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. (<u>www.amazon.com/Panasonic-BK-3MCCA16FA-eneloop-Pre-Charged-Rechargeable/dp/B00JHKSN4O/</u>). 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.)