Exam 1 Study Guide

Content on Exam 1 will include material from

- Prelectures, Checkpoints, and Lectures 1-4
- Homework 1 and 2
- Discussions 1-3
- Quizzes 2 and 3

We will not ask you questions about any rules, skills, or applications beyond what is listed on this sheet.

Rules and definitions you need to know:

- Direction of force between same and opposite charges
- Behavior of charges in a conductor
- Behavior of charges in an insulator
- Definition: Charging by conduction
- Definition: Charging by induction
- Magnitude of force between two point charges q_1 and q_2 separated by a distance r_{12}
- Superposition with electric forces
- Direction and magnitude of force on a test charge q placed in an existing electric field E
- (Newton's Third Law) Force of q_1 on q_2 is equal and opposite to force of q_2 on q_1.
- (Newton's Second Law) $\Sigma F=ma$, net force on an object causes it to accelerate

Skills you will need:

- Read problems and identify which physics rules apply
- Draw free body diagrams
- Determine whether a problem will require you to use vector addition
- Break vectors down into their x- and y-components when you know magnitude and angle (or triangle dimensions)
- Use x- and y-components of a vector to find its angle and magnitude
- Add two vectors together
    - Break each vector down into x- and y components
    - Add x and y components separately
    - Use resulting x_{total} and y_{total} to find the final vector's angle and magnitude
- For rules with equations, find the equations and correctly identify the variables from the problem that go into the equation (e.g., what are q_1 and r?)
- Set up and solve an equation where two forces cancel out (i.e., $\Sigma F=0$) or cause a net acceleration ($\Sigma F=ma$)
- Interpret electric field lines for the forces they exert on a test charge

Applications you will be tested on (**S** indicates simpler applications; **S+** indicates that two or more rules and/or skills must be applied; **A** indicates advanced applications where several skills and/or rules must be applied)

- What happens to charges on an object…
    - [**S**] If the object is a conductor or an insulator
    - [**S**] If a second charged object comes near to the first object but does not touch it
    - [**S**] If a second charged object touches the first object
    - [**S**] If the object is connected to ground
    - [**S**] Some combination of the above points
- [**S** if 1D, **A** if 2D] Relate the force (direction and magnitude) exerted by one charge q_1 on a second charge q_2, separated by a distance r_{12}
- Total force (direction and magnitude) exerted by 2-3 charges (e.g., q_1 and q_2) on a third charge (e.g., q_3) given the position and separation of each of the charges
    - [**S+**] In one dimension (on a straight line)
    - [**A**] In two dimensions (x and y coordinates, or a square or triangle configuration)
- [**A**] Equilibrium: Two charges q_1 and q_2 have locations x_1 and x_2. A third charge q_3 is placed at x_3 such that the total force on q_3 is 0.
- [**A**] Equilibrium: Two charged objects q_1 and q_2 are separated by a distance r_{12}. One or both objects may have a mass or other external information is present. One or more external forces (gravity, tension) are present. (Note: the exam will only include a 1D version of this scenario)
- A charge is placed in an electric field
    - [**S**] Relate the direction of force a positive or negative point charge would feel to the direction of the field at that location.
    - [**S**] Relate the magnitude of force exerted on the charge to the magnitude of the electric field
    - [**S+**] Relate the direction and magnitude of acceleration of the charge (note that electron mass is in the formula sheet) to the direction and magnitude of the electric field
    - [**A**] Combine force from electric field with other forces (gravity, tension) to determine some condition for equilibrium