state what is meant by speed and velocity

Speed and Velocity

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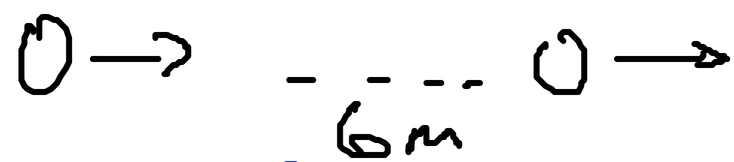
Speed = distance a body travels in unit time.
e.g. in 1 s, 1 h, or 1 day.

e.g. 2 s



Ball travels $\frac{6}{2} = 3$ m in 1 s

Speed = 3 m/s.

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

speed: v; distance: s; time: t

Velocity MEANS speed AND direction.

- just means that velocity must have both info.

e.g.

Velocity : 3 m/s, north   3 m/s, east

difference velocities !

calculate average speed using distance travelled / time taken

Average Speed

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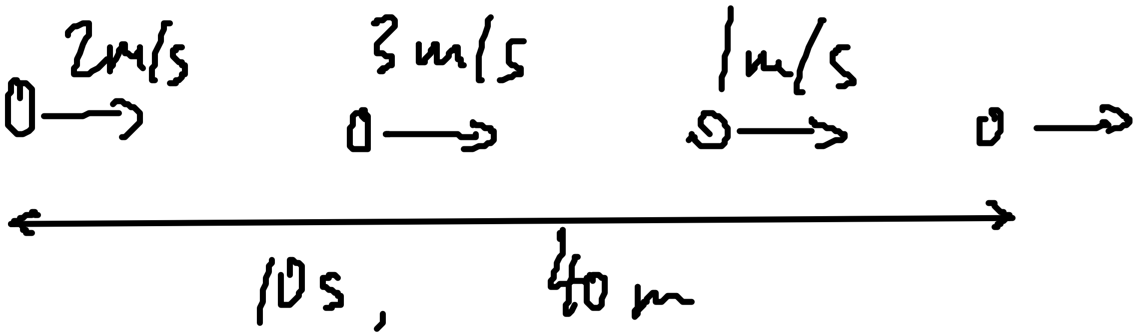
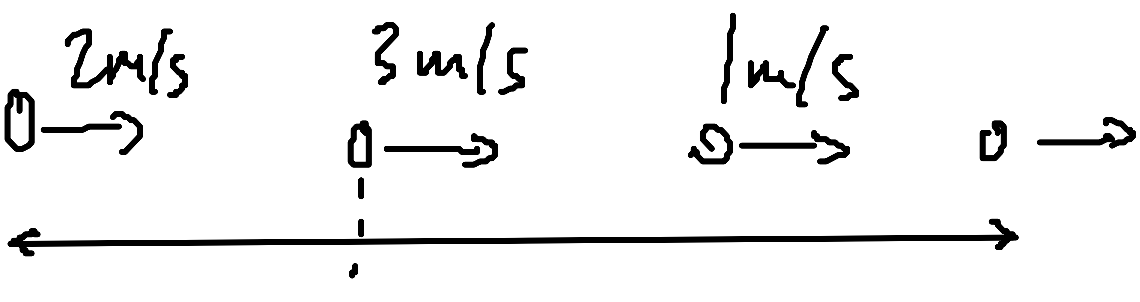
e.g. ball moving faster then slower.



average speed = $\dfrac{\text{total disance travelled}}{\text{time taken}}$

$$= \frac{40}{10} = 4 \text{ m/s}$$

In between, speed can change.



Over very short time, speed is 3 m/s.

Instantaneous speed

state what is meant by uniform acceleration and calculate the value of an acceleration using change in velocity / time taken

Acceleration

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e.g. 2 m/s O→ 1 s 4 m/s O→ 1 s 6 m/s O→ 1 s 8 m/s O→

Velocity increases by 2 m/s every 1 s.

