Physics' Tools Manual

This manual is to assist you in using the hardware and calculator programs utilized in the physics class. This manual will be referred to in labs and activities.

Unless you've downloaded this manual, it is to remain in class.

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Significant figures

…are made up of the digits you are absolutely sure of and an estimated digit. The estimated number is because the whole number comes from a measurement and measurements are not exact. When identifying the number of significant figures, the "significant digit" farthest to the right is the estimated digit. Below are the rules for determining the number of significant figures in an expression.

1. **Non-zero digits and zeros between non-zero digits are always significant.**
   Examples:
   2006 ..... 4 sig figs..... "6" is estimated
   34.0001 ..... 6 sig figs..... "1" is estimated
   35.04002 ..... 7 sig figs..... "2" is estimated
   250.04 ..... 5 sig figs..... "4" is estimated
   806 ..... 3 sig figs..... "6" is estimated

2. **Leading zeroes before the first non-zero digit are not significant.**
   Examples:
   0.005 ..... 1 sig fig (underlined numbers)..... "5" is estimated
   0.0000650 ..... 3 sig figs (underlined numbers)..... "0" is estimated
   0.000043 ..... 2 sig figs (underlined numbers)..... "3" is estimated

3. **Trailing zeroes to the right of the decimal point are always significant.**
   Examples:
   15.00670 ..... 7 sig figs..... "0" is estimated
   21.0 ..... 3 sig figs..... "0" is estimated
   34.5000 ..... 6 sig figs..... "0" is estimated

4. **Trailing zeroes left of the decimal point are ambiguous**
   Examples:
   4300 ..... Was this measured to the tens or ones place?
   56 000 ..... Was this measured to the hundreds, tens or ones place?
   300 ..... Was this measured to the tens or one's place?

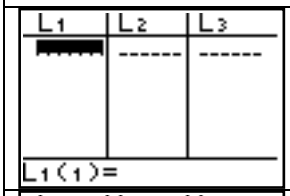
5. **These numbers need to be expressed in scientific notation showing the significance.** For example, all these ambiguous numbers are expressed with 3 sig figs.
   4300 ..... 4.30×10^3 ..... "0" is estimated"
   56 000 ..... 5.60 x 104 ..... "0" is estimated
   300 ..... 3.00 x 102 ..... "0" is estimated

6. **Counting numbers are exact. There are missing estimated digits and do not affect a calculation's significance.**
   Examples:
   A gross of donuts .....144 donuts are counted out exactly
   3 feet equals 1 yard.....This is exact by definition
   1 in = 2.54 cm.....This is exact by definition
   A dozen eggs .....12 eggs are counted out -exactly (you can't have a 1/10 of an egg)

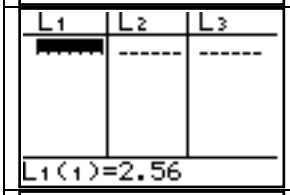
Calculator

Finding average and standard deviation -on the TI

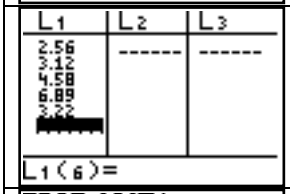
- The goal is to find the average and plus or minus error of 2.56, 3.12, 4.58, 6.89 and 3.22.
- Press "Stat" in the 3rd row from the top and the 3rd column from the left. This is the menu you will see.
- Select "Edit"



- This is the screen you will see after selecting :"Edit."



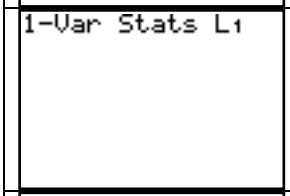
- Type the first number, "2.56"
- Notice that the number shows up at the bottom of the screen



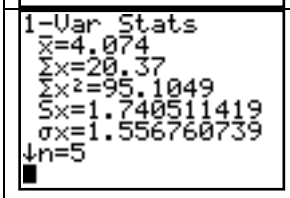
- After each number press enter.
- The list will look like this when all the numbers are entered.
- Note that the bottom of the list shows the entry number you are on.

- After all the numbers are entered, Press the Stat button again.
- Select CALC and 1-Var Stats.
- Press Enter.

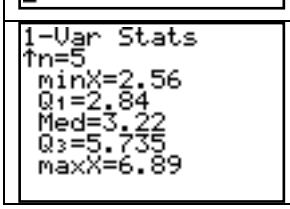
- The screen will look like this.
- The calculator is waiting for you to tell it which list to perform the statistics on.
- Type "L1." It is in blue above number "1."



- The screen will look like this.
- Press "Enter."



- This is the average of the list of numbers.
- This is the "plus or minus" value.
- The answer to the question is 4.07 ± 1.74 to two decimal places. Note that the average and the plus or minus must both have the same number of decimal places.



- This is number of entries in the list.

