Kevin SIJ

SPH 4U Lab: Jerk Motion

Background:
Define or explain the meaning of jerk motion.

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Purpose:
To study and graphically analyze jerk motion.

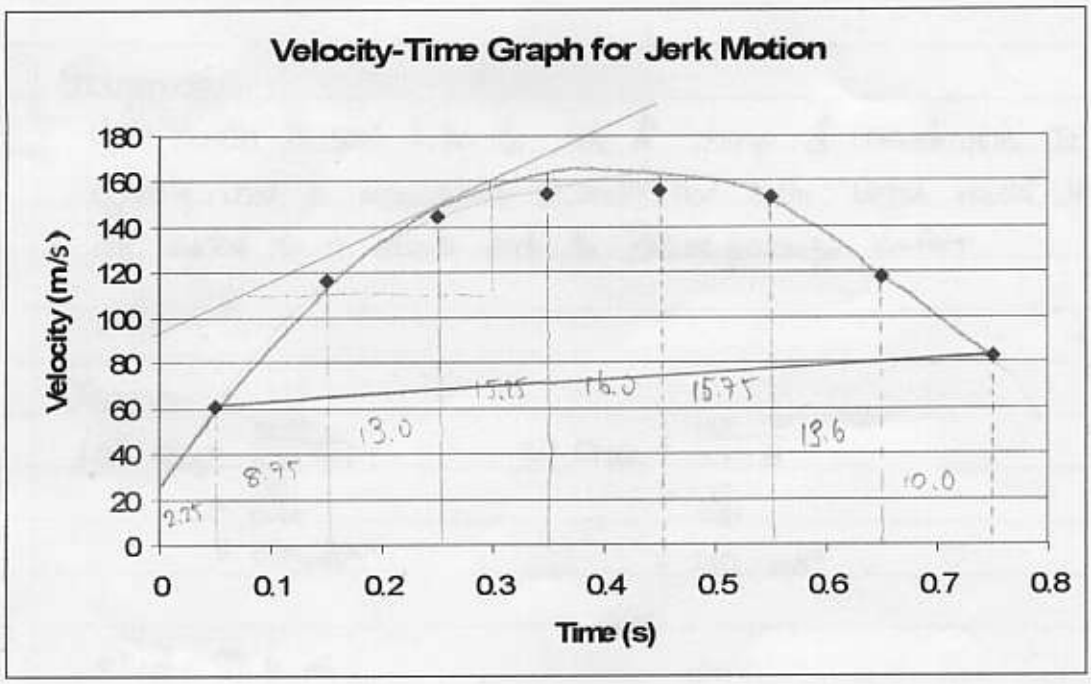
Materials:
Air track or Dynamics cart, ticker tape and 60 Hz timer, rubber band, ruler, retort stand

