EE 100 HOMEWORK SET 1 Fall, 2004

Issued: August 30, 2004 Due: September 8, 2004

1. Do Problem 2.2 on page 61 of text.
2. Do Problem 2.3 on oage 61 of text.
3. Do Problem 2.4 on page 61 of text.
4. Do Problem 2.5 on page 61 of text.

HOMEWORK PROBLEMS

Section 2.1: Definitions

2.1 An isolated free electron is traveling through an electric field from some initial point where its coulombic potential energy per unit charge (*voltage*) is 17 kJ/C and velocity = 93 Mm/s to some final point where its coulombic potential energy per unit charge is 6 kJ/C. Determine the change in velocity of the electron. Neglect gravitational forces.

2.2 The unit used for voltage is the volt, for current the ampere, and for resistance the ohm. Using the definitions of voltage, current, and resistance, express each quantity in fundamental MKS units.

2.3 The capacity of a car battery is usually specified in ampere-hours. A battery rated at, say, 100 A-h should be able to supply 100 A for 1 h, 50 A for 2 h, 25 A for 4 h, 1 A for 100 h, or any other combination yielding a product of 100 A-h.

a. How many coulombs of charge should we be able to draw from a fully charged 100 A-h battery?

b. How many electrons does your answer to part a require?

2.4 The charge cycle shown in Figure P2.4 is an example of a *two-rate charge*. The current is held constant at 50 mA for 5 h. Then it is switched to 20 mA for the next 5 h. Find

a. The total charge transferred to the battery.

b. The energy transferred to the battery.

Hint: Recall that energy w is the integral of power, or $P = dw/dt$.

2.5 Batteries (e.g., lead-acid batteries) store chemical energy and convert it to electric energy on demand. Batteries do not store electric charge or charge carriers. Charge carriers (electrons) enter one terminal of the battery, acquire electrical potential energy, and exit from the other terminal at a lower voltage. Remember the electron has a negative charge! It is convenient to think of positive carriers flowing in the opposite direction, that is, conventional current, and exiting at a higher voltage. All currents in this course, unless otherwise stated, are conventional current. (Benjamin Franklin caused this mess!) For a battery with a rated voltage = 12 V and a rated capacity = 350 A-h, determine

a. The rated chemical energy stored in the battery.

b. The total charge that can be supplied at the rated voltage.

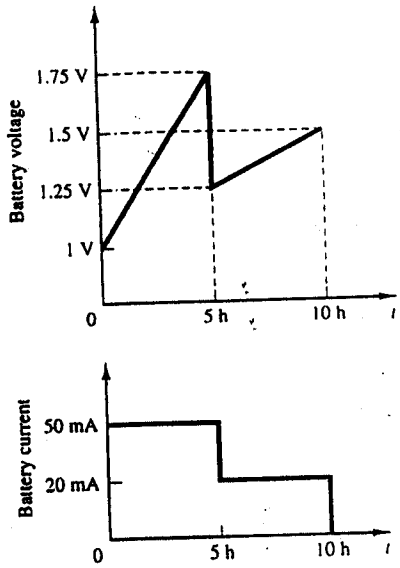

Figure P2.4

2.6 What determines the following?

a. How much current is supplied (at a constant voltage) by an ideal voltage source.

b. How much voltage is supplied (at a constant current) by an ideal current source.

Sections 2.2, 2.3: KCL, KVL

2.7 Use Kirchhoff's current law to determine the unknown currents in the circuit of Figure P2.7. Assume that $I_0 = -2$ A, $I_1 = -4$ A, $I_S = 8$ A, and $V_S = 12$ V.

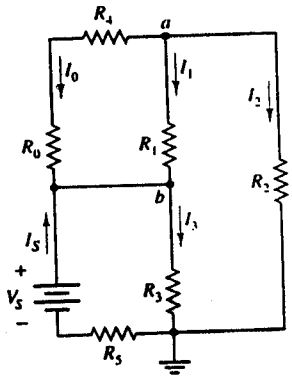

Figure P2.7