GreatHearts
Irving

Physics Remote Learning Packet

Please submit scans of written work in Google Classroom at the end of the week.

May 4-8, 2020

Course: 11 Physics
Teacher: Miss Weisse natalie.weisse@greatheartsirving.org
Resource: *Miss Weisse's Own Physics Textbook* — new pages found at the end of this packet

Weekly Plan:
Monday, May 4
- [ ] Review *Unit 8 Part 4 – Hooke's Law and Elastic Energy*
- [ ] Complete Unit 8 Worksheet 2 - Extra Problems
- [ ] Email Miss Weisse with Questions and to Request Solutions

Tuesday, May 5
- [ ] Read *Unit 8 Part 5 – Gravitational (Potential) and Kinetic Energy*
- [ ] Watch *"Introduction to Kinetic Energy Lab – Tuesday May 4"* Video
- [ ] Complete Pre-Lab Work
- [ ] Linearizing Graphs Review

Wednesday & Thursday, May 6-7
- [ ] Collect Data
- [ ] Graph & Linearize Data
- [ ] Analysis of Linearized Data
- [ ] Determine the Meaning of the Slope
- [ ] Write Conclusion
- [ ] Email Miss Weisse with Questions

Friday, May 8
- [ ] Attend Our Post Lab Discussion During Office Hours at 9:30 AM!
- [ ] Submit This Week's Work on Google Classroom by The End of the Day Sunday, May 10

Statement of Academic Honesty

I affirm that the work completed from the packet is mine and that I completed it independently.

I affirm that, to the best of my knowledge, my child completed this work independently

Student Signature

Parent Signature

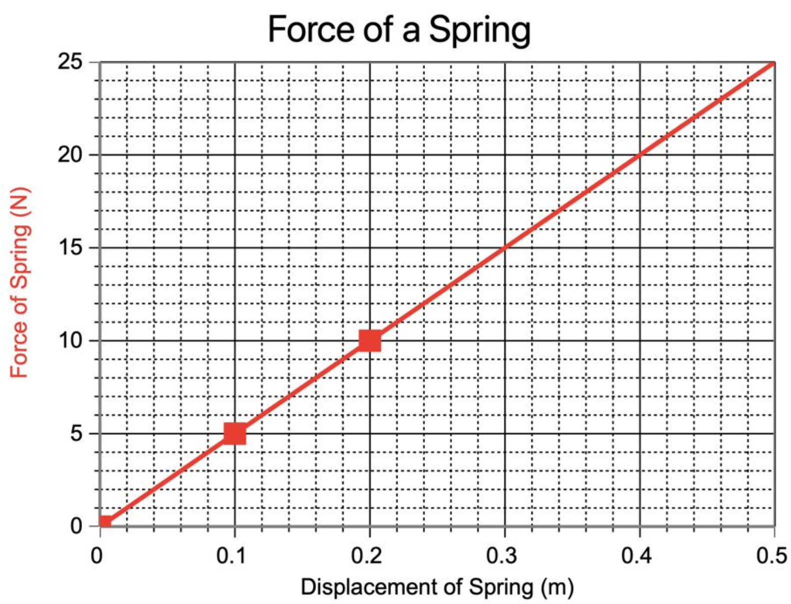
Monday, May 4

- ➔ Review *Unit 8 Part 4 – Hooke's Law and Elastic Energy*
- ➔ Complete Unit 8 Worksheet 2 - Extra Problems
- ➔ Email Miss Weisse with Questions and to Request Solutions

Unit 8 Energy Storage and Transfer Model
Worksheet 2 – Extra Practice

1) What does the spring constant number tell you about a spring? In other words, if two springs are given to you, and one has a spring constant of 100 N/m and the other has a spring constant of 125 N/m, what do these numbers tell you about the springs?

2) Using the graph below, determine the following:



a. The spring constant of the spring

b. The equation that best represents the graph.

c. The amount of force if the spring were stretched 0.22 m.

d. Graphically determine the amount of energy stored in the spring from stretching the spring from x = 0 to x = 0.2 m

e. Graphically determine the amount of energy stored in the spring from stretching the spring from x = 0.3 to x = 0.5 m

3) You are given a spring and you have a 0.50 kg mass and a 1.0 kg mass and a meter stick. Explain how you could use these devices to determine the spring constant in the spring.

4) Upon hanging the 1.0 kg mass on the spring it stretches 4 cm. When you attach the 0.50 kg mass to the bottom of the 1.0 kg mass, the spring stretches 2 more cm. What is the spring constant? (Hint: what force is being applied to the spring? Can you make a graph of the Force and the distance stretched to help?)

5) Conceptual Question: Two springs with the same spring constant are connected together to make a longer spring. If you hang a 1 kg mass to the end, does each spring stretch the same as, half as much, or twice as much as if the 1 kg mass was hung from just 1 of the springs. Consider a force diagram for each spring to think about how much force is applied to each spring.

Tuesday, May 5

- ➔ Read *Unit 8 Part 5 – Gravitational and Kinetic Energy*
- ➔ Watch *"Introduction to Kinetic Energy Lab – Tuesday May 4"* Video found in the "Materials" section in Google Classroom
- ➔ Complete Pre-Lab Work (spelled out in *Unit 8 – Part 5*)
    - ◆ Purpose, Variables, Constants, Description of Procedure
    - ◆ Create your data table as shown below. You will be graphing the data from columns in **green**.
- ➔ Linearizing Graphs Review (at the end of *Unit 8 – Part 5*)

Data Table

Height (cm)	Height (m)	E_k (= E_g = mgh)	Velocity (m/s)			
			Trial 1	Trial 2	Trial 3	**Average Velocity**

Wednesday *and* Thursday, May 6-7

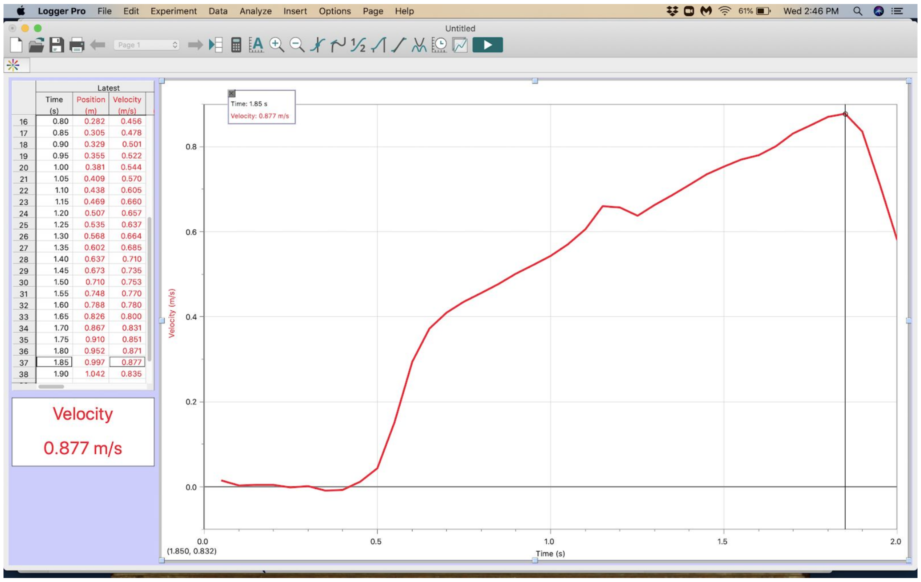
- ➔ Collect Data from Screen Shots of *LoggerPro* found on the following pages before *Miss Weisse's Own Physics Textbook*
  - ◆ You will be collecting data for velocities at 10 different ramp heights, and three trials for each height.
  - ◆ After you've collected all the data,
    - Convert heights to meters
    - Complete the E_g (and therefore E_k) calculations
    - Average the three trials of velocity data per height
- ➔ Graph & Linearize Data
  - ◆ Even though Kinetic Energy is technically our Independent Variable, we want an equation for E_k so we are going to use it as our y-axis, dependent variable.
  - ◆ Linearize your graph – compare the shape to the common graph shapes in the notes you read yesterday
    - determine the relationship between E_k and velocity.
    - Regraph the data after manipulating your velocity values
    - Draw your best fit line, find it's slope, and write your equation
- ➔ Analysis of Linearized Data
  - ◆ What does the slope tell us?
  - ◆ What does the y-intercept tell us?
- ➔ Determine the *Meaning* of the Slope
  - ◆ *Think about the units! Rewrite Joule as kg m^2/ s^2 and see what happens! It has to do with specific physical properties of our set-up.*
- ➔ Write Conclusion (refer to guidelines given last week)
- ➔ Email Miss Weisse with Questions

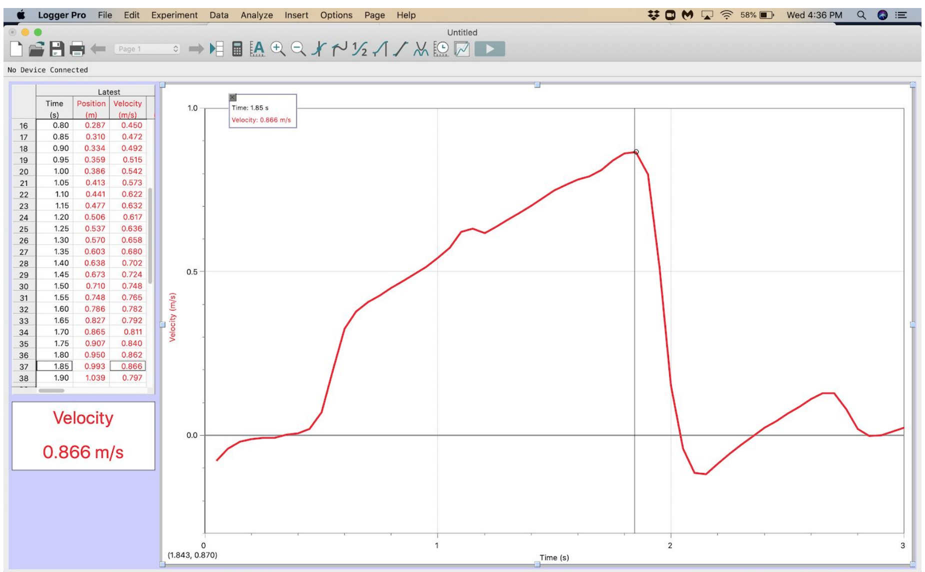
Friday, May 8

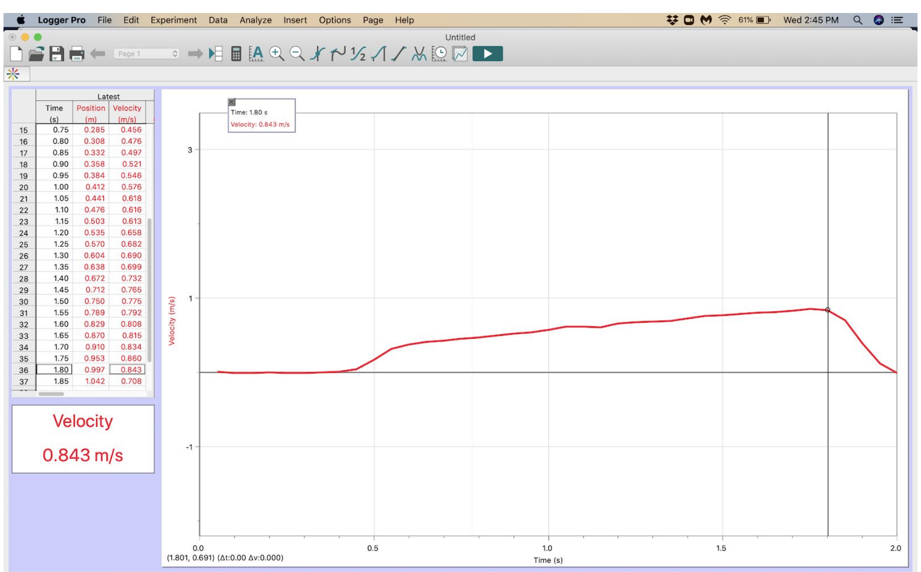
- ➔ Attend Our Post-Lab Discussion During Office Hours at 9:30 AM!

