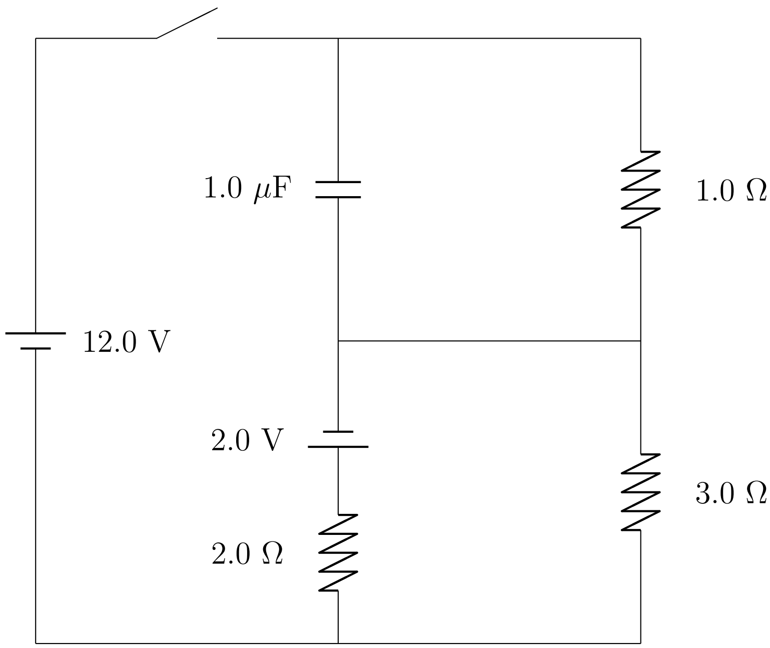
Practice 2; Phys 186 Name ______________

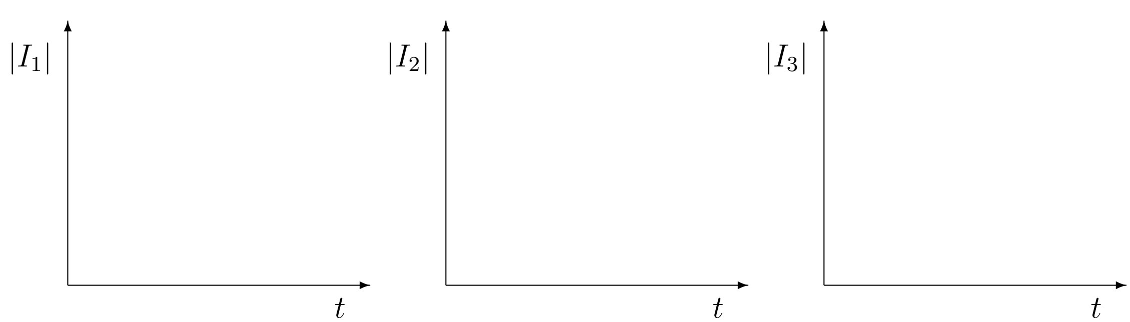
1. (0 points) Just before the switch is closed, the capacitor in the following circuit is completely discharged. You then close the switch.



(a) Find the currents through all the resistors *immediately after* the switch is closed, before the capacitor has any time to charge up at all.

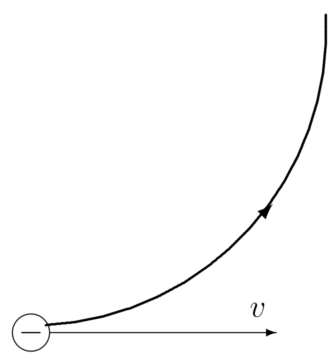
(b) Find the currents through all the resistors *a very long time after* the switch is closed, after the capacitor has completely charged up.

(c) Sketch qualitative I vs t graphs for each of the currents. The switch closes at $t = 0$. (I_1 is the current through the $1\,\Omega$ resistor, I_2 is the current through the $2\,\Omega$ resistor, and I_3 is the current through the $3\,\Omega$ resistor.)



2. (0 points) Let's say you did an experiment determining the charge to mass ratio of an electron, e/m_e, using only a magnetic field. You accelerate your beam of electrons, starting from rest, through an accelerating voltage V_a, and shoot them into a region with a uniform magnetic field perpendicular to their velocity. You then measure r, the radius of the arc into which the beam is bent.

(a) In the picture below, indicate the direction of the magnetic field. To the right of the picture, briefly explain your choice. The electrons come from the left; the picture shows one electron just entering the region with the magnetic field. The arc is the trajectory the electron will follow.



(b) Find an equation for e/m_e in terms of what you can measure or set in the lab: V_a, r (the radius of the arc), and B (the magnitude of the magnetic field). *Hint:* You may want to remind yourself about uniform circular motion from the first semester.

3. (0 points) You have an appliance that draws a large current I when in operation. This current creates a magnetic field in the next room, which we measure to be roughly uniform with magnitude $B = kI$, with a constant $k = 0.027$ T/A. In the next room, you have another appliance, which we shall model as a simple circuit with resistance 14.0 Ω, which presents an area of $A_\perp = 0.13$ m^2 perpendicular to the magnetic field, and an area of $A_\parallel = 0.049$ m^2 parallel to the magnetic field.

Starting from $I = 0$, you switch your appliance on. The current rises at a constant rate for a time interval of 0.21 s, reaching a value of 18.0 A. After this interval, the current remains constant at 18.0 A.

Hint for the following: You might need to calculate the rate of change of the magnetic field. To do so, notice that k is a constant, so that $\frac{d}{dt}B = \frac{d}{dt}(kI) = k\frac{d}{dt}I$.

(a) Find the current induced in the circuit in the other room *just before the current is switched on.*

(b) Find the current induced in the circuit in the other room *during the 0.21 seconds in which the current is rising.*

(c) Find the current induced in the circuit in the other room *after the current reaches its constant* 18.0 A *value.*

(d) If your appliance worked on an AC rather than DC power supply, would you expect it to disrupt surrounding circuits differently before, during, and after you turn the power on? Explain.

4. (0 points) You have a proton and an antiproton at rest on Earth. They annihilate to produce a muon-antimuon pair: $p + \bar{p} \rightarrow \mu^- + \mu^+$. The muon heads toward the Moon, 3.8×10^8 m away, and the antimuon is captured by a detector here on Earth. The typical lifetime of a muon is 2.2×10^{-6} s. Will the muon make it to the Moon to be captured by a detector there? A muon's mass is $m_\mu = 1.9 \times 10^{-28}$ kg, or 110 MeV/c^2. A proton's mass is $m_p = 1.7 \times 10^{-27}$ kg or 940 MeV/c^2. The speed of light is 3.0×10^8 m/s. Note:

- Relativistic energy (γmc^2) and momentum ($\gamma m\vec{v}$) are both conserved in this reaction. Show how you use both.
- You'll get a **bonus +5 points** if you solve this using the masses given in MeV/c^2.