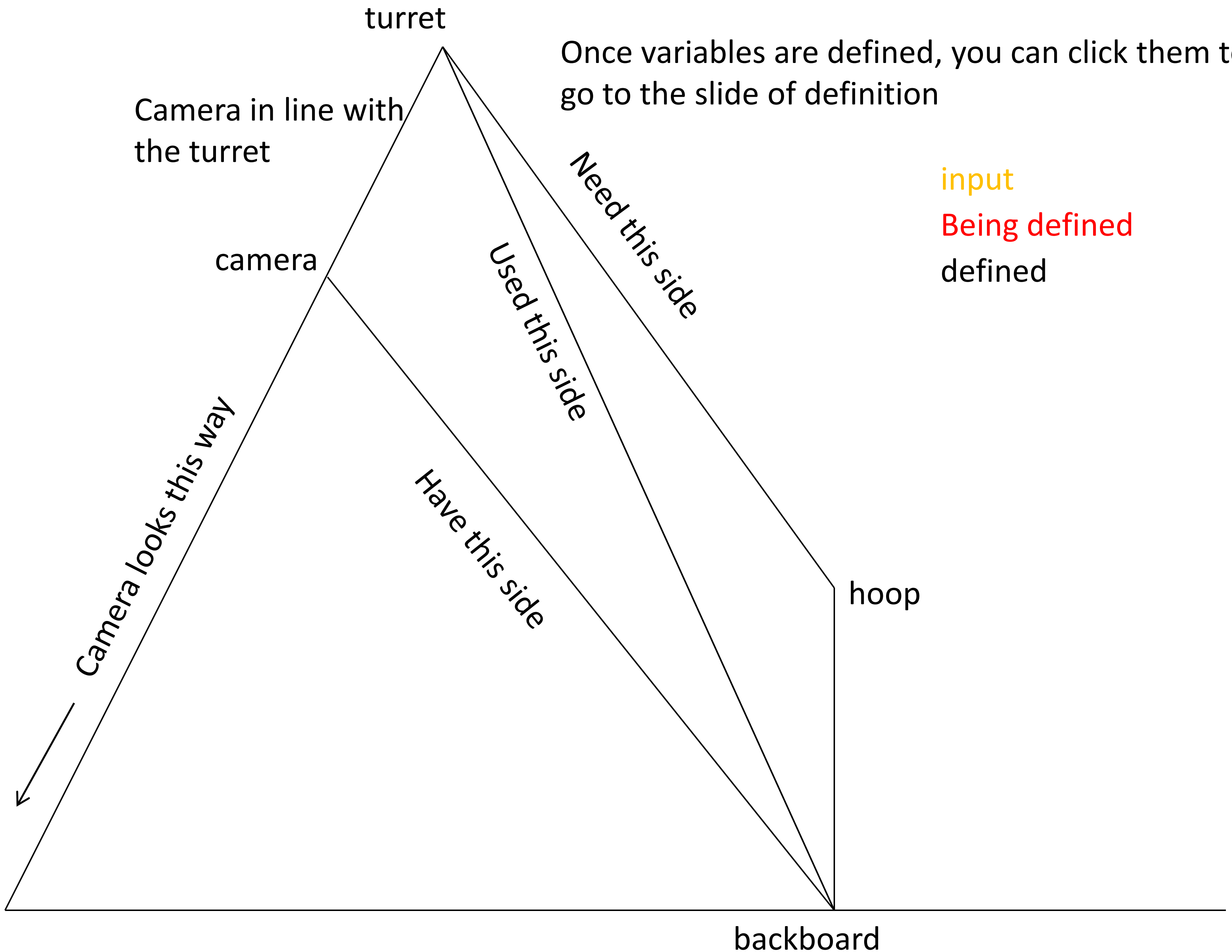
Finding the Distance Between the Turret and the Hoop

- The camera finds the distance between the camera and the backboard. But, we want the distance from the turret to the hoop.
  - The camera is not always aligned with the turret and backboard with our design
  - Hoop is not always aligned with the turret and backboard.
- The next slides walk through the geometric steps that convert the given camera-backboard distance to the required turret-hoop distance.
  - The variables on each page are hyperlinked to their definitions… have fun.

2/1/12 –Knue IRS1318

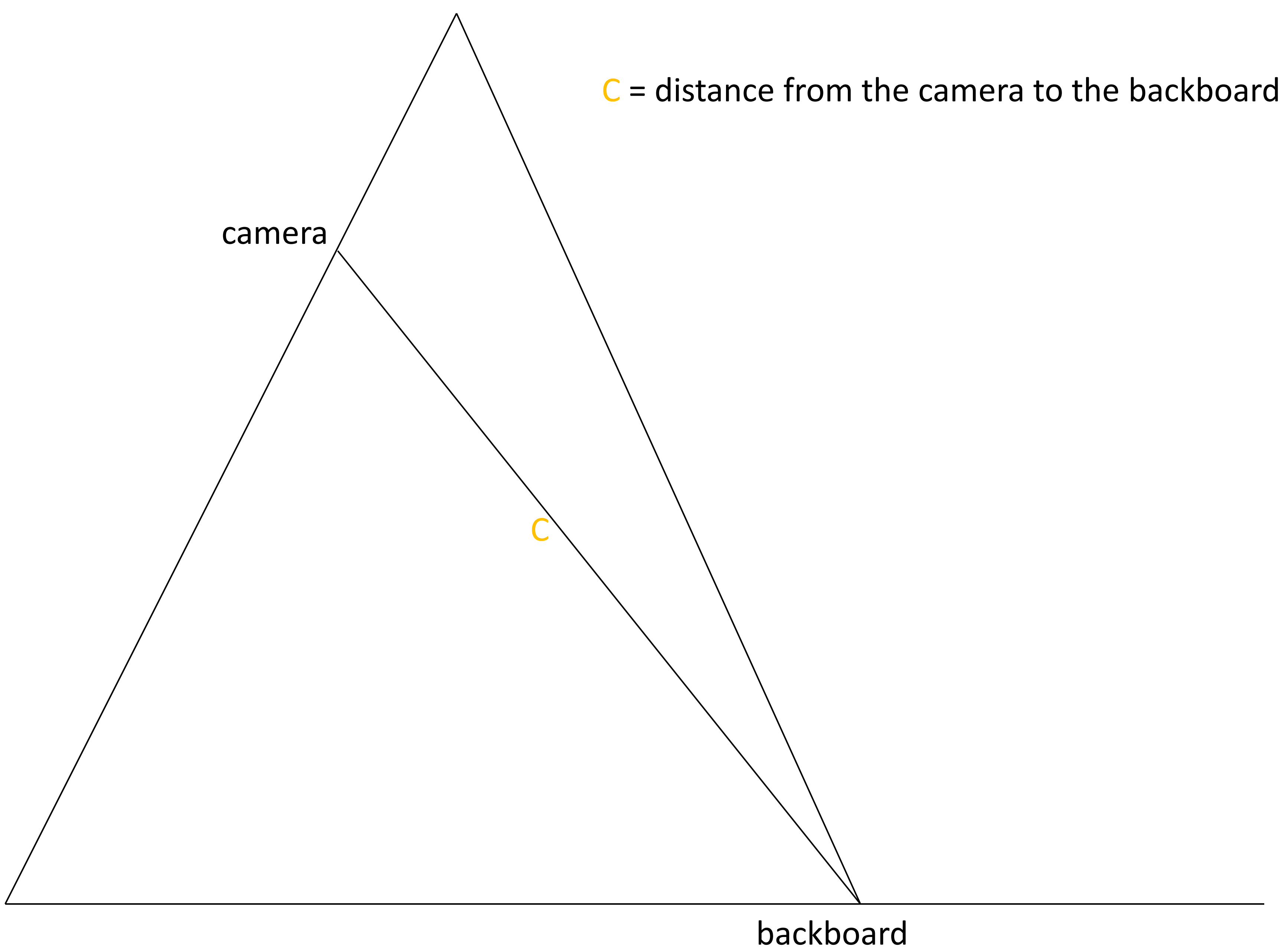
Once variables are defined, you can click them to go to the slide of definition