******************************* **LAB DATA** *******************************

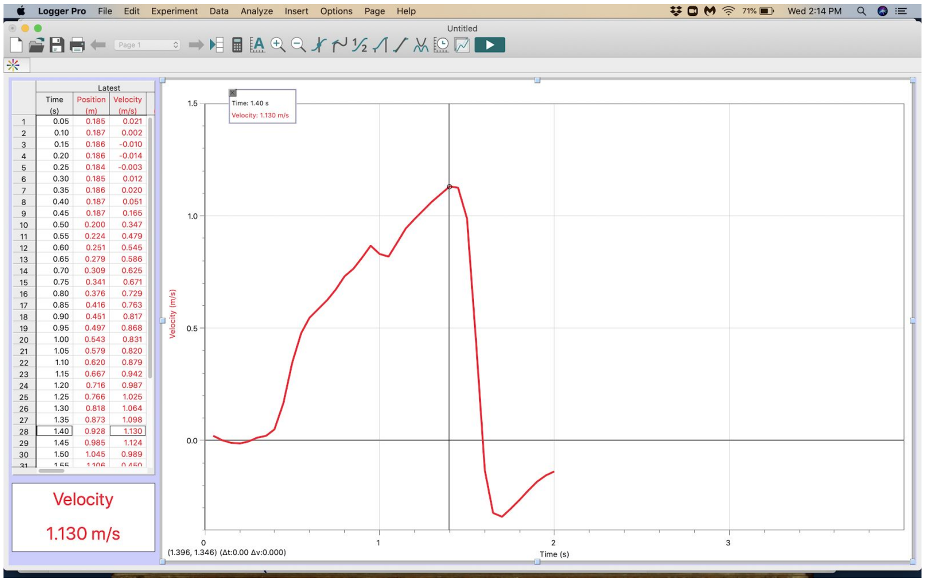
Height 9 cm



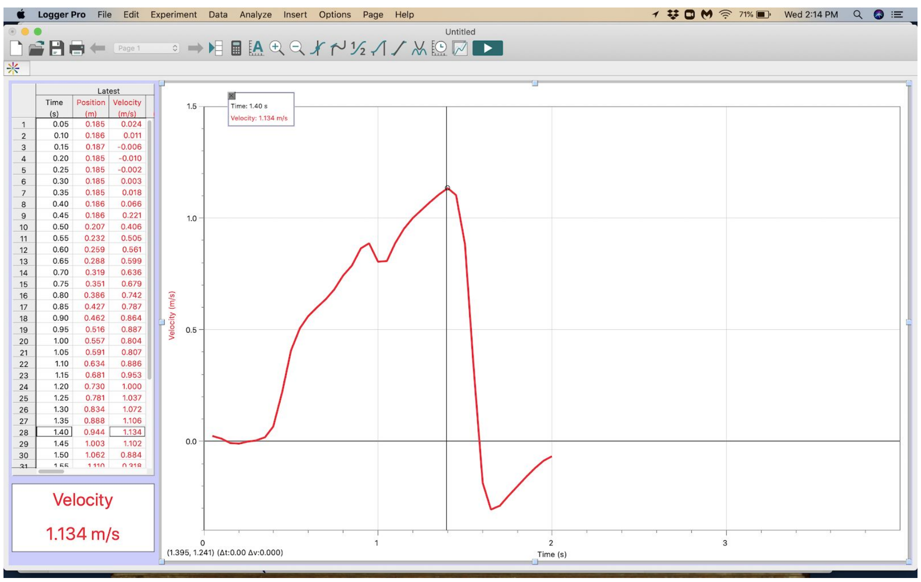




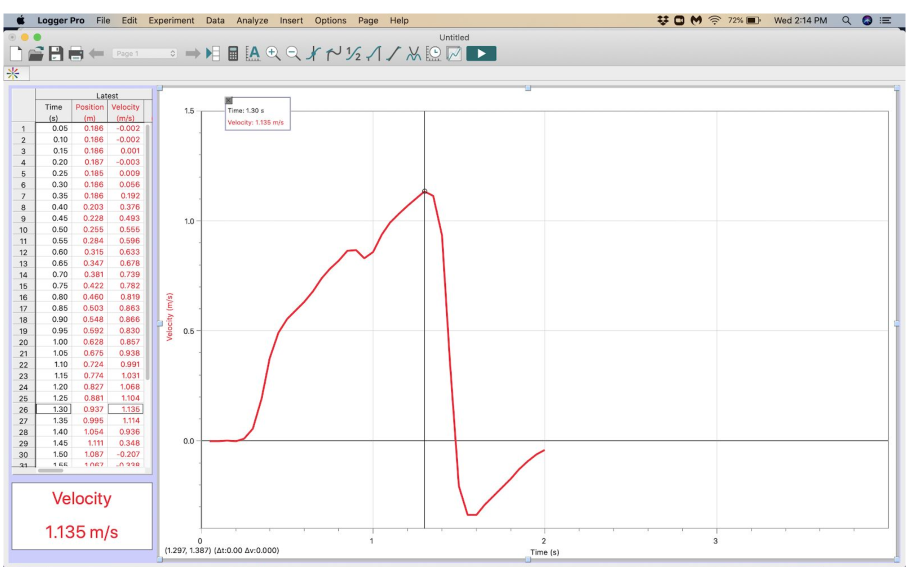
Height 13 cm



	Time (s)	Position (m)	Velocity (m/s)
1	0.05	0.185	0.021
2	0.10	0.187	0.002
3	0.15	0.186	-0.010
4	0.20	0.186	-0.014
5	0.25	0.184	-0.003
6	0.30	0.185	0.012
7	0.35	0.186	0.020
8	0.40	0.187	0.051
9	0.45	0.187	0.165
10	0.50	0.200	0.347
11	0.55	0.224	0.479
12	0.60	0.251	0.545
13	0.65	0.279	0.586
14	0.70	0.309	0.625
15	0.75	0.341	0.671
16	0.80	0.376	0.729
17	0.85	0.416	0.763
18	0.90	0.451	0.817
19	0.95	0.497	0.868
20	1.00	0.543	0.831
21	1.05	0.579	0.820
22	1.10	0.620	0.879
23	1.15	0.667	0.942
24	1.20	0.716	0.987
25	1.25	0.766	1.025
26	1.30	0.818	1.064
27	1.35	0.873	1.098
28	1.40	0.928	1.130
29	1.45	0.985	1.124
30	1.50	1.045	0.989

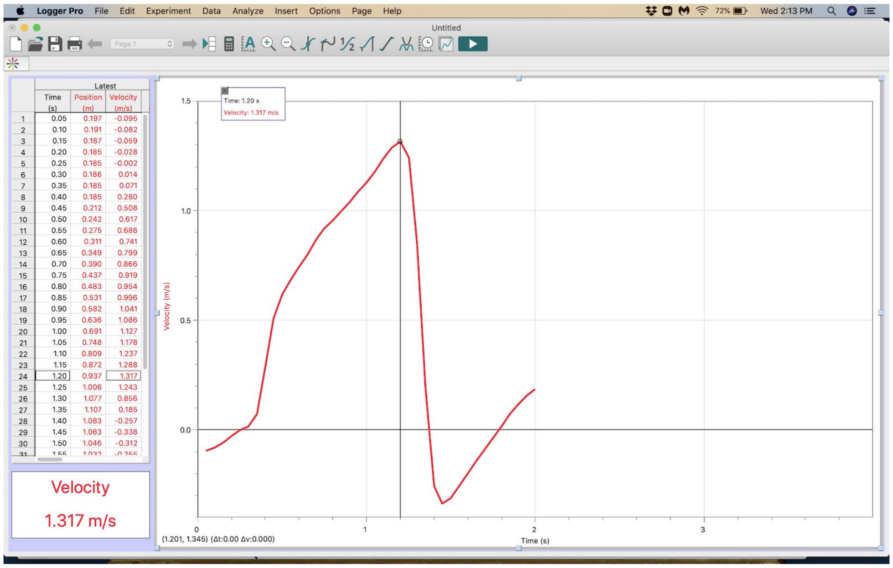


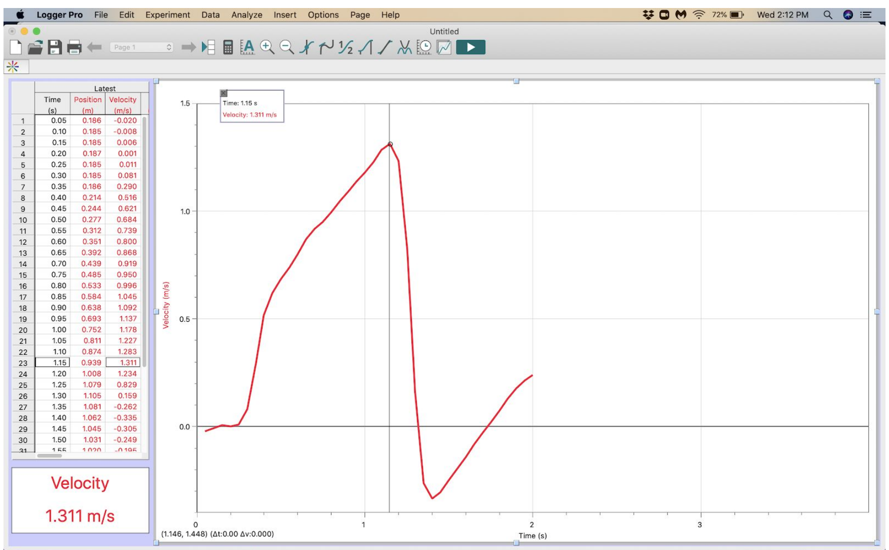
	Time (s)	Position (m)	Velocity (m/s)
1	0.05	0.185	0.024
2	0.10	0.186	0.011
3	0.15	0.187	-0.006
4	0.20	0.185	-0.010
5	0.25	0.185	-0.002
6	0.30	0.185	0.003
7	0.35	0.185	0.018
8	0.40	0.186	0.066
9	0.45	0.186	0.221
10	0.50	0.207	0.406
11	0.55	0.232	0.505
12	0.60	0.259	0.561
13	0.65	0.288	0.599
14	0.70	0.319	0.636
15	0.75	0.351	0.679
16	0.80	0.386	0.742
17	0.85	0.427	0.787
18	0.90	0.462	0.864
19	0.95	0.516	0.887
20	1.00	0.557	0.804
21	1.05	0.591	0.807
22	1.10	0.634	0.886
23	1.15	0.681	0.953
24	1.20	0.730	1.000
25	1.25	0.781	1.037
26	1.30	0.834	1.072
27	1.35	0.888	1.106
28	1.40	0.944	1.134
29	1.45	1.003	1.102
30	1.50	1.062	0.884



