

MEETKUNDIGE INFINITESIMAALREKENING IN DE 17E EEUW

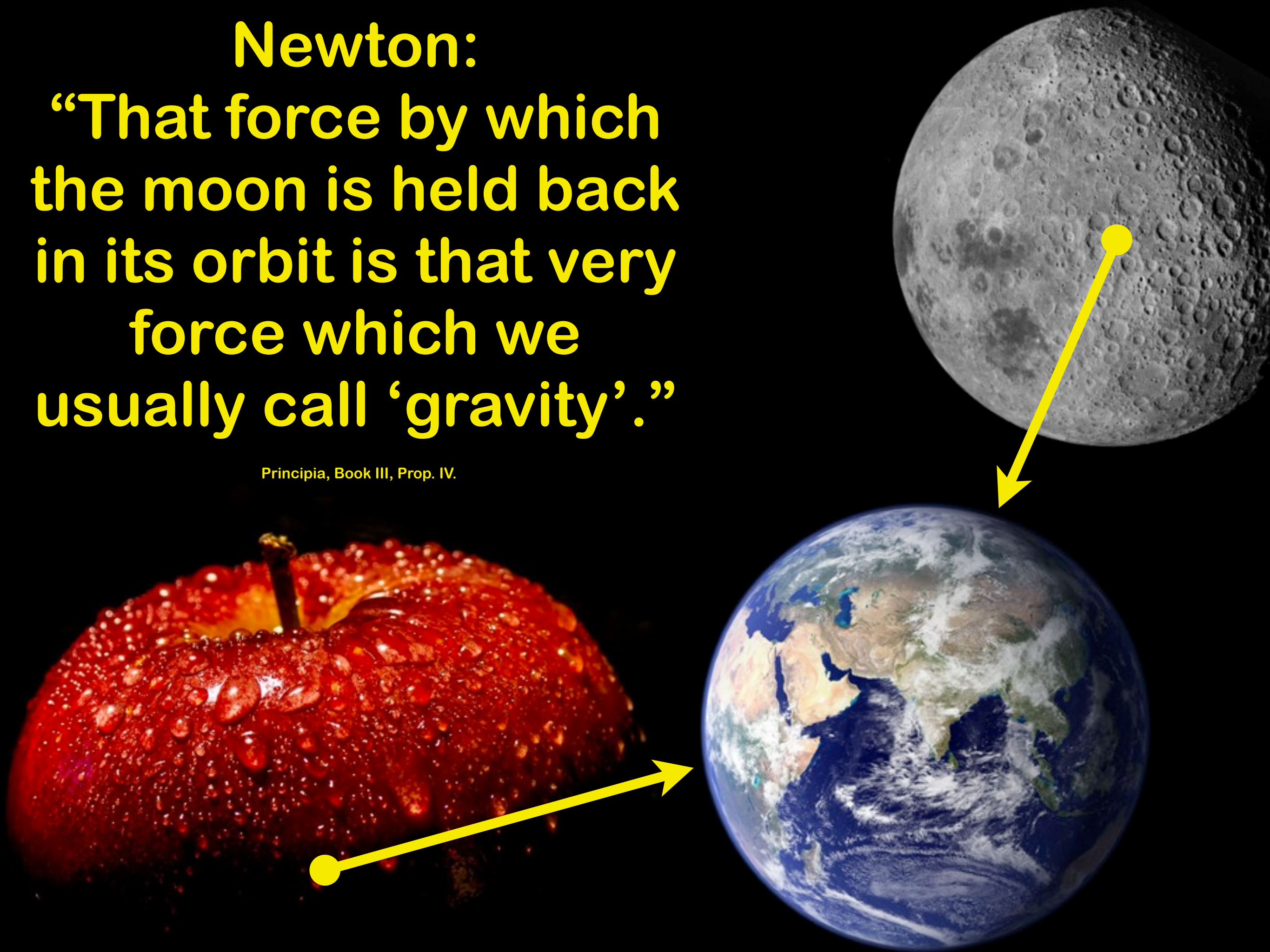
VIKTOR BLÅSJÖ
Universiteit Utrecht



Newton:

**“That force by which
the moon is held back
in its orbit is that very
force which we
usually call ‘gravity’.”**

Principia, Book III, Prop. IV.



“If the moon be supposed to be deprived of all motion and dropped, so as to descend towards the earth.”

Principia, Book III, Prop. IV.



1 sec.

1022 m



?

$t = 2.36 \times 10^6 \text{ s}$
 $s = 2.41 \times 10^9 \text{ m}$



1 sec.

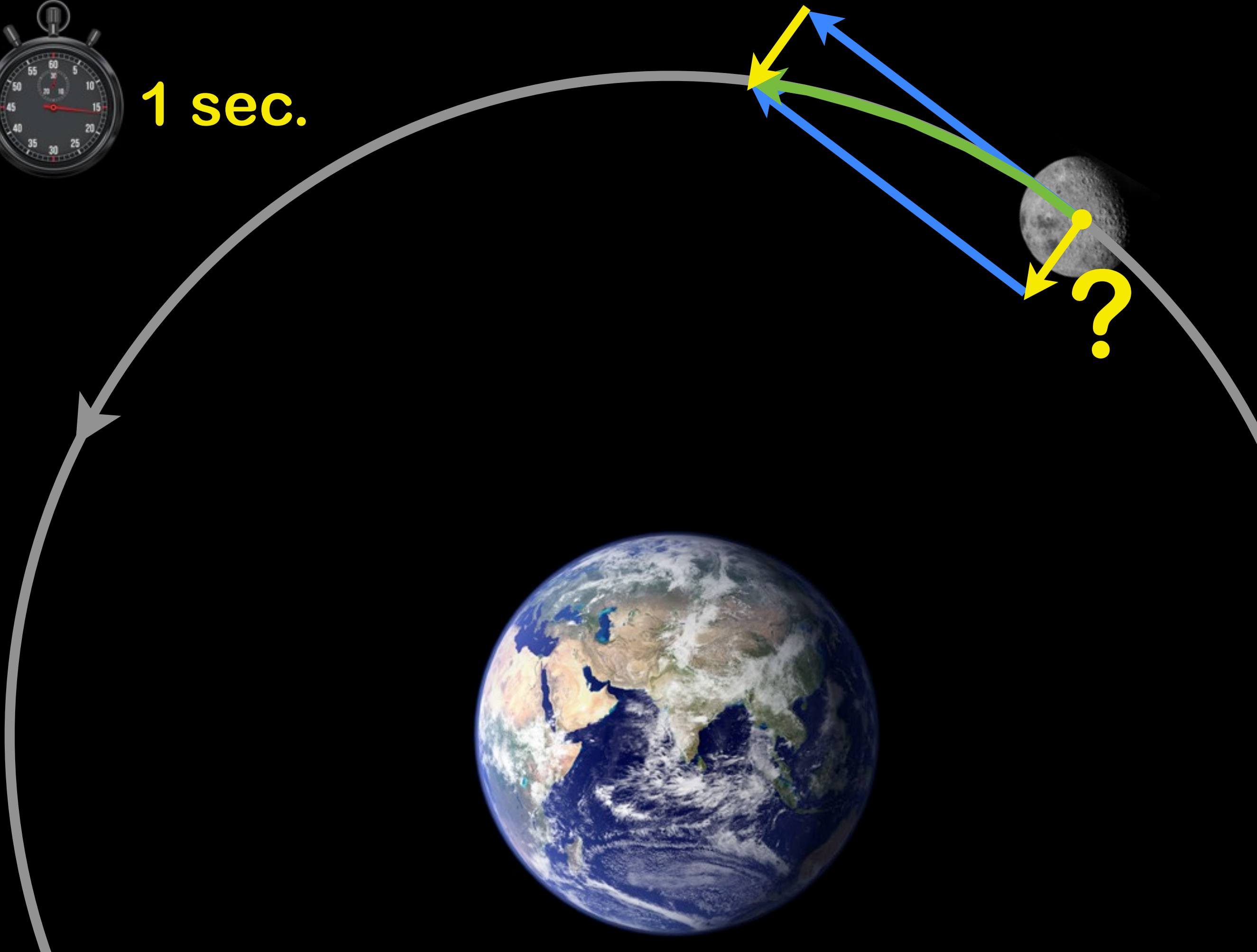




1 sec.

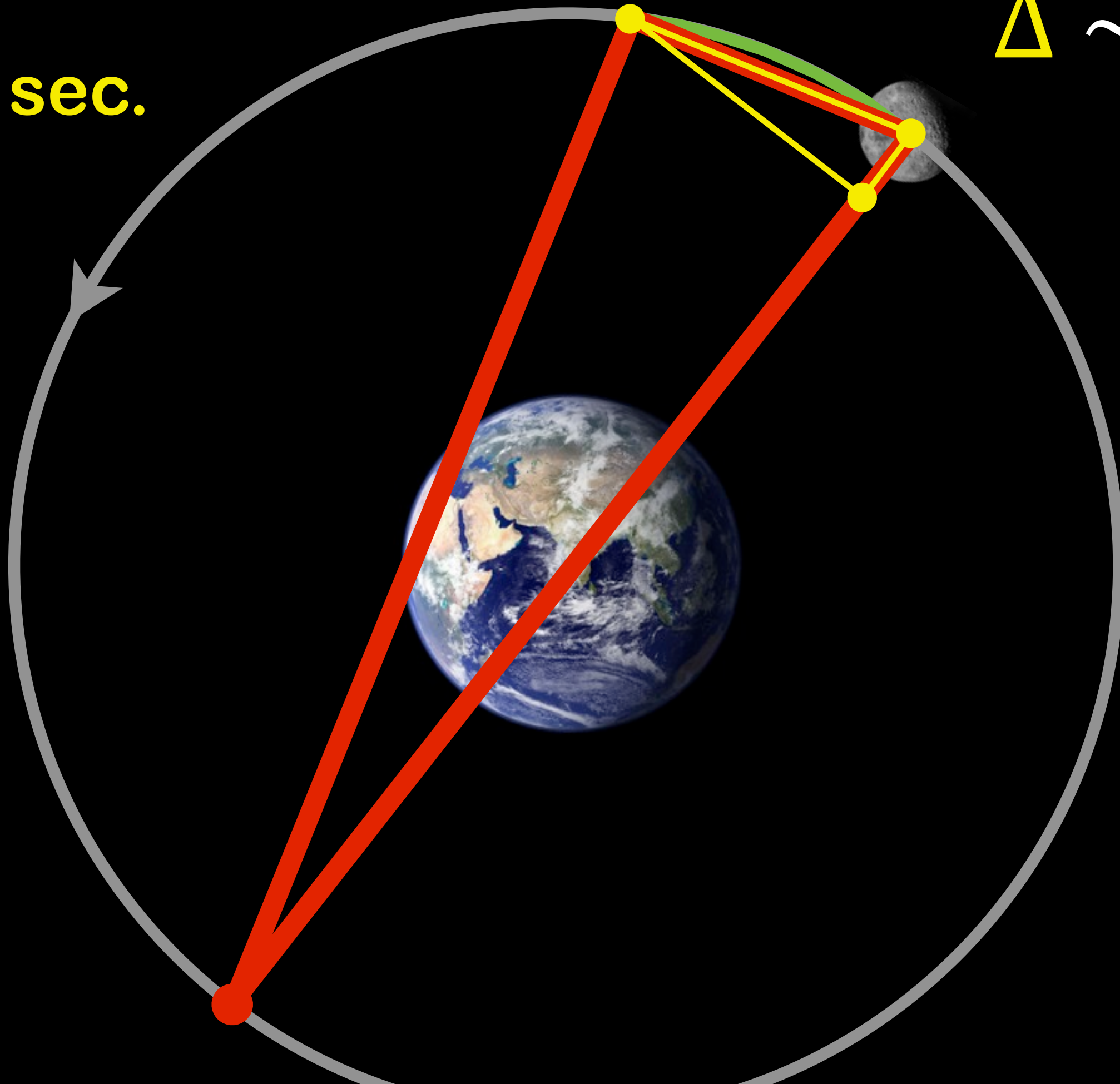


?



