Assignment 5
Physics 205

(Do any eight problems)

Q1 A silver wire 1 mm in diameter carries a charge of 90 C in one hour and 15 min. Silver contains 5.8×10^{28} free electrons per m^3. (a) What is the current in the wire? (b) What is the drift velocity of electrons in the wire? **(0.02 A, 2.76×10^{-6} m/s)**

Q2. A vacuum diode can be approximated to a plane cathode, and a plane anode, parallel to each other, and 5mm apart. The area of both cathode and anode is 2 cm^2. In the region between cathode and anode, the current is solely carried by electrons. If the electron current is 50 mA, and the electrons strike the anode surface with a velocity of 1.2×10^7 m/s, find the number of electrons per cubic millimeter in the space just outside the surface of anode. **(1.3×10^5/(mm)^3)**

Q3 In the Bohr model of the hydrogen atom the electron makes about 6×10^{15} rev s^{-1} around the nucleus. What is the average current at a point on the orbit of the electron? **(9.6×10^{-4} A)**

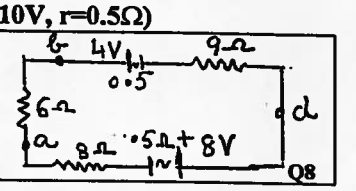
Q4 A wire 100 m long and 2mm in diameter has a resistivity of 4.8×10^{-8} Ωm. (a) What is its resistance? (b) A second wire of the same material has the same weight as the 100 m length, but twice its diameter. What is its resistance?**(1.53 Ω, 0.096 Ω)**

Q5 The resistance of a coil of copper wire is 200Ω at 20° C. What is its resistance at 50°C? **(223.6 Ω)**

Q6 A certain resistor has a resistance of 150.4 Ω at 20°C and a resistance of 162.4 at 40°C. What is the temperature coefficient of resistivity? **(3.99×10^{-3} c^{-1})**

Q7 The potential difference across the terminals of a battery is 8.5 V when there is a current of 3A in the battery from the negative to the positive terminal. When the current is 2A in the reverse direction, the potential difference becomes 11V. (a) What is the internal resistance of the battery? (b) What is the emf of the battery? **(emf=10V, r=0.5Ω)**

Q8 (a) What is the potential difference V_{ad} in the circuit shown in the figure?
(b) What is the terminal voltage of the 4V-battery?
© A battery of emf 17V and internal resistance 1Ω is inserted in the circuit at d, its positive terminal being connected to the positive terminal of the 8V-battery. What is now the difference of potential between the terminals of the 4V-battery? **(3.75V, 3.75V, 4.10V)**

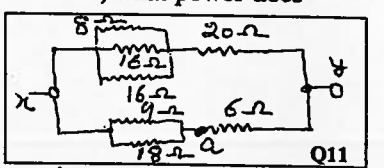


Q8

Q9 The internal resistance of a dry cell increases gradually with age, even though the cell is not used. The emf, however, remains fairly constant at about 1.5V dry cell may be tested for age at the time of purchase by connecting an ammeter directly across the terminals of the cell and reading the current. The resistance of the ammeter is so small that the cell is practically short-circuited. (a) The short-circuit current of a fresh No.6 dry cell is about 30A. Approximately, what is the internal resistance? (b) What is the internal resistance if the short-circuit current is only 10A? (c) The short-circuit current of a 6-v0lt storage battery may be as great as 1000A. What is the internal resistance? **(0.05, 0.15, 0.0006)**

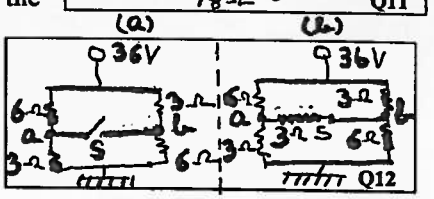
Q10 A 660W electric heater is designed to operate from 120V-line. (a) What is its resistance? (b) What current does it draw? (c) What is the rate of dissipation of energy, in calories per second? (d) If the line voltage drops to 110V, what power does the heater take, in watts? **(21.8Ω, 5.5A, 157.1 cal/s, 555W)**

Q11 (a) Calculate the equivalent resistance of the circuit of the figure between x and y. (b) What is the potential difference between x and a if the current in the 8Ω resistor is 0.5A?
(8Ω, 12V)



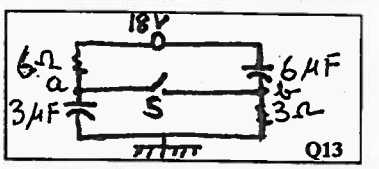
Q11

Q12 In the figures (a), what is the potential difference V_{ab} when switch S is open. (b) What is the current through switch S, when it is closed? (c) In figure (b) what is the potential difference V_{ab} when the switch S is open? (d) What is the current through switch S when it is closed? What is the equivalent resistance in Fig. (b), (e) when switch S is open? (f) When switch S is closed? **(-12V, -3A, -!2 V, 1.71A,4.2Ω)**



Q12

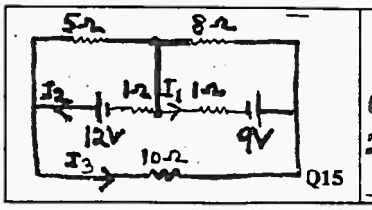
Q13 (a) What is the potential difference between a and b in the figure qhen switch S is open? (b) Which point a or b is at higher potential? (c) What is the final potential of point b when switch S is closed? (d) How much charge flows through switch S when it is closed? **(12V, a is at higher V, 6V, 36 μC)**



Q13

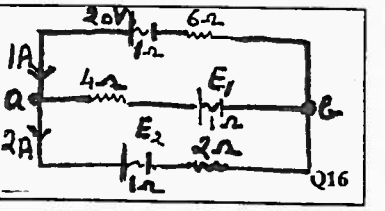
Q14 A 1000Ω, 2W resistor is needed, but only several 1000Ω ,1 W resistors are available. (a) How can the required resistance and power rating be obtained by a combination of the available units? (b) What power is then dissipated in each resistor? **(0.5W)**

Q15 Calculate the three currents in the circuit diagram. **(0.85A, 2.14A, 0.17A)**



Q15

Q16 Find the emf's E_1 *and* E_2 in the circuit of the figure and the potential difference between the points a, b.
(!8 V, 7V, 13V)



Q16