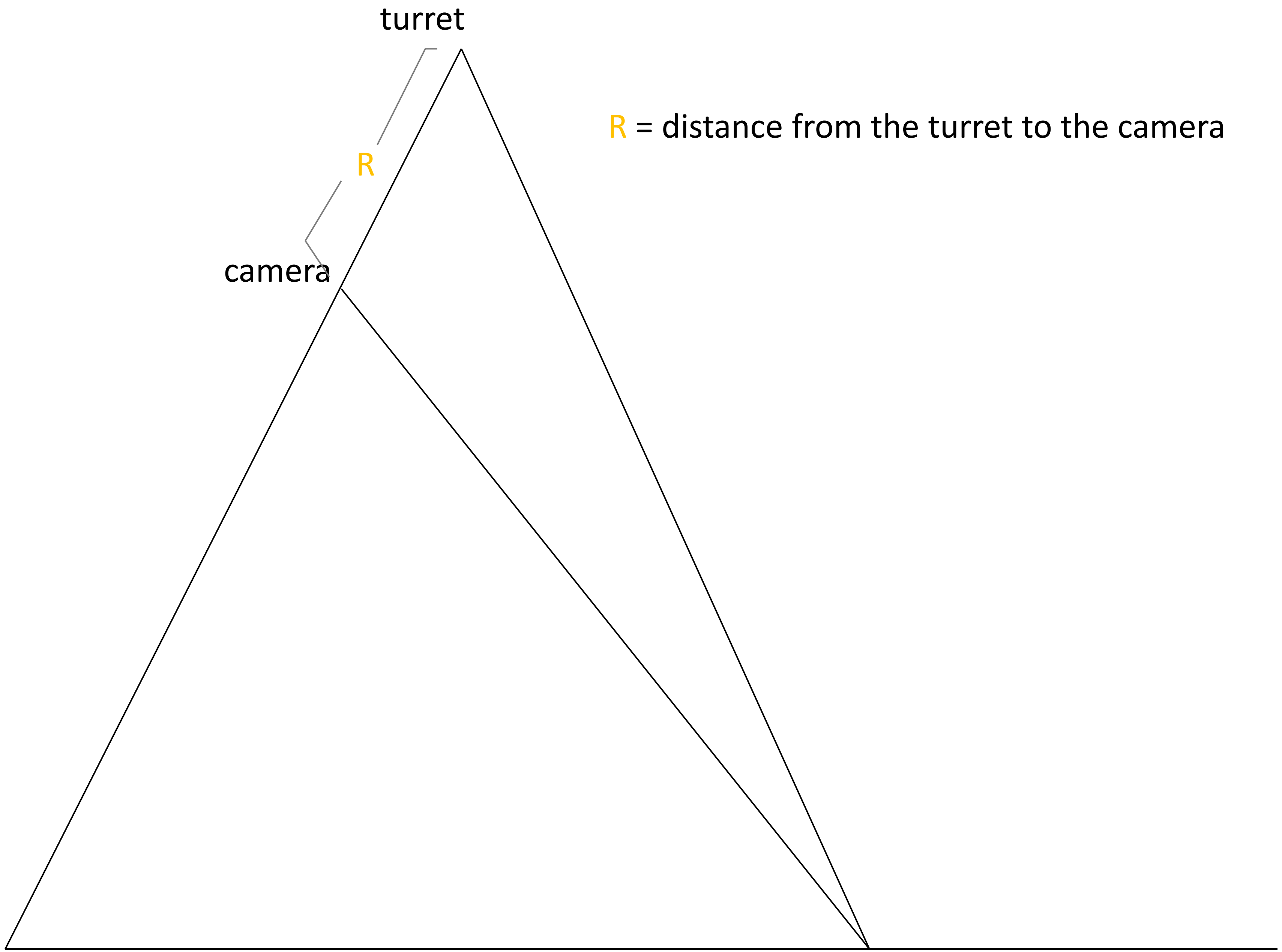


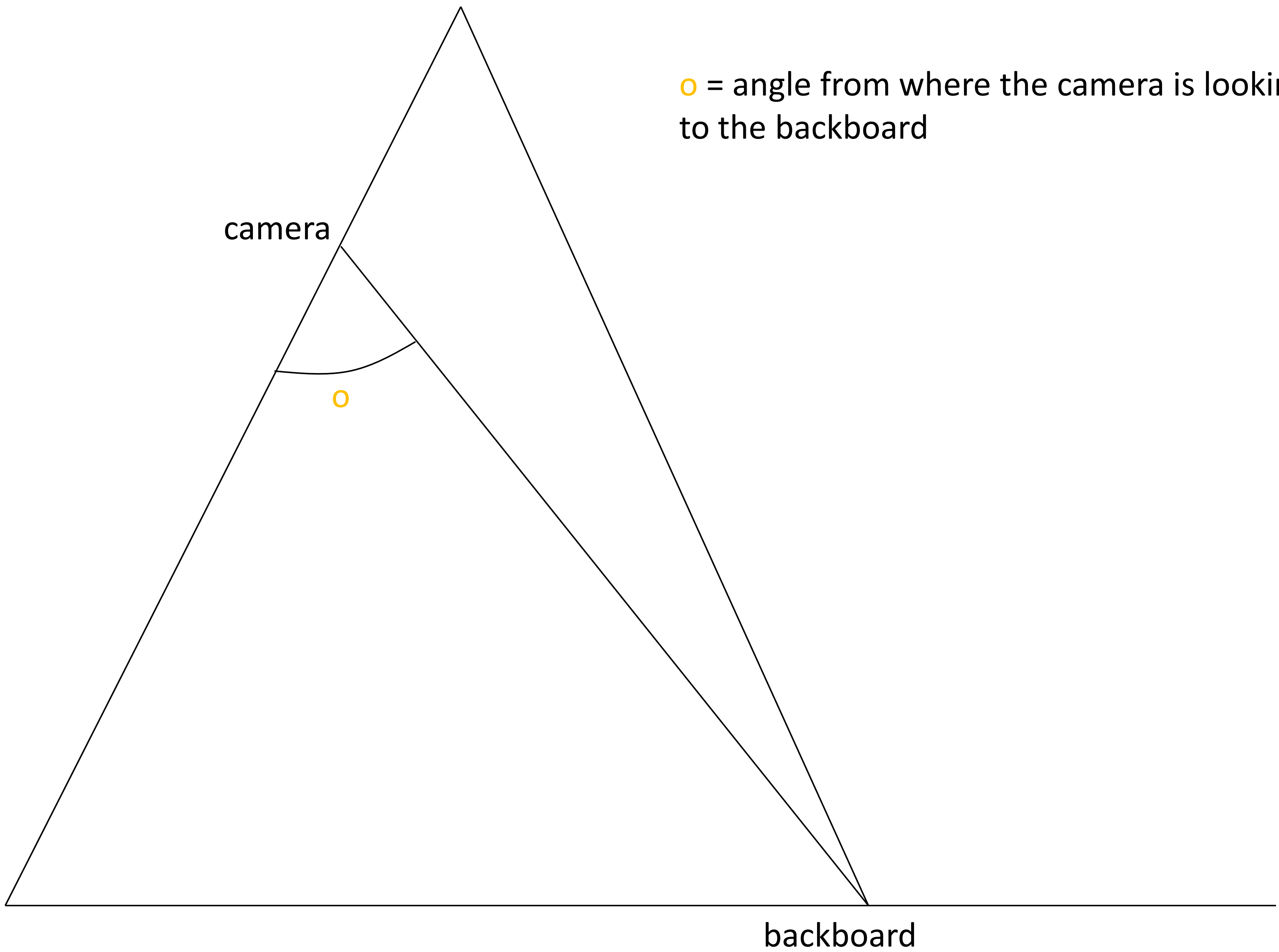
input

Being defined

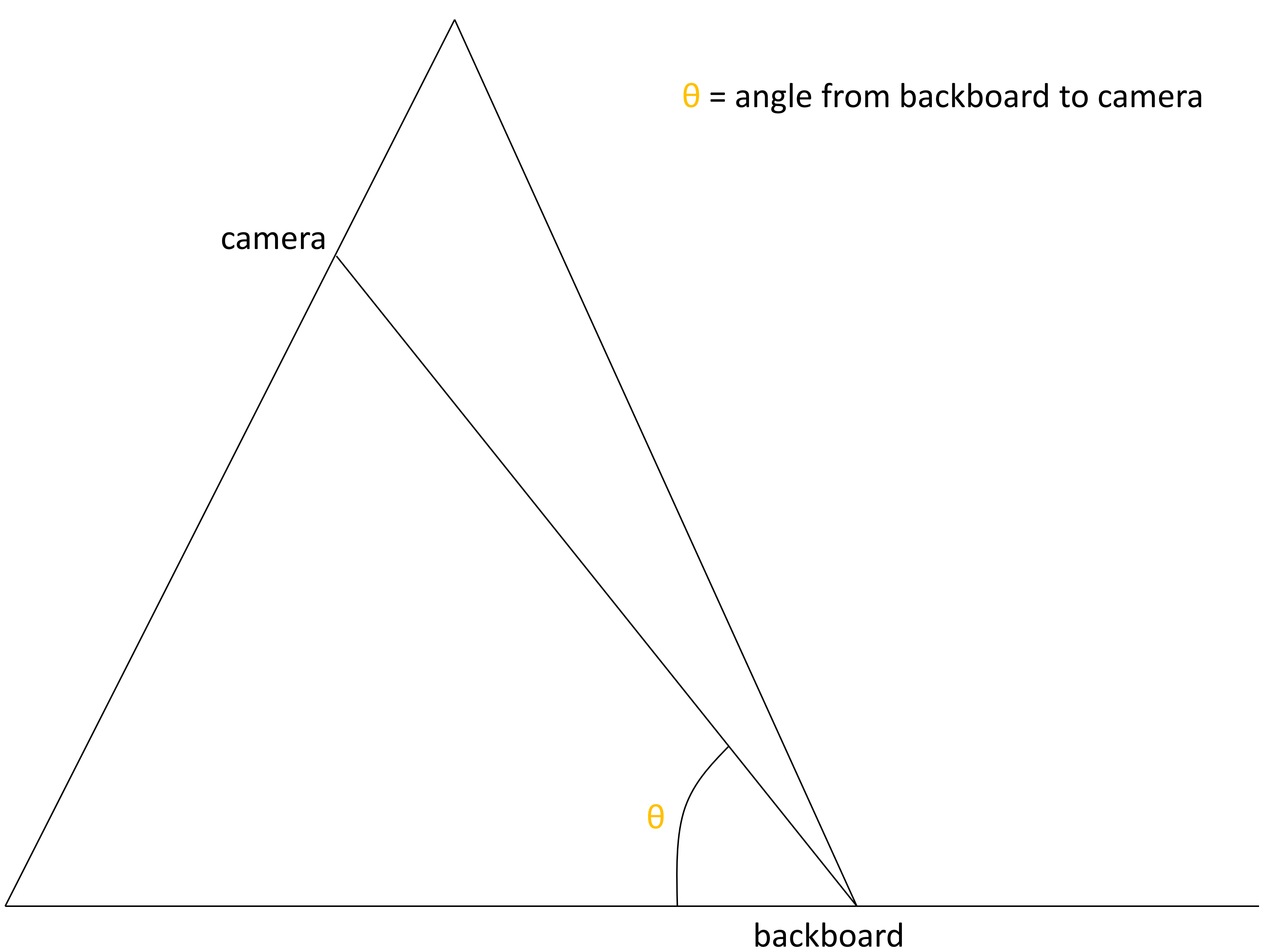
defined


C = distance from the camera to the backboard
camera
C
backboard


turret
R
camera