→ Acceleration = 2 m/s per sec.

$= \frac{2\ m/s}{1\ s} = 2\ m/s^2$ or $2\ m\,s^{-2}$

e.g. u: 2 m/s O→ v: 6 m/s O→

t 2 s.

$$\text{Acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

final vel. initial vel.

$$a = \frac{v - u}{t} = \frac{6-2}{2} = 2\ m/s^2$$

Acceleration = rate of change of velocity interpret given examples of non-uniform acceleration

Non-uniform Acceleration

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e.g.

2 m/s		4 m/s		6 m/s		8 m/s
	1 s		1 s		1 s	
$a = \frac{v-u}{t}$	$2 m/s^2$		$2 m/s^2$		$2 m/s^2$	

stays the same --> uniform acceleration

e.g.

rest		3 m/s		5 m/s		2 m/s
	1 s		1 s		1 s	
$a = \frac{v-u}{t}$	$3 m/s^2$		$2 m/s^2$		$-3 m/s^2$ (deceleration)	

keeps changing --> non-uniform acceleration plot and interpret a distance-time graph and a speed-time graph

Graphs

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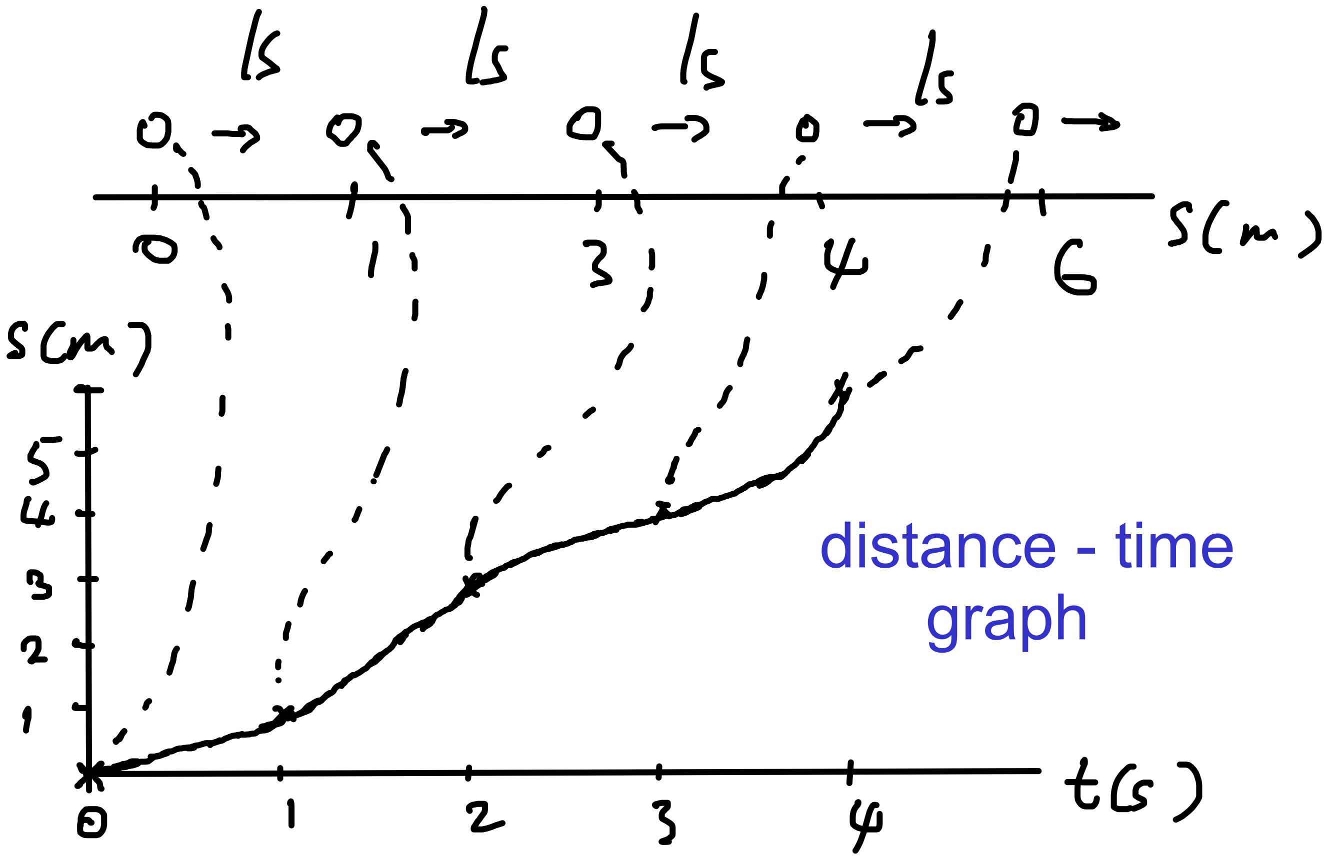
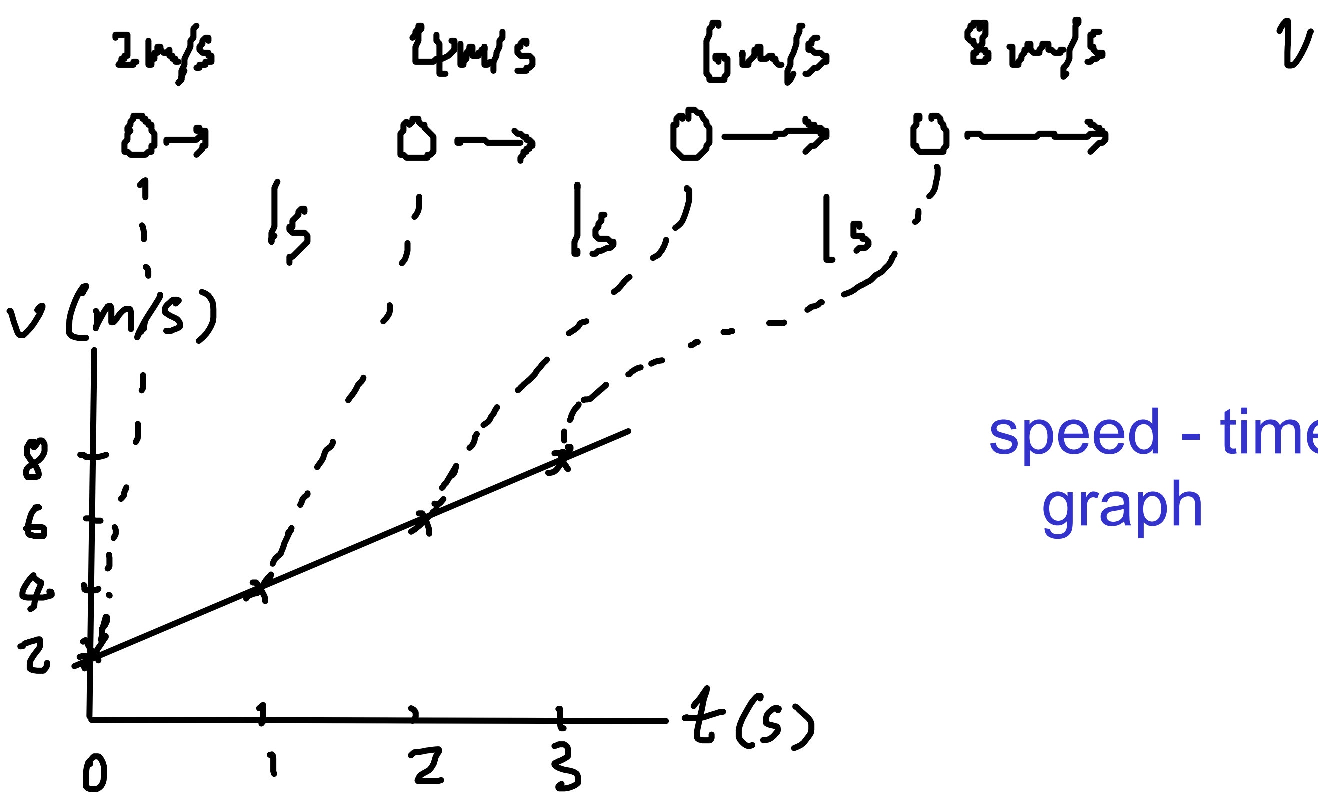
e.g.



