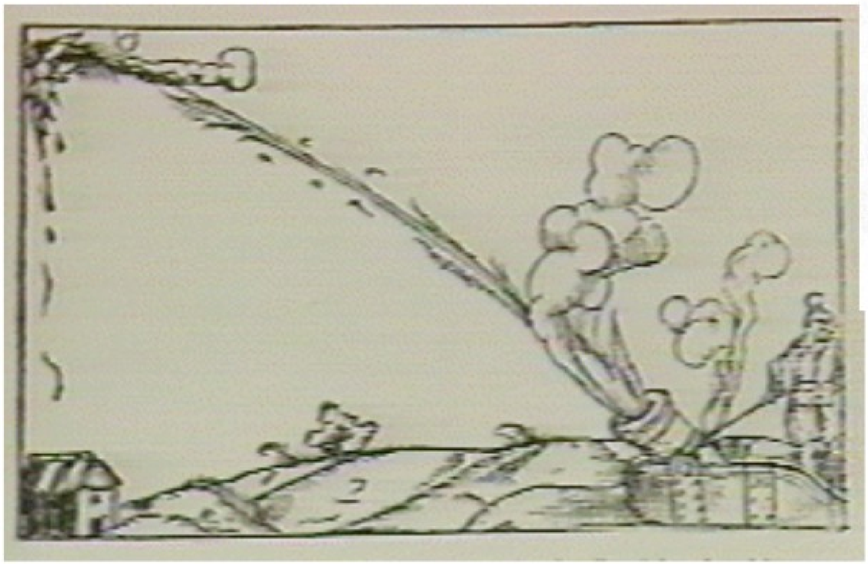
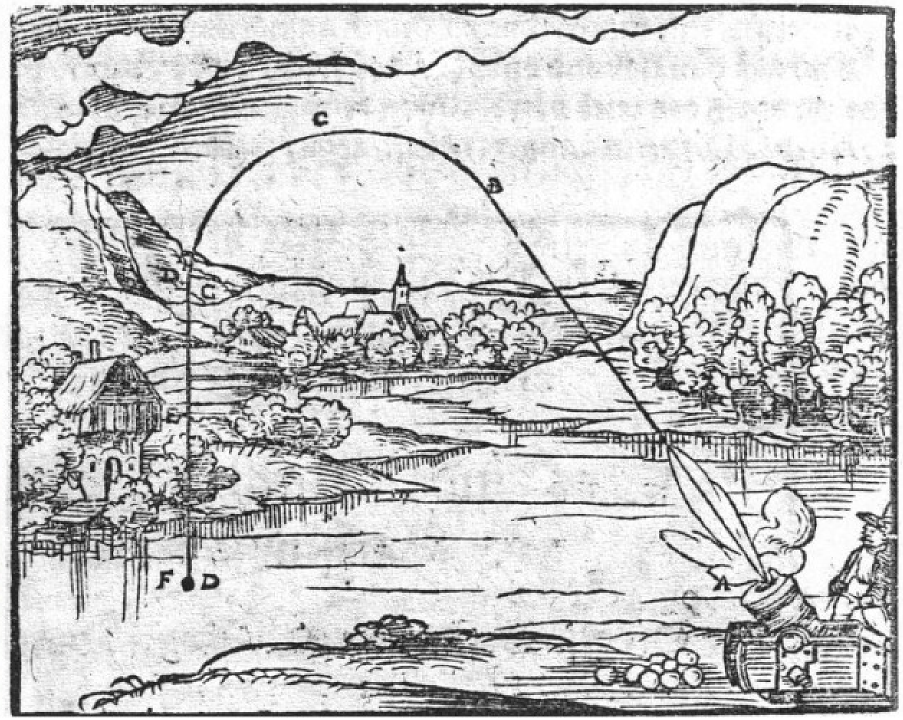
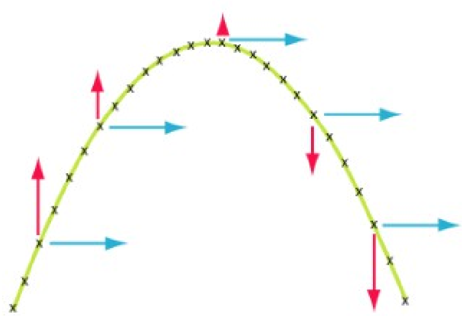
Vectors