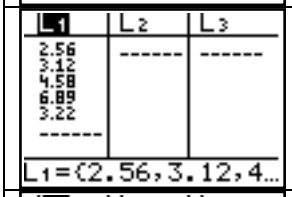
Calculator

Clearing the list –Method 1 -on the TI

- The goal is to erase the list of numbers in List #1, L_1.
- Press "Stat" in the 3rd row from the top and the 3rd column from the left. This is the menu you will see.
- Select "ClrList"

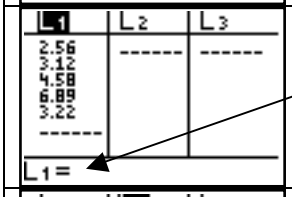
- Tell the calculator which list the erase. In this example tell it to erase L_1." L_1" is located in blue above the number "1."

- The screen will look like this. Press Enter.



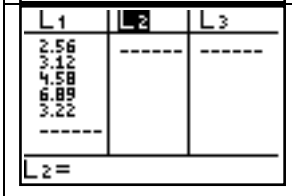
Clearing the list -Method 2 -on the TI

- The goal is to erase the list of numbers in List #1, L_1.
- When in the edit mode of the statistics, use the blue arrow keys to move the cursor to the top of the list. It will be highlighted.



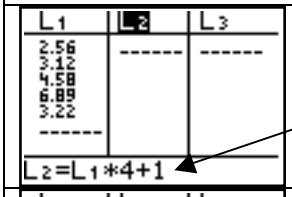
- Press the Clear key. DO NOT PRESS ENTER YET.
- The list of numbers at the bottom of the screen will disappear.

When you press Enter, the list will disappear.

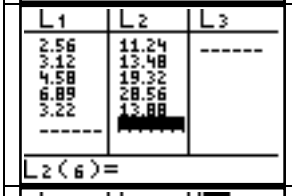


Doing the math with a list of numbers at a time -on the TI

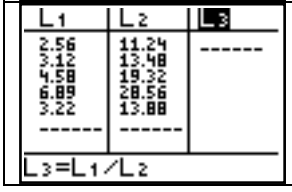
- The goal is to take all the numbers in L_1 and multiply them by 4 add 1 and put the answers in L_2. This might be a possibility when you need to use the formula y = 4x + 1 and all the "x" values are in the L_1 list.



- Use the arrow key to move to the top of an empty list, L2 in this example.
- Type "L_1*4+1" It will show up at the bottom of the screen.

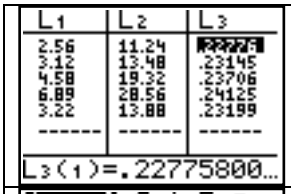
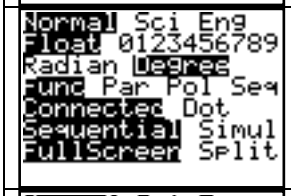
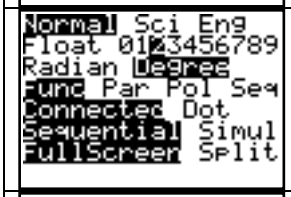
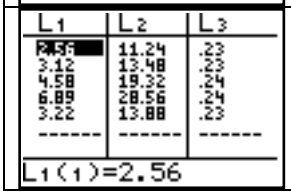


- Press Enter and each value in L_1 will be multiplied by 4 and 1 added. The row by row answer will be placed in L_2.



- Another example: Take the values in L_1, divide them by the values in L_2 and place the answer in L_3.

Calculator

	• Answer
	**Rounding numbers in a list –on the TI** • The goal is to round all the numbers in a list to 2 decimal places. • Press the Mode key.
	• Use the arrow keys to highlight the “2” in the second row. Press Enter then Quit.
	• Look at the lists. They will now be rounded to two decimal places.

Older Calculators
Using a non-graphical calculator to calculate the mean and standard deviation

Do the following on your **non-graphical** calculator to calculate the mean and standard deviation of 3,5 & 7.

Put the calculator in statistics mode.

mode ###

UNDERNEATH THE DISPLAY IS A LIST OF KEYS AND WHICH MODE THEY PUT THE CALCULATOR IN. CHOOSE THE ONE THAT SAYS STAT, OR STAT1

OR

2nd STAT

Enter the data.

3 Σ Σ+ DATA M+ 5 Σ Σ+ DATA M+ 7 Σ Σ+ DATA M+

Calculate the mean.

2nd INV Shift Alpha $\bar{x}$ Usually the mean key is located above another key

The display should say **2.333333333**

Calculate the standard deviation.

2nd INV Shift Alpha s σ_{n-1}

The display should say **2**

Before entering a new set of data clear the statics memory. This is done usually by pressing some of the keys below.

CA OR 2nd CLA OR Sometimes you have to take it out of statics mode.

