Module 5

Quiz: Battery and Voltage Regulation

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Battery	Voltage (V)	Storage (mAh)	Type
Alkaline	5*1.5=7.5	2000	Primary
Lithium	5*1.5=7.5	3000	Primary
NiCad	6*1.2=7.2	1200	Secondary
NiMH	6*1.2=7.2	1800	Secondary
Li-ion	2*3.6=7.2	1900	Secondary

Table 1. Storage capacities of AA-sizes batteries used to power a robot at about 7V.

Q1 Batteries

Assume your robot requires ½ amp to operate. How long will each battery type listed in Table 1 last?

Q2 Energy

Calculate the total energy in Joules, stored in the batteries listed in Table 1. Each robot will have multiple batteries so the voltage is above 7 V.

Part a) What is the total energy in five Alkaline batteries?

Part b) What is the total energy in five Lithium batteries?

Part c) What is the total energy in six NiCad batteries?

Part d) What is the total energy in six NiMH batteries?

Part e) What is the total energy in two Li-ion batteries?

Q3 Batteries

In what way is the Li-ion battery superior to the other batteries listed in Table 1? I.e., assuming cost is not a factor, why is Li-ion the best choice for use in a robot?

Q4 Definitions

Part a) What is the definition of **efficiency** for a regulator?

Part b) What is the definition of **power budget**?

Part c) What is the definition of **dropout voltage**?

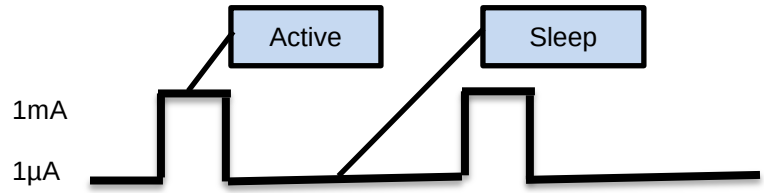
Part d) What is the definition of a **secondary battery**?

Q5 Power Budget

A battery can hold 2.2 A-hr. The embedded system runs at 100 mA. How long will the battery last?

Q6 Power Budget

A battery can hold 500 mA-hr. The embedded system runs with 1 mA in active mode and 1 µA in sleep mode. If the system runs needs to run for 1 year on a single battery, what percentage of the time should the system be in sleep mode?



Q7 Power

The V_{cc} pin on the MSP432 is used to power the microcontroller. Assume a simple resistive model for the integrated circuits in the MSP432. I.e., assume the resistance from V_{cc} to ground is fixed at 50 Ω. For example, at 3.3 V, it operates at 66 mA. What would be the power savings if you could run at 1.2V?

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