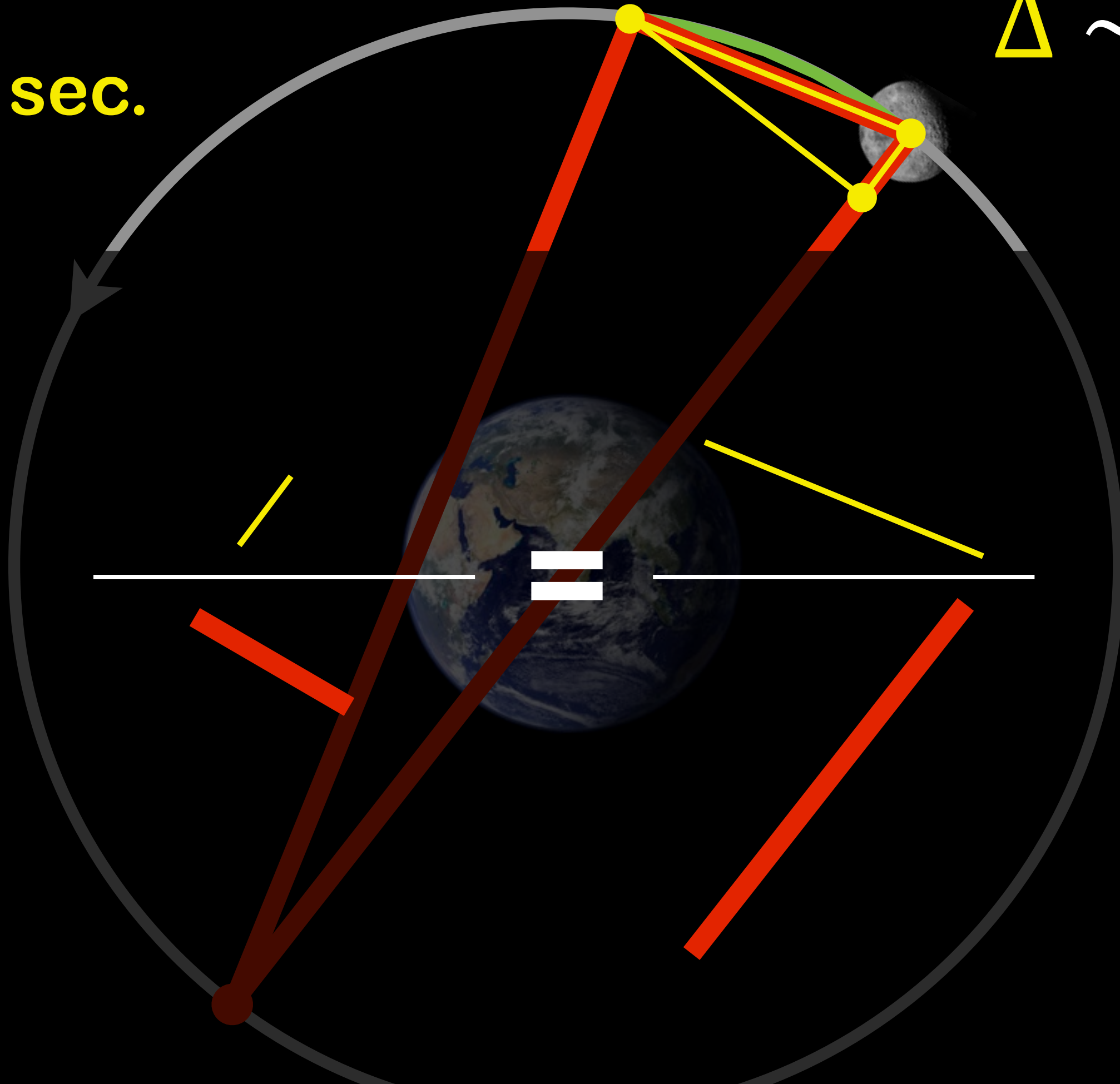


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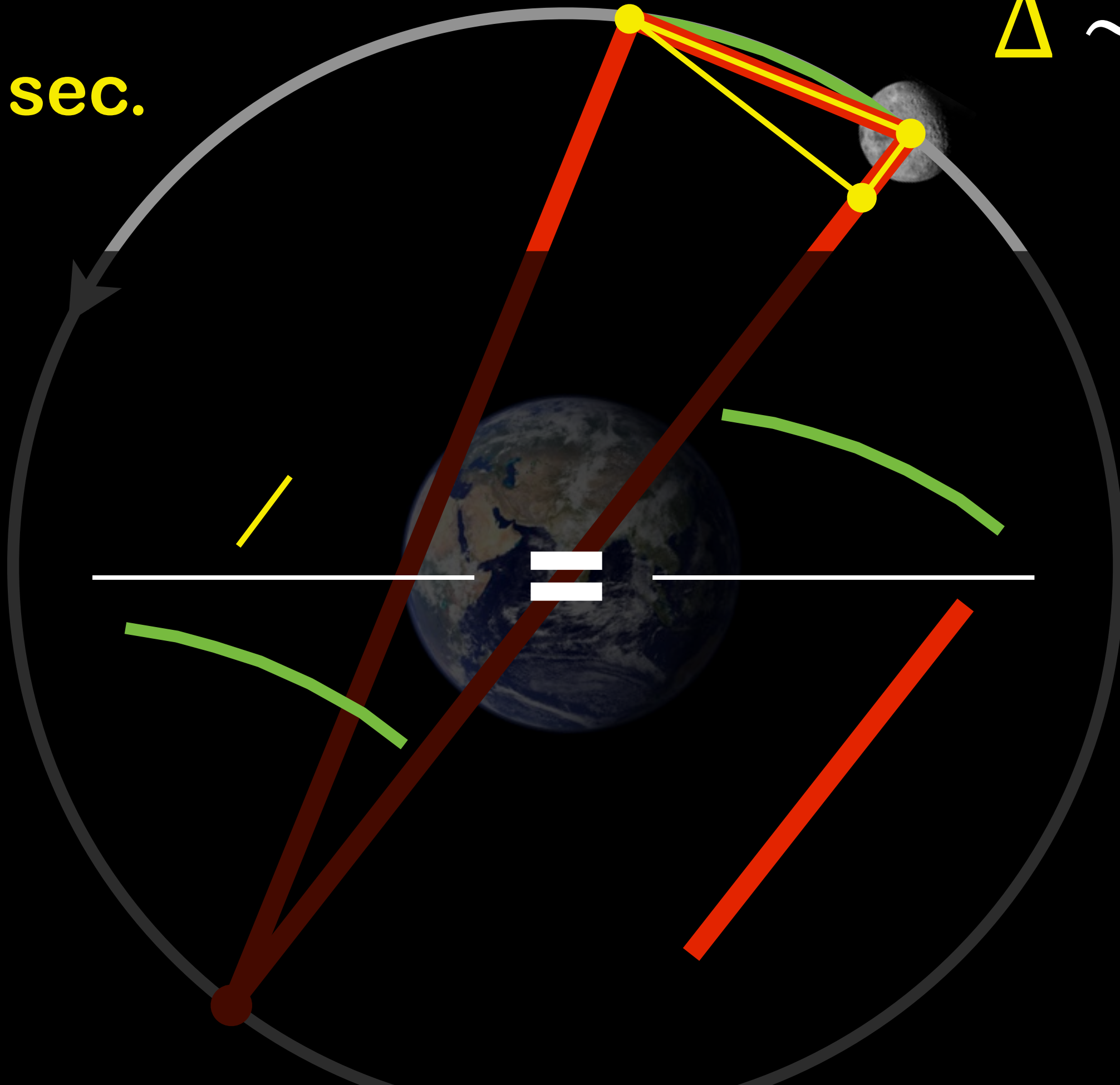


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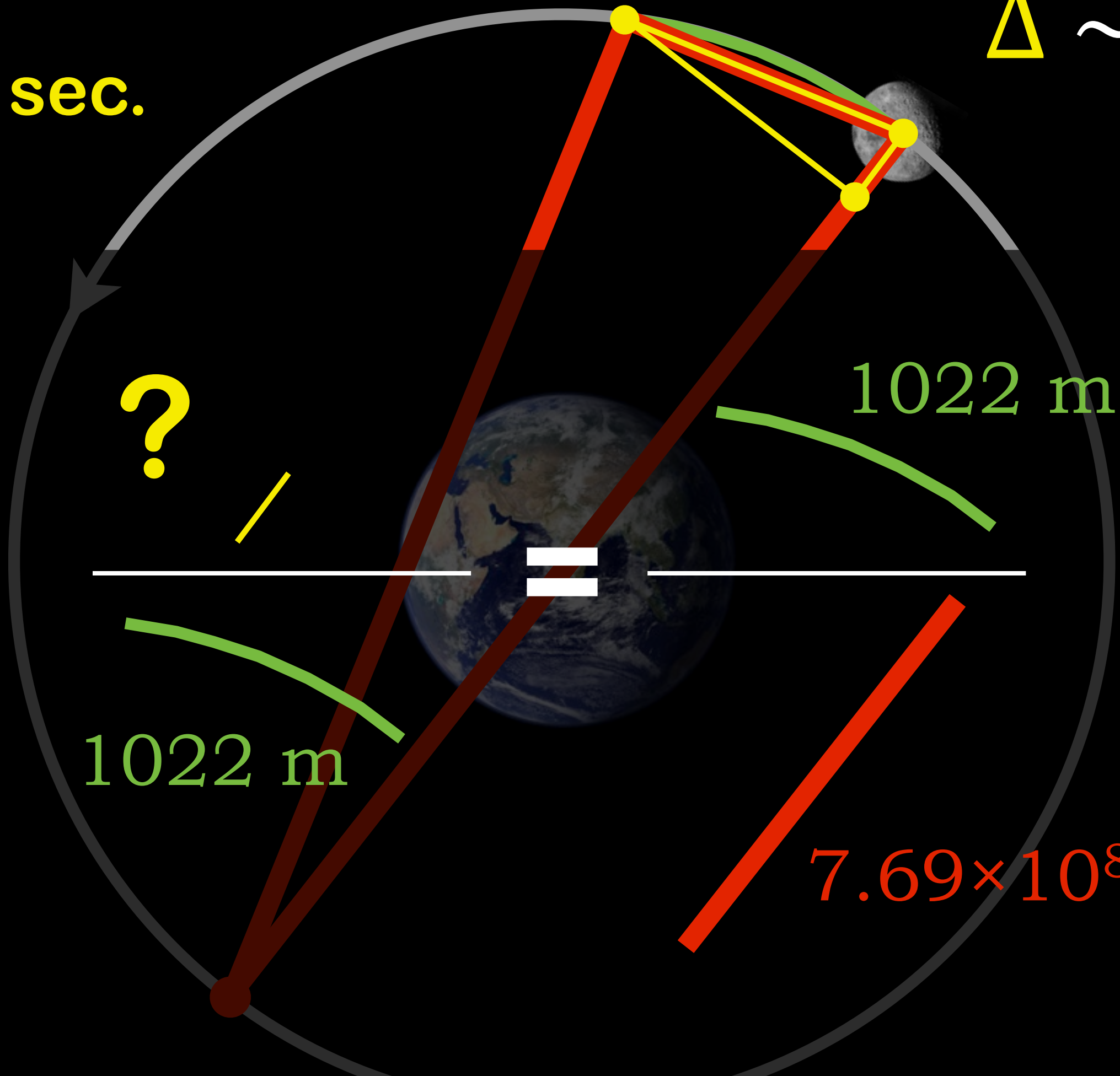
1 sec.





1 sec.

$\Delta \sim \Delta$



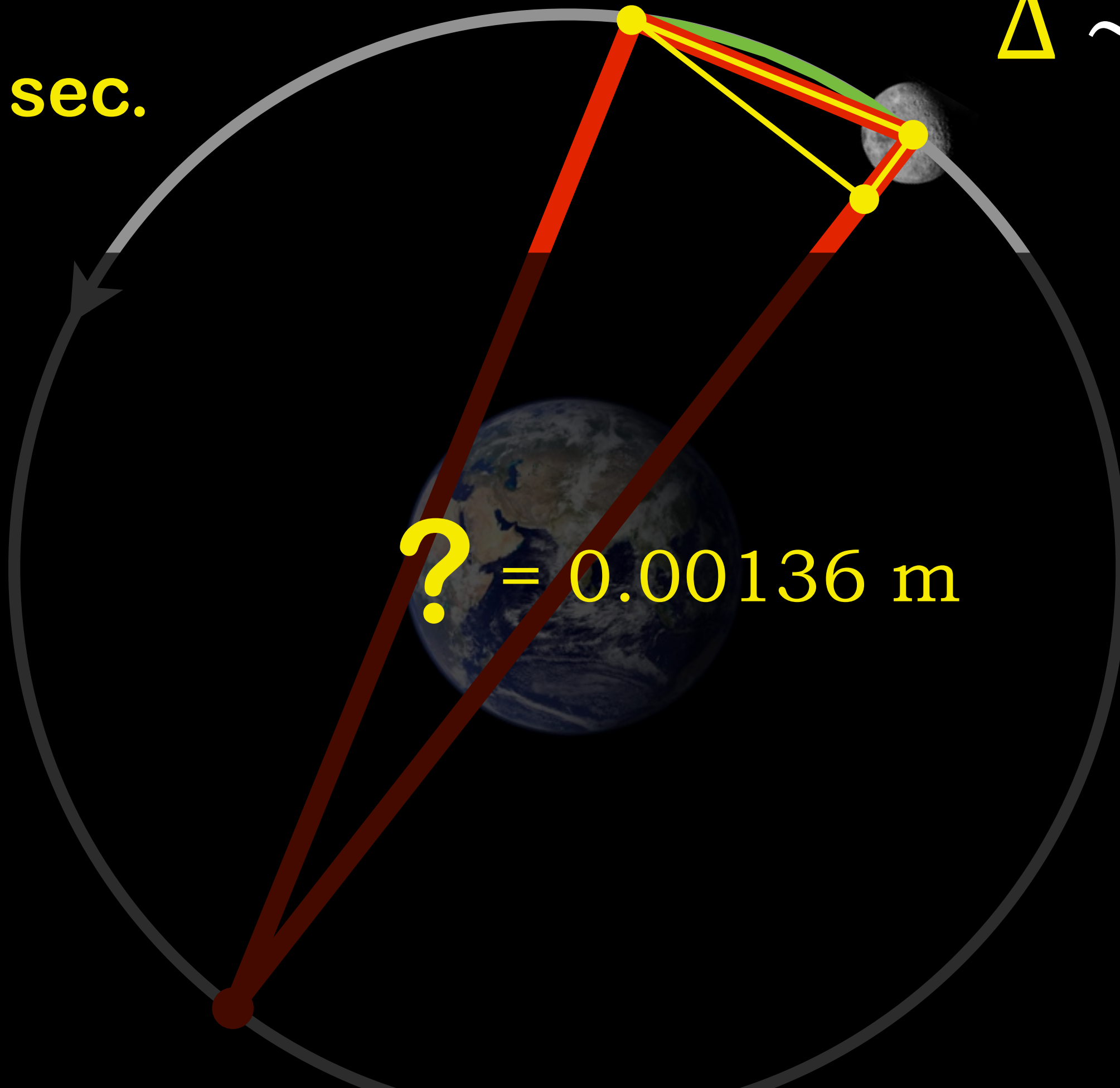
1022 m

1022 m

$7.69 \times 10^8 \text{ m}$



1 sec.



? = 0.00136 m



1 sec.



0.00136 m





1 sec.



0.00136 m

$60 \times R$



R





1 sec.

0.00136 m

0.00136×60^2
 $= 4.8909 \text{ m}$

$60 \times R$

R



1 sec.



?