	Time (s)	Position (m)	Velocity (m/s)
1	0.05	0.186	-0.002
2	0.10	0.186	-0.002
3	0.15	0.186	0.001
4	0.20	0.187	-0.003
5	0.25	0.185	0.009
6	0.30	0.186	0.056
7	0.35	0.186	0.192
8	0.40	0.203	0.376
9	0.45	0.228	0.493
10	0.50	0.255	0.555
11	0.55	0.284	0.596
12	0.60	0.315	0.633
13	0.65	0.347	0.678
14	0.70	0.381	0.739
15	0.75	0.422	0.782
16	0.80	0.460	0.819
17	0.85	0.503	0.863
18	0.90	0.548	0.866
19	0.95	0.592	0.830
20	1.00	0.628	0.857
21	1.05	0.675	0.938
22	1.10	0.724	0.991
23	1.15	0.774	1.031
24	1.20	0.827	1.068
25	1.25	0.881	1.104
26	1.30	0.937	1.135
27	1.35	0.995	1.114
28	1.40	1.054	0.936
29	1.45	1.111	0.348
30	1.50	1.087	-0.207

Height 17 cm


Time: 1.20 s
Velocity: 1.317 m/s
Velocity
1.317 m/s
(1.201, 1.345) (Δt:0.00 Δv:0.000)
Velocity (m/s)
Time (s)


Time: 1.15 s
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Velocity
1.311 m/s
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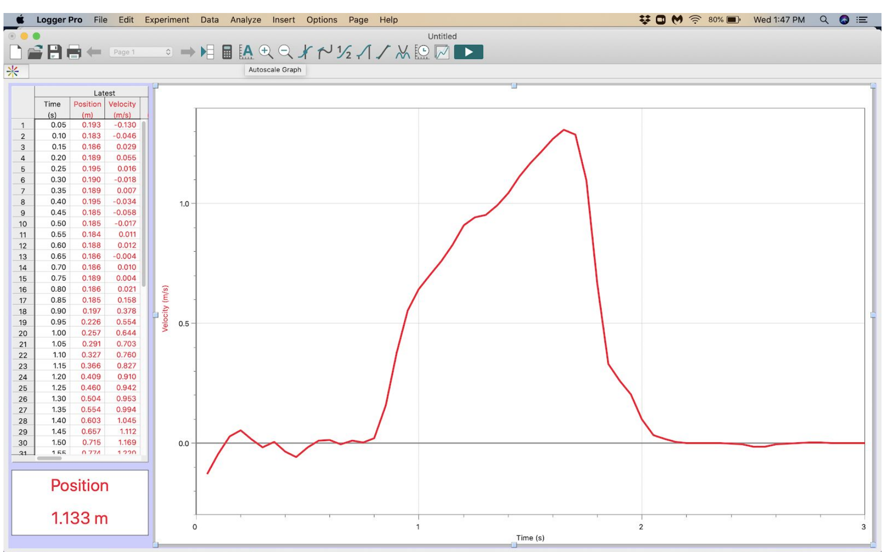
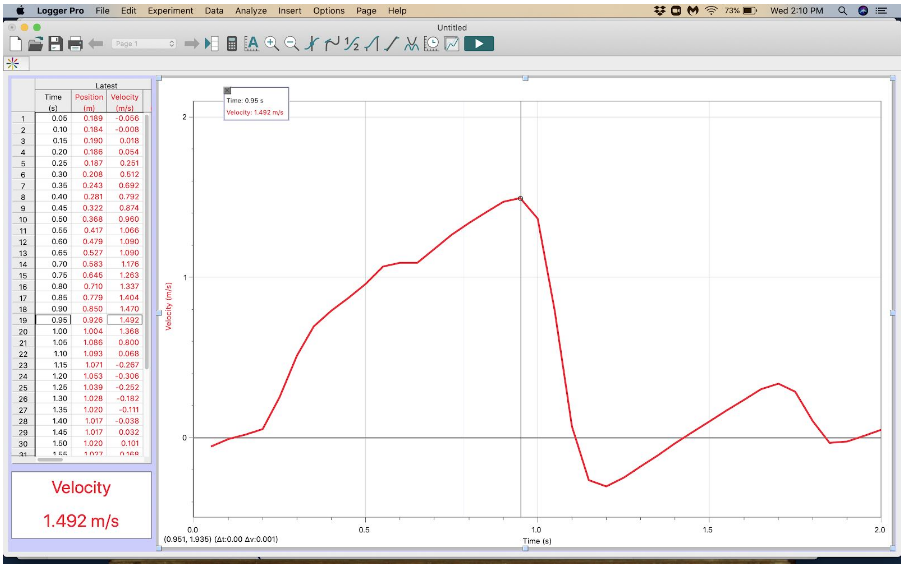
Velocity (m/s)
Time (s)


Autoscale Graph
Position
1.133 m
Velocity (m/s)
Time (s)

