One dimensional Motion

Names 1. _____
2. _____
3. _____

Responsibility Matrix

- The matrix below is the tool your team will use to divide the points for the responsibilities for the tasks shown below.
- Each team members' column must add up to exactly 80 points.
- The work may be divided between members as the members agree.
- Point allocations may be changed ***with the approval of your instructor.***
- Indicate who will lead in each task with a yellow highlighter.

Task	Due Date	Value	#1	#2	#3
Listen to my video instructions		15			
Submit Comp. Responsibility Matrix		9			
Supply one VHS tape		6			
Record data using video camera		6			
Extract data using transparency film		18			
Produce d/t and v/t graphs		18			
Quiz day on Ch 3 and part of Ch4		---			
Calculate regression equations (TI)		12			
Prepare the report to class --Pwr pt		21			
Present the report to class *		135			
Quiz on video lab one		---			
		240	80	80	80

* All students must participate in the presentation in a meaningful way.
**One written report is submitted per group.

Powerpoint Presentation guidelines:**, ***

pts:	
10 _____	• Introduce all group members, and clearly and briefly state the purpose and procedure of your lab.
20 _____	• Clearly state (or show) the type of motion your group analyzed
10 _____	• Clearly state how many frames per second your camera used and tell how you determined this value.
40 _____	• Show d/t, v/t, and a/t graphs. Preferably show all 3 on one slide.
10 _____	• tell what parallax is, explain parallax error and tell how vulnerable to this error your particular work is
15 _____	• Clearly state the relationships between d/t, v/t, and a/t graphs (how can we generate v/t from d/t, for instance)
10 _____	• Tell what a regression equation is.
15 _____	• All group members must participate in (speak during) the presentation.
05 _____	• Clearly tell what shape d/t graphs represent accelerated and unaccelerated motion.
$\sum_{poss} = 135$	

** please note that several guests (students and faculty, parents, community members) will be invited to listen to your presentations.

*** there will be a strictly enforced time limit in operation during the presentations.

One-dimensional-motion Lab: **using the video camera.**

Purpose: To study the motion of an object moving in one dimension, using the video camera to collect data.

Procedure: Use a video camera to videotape an example of one dimensional motion. Transfer the motion to a clear acetate (OHP) sheet, by taping the sheet to the TV screen, playing the motion frame by frame, and marking with a marker. *Figure out (by counting) how many "frames" your camera/ player uses per second.*

Data: Using an appropriate scale, construct a table showing the time and the x coordinates of the object for each "frame" of motion. Plan ahead and have something of known size (meter stick??) in the frame at the same distance from the camera as the object of interest. All distances should be expressed in meters.

Analysis: Construct the following graphs: position vs time (d/t), velocity vs time (v/t). The first graph comes directly from the data table. The values for the second graph are found using the definition of average velocity; $v=\frac{\Delta x}{\Delta t}$. If Δt is small enough, the average velocity and the instantaneous velocity are essentially the same.

You can use the list feature of the TI-83, or TI 83+, to calculate these values quickly. Set up your calculator as follows:

L1	L2	L3	L4	L5	L6
T1	X1	X1	X2	(X2-X1)/.01665	T1+.01665
T2	X2	X2	X3	(X3-X2)/.01665	T2+.01665
T3	X3	X3	X4	(X4-X3)/.01665	T3=.01665
T4	X4				

The Lists contain the following info.

L1 contains time in seconds

L2 contains x distances in cm

L3 contains x distances, delete last element

L4 contains x distances, delete first element

L5 contains the average velocity

L6 contains times

The Lists are set up as follows:

L1 is manually entered

L2 is manually entered.

L2 → L3 (delete the last value in L3)

L2 → L4 (delete the first value in L4)

"(L4-L3)/(0.03333)" → L5

"L1+.01665" → L6

Comments on the list set-up:

L3 and L4 contain the x distances with one deleted, to set up for rapid calculation.

L6 contains time values halfway between the consecutive time data numbers in L1. Since the velocities are calculated using successive pairs of position data values L6 gives times that are correct for the midpoint of these time intervals. Also, when doing statistical analysis (when having the TI find a regression equation) you may encounter a dimension mismatch error. When using stat plot to form a v/t graph, using L6 and L5, temporarily deleting the last value in L1 will cause L5 and L6 to contain the same number of elements, and avoid dimension mismatch errors.

Analysis, continued. In the analysis section of your lab report be sure to construct a d/t graph and a v/t graph. Try to use the TI to perform linear regressions to get lines (curves) of best fit for the d/t and v/t graphs. You can use the "TI graph link" hardware/software to capture an image of the screen on the TI (when a graph is displayed) and then save the image to a disk, or print it, and then incorporate it into your report. Needless to say, we're writing a formal lab report for this lab.

Conclusion. Be sure to discuss what type of relationship you have discovered, citing evidence, and specifically discussing the meaning of the shape of the graphs you have produced.

Opinion/reaction – strictly optional and not for points!

Here is an alternate method of doing data analysis. The science department has purchased a copy of the Vernier program, "Graphical Analysis". This is a nice graphing and data analysis utility. I am legally allowed to share copies of this with students to take home to use on their own PC's. If you'd like to try a copy, bring me a blank CD with your name on it, and I'll copy the disk for you. The graphs produced by this utility are better quality (as far as inserting into a word processor document is concerned) than the ones produced on the TI.

THE OHS ESSENTIAL GUIDE TO THE CBL/TI-83

Note: Buttons are in caps, menu items are in lower case, and comments are in Italics.