1 sec.



$$a = 9.8 \text{ m/s}^2$$

$$v = 9.8t \text{ m/s}$$

$$s = 9.8t^2/2 \\ = 4.9 \text{ m}$$





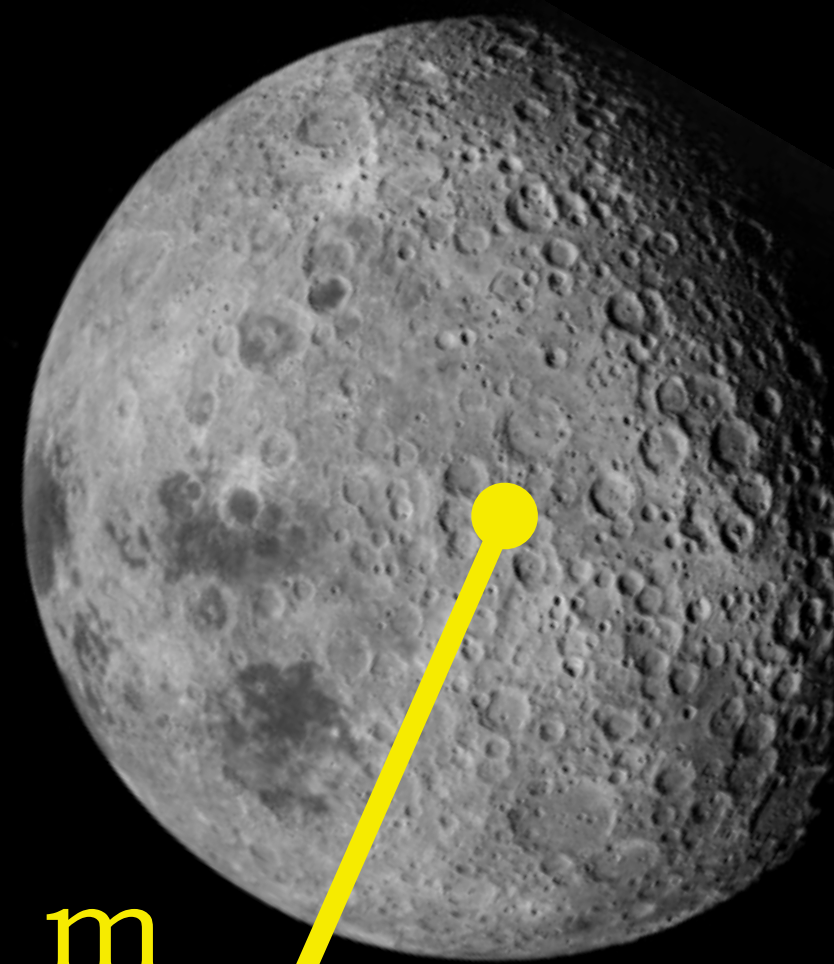
1 sec.

“Since both these forces are equal between themselves, they will have one and the same cause.”

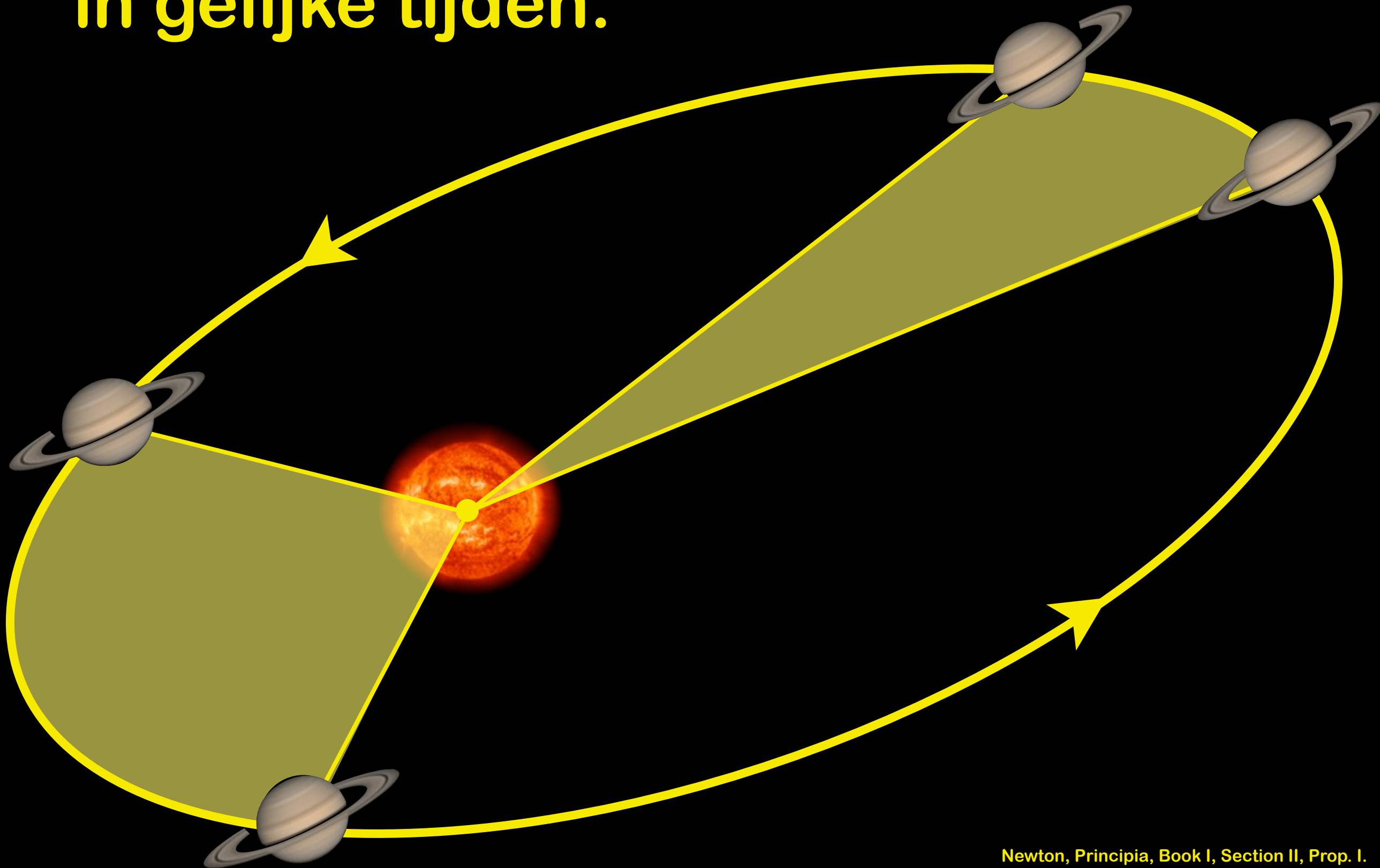
Principia, Book III, Prop. IV.

4.9 m

4.89 m

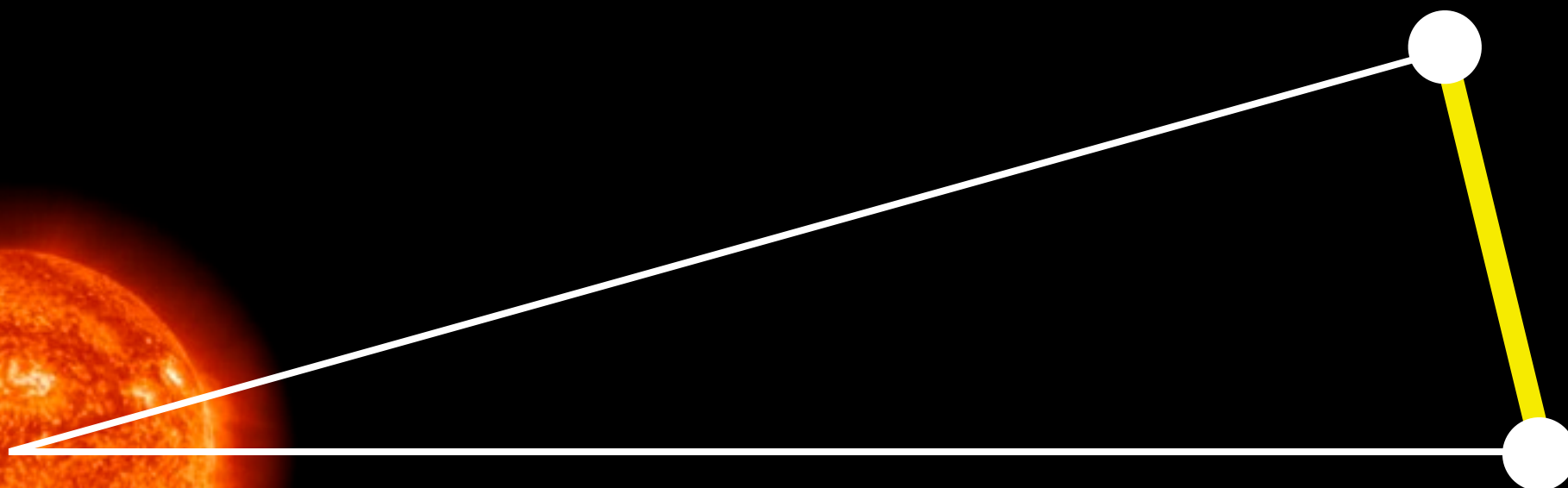
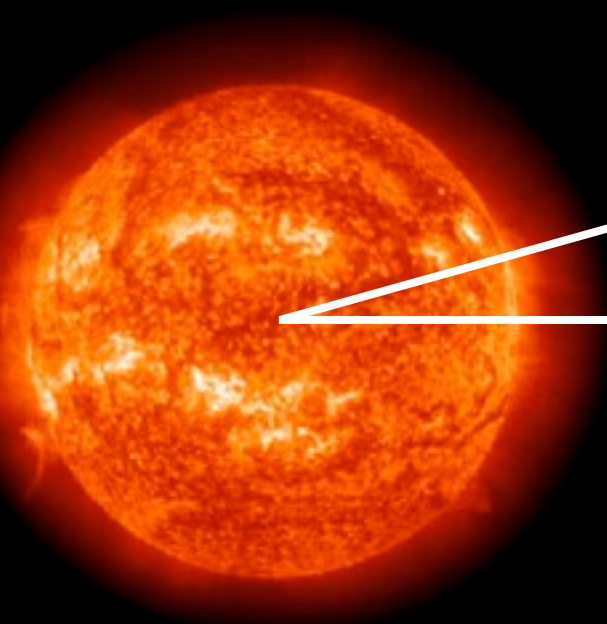


Kepler: Gelijke oppervlakken in gelijke tijden.