R = distance from the turret to the camera



o = angle from where the camera is looking to the backboard

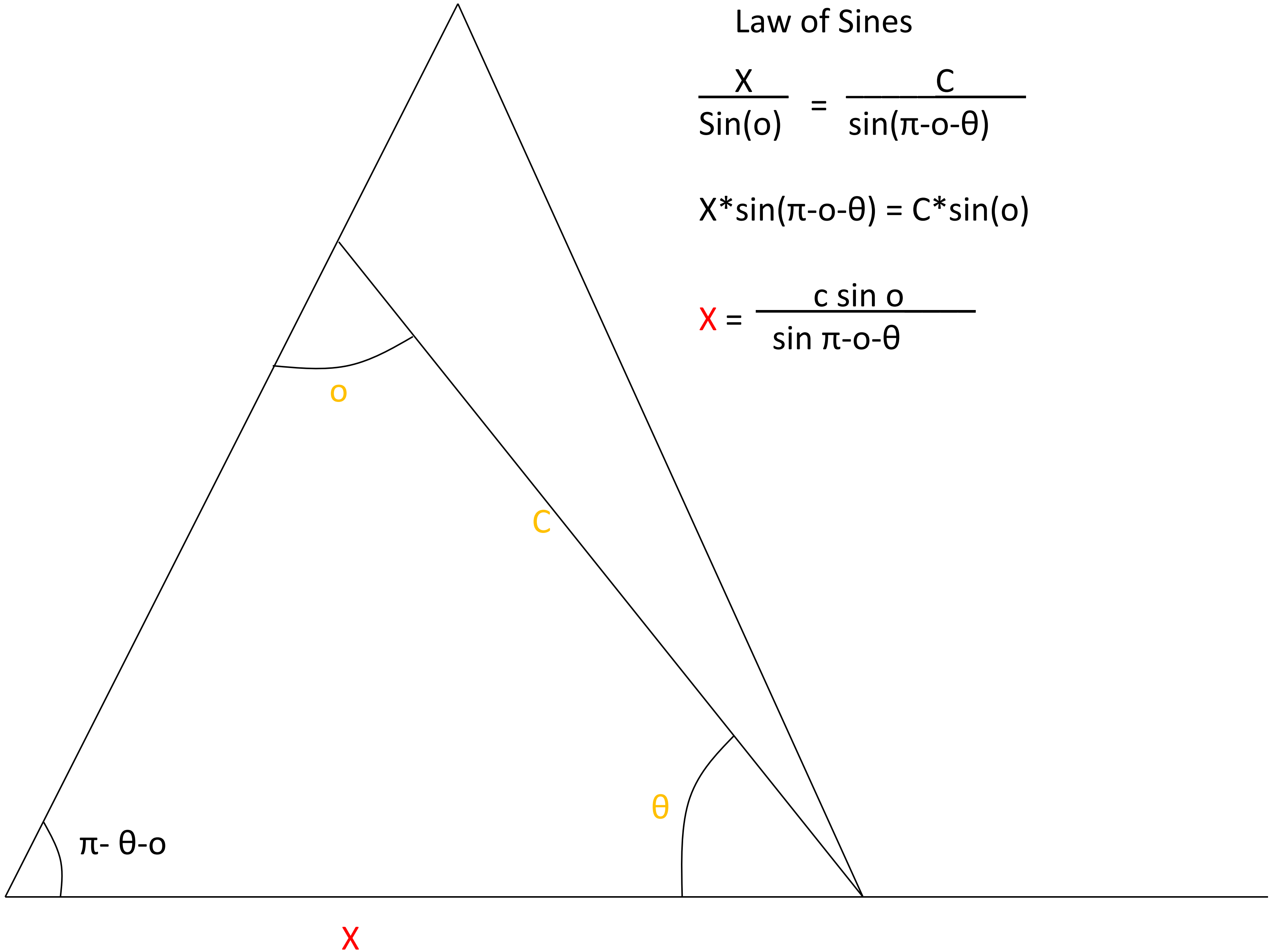

θ = angle from backboard to camera
camera
θ
backboard

Law of Sines

$$\frac{X}{\text{Sin}(o)} = \frac{C}{\sin(\pi\text{-}o\text{-}\theta)}$$