distance - time graph

e.g.



speed - time graph

deduce from the shape of a distance-time graph when a body is: (i) at rest (ii) moving with uniform speed (iii) moving with non-uniform speed

Distance-time Graph

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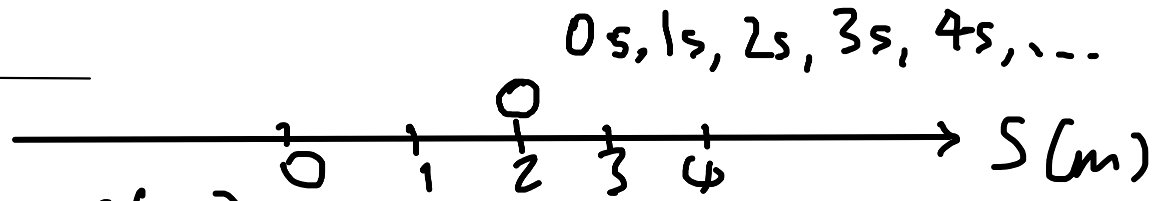
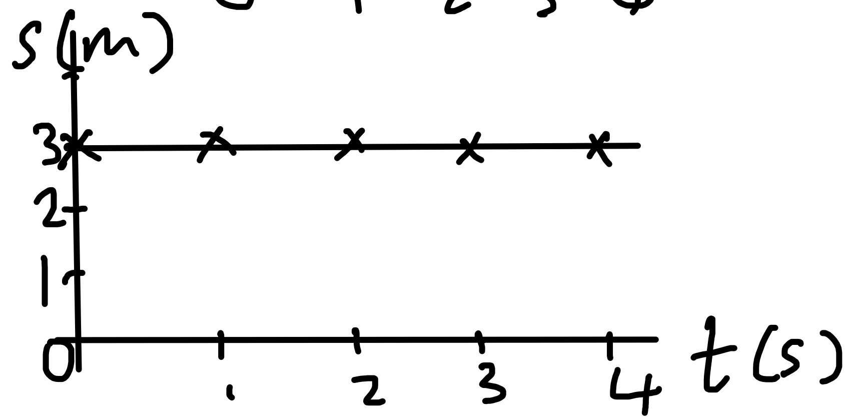
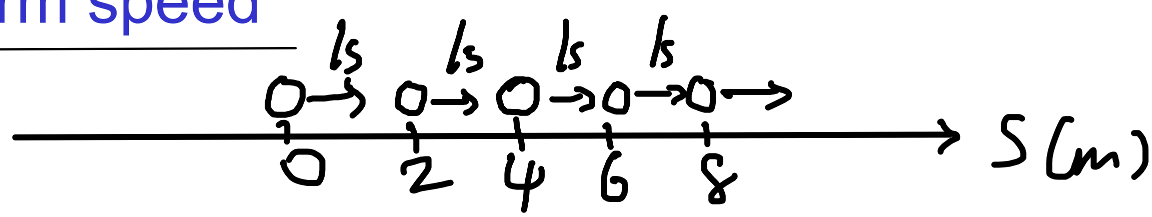
At rest