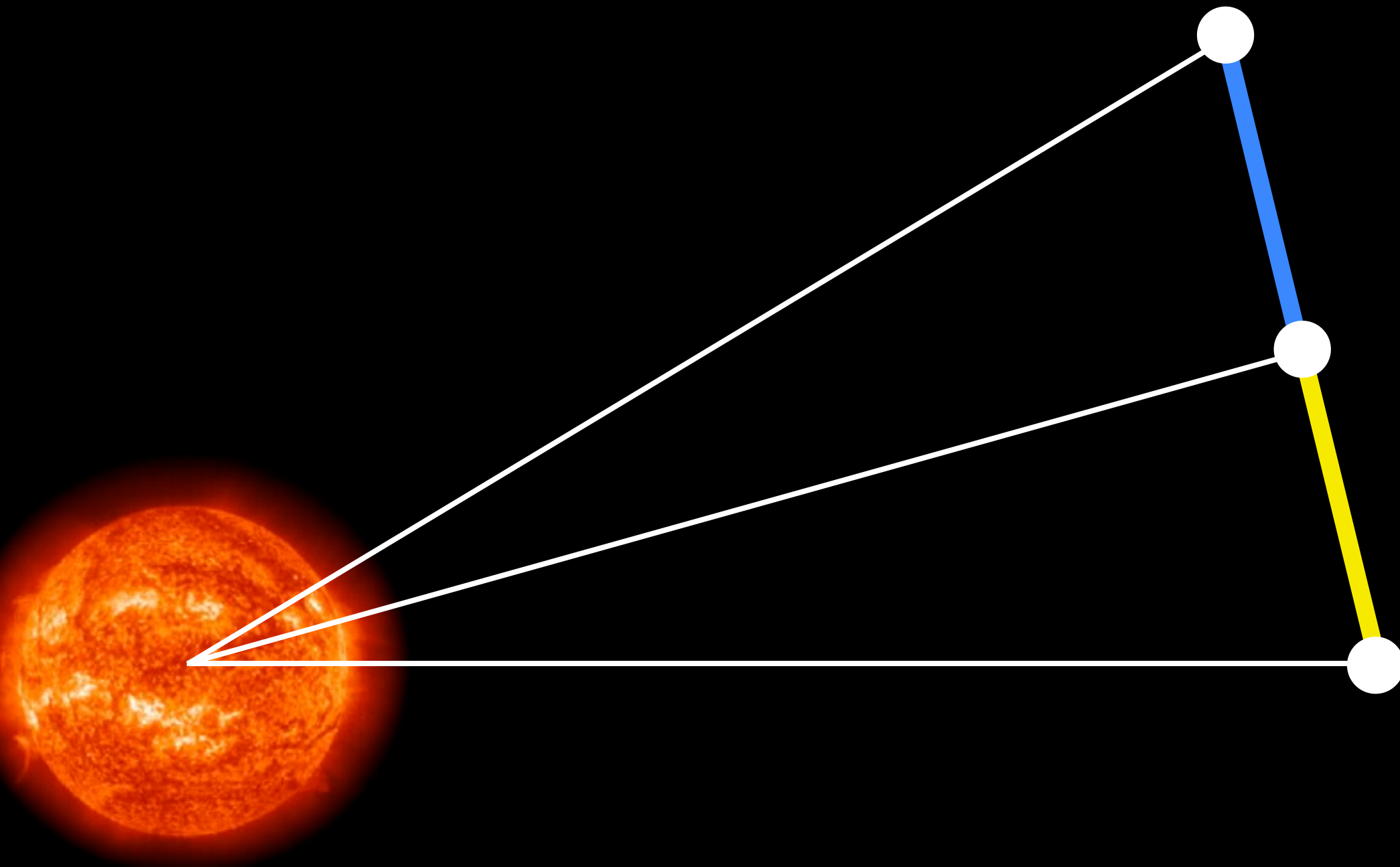
dt





dt

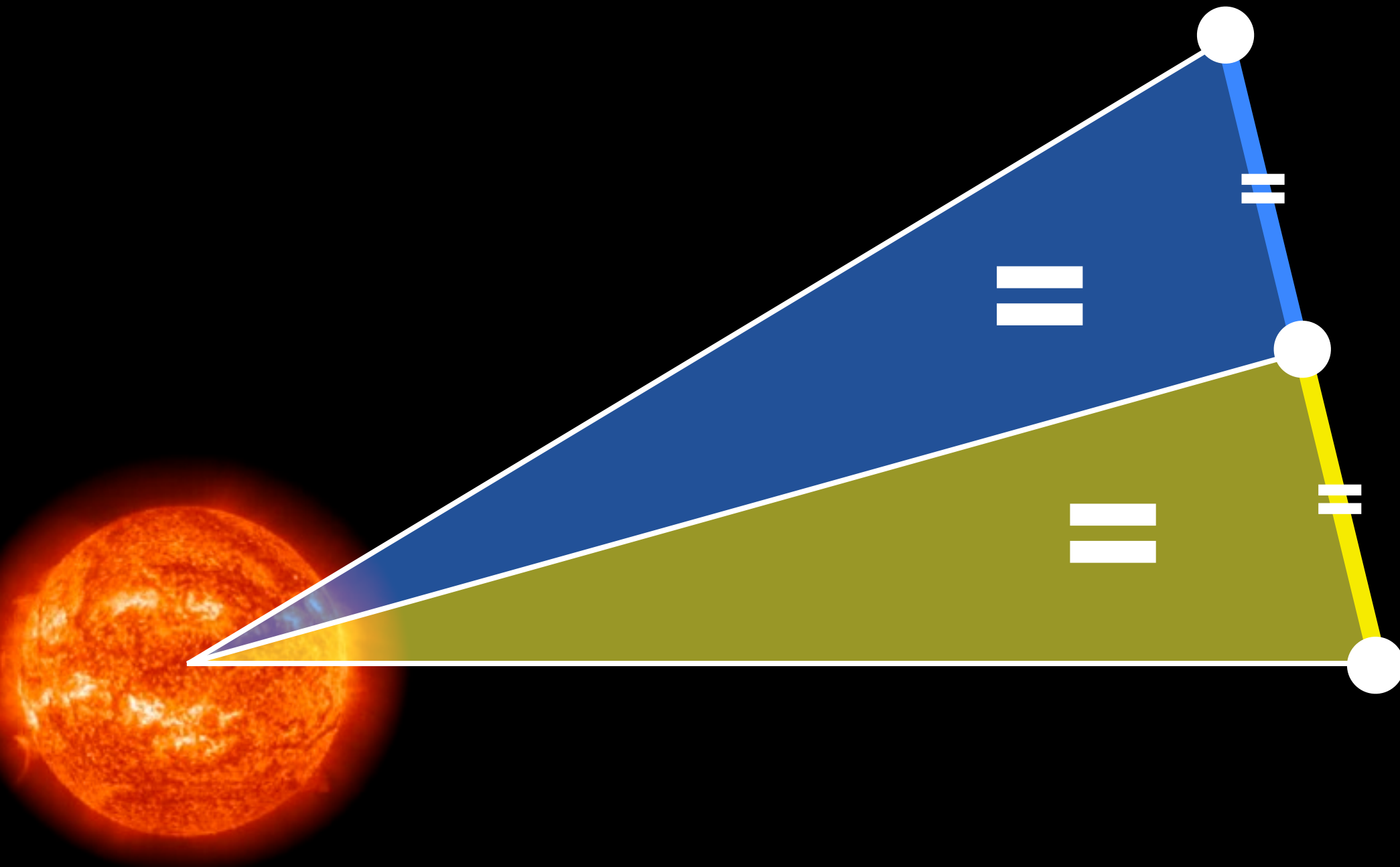
+ dt zonder zwaartekracht





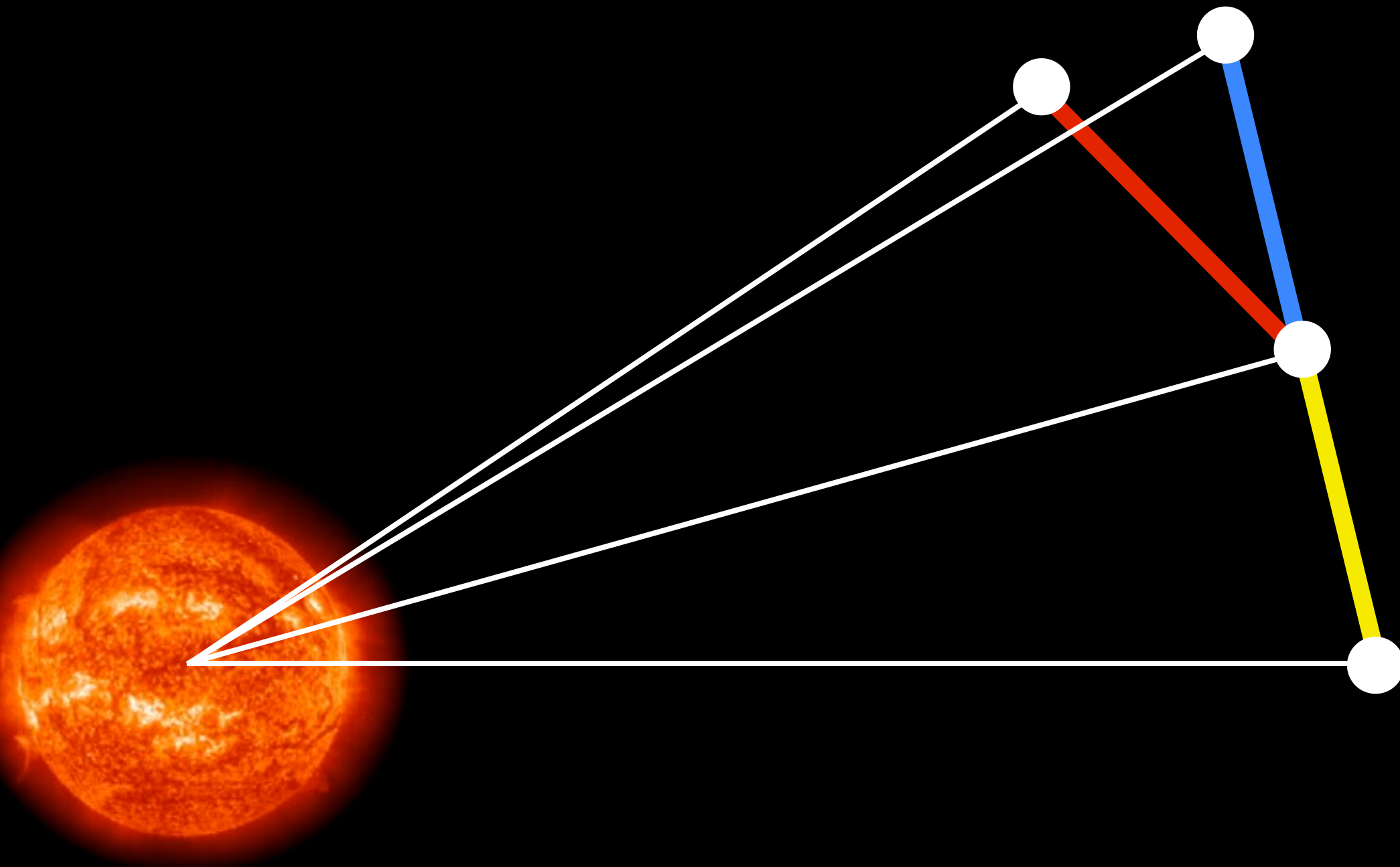
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+ dt zonder zwaartekracht



