Kevin SU
2005.09.13

SPH 4U Lab: Uniform Acceleration 313

Background:
1. Define or explain the meaning of acceleration and uniform acceleration
2. Distinguish between average acceleration (a_{av}) & instantaneous acceleration (a_{inst})

Purpose:
To study and graphically analyze uniform acceleration.

Materials:
Picket fence, Computer with "Champ" interface and photogates.

Method:
1. Set up the computer as instructed in class.
2. Drop the picket fence between the photogate and onto a sponge on the floor.
3. Instruct the computer to print the data table and three graphs (d-t, v-t, & a-t).
4. Make sure the a-t graph includes the origin.

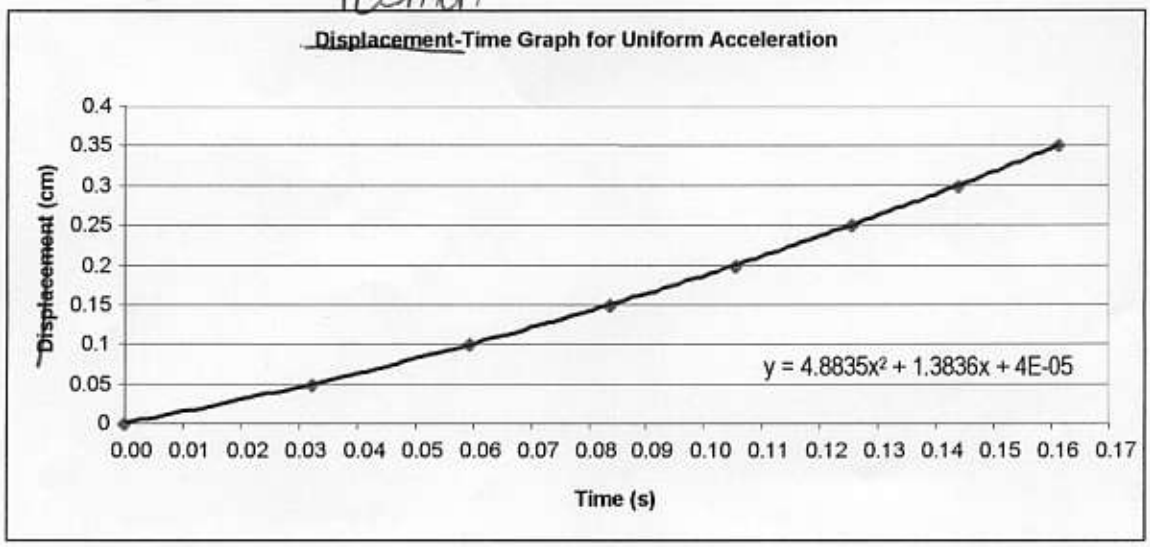
Results:
Chart & graphs

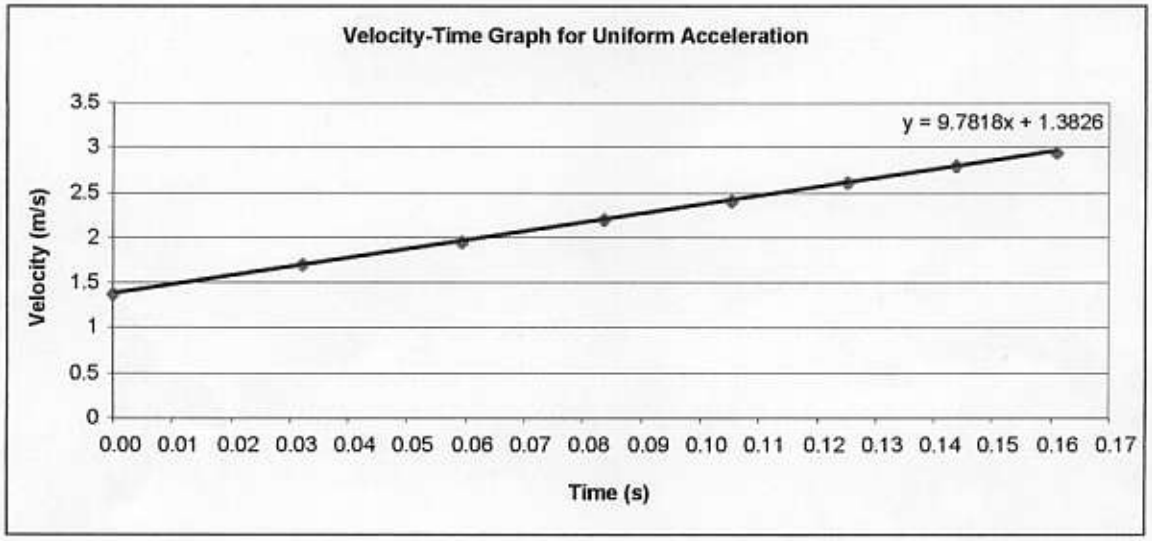
Discussion:
1. Calculate the value and state the physical significance of the:
   a) Slope of the d-t graph (at t=0.100s).
   b) Slope of the v-t graph.
   c) Total area under the v-t graph.
   d) Total area under the a-t graph.
2. Sketch the d-t, v-t and a-t graphs of pure uniform motion and describe and example where you think such motion might occur.
3. What (unavoidable) sources of experimental error caused your graphs to differ slightly from your sketched graphs?
4. Using the previously calculated value of average acceleration, (#1 b), and knowing that the accepted value for Newmarket is 9.804 m/s^2, determine the % error.
5. Would the % error have varied if a picket fence of different mass had been used?

