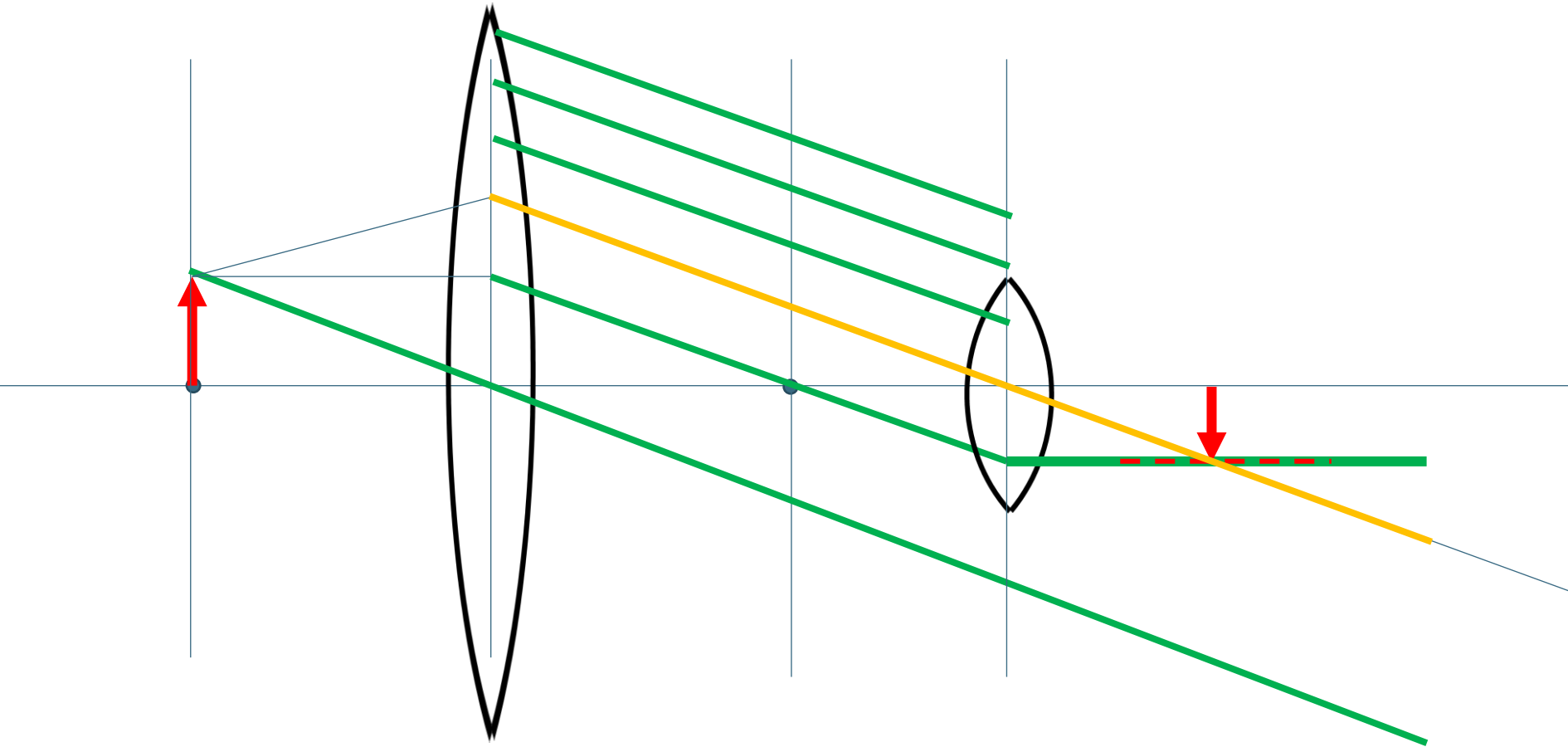
#3



# Plot the image

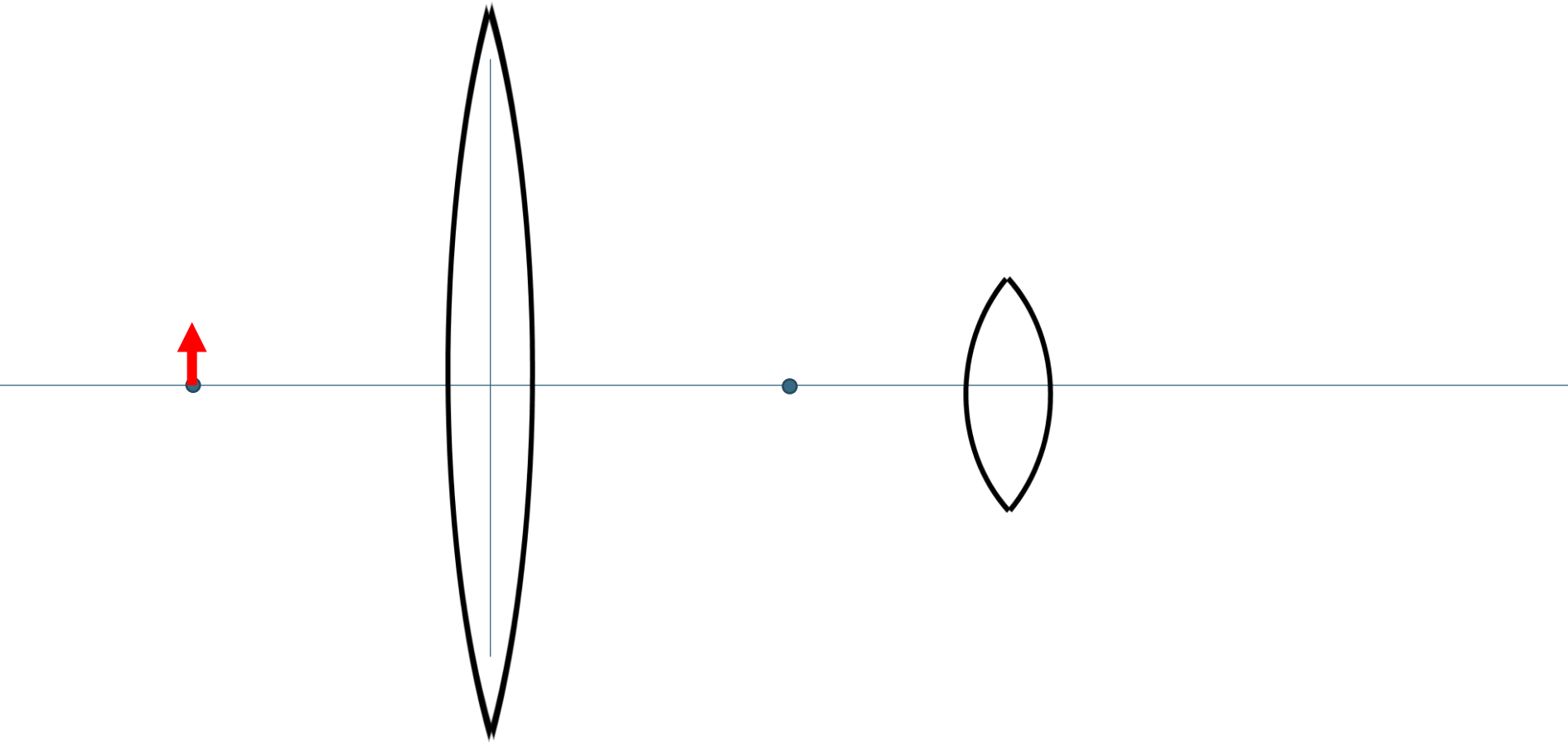
#3

MAKE SURE YOU UNDERSTAND THIS ONE!  
(Achten Sie darauf, dass Sie das wirklich verstehen!)