Using the Ultrasonic Motion Detector

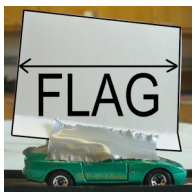
Press the APPS key to a list of applications. Press the up arrow to "go around the list and get to "**VST APPS**." With VST APPS selected pres the "**ENTER**" key.	APPLICATIONS 3:DataMate 4:DataMIn1 5:Physics 6:PolySmlt 7:SciTools 8:Transfrm 9:VST Apps
After a title screen this menu screen should up. Select "**1:DATAMATCH**" by pressing the number "**1**."	SELECT A PROGRAM 1:DATAMATCH 5:DATADROP 2:DATAGATE 6:FUNCTGEN 3:DATARAD 7:QUIT 4:DAROTARY
This is the title screen for the subprogram you just selected.	VERNIER SOFTWARE DATAMATCH (VER1.ØØ) GRAPH MATCH PROGRAM ROM1.13 (C)2ØØØ
Scroll down to "MODE:GRAPHMATCH." Then press the "**ENTER**" key. It should then read "**MODE:TIMEGRAPH–10**."	DIG:MOTION (M) ➤MODE: TIMEGRAPH–10 DISPLAY:DISTANCE 1:START 2: QUIT
Press the number "**2**" to check the settings.	DIG:MOTION (M) ➤MODE:TIMEGRAPH–10 DISPLAY:DISTANCE 1:START 3:GRAPH 2:SETTINGS 4:QUIT
If any settings do not match these, select "**2**" and change them to match these. Otherwise select "**1**" and continue.	TIME GRAPH SETTINGS TIME INTERVAL: .1 NUMBER OF SAMPLES 100 EXPERIMENT LENGTH: 10 1:OK 2:CHANGE TIME SETTINGS
Press the number "**1**." It will show a graph as you move towards and away from the motion detector. If you are using these settings it will be finished in 10 seconds.	DIG:MOTION (M) ➤MODE:TIMEGRAPH–10 DISPLAY:DISTANCE 1:START 3:GRAPH 2:SETTINGS 4:QUIT
Press the "**ENTER**" key to see the graph you just made. After the graph is displayed you can press the "**ENTER**" key again to return to this menu. You scroll up or down to display a different graph from the same data, e.g. Velocity, Acceleration, etc. Press "**1**"" to make another graph.	SELECT GRAPH ➤DISTANCE VELOCITY ACCELERATION 1:RETURN TO MAIN SCREEN 2:AUTOSCALE

Photogate

Measuring velocity at a single location using the photogate w/the TI

STEP	SCREEN SHOT	INSTRUCTIONS
0	The cbl is the device under the calculator.	The cable plugs into the jack that is labeled "DIG/SONIC." The plug is made in such a way that this is the only jack that fits.
1		Click on the "APPS" button in the 3rd row down and 2nd column from the left. It is circled on this picture.
2	APPLICATIONS 9 Login 0:Prob Sim :SciTools :StudyCrd :TImeSpan :Transfrm :VST Apps	From the list, scroll down to "VST Apps." Once highlighted, press the "ENTER" key
3	SELECT A PROGRAM 1:DATAMATCH 5:DATADROP 2:DATAGATE 6:FUNCTGEN 3:DATARAD 7:QUIT 4:DAROTARY	Press the number "2" to select, "DATAGATE."
4	DIG:PHOTOGATE --O-- MODE:MOTION 1:SETUP 4: ANALYZE 2:START 5:QUIT 3:GRAPH	Select option "1:SETUP."
5	PHOTOGATE SETUP 1:MOTION 2:GATE 3:PENDULUM 4:PULSE 5:RETURN TO MAIN SCREEN	Select option, "2:GATE."

