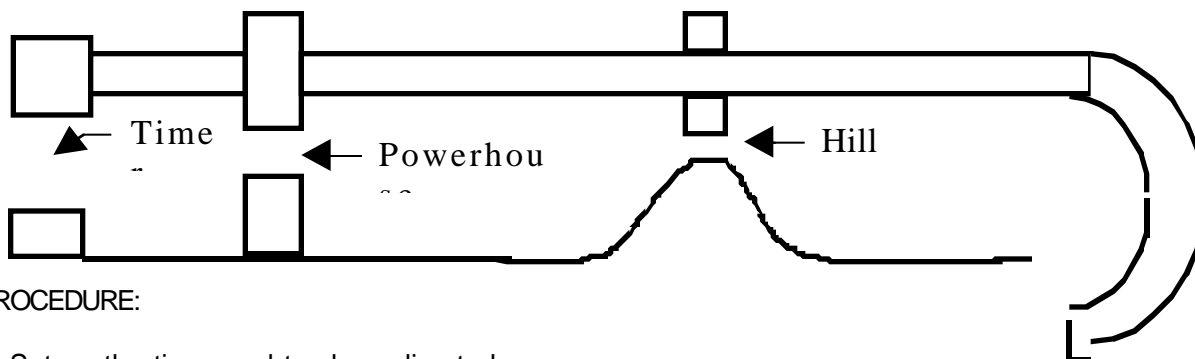


PHYSICS

LAB: ANALYSIS OF MOTION OF A "HOT WHEELS" CAR

PURPOSE: To determine the velocity and acceleration of a "Hot Wheels" car accelerated by a "Powerhouse."

APPARATUS: Timer and power supply, powerhouse and track layout as shown (curve optional):



PROCEDURE:

1. Set up the timer and track as directed.
2. Place the car on the short section of track behind the powerhouse. With the powerhouse on maximum setting, give the car a shove so that it coasts into the powerhouse and is accelerated. The car should not jump off the track, and should make it over the hill. Repeat a couple of times, and if the car does not perform well, exchange it for a different car.
3. Tear off a piece of paper timing tape about the same length as the track.
4. Thread one end of the tape through the guides on the timer, and use masking tape to attach the tape to the roof or back of the car when the car is on the short section of track. Make sure the rest of the tape is stretched out straight back from the timer guides, and is not twisted.
5. Make a trial run with the timer off, but the paper being pulled through the timer guides. The car should make it over the hill.
6. Calibrate the power supply and timer to 1.5 volts (3000 rpm, the instructor will help). **DO NOT ADJUST CONTROL KNOB ON POWER SUPPLY AFTER CALIBRATION;** after calibration, turn power supply on and off by connecting and disconnecting a clip, as noted by instructor. Be sure at this time that the bead rotation direction "helps" the paper tape go through the timer, and that the carbon paper push-pin is in the "back" hole, as noted by instructor.
7. If the trial run was satisfactory, rethread the paper tape, put a carbon disk in the timer, and make an actual run. Make sure the carbon disk is on top of the paper tape, with the carbon side of the disk down, so that when the bead hits it, it will make a mark on the paper tape. Repeat until your group obtains a satisfactory tape, with the car going over the hill before stopping, and the marks on the tape clear enough to use. **BE SURE TO MARK THE START OF THE TAPE (THE END THAT WAS ATTACHED TO THE CAR)! OTHERWISE THE TAPE MAY ACCIDENTALLY GET REVERSED IN THE ANALYSIS.**

ANALYSIS

1. Divide the tape into tocks, where 3 ticks = 1 tock, as discussed in class.
2. Measure each tock **SEPARATELY** in cm, and divide mentally each time by 1 tock, to obtain average velocity during that tock. Make v-t data table (see FIGURE 1 on other side for example).

3. Plot v-t graph on special graph paper provided. If necessary, change numbers on axes of special graph paper to fit your data (see instructor if you have a question about this).

(continued)

4. Divide the v-t graph into regions defined by STRAIGHT LINE SLOPES drawn with a STRAIGHTEDGE. Define as many of the following regions as you can reasonably identify (you may not be able to identify them all):

- initial push of car by hand
- car traveling before entering powerhouse
- car accelerating in powerhouse
- car slowing down on level track after powerhouse
- car going up hill
- car going down hill
- car slowing to stop on level track after hill

5. Divide the identified regions by using a STRAIGHTEDGE to draw VERTICAL dashed lines between them, and CLEARLY LABEL EACH REGION.