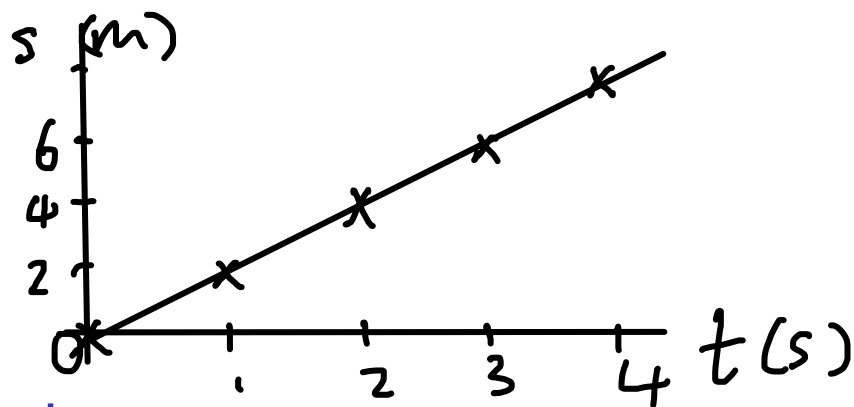
horizontal



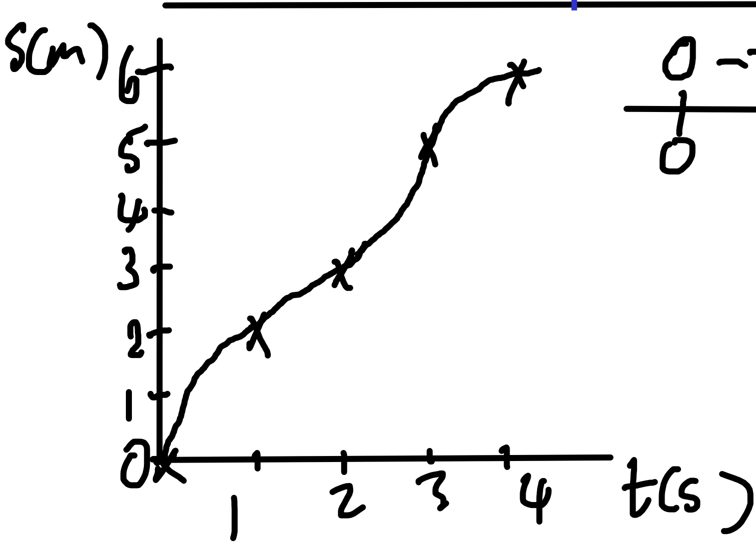
Uniform speed

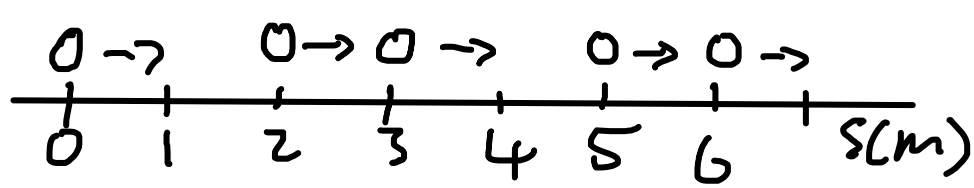


straight



non-uniform speed





not straight

deduce from the shape of a speed-time graph when a body is: (i) at rest (ii) moving with uniform speed (iii) moving with uniform acceleration (iv) moving with non-uniform acceleration

Speed-time Graph

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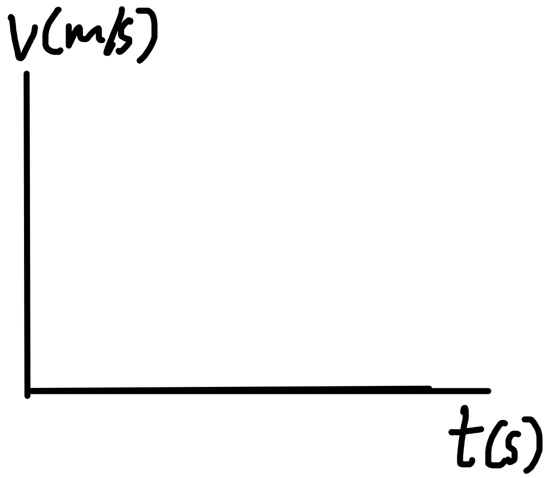
At rest