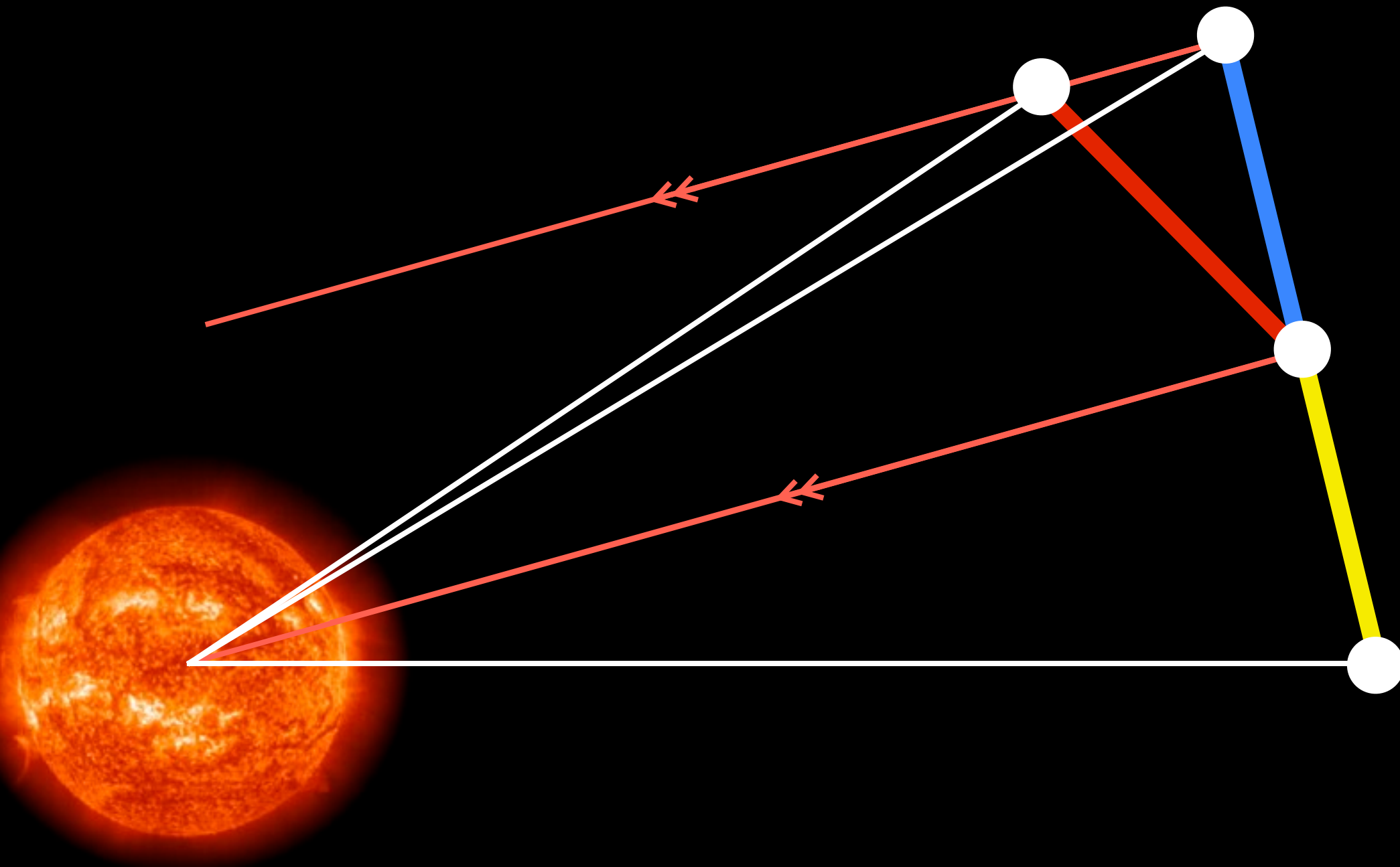


dt + dt zonder zwaartekracht
+ dt met zwaartekracht



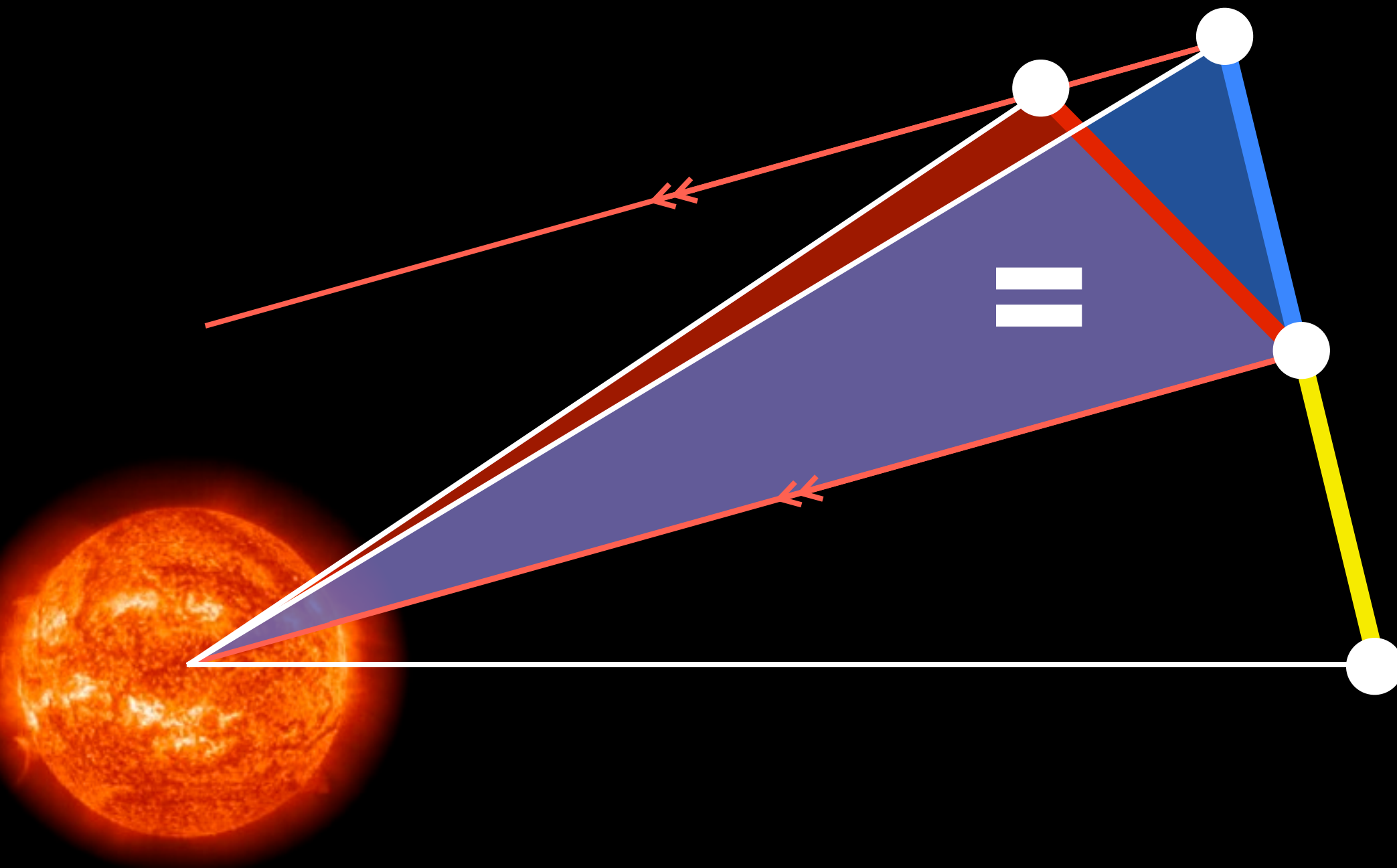


dt + dt zonder zwaartekracht
+ dt met zwaartekracht



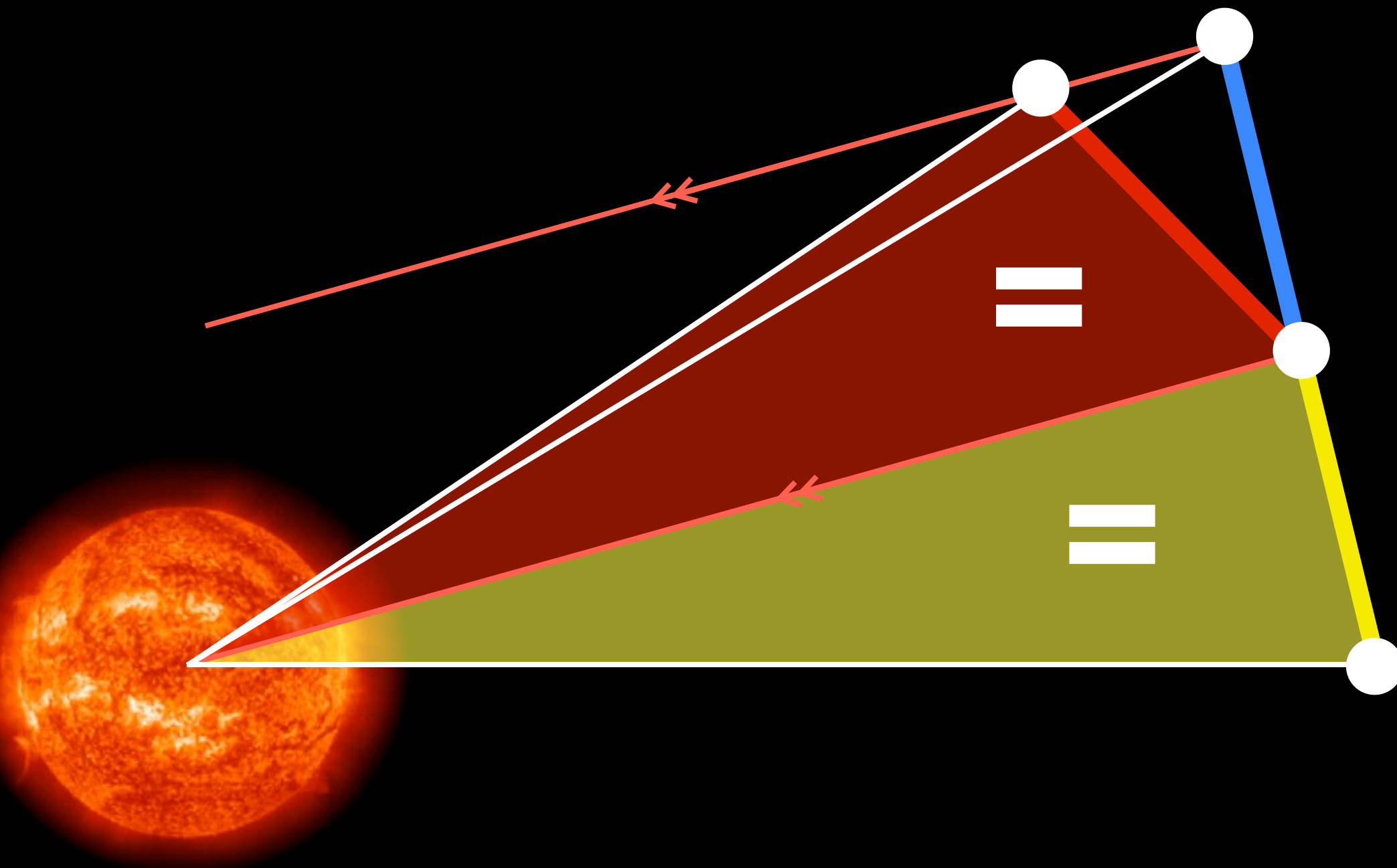


dt + dt zonder zwaartekracht
+ dt met zwaartekracht





dt + dt zonder zwaartekracht
+ dt met zwaartekracht



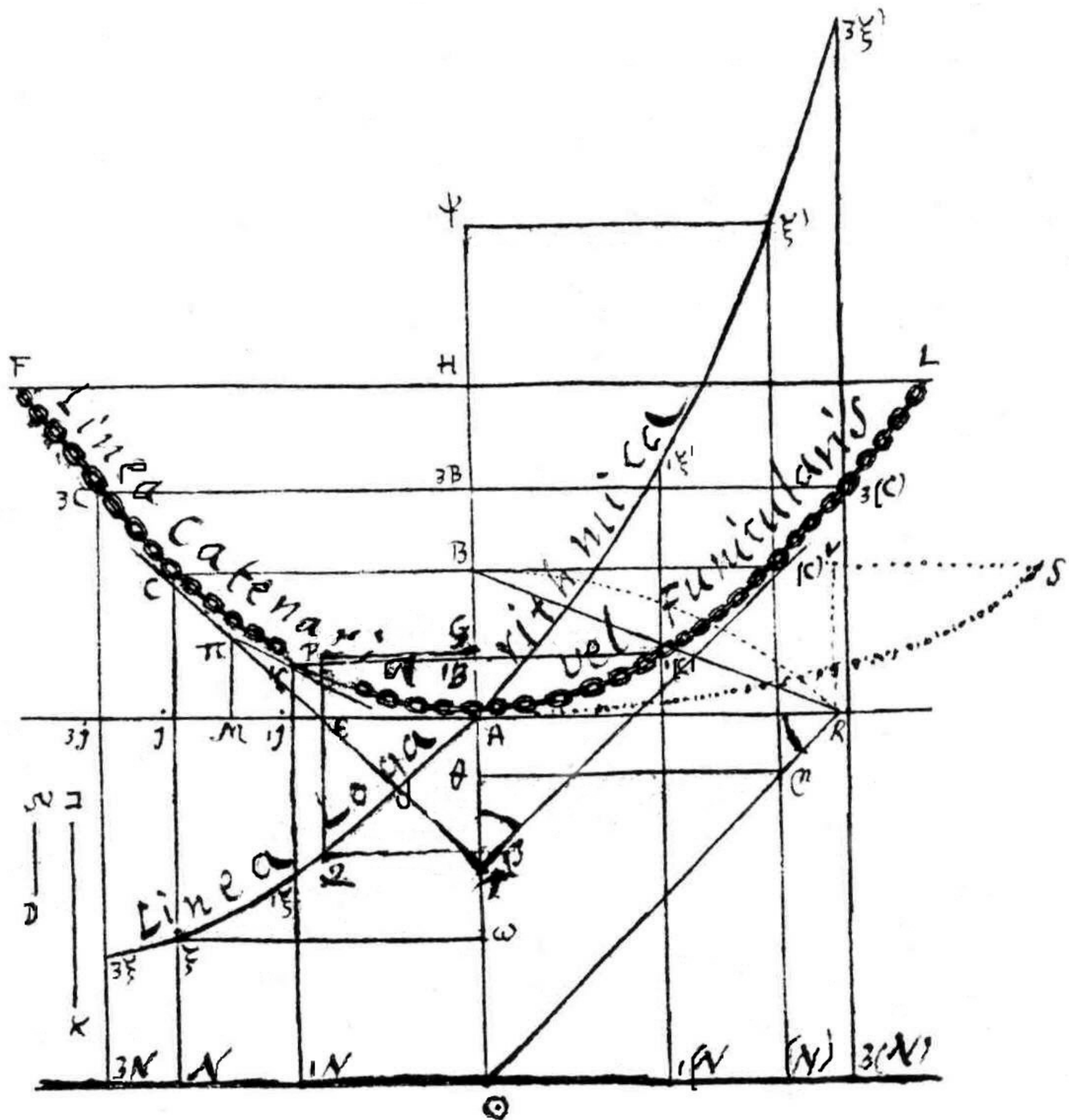
Newton: Conclusies

- Mooie bewijzen van diepe resultaten.
- Op basis van alleen maar “het oneindig kleine” en eenvoudige meetkunde.
- Wiskunde gaat om dingen te begrijpen.
- Geen formules nodig.

De kettinglijn



De kettinglijn volgens Leibniz



$$y = \frac{e^x + e^{-x}}{2}$$



UTRECHT-OVERVECHT
Seiner
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3562 (06) 261 00 11

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Totaal 1 stuk(s)

taalautoomaat (MAES)

