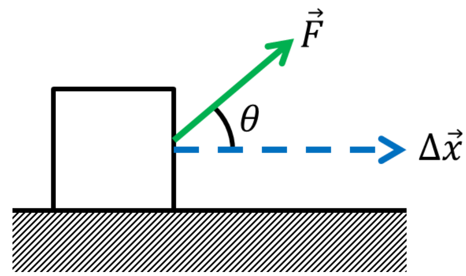
Honors Physics Final Review Summary

Work Done By A Constant Force:

- Work describes a force's tendency to change the speed of an object.

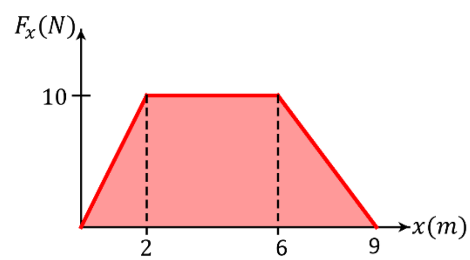
  Work is done only when an object moves in response to a force, and a component of the force points in the direction of the motion.



$$W = F\,\Delta x \cos\theta$$

Work Done By A Variable Force:

- When the forces changes as the object moves, the work done by the force is found by calculating the area under a force vs. position graph.



$$W = Area$$

Work-Energy Theorem:

- The Work-Energy Theorem says:

$$\sum W = \Delta KE$$

  Where $\sum W$ is the total work done by all forces.

- Conservatives forces conserve energy when they do work on a system. Non-conservative forces change the total energy when they do work on a system.

  The change in energy caused by work done by a non-conservative force is given by:

$$\sum W_{n.c} = \Delta E$$

Energy:

- In the absence of non-conservative forces, or when non-conservatives forces do no work on an object, energy is conserved.
  The types of energy we studied this year are:
  - $KE = \frac{1}{2} m\, v^2$ (Kinetic Energy)
  - $PE_g = m\, g\, h$ (Gravitational Potential Energy)
  - $PE_s = \frac{1}{2} k\, (\Delta x)^2$ (Spring Potential Energy)

Power:

- Power describes the rate at which work is being done. There are several formulas for calculating power, including:
  - $P = \frac{W}{\Delta t}$
  - $P = F\, v$
  - $P = \frac{\Delta E}{\Delta t}$ (For non-conservative)

Definition of Impulse:

- $\vec{J}_{avg} \equiv \vec{F}_{avg}\, \Delta t$

  Where $\vec{F}_{avg}$ is the average force exerted over some time Δt.

Impulse-Momentum Theorem:

- $\sum \vec{J} = \Delta \vec{p}$ (Impulse-Momentum Theorem)

  Remember that momentum is a vector

- $F_{thrust} = -v \left(\frac{dm}{dt}\right)$

Conservation of Momentum & Collisions:

- $\sum \vec{p}_f = \sum \vec{p}_0$ (Conservation of Momentum)

  Conservation of momentum applies:

- During all types of collisions
- When there is no external impulse

Collisions:

- Elastic Collision - Energy and momentum are conserved
- Inelastic Collision – Momentum is conserved, Energy is **not** conserved
- Perfectly Inelastic Collision – Objects stick to together after the collision. Momentum is conserved, Energy is **not** conserved.

Elastic Collisions: Variables:	Equations:
• 2 Initial velocities • 2 Final velocities	• Conservation of Momentum • Conservation of Energy

Perfectly Inelastic Collisions: Variables:	Equations:
• 2 Initial velocities • 1 Final velocities	• Conservation of Momentum

Center of Mass:

- $x_{c.m.} = \frac{\sum x_i \, m_i}{\sum m_i}$
- $x_{c.m.} = \frac{\int x \, \lambda(x) dx}{\int \lambda(x) \, dx}$

Learning Objectives:

