

Experiment 2

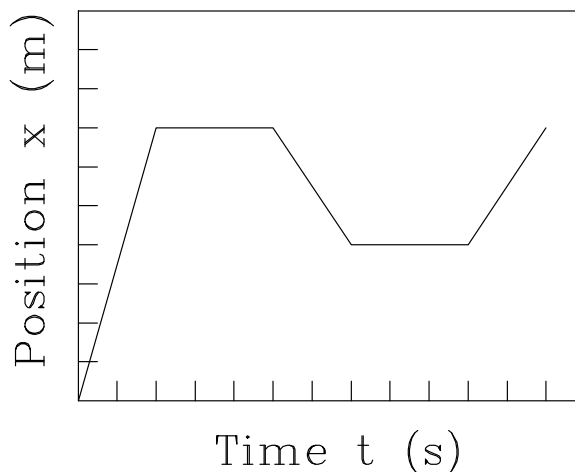
Data Analysis II

From the experiments you performed in Year-1 laboratories, you are already familiar with the data-acquisition interface and analysis tool called PhysicaLab. To review you may want to consult the lab manuals for the Year-1 courses (PHYS 1P91, 1P92, or 1P93), also available online from www.physics.brocku.ca. To reach Physica Online, point a browser to www.physics.brocku.ca/physica; even if you do not have a LabPro data acquisition interface available, you may simulate what happens in the lab by selecting a Demo mode from the Get Data screen.

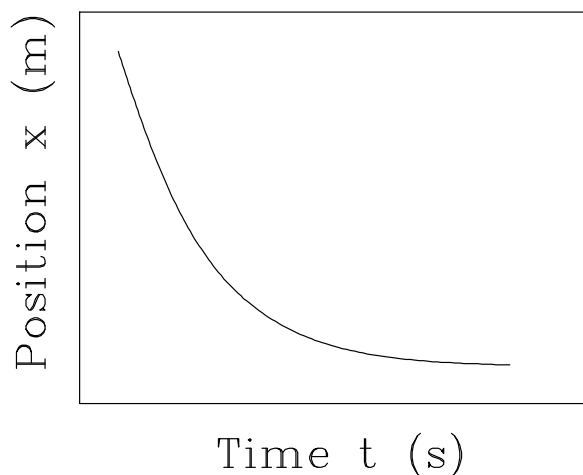
PhysicaLab uses an ultrasonic range finder attached to a LabPro interface to track the position of a runner moving along an air track, as a function of time. The distance vs. time data can be saved into a file for later analysis, and later retrieved to be used in full interactive PHYSICA, or some other data analysis software (maple, gnuplot, *etc.*).

2.1 Analyse LabPro Data with PHYSICA

1. Using PhysicaLab and your hand, see if you can generate a similar graph to the one given below:



2. By applying a slight push to the air car, generate a trace of constant velocity. Make sure the air track is level first! Each student should generate their own trace, save it as a file. Then using PHYSICA they should determine the actual velocity (slope of x vs. t) from their graph.
3. Using a few sheets of folded paper on the track as a brake, generate a trace of deceleration. Plot the graph using PHYSICA and determine the average acceleration a . Determine the time at which braking first occurs, and at what time the car is stationary.



$$a_{avg} = \frac{\Delta v}{t} \quad (2.1)$$

The initial velocity is determined from the linear portion of the trace, while the deceleration time is measured from the first signs of slowing until the car is motionless.

2.2 Perform Least-Squares Analysis with PHYSICA

A student determines the “Moment of Inertia I^* ” of a cradle-cylinder combination. The results are

d (in 10^{-2}m)	2.00	4.00	6.00	8.00	10.00
I^* (in 10^{-3}kg m^2)	3.26	4.55	6.307	8.768	12.31

Theoretically I^* is given by:

$$I^* = I_c + M_\ell R_\ell^2 + 2M_\ell d^2 \quad (2.2)$$

where I_c is the moment of inertia of the cradle, M_ℓ is the mass of the cylinder, and R_ℓ is the radius of the cylinder.

Equation (2.2) is of the form $y = ax + b$, with I^* corresponding to y , and d^2 corresponding to x .

Use PHYSICA to generate a properly labelled graph and also do a least-squares analysis, using the 5 data pairs, and from the result, calculate M_ℓ and R_ℓ ($I_c = 2.562 \times 10^{-3} \text{ kg m}^2$).