Product Dissection & Benchmarking Project Handout II
Measurements and Dissection. Estimated time: 2 hours

Preparation before beginning the Lab:
Read *Noise Measurement* and *Electric Circuits* Handouts.

Section:	14
Team #:	7
Team Name:	WADL
Members:	Luke Safko
	Alex Bidwell
	Dan Martin
	Wade Satanik

Lab II Assignments:

1. Complete data sheet 2.
2. Submit your completed lab 1a and 1b on Angel. Make sure you have your product name on each sheet. The file MUST be saved as a PDF file (file/save as/pdf). The filename MUST be:

TeamN_ProductName.pdf
Example: Team3_Lab2_CrestSpinBrushPro.pdf

3. Prepare a comprehensive features comparison table for features that are in your list of features to be benchmarked.

Laboratory Tools:

1. Camera
2. Sound intensity (Decibel) meter
3. Hack saw
4. Screw driver
5. Pliers
6. Multimeter
7. Connectors
8. Ziplock bags

I. Noise Measurement:

Tasks:

In a quite environment, place the Decibel meter's microphone close to the product running with no load. Record the decibel readings for various distances on data sheet 2. To make good sound readings, you need to set the sound meter with the following settings:

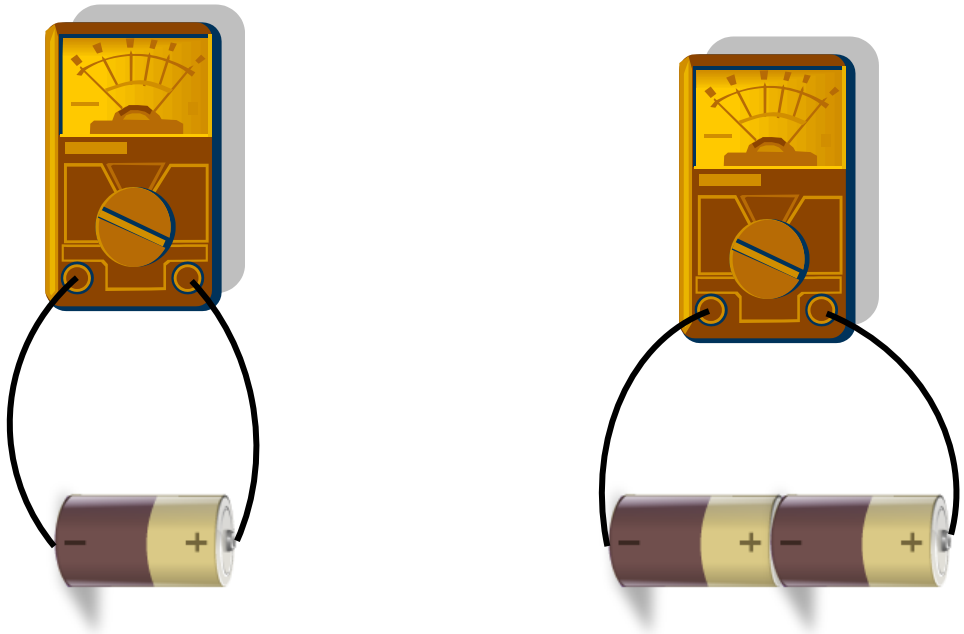
- Range: Lo
- Response: F
- Function: A

II. Power Measurement:

Tasks:

Battery measurement:

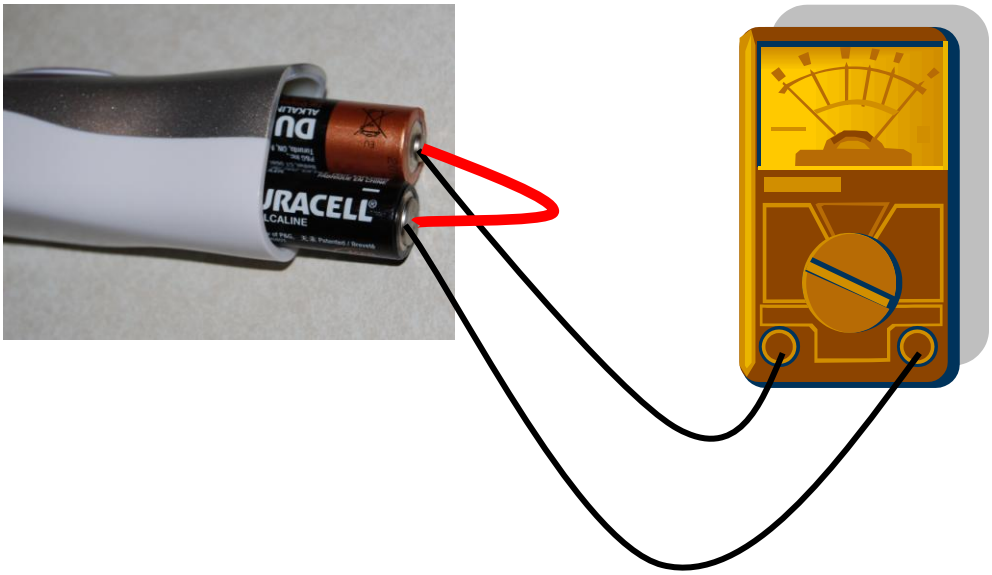
1. Remove the battery (batteries) from the product place them on the workbench.
2. Using a multimeter, measure the voltage across the battery (or batteries placed in series). Check the settings on the multimeter to make sure you are reading in Volts DC. Record the voltage on data sheet 2.
3. Note: If you arrange the batteries in the wrong order, the batteries will become warm. The batteries are being shorted.



