Phys 100 2024

Lecture 8

Fri: Read 3.4 - 3.5

HW 2 due by 5pm

- write on separate sheets of paper not HW question
- Q4, Q5 are "ratio questions" and are similar to:

"How many nickels in $18.75 ?"

$$\rightsquigarrow \frac{\text{total value}}{\text{value one nickel}} = \frac{\$18.75}{\$0.05} = 375$$

- Q7 video search - post to D2L

HW1 grading

Motion

We would like to understand how and why motion occurs. The overall idea will be

Provide basic motion concepts
- velocity
- acceleration
- force

Provide basic motion laws
- Newton's Laws
- energy conservation

Apply these to understand many physical situations and:
* predict what motion may occur in the future
* describe what motion may have occured in the past

DEMO: Honey Imayo video

The physics that we now use to describe this was developed by Newton in the 1600s. We first review the physics that existed before that time.

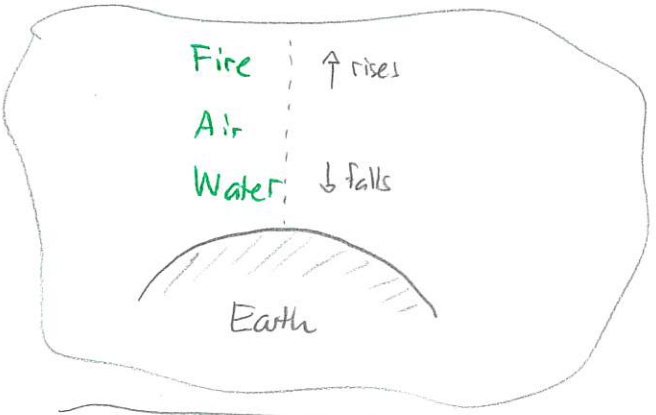
Aristotelian physics

The main framework for thinking about the physical world from ancient Greece to the 17th century was developed by Aristotle (384-322 BCE).

An ordinary object is a mixture of four basic elements

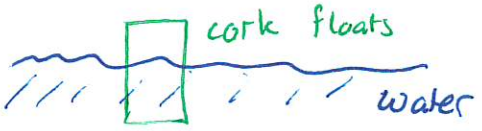
Elements: Fire, Air, Water, Earth

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



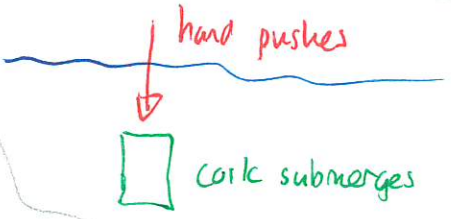
In any object which is a mixture of elements, the element that occurs in the greatest proportion determines the natural place of that object.

Example



cork = air + Earth with air dominant?

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



Quiz! 60% say C

Aristotle's system could make qualitative predictions but it struggled to make qualitative predicts such as:

"How long will it take for a rock to fall? How does this depend on the rock's mass?"

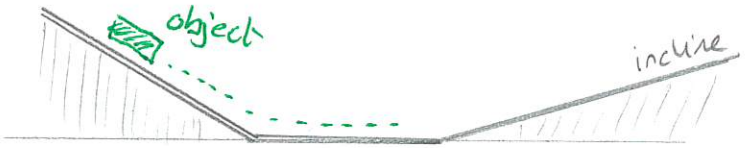
Some of the concepts from this endure today even though they are not correct.

Galileo's physics of motion

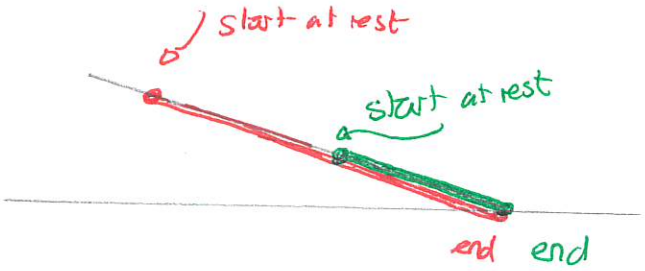
The first real changes to understanding motion that are still currently in use were due to Galileo (1564-1642). He focussed on restricted questions of motion that might eventually yield clues about general rules. An example was an object sliding up or down an incline.