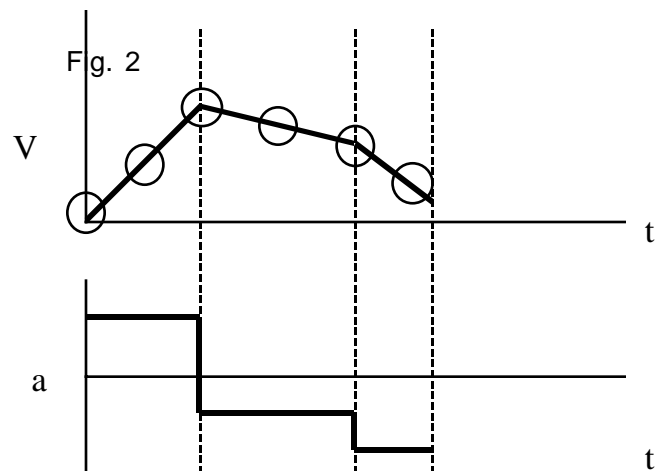
6. Extend the vertical dashed lines from the v-t graph down through the a-t graph, so that the time intervals of the identified regions correspond on both the v-t and a-t graphs.

7. Construct the a-t graph by finding the slope of each straight-line region of the v-t graph, and plotting this value for the entire corresponding time interval on the a-t graph.

FIGURE 2 below shows the general format for the graphs discussed above.

Fig. 1

V (cm/tock)	t (tock)
0	0
	1
	2
	etc.



LAB REPORT FORMAT

(start this on a SEPARATE SHEET of binder paper, and put them AFTER THE GRAPHS in the report)

Title

Purpose

Data (v-t data table per instructions above)

Graphs (v-t and a-t graphs on special graph paper provided (graphs constructed and labeled per instructions above))

Questions

1. How long was the car in the powerhouse? (copy question in lab report)
 - a) Express answer in tocks from direct reading of graph.
 - b) Express answer in sec (show unit analysis-type calculation).
2. What was the maximum speed of the car? (copy question in lab report)
 - a) Express answer in cm/tock from direct reading of the graph.
 - b) Express answer in cm/sec (show unit analysis-type calculation).
 - c) Express answer in mi/hr (show unit analysis-type calculation).
3. What was the acceleration of the car in the powerhouse? (copy question in lab report)
 - a) Express answer in cm/tock/tock from direct reading of graph.
 - b) Express answer in cm/sec/sec (show unit analysis-type calculation).
 - c) Express answer in mi/hr/sec (show unit analysis-type calculation).

4. Hot Wheels vs. Porsche (or other real car).

a) Look up data on some current real car, and list the following information:

year, make, and model (if possible) of car

how many seconds it takes to reach 60 mi/hr (usually given as 0-60 in ____seconds)

