Physics 24 Practice Midterm - 50 minutes
2 Pages - turn over!!

Harry Nelson

Monday, February 6

Write your answers in a blue book. Calculators and one page of notes allowed. No textbooks allowed. Please make your work neat, clear, and easy to follow. It is hard to grade sloppy work accurately. Generally, make a clear diagram, and label quantities. Make it clear what you think is known, and what is unknown and to be solved for. Except for extremely simple problems, derive symbolic answers, and then plug in numbers (if necessary) after a symbolic answer is available. **Put a box around your final answer... otherwise we may be confused about which answer you really mean, and you could lose credit.**

1. Paul makes a resistor out of salty ice which has a resistivity of $\rho = 25$ ohm-cm. For fun, he makes the resistor shaped like a trapezoid. One end is 10 cm tall, 1 cm deep, while the other end, 90 cm away, is only 1 cm tall, 1 cm deep. What is the resistance of Paul's resistor between the ends?
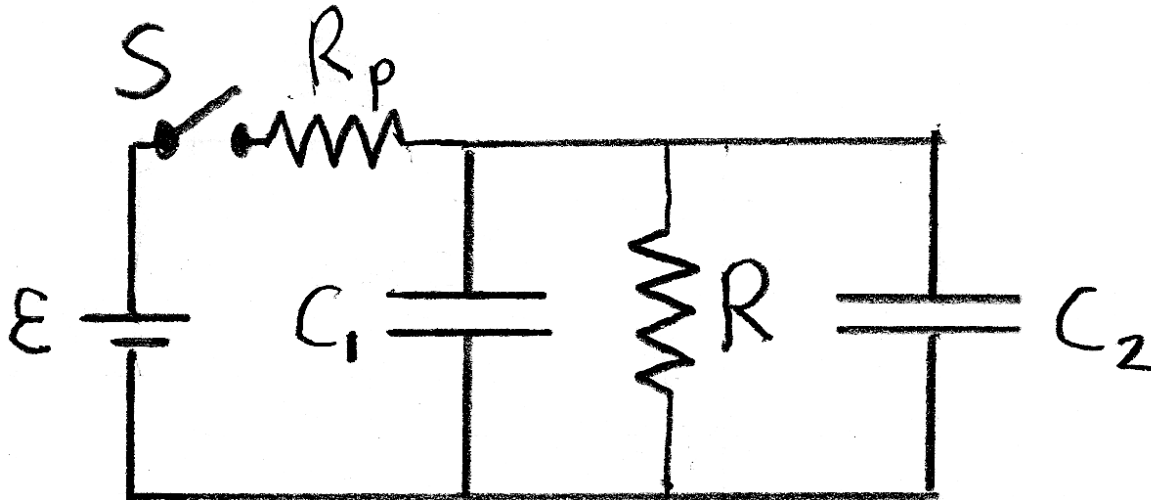

Figure 1: For use in Problem 2.

2. A circuit is shown in Fig. 1. The values of the symbols in the figure are $\varepsilon = 10\,\text{V}$, $R_P = 10\,\Omega$, $C_1 = 10\,\mu\text{F}$, $R = 10\,\text{M}\Omega$, $C_2 = 20\,\mu\text{F}$. Initially, there is no charge on either capacitor when the switch S is closed at $t = 0$.

   (a) At $t = 0$, what is the current through resistor R_P?
   (b) At $t = \infty$, what is the current through the resistor R_P?
   (c) At $t = \infty$, what charges are on the two capacitors?

3. Sally and Ted each have rulers 1 long, which they lay side by side along the x axis. Ted then runs at $\beta = \sqrt{15}/4$ in the x direction. Times measured in Sally's frame are called t, and those measured in Ted's frame are called t'. At $t = t' = 0$, the 0 of both Sally's and Ted's rulers are at $x = x' = 0$, where x' is Ted's coordinate. Take the speed of light to be $c = 0.3\,\mathrm{m/nanosecond}$.

   (a) At $t = 0$, Sally measures the other end of Ted's meter stick. How long is Ted's meter stick to her?

   (b) At $t' = 0$, Ted measures the other end of Sally's meter stick. How long is Sally's meter stick to him?

   (c) Explain how the answers to the two previous parts are consistent.