Simple observations show:

1) as an object descends an incline it speeds up.
2) as an object ascends an incline it slows down. It may eventually stop.



Galileo then considered an object sliding down an incline at a fixed angle but with variable lengths. One could, for example, ask



"If the length of a red track is two times that of a green track, how does the time to descend the red compare to the green? Two times??"

~~Demo: Physics video~~ Demo: Show ramp / cart

~~Demo~~: Quiz 2 ~80%

Demo: Physics video.

Demo: Roll cart down track ~ 50cm 100cm

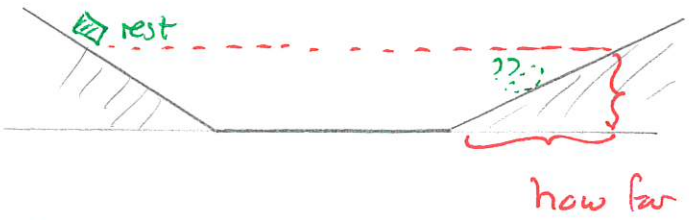
record times _____ _____

_____ _____

The questions would be:

* How many times longer for double length track?
* What underlying reason can explain this?

These questions were extended to consider an idealized situation of a double incline. If an object is released from rest at one side how high up the other side will it move before turning around.



DEMO: Inertia Thought Experiment Video

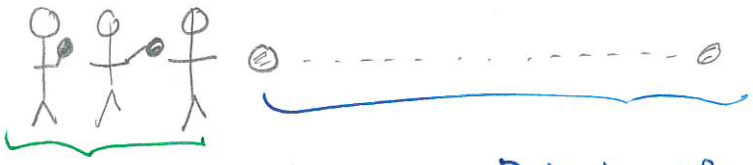
Observations show that the object will rise to almost the same height as it was released. If the friction and air resistance were removed it would rise to exactly the same height. In the limit as the right ramp became horizontal it would move forever, at a constant speed.

Presumably this extends 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 a constant speed.

Quiz 3

There are two stages to this situation



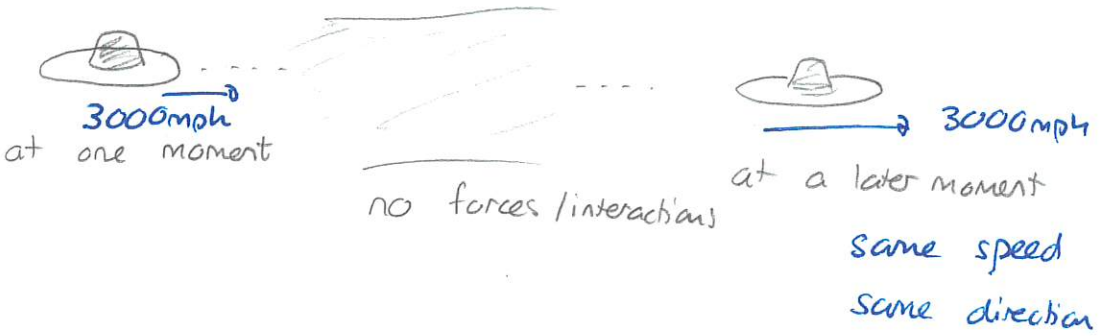
Astronaut launches ball
hand interacts with ball

Law of Inertia does not say anything about this

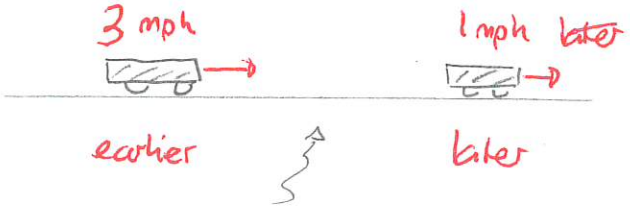
Ball has left astronaut
⇒ no overall external influence
⇒ straight line constant speed

Law of Inertia describes this

The law of inertia establishes a "natural" or "inherent" or "prefered" state of motion in classical physics



Note that there are often hidden forces and interactions in everyday situations. The cart will eventually slow to a stop on a horizontal track because of friction and air resistance



Quiz 4