PASHOUDERBON

0098 Winkelnr:

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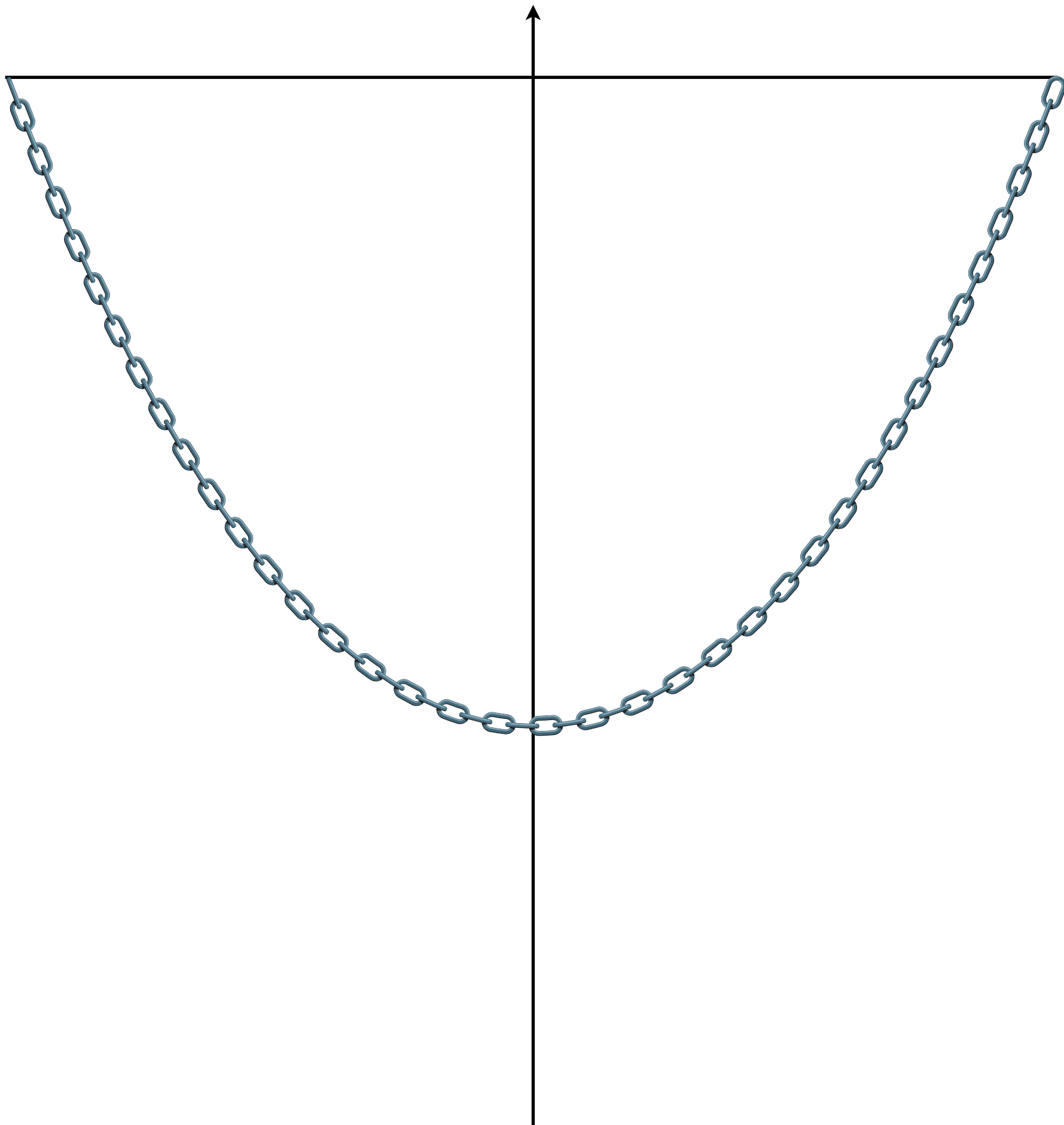
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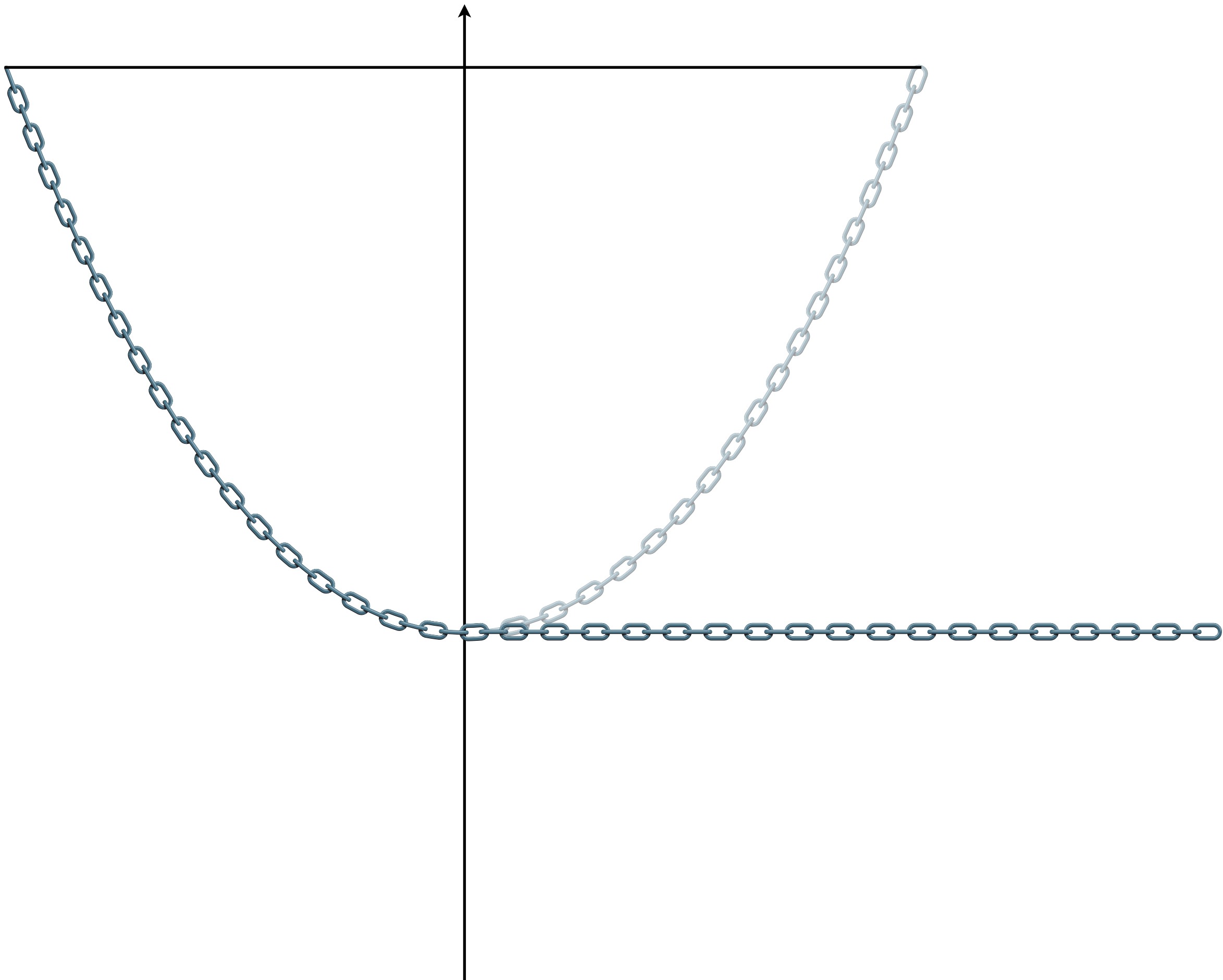
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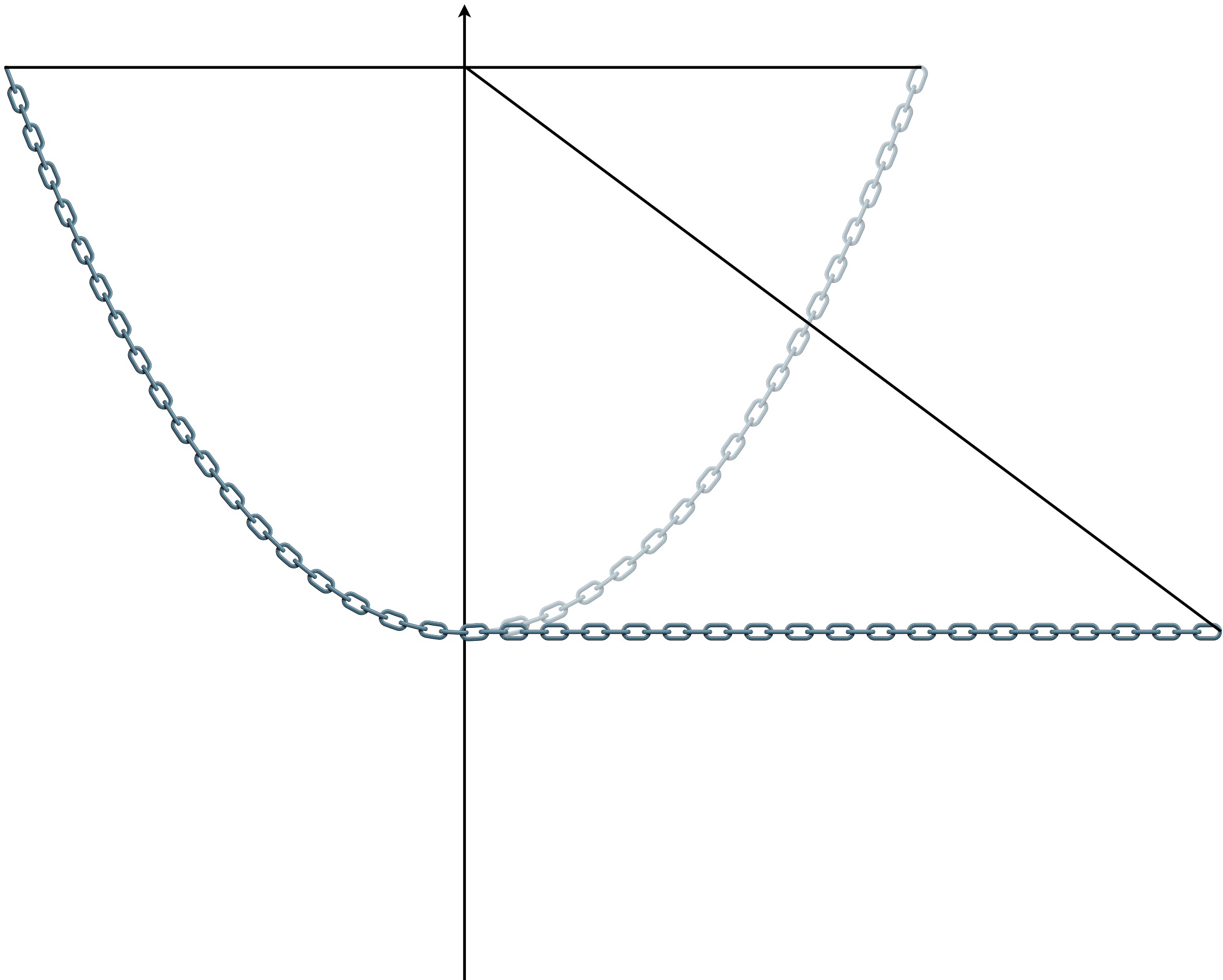


