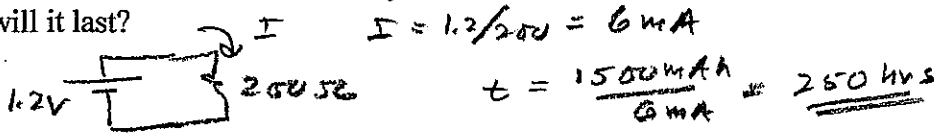


1. (15) A certain 1.2 V AA NiMH battery is rated at 1500 mAh. If this battery is connected to a 200 Ω resistor, how long will it last?



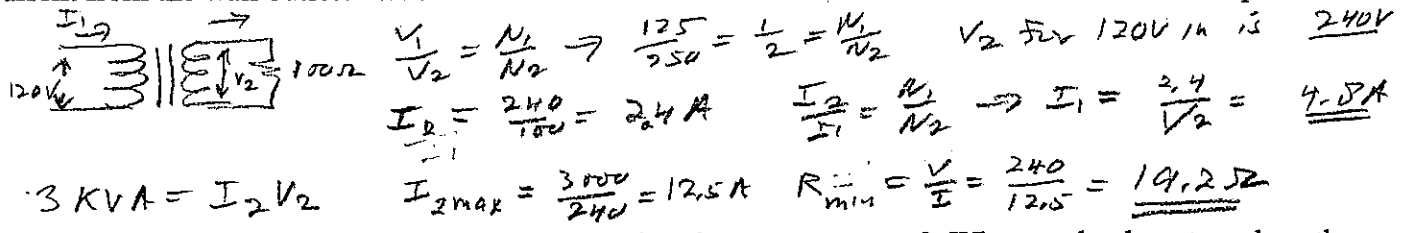
2. (10) Why can a (nominal) 1.2 V NiCd battery be used (almost) interchangeably with a (nominal) 1.5 V alkaline battery? Alkaline battery's voltages decay when used. Average voltage over its lifetime is about 1.2V, the same as NiCd.

3. (10) What is the "memory effect" in rechargeable batteries? If a battery is only partially discharged and then recharged over a number of cycles, it will "remember" its recharge point and have poor performance if discharged beyond that point.

4. (12) Indicate which type of rechargeable battery (SLA, NiCd, NiMH, Li-ion) might be best in each application below. Give a reason for each.
 Cell phone - Li-ion - because high energy density is required
 Cheap 40 kg industrial robot - SLA - because low cost and high power are required
 Replacement for AAA battery - NiCd or NiMH - because SLA and Li-ion won't fit.
 Digital camera - NiMH or Li-ion - NiMH has good energy density, but Li-ion has more, but requires special charger.

5. (13) Describe the differences between linear and switching voltage regulators and describe the advantages and disadvantages of each.
 Both voltage regulators provide stable output voltages. Linear voltage regulators are simpler but waste energy. A linear voltage regulator may require a heat sink. Switching voltage regulators are more complex, but do not waste energy. Switching voltage regulators frequently require added components, such as zener diodes and inductors.

6. (20) The nameplate data on a transformer reads: "Pri. 125 V, 60 Hz, Sec. 250 V, 3 KVA." If this transformer is plugged into the wall, and a 100 Ω load is connected to the output of the transformer, what is the current from the wall outlet? What is the minimum resistance that should be connected to the output?



7. (10) A certain sensor introduces random errors into its measurements? What can be done to reduce the severity of these errors? Measure the sensor output several times and average the results.

8. (10) What is a ground loop and why should it be avoided in sensor systems?
 A ground loop occurs when a system is grounded in more than one place. Small currents in the ground paths can cause voltages that will cause false sensor readings.