Height 21 cm


Logger Pro File Edit Experiment Data Analyze Insert Options Page Help
Wed 2:10 PM
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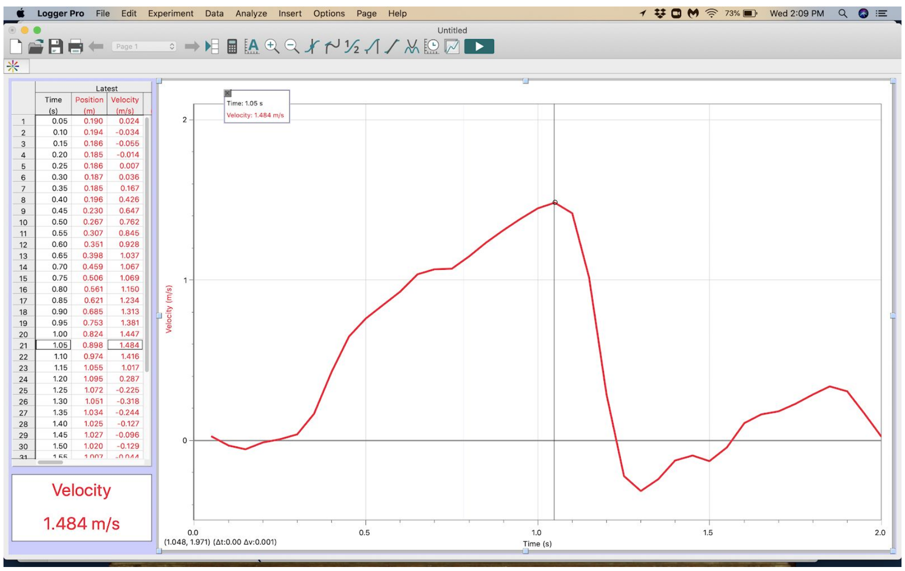
Latest
Time (s) Position (m) Velocity (m/s)
1 0.05 0.189 -0.056
2 0.10 0.184 -0.008
3 0.15 0.190 0.018
4 0.20 0.186 0.054
5 0.25 0.187 0.251
6 0.30 0.208 0.512
7 0.35 0.243 0.692
8 0.40 0.281 0.792
9 0.45 0.322 0.874
10 0.50 0.368 0.960
11 0.55 0.417 1.066
12 0.60 0.479 1.090
13 0.65 0.527 1.090
14 0.70 0.583 1.176
15 0.75 0.645 1.263
16 0.80 0.710 1.337
17 0.85 0.779 1.404
18 0.90 0.850 1.470
19 0.95 0.926 1.492
20 1.00 1.004 1.368
21 1.05 1.086 0.800
22 1.10 1.093 0.068
23 1.15 1.071 -0.267
24 1.20 1.053 -0.306
25 1.25 1.039 -0.252
26 1.30 1.028 -0.182
27 1.35 1.020 -0.111
28 1.40 1.017 -0.038
29 1.45 1.017 0.032
30 1.50 1.020 0.101
Velocity
1.492 m/s
Time: 0.95 s
Velocity: 1.492 m/s
Velocity (m/s)
Time (s)
(0.951, 1.935) (Δt:0.00 Δv:0.001)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Latest
Time (s) Position (m) Velocity (m/s)
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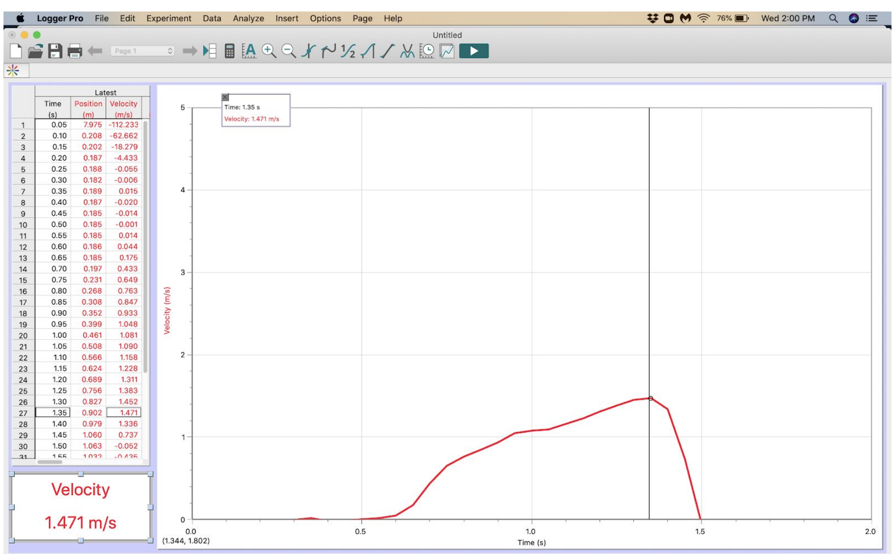
2 0.10 0.194 -0.034
3 0.15 0.186 -0.055
4 0.20 0.185 -0.014
5 0.25 0.186 0.007
6 0.30 0.187 0.036
7 0.35 0.185 0.167
8 0.40 0.196 0.426
9 0.45 0.230 0.647
10 0.50 0.267 0.762
11 0.55 0.307 0.845
12 0.60 0.351 0.928
13 0.65 0.398 1.037
14 0.70 0.459 1.067
15 0.75 0.506 1.069
16 0.80 0.561 1.150
17 0.85 0.621 1.234
18 0.90 0.685 1.313
19 0.95 0.753 1.381
20 1.00 0.824 1.447
21 1.05 0.898 1.484
22 1.10 0.974 1.416
23 1.15 1.055 1.017
24 1.20 1.095 0.287
25 1.25 1.072 -0.225
26 1.30 1.051 -0.318
27 1.35 1.034 -0.244
28 1.40 1.025 -0.127
29 1.45 1.027 -0.096
30 1.50 1.020 -0.129
Velocity
1.484 m/s
Time: 1.05 s
Velocity: 1.484 m/s
Velocity (m/s)
Time (s)
(1.048, 1.971) (Δt:0.00 Δv:0.001)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Latest
Time (s) Position (m) Velocity (m/s)
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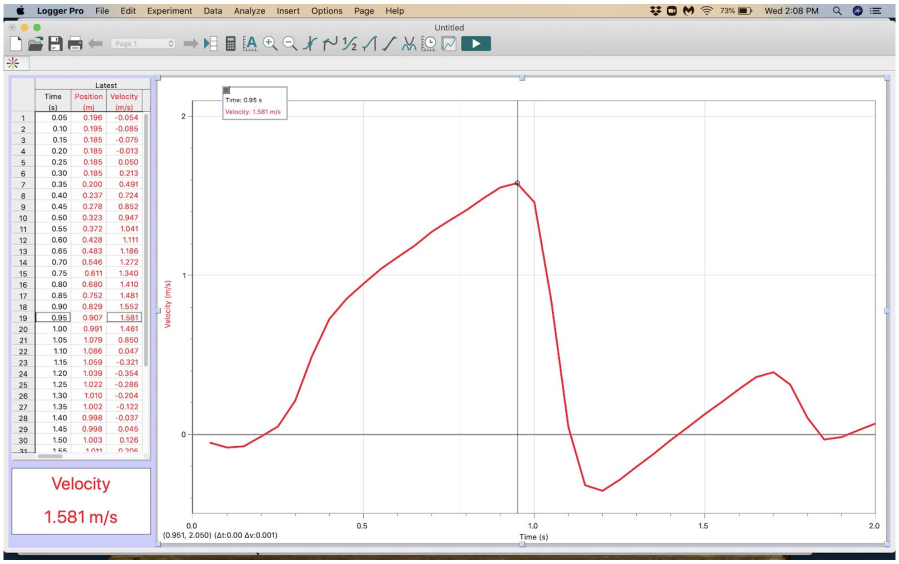
2 0.10 0.208 -62.662
3 0.15 0.202 -18.279
4 0.20 0.187 -4.433
5 0.25 0.188 -0.055
6 0.30 0.182 -0.006
7 0.35 0.189 0.015
8 0.40 0.187 -0.020
9 0.45 0.185 -0.014
10 0.50 0.185 -0.001
11 0.55 0.185 0.014
12 0.60 0.186 0.044
13 0.65 0.185 0.175
14 0.70 0.197 0.433
15 0.75 0.231 0.649
16 0.80 0.268 0.763
17 0.85 0.308 0.847
18 0.90 0.352 0.933
19 0.95 0.399 1.048
20 1.00 0.461 1.081
21 1.05 0.508 1.090
22 1.10 0.566 1.158
23 1.15 0.624 1.228
24 1.20 0.689 1.311
25 1.25 0.756 1.383
26 1.30 0.827 1.452
27 1.35 0.902 1.471
28 1.40 0.979 1.336
29 1.45 1.060 0.737
30 1.50 1.063 -0.052
Velocity
1.471 m/s
Time: 1.35 s
Velocity: 1.471 m/s
Velocity (m/s)
Time (s)
(1.344, 1.802)

Height 24 cm



Logger Pro
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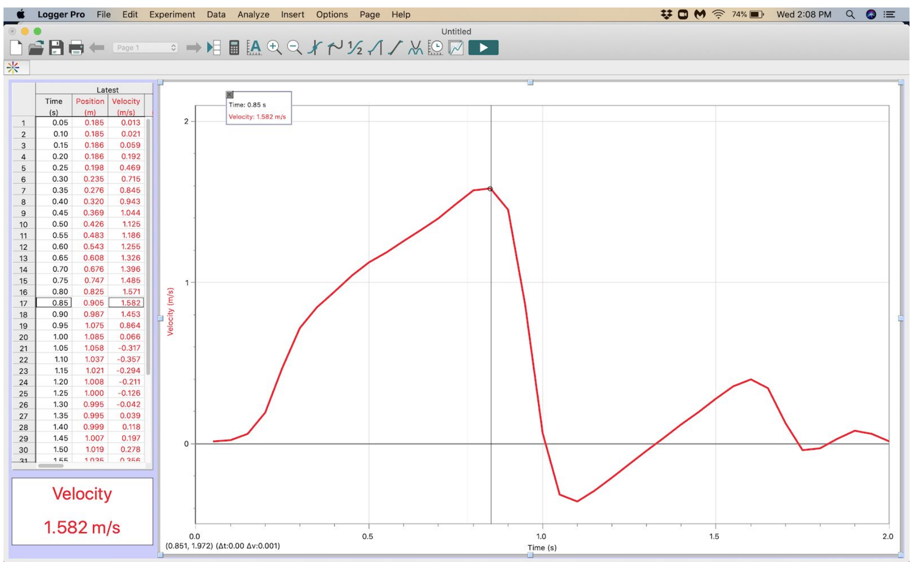
Latest
Time: 0.95 s
Velocity: 1.581 m/s
Velocity
1.581 m/s
Velocity (m/s)
Time (s)
(0.951, 2.050) (Δt:0.00 Δv:0.001)



Logger Pro
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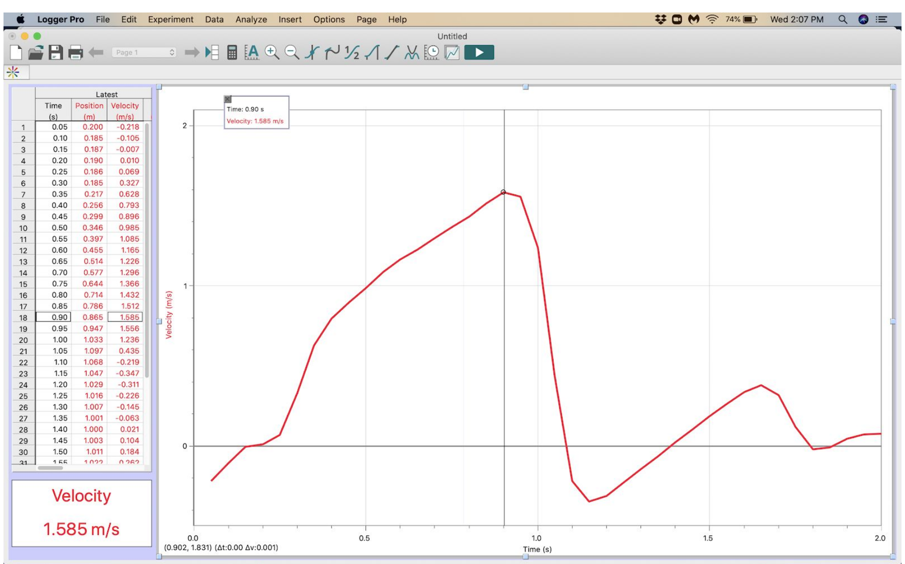
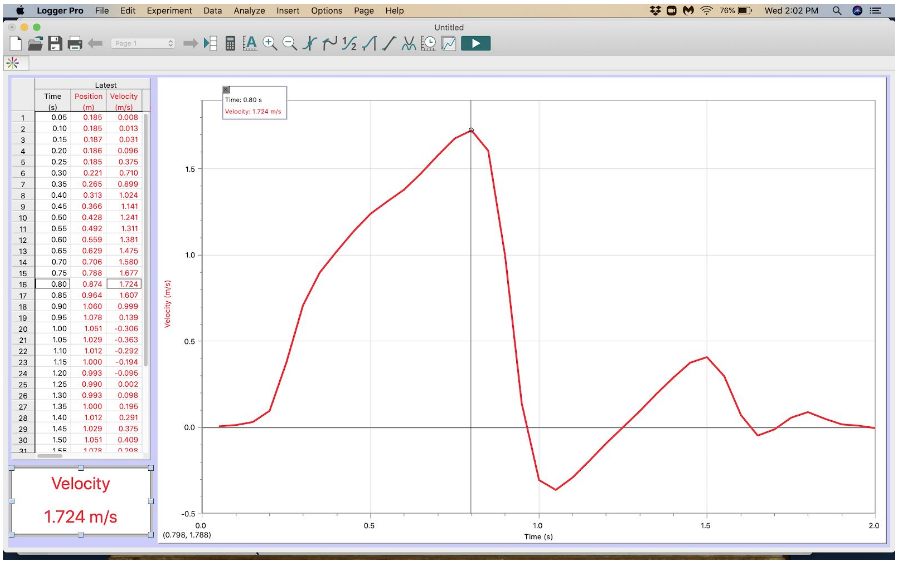
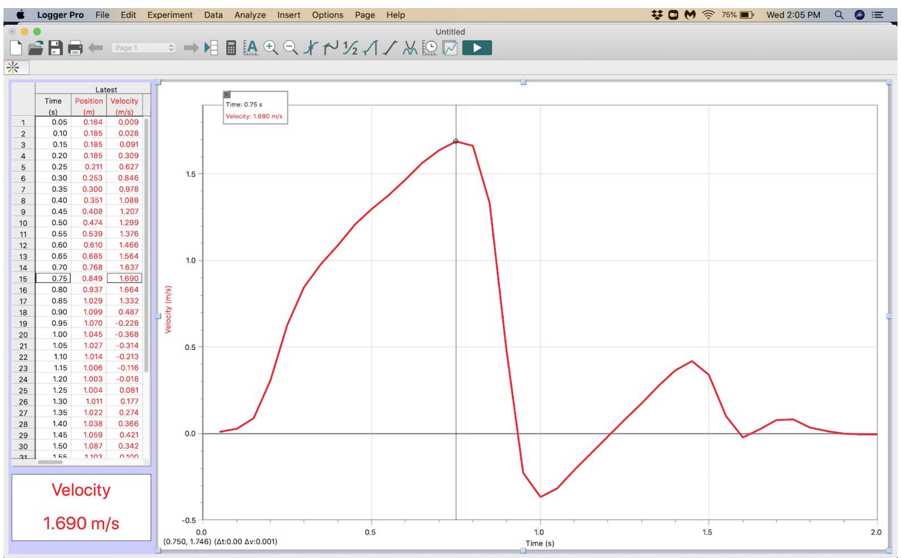
Latest
Time: 0.85 s
Velocity: 1.582 m/s
Velocity
1.582 m/s
Velocity (m/s)
Time (s)
(0.851, 1.972) (Δt:0.00 Δv:0.001)