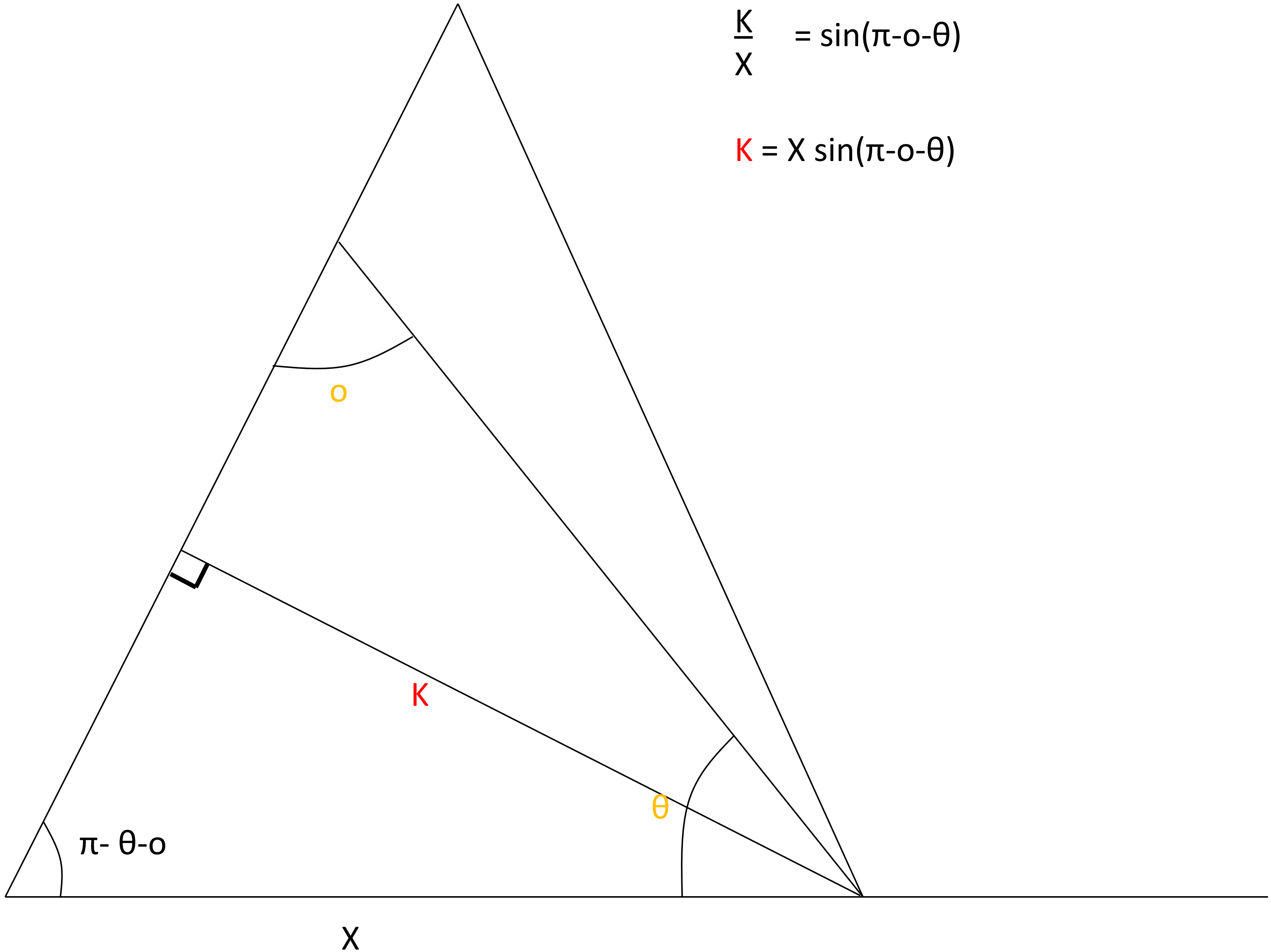
$$X*\sin(\pi\text{-}o\text{-}\theta) = C*\sin(o)$$

$$X = \frac{c \sin o}{\sin \pi\text{-}o\text{-}\theta}$$



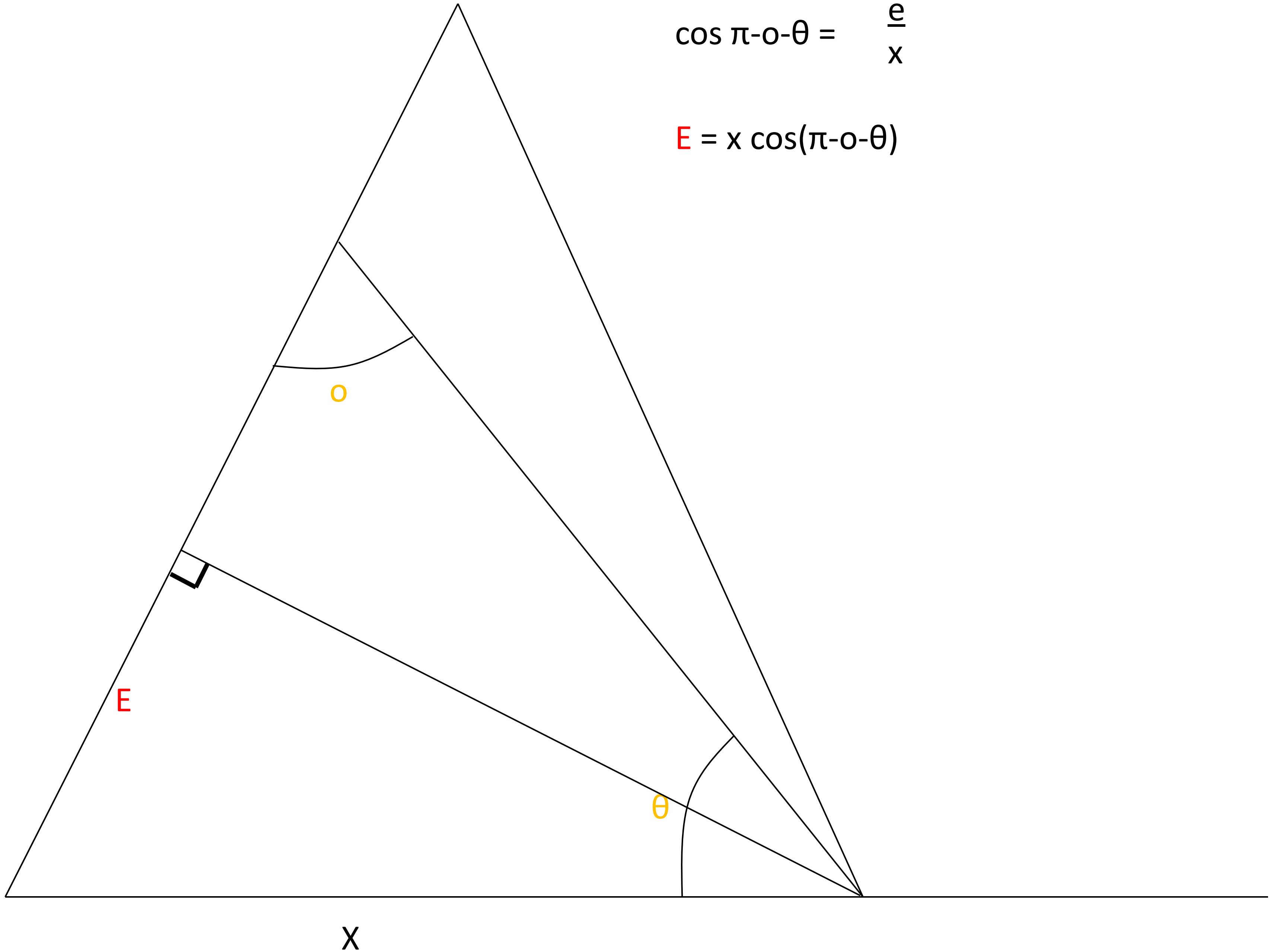
$$\frac{K}{X} = \sin(\pi - o - \theta)$$

