Describing the Physical Universe

Chapter 1

Tuesday, September 10, 2013
Chapter 1

1.1 What is Physics?

1.2 Distance and Time

1.3 Speed
1. Describing the organization of the universe.
   - Matter
   - Energy

2. Understanding Natural laws
   - A natural law is a rule that tells you how or why something happens the way it does.

3. Deducing and applying natural laws
   - Experiments
   - Analysis

Three aspects of physics
Matter – anything that has mass and takes up space

Mass – the amount of matter that makes up an object

Matter and Mass
Is air matter?  

**AIR**  
Air takes up space.

Is light matter?  

**LIGHT (No air)**  
Light does not take up space.
Energy – how we measure the amount of change that is possible in factors like temperature, height, or speed.
What is an experiment?

- Experiment – a situation you carefully set up to see what happens under controlled conditions
- Analysis – the detailed thinking you do to interpret and understand what you observed
- Both of these lead to the development and refinement of natural laws
- **System** – a group of objects, effects, and variables that are related

- **Variable** – a factor that affects the behavior of the system
Variables

- Independent – the variable that you change in the experiment (angle of the ramp)

- Dependent – the variable that shows the effects of what you changed (speed of the ball)

- Control – a variable that is kept the same (mass of the ball)

Variable Types
Macroscopic Scale – when things are large enough for us to see directly

Microscopic Scale – requires a microscope to be seen

Atomic Scale – on the scale of atoms
1. Ask a question.

2. Formulate a hypothesis.

3. Design a procedure to test the hypothesis.

4. Conduct the experiment and collect the data.

5. Analyze the data.

6. Use the data to make a conclusion.

7. If necessary, refine the question and go through each step again.
1.2 Distance and Time

{ Chapter 1, part 2 }
Systems of Measurement

- English system – inches, feet, yards, and miles. Used mostly in U.S. and England

- Metric system – millimeters, centimeters, meters, and kilometers. Primary system for science, and everywhere else in the world.
Standard Physics Units are
Meters (m) for distance
Kilograms (kg) for mass
Seconds (s) for time
Newtons (N) for force
## Typical Conversions

<table>
<thead>
<tr>
<th>English</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Gallon</td>
<td>3.78 Liters</td>
</tr>
<tr>
<td>1 Yard</td>
<td>.91 Meters</td>
</tr>
<tr>
<td>1 Mile</td>
<td>1.609 Kilometers</td>
</tr>
<tr>
<td>1 Pound</td>
<td>.45 Kilograms</td>
</tr>
<tr>
<td>.264 gallons</td>
<td>1 Liter</td>
</tr>
<tr>
<td>3.2 Feet</td>
<td>1 Meter</td>
</tr>
<tr>
<td>2.2 Pounds</td>
<td>1 Kilogram</td>
</tr>
<tr>
<td>.621 Miles</td>
<td>1 Kilometer</td>
</tr>
</tbody>
</table>
Distance – the amount of space between two points, also called length

Some units of distance are inches, miles, centimeters, kilometers, and meters

Time – Always measured in hours, minutes and seconds

Distance and Time
$\textbf{Speed} = \text{distance travelled in a given amount of time}$

$$v = \frac{d}{t}$$

Distance (m) \hspace{2cm} Time (s)

A distance of 30 meters travelled in 10 seconds gives a speed of 3 meters per second.

$$\frac{d}{t} = \frac{30m}{10s} = 3 \frac{m}{s}$$

1.3 Speed
Speed Triangle
How do we solve problems?
An airplane flies 450 meters in 3 seconds. What is its speed in meters per second?

1. Looking for: You are asked for the speed in meters/second.

2. Given: You are given the distance in meters and the time in seconds.

3. Relationships: Use this version of the speed equation: \( v = \frac{d}{t} \)

4. Solution: \( v = \frac{450 \text{ m}}{3 \text{ sec}} = 150 \text{ m/sec} \)