LABS !!

Weds: Warm Up 2 by 8am (D2L)

Thurs: Discussion / quiz

111 Ex:

Velocity and graphs of position versus time

Average velocity is defined by looking at displacement over an interval

$$v_{avg} = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i}$$

There is a procedure for extracting average velocity from a graph of position versus time for the special case of uniform motion:

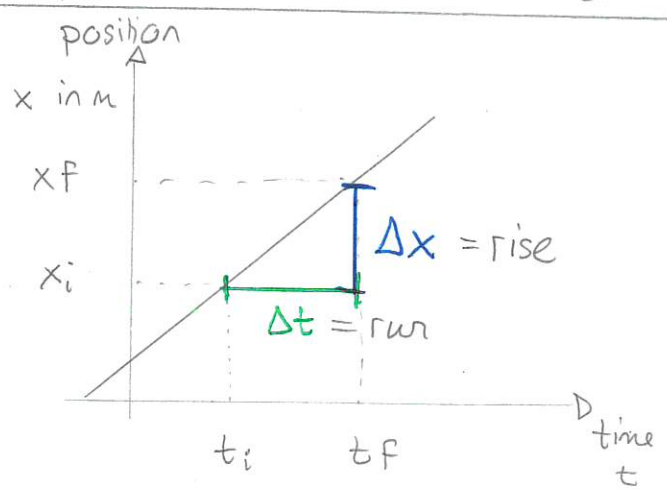
* motion with constant velocity ~ same speed + same direction at all times

For motion with constant velocity:

1) a graph of position vs time is a straight line

2) the average velocity is

v_{avg} = slope of graph of position vs time $= \frac{\text{rise}}{\text{run}}$



DEMO: Moving Man PhET

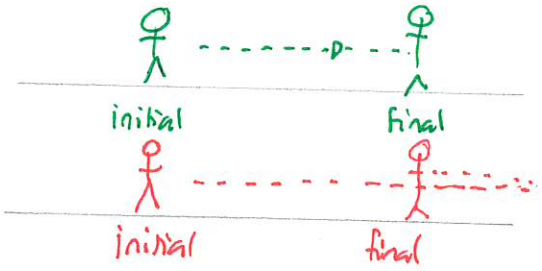
* Charts Tab $x_0 = -9$, $v_0 = 3$ } observe graph v vs t.

Quiz 1 50% - 90%

Instantaneous velocity

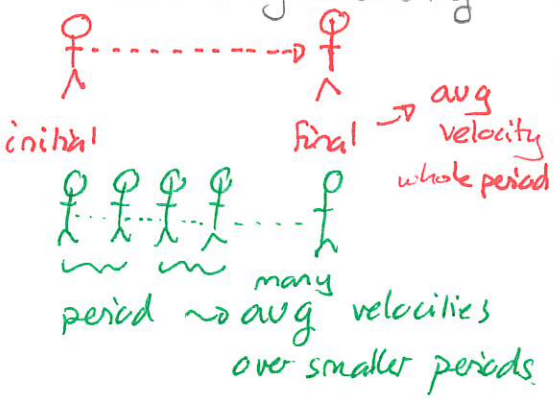
Average velocity only considers the initial and final instants of some period and ignores the details of motion between these.

Demo →



This will never describe situations where either speed or direction vary during the period.

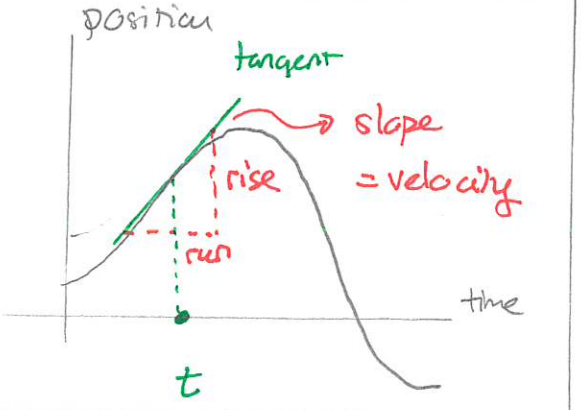
We can refine the definition of velocity to capture such details by considering periods of decreasing duration. In the limit as the duration of the period becomes vanishingly small we arrive at:



> (instantaneous) velocity at any instant = average velocity over a vanishingly small interval, starting at that instant.

