Homework # 1: Chapters 1 and 2

Rules:
1. Due by noon, Friday, February 8, 2013, in the "ECE4960" box next to room 219 Phillips Hall
2. Solve all the problems below for 100 points - **independent work only.**
3. Show full solution to the problems - do not skip steps.

Problem #1:
Assume a cellular phone with a battery of 1 [Amper*hour] capacity. The phone draws 35 [mA] while in the idle state and 250 [mA] during a call. The subscriber's calls lasts 3 [min], but he leaves the phone continuously on. Calculate the maximum available talk time before the battery needs to be recharged. Calculate the battery lifetime, if the subscriber makes 1 call: (a) once a day, (b) every 6 hours, (c) every hour.

Problem #2:
If a device were to operate in half-duplex ("push-to-talk") mode and assuming "voice activity" factor of 40%, how would the results in Problem #1 change?

Problem #3:
Repeat Problem #1 for a device that drains 5 [mA] in idle mode and 80 [mA] is transmission mode, for the following battery technologies (arrange your results in a table):

	Zinc-Carbon	Alkaline	Li-FeS_2	NiCd	NiMH	NiZn
IEC/ANSI name	R6/15D	LR6/15A	FR6/15LF	KR6/1.2K2	HR6/1.2H2	-/-
Capacity (at 500mA drain*)	400-1000 [mA*h]	1800-2600 [mA*h]	2700-3400 [mA*h]	600-1000 [mA*h]	2200-2900 [mA*h]	1500-1800 [mA*h]
Rechargeable	No	No	No	Yes	Yes	Yes

* Note that you do not need to use this information to solve this problem

Problem #4:
To extend the battery lifetime, most contemporary devices have "sleep mode," which reduces the duty cycle of the battery. Assume that there are the following three possible states of a device with the corresponding current drainage: sleep mode – 1 [mA], receive mode – 5 [mA], and transmit – 250 [mA]. Calculate the battery lifetime as a function of the battery duty cycle if the subscriber makes 1 call: (a) once a day, (b) every 6 hours, (c) every hour. Assume, that the battery capacity is 1[A*h] and that a call lasts 3[min].

Problem #5:
Assume that an analog signal of 30 [kHz] is transmitted over 10 segments, with an amplifier at the end of each segment. The original signal is 0[dBW] and each amplifier restores the signal to its original level. Assume that each segment is a coaxial cable of 2 [km] with attenuation of 2.25 [dB/100 feet]. Assuming "idea" amplifiers (i.e., thermal noise only or F=1) and operation at room temperature of 300^{o}K, what is the SNR at the exit of the system? (Clue: Read Appendix B in the textbook)