Physics 2.1 - Motion

Time instant (時間瞬間): e.g. Starting time
Time interval (時間長度): e.g. 3 hours

SI unit (公制單位) of time: second (s)

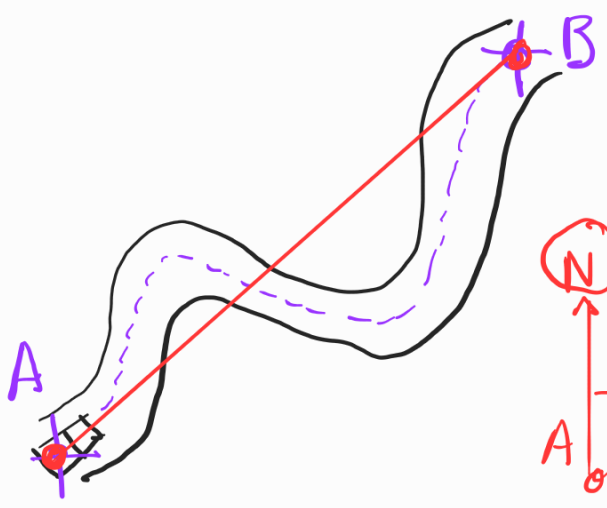
Measuring Time Interval:

1) Use stop watch (秒表) - less accurate
2) Use electronic light beam timer - more accurate
   (電子光感計時器)

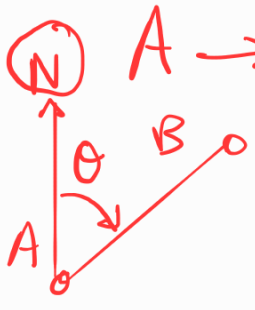
LENGTH

SI unit	metre (m) (米)
millimetre	$1\ mm = 10^{-3}\ m$
centimetre	$1\ cm = 10^{-2}\ m$
kilometre	$1\ km = 10^{3}\ m$

Distance vs Displacement



A → B distance travelled



A → B displacement includes magnitude and direction

Scalars vs Vectors

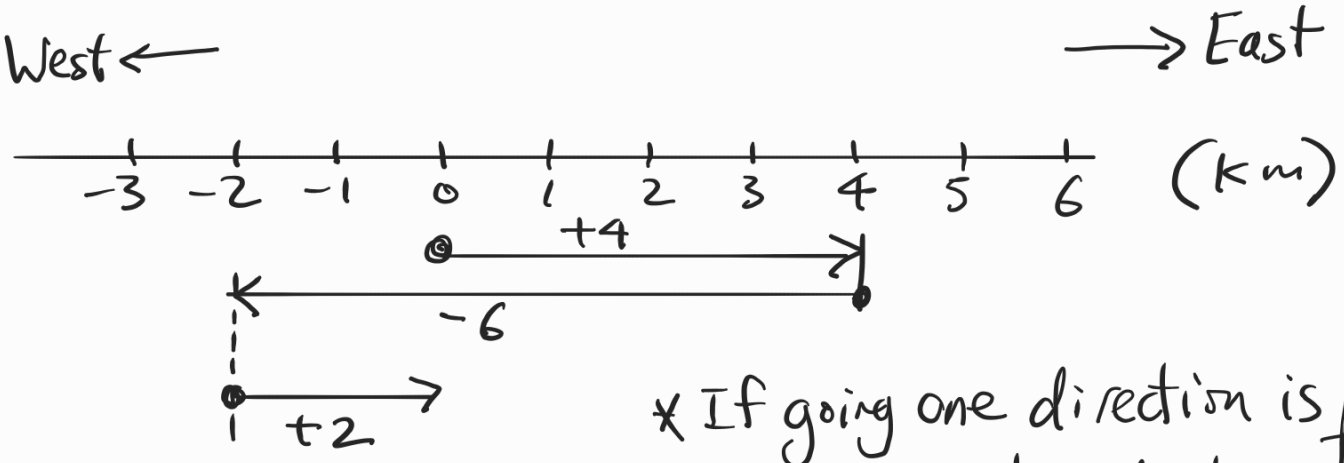
$\overrightarrow{AB}$ vector

$\overline{AB}$ scalar

Scalar : magnitude only (e.g. distance)