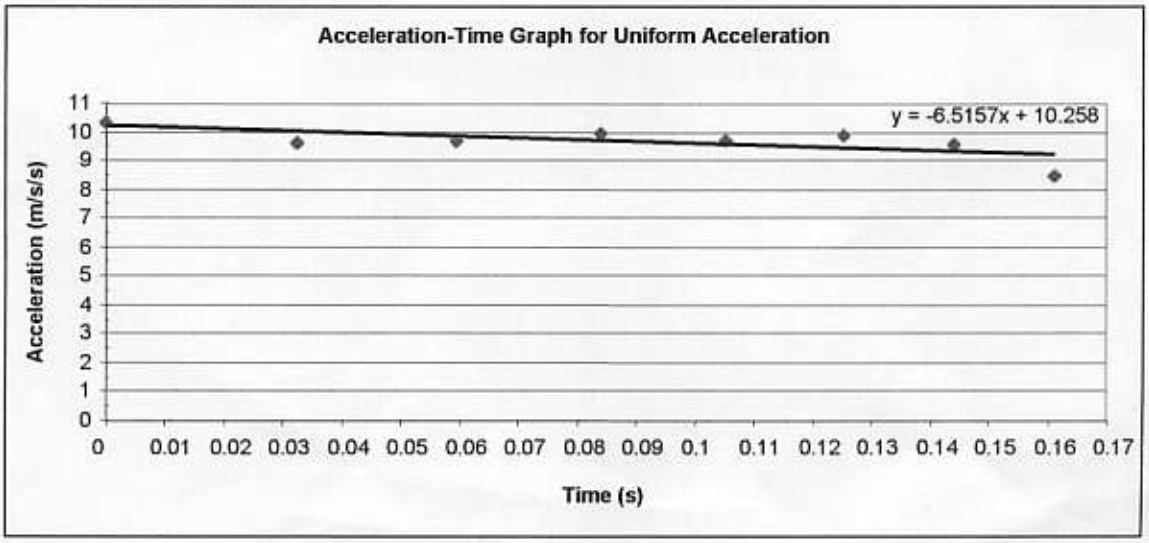
Header - LinearMotion
Num = Number of point
A = Time (s)
B = Displacement (m)
C = Velocity (m/s)
D = Acceleration (m/s/s)

Num	A	B	C	D
0	0	0	1.381	10.37
1	0.0324	0.05	1.705	9.625
2	0.05956	0.1	1.958	9.735
3	0.0838	0.15	2.203	9.96
4	0.1053	0.2	2.414	9.737
5	0.1253	0.25	2.608	9.911
6	0.1438	0.3	2.795	9.58
7	0.1612	0.35	2.952	8.508

Position


Displacement-Time Graph for Uniform Acceleration
Displacement (cm)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
y = 4.8835x² + 1.3836x + 4E-05
0.00 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.13 0.14 0.15 0.16 0.17
Time (s)


Velocity-Time Graph for Uniform Acceleration
Velocity (m/s)
3.5
3
2.5
2
1.5
1
0.5
0
y = 9.7818x + 1.3826
0.00 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.13 0.14 0.15 0.16 0.17
Time (s)


Acceleration-Time Graph for Uniform Acceleration
Acceleration (m/s/s)
11
10
9
8
7
6
5
4
3
2
1
0
y = -6.5157x + 10.258
0 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.1 0.11 0.12 0.13 0.14 0.15 0.16 0.17
Time (s)

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Background?

Background:

1. Acceleration is the rate of change of the velocity of an object. Uniform acceleration is when the rate of change does not change.

2. Average acceleration is the acceleration of the object over a period of time. Instantaneous acceleration is the acceleration of an object at a specific time or moment.

Discussion:

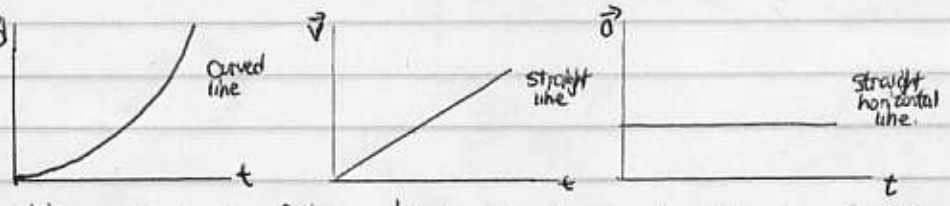
1. a) $m_{0.100s} = 2.36$ m/s - this is the instantaneous velocity at 0.100 s.

   b) $m = 9.78$ m/s^2 - this is the average acceleration of the object

   c) $A = \left(\frac{1.4+2.9}{2}\right)0.16 = 0.34$ m - this is the total displacement of the object.

   d) $A = \left(\frac{10.3+9.3}{2}\right)0.16 = 1.57$ m/s - the average velocity during the movement.

2.



This occurs in a falling object, or a car speeding up constantly.

3. The air resistance against the picket fence, lateral/diagonal movements of the fence that was difficult to control.

4. $\%\text{error} = \frac{9.78 - 9.804}{9.804} = -0.245\%$

5. A bigger mass may have prevented some air resistance and lateral movement, but in general, the % error would likely remain the same or very close.