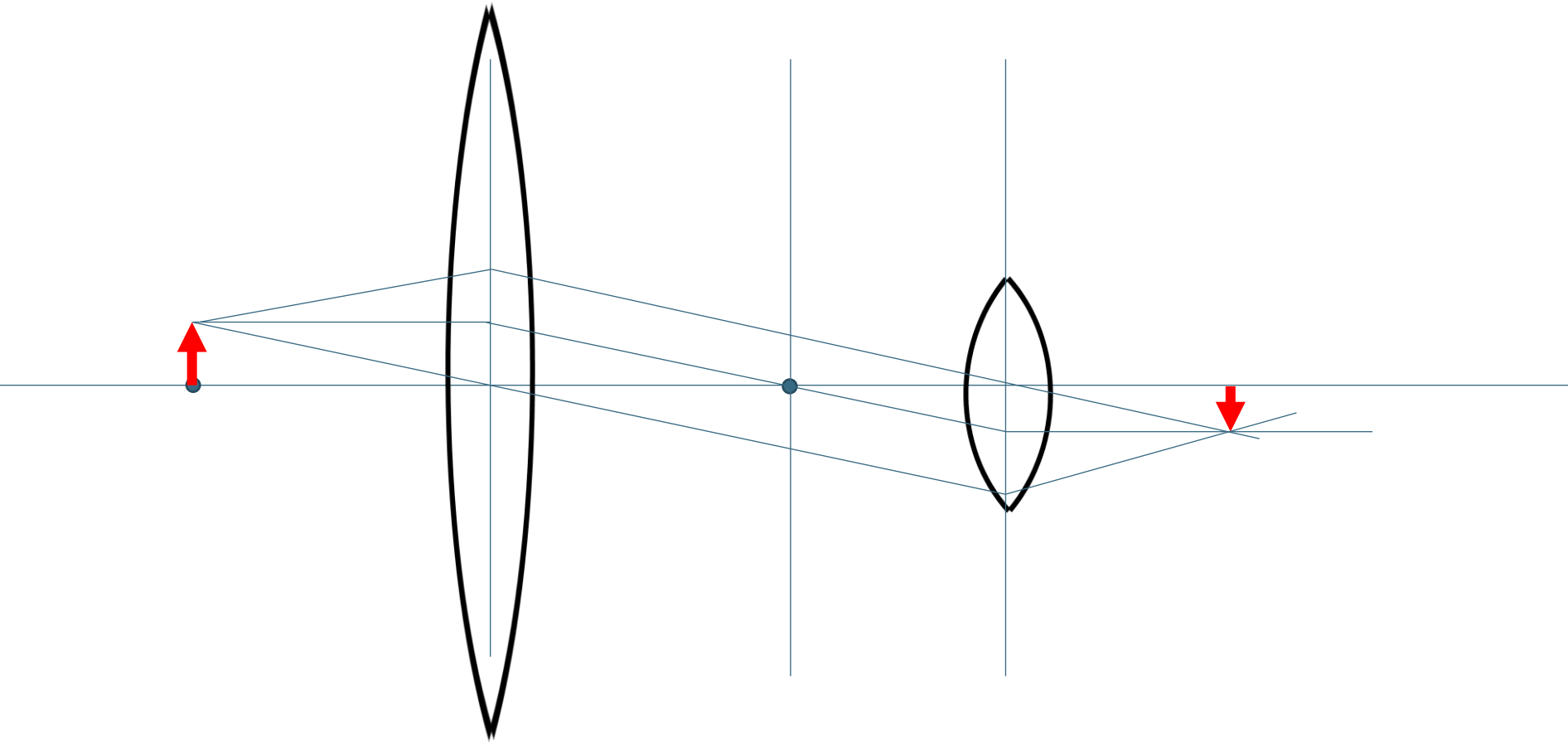
# Plot the image

#3



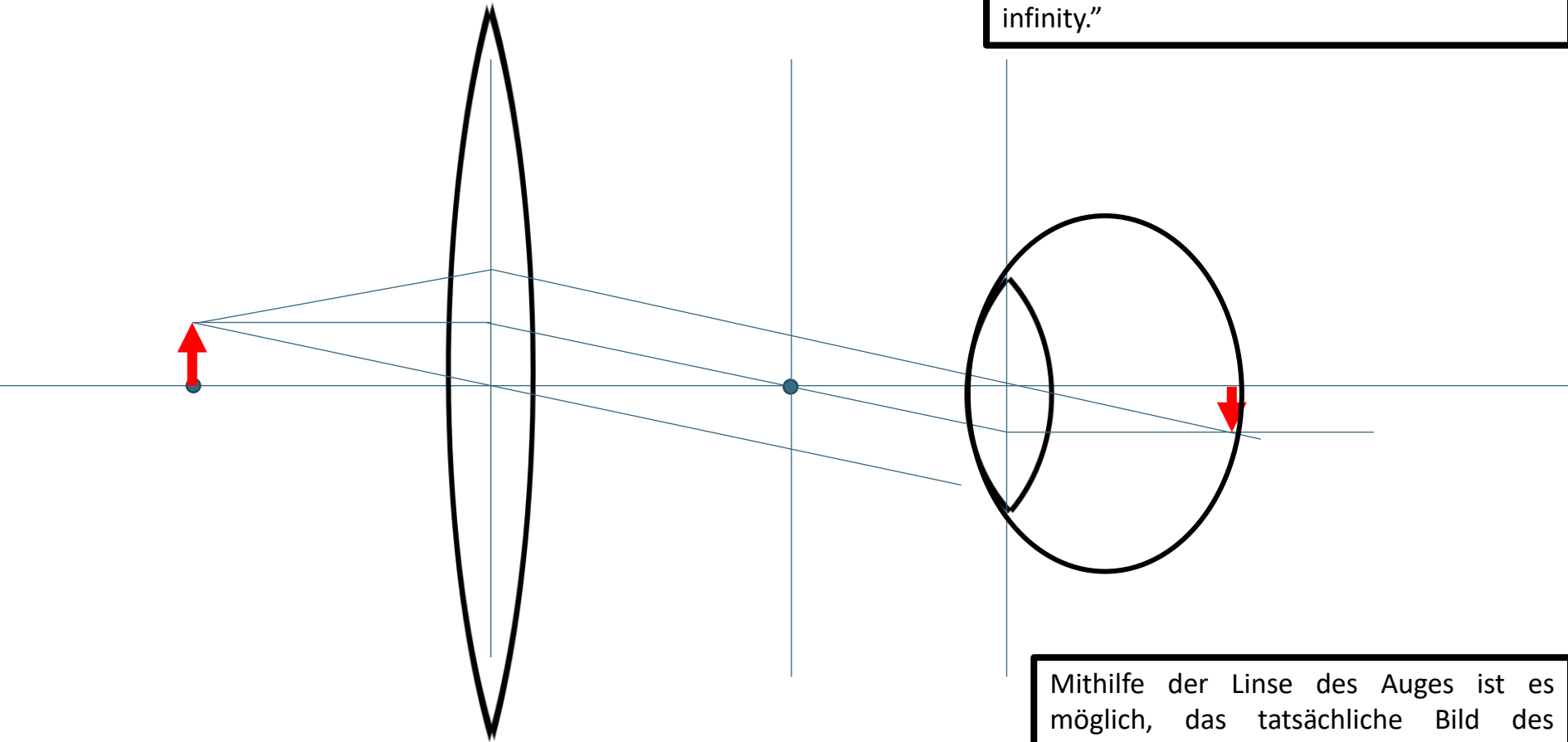
# Plot the image

#3



# Plot the image

#3

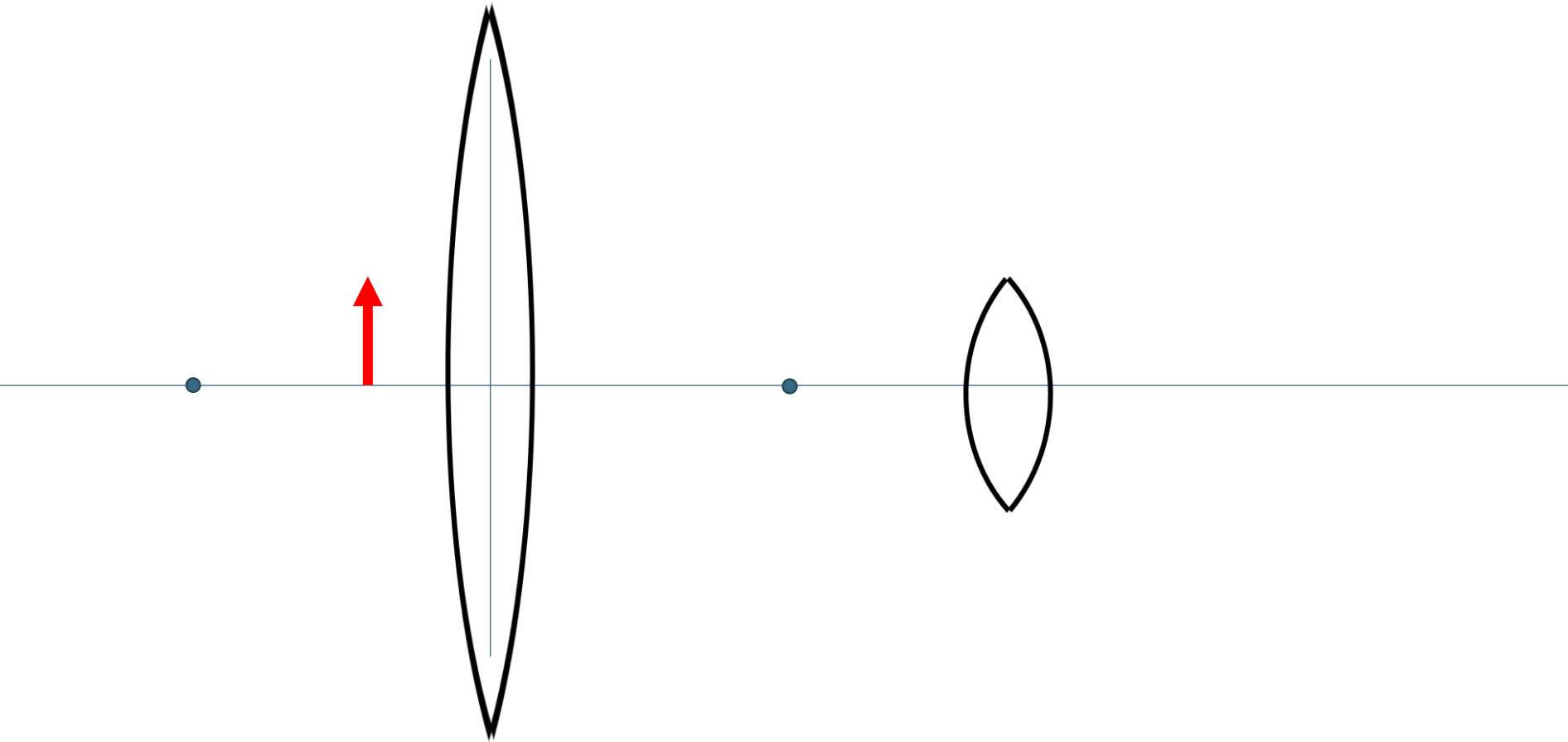


With the help of the eye's lens, it is possible to form (i.e., "see") the actual image of the object that is produced by the lens "at infinity."

Mithilfe der Linse des Auges ist es möglich, das tatsächliche Bild des Objekts, das von der Linse "im Unendlichen" gebildet wird, abzubilden (d.H. „zu sehen“).

