**EE 201 — HW 1-4** Name_____

The current cost of inexpensive AA alkaline (i.e. disposable) batteries seems to around $0.30 per battery. (www.amazon.com/AA-batteries/s?k=AA+batteries — some are a bit cheaper and some more expensive, but 30 cents seems to be a typical value.) Alkaline AA batteries produces a steady voltage of 1.5 V and are rated at around 2.5 A-hours.

a. What is the effective amount of charge (in coulombs) stored in one battery?

   $Q$ = _____

b. What is the amount of energy (in J) stored in one battery? $E$ = _____

c. If one of these batteries could be drained all way down to 0 J, how long will it last if a constant 10 mA is flowing out of it?

   $t$ = _____

d. Calculate the cost of the energy stored in this battery, expressed in $/kW·hr. (As a point of comparison, the cost of energy delivered by the electric utility is probably around $0.15/kW·hr.)

   cost = _____

Re-chargeable lithium NiMH batteries are around $2 each. (www.amazon.com/Panasonic-BK-3MCCA16FA-eneloop-Pre-Charged-Rechargeable/dp/B00JHKSN4O/). These produce a voltage of 1.2 V, are rated for 2 A·hr, and can be re-charged 2000 times. What is the cost of the using a rechargeable battery 2000 times, if the energy for re-charging is $0.15/kW·hr and the charging efficiency is 50%? (Meaning only half of the incoming energy is actually stored in the battery — the rest is lost as heat or something else. This efficiency is a just a guess, but let's go with it for the purposes of this problem.) How much would it cost to use alkaline (single-use) batteries to provide the same energy as 2000 re-uses of the lithium battery?

a. Total cost of using the rechargeable 2000 times. _____

b. Cost of comparable amount of energy from alkalines. _____

(Caveats: The rechargeable battery requires a charging unit, which should be included in the total cost. A charger might cost $25 — or $3 if you built it yourself. In general, batteries cannot be depleted down to zero percent. For this problem we are ignoring both of these factors.)

*Write your answers — and whatever work will fit — on this sheet. Staple any sheets with additional work behind.*