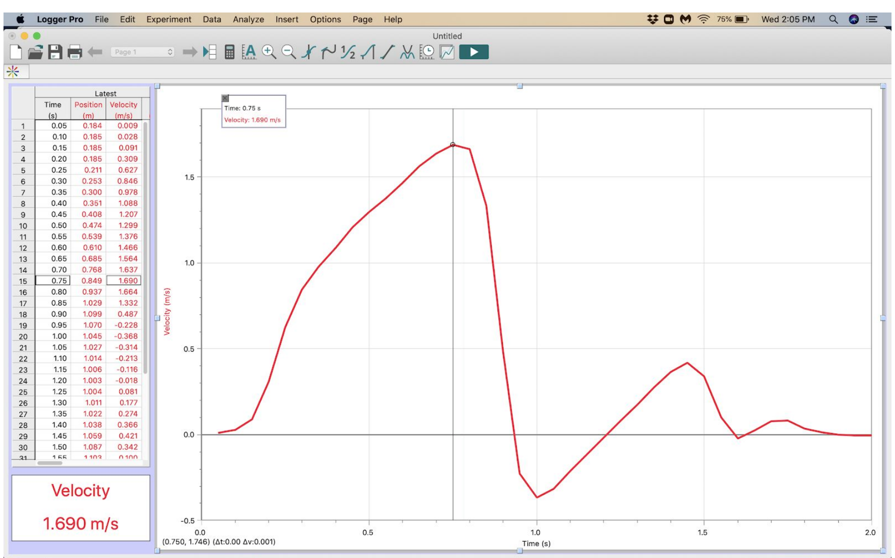


Logger Pro
Untitled
Latest
Time: 0.90 s
Velocity: 1.585 m/s
Velocity
1.585 m/s
Velocity (m/s)
Time (s)
(0.902, 1.831) (Δt:0.00 Δv:0.001)

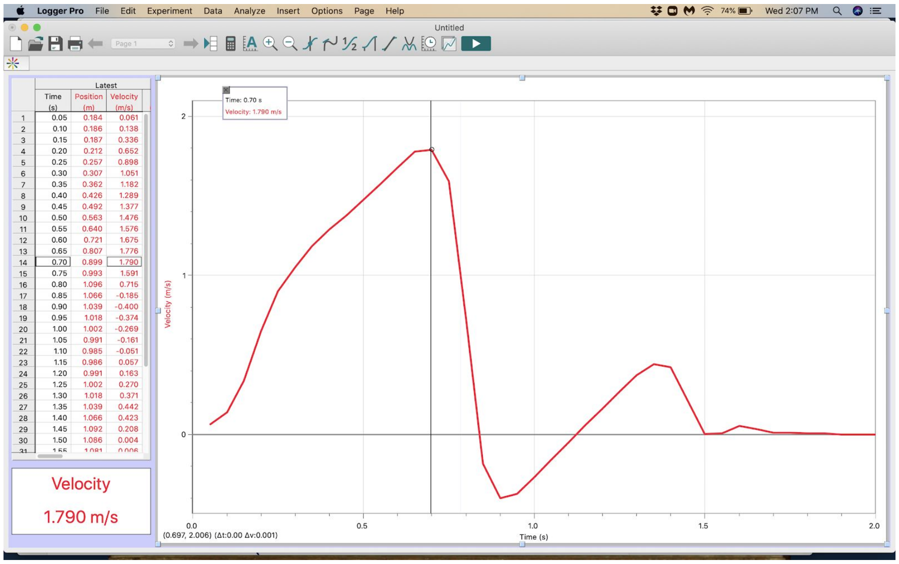
Height 28 cm

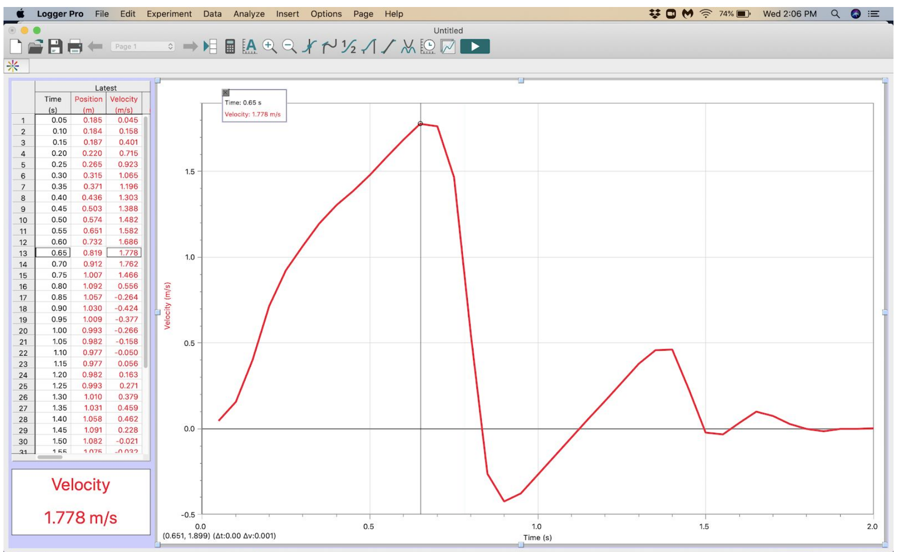

Logger Pro File Edit Experiment Data Analyze Insert Options Page Help
Wed 2:02 PM
Untitled
Time: 0.80 s
Velocity: 1.724 m/s
Velocity
1.724 m/s
Velocity (m/s)
Time (s)
(0.798, 1.788)

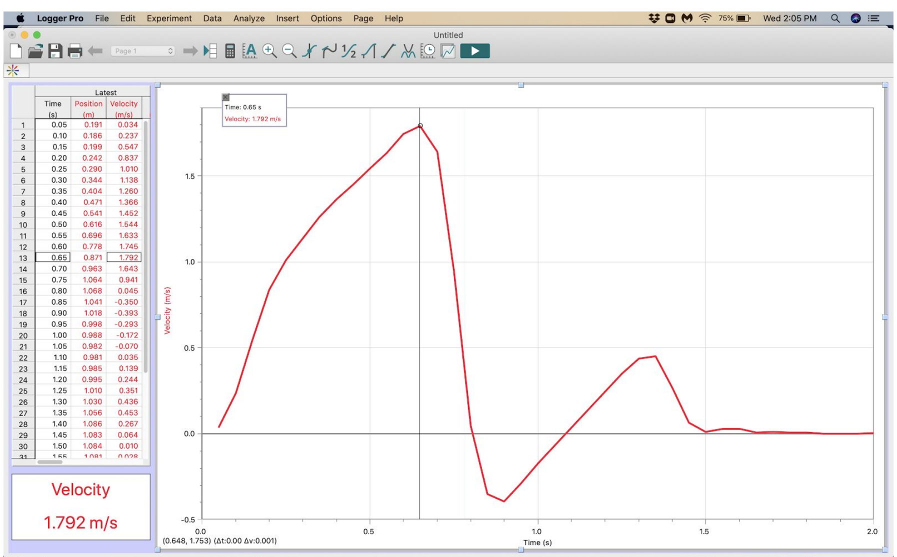

Logger Pro File Edit Experiment Data Analyze Insert Options Page Help
Wed 2:05 PM
Untitled
Time: 0.75 s
Velocity: 1.690 m/s
Velocity
1.690 m/s
Velocity (m/s)
Time (s)
(0.750, 1.746) (Δt:0.00 Δv:0.001)


Logger Pro File Edit Experiment Data Analyze Insert Options Page Help
Wed 2:05 PM
Untitled
Time: 0.75 s
Velocity: 1.690 m/s
Velocity
1.690 m/s
Velocity (m/s)
Time (s)
(0.750, 1.746) (Δt:0.00 Δv:0.001)

Height 31 cm


Logger Pro File Edit Experiment Data Analyze Insert Options Page Help
74% Wed 2:07 PM
Untitled
Page 1
Latest
Time (s) Position (m) Velocity (m/s)
1 0.05 0.184 0.061
2 0.10 0.186 0.138
3 0.15 0.187 0.336
4 0.20 0.212 0.652
5 0.25 0.257 0.898
6 0.30 0.307 1.051
7 0.35 0.362 1.182
8 0.40 0.426 1.289
9 0.45 0.492 1.377
10 0.50 0.563 1.476
11 0.55 0.640 1.576
12 0.60 0.721 1.675
13 0.65 0.807 1.776
14 0.70 0.899 1.790
15 0.75 0.993 1.591
16 0.80 1.096 0.715
17 0.85 1.066 -0.185
18 0.90 1.039 -0.400
19 0.95 1.018 -0.374
20 1.00 1.002 -0.269
21 1.05 0.991 -0.161
22 1.10 0.985 -0.051
23 1.15 0.986 0.057
24 1.20 0.991 0.163
25 1.25 1.002 0.270
26 1.30 1.018 0.371
27 1.35 1.039 0.442
28 1.40 1.066 0.423
29 1.45 1.092 0.208
30 1.50 1.086 0.004
Velocity
1.790 m/s
Time: 0.70 s
Velocity: 1.790 m/s
Velocity (m/s)
Time (s)
(0.697, 2.006) (Δt:0.00 Δv:0.001)