# Plot the image

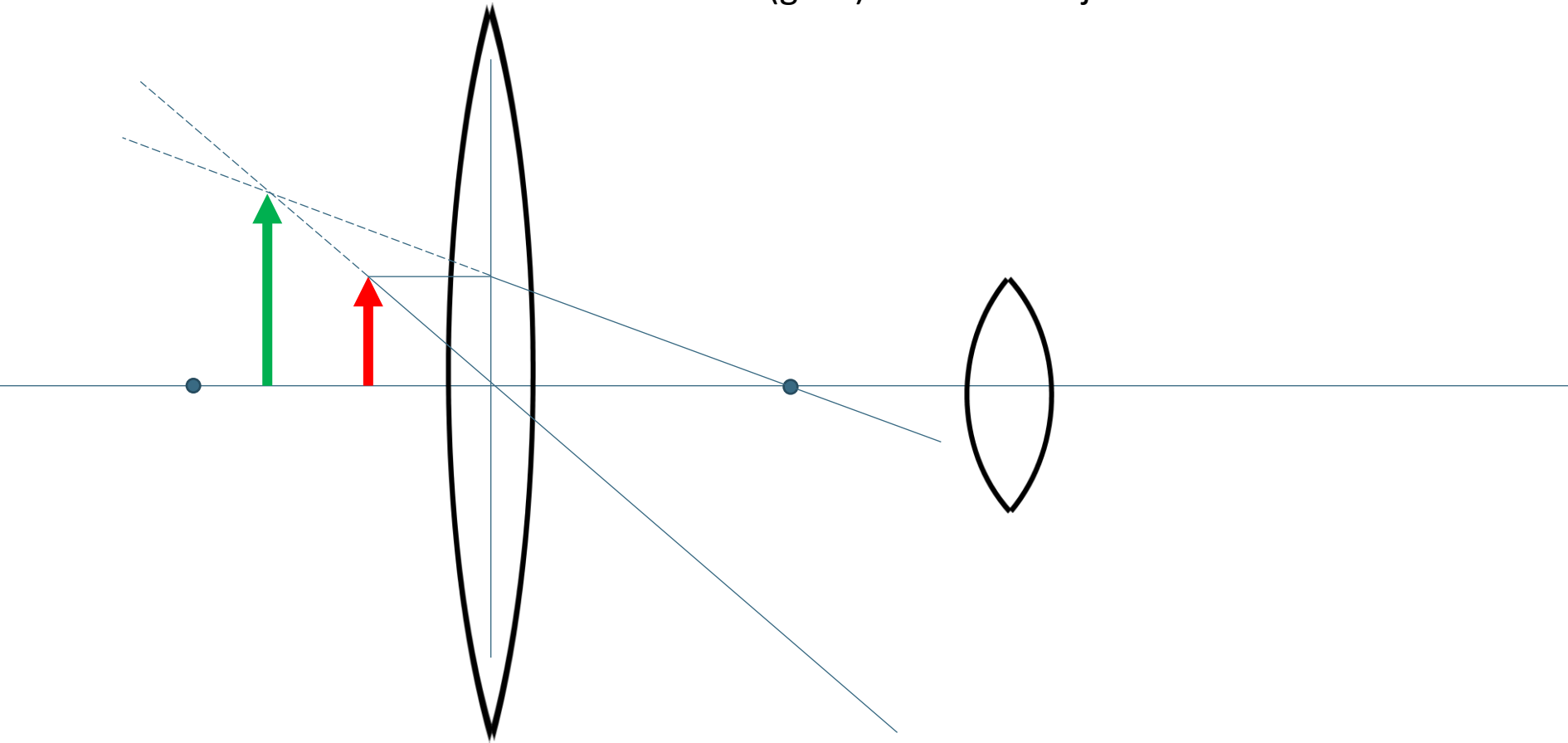
#4



# Plot the image

#4

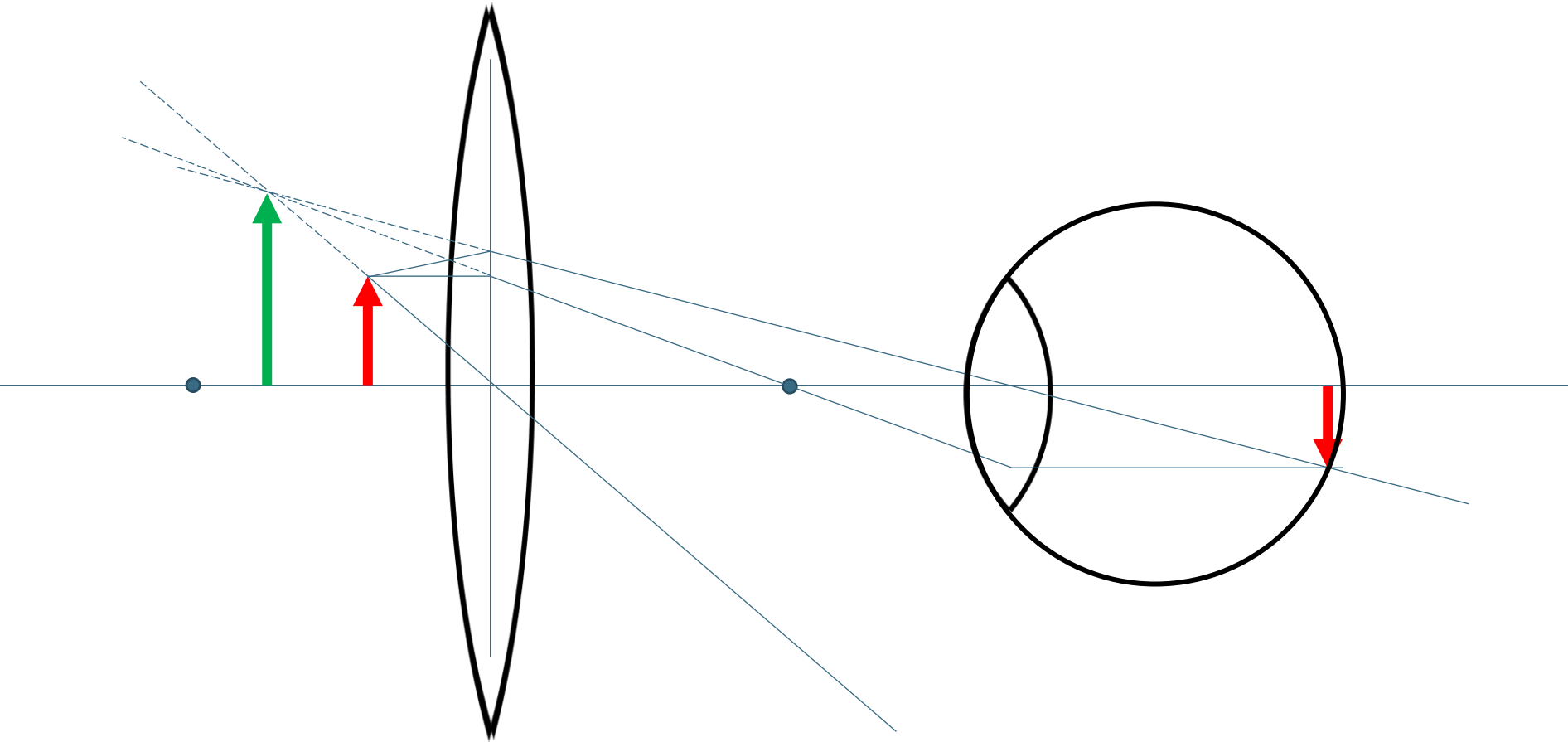
The image (green) becomes the object for the second lens!  
Das Bild (grün) wird zum Objekt für die zweite Linse!



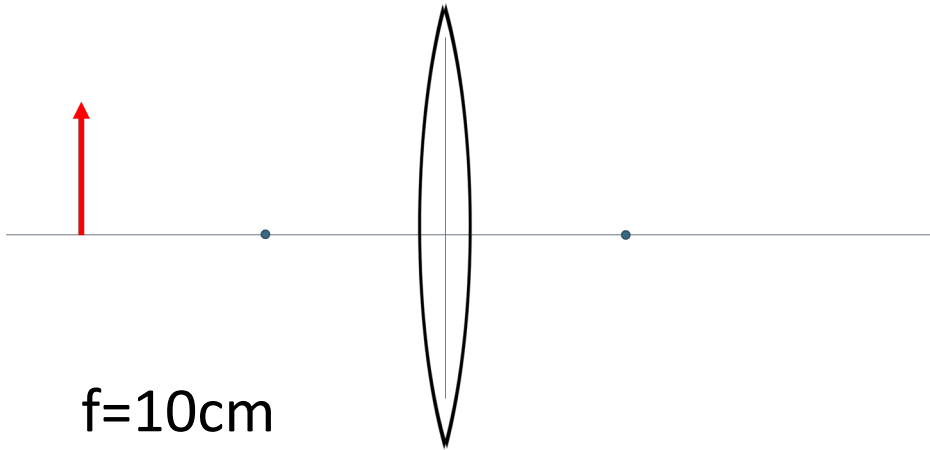


# Plot the image

#4

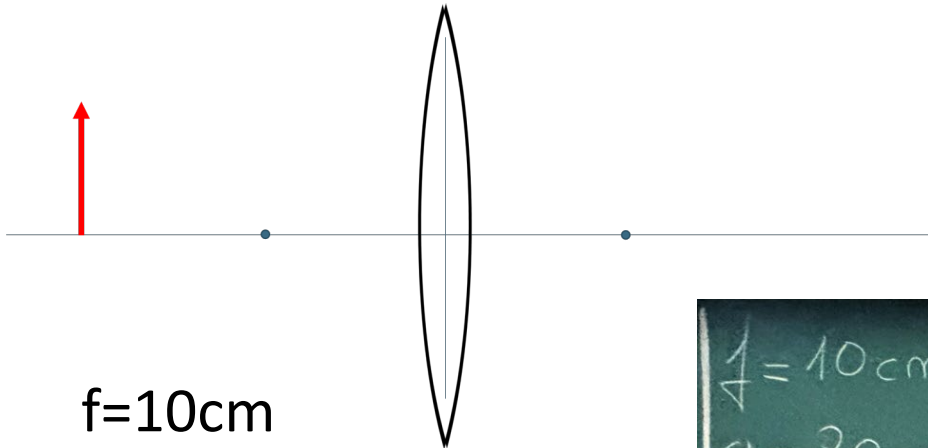


# Compute



$f=10\text{cm}$   
 $a=20\text{cm}$   
 $b?$

# Compute



$f=10\text{cm}$   
 $a=20\text{cm}$   
 $b?$   
 $M?$

Handwritten solution on a chalkboard:

