Phys 111 2023

Lecture 2

Today: Turn in Math Diagnostic Test

Physics diagnostic test - class average 25%

- will put grades on D2L

Thursday: Discussion / quiz

* Do following before class
  - Ex: 1, 2, 3, 4, 5, 6, 8, 9
* Will discuss in groups
* Quiz at end of class → 10 min → 5 pts (Grand total 600 pts)

Friday Warm Up 1 (reading exercise)

* On D2L
* Instructions in email and on Thursday.

Motion in Physics

Classical physics considers the motion of objects.

Demo: YouTube Cheerios Effect

There are two parts to this:

1) how to describe motion kinematics
2) why objects move as they do. dynamics

The goal is to answer: Given various objects (cheerios, water, air) in a known initial configuration (arrangement in bowl) / state and knowledge of how they interact with each other, what will their configuration / state be later?

Motion in One Dimension: Motion Diagrams

Consider an object moving in one dimension (i.e. along a single straight line). We can represent the motion in various ways:

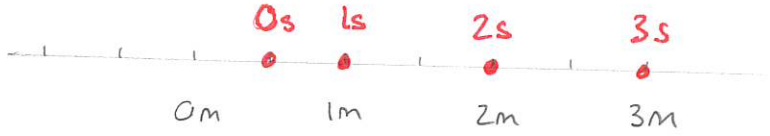
1) motion diagrams
2) data table + graphs
3) mathematical quantities and equations

A motion diagram consists of a series of dots, each representing the location (position) at one instant (moment of time). Usually the time elapsed between successive dots is the same

DEMO: Duffy motion diagrams

Red : ~~Ac~~ Default
Blue : v=5 a=1

This provides a partial record of the object's motion

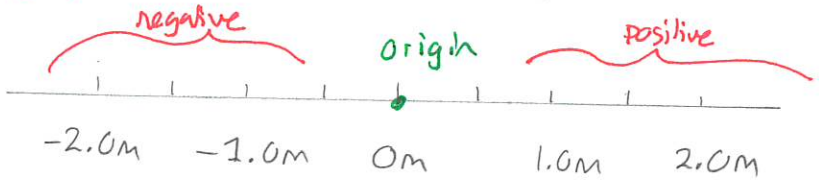


Quiz 1 80% → 95%

Motion in One Dimension: Data and Graphs

Motion diagrams only provide qualitative information about an object's motion. This can be converted into data and we use:

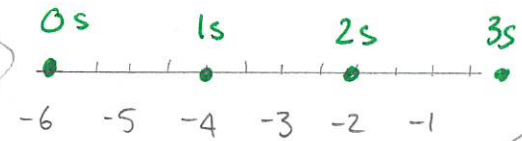
1) seconds (s) to represent time. – usually starting at 0s
2) an axis with an origin and locations separated by units of meters (m) or a fraction of these



Note that locations to the right of the origin are represented by positive numbers and to the left by negative numbers

We can then record the position of an object as time varies:

Motion Diagram



Data

time, t	position, x
0.0s	-6.0m
1.0s	-4.0m
2.0s	-2.0m
3.0s	0.0m
4.0s	2.0m

DEMO

PhET Moving Man

↓

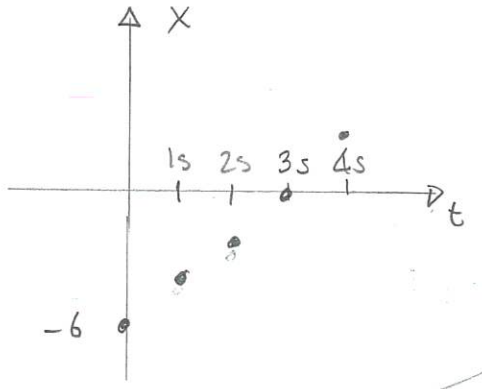
* Charts

↓

* $x_0 = -6$
* $v_0 = 2$
* $a = 0$

↳ Only position

Graph position vs Time



Quiz 2 80% → ~~90~~ 100%

Describing motion: speed + velocity

It is useful to describe the motion of an object in terms of the rate at which its position changes. A preliminary notion is speed.

Conceptual Idea

speed ≈ rate at which distance is covered

Preliminary definition.

The average speed of an object over some time interval is

$$\text{ave speed} = \frac{\text{distance traveled in interval}}{\text{time elapsed in interval}}$$

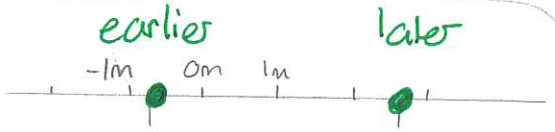
Units m/s

We use the word "average" to account for varying speeds during the interval. This is actually not very convenient for the resulting physics. A more useful quantity is velocity. Here

Conceptual Idea: velocity ≈ rate at which position changes over time

A more precise definition is:

Observe the object at two instants (initial, final). Record the positions and times



time t_i t_f

position x_i x_f

The displacement of the object is the change in position

$$\Delta x = x_f - x_i$$

↑ delta

The average velocity over the interval is

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

Units: m/s

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Quiz 3

$t_i = 0s$ $\quad t_f = 2.0s$

$x_i = 0m$ $\quad x_f = 10m$

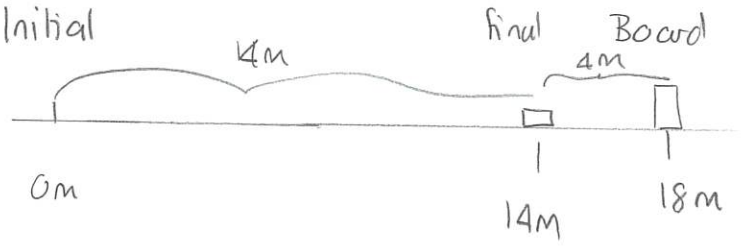
$$v_{avg} = \frac{x_f - x_i}{t_f - t_i} = \frac{10m - 0m}{2.0s - 0.0s}$$

$$= 5.0 m/s$$

7 Bouncing hockey puck

A hockey puck can slide along a horizontal surface. Starting at an initial location, it slides right and takes 3.0 s to hit a board 18 m away. It bounces back to the left and reaches a final point 4.0 m from the board 2.0 s from the time it first hit the board. Determine the average velocity of the puck from the initial to final moments. *(111F2023)*

(1) Diagram



(2) List data

$t_i = 0s$ $t_f = 3.0s + 2.0s = 5.0s$

$X_i = 0m$ $X_f = 14.0m$

(3) formula

$$V_{avg} = \frac{X_f - X_i}{t_f - t_i} = \frac{14.0m - 0.0m}{5.0s - 0.0s} = \frac{14.0m}{5.0s} = 2.8m/s$$