v always zero

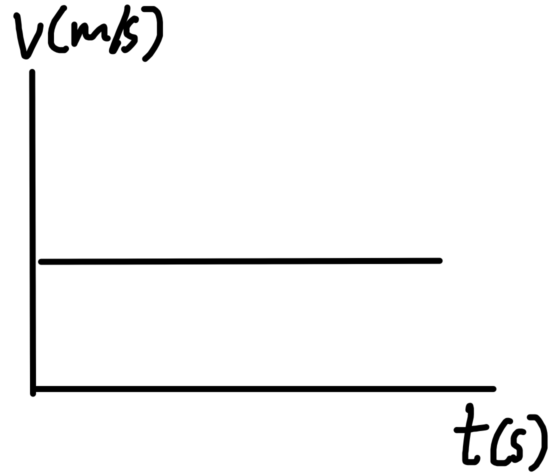
straight line on axis.



Uniform speed

v always same

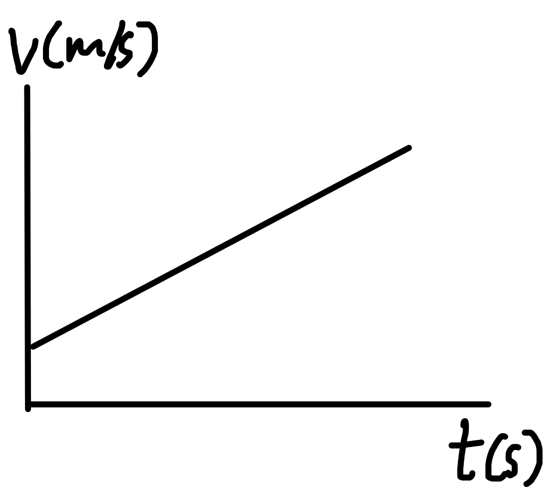
horizontal line.



Uniform acceleration

every 1 s, velocity changes same amount.

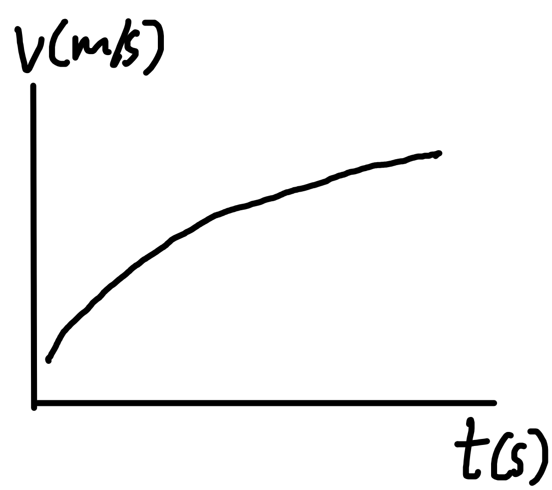
Straight line



Non-uniform acceleration

every 1 s, velocity changes different amount.

Curve



calculate the area under a speed-time graph to determine the distance travelled for motion with uniform speed or uniform acceleration