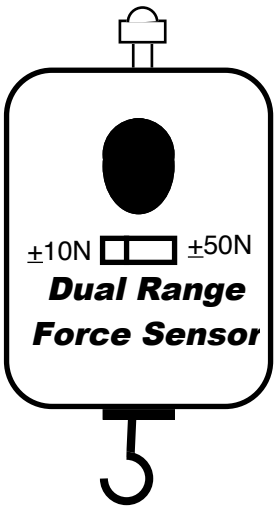
Photogate

STEP	SCREEN SHOT	INSTRUCTIONS
6	ENTER WIDTH OF FLAG IN METERS:	The "flag" is the piece of the card that travels through the photogate. 
7	SETTINGS MODE:GATE FLAG WIDTH(M): 0.2 1:OK 2:CHANGE SETTINGS	Check the settings. The flag width shown to the is just an example. Your flag will probably be different. If the settings are acceptable, click on "1:OK' …Otherwise enter the flag's width.
8	DIG:PHOTOGATE --O-- MODE:GATE 1:SETUP 4:QUIT 2: START 3:GRAPH	The screen should look like this. Notice just abo the horizontal line in the middle of the screen is text, "MODE:GATE." This is what it should say. When you are set up to take data… Select option, "2:START." **Record every piece of data the calculator gives you when it gives you the data.**
9	GATE MODE TRAIL NUMBER : --- TIME GATE1(S): --- PRESS [STO] TO STOP	Every time an object breaks the beam of light in photogate, the "TRIAL NUMBER:" will incremen itself up. Press, "[STO]," when you have recorded all of y trials. FYI … **Velocity through gate = $\frac{\text{Flag width}}{\text{CBL's time}}$**
10	DIG:PHOTOGATE --O-- MODE:GATE 1:SETUP 4:QUIT 2:START 3:GRAPH	If you are finished select, "4:QUIT." If you decide you need more data, do not selec
11	GATE 1 TIME IN ... VEL. IN L4 -DONE-	Note that the software tells you where the times and velocities are stored (L_4). L_1 is the trial num L_2 are the times. **Record *EVERY* piece of dat the calculator gives you.**

Force Probe
Using the force probes w/ the TI.

The hook end of the sensor can be pushed or pulled. (That's what the "±" indicates. 5 N is *close* to 1 pound of force. The sensor is not to exceed 10 pounds of force on the 50N setting or 2 pounds in the 10N setting. This is easy to do by hand. Please gentle and don't try to, "max out," the sensor.

It can break when maxed out.



APPLICATIONS 1:Finance… 2:CBL/CBR 3:CabriJr 4:Conics 5:DataMIn1 6:Inequalz 7:LearnChk	Plug the magnetic field probe into, "**~CH1**," on the side of the CBL unit. Press the "**APPS**" button. Use the direction keys to scroll down to a program called, "**DataMIn1**." Press enter to select this application.
CH 1:FORCE(n) -.54 MODE:TIME GRAPH-9 1:SETUP 4:ANALYZE 2:START 5:TOOLS 3:GRAPH 6:QUIT	A title screen will appear for a few seconds before this screen appears. If a different screen appears saying something about, "finished collecting data…" then ignore it and press the enter key. The applied force is shown in the top right of the screen. Note: The force uses the wrong symbol. It should be, "N." **To quit taking data choose option 6 on this screen.**
CH 1:FORCE(n) -.54 MODE:TIME GRAPH-9 1:SETUP 4:ANALYZE 2:START 5:TOOLS 3:GRAPH 6:QUIT	**ZERO'ING the force meter.** Sometimes the meter will give a force when it should read zero Newtons. To make it read zero again select item, "**1**."
CH 1:DUAL R FORCE 5Ø(n) CH 2: CH 3: DIG : MODE:TIME GRAPH-3_6 1:ON 3:ZERO 2:CALIBRATE 4:SAVE/LOAD	Select option, "**3:ZERO**."

Force Probe

SELECT CHANNEL **1:CH1-FORCE(n)** **2:ALL CHANNELS** **FORCE(n)** **CALIBRATION:LINEAR**	Select, "**CH1-FORCE(n).**"
CH1:FORCE(n) -.54 **PRESS [ENTER] TO ZERO**	The screen is reading the current force on the meter. If nothing is pulling or pushing on the meter it should read zero. To make it read zero, press [**ENTER**]. -Done

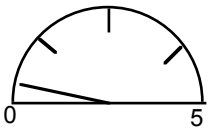
TEACHER USE

NOTE: LINEAR CALIBRATION
±10N: m = - 4.9 N/V: b = 12.25 V
±50N: m = - 24.5 N/V: b = 61.25 V

Light Probe
Measuring light intensity w/the TI

When using the probe you need to either have the light source as the only other light in the room of place a tube made from black paper between the probe and the light source.

APPLICATIONS 1:Finance… 2:CBL/CBR 3:CabriJr 4:Conics 5:DataMIn1 6:Inequalz 7:LearnChk	Plug the magnetic field probe into, "**~CH1**," on the side of the CBL unit. Press the "**APPS**" button. Use the direction keys to scroll down to a program called, "**CBL/CBR**." Press enter to select this application.
CBL/CBR APP: 1:GAUGE 2:DATA LOGGER 3:RANGER 4:QUIT	A title screen will be displayed. Press any key to continue. SELECT, "**1:GAUGE.**"
PROBE: Temp Light Volt Sonic TYPE: Bar Meter MIN:Ø MAX:5 UNITS: MW/cm^2 DIRECTNS: On ff Go...	From this screen, move the cursor over the highlighted items and press the, "**Enter**," key When they have each been selected, move the cursor over, "**Go...**" and press, "**Enter**."
CBL TI-83 Plus USE UNIT-TO-UNIT CORD TO LINK THE CBL AND TI-83 Plus. [ENTER]	This instruction screen will appear. Press the, "**ENTER**," key after the, short, animation is over.
CBL TI-83 Plus PLUG THE LIGHT PROBE INTO THE CH1 PORT OF THE CBL.. [ENTER]	This instruction screen will appear. Press the, "**ENTER**," key.
CBL TI-83 Plus TURN THE CBL ON. [ENTER]	This instruction screen will appear. Press the, "**ENTER**," key.
NOW CHECKING THE CALCULATOR CBL LINK CONNECTION. PLEASE WAIT.... STATUS: O.K. [ENTER]	This instruction screen will appear. Press the, "**ENTER**," key.