Before 1638

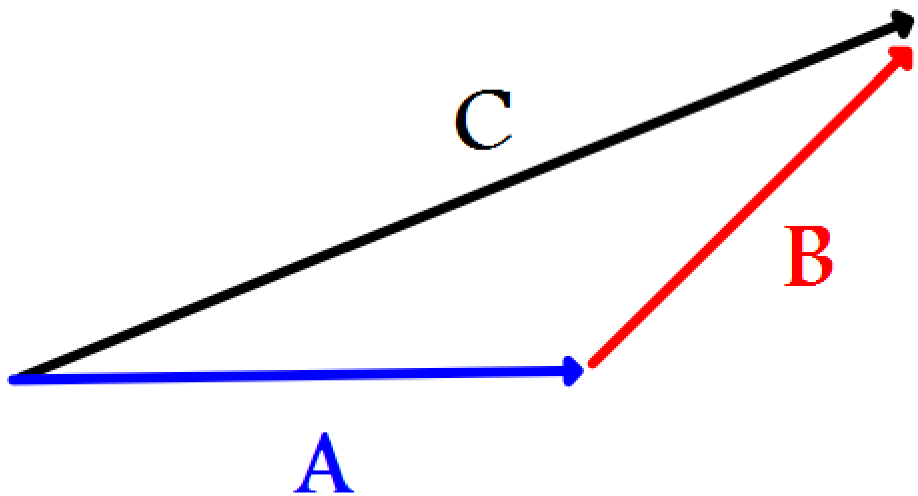




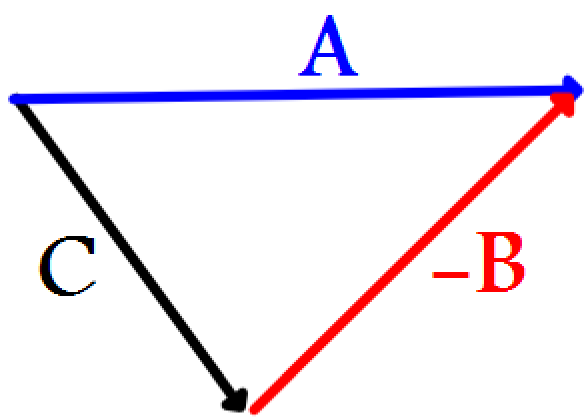


1638:

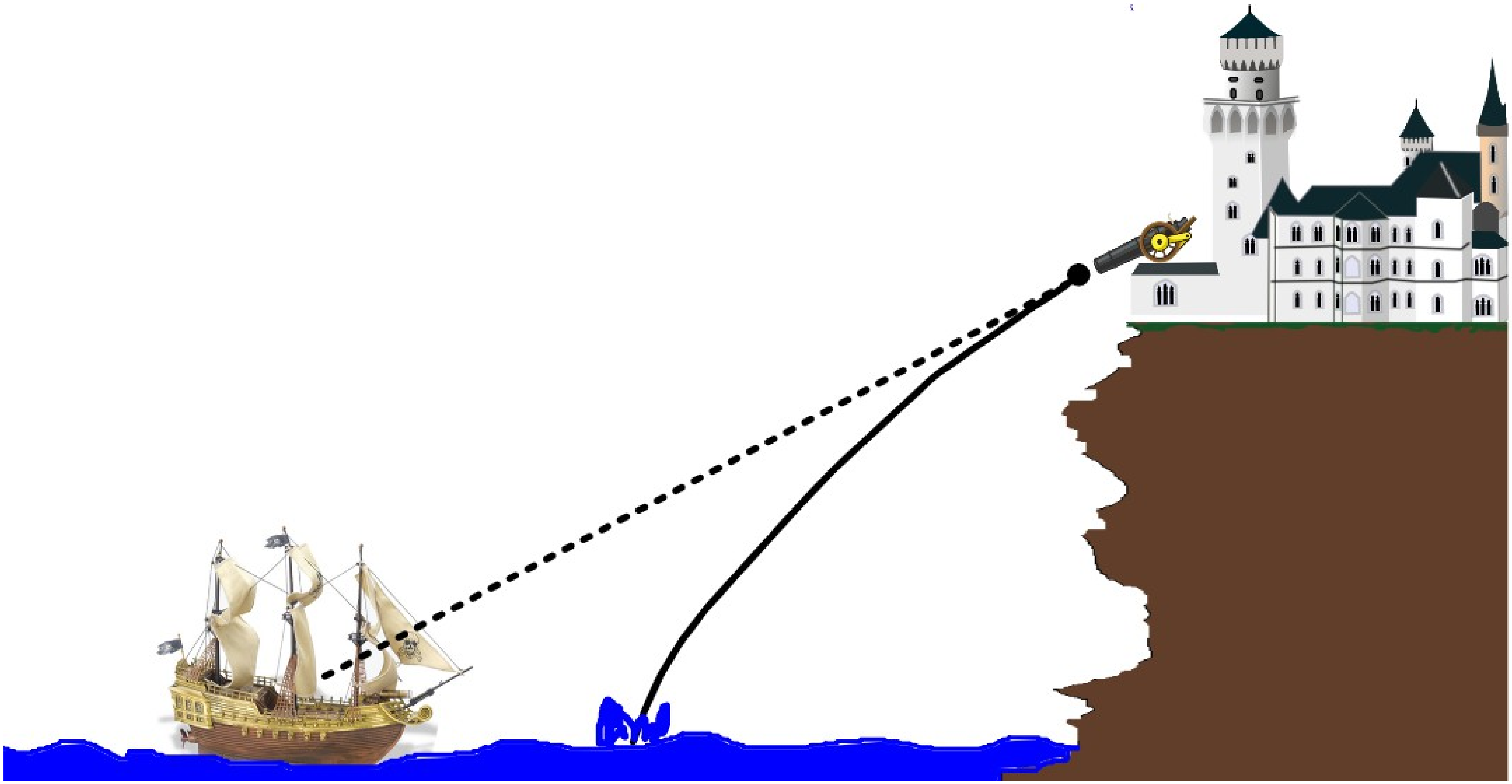
Galileo, Dialogues of the Two New Sciences