TO CLEAR CALCULATOR MEMORY

2nd → MEM
(5:) Reset
(1:) All Memory
(2:) Reset

TO TRANSFER PROGRAMS

Connect both calculators with a Graph Link.

SOURCE CALCULATOR

2nd → LINK
Send
(1:) All +
Transmit
(1:) Transmit

or

2nd → LINK
Send
(3:) Program…
Highlight Desired Program(s)
ENTER
Transmit
(1:) Transmit

TARGET CALCULATOR

2nd → LINK
Receive
(1:) Receive

TO GRAPH AN EQUATION

Y=
Y1=
Enter Equation
GRAPH

Note: highlighting the "=" turns a specific graph on or off.

ZOOM
(0:) ZoomFit

TO GRAPH DATA

Entering Data

STAT
(1:) Edit
Enter data in L1 and L2

Plotting Data

STAT PLOT
(1: Plot 1)
Xlist:
2nd → L1
Ylist:
2nd → L2
Select type and mark

GRAPH

ZOOM
(9:) ZoomStat

Notice that you can turn individual plots on and off.

TO FIND A REGRESSION EEQUATION

STAT
CALC
(4:) LinReg
2nd → L1, 2nd L2
ENTER

TO PLOT A REGRESSION LINE

Y=
VARS
(5:) Statistics
EQ
(1:) RegEq
GRAPH

TO INTERPROLATE DATA

TRACE
Use Arrow Keys

TO RUN PROGRAMS

PRGM
EXEC
(#:) *Choose Program*

Don't forget to select data range where appropriate!

Analysis of Data on the TI-83+

'Saver's Data 9/20/01

On the plastic transparency:

The scale: 1 marker (screen) = 4.5 cm
1 marker (actual) = 12.3 cm
so mult d by 2.73

t (frames)	$d_{screen-cm}$
0	0
3	3.6
6	7.1
9	10.4
12	13.5
15	16.85
18	20.3
21	23.7
24	26.89

$t_{(real)}$	$d_{(real)}$
0	0
0.1	9.83
0.2	19.38
0.3	28.39
0.4	36.86
0.5	46.00
0.6	55.42
0.7	64.70
0.8	73.41

THIS scale factor will certainly vary from group to group. You must calc. your own scale Factor!

Clear lists by:

[2ND] [MEM] 4: ClrAll Lists [Enter]

Access Lists by

[STAT] EDIT

Enter the numbers from the right hand df table above into ~~L3~~ L1 + L2.

Now, we'll do a little work to get distance values into L3 & L4 in a way which will let the TI calculate velocities for us.

[2nd] QUIT [CLEAR] gets a clear home screen.

[2nd] L2 [STO] [2nd] L3 , ENTER

← screen display

L2 → L3 copies L2 to L3

[2nd] L2 [STO] [2nd] L4 ENTER

now

[redacted] [STAT] EDIT & L3 & L4 contain copies of L2.

now delete the last value in L3 & delete the first value in L4.

clear the home screen & type:

"(L4-L3)/0.1" → L5

& finally enter

"L1 + 0.05" → L6

NOTE: I used 0.1 since in this example I'm going 3 "frames" per data point. If you go 1 frame per point, use 0.03333 which is $\frac{1}{30}$

To Plot Points

[2nd] StatPlot [1] select stat plot 1

[ON]

[↓] select first Type [⋰⋱]

X List: L1

Y List: L2

Mark ⊡

THEN SELECT [GRAPH]

we probably need to adjust [WINDOW]

[ ] Window

X min 0

X max 1

X scl .1

Y min 0

Y max 80

Y scl 10

X res 1

now, [graph]

To do a linear regression:

[STAT] [→] CALC 4

THE screen says

LinReg(ax+b)

you type the additional part

LinReg(ax+b) L1, L2, Y1

& then [ENTER]

[VARS] [→] [Y-VARS] [1]

[FUNCTION] [ENTER]

[1]

THE Screen says

LinReg

y=ax+b

a = 91.3

b = 0.58

hit [Y=] & notice the equation y=ax+b is in Y1

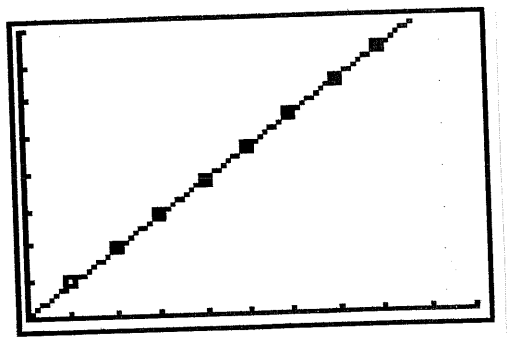
now, [Graph] & we have the TI drawing the line of best fit on the graph for us.

To capture & print the screen:

I have to be present

run TI Graph Link 83 on my computer
attach link cable to TI-83
click on Link & select Get Screen
click the Get Screen button.
to print, click print, or save on a floppy to take to your home P.C.

Titles, scale, & units can be handwritten on a graph like this, or the graph can be modified using a graphics utility like paint.



Much nicer Appearing graphs can be produced using the program Graphical Analysis, which the school owns, & I AM allowed to give out copies.

Row Num	Data Set 1: Data L1 ()	L2 ()
1	0.00000	0.000
2	0.10000	9.830
3	0.20000	19.380
4	0.30000	28.390
5	0.40000	36.860
6	0.50000	46.000
7	0.60000	55.420
8	0.70000	64.700
9	0.80000	73.410
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21