LINK ERROR PUSH IN THE LINK CORD CONNECTORS FIRMLY THEN PRESS [ENTER]	**TROUBLE SHOOTING AND ERRORS** If the CBL is not connected to the calculator, you will see this screen. Just push the link cable in and make sure the CBL is turned on and the batteries are good.
PRESS [ENTER] TO BEGIN.	Follow the screen's instructions
 .01245mW/cm^2	Here is where the readings will occur. The units are milli-Watt per cm^2. So all the displayed values are x10^{-3} W. Example: 0.1245 mW/cm^2=0.1245x10^{-3} W/cm^2. When you have finished, press the, "**CLEAR**," button. The screen will go back to the main menu. See the screen below.
PROBE: Temp Volt Sonic TYPE: Bar MIN:Ø MAX:5 UNITS: MW/cm^2 DIRECTNS: /Off Go...	Press, "**2nd Mode**," to go back a menu screen.
CBL/CBR APP: 1:GAUGE 2:DATA LOGGER 3:RANGER 4:QUIT	Choose option, "**4:QUIT**," to quit the program. **THEN TURN OFF THE CBL TO CONSERVE THE BATTERIES' LIFE.**

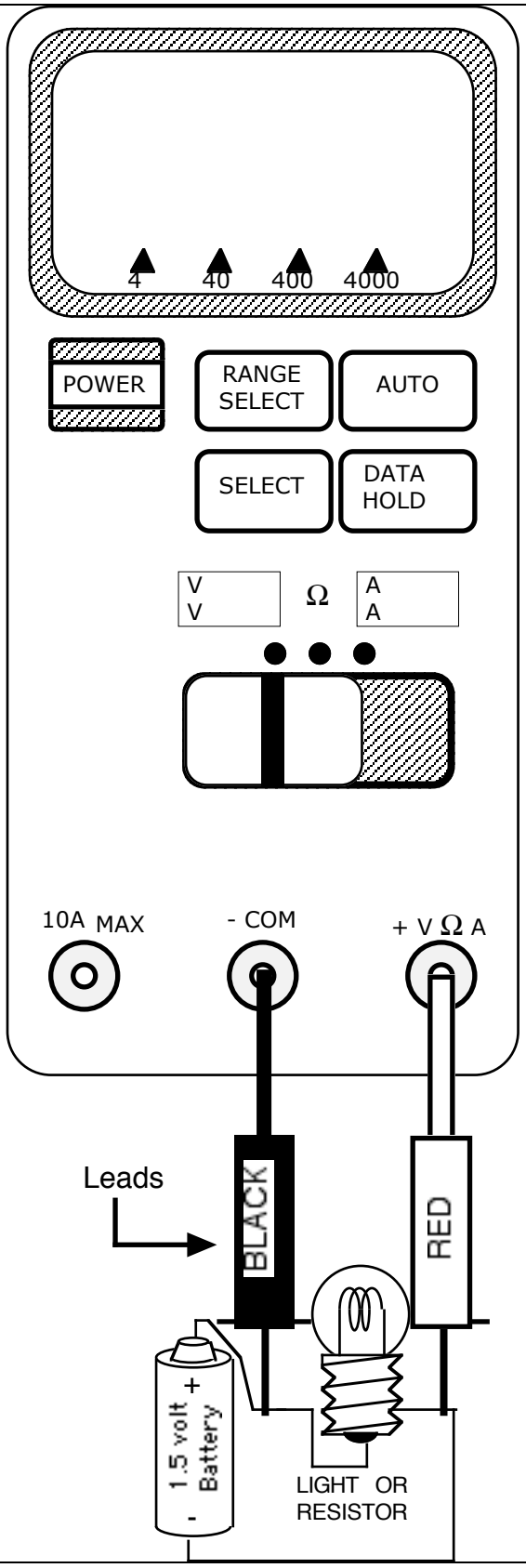
Magnetic Field Probes

Measuring magnetic fields using the b-field probe and the TI

The white dot on the sensor should face a magnet's south pole. This will give a positive field reading. On the LOW setting, the probe measures up to 0.3×10^{-3} T; on HIGH, it measures up to 6.4×10^{-3} T.