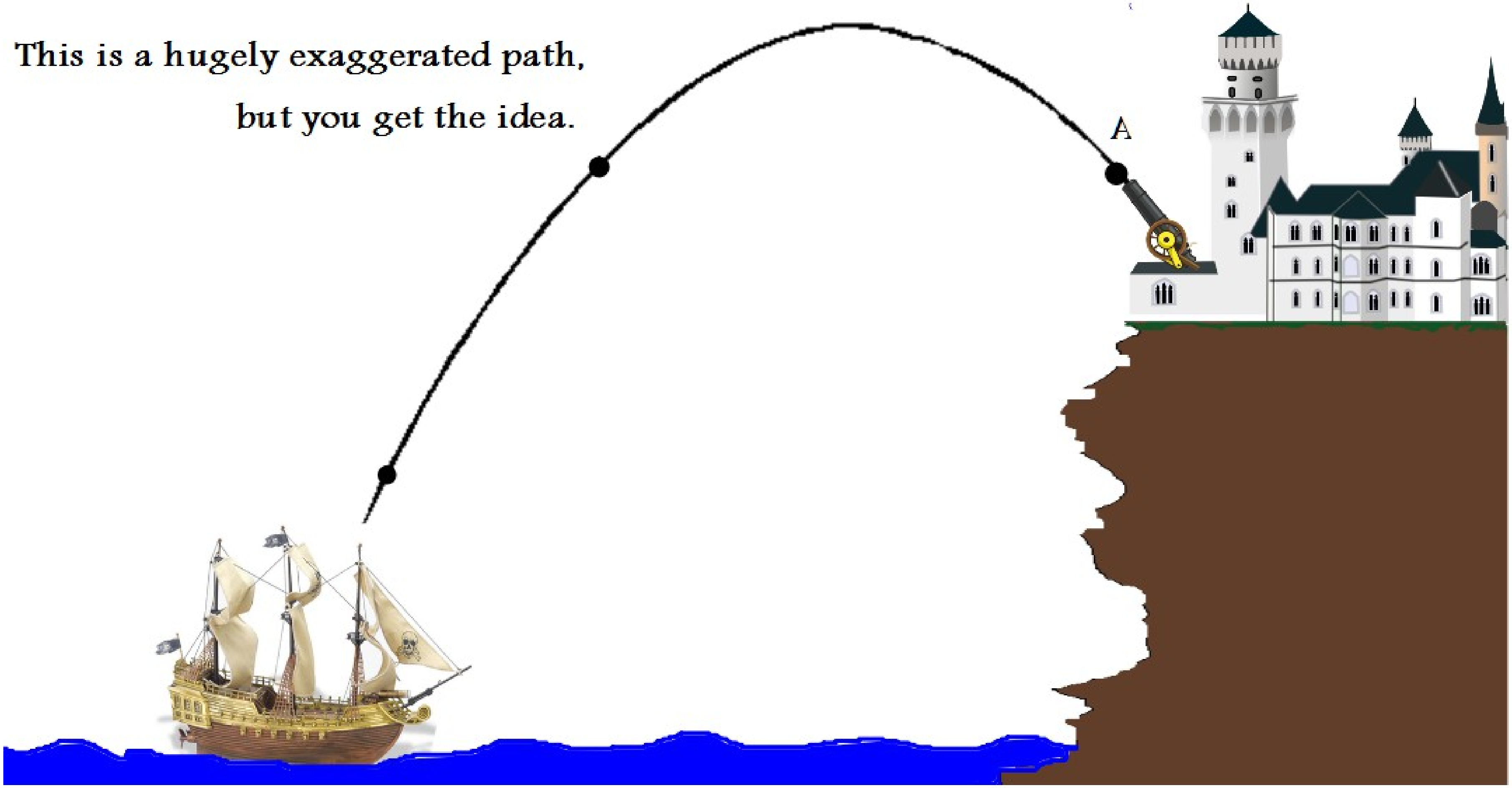


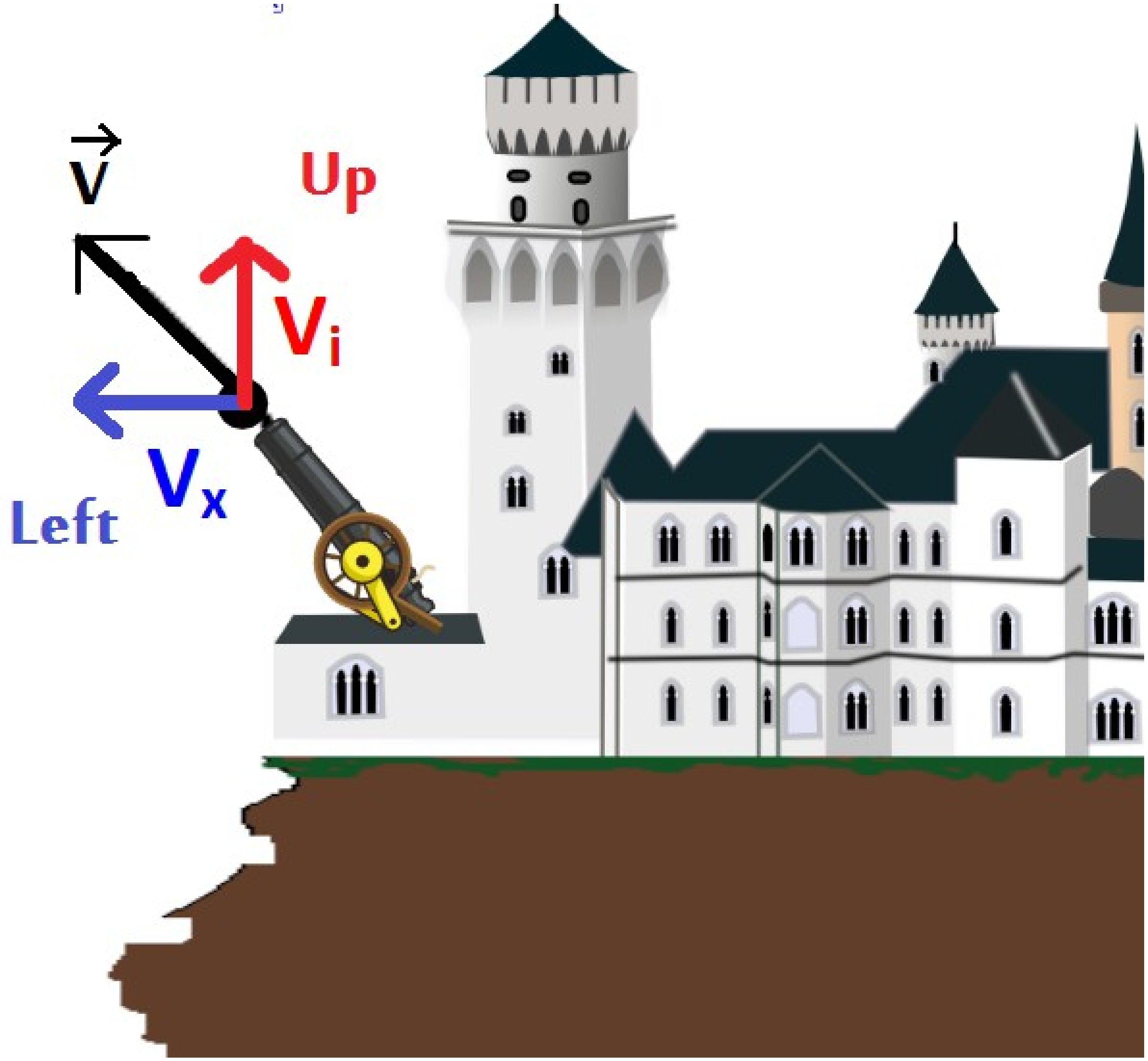
$$\vec{A} + \vec{B} = \vec{C}$$



