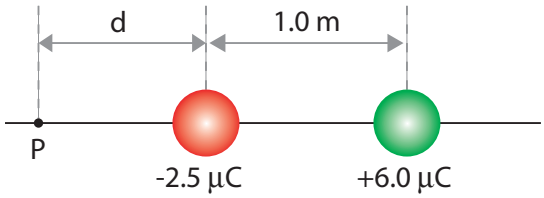
**PHYSICS 102 PRACTICE FINAL EXAM**

# Question 1:

Determine the location of the field point $P$ for which the net electric field due to the two charges shown in the figure below is zero. Neglect the trivial solution $P$ at $\infty$.



# Question 2:

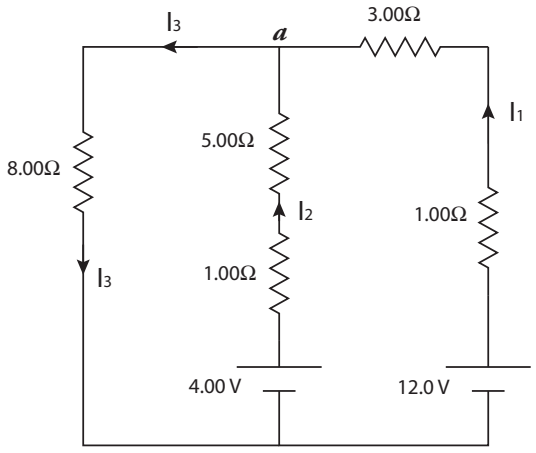
The potential difference between a pair of oppositely charged parallel plates is 400 V.

a.) If the spacing between the plates is doubled without changing the charge on the plates, what is the new potential difference between the plates?

b.) If the plate spacing is doubled and the potential difference between the plates is kept constant, what is the ratio of the final charge to the original charge on one of the plates?

# Question 3:

Determine the current in each branch of the circuit presented below.



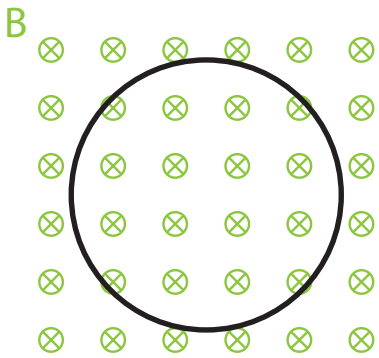
# Question 4:

A deuteron with mass $m = 3.34 \times 10^{-27}\ kg$ and charge $+e$ is traveling in a circular path with radius 3.48 $cm$ in a magnetic field of magnitude $B = 1.5\ T$, as shown in the figure.

a) Indicate the direction that the deuteron is traveling.

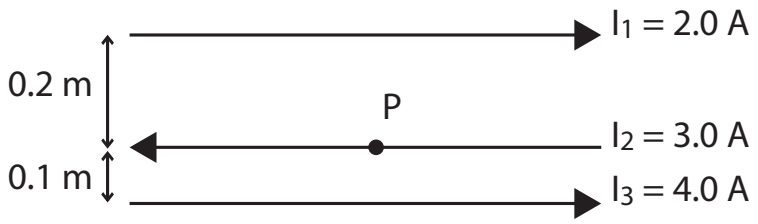
b) Find its speed.

c) How much time does it take for the deuteron to complete one revolution?



## Question 5:

Consider three long, co-planar and parallel conducting wires with currents $I_1$, $I_2$ and $I_3$ as shown in the figure below.




a) Determine the magnetic field (the magnitude and direction) at point $P$ on conductor $I_2$.

b) Determine the force per unit length (both the magnitude and direction) at point $P$ on conductor $I_2$.

c) In order to obtain a zero net magnetic field at point $P$, what should the value of the current $I_1$ be changed to?

# Question 6:

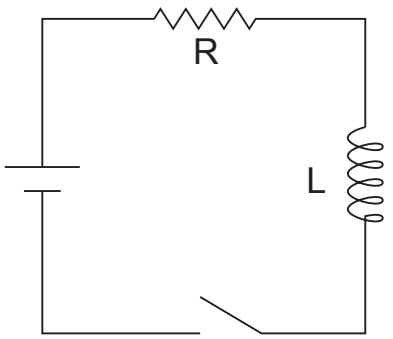
The circuit to the right has an inductor of $L = 200\,\text{mH}$ and a resistor of $R = 50\,\Omega$. The switch is closed, and the current measured to be $0.1\,\text{A}$ and rising at a rate of $35\,\text{A/s}$.

a) What is the size of the battery?

b) What is the time constant of the circuit?

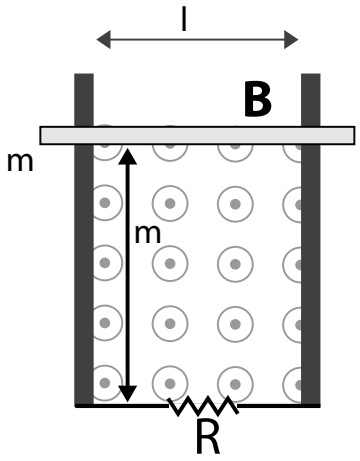
c) What is the steady-state current through the circuit?

d) After the current has reached the steady state, the battery is accidentally short-circuited by a clumsy teaching assistant. How long does it take for the current to drop $1\,\mu\text{A}$?



## Question 7:

A horizontal wire is free to slide on the vertical rails of a conducting frame, as seen below. The wire has a mass $m$ and a length $\ell$, and the resistance of the circuit is $R$. If a uniform magnetic field is directed perpendicular to the frame, what is the terminal speed of the wire as it falls under the force of gravity?



# Question 8:

In the circuit shown on the right, $R = 30\,\Omega$, $L = 1\,\text{mH}$, and $C = 80\,\text{pF}$. A sinusoidal voltage $v$ with a r.m.s. amplitude of 100 mV is applied.

a) At what frequency will the voltage across $R$ be largest? Calculate the size of this voltage, and the power dissipated by $R$ at this frequency.

b) If $C$ is increased to 120 pF, and the frequency remains the same as in part a, what will be the new voltage across $R$? What power will be dissipated by $R$?

c) Based on your results from a and b, can you explain how one might construct a simple radio tuner?