K=9.0E9N.m^2 /C^2; ε_0=8.85E-12C^2/N.m^2 ; e=1.602E-19C; 1eV=1.602E-19; Mass of electron 9.11E-31kg

P1 20	P2 20	P3 20	P4 25	P5 20	Total 105

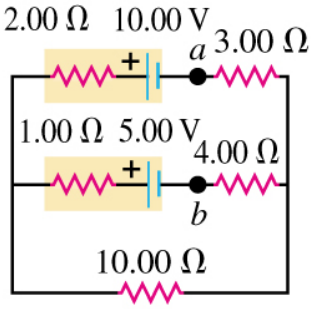
1. (20) A 1.30 m cylindrical rod of diameter 0.550 cm is connected to a power supply that maintains a constant potential difference of 13.0 V across its ends, while an ammeter measures the current through it. You observe that at room temperature (20.0 ^{0}C) the ammeter reads 18.4 A, while at 92.0 ^{0}C it reads 17.3 A. You can ignore any thermal expansion of the rod
   a. Draw a simple diagram of the problem using the circuit symbols. Place an Ammeter and voltmeter in appropriate arrangements to measure the voltage across the rod and the current through it.

   b. Find the resistivity and for the material of the rod at 20.0 ^{0}C.

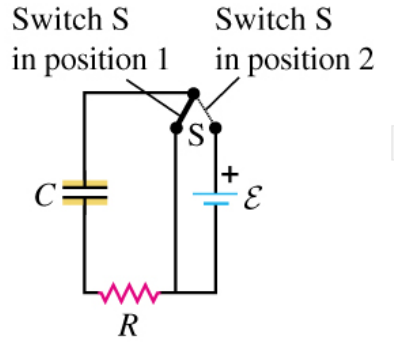
   c. Find the temperature coefficient of resistivity (between 20 and 90 degrees assuming it is the behavior is linear) for the material of the rod.

   d. How much power is consumed in the rod at 20.0 ^{0}C and 92.0 ^{0}C?

2. (18 points 3 points for each equation, 3 points for each current) In the circuit below find all the currents using the Kirchhoff ’s loop and junction rules. (be organized and clean. Messy solutions will suffer even correct).



3. (12 points) In the figure below a capacitor (C= 1.40×10−5 F) is connected as shown with a resistor (R= 980Ω) and an emf source (ε= 18.0 V and negligible internal resistance). Initially the capacitor is uncharged and the switch S is in position 1. The switch is then moved to position 2, so that the capacitor begins to charge.



a. What is the time constant of the circuit?

b. After 10.0 s, what is the charge on the capacitor?

c. How long it takes to charge the capacitor to 1/e of its capacitance?

d. What is the current through the circuit at t=10s?

4. (25 points) An electron is moving along +x direction with velocity of 4.0^6 m/s in a 5.0 T magnetic field along +y direction.
    a. What is the direction and magnitude of the magnetic force on the electron?

    b. What is the magnitude and direction of the acceleration of the electron?

    c. What is the radius of the circular path that electron moves around it?

    d. What is the cyclotron frequency of the electron motion?

    e. To make the electron motion unaffected by the magnetic field we apply an electric field. What should be the direction and magnitude of this electric field?

5. (20 points) Two infinitely long parallel wires each carrying a current of I along the +x direction are 2-cm apart cut the y-axis at +1 and -1 cm.
   a. Find the net magnetic field and its direction due to both currents at point P located at x=0, y=0, z=2 (draw a picture on yz plane and show the B-vectos due to each wire)

   b. What is the magnitude and direction of the force exerted on each wire by the other one F_{12} and F_{21}

6. (10 points) Calculate the **current required** to generate a magnetic field of 0.015 T at the desired location for each of the fooling systems.
   a. Write the equation for the current in each case (4 pts)
      i. Inside of a toroid at 5.00cm from its center with 1000 turns of wire.

      ii. At center of a current loop of radius 2.00cm.

      iii. Inside of an infinite solenoid of radius 2.500cm with 8000 turns of wire per meter.

      iv. 2 cm away from a long current carrying wire

   b. Rank the systems in terms of the current they require from lowest to highest (6 pts)

c. (10 points)Find the potential V across each capacitor, and the charge on each, after the switch is closed.