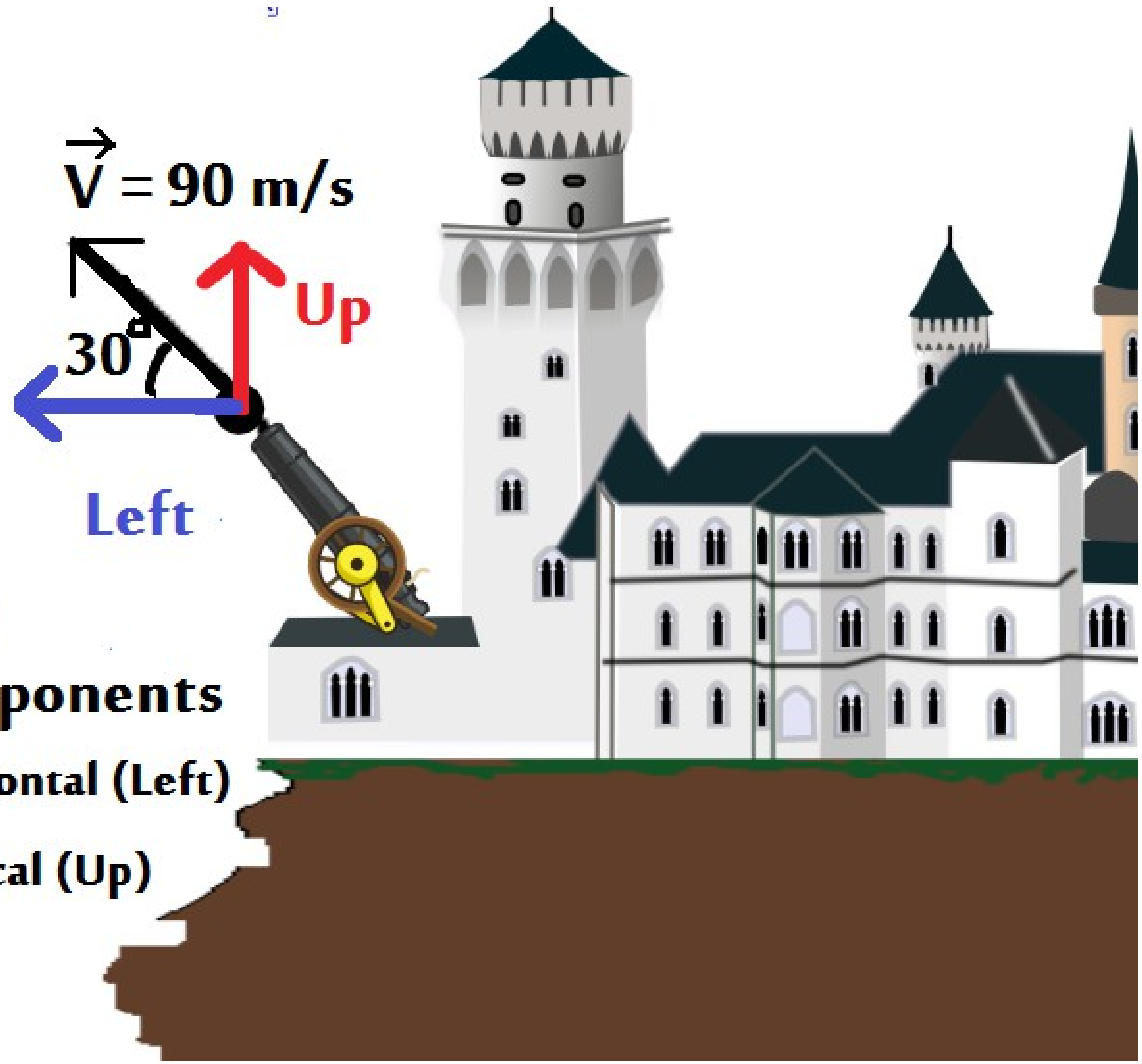
$$\vec{A} - \vec{B} = \vec{C}$$




This is a hugely exaggerated path,
but you get the idea.
A