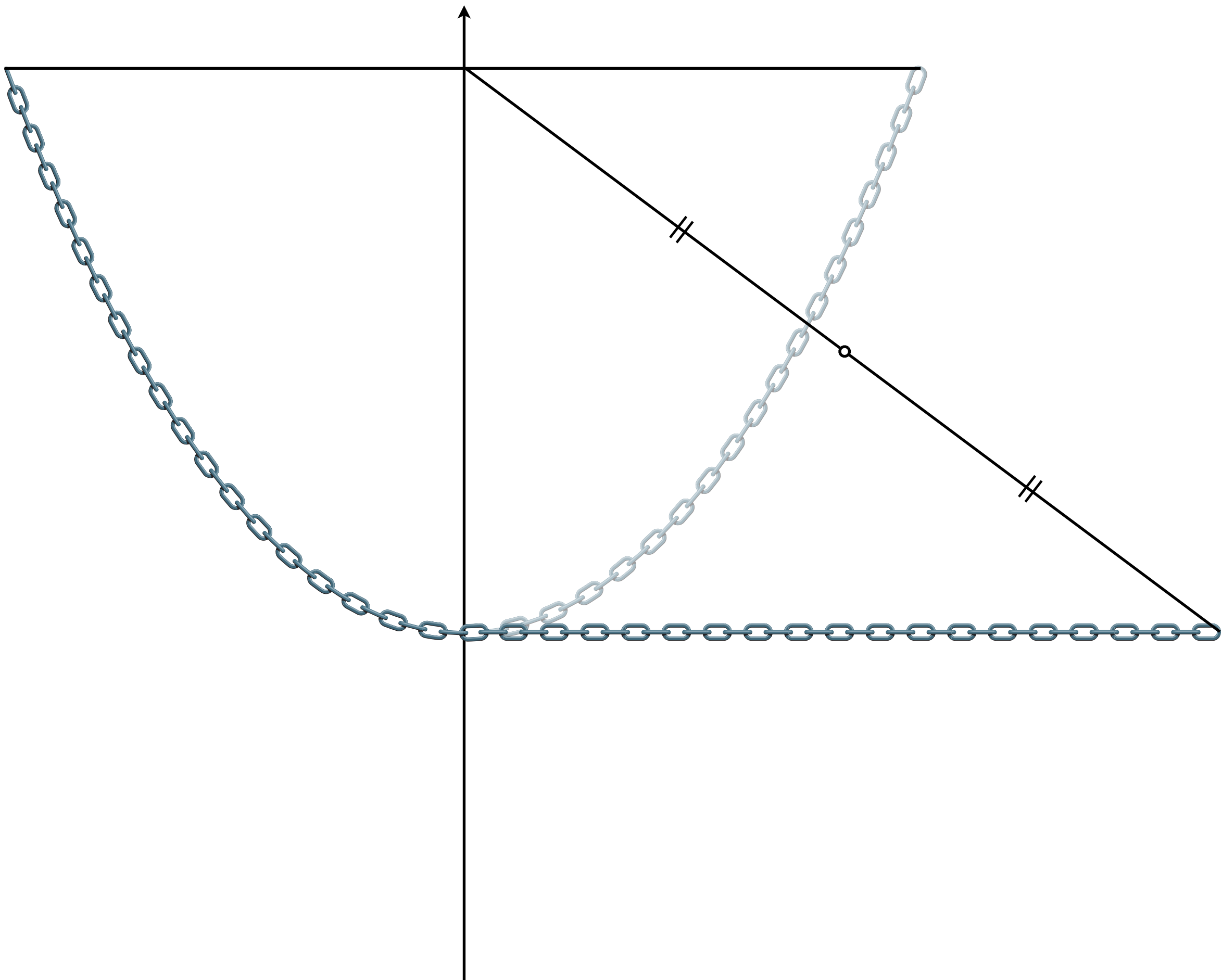


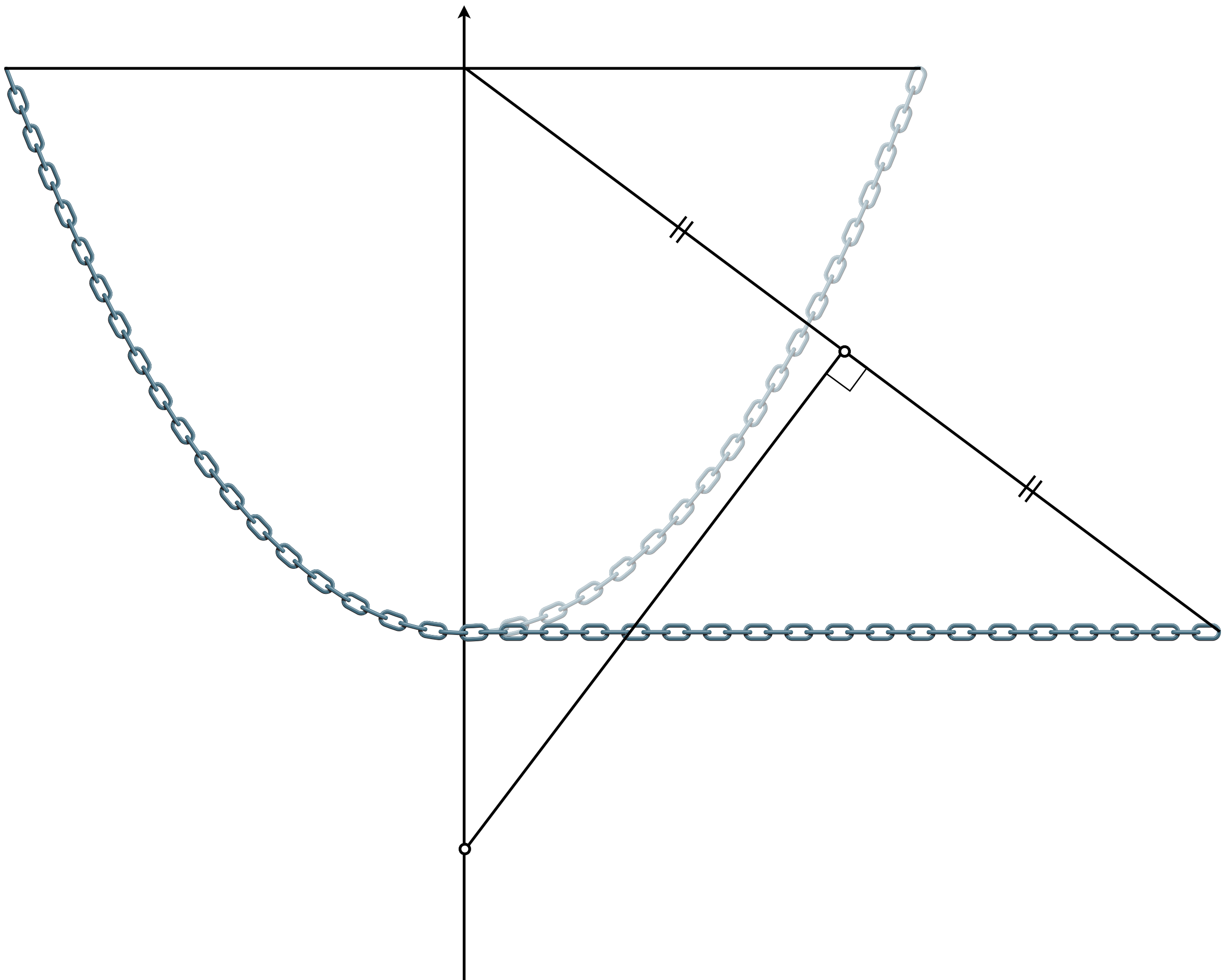


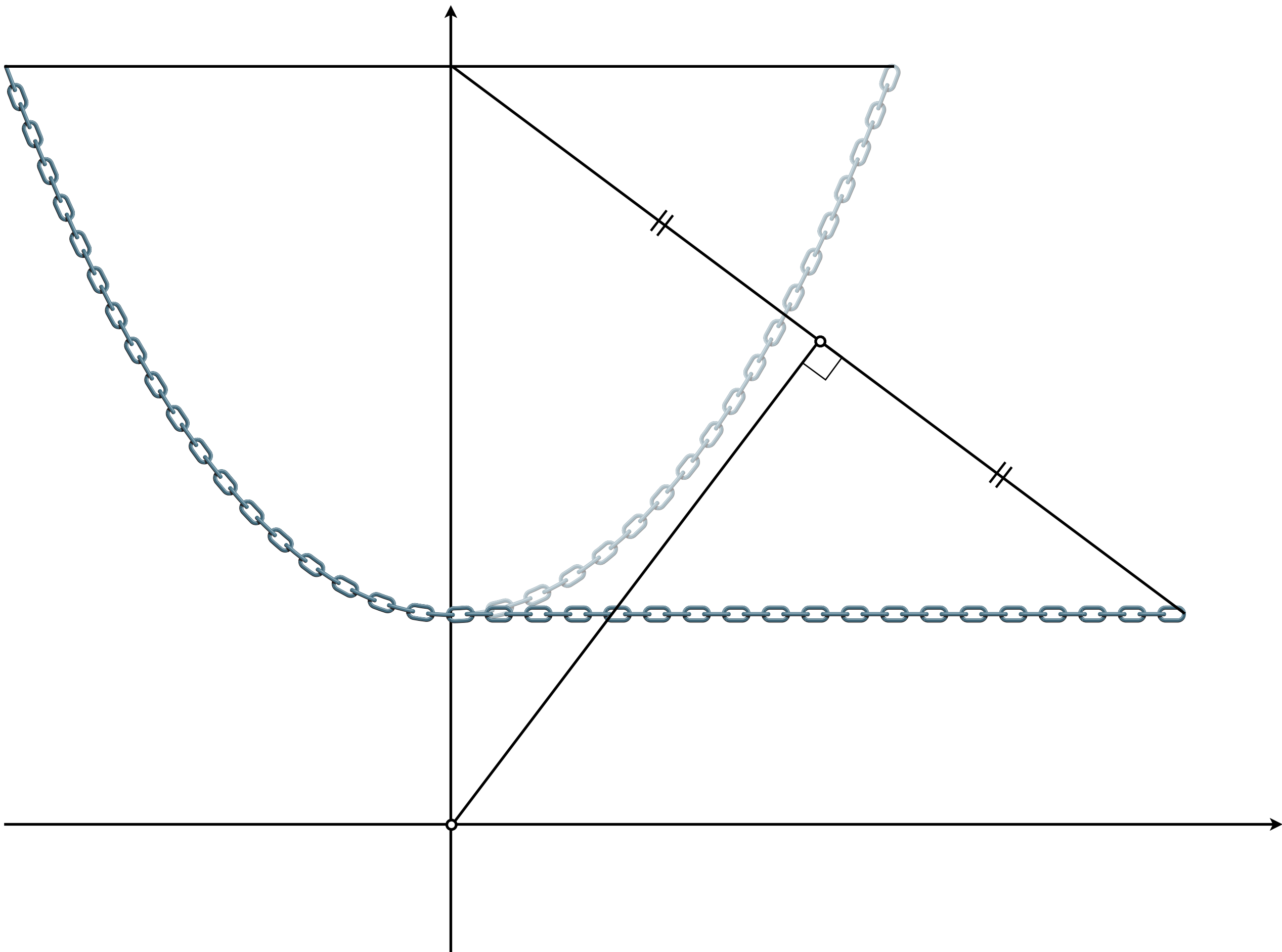


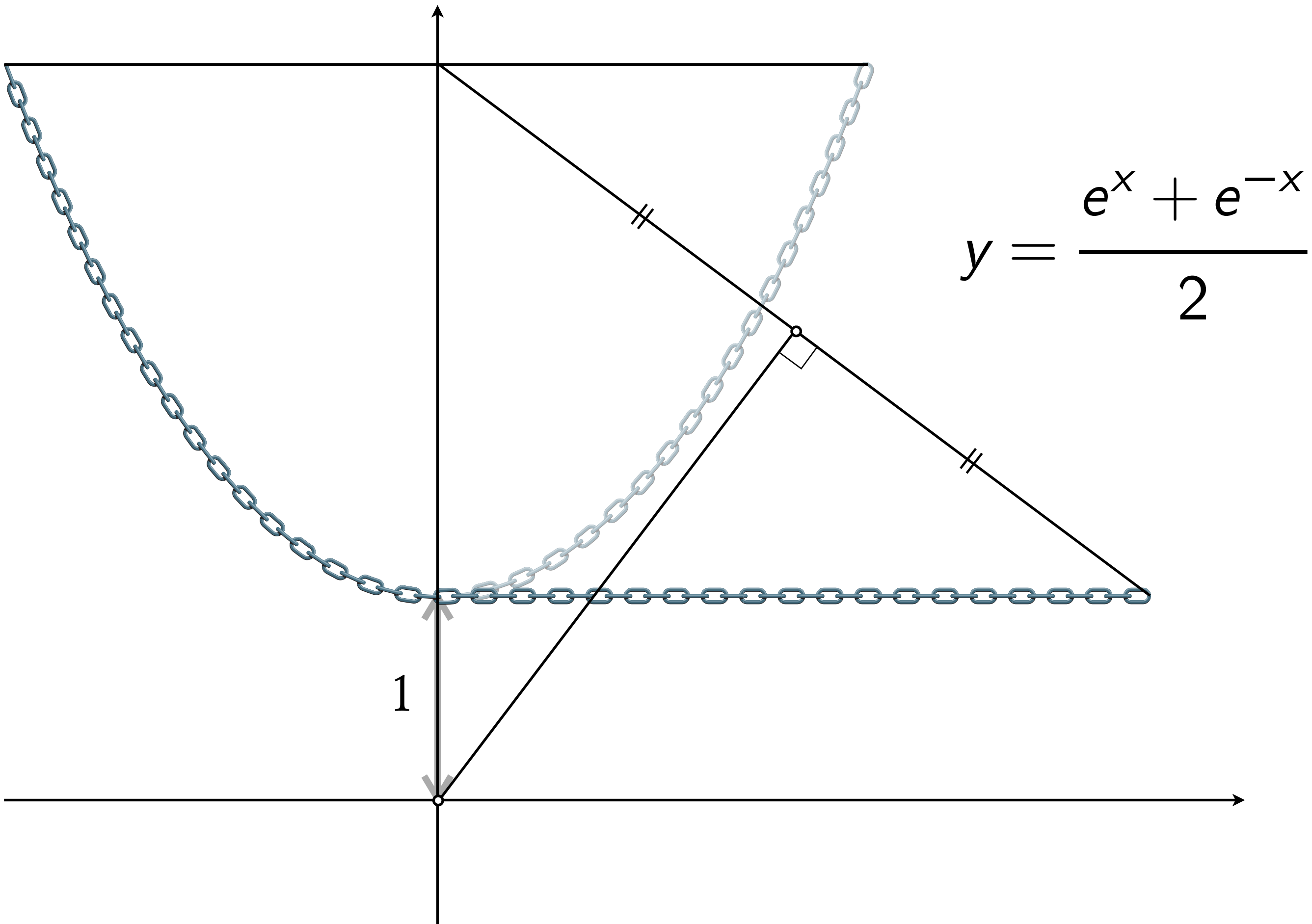




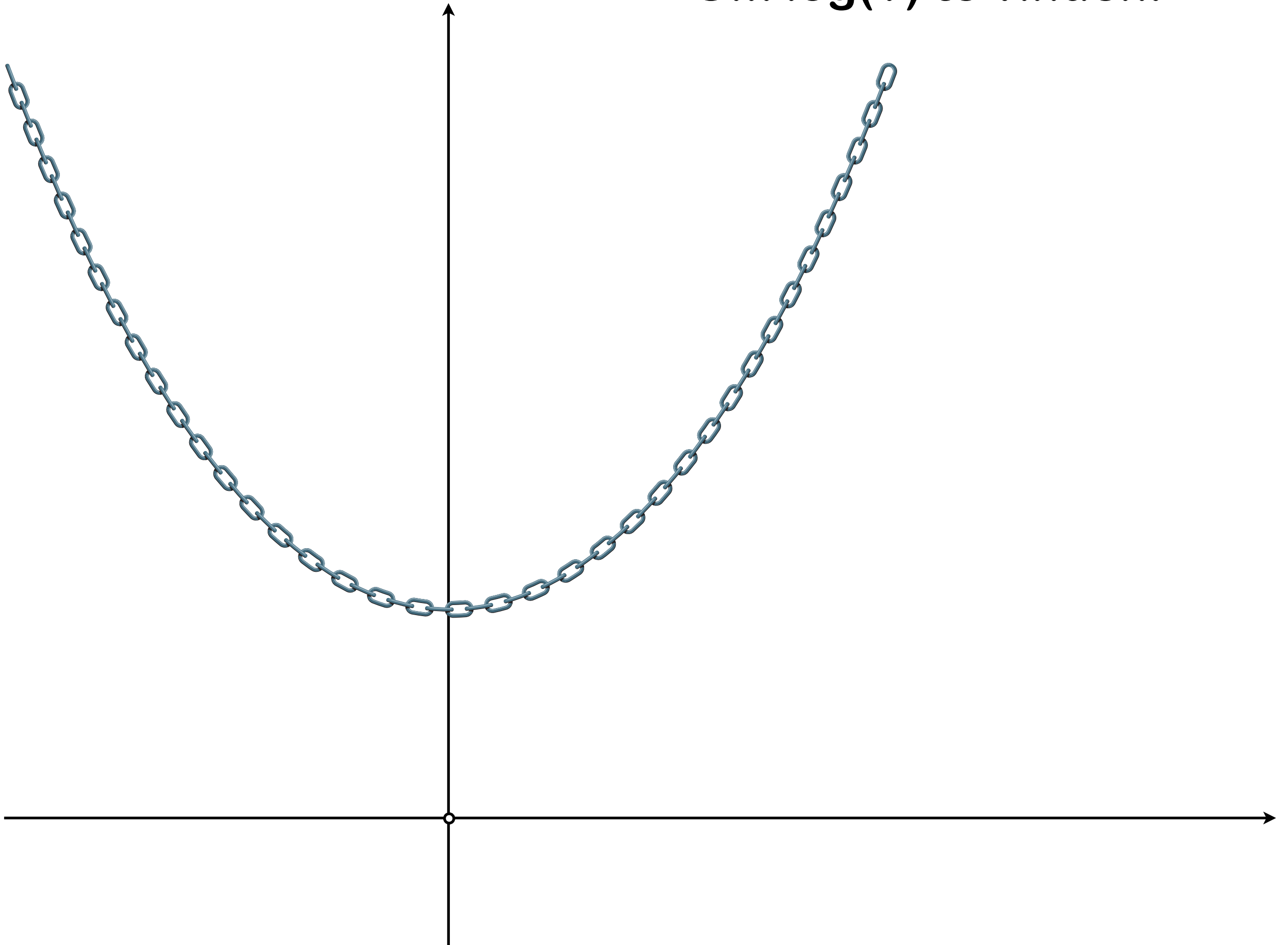




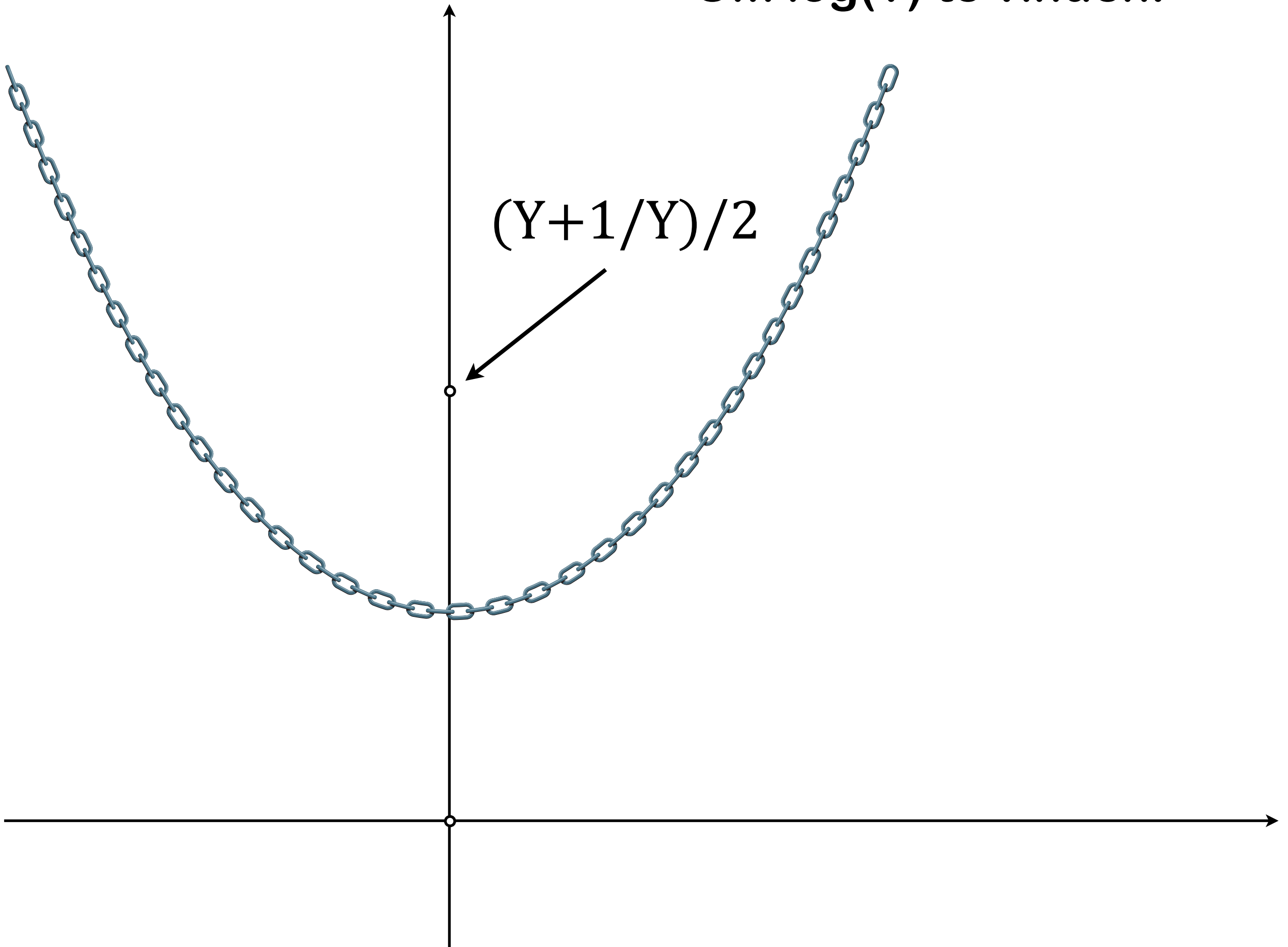




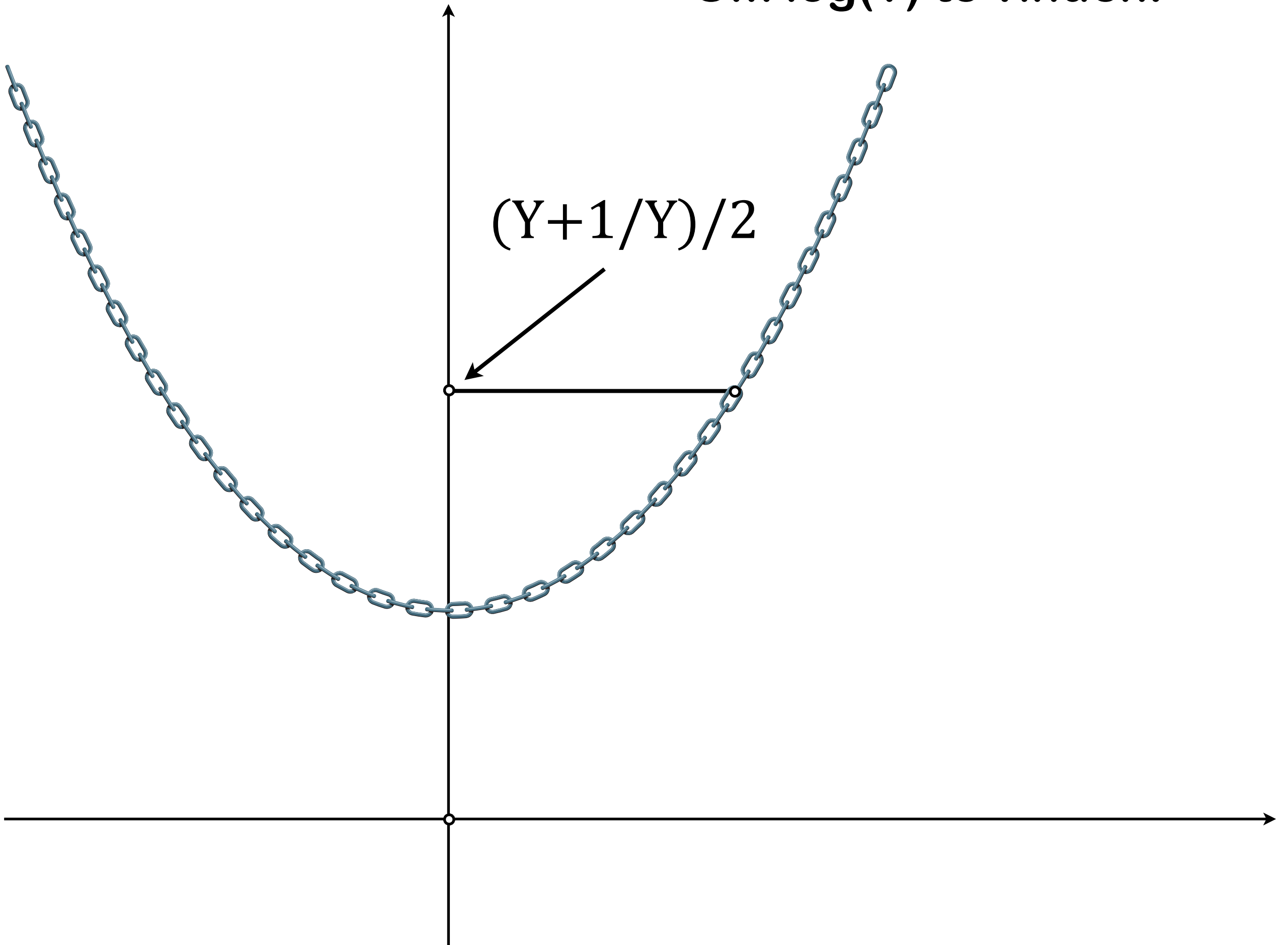
Om $\log(Y)$ te vinden:



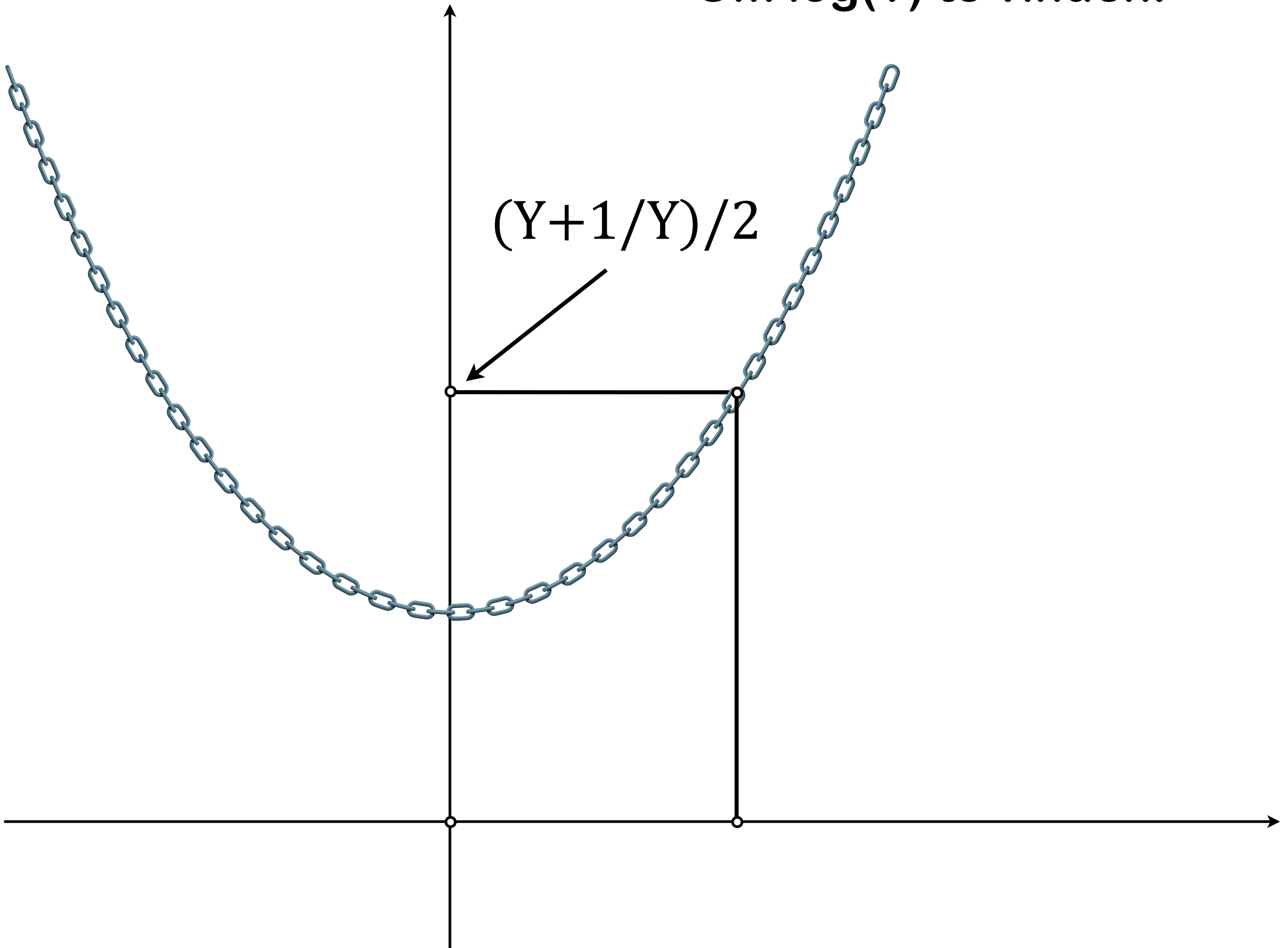