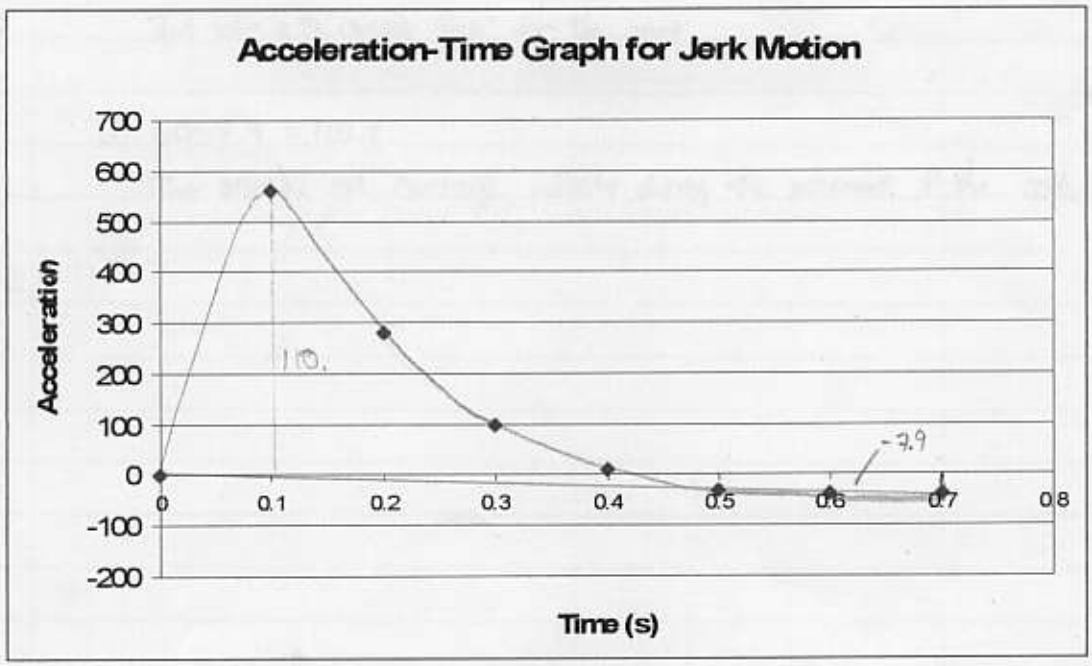
Method:
1. Set up the apparatus as instructed.
2. Pull your cart (glider) to stretch the elastic band.
3. Start your timer and when it has stabilized, release your cart (glider).
4. Measure and record in a chart the total distance travelled (from the start) and the corresponding time elapsed as outlined in the example on the overhead.
5. Complete the rest of the "ticker timer table", including the acceleration column.
6. Using excel, create v-t and a-t graphs. (You may wish to draw the lines of best fit by hand)

Results:
Chart and graphs as per procedure.

Discussion:
1. On your v-t graph:
   a) Use the secant method (join the first and last data points) to find the average acceleration for the whole trip.
   b) Use the tangent method to find the instantaneous acceleration at t=0.30s.
   c) Use the area method to find the total displacement undergone for the whole trip.
2. On your a-t graph:
   a) Join the first and last data points with a straight line, calculate its slope, and state its physical significance.
   b) Calculate the total area "***under***" the graph and state its physical significance.
   NOTE: Some area are "+" and some are "-".

Time (s)	Total Displacement $\vec{d}$ (cm) [F]	Change in Displacement $\Delta\vec{d}$ (cm) [F]	Velocity $\vec{v}$ (cm/s) [F]	Acceleration $\vec{a}$ (cm/s^2) [A]
0.00	0			
		6.1	61	
0.10	6.1			560
		11.7	117	
0.20	17.8			280
		14.5	145	
0.30	32.3			100
		15.5	155	
0.40	47.8			10
		15.6	156	
0.50	63.4			-30
		15.3	153	
0.60	78.7			-35
		11.8	118	
0.70	90.5			-35
		8.3	83	
0.80	98.8			
0.90				
1.00				
1.10				
1.20				
1.30				
1.40				
1.50				


Velocity-Time Graph for Jerk Motion
Velocity (m/s)
180
160
140
120
100
80
60
40
20
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Time (s)
2.25
8.95
13.0
15.75
16.0
15.75
13.6
10.0


Acceleration-Time Graph for Jerk Motion
Acceleration
700
600
500
400
300
200
100
0
-100
-200
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Time (s)
-7.9

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Background:

Jerk motion is said to be the rate of change of acceleration. It is a vector quantity, used in measurements of comfort and motion. Certain vehicles, like subways, are limited to a certain jerk to ensure passenger comfort.

Discussion:

1.a) $a_{avg} = \frac{80-60}{0.65-0.05}$

$= \frac{20}{0.60}$

$= 33.3 \text{ m/s}^2$

b) $a_{inst} = \frac{160-110}{0.30-0.10}$

$= \frac{50}{0.20}$

$= 250 \text{ m/s}^2$

c) $\Delta\vec{d} = 94.6 \text{ m}$

2.a) slope $= \frac{-35-0}{0.70} = -50 \text{ m/s}^3$

This value is the average "jerk" for the cart.

b) $110 - 7.9 = 102.1$

This value is the average velocity during the movement of the cart.