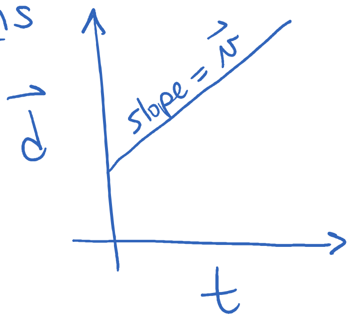
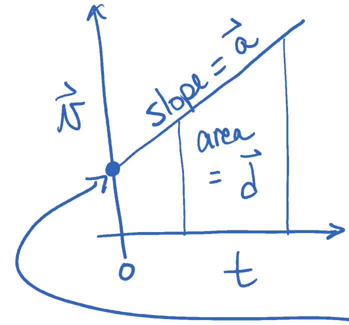
Notes: Kinematics (description of motion)

Graphs





$\vec{v} = \frac{\vec{d}}{t}$

$\vec{d} = \vec{v}t$

$t = \frac{\vec{d}}{\vec{v}}$

$$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$y = \underset{\text{slope}}{m}x + \underset{\text{y-int}}{b}$$

Formula (for constant/uniform acceleration only)

$$\vec{v}_{avg} = \frac{\vec{d}_{total}}{t_{total}}$$

$$\left(\frac{\vec{v}_f + \vec{v}_i}{2}\right) = \frac{d}{t}$$

↑ only if same length of time

$v_0 = v_i$

$$\vec{v}_f = \vec{v}_i + \vec{a}t$$

$$\vec{d} = \vec{v}_i t + \tfrac{1}{2}\vec{a}t^2$$

$$\vec{v}_f^{\,2} = \vec{v}_i^{\,2} + 2\vec{a}\vec{d}$$

signs and direction:

↑ up +

↓ down −

← left −   right → +

N +, S −, −W, E +

ex A ball drops from 5.0 m; what is its final velocity?

list variables:

$\vec{d} = -5.0\,m$

$\vec{a} = -9.81\,\frac{m}{s^2}$

$\vec{v}_i = 0\,\frac{m}{s}$

$\vec{v}_f = ?$

use formula that doesn't include time

$$\vec{v}_f^{\,2} = \vec{v}_i^{\,2} + 2\vec{a}\vec{d}$$

$$v_f = \sqrt{0^2 + 2(-9.81\,\tfrac{m}{s^2})(-5.0\,m)}$$

$$= \pm 9.9\,\frac{m}{s}$$

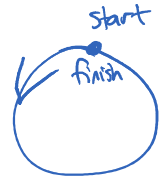
$$= -9.9\,\frac{m}{s} = 9.9\,\frac{m}{s}\ [\text{down}]$$

use formula that ...
include time

$= -4.4\frac{m}{s} = 4.4\frac{m}{s}$ [down]

Vectors: displacement (m), velocity ($\frac{m}{s}$), acceleration ($\frac{m}{s^2}$) ← include direction
(but not distance or speed ← scalar, no direction)

ex run around a 1.0 km → 1000 m track in 5.0 min $\times \frac{60\,s}{1\,\cancel{min}} = 300\,s$



speed = ?

$V = \frac{d}{t}$

$= \frac{1000\,m}{300\,s}$

$= 3.333\ldots\frac{m}{s} = 3.3\frac{m}{s}$

velocity = ?

$\vec{v} = \frac{\vec{d}}{t}$ ← "change in position" $d_f - d_i$

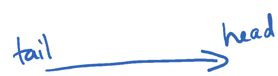
$= \frac{0\,m}{300\,s}$

$= 0\frac{m}{s}$

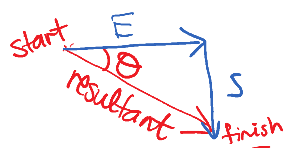
convert to $\frac{km}{h}$:

$$3.\overline{3}\frac{\cancel{m}}{\cancel{s}} \times \frac{1\,km}{1000\,\cancel{m}} \times \frac{3600\,\cancel{s}}{1\,h} = 12\frac{km}{h}$$

- add vectors head to tail



ex $\xrightarrow{E}$ + $\downarrow S$ =



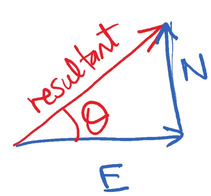
resultant [θ S of E]

- subtract vectors by adding the opposite of the 2nd vector:

ex $\xrightarrow{E}$ − $\downarrow S$

$\xrightarrow{E}$ + $(-\downarrow S)$

$\xrightarrow{E}$ + $\uparrow N$ =



- can add vectors by using components or $\boxed{\text{sin/cos Laws}}$

components ← workbook

sin/cos Laws ← we will use

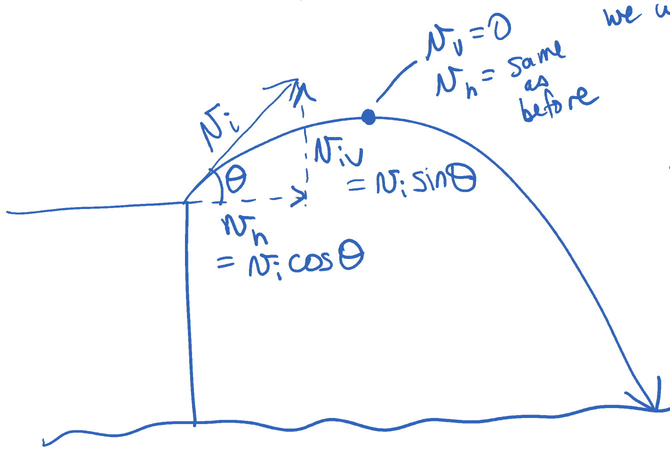
$N_v = 0$ ... same

workbook

we will use

Projectiles

v_v changes due to effects of gravity



v_h remains constant thru whole problem (ignore air friction)

To solve projectile problems:

1st find components of initial velocity: v_h, v_{vi}

2nd find "t" if not given

3rd

vertical

use uniform acceleration formula

t same

horizontal

$v_h = \frac{d_h}{t}$ ← range