Ph170- General Physics I

Ch. 1

Overview, Fundamental Units, Dimensional Analysis, How to Study Physics

Pui K. Lam

Overview: What is Physics?

(1) Physics seeks to discover and study the fundamental interactions that are responsible for all physical phenomena at all scales − from subatomic scale to the entire universe.

Q. At present, there are how many known fundamental interactions (forces) and can you name them?

(2) Physics is a quantitative science, it seeks to describe observations in terms of **quantified** measurements.

Q. What quantities you may want to measure for for a trip from Honolulu to Tokyo?

(3) Physics seeks to discover relationships among different measurements and to express the relationships in terms of "physical laws" (i.e. mathematical statements).

Q. Can you name a known physical law?

(4) Physics seeks to formulate conceptual frameworks (models and theories) that unify the physical laws.

Q. What is your conceptual model of an atom?

Physics 170 Topics

- In this course, we will focus on ***two main*** topics:
- (1) **Classical Mechanics** - Study motions of idealized "point" particles and "rigid" bodies that are larger than molecular scale. (For molecule scale or smaller, we need Quantum Mechanics)

  This entails two parts:
  - (i) The description of motions (kinematics)
  - (ii) The cause of motions (dynamics)

  ** "Point" particles and "rigid" bodies are models which ignores the "internal" motions (such as molecular motions)
- (2) **Vibrations and Waves** - One way to account for some aspects of the internal motions is to treat the objects as an elastic medium. The internal motions can then be described as vibrations and waves.

Fundamental Units

- In kinematics (mathematical description of motions), we measure the position of an object as a function of time. Hence the fundamental quantities are length and time.
- In dynamics, we need to include one more fundamental quantity, (inertial) mass, such as in the equation F=ma
- We will be using "Scientific International" (SI) units which are:

  length (meter), time (second), mass (kg)).
- All other quantities (units) in this course can be built from these fundamental units, those quantities are called 'derived units"

- **Activity:** Think of a few derived units in kinematics and in dynamics.

Dimensional analysis

- ***Balancing units on both sides of an equation is called dimensional analysis.***

  Example: Distance travelled= speed x time

  $$d=vt$$

  $$m = (m/s)\ s$$

  ** Both sides of an equation must have the same unit (in this case, it is meter), **if they don’t then your equation is incorrect. If the units do agree on both sides, does it mean that the equation is correct?**

Activity for dimensional analysis

(Each group is assigned to work on one formula - 2 minutes
Class discussion – 3 minutes)

- Which of the following is a possible formula for the period (T) of a pendulum?

$$(a) \quad T = 2\pi\sqrt{gl}$$

$$(b) \quad T = 2\pi\sqrt{g/m}$$

$$(c) \quad T = 2\pi\sqrt{l/g}$$

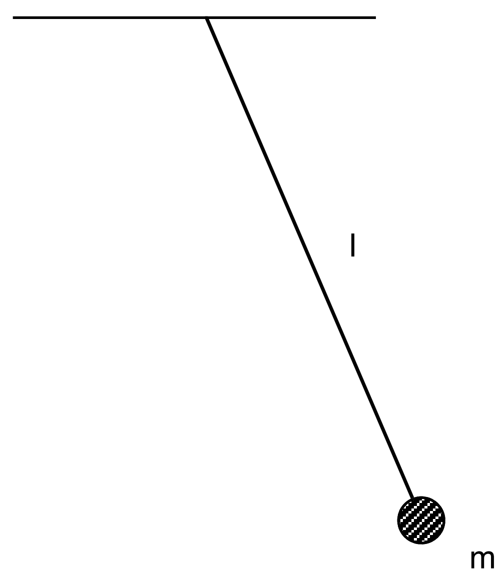
$Given:$

$T = period\ in\ \mathrm{sec}onds,$

$g = 9.8m/s^2,$

$l = length\ of\ pendulum\ in\ meters$

$m = mas\mathrm{s}\ in\ kg$



How to Study Physics

- Create your conceptual framework or model
- From known information, deduce logically the consequence (usually involve math because math is a logical language)
- Be inquisitive & critical − ask yourself, ”How do I know that?”

Activities -1

- How many degrees does the Earth rotate about its axis in one hour?
- Steps:
- 1. What is your conceptual framework of the Earth-Sun system?
- What known information do you need to answer this question?
- How would you relate the answer of this question to your everyday life?

Activity-2

- According to the textbook, the Sun's diameter is 864,000 miles
- Be inquisitive: How do we measure the radius of the Sun?
- Steps:

1. What is your conceptual framework of the Earth-Sun system?
2. What can we measure on Earth that would be related to the radius of the Sun?
3. . . . ?

Activity -3

- Given that there are 9×10^{22} copper atoms in a 1 cm^3. What is the approximate "diameter" of a copper atom?
- Steps:

1. What is your conceptual framework of a solid consists of copper atoms?
2. With this framework, how would the "diameter" of the copper atom related to the information given?