Speed-Time Graph Area

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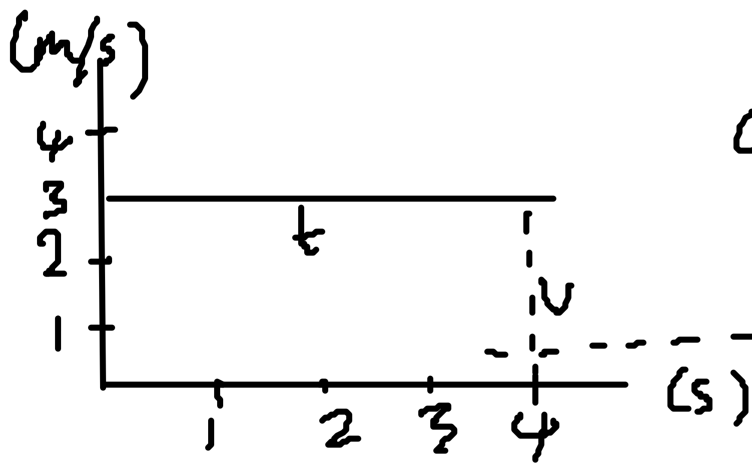
Uniform speed

0 → 3 m/s in 4 s ?

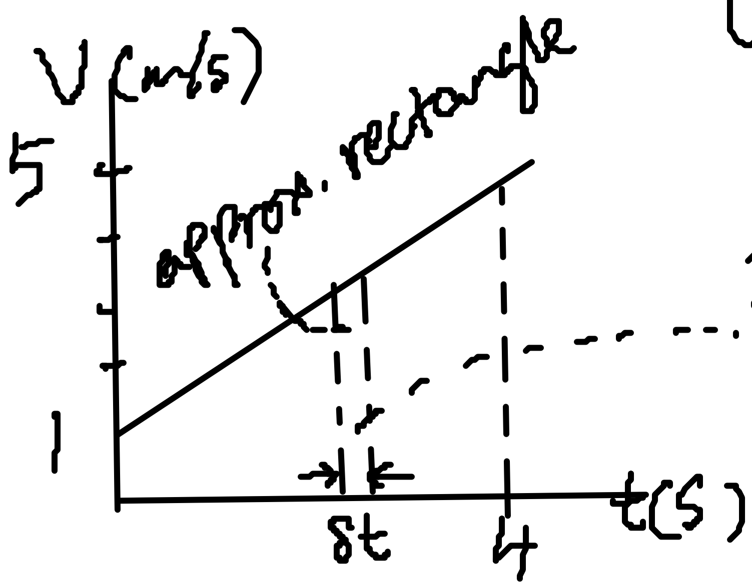


distance = v × t

(height , base of rectangle)

= area !

Uniform acceleration



Cannot use v×t if v not const.

In short time δt
V ≃ const.
So dist. ≃ area

∴ over the whole time, total

area under graph = distance travelled

state that the acceleration of free fall for a body near to the Earth is constant and is approximately 10 m/s^2

Acceleration of Free Fall

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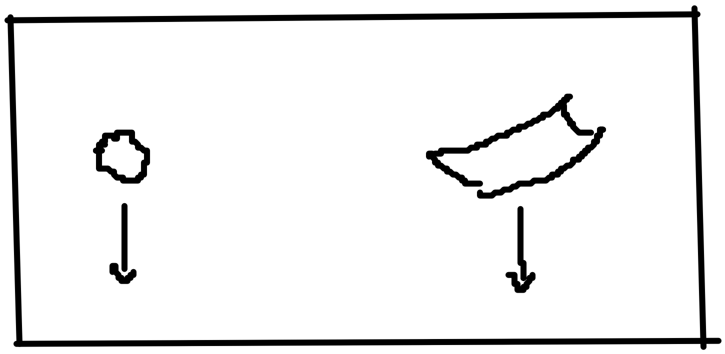
- falls slowly because of air resistance

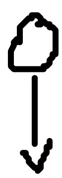
If inside vacuum :



fall at same rate:

