Units

- How to convert units (Get the 1 the right way up)
- Always carry units around in problems!
- **Your answer to a question should always include units!**
- Use dimensional analysis to make sure you've solved a problem correctly – do the units make sense?

Vectors

- Have magnitude (numerical value) and direction
- Add by graphical method: put tail of B at head of A, draw sum from tail of A to head of B
- Component method
  - YOU MUST REMEMBER YOUR TRIG!!
  - Vital for figuring out how things move using Newton's laws

How objects move

- Speed = distance / time, is a scalar (no direction)
- Velocity = distance / time, is a vector (has direction)
- Acceleration = change in velocity / time, is a vector
  - = (final v – initial v) / time

- These quantities are considered averages, because they tell you the overall motion, not the motion at each single instant of time

Special case of motion: **constant acceleration**

- Equations you can use to solve problems:
  - a = (final v – initial v) / time
  - distance = v * time, where v is AVERAGE
    - $= \frac{(\text{initial v} + \text{final v})}{2} * t$
  - Can make 2 other equations:
    - a in terms of velocity and distance
    - distance in terms of velocity, time, and a

Special case of motion:
constant acceleration

- a in terms of velocity and distance
  - Solve $d = \frac{(\text{initial v} + \text{final v})}{2} * t$ for time
  - substitute into $a = (\text{final v} - \text{initial v}) / \text{time}$
  - Get $a = \frac{(\text{final v}^2 - \text{initial v}^2)}{2 * d}$

- distance in terms of velocity, time, and a
  - Solve $a = (\text{final v} - \text{initial v}) / \text{time}$ for final velocity
  - Substitute into $d = \frac{(\text{initial v} + \text{final v})}{2} * t$
  - Get $d = (\text{initial v} * t) + (\frac{1}{2} * a * t^2)$

Special case of motion:

constant acceleration (ex: Falling Bodies)

- Galileo: In the absence of air resistance, all bodies fall with the same acceleration, a
  - ex: drop a sheet of paper vs crumpled sheet of paper, which falls faster?
  - This constant acceleration is due to gravity
  - a due to gravity = g, g = 9.8 m/s^2

Why objects move

- Forces: push or pull, vectors with direction
- Newton's 3 Laws
  1. Law of inertia: every object in UNIFORM motion (at rest or moving) tends to remain in that state unless an external force is applied to it
  2. F = m * a, where F = NET force, a = TOTAL acceleration of object
  3. For every action there is an equal and opposite reaction
     - Must involve 2 bodies acting on each other! These action/ reactions are 2 forces of same magnitude but opposite direction, acting on 2 different bodies

Other properties of matter

- Mass: amount of stuff or material in an object
- Weight: gravitational force acting on an object
  - Weight = F due to gravity = m * g