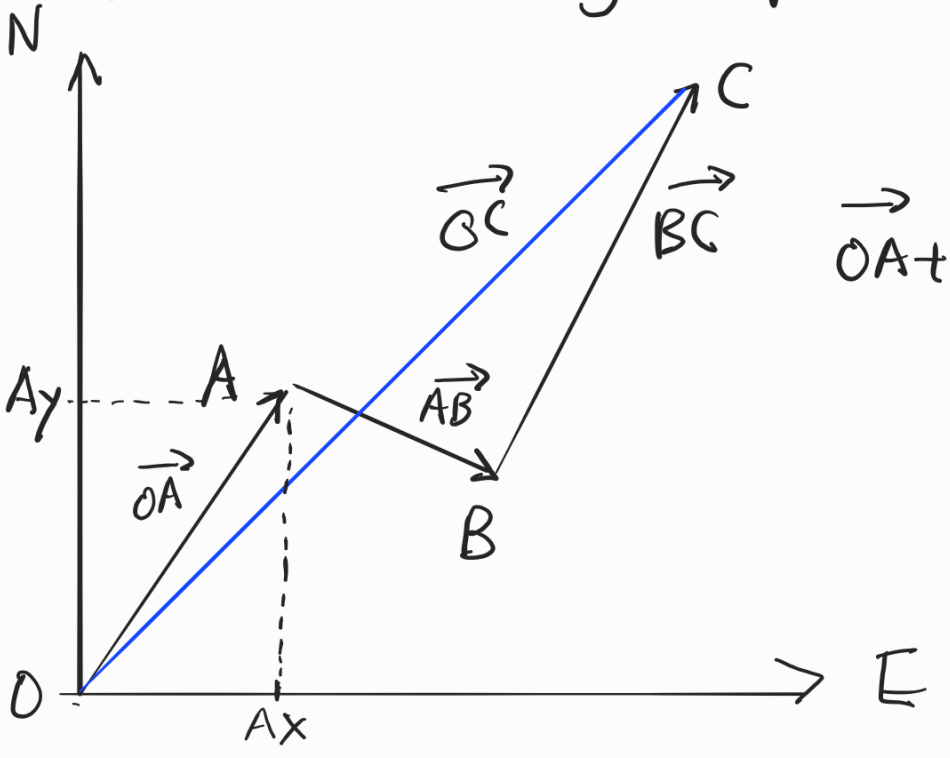
Vector : magnitude and direction (e.g. displacement)

Displacement along a straight line



* If going one direction is positive
* going opposition direction is negative

Displacement along a plane



$\overrightarrow{OA} + \overrightarrow{AB} + \overrightarrow{BC} = \overrightarrow{OC}$

Speed (scalar) vs Velocity (vector)

Speed is the distance travelled per unit time (m/s) (or ms^{-1})

vs Instantaneous Speed (瞬間速度) : Speed at that moment
Average Speed (平均速度) : speed over a period of time

Average Speed = total distance / total time (ms^{-1})

Velocity = displacement / time (ms^{-1})

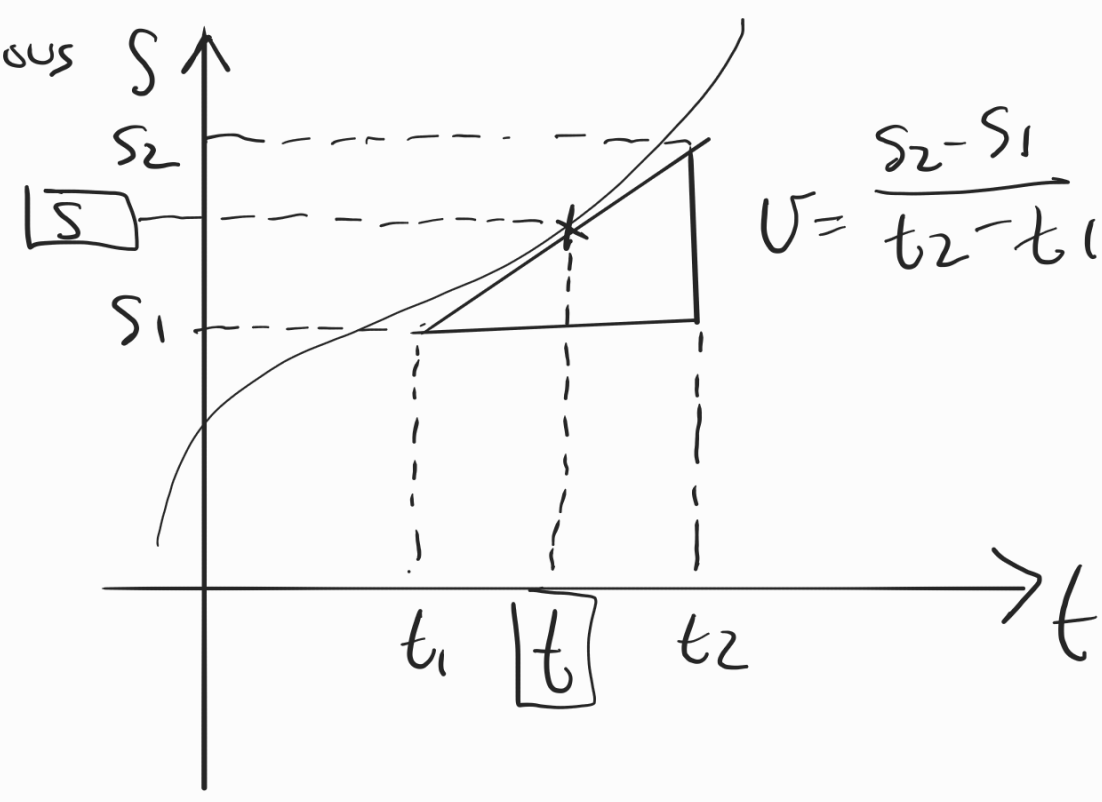
Average Velocity = overall displacement / total time (ms^{-1})

