Exam 1 Information

Exam 1 will take place on Thursday March 16 from 7:30-9:30 pm.

The Friday classes on 17 March are cancelled because of the evening exam.

Exam 1 Room Assignments:

L01 in 50-340 (Walker)
L02 in 50-340 (Walker)
L03 in 26-100
L04 in 26-100
L05 in 32-123
L06 in 34-101
L07 in 26-100
L08 in 26-152

Conflict Exam 1 will be held Friday Morning 17 March from 8-10 am in 26-322 and from 9-11 am in 32-123

If you have an academic conflict or a regular scheduled activity like MITSO, please fill out the online google form at

https://docs.google.com/forms/d/e/1FAIpQLScHSwpZMJeNaiMujJwOsTDLudf9fxk9dVdgxE1b2XFbAgmLEg/viewform?usp=sf_link

Please describe the conflict and indicate which of the times you would like to take the conflict exam. If you are not at MIT on Thursday or Friday, please describe the event and when you will be back on campus.

Exam Preparation

To study for this exam, we suggest that you review pre-class reading questions, in-class problems, in-class concept questions, Friday problem solving sessions, problem sets, relevant parts of the study guide, class notes, and work through past exams.

What We Expect From You on The Exam

(1) Ability to calculate the electric field of both discrete and continuous charge distributions. We may give you a problem on setting up the integral for a continuous charge distribution, although we do not necessarily expect you to do the integral,
unless it is particularly easy. You should be able to set up problems like: calculating the field of a small number of point charges, the field on the perpendicular bisector of a finite line of charge; the field on the axis of a ring of charge; and so on.

(2) To be able to recognize and/or draw the electric field line patterns for a small number of discrete charges, for example two point charges of the same or of opposite sign.

(3) To be able to apply the principle of superposition to electrostatic problems.

(4) To be able to calculate the electrostatic force on a charge moving in an electric field and to apply either Newton’s Second Law or the work-kinetic energy theorem to such motion.

(5) An understanding of how to use Gauss's Law. In particular, we may give you a problem that involve finding the electric field of a non-uniformly filled cylinder, slab, or sphere of charge. You must be able to explain the steps involved in this process clearly, and in particular to argue how to evaluate $\int\int\int \mathbf{E} \cdot d\mathbf{A}$ on every part of the closed surface, which you must choose to apply Gauss's Law, even those parts for which this integral is zero.

(6) An understanding of how to calculate the electric potential function of a discrete set of charges, that is the use of the equation

$$V(\mathbf{r}) = \sum_{i=1}^{N} \frac{q_i}{4\pi \varepsilon_0 |\mathbf{r} - \mathbf{r}_i|}$$

for the potential of $N$ charges $q_i$ located at positions $\mathbf{r}_i$ with $V(\infty) = 0$. Also you must know how to calculate the configuration energy necessary to assemble this set of charges. For a continuous charge distribution, you must know how to set up the integrand for the electric potential

$$V(\mathbf{r}) = \int_{\text{source}} \frac{dq}{4\pi \varepsilon_0 |\mathbf{r} - \mathbf{r}'|}$$

(7) You must know how to calculate the change in potential energy when you move a charged object with charge $q$ from one point in space to another, $\Delta U = q\Delta V$ and apply the energy principle to a closed and isolated system $0 = \Delta U + \Delta K$.

(8) The ability to calculate the electric potential given the electric field e.g. being able to apply the equation

$$V_b - V_a = -\int_a^b \mathbf{E} \cdot d\mathbf{s}$$

(9) To be able to answer conceptual questions. There will be concept questions similar to
those done in class, where you will be asked to make a choice out of a multiple set of choices.

(10) Understand the properties of conductors in static equilibrium and shielding. In particular, on the surface of a conductor knowing the direction of the electric field and the relation between the magnitude of the electric field and the magnitude of the surface charge density.

(11) Understanding the definition of capacitance \( C = \frac{Q}{\Delta V} \): in particular being able to explain relation between the charges on a conductors and the potential difference between the conducting surfaces. Know how to calculate capacitance for charged conductors that have enough symmetry that is at first possible to calculate the electric field and then calculate the potential difference using \( V_b - V_a = -\int_a^b \mathbf{E} \cdot d\mathbf{s} \). Finally using the definition of capacitance to find \( C = \frac{Q}{\Delta V} \).

(12) Calculate the stored energy by integrating the energy density over regions of space with non-zero energy density,

\[
U_E = \int u_E \, dV = \frac{1}{2} \int \varepsilon_0 E^2 \, dV .
\]

Equivalently, calculate the stored energy by \( U_E = (1/2)C(\Delta V)^2 \) or \( U_E = \frac{Q^2}{2C^2} \).

(13) Understand how inserting dielectrics in capacitors effects the electric field, energy stored, potential difference and induced charge distributions.
Study Guide

For each of these topics, we suggest you write up a study guide that consists of three sections

**Part I:** Conceptual Explanation of Key Concepts. You may want to print up Concept Questions from Class or Old Exams and add them here.

**Part II:** A summary of methodological approaches to problem solving. Many students do not apply enough detail and hence make errors on exam questions even though they have understood the concept. Applying the concept is much harder and you need to be very careful. You can compare your summaries with problem set solutions and in-class problem solutions to see if your summary is comprehensive enough.

**Part III:** Write up a set of solutions to problems that illustrate all the basic cases. You can draw from the in-class problems, and the problem sets. This part is critical. If you have enough examples that cover the concept, then when taking practice tests you have a basis of knowledge to draw on.

Attending Class

Please keep in mind that coming to class is the single most important thing you can do. Please carefully read and then answer the Reading Questions for each class. Don’t just search for the answers or ask your friends. Preparing for class is a crucial piece of time management. If you do prepare, your learning will be much more efficient and you will save valuable time.

Good Problem Set Habits

The problems sets are a crucial part of the course. I strongly encourage you to start the problem set early, and try it on your own before you talk to your peers or ask for help. This will especially help time management and you will discover that by starting the problem set early you will get more out of class.

Reviewing Solutions

You should print up and review solutions to all the in-class problems and problem sets!

Additional Resources

Go to anyone's office hours (see website for times)
Go to Sunday tutoring in 26-152
Go to Exam One Review Night