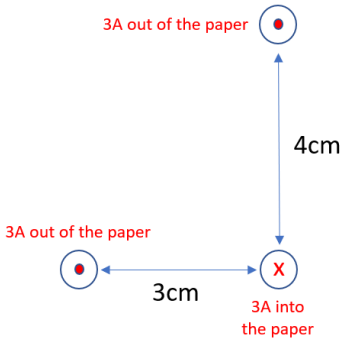
Physics 1320 - Calculus-based Physics II
Summer 2022
Final Exam

Question 1 (15 pts)

Consider three infinitely long current carrying wires as shown below:

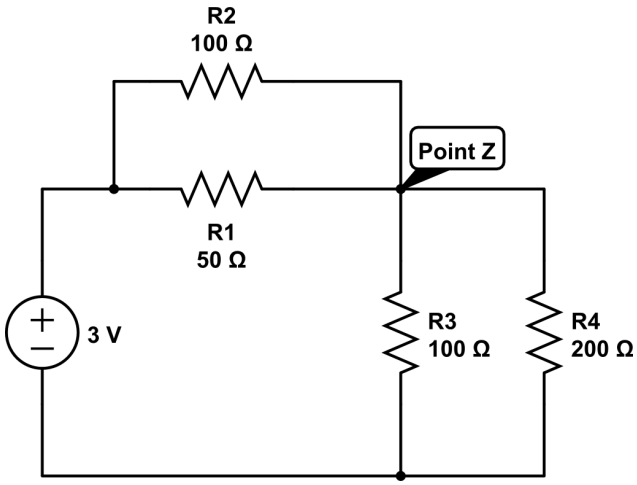
- Wire 1 is at the origin and carries $3A$ out of the paper.
- Wire 2 is at coordinates (3cm,0cm) and carries $3A$ into the paper.
- Wire 3 is at coordinates (3cm,4cm) and carries $3A$ out of the paper.



What is the Force per unit length (magnitude and direction) exerted on Wire 3?

Question 2 (15 pts)

Consider the circuit drawn below



A What is the equivalent resistance of this circuit?

B What is the voltage at Point Z?

C What is the current through resistor R4?

Question 3 (20 pts)

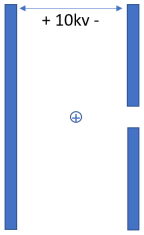
The LightSail spacecraft has a totally reflective mirror sail that has an area of $32m^2$ and the total spacecraft weight is $5.0kg$. A laser beam is directed at the sail and has an intensity of $13700\frac{W}{m^2}$ when it reaches the LightSail.

A What is the maximum acceleration the LightSail spacecraft can achieve?

B Assuming the intensity remains constant during the journey, how fast with the LightSail be moving after a year?

Question 4 (15 pts)

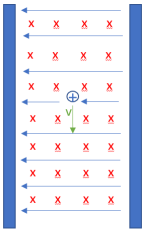
Recall the relationship that for two parallel plates separated by distance d that $E = \frac{V}{d}$. Consider a proton placed directly between the two plates with voltage of $10kV$.



At what speed and in what direction will the proton exit the plates.

Question 5 (15 pts)

Consider the same proton from Problem 4, not traveling with a velocity $\vec{v} = -xxxx\hat{k}\frac{m}{s}$. It is passing through a chamber with an Electric Field $\vec{E} = xxxx\hat{j}$ and Magnetic Field $\vec{B} = xxxxx\hat{i}$.



A What is the force from the Electric Field ($\vec{F}_E$) experienced by the proton?

B What is the force from the Magnetic Field ($\vec{F}_B$) experienced by the proton?

C What is the net (or total) force ($\vec{F}$) experienced by the proton?

Question 6 (15 pts)

If the proton from Problem 6 now enters a uniform magnetic field ($\vec{B} = xxT$) at the origin – point (0,0):

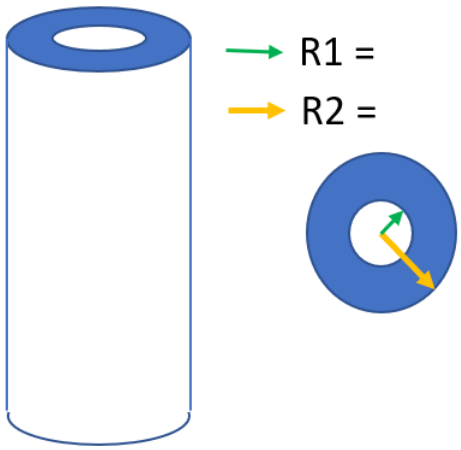
A Where does the proton exit the magnetic field?

B How long does the proton spend in the magnetic field?

C If we combine the parts from Questions 4,5, and 6, what device do we have?

Question 7 (20 pts)

Consider the following current-carrying conductor with $R_1 = xxx$ and $R_2 = xxx$. Assume the current of $xxxA$ has a uniform current density in the conductor.



Utilizing Ampere's Law, write the equations for the magnitude of the magnetic field (B) for the below conditions.

- $r < R_1$?
- $R_1 < r < R_2$?
- $r > R_2$?

Finally, draw the resulting magnitude of magnetic field as a function of r?

Question 8 - Extra Credit (5pts) Which of Maxwell's Equations can be attributed to Benjamin Franklin?