$$v = \frac{s}{t}$$

← displacement

← time

instantaneous Velocity



$$v = \frac{s_2 - s_1}{t_2 - t_1}$$

Acceleration (加速) Deceleration (減速)

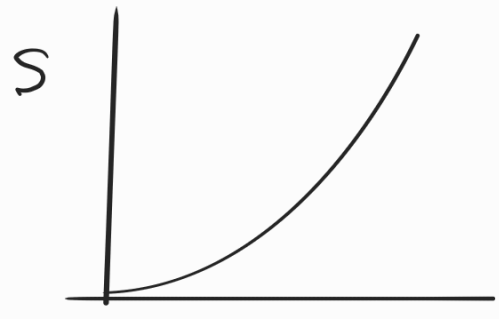
change in velocity per unit time ($m s^{-2}$)

for uniform acceleration $a = \frac{v - u}{t}$

u : initial velocity
v : final velocity t : time taken

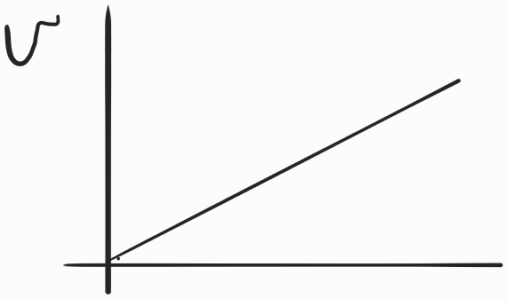
Unit of a $\Leftarrow$ $+ m s^{-2}$ → acceleration
$- m s^{-2}$ → deceleration

Motion Graphs



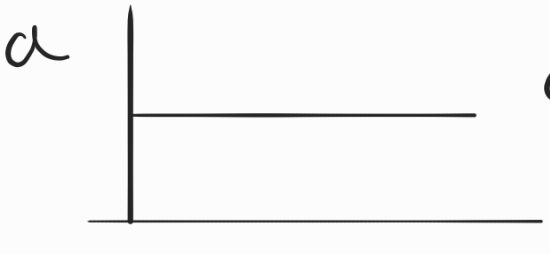
increase in gradient

* slope of s-t graph = velocity



straight line

* area under v-t graph = displacement



constant

* slope of v-t g = acceleration

* area under a-t g = velocity

Equations of uniform accelerated motion

$s = \frac{1}{2}(u+v)t$ ~~(4)~~

$s = ut + \frac{1}{2}at^2$ ~~(5)~~

$v = u + at$ ~~(6)~~

$v^2 - u^2 = 2as$ ~~(7)~~

u : initial velocity
v : final velocity
a : acceleration
t : time
s : displacement

Vertical Motion under Gravity

acceleration due to gravity (g) : $9.81\ ms^{-2}$ ($1g$)