Logger Pro File Edit Experiment Data Analyze Insert Options Page Help
74% Wed 2:06 PM
Untitled
Page 1
Latest
Time (s) Position (m) Velocity (m/s)
1 0.05 0.185 0.045
2 0.10 0.184 0.158
3 0.15 0.187 0.401
4 0.20 0.220 0.715
5 0.25 0.265 0.923
6 0.30 0.315 1.065
7 0.35 0.371 1.196
8 0.40 0.436 1.303
9 0.45 0.503 1.388
10 0.50 0.574 1.482
11 0.55 0.651 1.582
12 0.60 0.732 1.686
13 0.65 0.819 1.778
14 0.70 0.912 1.762
15 0.75 1.007 1.466
16 0.80 1.092 0.556
17 0.85 1.057 -0.264
18 0.90 1.030 -0.424
19 0.95 1.009 -0.377
20 1.00 0.993 -0.266
21 1.05 0.982 -0.158
22 1.10 0.977 -0.050
23 1.15 0.977 0.056
24 1.20 0.982 0.163
25 1.25 0.993 0.271
26 1.30 1.010 0.379
27 1.35 1.031 0.459
28 1.40 1.058 0.462
29 1.45 1.091 0.228
30 1.50 1.082 -0.021
Velocity
1.778 m/s
Time: 0.65 s
Velocity: 1.778 m/s
Velocity (m/s)
Time (s)
(0.651, 1.899) (Δt:0.00 Δv:0.001)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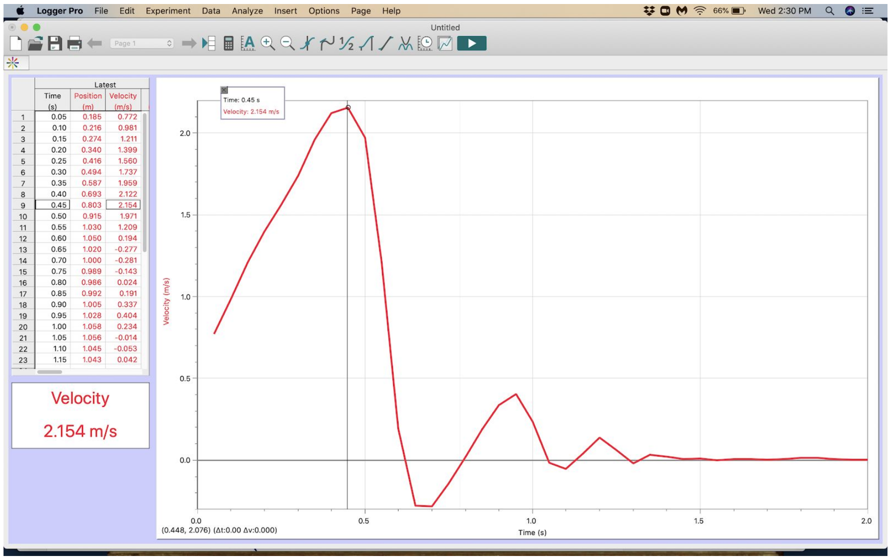
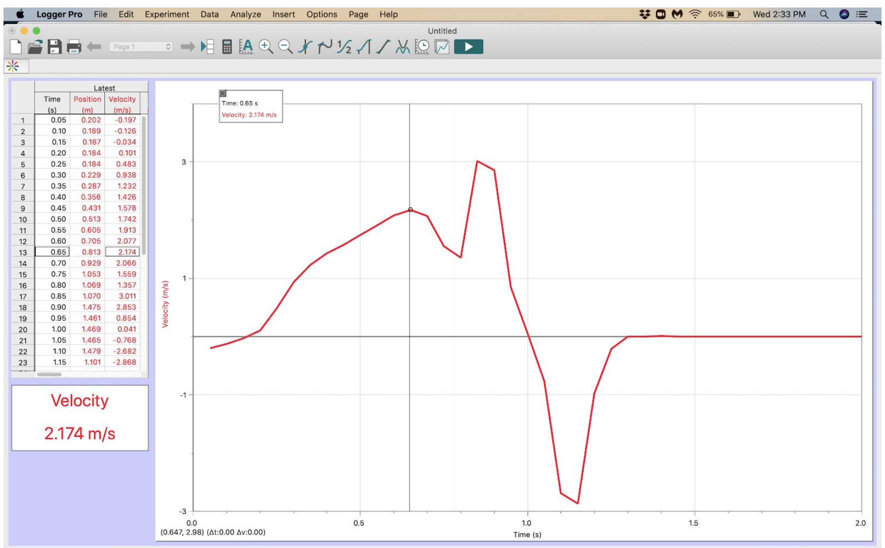
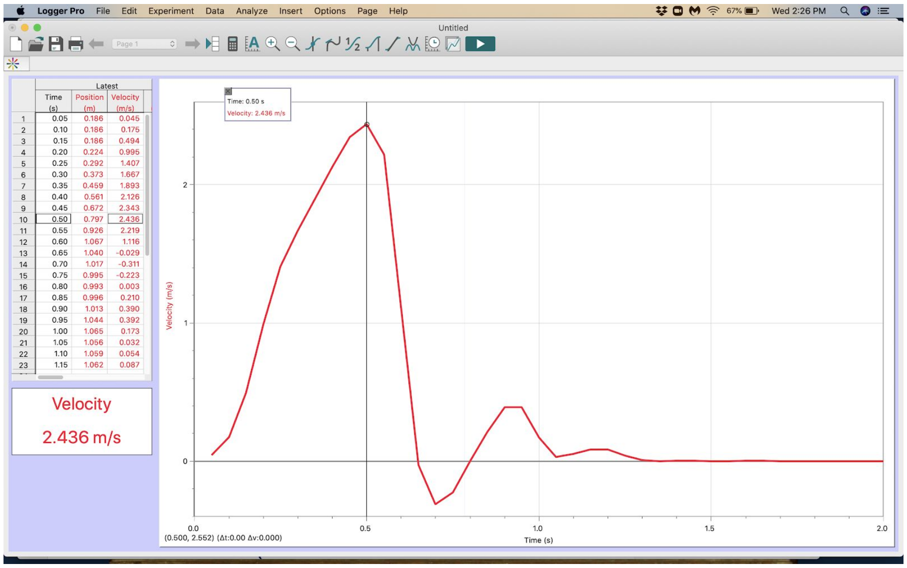
Page 1
Latest
Time (s) Position (m) Velocity (m/s)
1 0.05 0.191 0.034
2 0.10 0.186 0.237
3 0.15 0.199 0.547
4 0.20 0.242 0.837
5 0.25 0.290 1.010
6 0.30 0.344 1.138
7 0.35 0.404 1.260
8 0.40 0.471 1.366
9 0.45 0.541 1.452
10 0.50 0.616 1.544
11 0.55 0.696 1.633
12 0.60 0.778 1.745
13 0.65 0.871 1.792
14 0.70 0.963 1.643
15 0.75 1.064 0.941
16 0.80 1.068 0.045
17 0.85 1.041 -0.350
18 0.90 1.018 -0.393
19 0.95 0.998 -0.293
20 1.00 0.988 -0.172
21 1.05 0.982 -0.070
22 1.10 0.981 0.035
23 1.15 0.985 0.139
24 1.20 0.995 0.244
25 1.25 1.010 0.351
26 1.30 1.030 0.436
27 1.35 1.056 0.453
28 1.40 1.086 0.267
29 1.45 1.083 0.064
30 1.50 1.084 0.010
Velocity
1.792 m/s
Time: 0.65 s
Velocity: 1.792 m/s
Velocity (m/s)
Time (s)
(0.648, 1.753) (Δt:0.00 Δv:0.001)

Height 48 cm (there are only 2 trials for this height)





Height 58 cm



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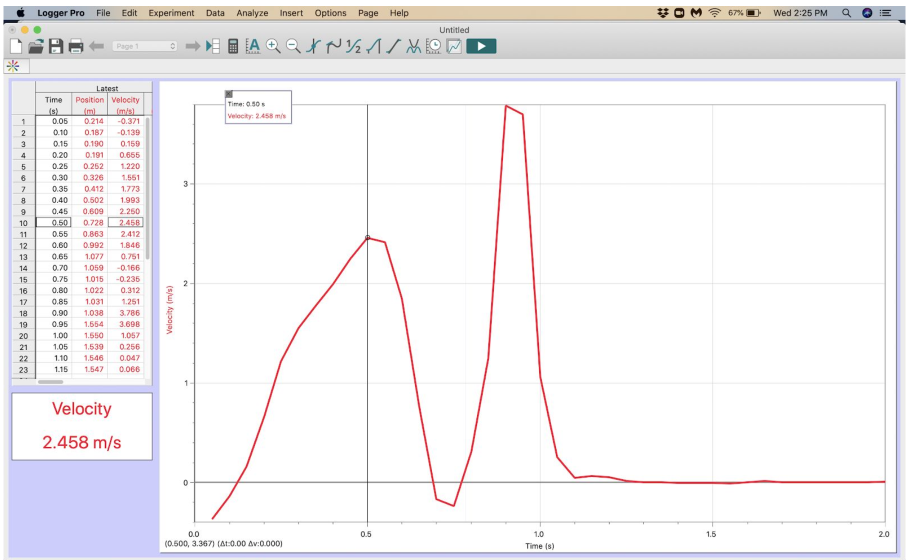
Page 1
Latest
Time (s) Position (m) Velocity (m/s)
1 0.05 0.186 0.045
2 0.10 0.186 0.175
3 0.15 0.186 0.494
4 0.20 0.224 0.995
5 0.25 0.292 1.407
6 0.30 0.373 1.667
7 0.35 0.459 1.893
8 0.40 0.561 2.126
9 0.45 0.672 2.343
10 0.50 0.797 2.436
11 0.55 0.926 2.219
12 0.60 1.067 1.116
13 0.65 1.040 -0.029
14 0.70 1.017 -0.311
15 0.75 0.995 -0.223
16 0.80 0.993 0.003
17 0.85 0.996 0.210
18 0.90 1.013 0.390
19 0.95 1.044 0.392
20 1.00 1.065 0.173
21 1.05 1.056 0.032
22 1.10 1.059 0.054
23 1.15 1.062 0.087
Velocity
2.436 m/s
Time: 0.50 s
Velocity: 2.436 m/s
Velocity (m/s)
Time (s)
(0.500, 2.552) (Δt:0.00 Δv:0.000)



