Physics 7B, Section 2, Speliotopoulos
Final Exam, Fall 2012
Berkeley, CA

Rules: *This final exam is closed book and closed notes. You are allowed two sides of one sheet of 8.5" x 11" of paper on which you may write whatever you wish.* ***You may not use any type of calculators on this exam****. Cell phones must be turned off during the exam, and placed in your backpacks.*

Please make sure that you do the following during the final exam:

- ***Show all your work in your blue book***
- *Write your name, discussion number, ID number on all documents you hand in.*
- *Make sure that the grader knows what s/he should grade by circling your final answer.*
- *Cross out any parts of the your solutions that you do not want the grader to grade.*

Each problem is worth 20 points. We will give partial credit on this final exam*, so if you are not altogether sure how to do a problem, or if you do not have time to complete a problem, be sure to write down as much information as you can on the problem. This includes any or all of the following: Drawing a clear diagram of the problem, telling us how you would do the problem if you had the time, telling us why you believe (in terms of physics) the answer you got to a problem is incorrect, and telling us how you would mathematically solve an equation or set of equations once the physics is given and the equations have been derived. Don't get too bogged down in the mathematics; we are looking to see how much physics you know, not how well you can solve math problems.*

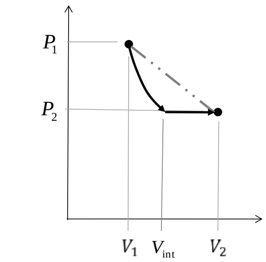
If at any point in the exam you have any questions, just raise your hand, and we will see if we are able to answer them.

Copy and fill in the following information on the front of your bluebook:

Name: _______________________________ *Disc Sec Number:* ________________________

Signature: ____________________________ *Disc Sec GSI:* ___________________________

Student ID Number: ____________________

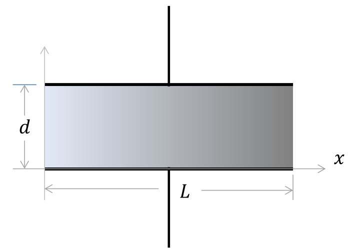


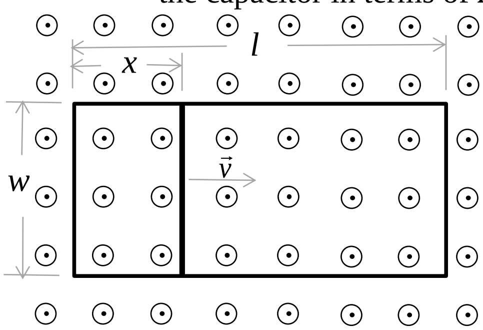
1. A diatomic gas with n moles has an initial state with a pressure, P_1, and a volume, V_1. It is brought to a final state with a pressure, P_2, and a volume, V_2, using an *irreversible* process (see dotted line on PV diagram on the left). The system can be brought from its initial state to its final state using the combination of an adiabatic and isobaric process. Use this to calculate the change in entropy of the gas. In terms of n, R, P_1, V_1, P_2, and V_2. You will get partial credit if you determine the volume, V_{int}, of the intermediate state.

2. The capacitor on the right has an area, A, width, L,and a separation, d, is filled with a dielectric,

$$K = 1 + K_0 \frac{x}{L},$$

that varies linearly with the horizontal position. What is the capacitance of the capacitor in terms of A, d, ϵ_0, and K_0?



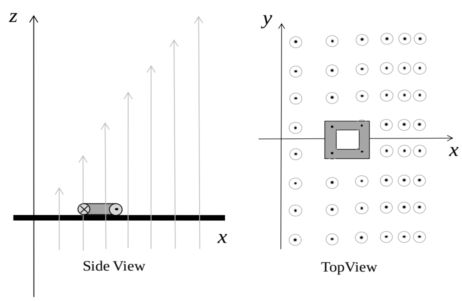


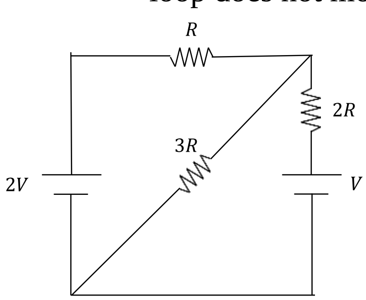
3. The figure to the left shows a wire loop, which has a length, l, and width, w, inside a magnetic field, B. The loop is made out of a wire with resistivity, ρ, and cross-sectional area, A. A crossbar made of a conducting metal with negligible resistance is in contact with the loop, and at the instant shown in the figure, it has velocity, v, and there are currents on both sides of the bar. What force, F, (magnitude and direction) must be placed on the rod when it is at the position shown so that the velocity of the rod is constant?

4. The figure to the right shows a rigged square current loop with side, s , current, I, and mass, m, on a table with coefficient of static friction, μ_s. The magnetic field is pointed along the vertical direction, and has magnitude that increases linearly with position,

$$B(x) = B_0 \left(\frac{x}{a}\right),$$

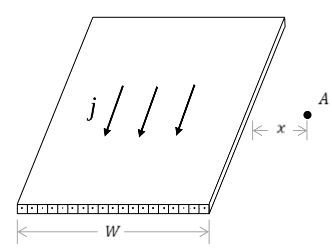
for a constant a. What is the minimum that μ_s can be if the loop does not move?





5. For the circuit on the left, find the current, I, through the resistor, $3R$, in terms of V and R.

6. The figure to the right shows a sheet of current with a *current per unit width*, j, that is infinitely long, but has a width, W. Find the magnetic field (direction and magnitude) at the point, A, in the figure.



7. The capacitor in the LC circuit to the left is initially charged with a charge, Q_0. If the switch is closed at $t = 0$, find the following:
   a. The shortest time, T, that it takes for the capacitor to fully discharge.
   b. The current through the capacitor at time, T.