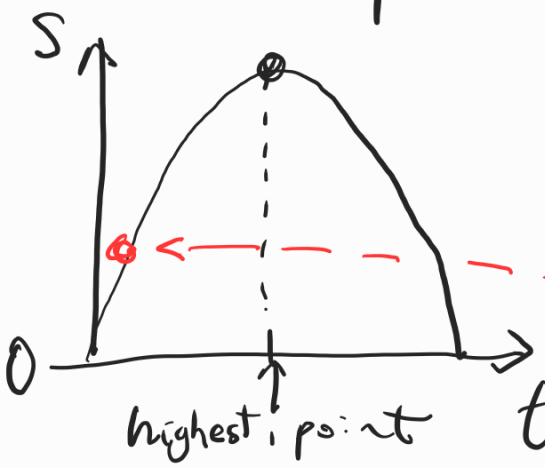
* Neglect air resistance
* Heavy or light objects, same g

Solving problems related to gravity motion – use the same set of "uniform accelerated motion" equation

Example

A ball is thrown upwards $u = +29.43\ ms^{-1}$

Find the path of motion. Neglect air resistance.

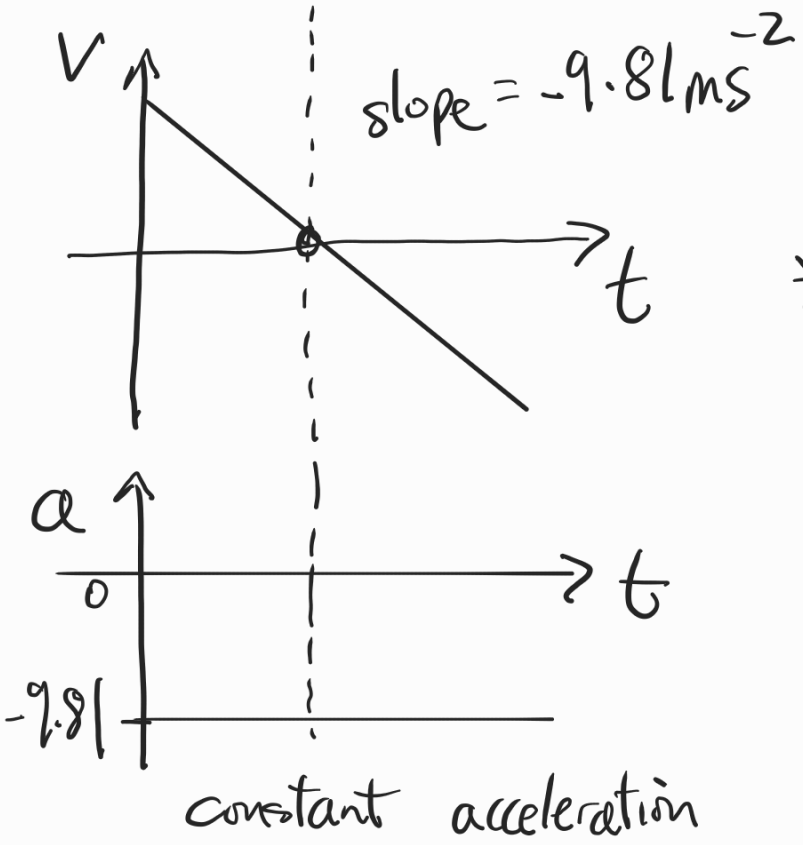


when $t = 1$

$* s = ut + \frac{1}{2}at^2$

$= 29.43 + \frac{1}{2}(-9.81)1^2$

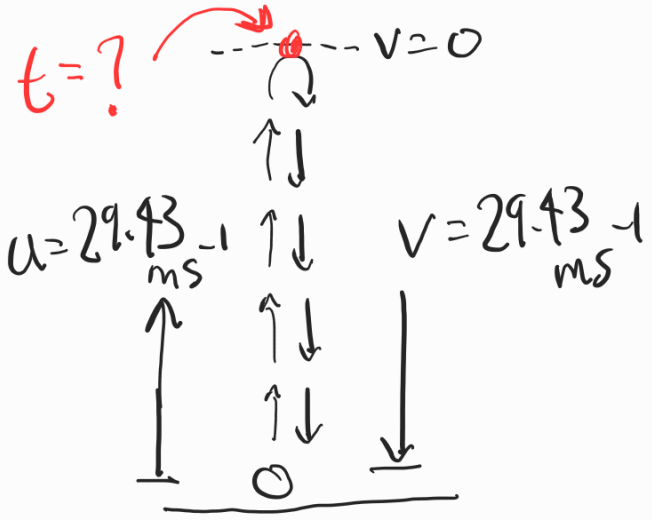
$= +19.62\ m$ //



constant acceleration

* At highest point $v = 0$

* Then it falls down with $a = 9.81\ ms^{-2}$



use: $v = u + at$

$29.43 = 0 - 9.81t$

find t

END
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