Phys 100 2023

Lecture 6

Fri: HW by 5pm (next HW due 8 Sept).

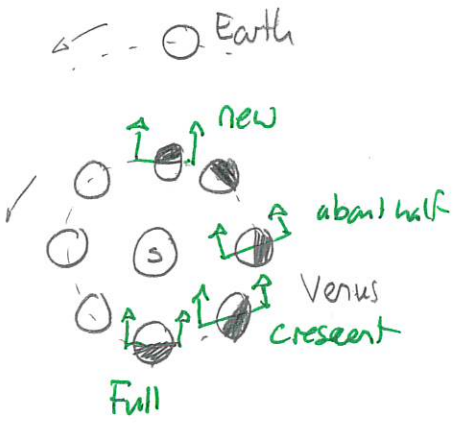
Mon: Read 2.4-2.5

Return graded grasp ex.

Recap: We were presented with varias models of the solar system. In order to decide between models, we use them to predict what we would observe in particular situations. We compare these predictions to actual observations and use this to decide between the models.

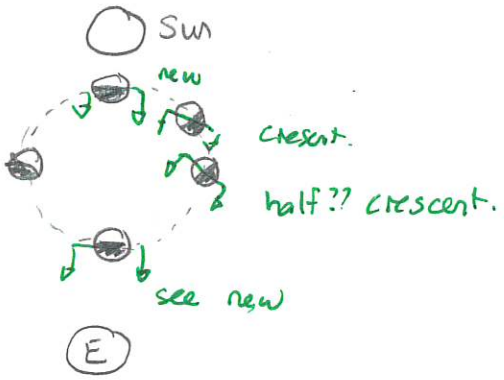
The previous exercise consider the question of the phases of Venus as observed from Earth. Two competing models make distinctly different predictions.

Heliocentric (Copernicus)



⇒ See all phases from New → (almost) Full

Geocentric Ptolemy



⇒ See New, crescent but not much more

DEMO: ESO Venus Phases ⇒ ??

Constituents of Matter

A basic question in most sciences is what types of matter make up the ordinary material universe. So:

"What makes up ordinary matter?"

"Are there elementary basic building blocks for all matter?"

Evidence from the everyday world is that one can combine basic materials (ingredients) to produce new materials (products). Examples are:

1) flour + water ⇝ bread
2) eggs + oil ⇝ mayonnaise

DEMO: YT video Honey / Mayo mixture.

In order to answer these questions we do the same general system that we used to explain the solar system:

Create a model

* Describe basic constituents of all matter.
* Describe properties of basic constituents
* Describe rules for how the basic constituents interact with each other + their surrounds.

Predict

* Types of combinations of basic constituent?
* Behavior in certain circumstances

Observe

* Combinations
* Behavior

compare.

Atomic Model

The model we use is the atomic model. The situation is as follows:

ATOMS

* The basic building blocks of all matter are atoms.
* An atom is the smallest (indivisible) unit of matter.
* Atoms of one or more type combine to form ordinary materials

Details of atoms

* There are a limited number of types of atoms, each corresponding to a particular chemical element:
  Hydrogen, oxygen, carbon, ...
* All atoms of a given chemical element are the same as all others of the same element. But they are different to atoms of a different element.
* atoms are extremely small compared to everyday objects

BEHAVIOR / RULES FOR ATOMS

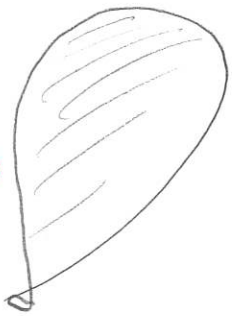
* the laws of chemistry describe how atoms combine to form the various chemical compounds that exist
* the laws of physics describe how atoms interact at a more basic level

We will explore how the laws of physics and the atomic model can predict observable properties of gases.

Properties of gases

Any gas can be described in terms of various measurable quantities:

1) volume of gas (space occupied)
2) pressure of gas (how it pushes)
3) temperature (hot vs cold)

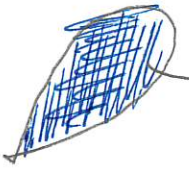


Gases have been studied extensively since the late 18th century and various rules have been obtained. For example

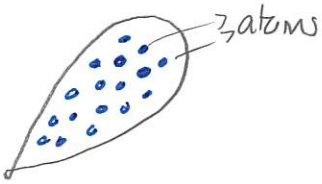
$$(\text{gas pressure}) \times (\text{gas volume}) = (\text{special constant number}) \times (\text{amount of gas}) \times (\text{gas temperature})$$

The field of thermodynamics studies these rules. But it works equally well for two models of gas.

→ continuous fluid



→ collection of many individual atoms



The model that we now use to explain gases such as Helium, Neon

> The gas is a dilute collection of individual atoms. The atoms move freely except when they collide with each other or the walls of the container.

DEMO: PhET Gas Properties

* Explore Tab
* Set: Temp °C

Observe Temp:

* Add heat
* Remove heat.

A detail physical theory (statistical physics) gives an important rule that the animation shows

For a given gas:

larger temperature ⟺ atoms typically move faster

smaller " ⟺ " " " slower.

We can now ask what happens when the gas is compressed by moving a wall

Quiz 1 90%

DEMO: PhET - just one atom
- bat inwards

Quiz 2 60%

DEMO: Fire Syringe Video 2:36