APPLICATIONS 1:Finance… 2:CBL/CBR 3:CabriJr 4:Conics 5:DataMIn1 6:Inequalz 7:LearnChk	Plug the magnetic field probe into, "**~CH1**," on the side of the CBL unit. Press the "**APPS**" button. Use the direction keys to scroll down to a program called, "**DataMIn1**." Press enter to select this application.
CH 1:MAGNET F(MT) - .Ø32 MODE:TIME GRAPH-9 1:SETUP 4:ANALYZE 2:START 5:TOOLS 3:GRAPH 6:QUIT	A title screen will stay on for a few seconds before this screen shows up. **The number at the top left of the screen in the magnetic field strength in 10^{-3} Tesla's**. (Pay attention to the lab to see what setting HIGH or LOW is used in the lab.)
CH 1:LOMAGNET FLD(MT) CH 2: CH 3: DIG : MODE:TIME GRAPH-9 1:ON 4:ZERO 2:CALIBRATE 5:SAVE/LOAD	**"Zero'ing the probe"** Every time the magnetic field probe is moved, you will need to subtract out the Earth's magnetic field from the readings. To do this, Press number "**1**" on the screen shown above. Press "**4:ZERO**."
SELECT CHANNEL 1:CH1-MAGNET F(MT) 2:ALL CHANNELS	Press "**1**" to calibrate the magnetic field probe.
CH1:MAGNET F(MT) -.Ø32 PRESS[ENTER] TO ZERO	Press the "**ENTER**" key. You may need to hold the key down fro a second before the calculator responds.
TIME IN L1 CH1 IN L2 CH2 IN L3 CH3 IN L4 D IN L6,V IN L7 A IN L8 [ENTER]	This is the screen that shows when you are done. Because you did not make a graph, L2 will be empty.

Multimeter: Measuring the voltage



VOLTAGE

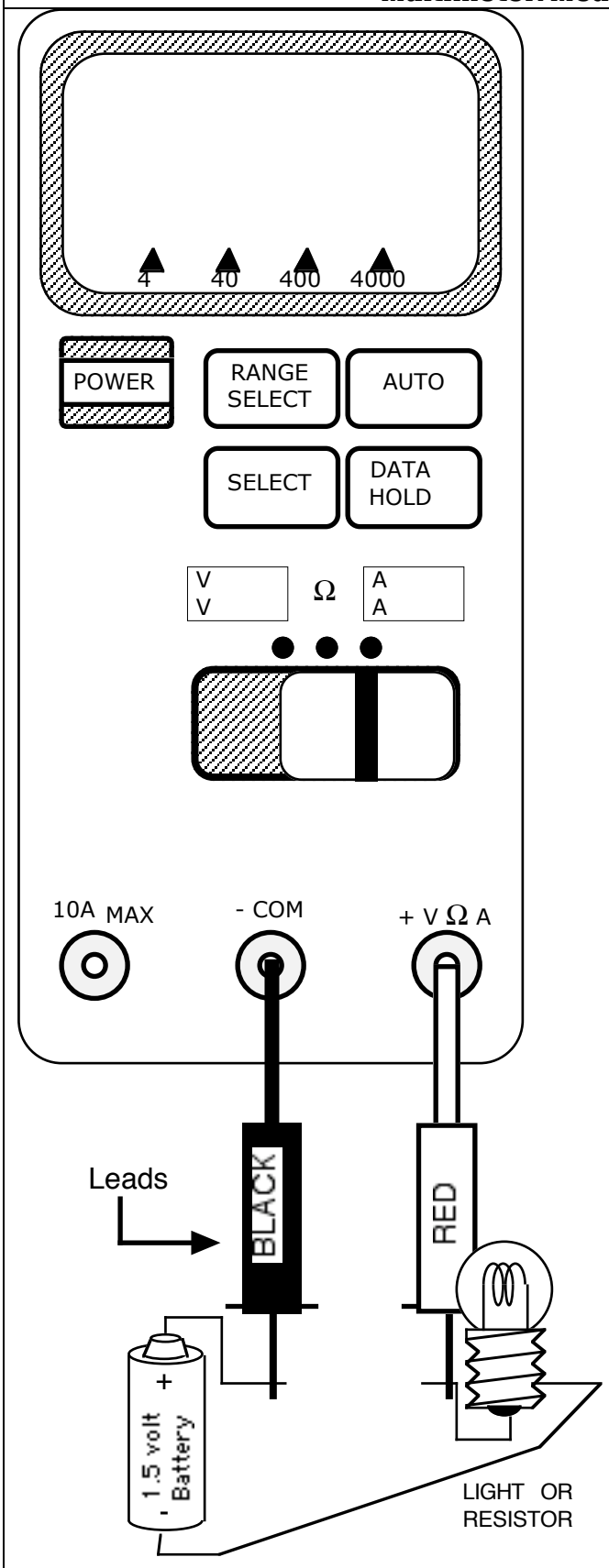
Voltage measurements compare the energy on the black lead wire to the energy on the red lead. When these two wires sense different energy levels, the meter shows energy difference. This difference is called voltage and has the units of volts (V).

This also means to measure the voltage of something you will need to measure the voltage **ACROSS** the object.