Om $\log(Y)$ te vinden:



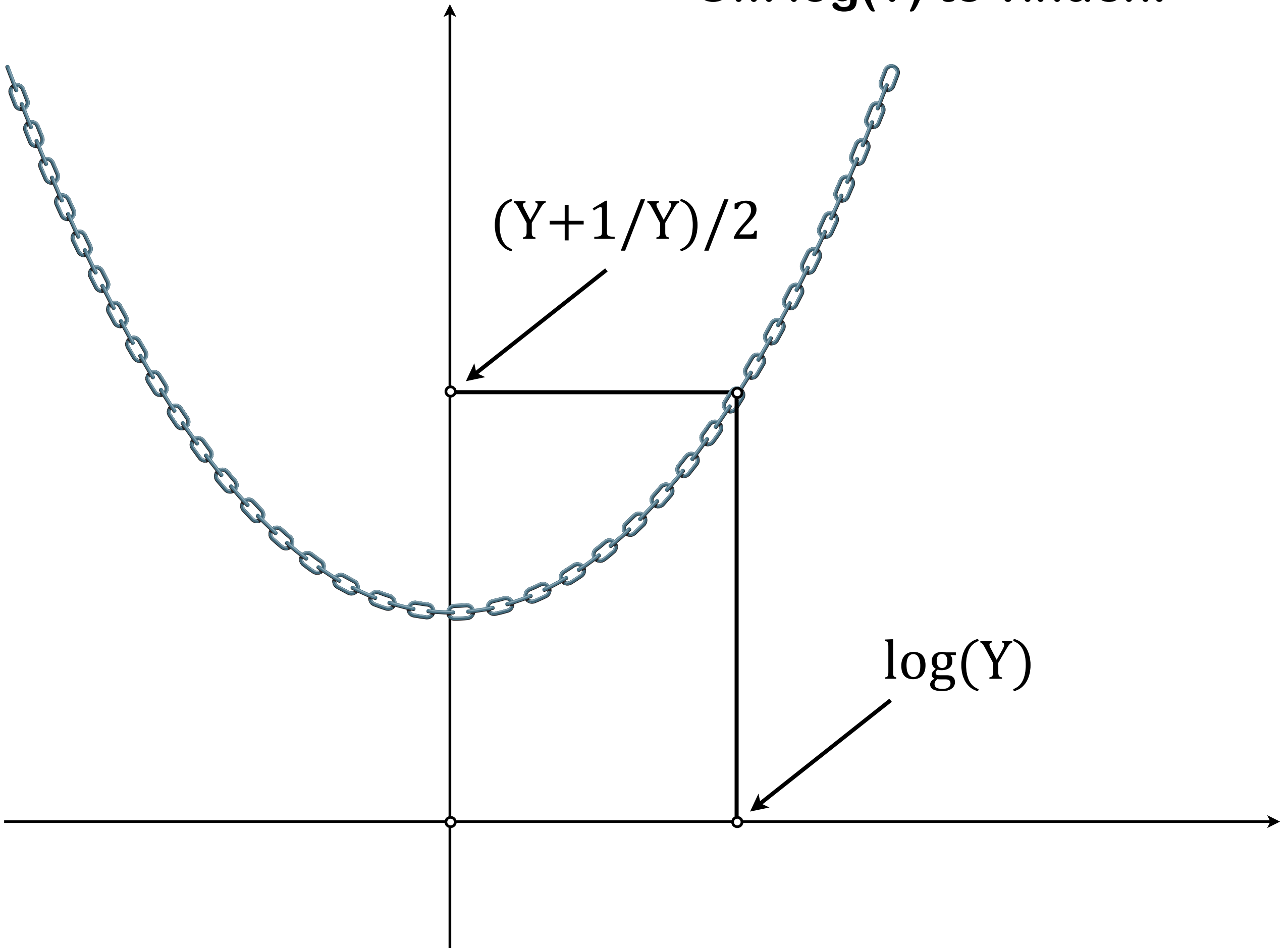
Om $\log(Y)$ te vinden:



Om $\log(Y)$ te vinden:



Om $\log(Y)$ te vinden:



Leibniz: Conclusies

- Wat is een oplossing?

- Wat zegt dit:

$$y = \frac{e^x + e^{-x}}{2}$$

- Niet: kettinglijnprobleem wordt opgelost door exponentiële functies.
- Wel: kettinglijn kan gebruikt worden om logaritmen te vinden.