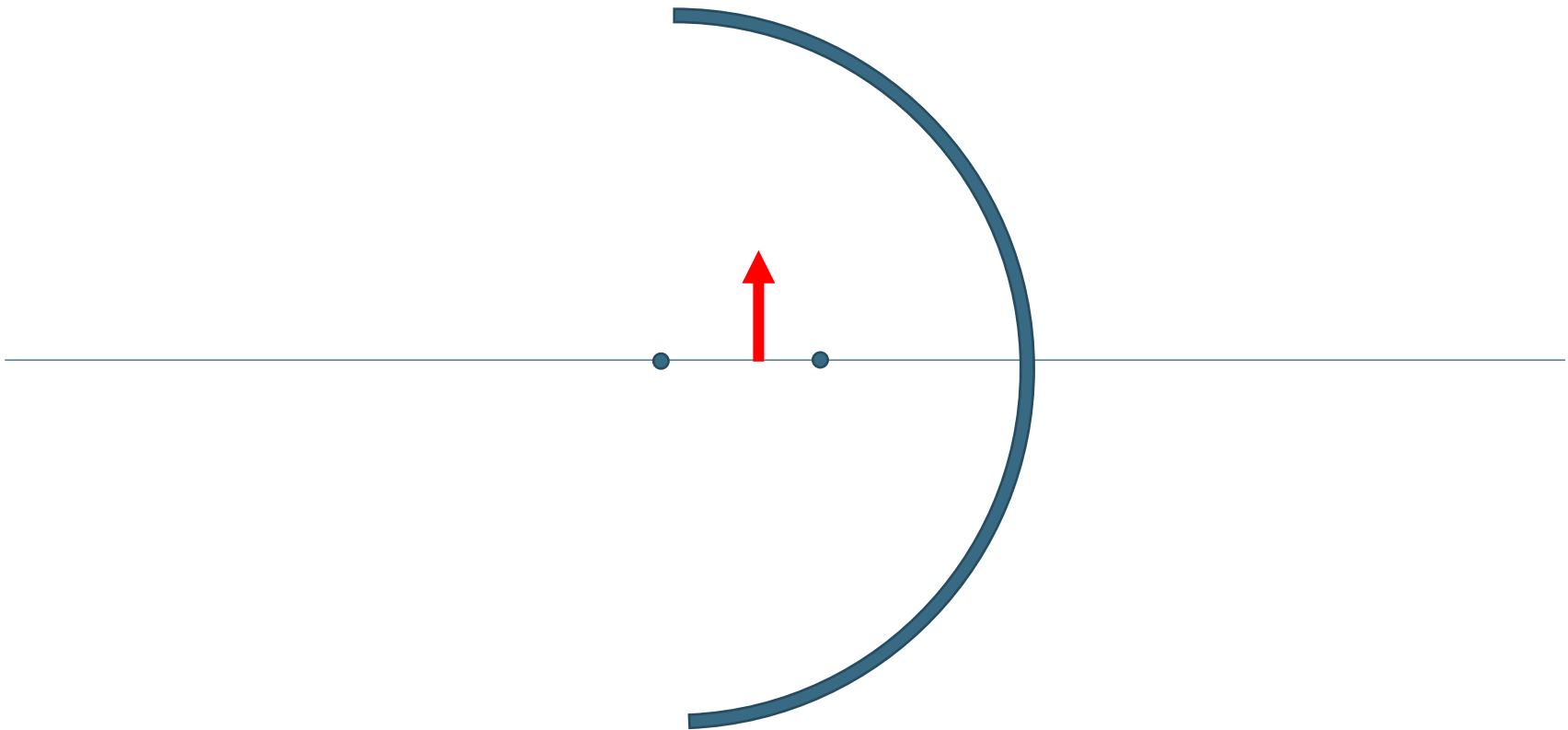
$f = 10\text{cm}$   
 $a = 20\text{cm}$

$\frac{1}{20} + \frac{1}{b} = \frac{1}{10}$   
 $\frac{b+20}{20b} = \frac{1}{10}$   
 $10(b+20) = 20b$   
 $200 = 10b$   
 $\Rightarrow b = 20\text{ cm}$