To measure the voltage output, you need to put across the ends of what you are testing. If you are testing a battery then one lead goes across the positive end. The other lead touches the negative end. The voltage will show up on the meter. If the voltage is negative, don't worry about it.

1. Plug the black lead into the center hole at the bottom of the meter.
2. Plug the red lead into the hole at the bottom of the meter on the right.
3. Turn on the power by pressing the **POWER** button.
4. Press the **AUTO** button.
5. Slide the selector switch all the way to the **left**.
6. Take a reading

Multimeter: Measuring the current



CURRENT

Current measurements read the flow of charges **THROUGH** the meter. To measure the flow, the meter must go between the energy source, (the battery), and the component to be measured. Current is measured in Amperes, "A."

When measuring the output of battery, the battery must be under "load." A resistor is a device that makes it more difficult for charges to flow. When connected to a battery it puts a load on the battery, In other words, it makes it harder for the battery to deliver energy. When measure the output of a battery use a 10 ohm resistor. When measuring the current of a fruit battery, use a resistor equal to 1 ohm or less.

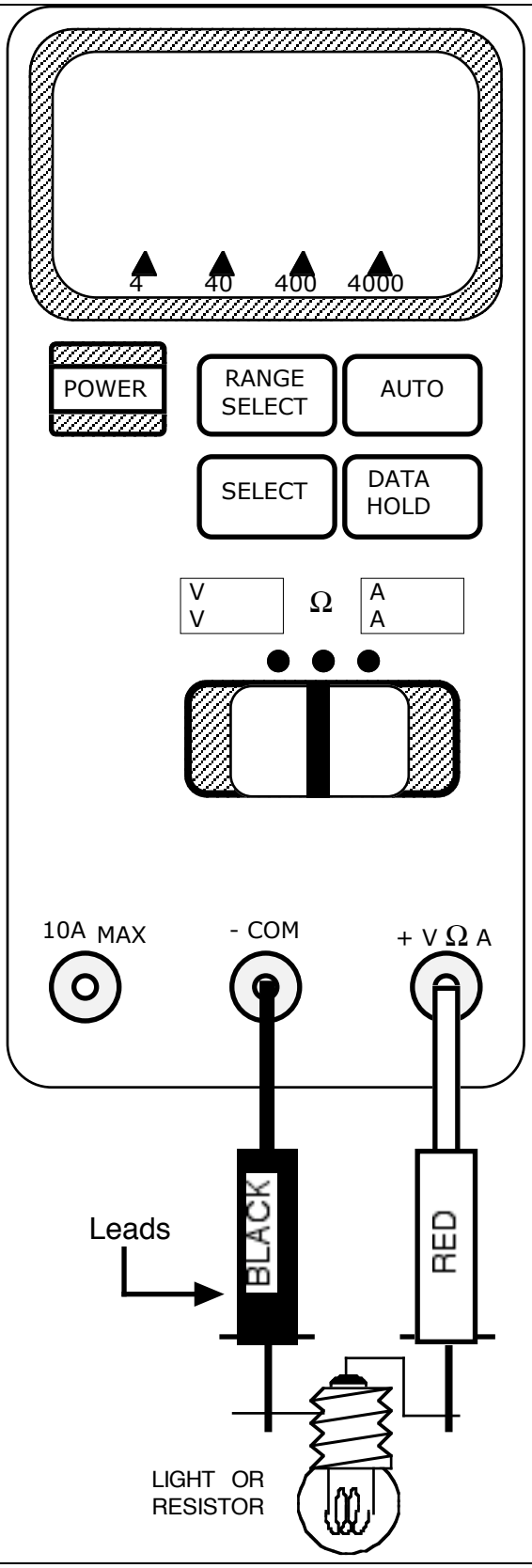
IF the reading flashes, then move the RED lead to the far left hole at the bottom (10AMAX).

1. Plug the black lead into the center hole at the bottom of the meter.
2. Plug the red lead into the hole at the bottom of the meter on the right.
3. Turn on the power by pressing the **POWER** button.
4. Press the **AUTO** button.
5. Slide the selector switch all the way to the **right**.
6. Take a reading.

Multimeter: Calculating the power

Power is not measured with this meter, it is calculated.
Power = (Current)(Volts)
Power is measured in Watts, "W."

Multimeter: Measuring the resistance



Resistance

Note: There is not a battery in the circuit when measuring the resistance of a component.

To get a reading, connect the object to be measured to the leads. A battery's resistance cannot be measured. Do not measure the resistance of an electrical component with a battery in the circuit. The battery must be removed.