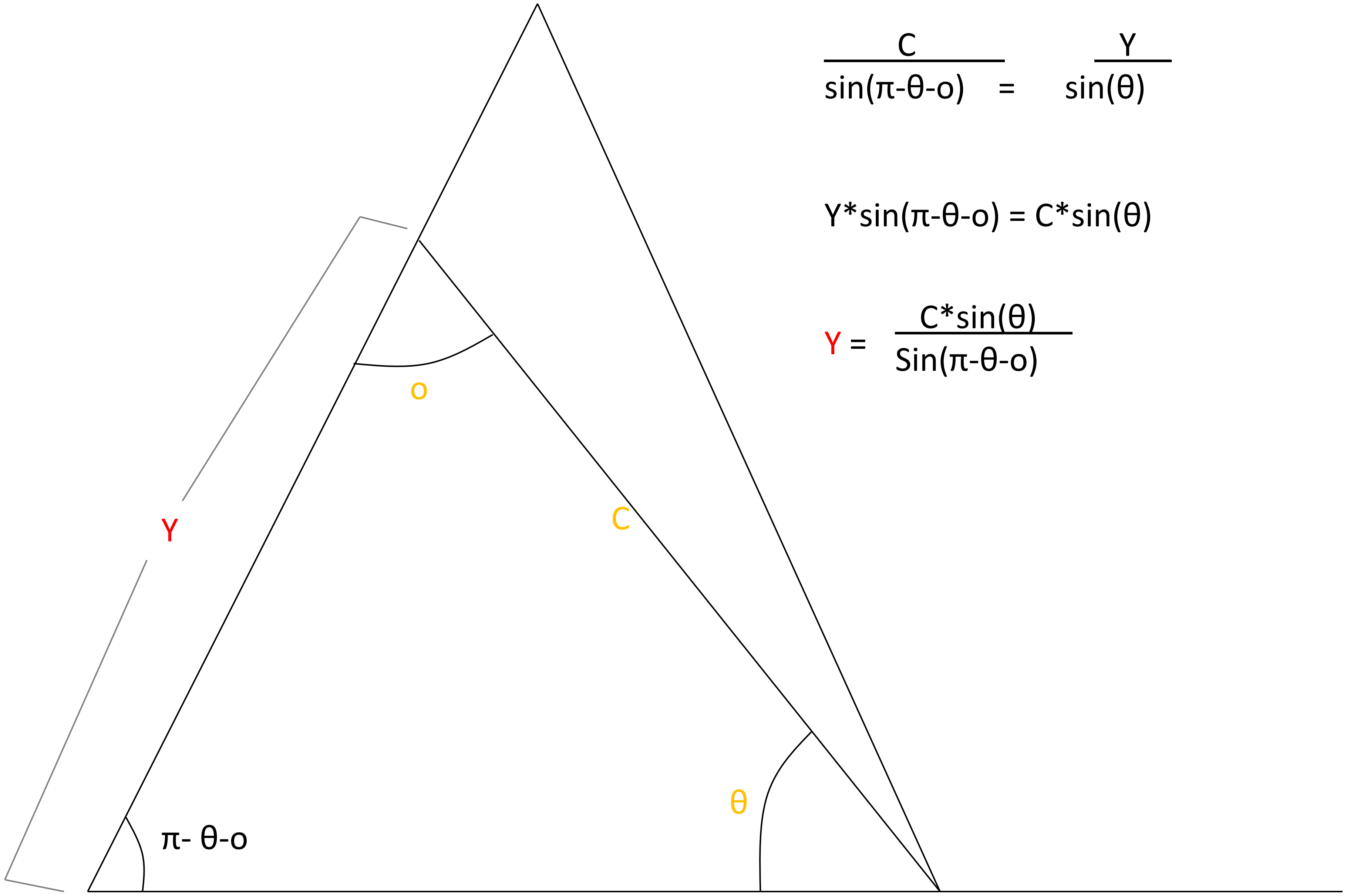
$$K = X \sin(\pi - o - \theta)$$



$$\cos \pi - o - \theta = \frac{e}{x}$$

$$E = x\cos(\pi - o - \theta)$$





Law of Sines

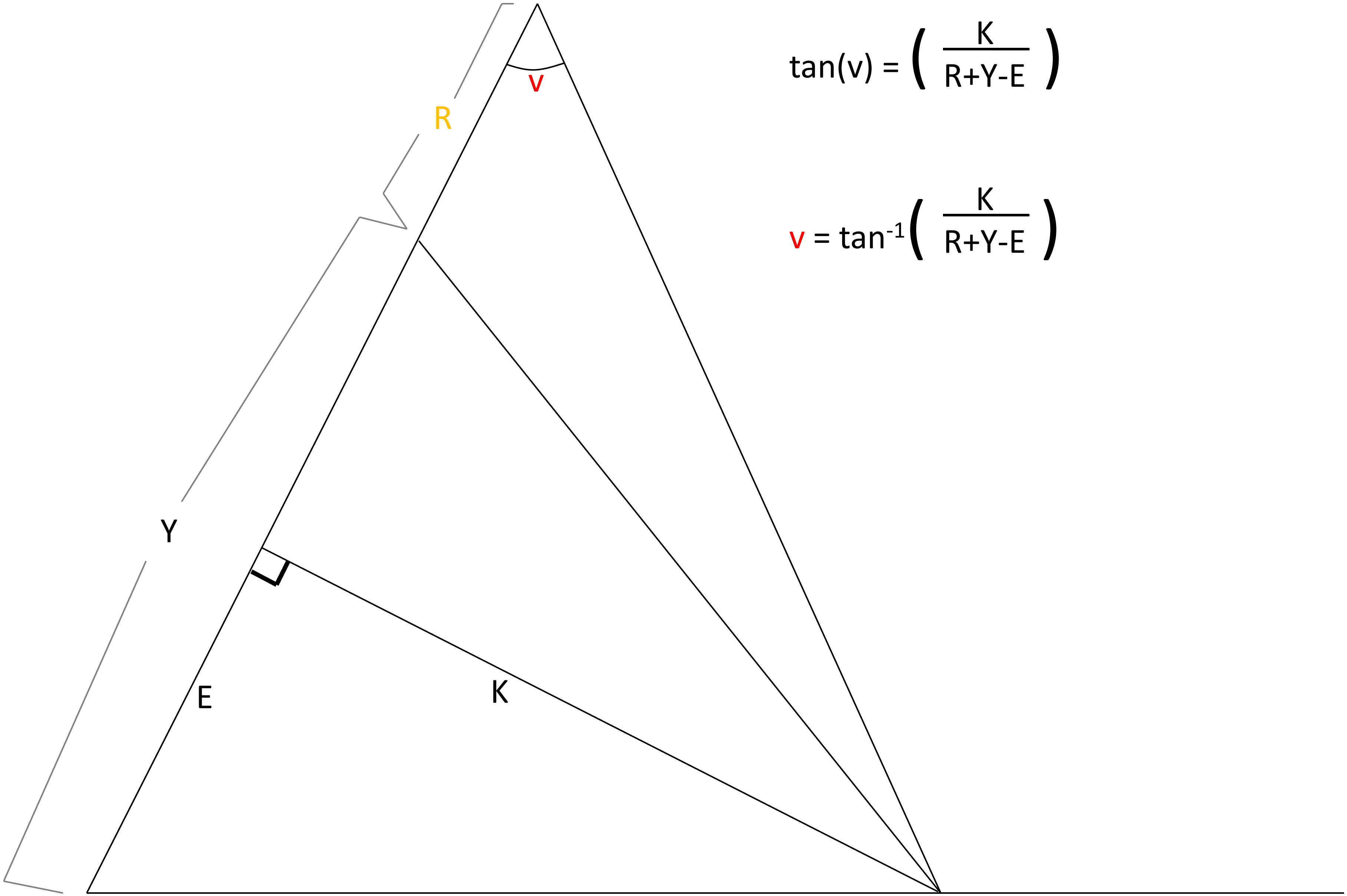
$$\frac{C}{\sin(\pi-\theta-o)} = \frac{Y}{\sin(\theta)}$$

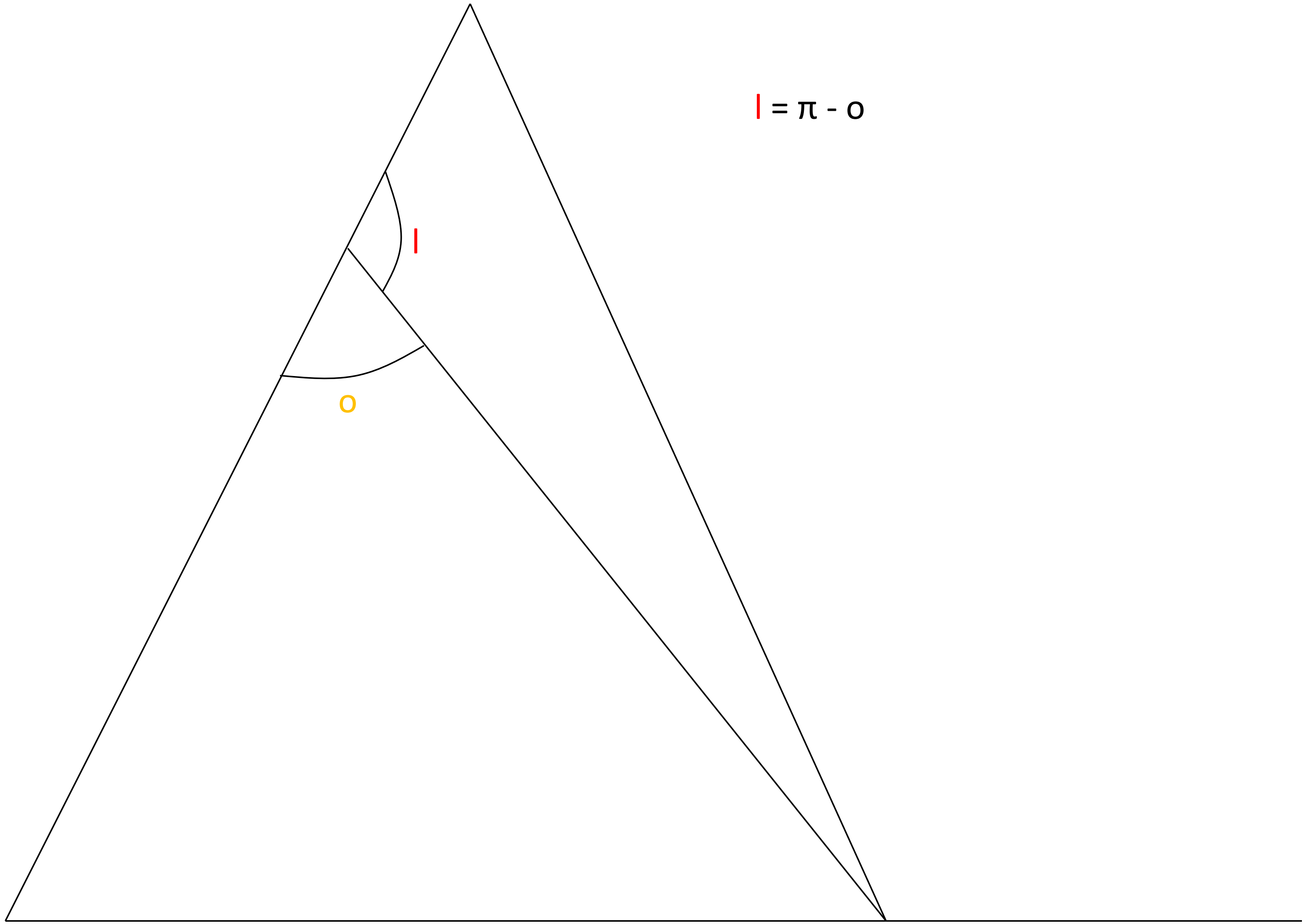
$$Y*\sin(\pi-\theta-o) = C*\sin(\theta)$$

