Today  Ch 1  Mathematical Background  HW1  
Friday  Ch 2  Kinematics in 1-D  HW2  
Lab 0  Problem Solving (no lab handout)  

- Unit Agreement  
- Dimensional Analysis  
  - Dimensions: Length, Time, and Mass  
- Error Checking  
  
  **Example 1:**  
<table>
<thead>
<tr>
<th>Dimension</th>
<th>Dimension</th>
<th>Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance(x)</td>
<td>[L]</td>
<td>Acceleration(a)</td>
</tr>
<tr>
<td>Time(t)</td>
<td>[T]</td>
<td>Force(F)</td>
</tr>
<tr>
<td>Mass(m)</td>
<td>[M]</td>
<td>Energy(E)</td>
</tr>
<tr>
<td>Speed(v)</td>
<td>[L]/[T]</td>
<td></td>
</tr>
</tbody>
</table>

Which of the following equations are dimensionally *incorrect*?  
(a) $F \sim ma$  
(b) $x \sim \frac{1}{2} at^3$  
(c) $v \sim \sqrt{Fx/m}$  

**Example 2:**  
(d) $E \sim max$  
(e) $E \sim \frac{1}{2} mv$  

- Limitation  

1.5 The Nature of Physical Quantities: Scalars and Vectors  

Vectors  
- Graphical Representation  
- Addition  
- Subtraction  

- Essential pieces for working with vectors  
  - Coordinate system  
    - Basis directions  
    - Origin  
  - Coordinate Components  
    - Units  

Cartesian Vs. Polar Coordinates  
- Cartesian  
  - Alternative representations  
- Polar  
  - Polar/radial components  
  - Graphical Representation
1.4 Trigonometry
  o Trig functions
  o Example 3
    ▪ (a) Using your calculator, verify that \( \sin(\theta) \) divided by \( \cos(\theta) \) is equal to \( \tan(\theta) \), for 30°.
    ▪ (b) Prove that this result is true in general by using the definitions for sin, cos, and tan.
  o Pythagorean’s theorem
  o Translating between Polar and Cartesian
    • Example 4 You’re on an orienteering course out in the desert. Hidden beneath a rock you find your next set of directions “Go 100 m North and 60 m East. Pick up the cell phone and dial 555-2939 for further instructions.” As it’s rather hot out there in the desert, you want to save a little time by going directly to the cell phone. What direction (angle relative to due East) and distance would you go?

22. (a) Two workers are trying to move a heavy crate. One pushes on the crate with a force \( A \), which has a magnitude of 445 newtons and is directed due west. The other pushes with a force \( B \), which has a magnitude of 325 newtons and is directed due north. What are the magnitude and direction of the resultant force \( A + B \) applied to the crate? (b) Suppose that the second worker applies a force \( -B \) instead of \( B \). What then are the magnitude and direction of the resultant force \( A - B \) applied to the crate? In both cases express the direction relative to due west.

36. On takeoff, an airplane climbs with a speed of 180 m/s at an angle of 34° above the horizontal. The speed and direction of the airplane constitute a vector quantity known as the velocity. The sun is shining directly overhead. Who fast is the shadow of the plane moving along the ground (That is, what is the magnitude of the horizontal component of the plane’s velocity?)