Phys 100 2023

Lecture 9

Fri: HW by 5pm

Mon: Cover Chapter ...

This class * early attempts to understand motion

Motion

A central part of classical physics has been to understand the motion of objects.

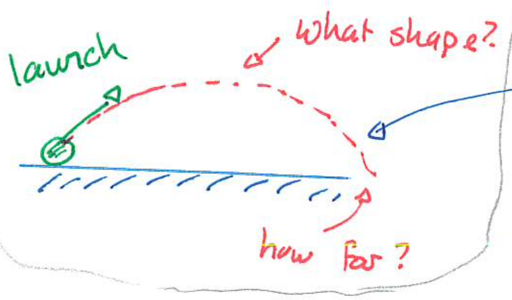
DEMO: PhET Projectile Motion

* Launch various objects and observe trajectories.

DEMO: Falling Monkey (Iowa – third video)

The basic questions in physics have been:

How do objects move?
How can we describe motion?



Why do objects move the way that they do?

Why this particular shape?

We can ask these questions about a wide variety of situations. We aim to

1) describe what motion may have occured in the past.
2) predict " " may occur in the future.
3) develop a general understanding about motion

DEMO: 1) Video – Hawk Eye Tennis

2) Video – Hawk Eye Cricket

3) 3D Solar System (~~Solar System Scope~~) The Sky

We will see that classical physics provides a framework for understanding motion that consists of

Language for describing motion

* speed
* velocity
* acceleration ...

Rules (using the language) that can be used to understand all motion (of classical objects)

* Newton's Laws
* Energy
* ...

to

Projectiles, Solar system, Cheerio effect, terminal velocity, gravity, athletics, ...

In all cases we will create a model that uses as few basic rules to understand as many phenomena as possible.

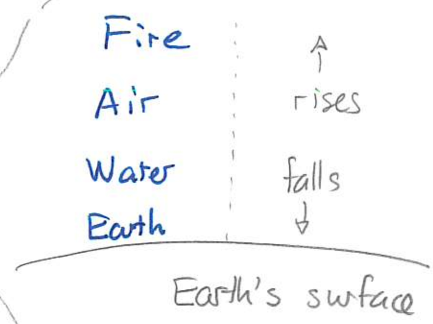
Aristotelian physics

The primary system of thinking about the physical world from the time of ancient Greece (over 2000yrs ago) to the 17th century was due to Aristotle (384-322 BCE). The basic framework was:

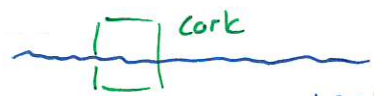
Any ordinary object is a mixture of four basic elements

Elements: Fire, Air, Water, Earth

Each element has a prefered "natural" place and tends to "seek" that place



In any material which is a mixture of elements, the element that occurs in the greatest proportion determines the natural place of that object



cork = Earth + Air ⇒ cork floats

OR

steam = water + fire

rises above water

An object can only undergo unnatural motion if there is another object or influence that applies a force to sustain the motion.

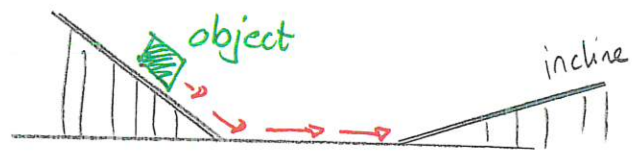
Quiz 1

Aristotle's system was not well designed to make quantitative predictions even in simple situations.

Galileo's contributions

By the 16th century scientists had begun to focus on quantitative aspects of motion specifically matters to do with the time taken for objects to move in various ways. Aristotelian physics did not address these questions.

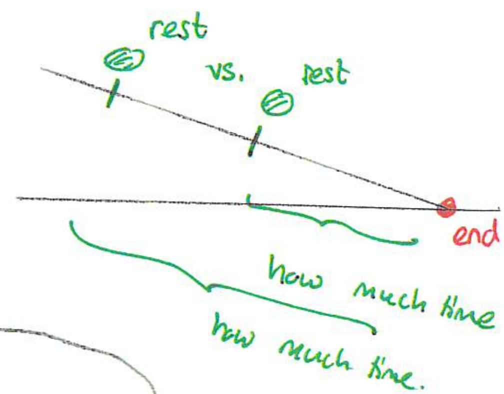
Galileo (1564-1642) was the first scientist to develop the modern approach to science - focus on smaller questions that might capture the essence of a physical situation. One type of motion that he considered was an object that could slide up and down various inclines. Simple observations show:



1) as an object descends it speeds up

2) as an object ascends it slows down and it may eventually stop.

Galileo extended these by considering the time taken to slide down ramps of different length but inclined at the same angle.



Demo: Physiege video ~15s

The demonstration shows that

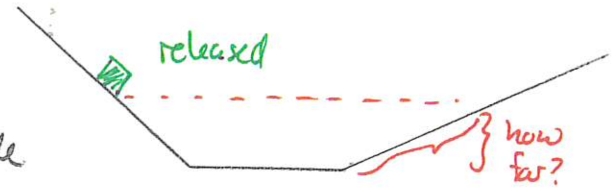
> When an object slides down a ramp it will speed up at a constant rate.

Quizz ~ 70%

This lead Galileo to consider the idealized situation:

- there is no friction between the ramp and sliding object and there is no air resistance.

Given that an object is released from one side of a "double" ramp, how far will it slide up the other side



Demo: Inertia Thought Expt Video

Based on observations and taking the limit as the right ramp becomes horizontal, the conclusion was:

> An object sliding along a horizontal surface will move with constant speed (neither speeding up nor slowing down)

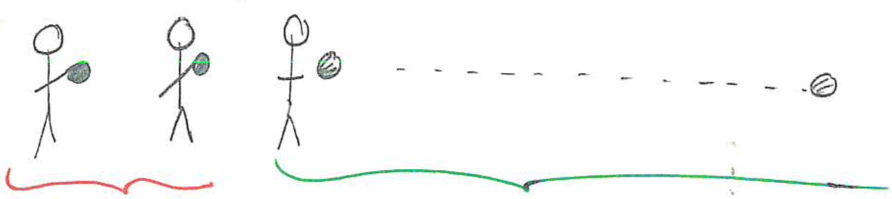
In usual situations where we observe this there is friction and air resistance and this changes the conclusions.

The next step was to extend this to all situations. The result is the Law of Inertia.

> If there is no overall external influence (force, interaction) on an object, then the object will move in a straight line with constant (unchanging with time) speed.

Quiz 3

When considering the astronaut/ball situation there are two stages



Astronaut launches ball
⇒ Ball is in astronaut's hand
⇒ Hand interacts with ball

Law of Inertia does not apply.

Ball leaves astronaut
⇒ no external influence
⇒ constant speed

} Law of Inertia applies