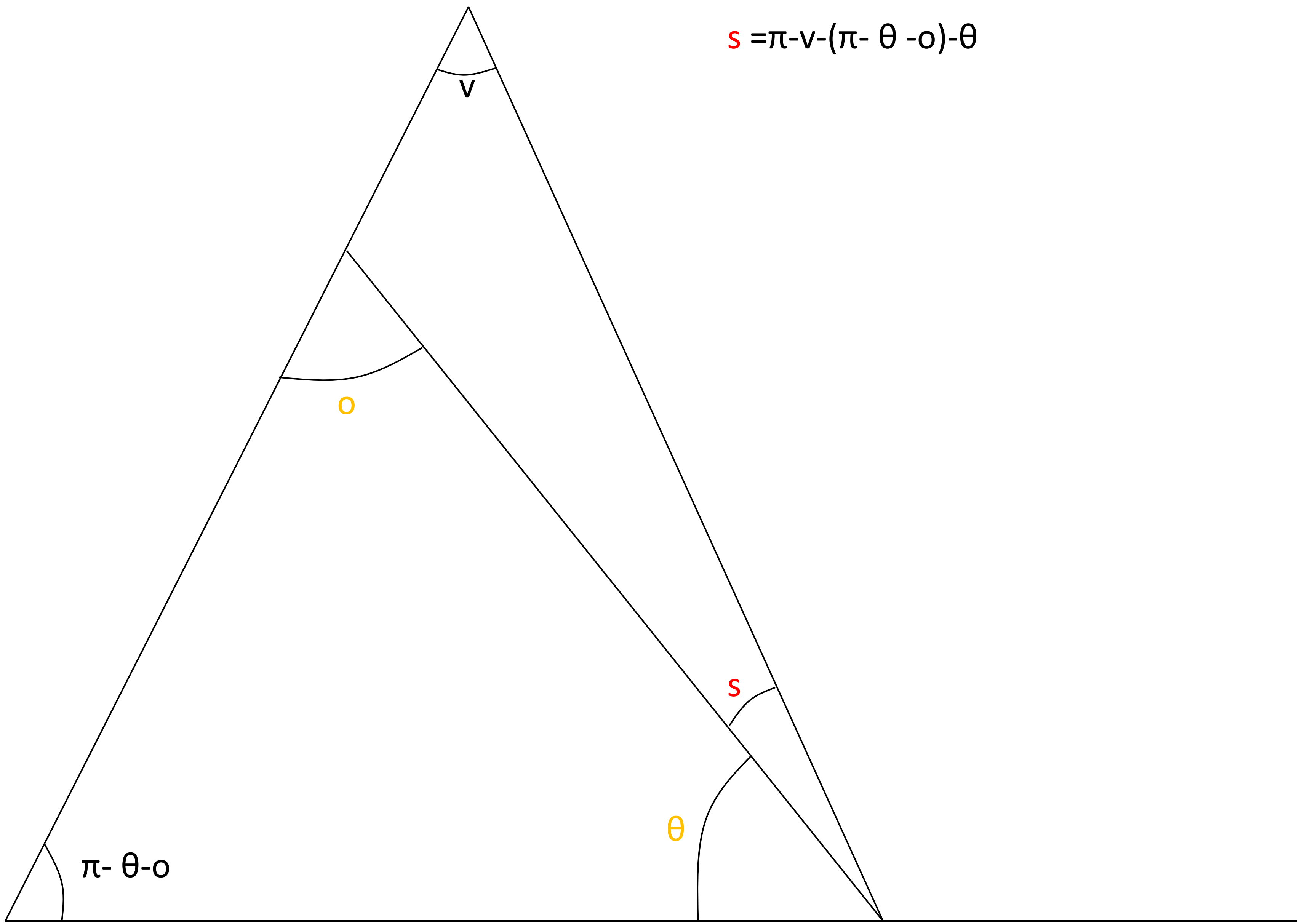
$$Y = \frac{C*\sin(\theta)}{\sin(\pi-\theta-o)}$$

$$\tan(v) = \left(\frac{K}{R+Y-E} \right)$$

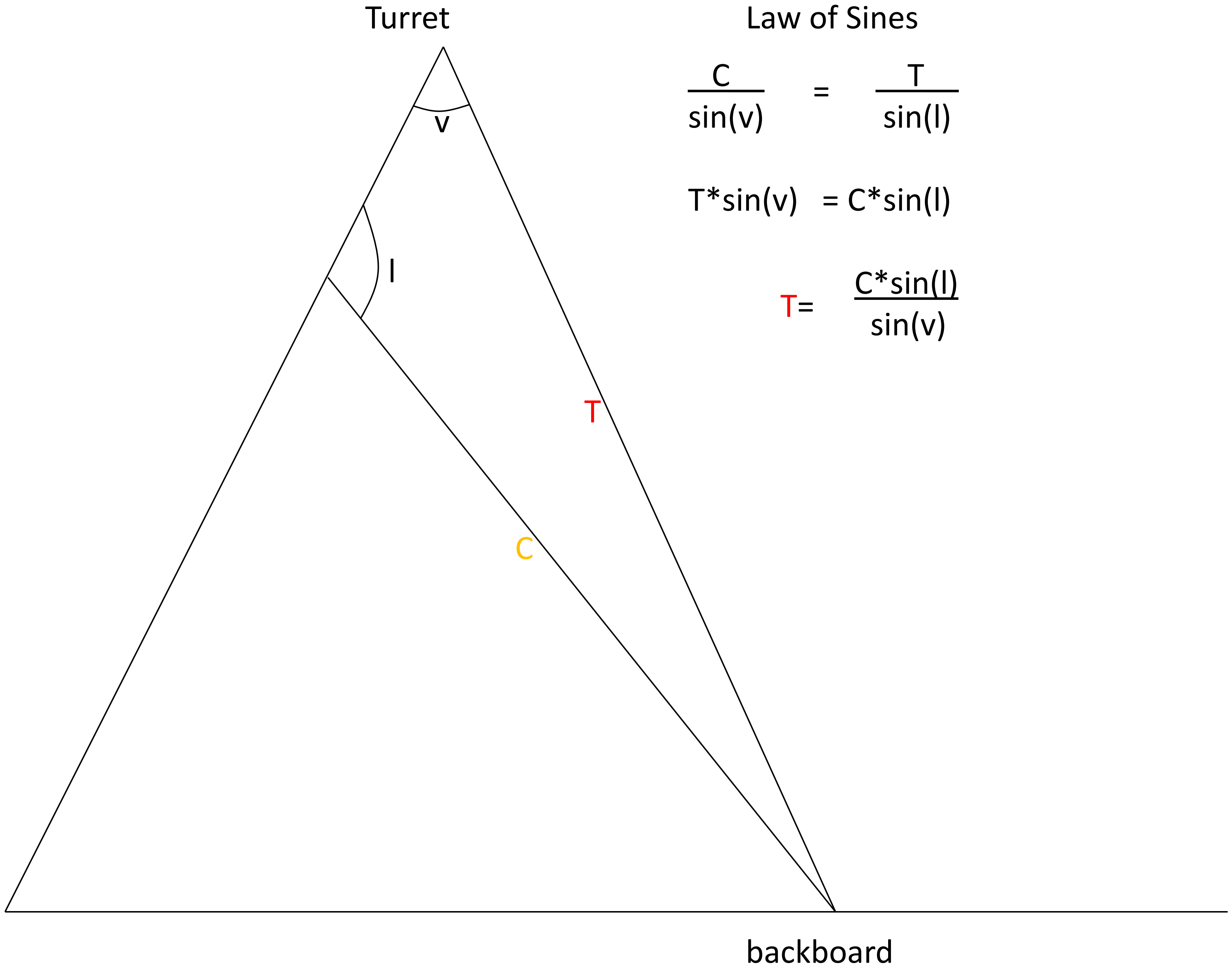
$$v = \tan^{-1}\left(\frac{K}{R+Y-E} \right)$$