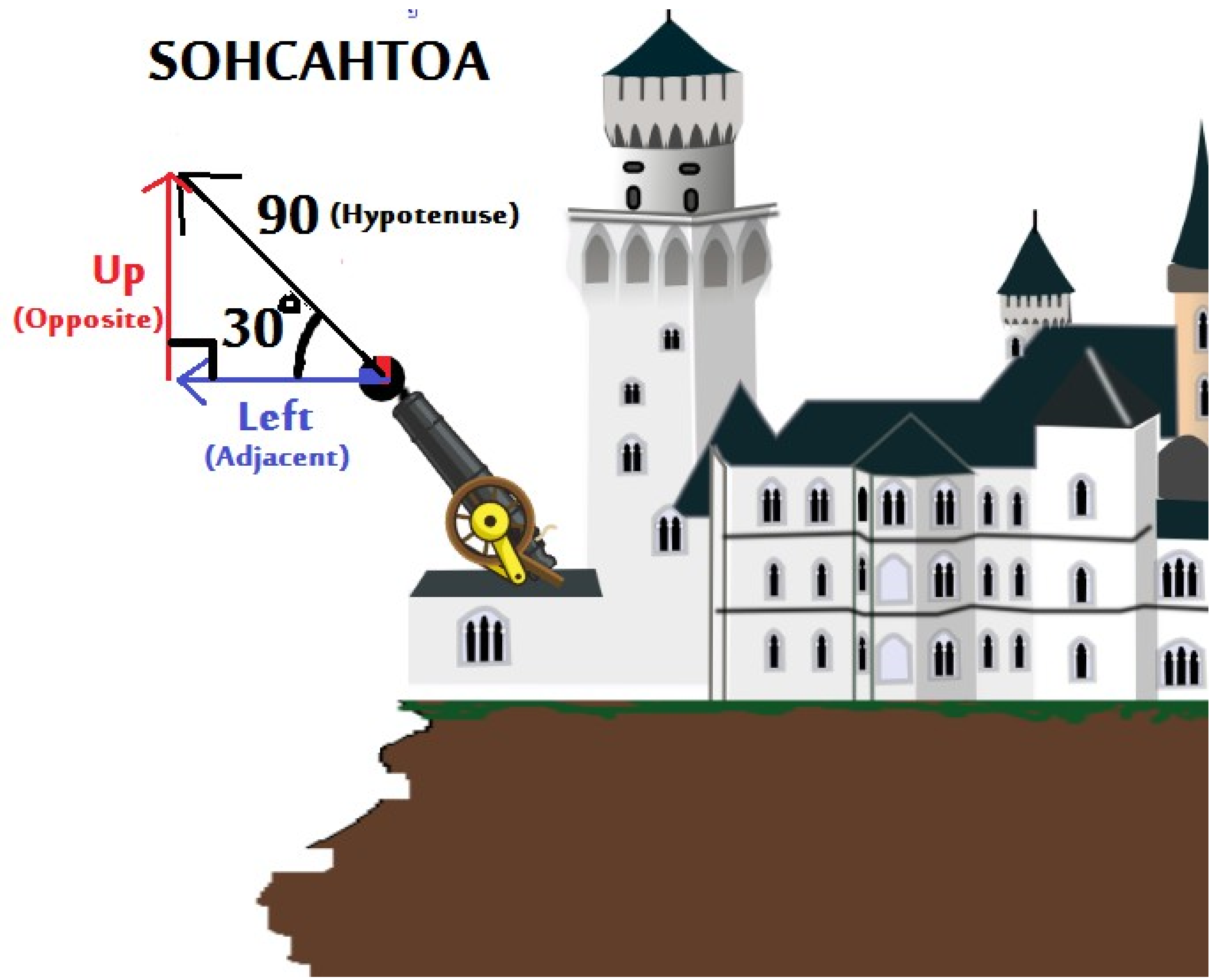
V
Up
Vi
Vx
Left



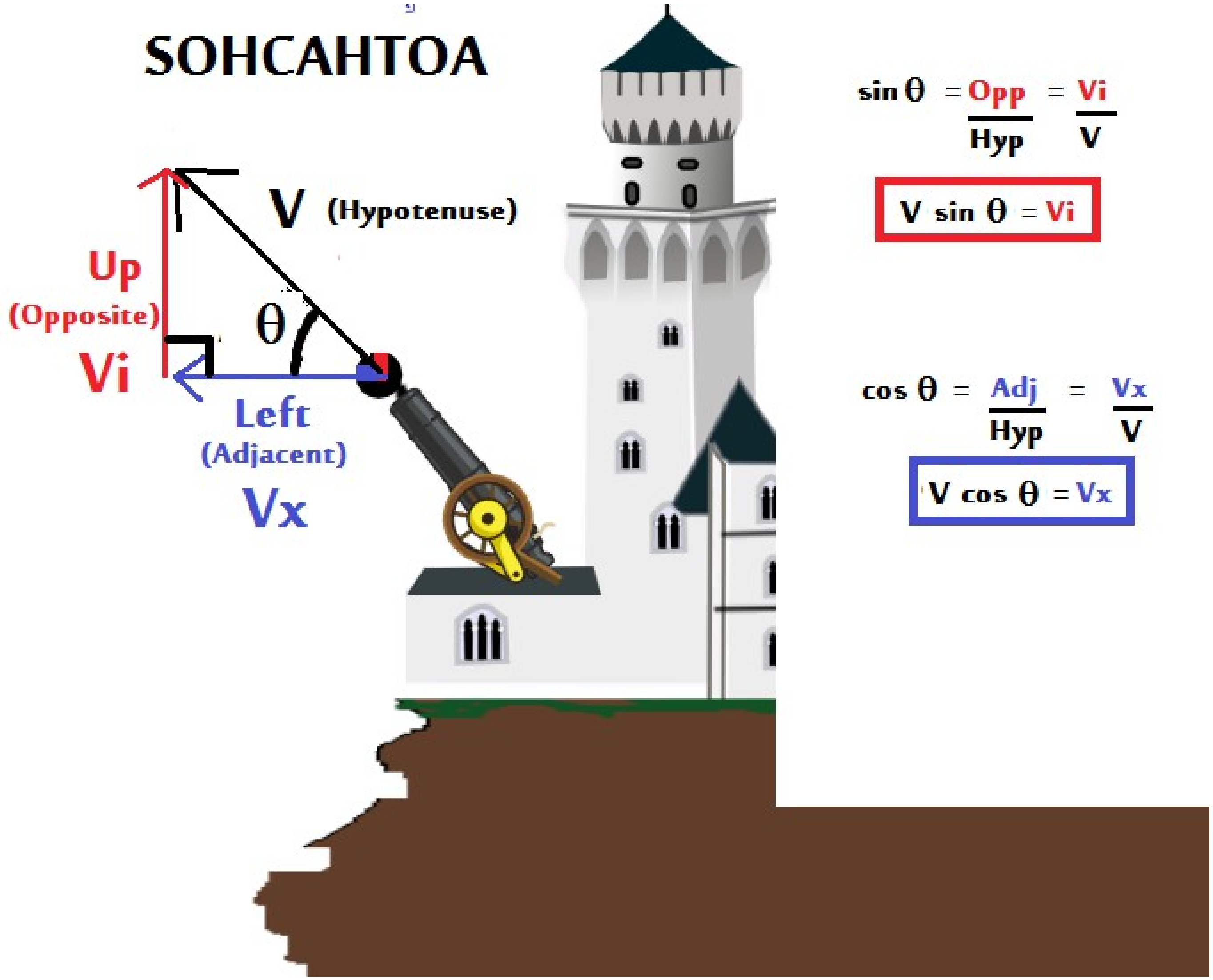
Two Components

> Horizontal (Left)