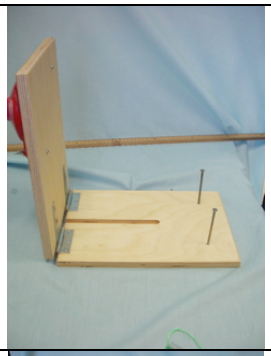
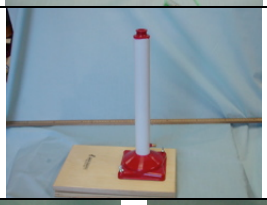
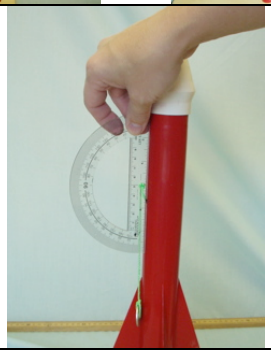
1. Plug the black lead into the center hole at the bottom of the meter.
2. Plug the red lead into the hole at the bottom of the meter on the right.
3. Turn on the power by pressing the **POWER** button.
4. Press the **AUTO** button.
5. Slide the selector switch all the way to the **middle**.
6. Read the numbers on the screen.

NOTE: Look for the symbol "k" or "M" on the LCD screen. The, "k," symbol means to multiply the LCD's number by 1000. The, "M," symbol means to multiply the LCD's number by 1,000,000. No extra letter means do not multiply the number by anything.

Air-Rocket Set Up and Launching Instructions ... for VERTICAL LAUNCH

Safety first. Never stand in front of the rocket under any circumstances.
NEVER LAUNCH or pump the tire pump without the teacher's permission.

Air-Rocket launcher set up for VERTICAL flight

STEP 1 Place the base on a "level" piece of ground. Open it up. Push two nails through the holes on the base into the ground. This will stabilize the launcher.	
STEP 2 Close the launcher so that it is pointing vertically.	
STEP 3 Place the yellow washer on top of the launcher.	 
STEP 4 Make sure the white nose cone is on the rocket's body. Slide the rocket over the launcher.	 
STEP 5 Hold the protractor next to the rocket's body. The string should hand down. You are checking to see if the rocket is pointed straight up. If the rocket is not straight up, then adjust THE BASE so that the rocket's points straight up.	

Air-Rocket Set Up and Launching Instructions ... for VERTICAL LAUNCH

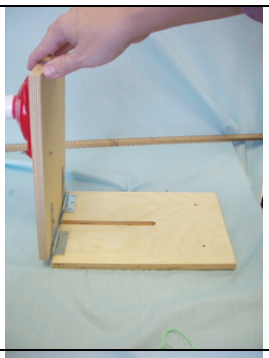
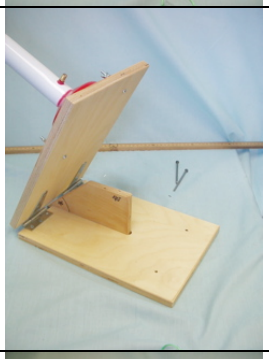
Safety first. Never stand in front of the rocket under any circumstances.
NEVER LAUNCH or pump the tire pump without the teacher's permission.

STEP 6 Place the pump's hose on the bottom of the rocket launcher. The "flip switch" should be down –parallel to the hose. This is shown in the LEFT picture. Once the end is in place, flip the switch up –perpendicular to the hose. This is shown in the RIGHT picture. **Do NOT pump the tire pump without the teacher's permission.**	 
STEP 7 The hose should be stretched out away from the rocket. **EVERYONE STANDS BEHIND THE PERSON USING THE PUMP .** When the teacher gives you permission –and only then- launch your rocket. If you launch without teacher permission, your group will receive a ZERO for this activity.	**- WARNING -** **If you launch or pump the tire pump without teacher permission, your group will receive a ZERO for this activity.** **Everyone in your group should raise his/her hands when you are ready to launch.**
STEP 8 **AFTER RECEIVING TEACHER PERMISSION**, stand behind the launcher.	
STEP 9 Stand on the base of the pump and begin to pump. The rocket will launch between 2 and 6 pumps. It will launch with a POP sound. If you are timing the rocket's flight, Stand 20 feet away from the rocket and get ready to start. Stop timing when the rocket hits the ground.	 
STEP 10 Do not lose sight of the rocket. It will come NEARLY straight down.	Do not lose sight of the rocket. It will come NEARLY straight down.

Air-Rocket Set Up and Launching Instructions

Angled Launch

Safety first. Never stand in front of the rocket under any circumstances.
NEVER LAUNCH or pump the tire pump without the teacher's permission.
Air-Rocket launcher set up for ANGLED flight

STEP 1 Open up the base. (It is hinged.) Leave the nails in the base.	
STEP 2 Insert the wooden wedge into the slot. The base will lean against the wedge at a pre-described angle. The angle is written on the wedge.	
STEP 3 Put the yellow cap on the launcher.	
STEP 4 Place the rocket on the white launcher and check the angle with the protractor, (astrolabe). **Do not pump the tire pump.**	
STEP 5 **Get permission from the teacher before launching.** Stand behind the rocket when launching. It takes no more than 6 pumps to launch the rocket.