$M = -1$

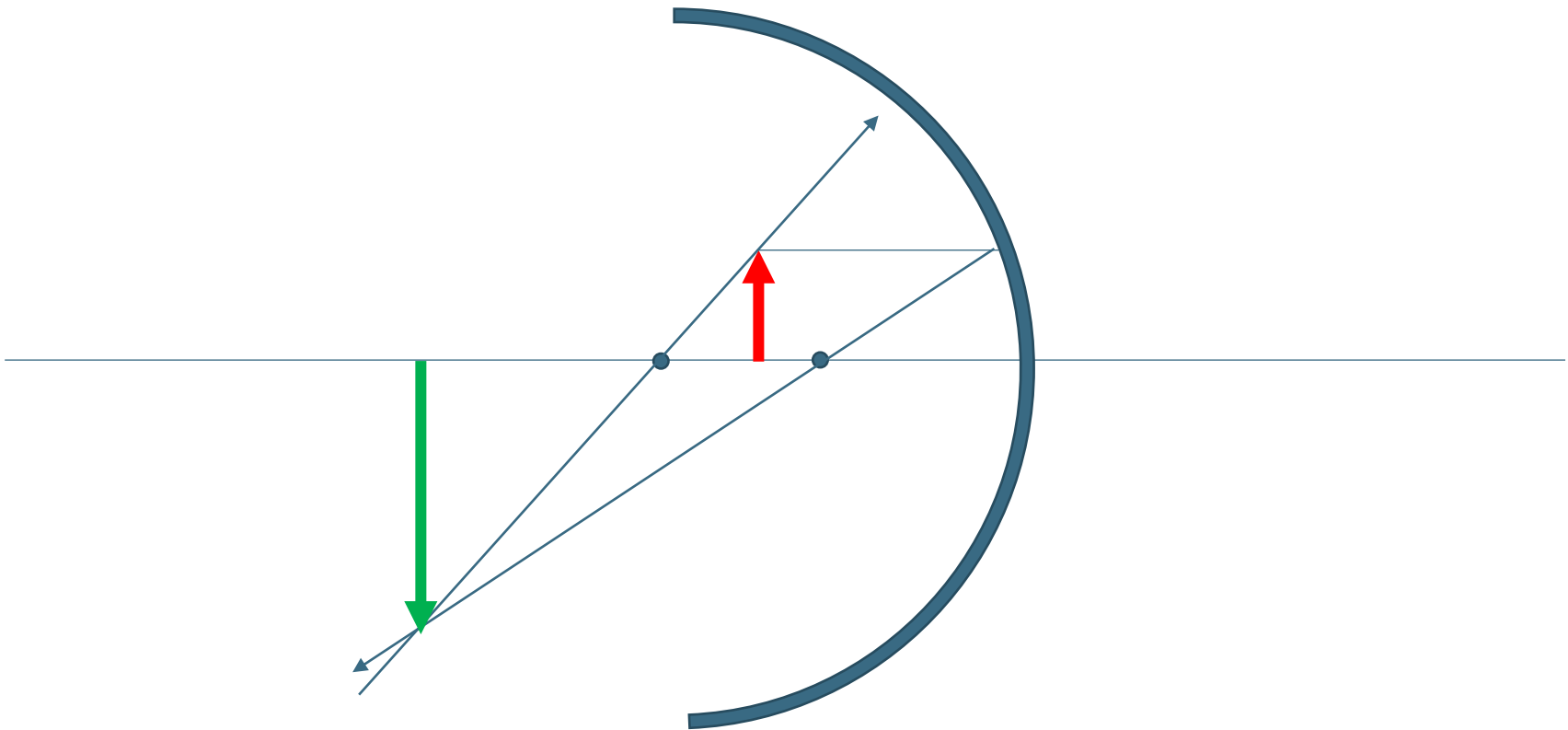
# Plot the image

#5



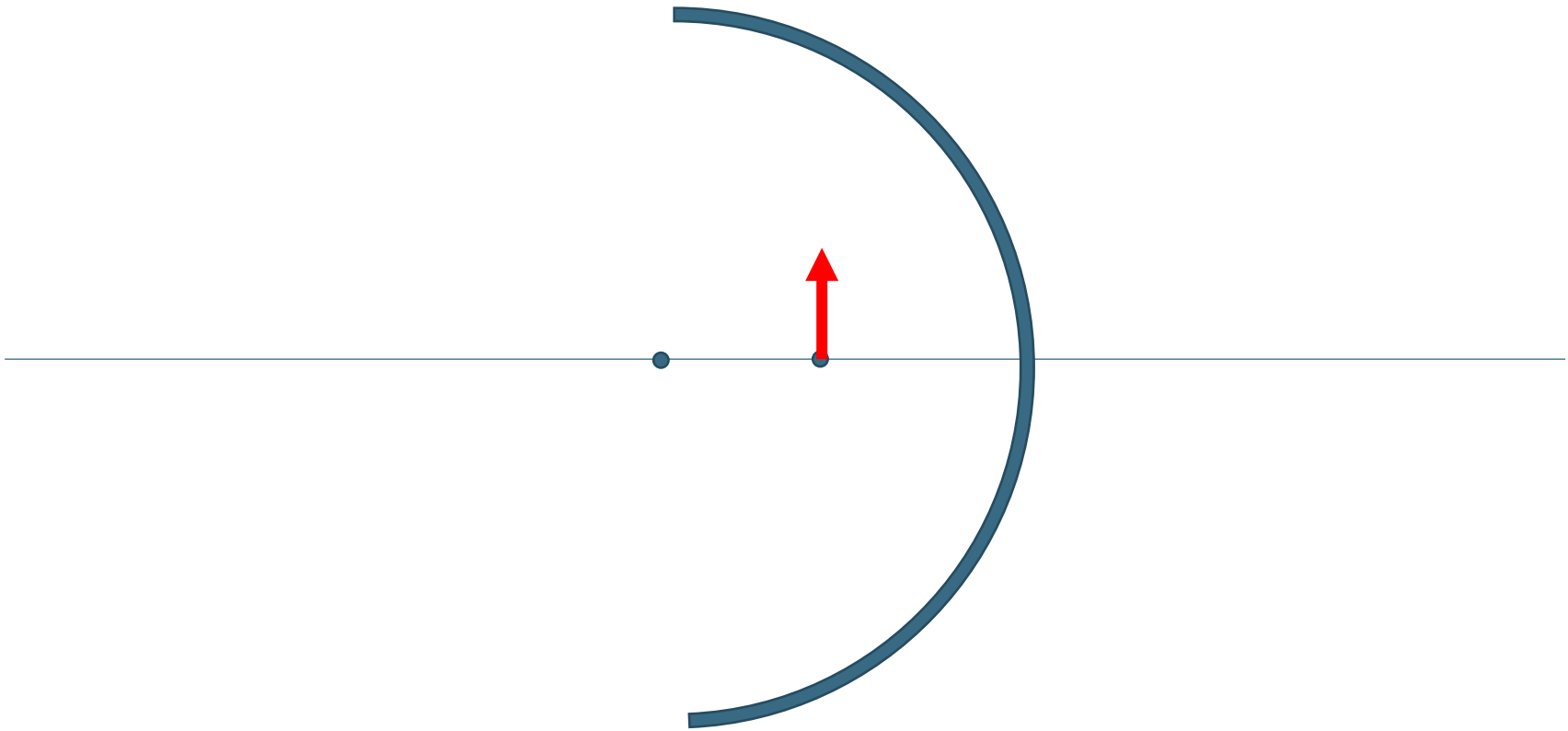
# Plot the image

#5



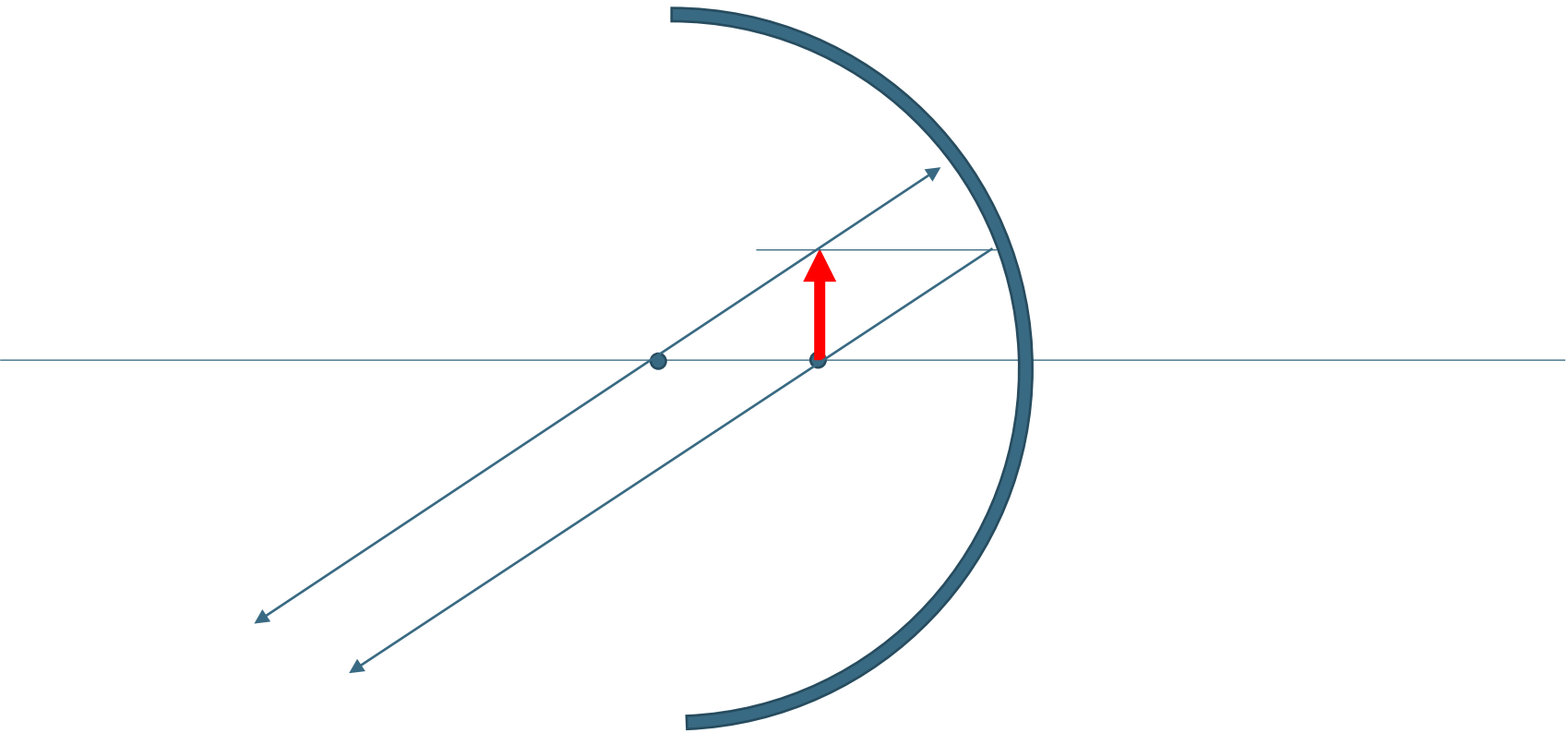
# Plot the image

#6



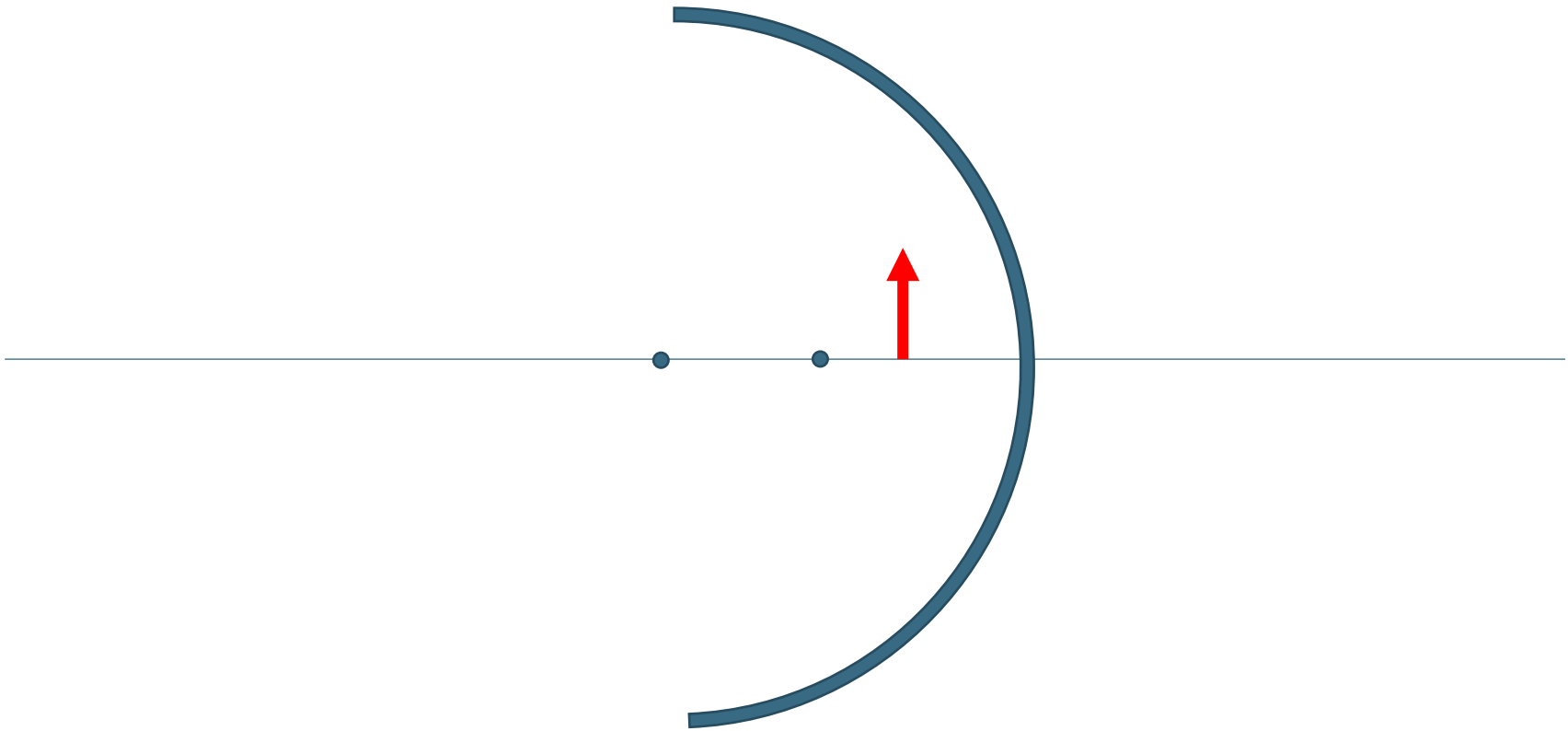
# Plot the image

#6



# Plot the image

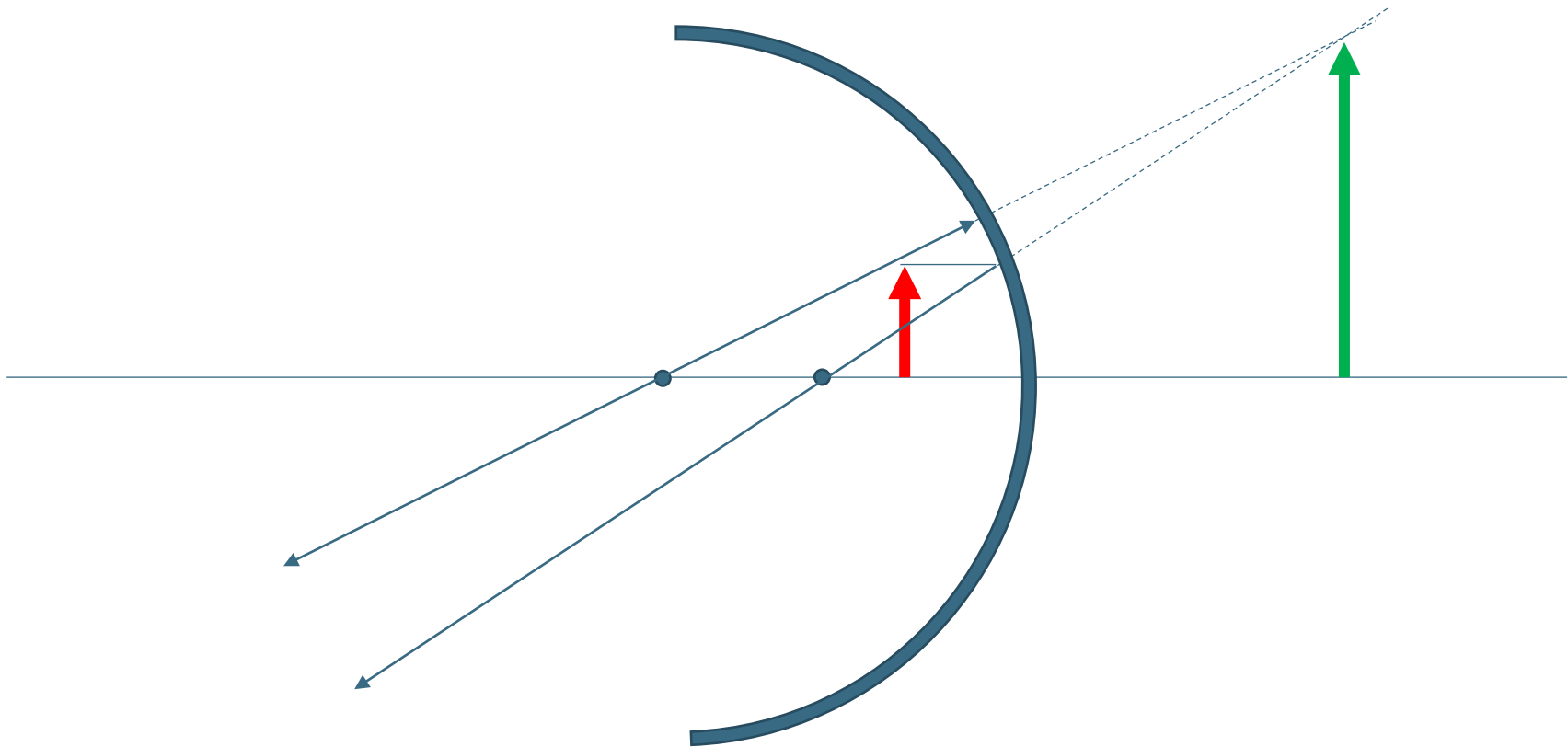
#7





# Plot the image

#7



# Acoustics

The pain threshold is around 140 dB. What pressure (in pascals) does this correspond to?

Die Schmerzgrenze liegt bei etwa 140 dB. Welchem Schalldruck (in Pascal) entspricht das?

