Physics 10164 – Spring 2019 Exam 2F

(30 pts) A circuit contains a 12 Volt battery, a 3.0 Ohm resistor and an unknown capacitor. A switch is closed at t = 0 to complete the circuit, and the capacitor begins to charge. At t = 3.6 μs, the voltage drop across the capacitor is 4.5 Volts.

a) What is the capacitance of the capacitor?
b) At that time, what is the voltage drop across the resistor?
c) At what time is the voltage drop across the capacitor equal to the voltage drop across the resistor?

2.   (40 pts) A long straight wire with current I_4 pointing out of the page generates a magnetic field in the vicinity of the rectangular loop shown.   Assume the magnetic field in that loop is uniform and equal to the magnitude and direction of the field at the geometric center of the loop, located 96.0 cm away from wire I_4.   The 5.0 cm x 18 cm single-turn rectangular loop is in the plane of the page and contains a clockwise current I_3.

a)   Determine the magnitude and direction of the magnetic force on (i) the left wire of the loop and (ii) the top wire of the loop.
b)   Determine the magnitude of the torque acting on the loop.
c)   Describe how the loop will rotate in response to the torque.

$I_4 = 4.0$ A

96.0 cm

$I_3 = 3.0$ A
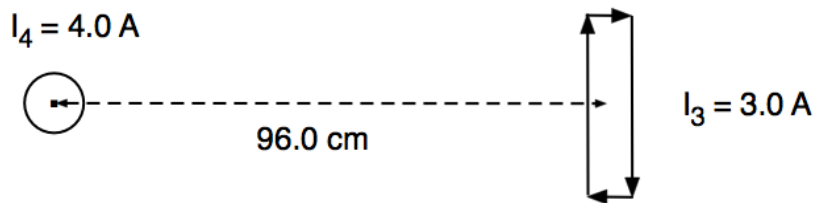
3. (30 pts) A 75-cm long thin conducting rod is oriented North-South and is falling vertically downward with a speed of 45 m/s through a 75 μT magnetic field that points 22° vertically above due East.

a) What is the magnitude of the induced EMF in the rod?
b) Which end of the rod is positive, North or South?
c) Assume 0.25 Amps of current flow through the rod in the direction that positive charges are forced, what is the magnitude and direction of the magnetic force on the rod?