

Constant Motion Lab

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Introduction

Constant motion is when the acceleration is zero; the velocity stays the same the entire duration. This is very easy to use in calculations, but is highly unlikely to occur in nature. However, given an artificially created environment, it is possible to approximate motion as constant, which is what we did in the lab.

Procedure

We taped toilet paper to several vehicles and marked the tape as it passed a certain point every interval. The intervals were determined by a metronome; I used 60 beats per minute (one mark per second, or 1 Hz) and 120 beats per minute (two marks per second, or 2 Hz). After this, we ran tape through an electronic tape timer which marked the tape at 60 Hz and 10 Hz (60 and 10 times per second, respectively) at different speeds.

Data

Vehicles

All measurements are in centimetres.

Vehicle #1 (Tank)		Vehicle #2 (Two-Wheeler)	
1 Hz	2 Hz	1 Hz	2 Hz
8	6	9	3
11	6	22	5
7	8	20	12
12	7	21	11
12	7	18	9
14	8	20	9
14	7	19	10
13	8	19	10
13	7	18	11
14	7	17	9
14	8	-	10
13	8	-	9
14	6	-	11
12	9	-	10
-	6	-	9
-	7	-	10
-	7	-	10
-	7	-	8
-	8	-	10
-	8	-	9
-	6	-	8
-	6	-	9
-	7	-	-
-	8	-	-

Tapes

There were too many dots on the tapes to measure each and record, but on average the constant portions were .5 cm at 60 Hz "Slow", 1 cm at 60 Hz "Fast", 1.5 cm at 10 Hz "Slow" and 4 cm at 10 Hz "Fast".

Calculations

Speeds

Because $v = \frac{d}{t}$, v can be calculated directly from the data we have. In the case of $d = 13 \text{ cm}$ at $t = 1 \text{ sec}$ (1 Hz), $v = 13 \text{ cm/sec}$. The data for the cars is as follows (in cm/sec):

Vehicle #1 (Tank)		Vehicle #2 (Two-Wheeler)	
1 Hz	2 Hz	1 Hz	2 Hz
8	12	9	6
11	12	22	10
7	16	20	24
12	14	21	22
12	14	18	18
14	16	20	18
14	14	19	20
13	16	19	20
13	14	18	22
14	14	17	18
14	16	-	20
13	16	-	18
14	12	-	22
12	18	-	20
-	12	-	18
-	14	-	20
-	14	-	20
-	14	-	16
-	16	-	20
-	16	-	18
-	12	-	16
-	12	-	18
-	14	-	-
-	16	-	-

For the tapes, on average the constant portions were 30 cm/sec at (60 Hz "Slow"), 60 cm/sec at (60 Hz "Fast"), 15 cm/sec at (10 Hz "Slow") and 40 cm/sec at (10 Hz "Fast").

Average Speeds

For numbers denoted as j_i , the average of $j_1 \dots j_n$ can be calculated with:

$$\frac{1}{n} \sum_{i=1}^n j_i$$

Averages (in cm/sec)

Tank		Two-Wheeler		Slow Paper		Fast Paper	
1 Hz	2 Hz	1 Hz	2 Hz	10 Hz	60 Hz	10 Hz	60 Hz
12	14	18	18	15	30	40	60

Discussion

Objects with any form of acceleration would be difficult to measure using this method, and any object with non-linear acceleration would be nearly impossible to track. The results would be similar if the metronome

ticked at a higher rate, the only changes would be caused by human error. To get more accurate results, humans should not have a direct influence on the experiment (a machine should pull the tape, and mark the paper). This would reduce error significantly. Another way would be to run the experiment many more times to get more accurate data.