- Calculate the center of mass for a set of discrete masses

Calculate the center of mass for a continuous object with a mass distribution

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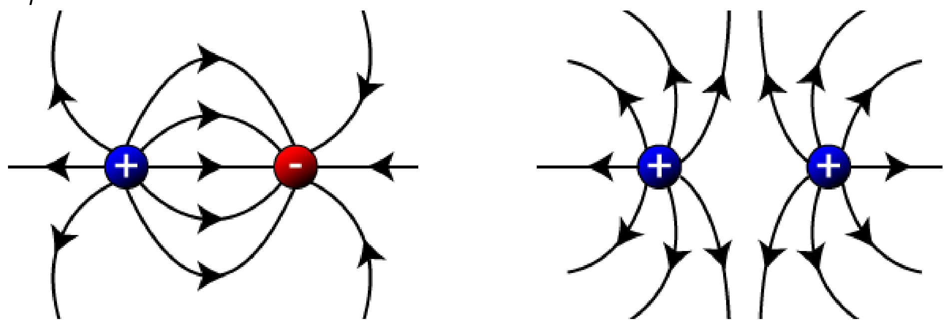
Electrostatic Force:

- Between point charges:
  - $\left|\vec{F}_C\right| = k \frac{q_1 \, q_2}{r^2}$ (Coulomb's Law)
  - Attractive for opposite charges, repulsive for like charges
- Caused by an electric field:
  - $\vec{F}_E = q \, \vec{E}$

Electric Fields:

- The electric field generated by a point charge
    - $E = k\frac{q}{r^2}$ (for point charges)



- Rules for drawing electric field lines:
    1. Point away from positive charges, towards negative charges
    2. Lines start and end on either a charge or at an infinite distance away
    3. Electric field lines never cross

Electrostatic Energy:

- Between point charges:
    - $PE_E = k\frac{q_1 q_2}{r}$

Electrostatic Potential (Voltage):

- Created by a point charge:
    - $V = k\frac{q}{r}$
- Relationship to Energy:
    - $\Delta PE = q\,\Delta V$
- Equipotential lines always point perpendicular to the electric field lines

Electrostatics & Conductors:

- Inside a conductor:
    - $|\vec{E}| = 0\,\frac{N}{C}$
    - $V = constant$

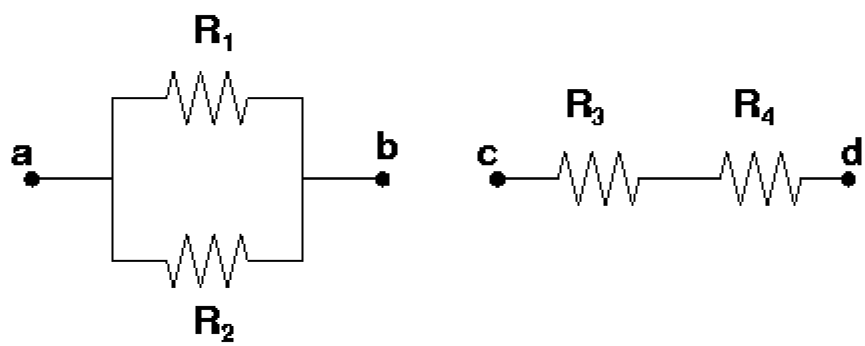
Current:

- Defined as: $I = \frac{\Delta q}{\Delta t}$

Resistors:

- Resistance of a wire:
    - $R = \frac{\rho L}{A}$

      Where ρ is the resistivity of the wire, L is its length, and A is its cross-sectional area
- Ohm's Law: $\Delta V = I\,R$
- Power lost inside a resistor:
    - $P = I\,V = I^2 R = \frac{V^2}{R}$
- Equivalent Resistance:
    - $R_{eq} = R_1 + R_2 + \cdots$ (for resistors in series)
    - $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$ (for resistors in parallel)



Parallel Series

Circuits:

- Kirchoff's Laws:
    - Voltage drop around any closed loop in a circuit is always $0\ V$.
    - Current flowing into a junction must equal the current flowing out of the junction
- Measurements:
    - An ammeter is used to measure current
        - The ammeter has very little resistance
        - The ammeter must be connected in series with the circuit
    - A voltmeter is used to measure the voltage drop across a circuit
        - The voltmeter must be connected in parallel with the circuit
        - The voltmeter has a very large resistance