A correct definition requires calculus. However, calculus provides the following result that we can use

> Instantaneous velocity at any time = slope of tangent of graph of x vs t at that time
>
> v
>
> units: m/s



Quiz 2 80% - 100%

Quiz 3 90%

DEMO: Moving Man

$x_0 = 10$

$v_0 = -6$

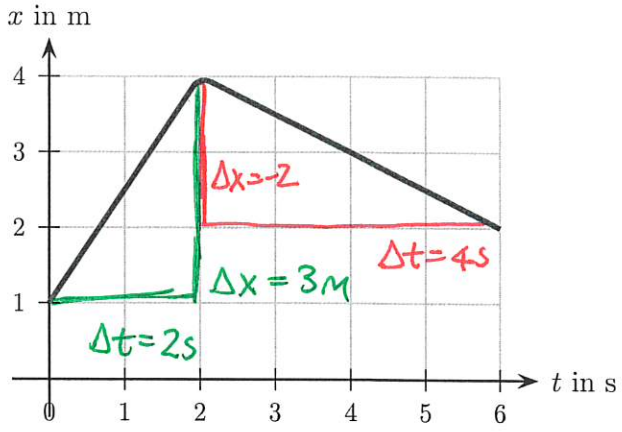
$a = 2$

22 Slug on a stick

A slug crawls along a straight stick. The graph illustrates the slug's position vs. time. Answer the following, giving explanations for each answer. *(111F2023)*

a) Determine the velocity of the slug at 1.0 s.

b) Determine the velocity of the slug at 4.0 s.



Answers: In both cases

velocity = slope of position vs time = $\frac{\text{rise}}{\text{run}}$

a) rise = $\Delta x = 3m$
run = $\Delta t = 2s$
slope = $\frac{\text{rise}}{\text{run}} = \frac{3m}{2s} = 1.5m/s \Rightarrow V = 1.5m/s$

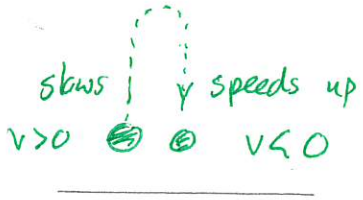
b) rise = $\Delta x = -2m$
run = $\Delta t = 4s$
slope = $\frac{\text{rise}}{\text{run}} = \frac{-2m}{4s} = -0.5m/s \Rightarrow V = -0.50m/s$

Acceleration

In physics the interesting situations arise when velocity changes (these are related to interactions between objects and forces)

We will quantify this using

acceleration ≈ rate of change of velocity

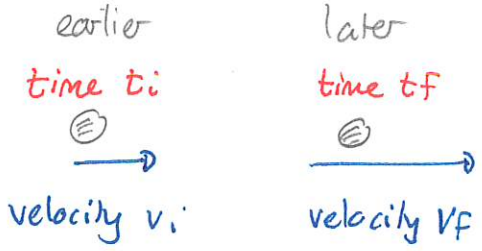


Earth gravity??

A precise definition is:

Observe the object at two instants and record the times and velocities at these instants. Then the average acceleration between these instants is

$$a_{avg} = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i}$$



UNITS m/s^2

General Physics: Group Exercise 1

28 August 2023

Names: _____ _____ _____

_____ _____

1 Rotating object

Take a rectangular object with three sides of different lengths: a phone is a good example. Try to flip the phone in such a way that it rotates and does not "tumble." Try this for three distinct axes. Is it easier to to this about some axes rather than others? Have you ever noticed this before? Where? *The instructor will provide some assistance.*

2 Moving man animation

An animation shows a man moving horizontally. The table provides data for the positions and velocities of the man at various times.

Time	Position	Velocity
0.0 s	−10.0 m	1.0 m/s
1.0 s	−7.5 m	4.0 m/s
2.0 s	−2.0 m	7.0 m/s
3.0 s	6.5 m	10.0 m/s

a) Does the velocity of the man stay constant, increase at a steady rate or increase at a varying rate during the period from 0.0 s to 3.0 s?

b) By how much does the man's velocity increase every second?

c) Determine the average acceleration of the man from 0.0 s to 1.0 s.

d) Determine the average acceleration of the man from 1.0 s to 2.0 s.

e) Determine the average acceleration of the man from 2.0 s to 3.0 s.

a) b) It appears to increase by 3.0 m/s every second

c) $a_{avg} = \frac{v_f - v_i}{t_f - t_i} = \frac{4.0\,m/s - 1.0\,m/s}{1.0\,s - 0.0\,s} = \frac{3.0\,m/s}{1.0\,s} = 3.0\,m/s^2$

d) $a_{avg} = \frac{v_f - v_i}{t_f - t_i} = \frac{7.0\,m/s - 4.0\,m/s}{2.0\,s - 1.0\,s} = \frac{3.0\,m/s}{1.0\,s} = 3.0\,m/s^2$

e) $a_{avg} = \frac{v_f - v_i}{t_f - t_i} = \frac{10\,m/s - 7.0\,m/s}{3.0\,s - 2.0\,s} = \frac{3.0\,m/s}{1.0\,s} = 3.0\,m/s^2$