**Name (Please Print)**_____ **Student I.D.** _____
**CONSTANTS:**

$$k = 9 \times 10^9 \, \frac{N.m^2}{C^2} \quad , \quad \varepsilon_o = 8.85 \times 10^{-12} \, \frac{C^2}{N.m^2} \quad , \quad \mu_o = 4\pi \times 10^{-7} \, \frac{T.m}{A}$$

***Important Instructions:***
*1. You can use a scientific calculator that does not have programming or graphing capabilities.*
*2. You may **NOT** borrow a **calculator** from anyone.*
*3. Do not use **RED pen**.*
*4. This is a closed books and notes exam. Do **NOT** use notes or textbooks.*
*5. There should be **NO** talking during the examination.*
*6. Your will be **expelled** immediately from the exam if your mobile phone is seen or heard.*
*7. Any signs of **cheating** may cause you being expelled from the exam.*
*8. This examination has **2 parts**. **Part 1** has **4 multiple choice** questions, each question worth **1** point. **Part 2** has **four** workout problems worth a total of **9 points**.*
    *Make sure your paper has all the questions and problems.*

1- A proton, which moves perpendicular to a magnetic field of 1.2 T in a circular path of radius 0.08 m, has what speed? ($q_p = 1.6 \times 10^{-19}$ C and $m_p = 1.67 \times 10^{-27}$ kg)

a) $3.4 \times 10^6$ m/s      b) $4.6 \times 10^6$ m/s      c) $9.6 \times 10^6$ m/s      d) $9.2 \times 10^6$ m/s

2- A proton enters a solenoid. Upon entry, the proton is moving in a straight line along the axis of the solenoid. Which of the following is a correct description of the proton's motion within the solenoid?

a) The proton will be bent in a circular path.

b) The proton will continue in its straight path at constant velocity.

c) The proton will continue in its straight path and slow down.

d) The proton will continue in its straight path and speed up.

3- In the shown figure, two long wires carry currents in the directions indicated. At some instant, an electron is moving towards the top of the page at the shown location. What is the direction of the magnetic force acting on the electron at this instant?

a) into the page.                    b) out of the page.

c) towards the left of the page.      d) towards the right of the page.
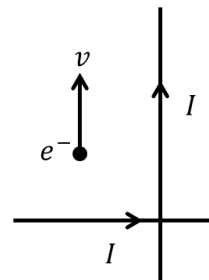


4-Two coplanar and concentric circular loops of wire each carries a current of 3 A in the shown directions. if the radius of the inner loop is 4 cm and of the outer loop is 8 cm, what is the magnetic field at the center of the loops?

a) $2.36 \times 10^{-5}$ T into the page      b) $1.50 \times 10^{-5}$ T out of the page
c) $3.00 \times 10^{-5}$ T into the page      d) $4.71 \times 10^{-5}$ T out of the page
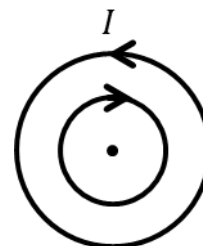
## Part 2: Solve the following four problems in the space provided in between showing all your steps,

## Problem 1 (2 marks):

In the figure, the current in the long wire is $I_1 = 10\ A$ and in the rectangular loop is $I_2 = 5\ A$. If $a = 0.2\ m, b = 0.4\ m$, and $c = 0.1\ m$, calculate the magnitude and direction of the net force that acts on the loop due to the magnetic field of the long wire.

(Hint: the forces on the upper and lower sides cancel out)
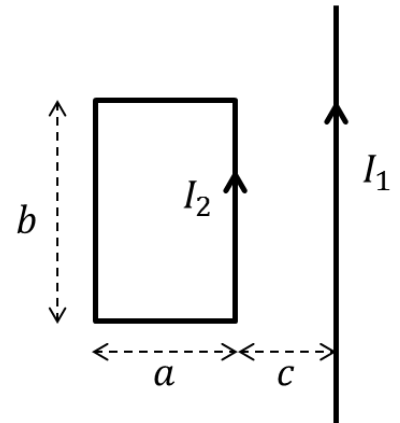
**Question 2( 2 marks):**

An 120 µf capacitor is connected in series to a 50 kΩ resistor thorough a battery of 150 volts. If the circuit is closed at t=0,

a) Find the current in the circuit at  t = 4.5 s.

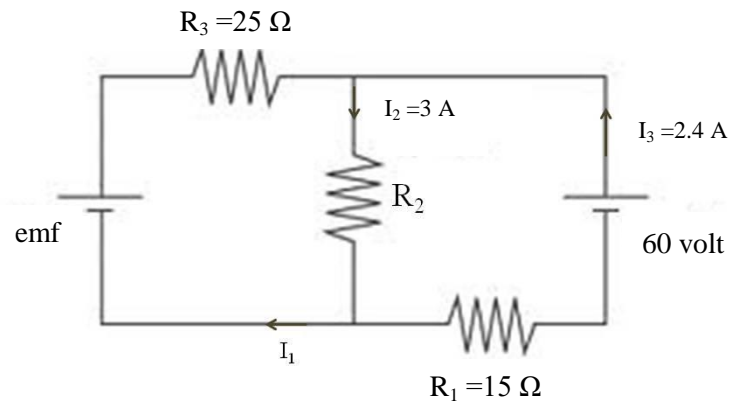b) How much time is needed for the capacitor to be charged to 80% of its maximum charge?

(2 points) In the figure, if the charge on the 20 $\mu$F capacitor is 34 $\mu$C, what is the potential difference across the 6 $\mu$F capacitor?

15.0 $\mu$F    3.00 $\mu$F

20.0 $\mu$F

a

b

6.00 $\mu$F
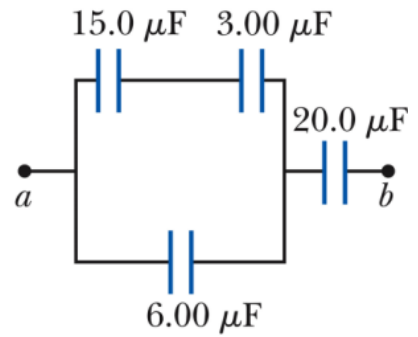
## Question 4( 3 marks):

In the circuit shown, use Kirchhoff's rules to find the values of the unknowns $R_2$, $I_1$, emf



$R_3 = 25\ \Omega$

$I_2 = 3\ A$

$I_3 = 2.4\ A$

$R_2$

emf

60 volt

$I_1$

$R_1 = 15\ \Omega$

# *Scratch Paper*