4. Replace the battery (batteries) into their working positions, replace the battery cover, and turn the product on to ensure the batteries are placed correctly.

Measuring current under 'no load' conditions:

5. Remove the battery cover and leave the batteries inside the product. You may have to hold the batteries on the contacts inside the toothbrush housing.
6. Turn on the product.
7. Take a small piece of wire and connect the batteries in series. If you only have one battery use the small piece of wire to connect to the battery contact.
8. Switch on the multimeter. Set the multimeter to read current in milliamps (mA). Check the leads from the multimeter and make sure connected properly.
9. Connect a multimeter in series with the exposed ends of the batteries.
10. Record the current reading for the 'no load' condition. Note that the reading will fluctuate a little. Record several readings and take the average.



Measuring current under 'load' conditions:

11. Measuring current under load. Repeat steps 5-10, except the toothbrush should be positioned with the bristles rubbing against the workbench (simulating brushing of teeth). The toothbrush should be pressed down with similar pressure as when brushing ones teeth. This will be the first 'under load' measurement.

12. Step 11 should be repeated with each group member taking a turn at simulating brushing. At the end of this step, there should be as many averaged 'under load' measurements as the number of team members.

Calculating Power

13. Using the formula P=VI calculate the power required to run the product.

14. Assume that an average non-rechargeable AA battery has a capacity of 2500 mAh and an average non-rechargeable AAA battery has a capacity of 1500mAh. Using the average power consumption 'under load' calculate how long (in hours) the tooth brush can run before the batteries die.

15. Estimate how long it takes (or you should take to brush your teeth). Assuming you brush your teeth twice a day, calculate how many days use before you need to replace your batteries.

DATA SHEET 2	Team #: 7
Electric Toothbrush - Testing: Lab II	
Colgate/SpongeBob	

1. Product Weight:

Item:	**Weight:**
Complete Toothbrush	.108g
Batteries	.052g
Detachable brush head if applicable	n/a

Notes:
The batteries make up half the weight.

2. Noise Measurement:

Location:	**Noise level:**
Brush head 4 in away from decibel meter	72.3dB
Brush head 3 in away from the decibel meter	77.1dB
Brush head 2 in away from decibel meter	77.2dB
Brush head 1 in away from the decibel meter	79.9dB
DC motor 4 in away from decibel meter	74.1dB
DC motor 3 in away from the decibel meter	77.0dB
DC motor 2 in away from the decibel meter	79.6dB
DC motor 1 in away from the decibel meter	82.9dB

Notes:
The DC motor is louder.

3. Power Measurement:

Voltage supplied to the circuit:

	Battery Type	**Measured Volts (V DC)**
Battery 1	Energizer AAA	1.504
Battery 2	Energizer AAA	1.502

Total Voltage:

	Connection Type	**Measured Volts (V DC)**
Battery 1 and Battery 2	Series	3.006

Current Measurements	**Averaged Current Value (mA)**
No Load Condition	0.17mA

Current Measurements	**Current Value (mA)**
Load 1.	0.26 mA
Load 2.	0.52 mA
Load 3.	0.2 mA
Load 4.	0.4 mA
Load 5.	0.25 mA
Mean current 'under load'	0.326 mA

	Voltage		Current				
Power (no load) =	3.006	X	0.17	=	0.511	Units	W

	Voltage		Current				
Power (under load) =	3.006	X	0.326	=	0.979	Units	W

3. Battery Life

1. Number of hours available per single battery 'under load' conditions: **4.6** Hours

2. Estimate duration for each brushing **0.03** Hours

3. Number of days before battery replacement **76.7** Days