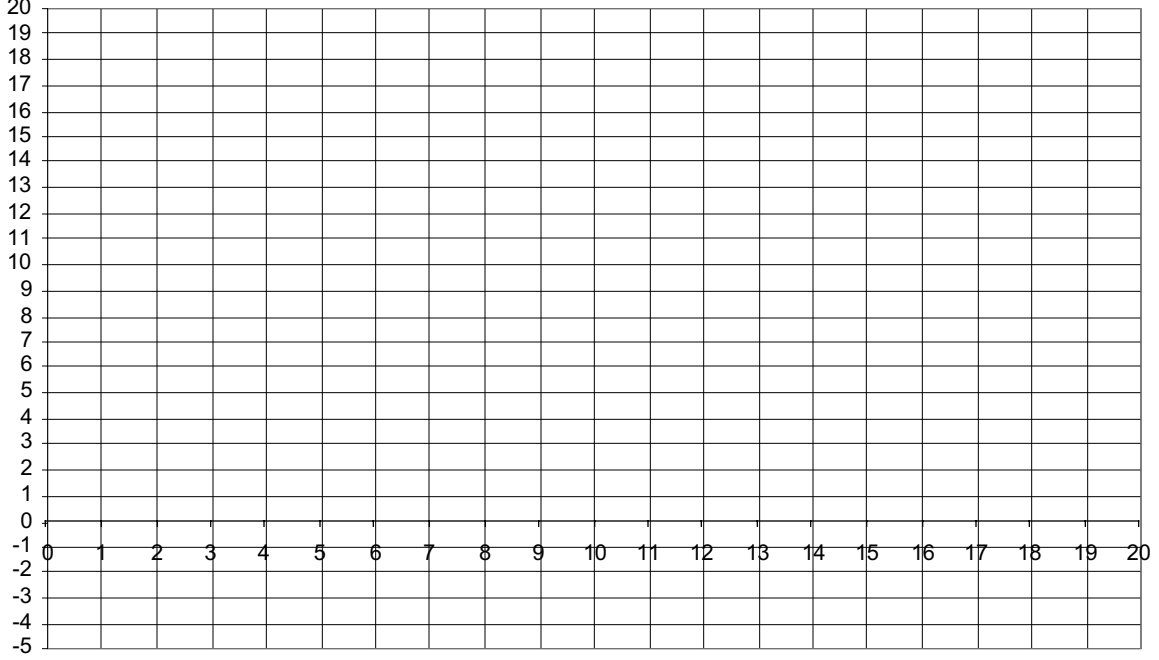
source of your information

b) How many seconds would it take your Hot Wheels car to reach 60 mi/hr? (show method)

c) How fast would your Hot Wheels car be going if it accelerated as long as the real car? (show method)

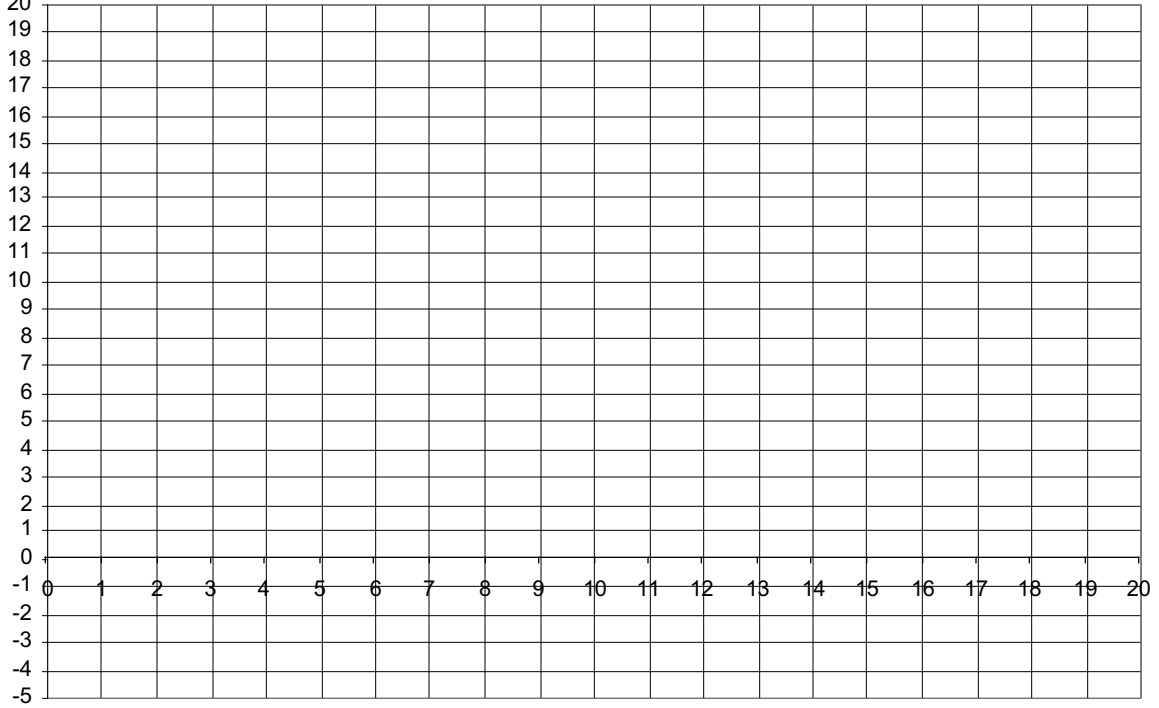
d) If the Hot Wheels car is a 1:30 scale model, how fast is its "scale speed?" (show method)

V (CM/TOCK)



TIME (TOCKS)

a (CM/TOCK²)



TIME (TOCKS)