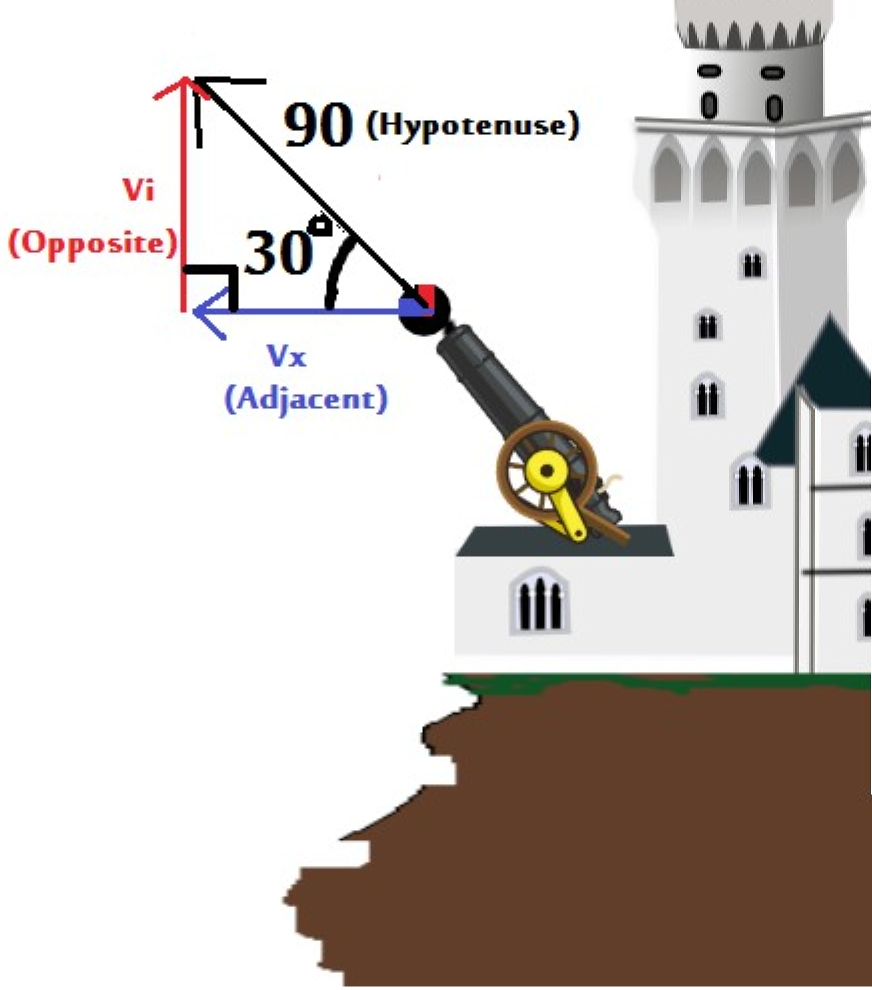
> Vertical (Up)


SOHCAHTOA
90 (Hypotenuse)
Up
(Opposite)
30°
Left
(Adjacent)

SOHCAHTOA


V (Hypotenuse)
Up
(Opposite)
Vi
θ
Left
(Adjacent)
Vx
sin θ = Opp / Hyp = Vi / V
V sin θ = Vi
cos θ = Adj / Hyp = Vx / V
V cos θ = Vx

