IB Physics **Name** :_____

Exam 2

$$E = -\frac{\Delta V}{\Delta x}$$

$$C = \frac{Q}{V}$$

$$I = \frac{\Delta Q}{\Delta t}$$

$$V = IR$$

$$P = IV$$

Parallel: $$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$$

Series: $$R_{eq} = R_1 + R_2$$

$$\overrightarrow{F}_B = q\overrightarrow{v} \times \overrightarrow{B}$$

$$\overrightarrow{F}_B = \overrightarrow{IL} \times \overrightarrow{B}$$

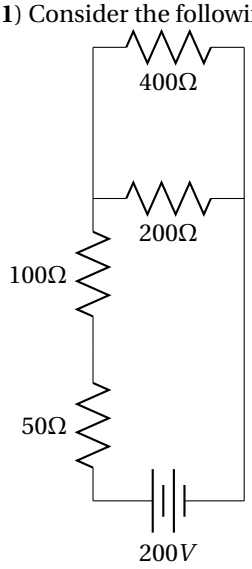
$$B_{wire} = \frac{\mu_0 I}{2\pi r}$$

Description	Symbol	Quantity
Gravitational Constant	G	6.67×10^{-11} N·m^2/kg^2
Electrostatic Constant	k_e	8.99×10^{9} N·m^2/C^2
Boltzmann's Constant	k_B	1.38×10^{-23} J/K
Avogado's Number	N_A	6.02×10^{23}
Plank's Constant	h	6.63×10^{-34} J·s
Speed of Light	c	3.0×10^{8} m/s
Fundamental Charge	e	1.6×10^{-19} C
Mass of the Electron	m_e	9.1×10^{-31} kg
Mass of Proton	m_p	1.7×10^{-27} kg
Gas Constant	R	8.31 J/mole·K
Vacuum Permativity	ε_0	8.85×10^{-12} F/m
Vacuum Permeablity	μ_0	$4\pi \times 10^{-7}$ T·m/A
Bohr Radius	a_0	0.53×10^{-10} m
Fine Structure Constant	α	1/137

Table 1: A list of physical quantities with SI units and dimensions.

The first question of the exam is worth 30 points.

1) Consider the following circuit



a. Determine the equivalent resistance of the circuit.

b. Determine the current through the 50Ω resistor.

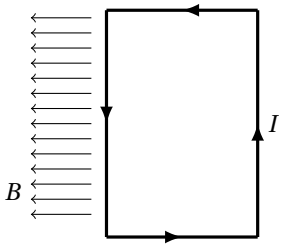
c. Determine the current through the 200Ω resistor.

d. Determine the voltage drop across the 100Ω resistor.

e. Determine the power dissipated by the 400Ω resistor.

The second question is worth 30 points.

2) Consider a magnetic field interacting with a loop of current. The loop is a 4x6 cm rectangle. The wire contains 10^{18} free moving electrons. The magnetic field is $B = 0.050$ Tesla. The current is $I = 1.6$ Amperes.



a. Determine the direction of magnetic force on each section of the loop.

b. Determine the magnitude of force on each section of the loop.

c. Describe the structure of the magnetic field created by the loop.

d. Determine the subsequent motion of the loop if it is free to move.

Question three is worth 30 points.

3) Consider a charged capacitor that holds 60×10^{-3} Coulombs with 12 Volts of potential. The capacitor is connected in series with a 300 Ω resistor. The capacitor begins discharging at $t = 0$.

a. Draw the circuit described above.

b. Draw a graph of the current as a function of time, $I(t)$. Include the value of the initial current.

c. Explain how the capacitor functions as a battery in this system.

Question four is worth 10 points.

4) Two long straight wires, separated by 50 cm, run parallel and carry current in opposite directions.

Describe the magnetic force between the wires.

Explain how these wires could be used to define the Ampere.