# Acoustics

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Die Schmerzgrenze liegt bei etwa 140 dB. Welchem Schalldruck (in Pascal) entspricht das?

$$\begin{aligned}140 &= 20 \cdot \log_{10} \left( \frac{p}{0.00002} \right) \\ \Rightarrow \frac{140}{20} &= \log_{10} \left( \frac{p}{0.00002} \right) \\ \Rightarrow 7 &= \log_{10} \left( \frac{p}{0.00002} \right)\end{aligned}$$

$$\Rightarrow \frac{p}{0.00002} = 10^7$$

$$\Rightarrow p = 0.00002 \times 10^7$$

$$\Rightarrow p = 0.00002 \times 10,000,000 = 200 \text{ Pa}$$

# Acoustics

(2 points)

A powerful lightning strike occurs during a thunderstorm, at a distance of about 3 km. The sound will be heard after:

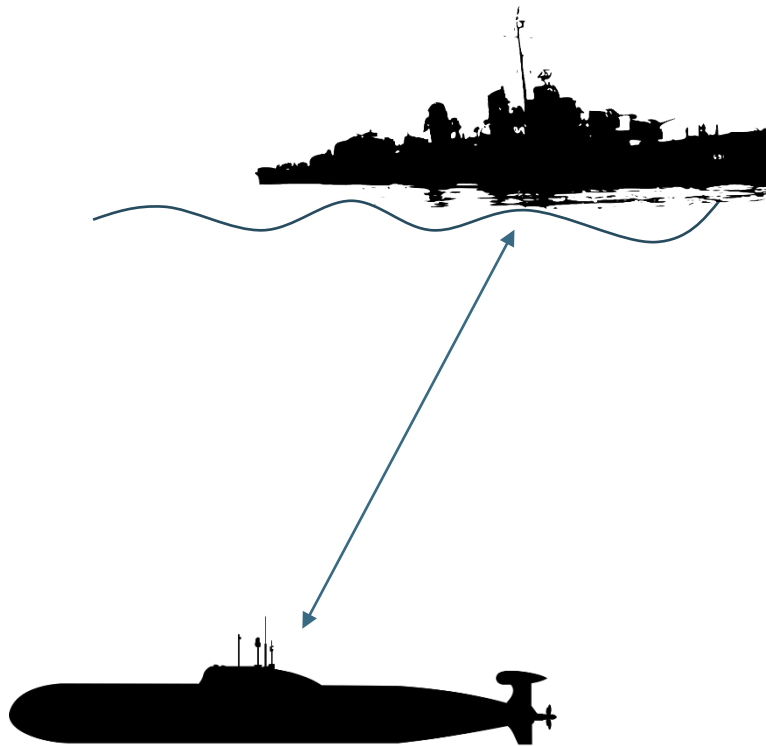
- ☐ 3 s
- ☐ 6 s
- ☐ 9 s
- ☐ 12 s

(1 point)

Ultrasound sound waves have frequencies above:

- ☐ 12 kHz
- ☐ 18 kHz
- ☐ 1 MHz
- ☐ 1800 Hz

# Acoustics



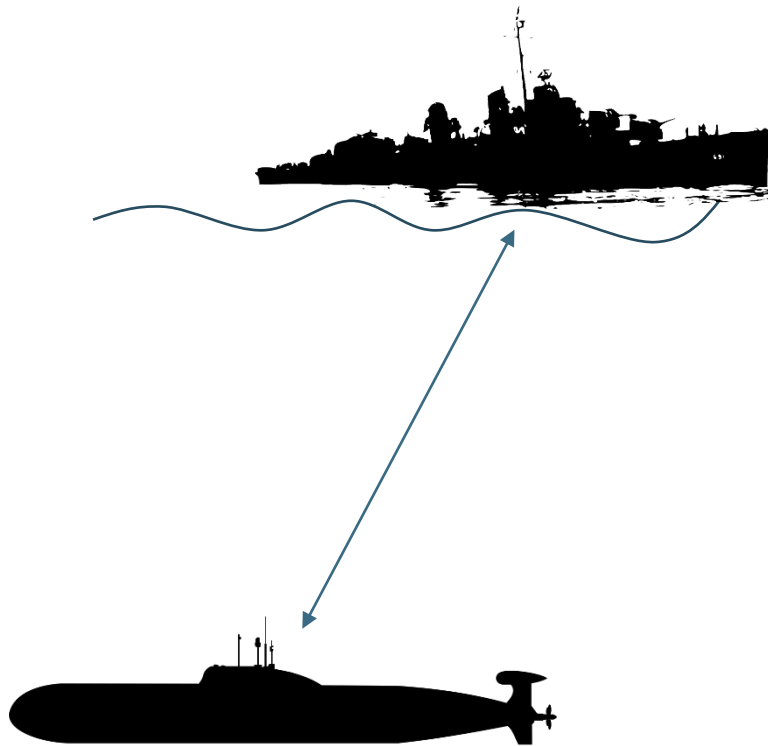
Das Sonar sendet einen ‚Ping‘ aus.  
Ein Echo wird 2 Sekunden später  
empfangen.

Wie weit entfernt befindet sich  
das U-Boot?

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das U-Boot?

# Acoustics



Time for echo to return:  $t = 2 \text{ s}$

Speed of sound in water:  $v \approx 1500 \text{ m/s}$

$$d = \frac{1500 \times 2}{2} = \frac{3000}{2} = 1500 \text{ m}$$