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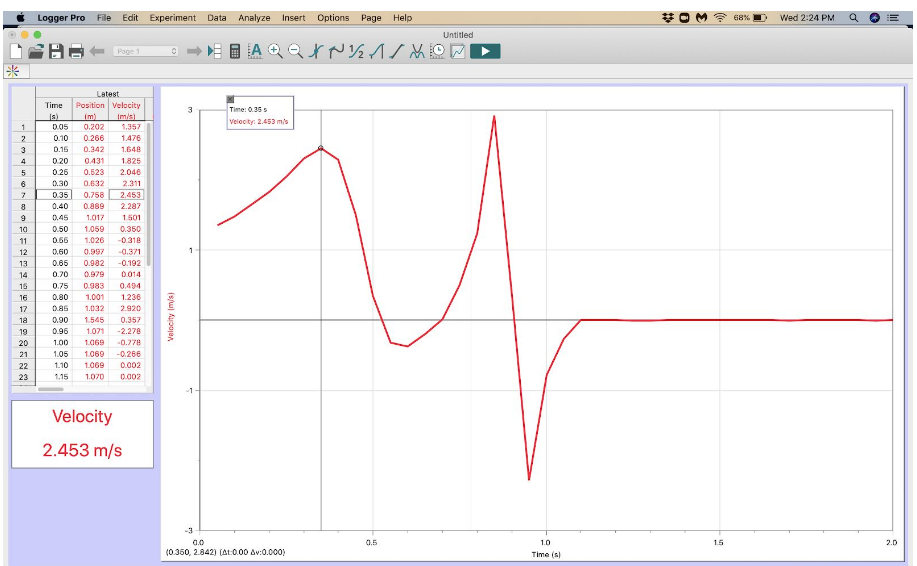
Page 1
Latest
Time (s) Position (m) Velocity (m/s)
1 0.05 0.214 -0.371
2 0.10 0.187 -0.139
3 0.15 0.190 0.159
4 0.20 0.191 0.655
5 0.25 0.252 1.220
6 0.30 0.326 1.551
7 0.35 0.412 1.773
8 0.40 0.502 1.993
9 0.45 0.609 2.250
10 0.50 0.728 2.458
11 0.55 0.863 2.412
12 0.60 0.992 1.846
13 0.65 1.077 0.751
14 0.70 1.059 -0.166
15 0.75 1.015 -0.235
16 0.80 1.022 0.312
17 0.85 1.031 1.251
18 0.90 1.038 3.786
19 0.95 1.554 3.698
20 1.00 1.550 1.057
21 1.05 1.539 0.256
22 1.10 1.546 0.047
23 1.15 1.547 0.066
Velocity
2.458 m/s
Time: 0.50 s
Velocity: 2.458 m/s
Velocity (m/s)
Time (s)
(0.500, 3.367) (Δt:0.00 Δv:0.000)



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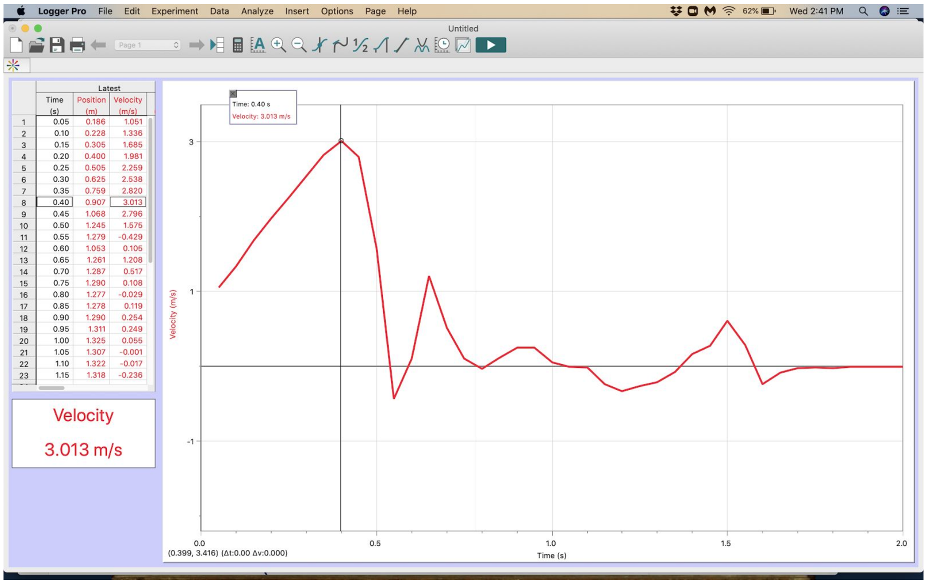
Page 1
Latest
Time (s) Position (m) Velocity (m/s)
1 0.05 0.202 1.357
2 0.10 0.266 1.476
3 0.15 0.342 1.648
4 0.20 0.431 1.825
5 0.25 0.523 2.046
6 0.30 0.632 2.311
7 0.35 0.758 2.453
8 0.40 0.889 2.287
9 0.45 1.017 1.501
10 0.50 1.059 0.350
11 0.55 1.026 -0.318
12 0.60 0.997 -0.371
13 0.65 0.982 -0.192
14 0.70 0.979 0.014
15 0.75 0.983 0.494
16 0.80 1.001 1.236
17 0.85 1.032 2.920
18 0.90 1.545 0.357
19 0.95 1.071 -2.278
20 1.00 1.069 -0.778
21 1.05 1.069 -0.266
22 1.10 1.069 0.002
23 1.15 1.070 0.002
Velocity
2.453 m/s
Time: 0.35 s
Velocity: 2.453 m/s
Velocity (m/s)
Time (s)
(0.350, 2.842) (Δt:0.00 Δv:0.000)

Height 77 cm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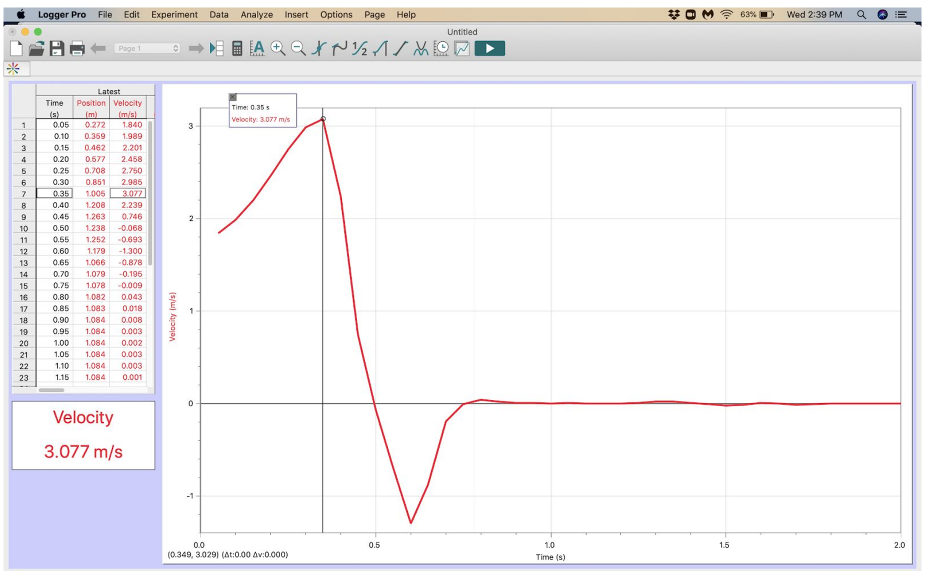
Latest
Time (s) Position (m) Velocity (m/s)
1 0.05 0.186 1.051
2 0.10 0.228 1.336
3 0.15 0.305 1.685
4 0.20 0.400 1.981
5 0.25 0.505 2.259
6 0.30 0.625 2.538
7 0.35 0.759 2.820
8 0.40 0.907 3.013
9 0.45 1.068 2.796
10 0.50 1.245 1.575
11 0.55 1.279 -0.429
12 0.60 1.053 0.105
13 0.65 1.261 1.208
14 0.70 1.287 0.517
15 0.75 1.290 0.108
16 0.80 1.277 -0.029
17 0.85 1.278 0.119
18 0.90 1.290 0.254
19 0.95 1.311 0.249
20 1.00 1.325 0.055
21 1.05 1.307 -0.001
22 1.10 1.322 -0.017
23 1.15 1.318 -0.236
Velocity
3.013 m/s
Time: 0.40 s
Velocity: 3.013 m/s
Velocity (m/s)
Time (s)
(0.399, 3.416) (Δt:0.00 Δv:0.000)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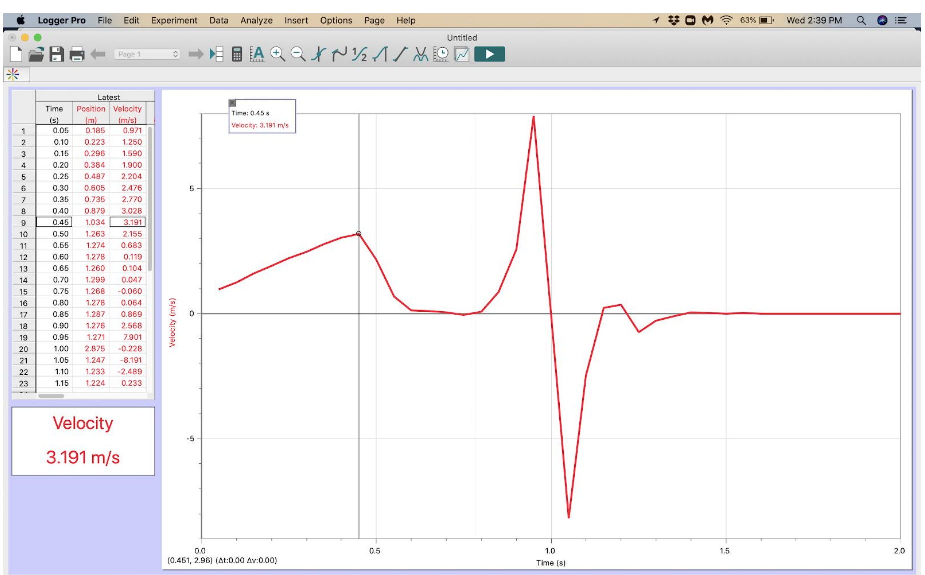
Untitled
Latest
Time (s) Position (m) Velocity (m/s)
1 0.05 0.272 1.840
2 0.10 0.359 1.989
3 0.15 0.462 2.201
4 0.20 0.577 2.458
5 0.25 0.708 2.750
6 0.30 0.851 2.985
7 0.35 1.005 3.077
8 0.40 1.208 2.239
9 0.45 1.263 0.746
10 0.50 1.238 -0.068
11 0.55 1.252 -0.693
12 0.60 1.179 -1.300
13 0.65 1.066 -0.878
14 0.70 1.079 -0.195
15 0.75 1.078 -0.009
16 0.80 1.082 0.043
17 0.85 1.083 0.018
18 0.90 1.084 0.008
19 0.95 1.084 0.003
20 1.00 1.084 0.002
21 1.05 1.084 0.003
22 1.10 1.084 0.003
23 1.15 1.084 0.001
Velocity
3.077 m/s
Time: 0.35 s
Velocity: 3.077 m/s
Velocity (m/s)
Time (s)
(0.349, 3.029) (Δt:0.00 Δv:0.000)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Latest
Time (s) Position (m) Velocity (m/s)
1 0.05 0.185 0.971
2 0.10 0.223 1.250
3 0.15 0.296 1.590
4 0.20 0.384 1.900
5 0.25 0.487 2.204
6 0.30 0.605 2.476
7 0.35 0.735 2.770
8 0.40 0.879 3.028
9 0.45 1.034 3.191
10 0.50 1.263 2.155
11 0.55 1.274 0.683
12 0.60 1.278 0.119
13 0.65 1.260 0.104
14 0.70 1.299 0.047
15 0.75 1.268 -0.060
16 0.80 1.278 0.064
17 0.85 1.287 0.869
18 0.90 1.276 2.568
19 0.95 1.271 7.901
20 1.00 2.875 -0.228
21 1.05 1.247 -8.191
22 1.10 1.233 -2.489
23 1.15 1.224 0.233
Velocity
3.191 m/s
Time: 0.45 s
Velocity: 3.191 m/s
Velocity (m/s)
Time (s)
(0.451, 2.96) (Δt:0.00 Δv:0.00)