I = π - o
I
o



s =π-v-(π- θ -o)-θ
v
o
s
θ
π- θ-o



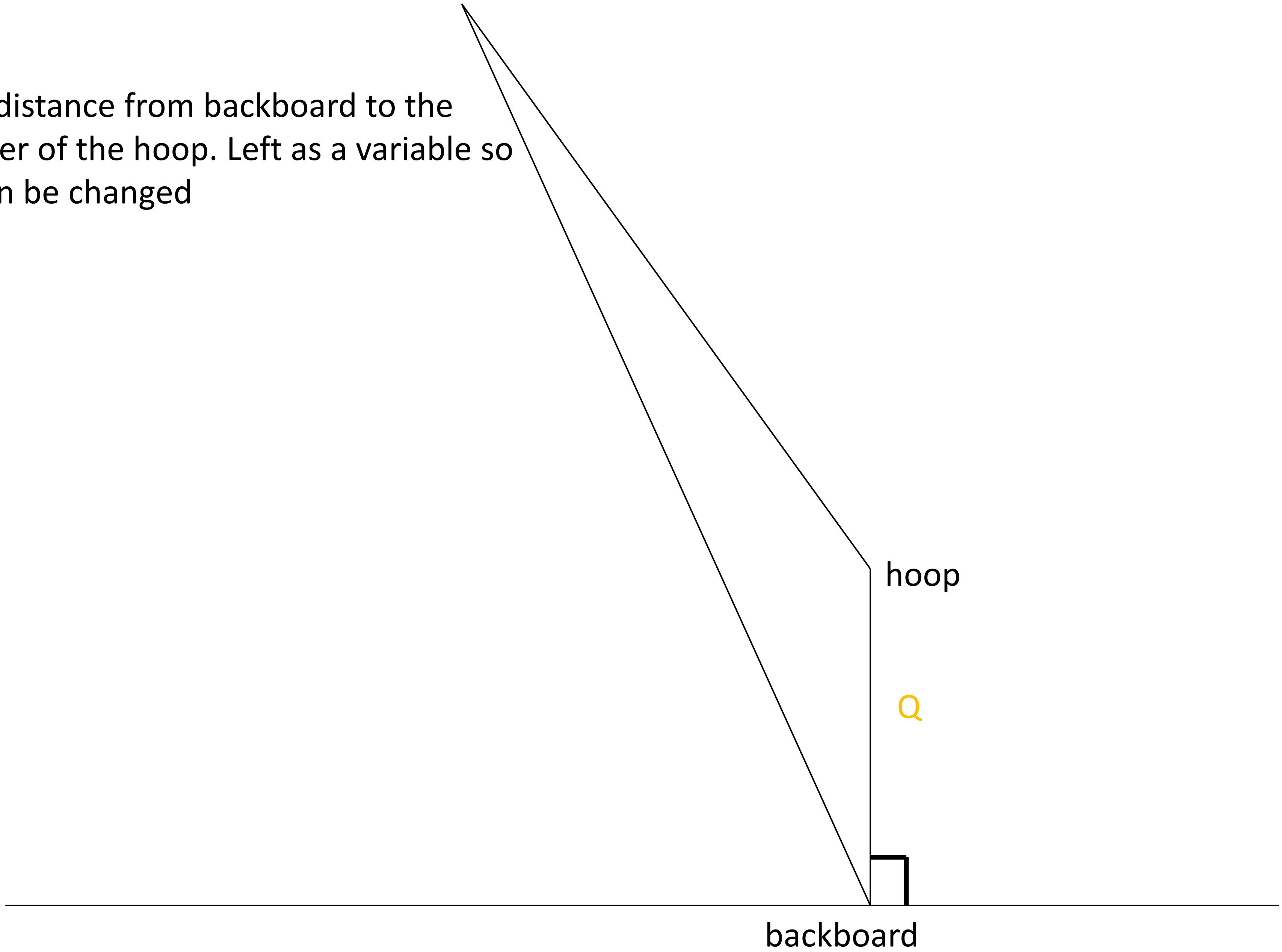
Law of Sines

$$\frac{C}{\sin(v)} = \frac{T}{\sin(l)}$$

$$T*\sin(v) = C*\sin(l)$$

$$T = \frac{C*\sin(l)}{\sin(v)}$$

Q = distance from backboard to the center of the hoop. Left as a variable so it can be changed



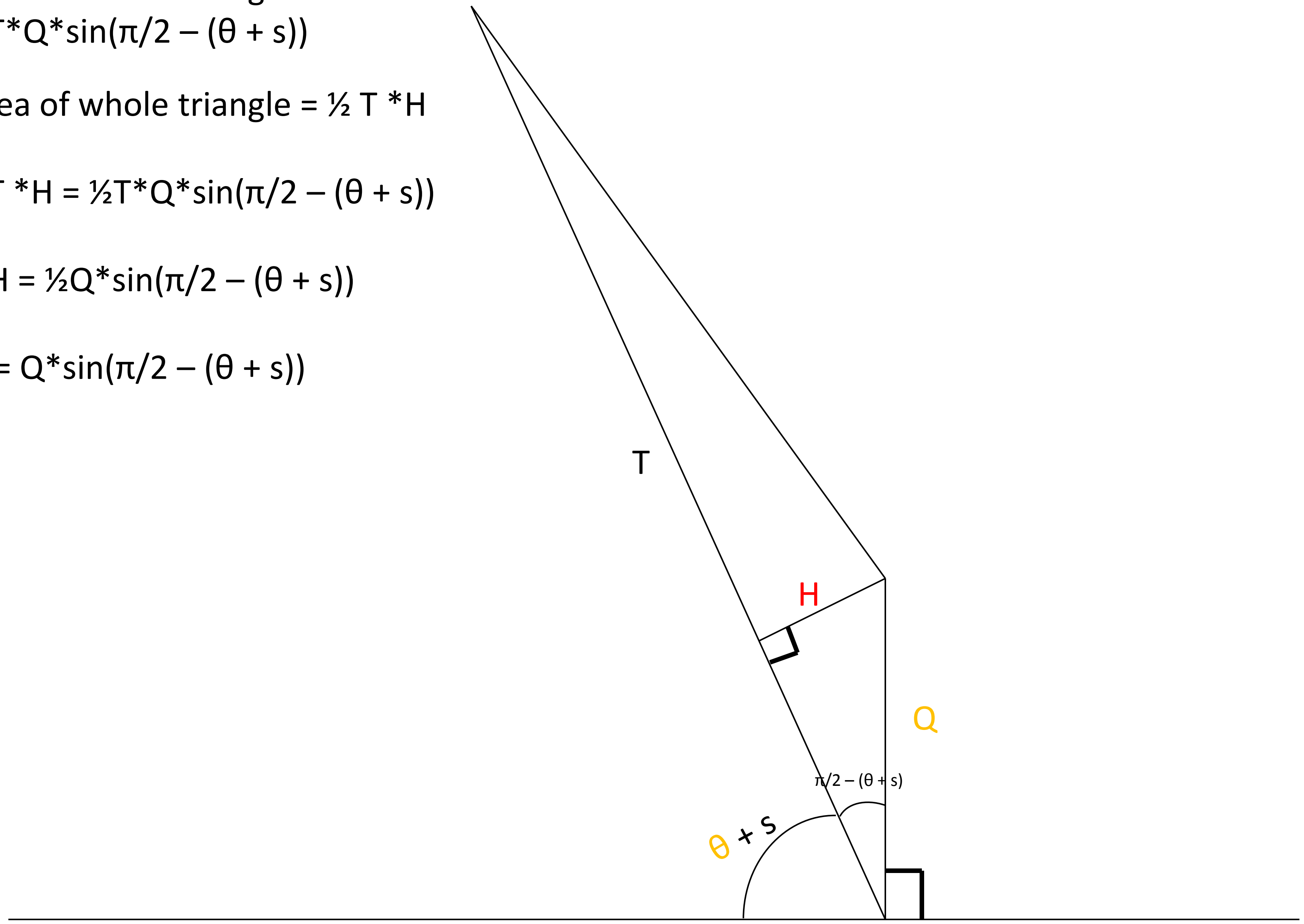
Area of whole triangle =
$\frac{1}{2}T*Q*\sin(\pi/2 - (\theta + s))$