SOHCAHTOA



$\sin 30 = \frac{\text{Opp}}{\text{Hyp}} = \frac{V_i}{90}$

$90 \sin 30 = V_i$

$V_i = 90 \sin 30$

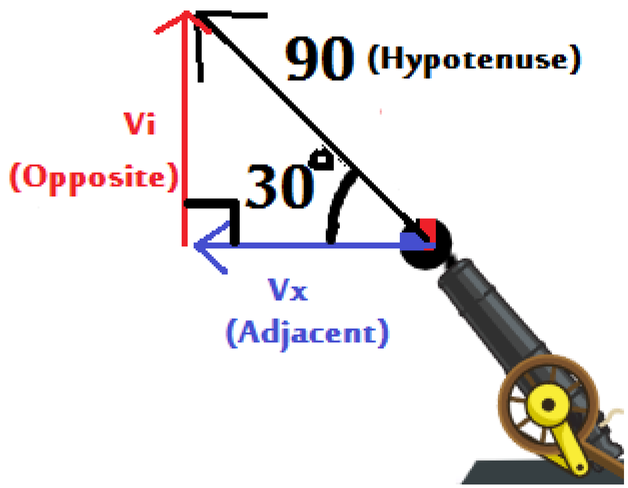
V_i = 45 m/s up

$\cos 30 = \frac{\text{Adj}}{\text{Hyp}} = \frac{V_x}{90}$

$90 \cos 30 = V_x$

$V_x = 90 \cos 30$

V_x = 78 m/s left



$\sin 30 = \frac{\text{Opp}}{\text{Hyp}} = \frac{\text{Vi}}{90}$

$90 \sin 30 = \text{Vi}$

$\text{Vi} = 90 \sin 30$

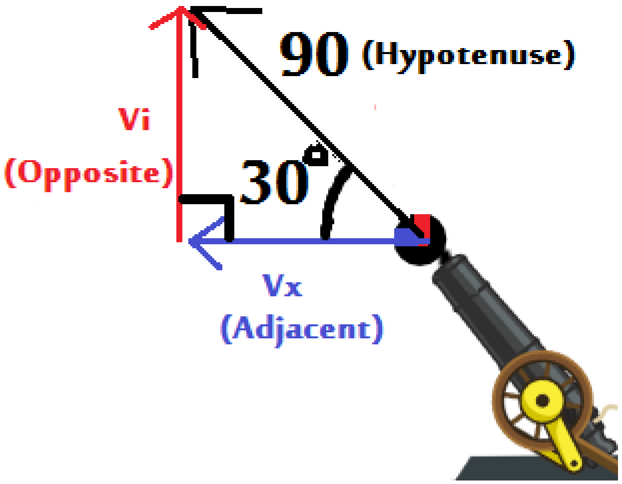
This will CHANGE over time because of gravity. → **Vi = 45 m/s up**

$\cos 30 = \frac{\text{Adj}}{\text{Hyp}} = \frac{\text{Vx}}{90}$

$90 \cos 30 = \text{Vx}$

$\text{Vx} = 90 \cos 30$

This is a CONSTANT VELOCITY. → **Vx = 78 m/s left**



$$\sin 30 = \frac{Opp}{Hyp} = \frac{Vi}{90}$$

$$90 \sin 30 = Vi$$

$$Vi = 90 \sin 30$$

Vi = 45 m/s up

Can be used in the eqns of constant acceleration

$$\cos 30 = \frac{Adj}{Hyp} = \frac{Vx}{90}$$

$$90 \cos 30 = Vx$$

$$Vx = 90 \cos 30$$

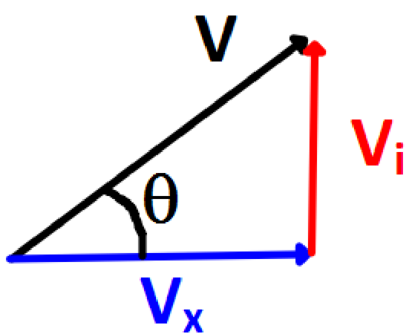
Vx = 78 m/s left

Can be used in equation

$$Vx = \frac{x}{t}$$

Working with Angles

The difference with these problems, is that we have one extra step.



$V_i = V \sin \theta$

$V_x = V \cos \theta$

A. Equations for an acceleration (y-direction, vertical)

$$a = \frac{v_f - v_i}{t}$$

$$x = v_i t + \frac{1}{2} a t^2$$

$$v_f^2 = v_i^2 + 2ax$$

$$x = \frac{(v_f + v_i)\, t}{2}$$

B. Equation for constant velocity (x-direction, horizontal)

$$V_x = \frac{x}{t}$$

V_x = velocity in x-direction