Unit 8- Energy
Part 5
Gravitational (Potential) Energy
and
Kinetic Energy

Gravitational (Potential) Energy

Gravitational Energy is energy that is stored in a field. This is because E_g is caused by the gravitational force which is a non-contact force. The gravitational Force ($\vec{F_g} = m\vec{g}$, where $\vec{g} = -10\,m/s^2$) is constant for a given mass near the surface of Earth.

While the gravitational force is approximately constant near the surface of Earth, the gravitational energy increases with distance from the surface of the Earth. This is similar to elastic potential energy – the further you stretch the spring the more energy it will have to snap back to its original length.

$$E_{el} = F_{el} \cdot \Delta x$$

Similarly...

$$\boxed{E_g = F_g \cdot \Delta y}$$

$$E_g = mg \cdot \Delta y$$

$$\boxed{E_g = mgh}$$

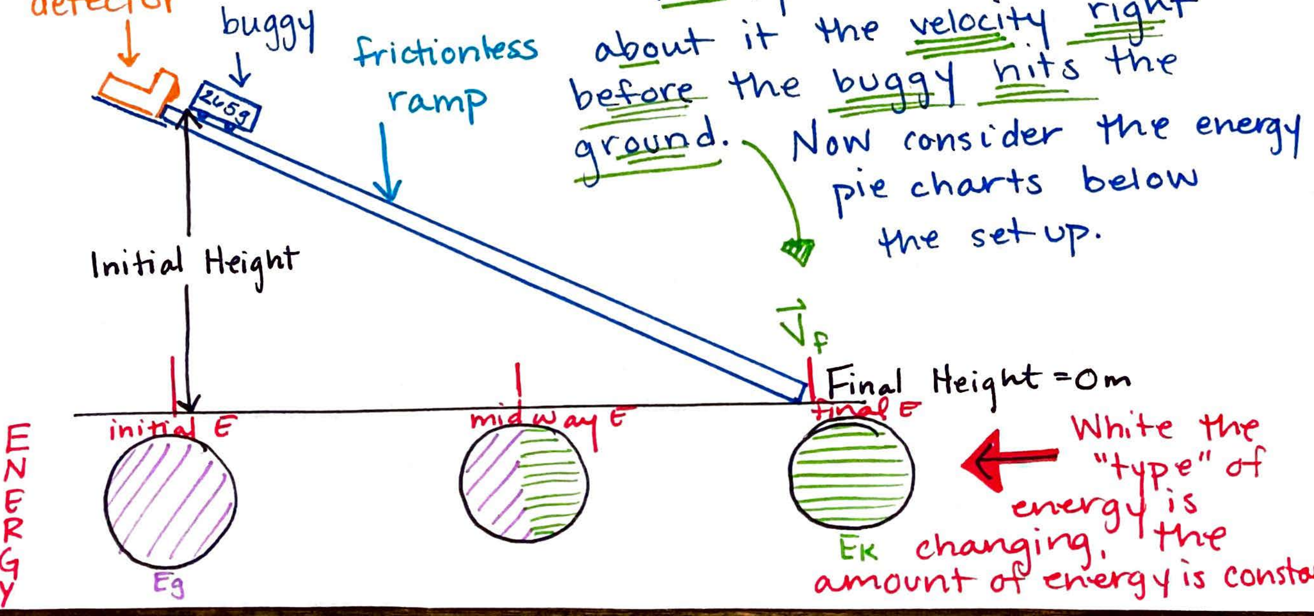
This is most often used, with h = height $= \Delta y$

Kinetic Energy

Finding an equation for kinetic energy is not going to be as simple. To do so we're going to do another lab.

We know E_K is the energy of objects in motion (just like kinematics describes the motion of objects). So to find an equation for E_K, we will look at objects with different velocities. But here's the tricky part - how can we measure the energy associated to each velocity? The solution is... CLEVERNESS! And more specifically, the CONSERVATION OF ENERGY.

Here is our lab set up. We are measuring the velocity of a buggy on a frictionless ramp at different initial heights. The only velocity we actually care about it the velocity right before the buggy hits the ground. Now consider the energy pie charts below the set up.



As the pie charts below the set up show, the energy before the car is released is ALL gravitational energy (and depends on height), and the energy right before the buggy hits the ground is ALL kinetic. Because energy is conserved and because this is a frictionless ramp ($\therefore$ no thermal energy transfer) we can say

$$E_{initial} = E_{final}$$

and, importantly, $\boxed{E_{g,initial} = E_{K,final}.}$

We know how to calculate E_g ($E_g = mgh$) and we can easily measure the initial height to make this calculation. So, once we know the initial E_g WE ALSO KNOW THE E_K at the bottom of the ramp. Using our data from the motion detector, we can find the velocity at the bottom of the ramp.

Now we have a way to relate Kinetic Energy and velocity! By collecting data at different heights of the ramp (and $\therefore$ different initial E_g ... and $\therefore$ final E_K) we can come up with an equation!

I'll help you set up your lab.

Kinetic Energy versus Velocity Lab

Purpose: To find and understand the equation for Kinetic Energy and Kinetic Energy's relationship to motion (velocity).

Variables and Constants:

→ Independent Variable: velocity

→ Defendent Variable: Kinetic Energy

→ Constants:
- mass of the car (265 g)
- length of ramp
- position of motion detector

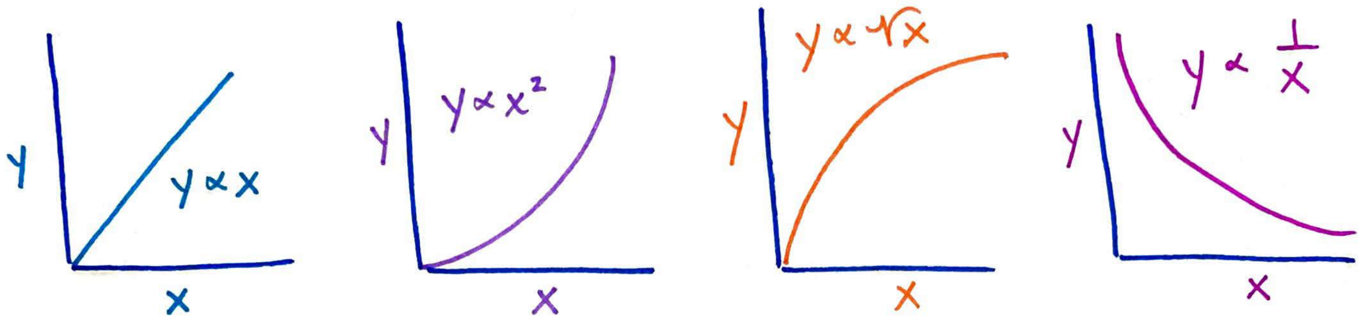
Technically in this lab we are controlling the Kinetic Energy NOT the velocity. And we're controlling E_K by controlling E_g, which is determined by height.

In your lab you will be taking measurements of velocity (IV) and height (used to calculate energy - DV).

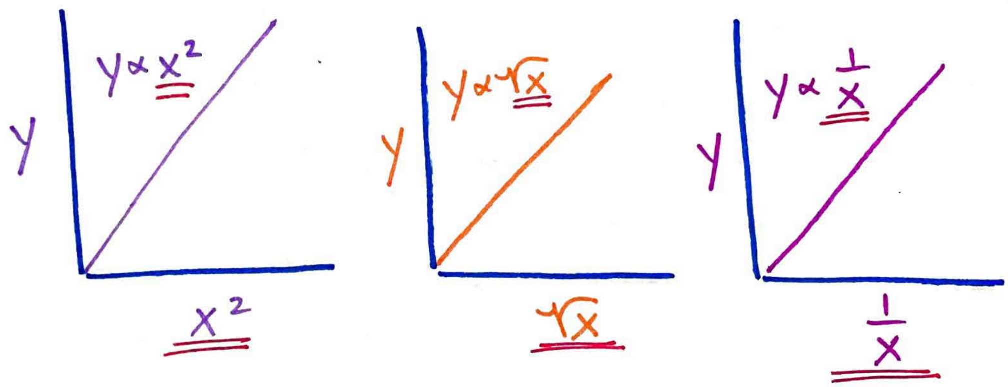
Your graph will have E_K on the vertical axis and velocity on the horizontal axis.

Spoiler Alert! Your graph is not going to be linear! You will have to linearize your graph. Let me give you a reminder.

Common shapes of graphs include

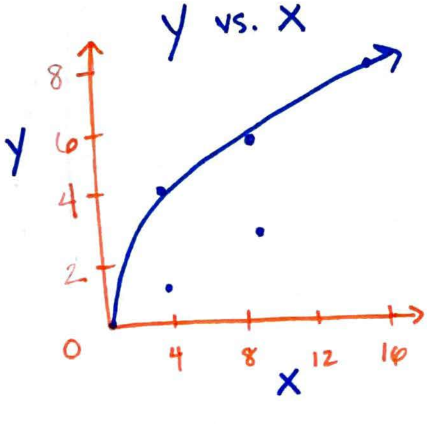


To Linearize, you recalculate the horizontal axis variables to match the shape of the graph.



FOR EXAMPLE

x	y
0	0
4	4
9	6
16	8



$\sqrt{x}$	y
$\sqrt{0} = 0$	0
$\sqrt{4} = 2$	4
$\sqrt{9} = 3$	6
$\sqrt{16} = 4$	8