Area of whole triangle = $\frac{1}{2} T *H$

$\frac{1}{2}T *H = \frac{1}{2}T*Q*\sin(\pi/2 - (\theta + s))$

$\frac{1}{2}H = \frac{1}{2}Q*\sin(\pi/2 - (\theta + s))$

$H = Q*\sin(\pi/2 - (\theta + s))$

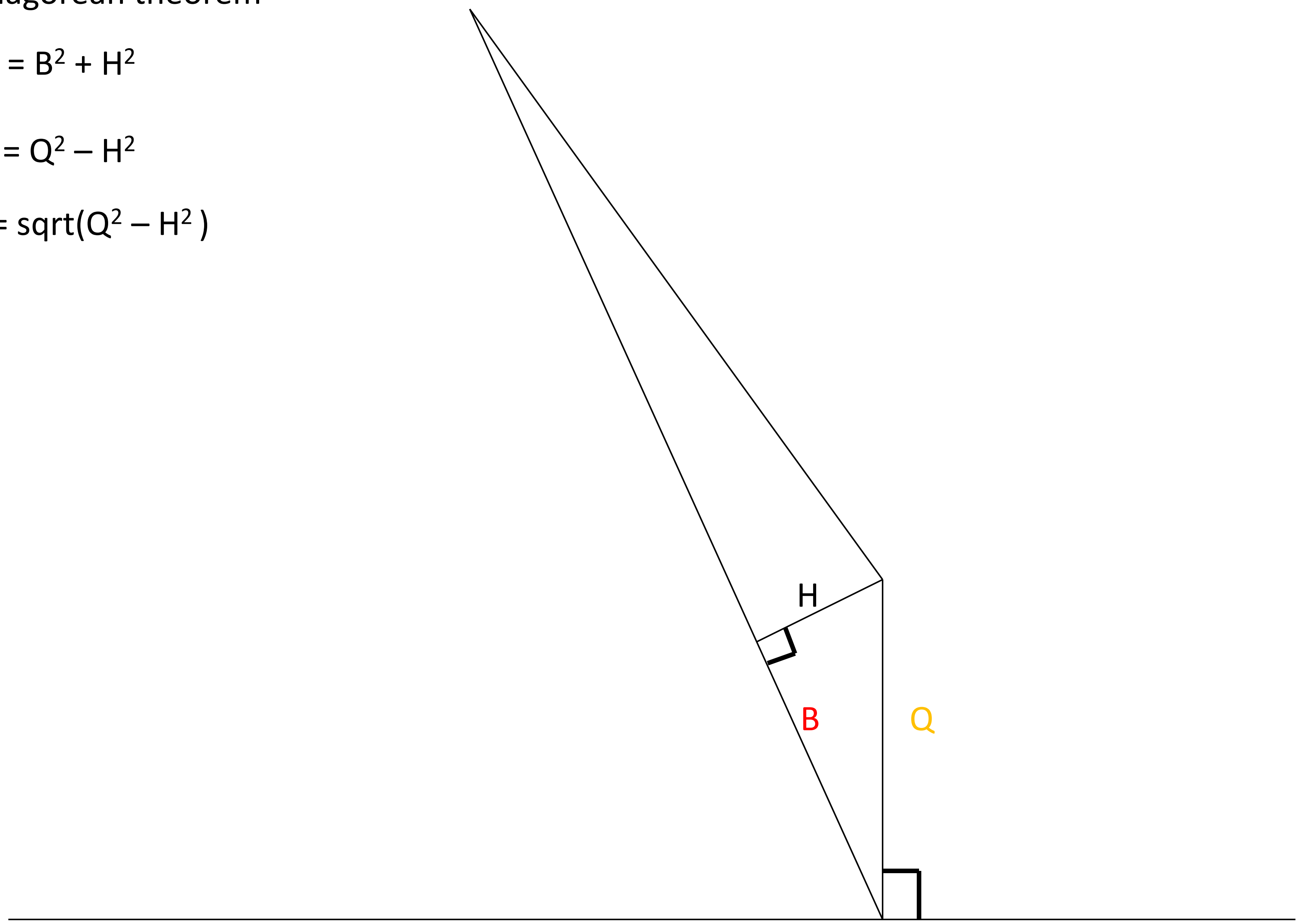


Pythagorean theorem

$Q^2 = B^2 + H^2$

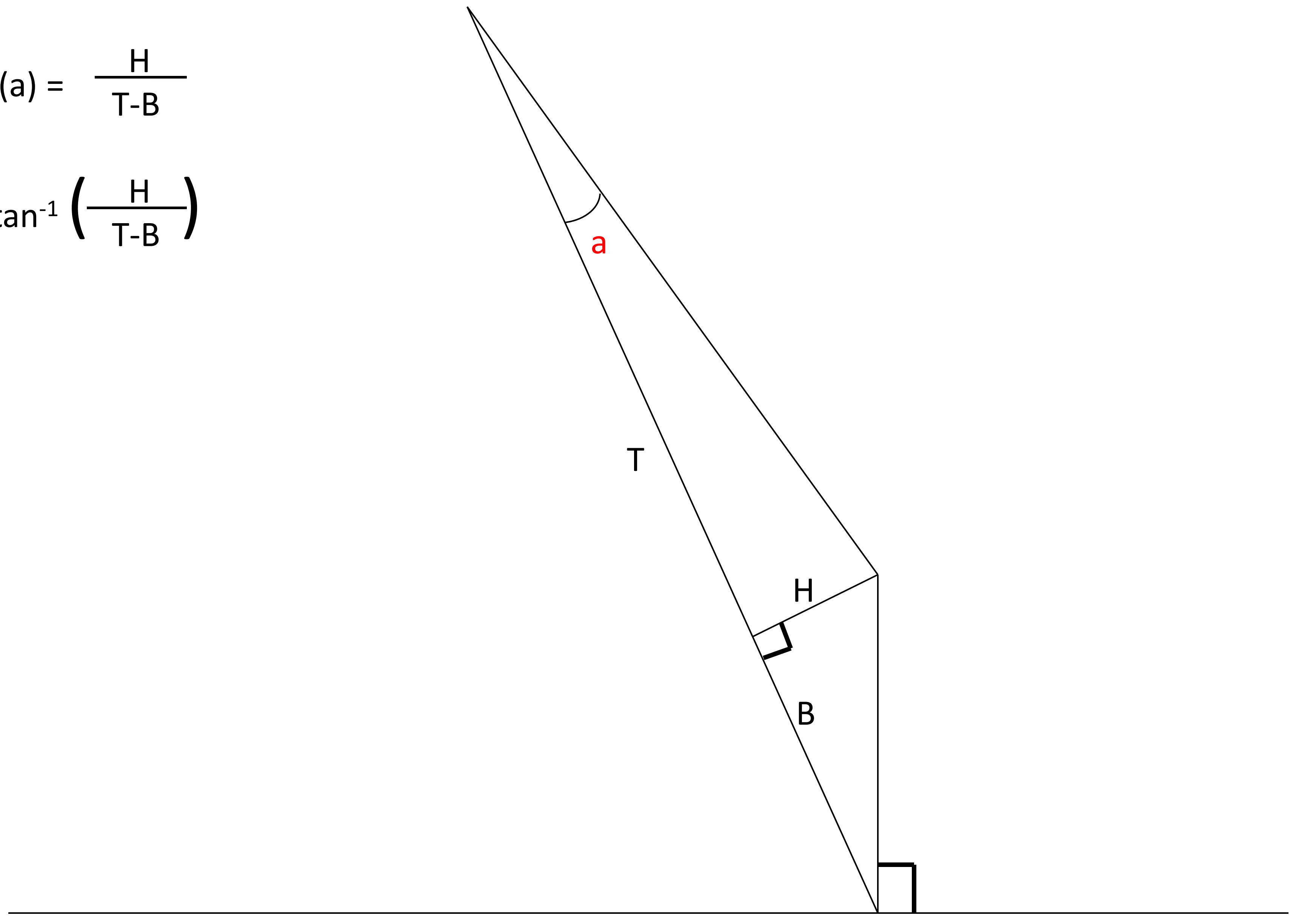
$B^2 = Q^2 - H^2$

$B = \mathrm{sqrt}(Q^2 - H^2)$



$$\text{Tan}(a) = \frac{H}{T-B}$$

$$a = \tan^{-1}\left(\frac{H}{T-B}\right)$$



Law of Sines

$$\frac{Q}{\text{Sin}(a)} = \frac{F}{\sin(\pi/2-(\theta+s))}$$

$$\text{Sin}(a)F = Q*\sin(\pi/2-(\theta+s))$$

$$F = \frac{Q*\sin(\pi/2-(\theta+s))}{\sin(a)}$$