$a \approx 10\ m/s^2$

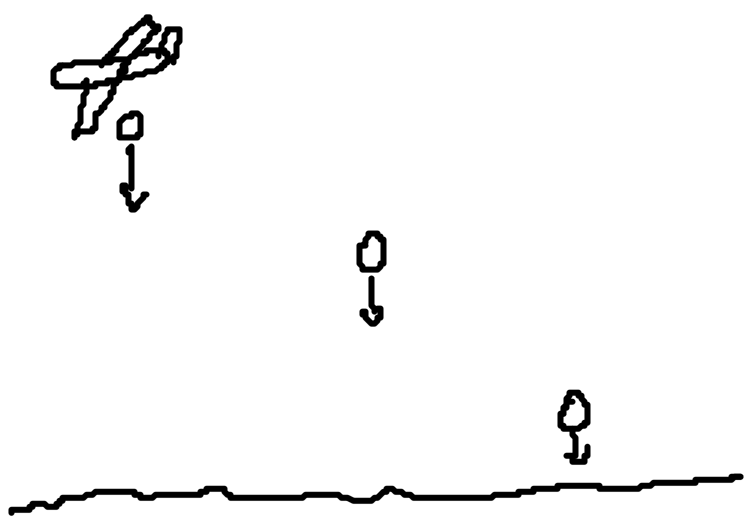
Outside, if weight much bigger than air resistance, then



$a \approx 10\ m/s^2$

Up to ~100 km,

$a \approx 10\ m/s^2$.



Accurate value:

$g = 9.81\ m/s^2$

describe the motion of bodies with constant weight falling with or without air resistance, including reference to terminal velocity

Terminal Velocity

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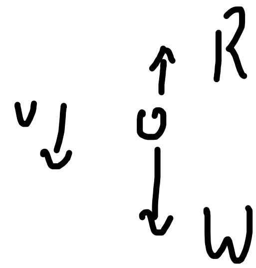
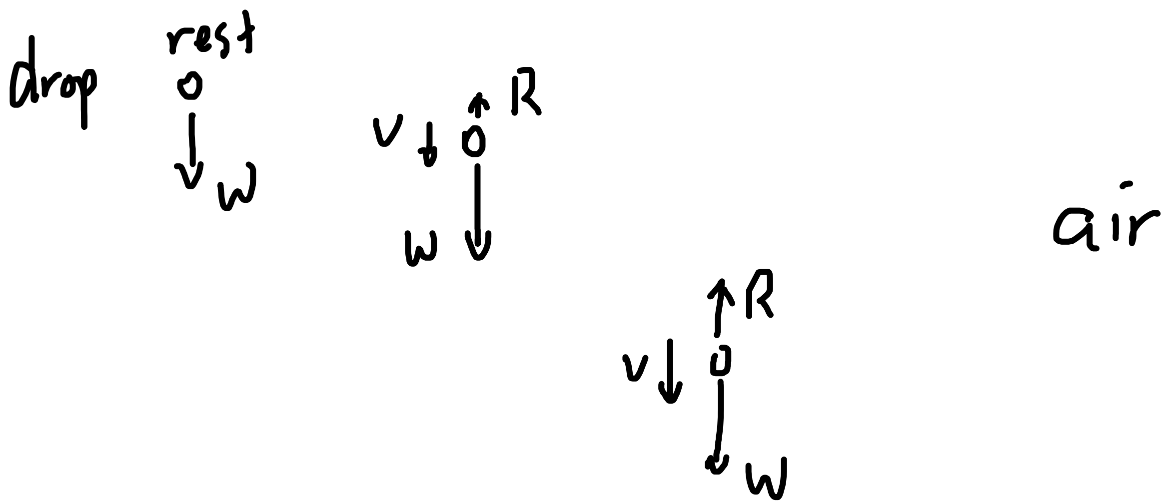
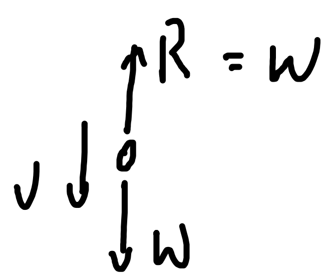
With air resistance R when falling:



faster v => bigger R



until R can be as big as W !



→ Zero force

no acceleration

terminal velocity