

**Test 2 Sample (100 points)****10/11/04**

**This exam contains four problems; only three may be graded. You may choose to solve any three. Please indicate which three problems you would like us to grade. We will grade only the problems you select.**

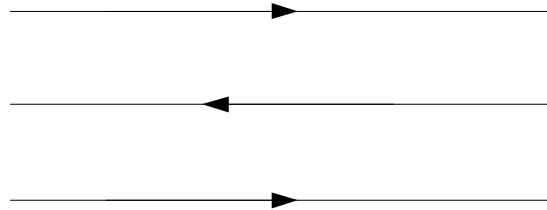
Question 1	/5
Question 2	/5
Problem ____	/30
Problem ____	/30
Problem ____	/30
Total	/100

Questions (5 points each) Please blacken the letter of the best answer for each question.

Q1 A power line carries current  $I$  due North. An electron 10 cm below the wire is traveling due South. The magnetic force on the electron will be

- a) To the East
- b) To the West
- c) To the North
- d) To the South
- e) Straight up
- f) Straight down
- g) zero

Q2 The diagram at the right shows three infinite, straight current carrying wires. The directions of the currents are as shown. The force on the middle wire will be

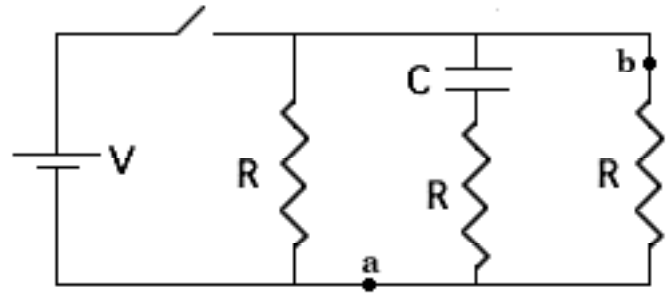


- a) Down
- b) Out of the page
- c) Into the page
- d) Zero
- e) Up
- f) None of the above

Problems (30 points each). **Please show your work and circle your answers.** Missing or incorrect reasoning will earn no credit.

**P1** An ideal battery of voltage  $V = 10 \text{ V}$  is attached to three identical resistors of value  $R = 50 \ \Omega$  and a capacitor of value  $C = 25 \ \mu\text{F}$ . Initially no currents are flowing and the capacitor is uncharged.

Please answer each of the following questions.



**Just after the switch is closed...**

- What is the current through each resistor (label them  $I_1, I_2, I_3$  from left to right)?
- What is the voltage across the capacitor?
- What is  $V_{ab}$ ?

**The switch is left closed for a long time...**

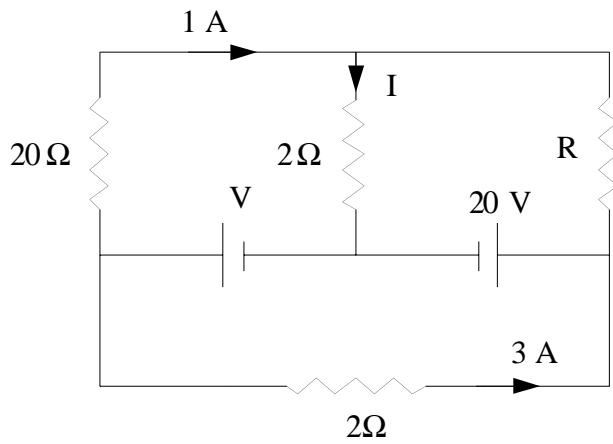
- What is the current through each resistor?

**Finally, the switch is reopened. Just after it is reopened...**

- What is the current through each resistor?
- What is  $V_{ab}$ ?

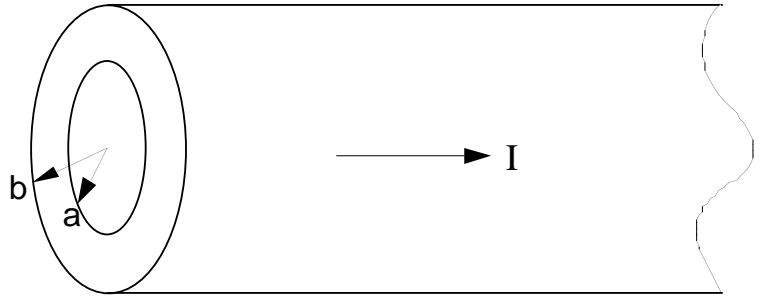
**P2** In the circuit shown at the right,  
please calculate

- a) The unknown voltage  $V$
- b) The unknown current  $I$  (where marked).
- c) The unknown resistance  $R$



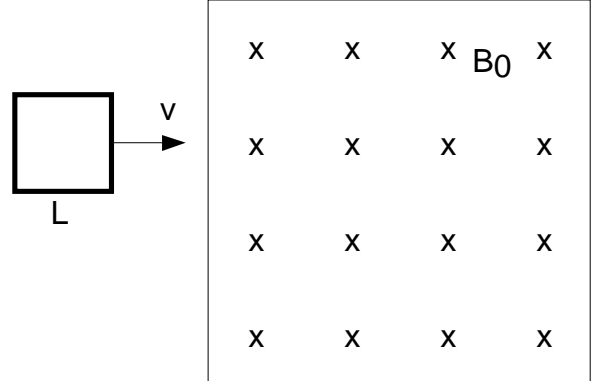
**P3** Total current  $I$  is carried in the positive  $x$  direction by a conductor in the shape of an infinitely long hollow cylinder. The inner radius is  $a$ , the outer radius is  $b$ , and the current is uniformly distributed over the cross section. Please determine

- a) The current density in the conductor.
- b) The magnetic field in the region  $r < a$
- c) The magnetic field in the region  $a < r < b$



**P4**

A square, conducting loop has side length  $L$ , and resistance  $R$ . The loop moves into a region containing a magnetic field of magnitude  $B_0$  at velocity  $v$ , as shown. The magnetic field is directed into the plane of the paper.



Please answer each of the following questions.

- a) What is the magnitude of the induced current as the loop enters the magnetic field?
- b) Will the current flow clockwise or counterclockwise?
- c) Find the magnitude and direction of the total force on the loop as it enters the field.