An Introduction to Computerized General Physics Experiments

A. Lab Rules

a. Please keep silent and clean inside the lab. Food and drinks are strictly prohibited.
b. Any software installation without authorities' permission is not allowed.
c. Only the experiment-related figures and forms are allowed to be printed out in the labs. And every page of the documents printed out must have your name and team clearly specified.
d. Please do not operate or dismantle the instruments without permission prior to understanding the functions and the operation procedures of any instruments and,
e. If any faults occurs upon your operation, please report to the teacher or the teaching assistant immediately.
f. Only can you leave when the instruments are thoroughly checked and restored to their original states.

B. The purpose of Computerized General Physics Experiments

a. To expand the teaching efficiency and content of general physics experiments via practical operations of computerized interfaces, software applications and computerized programming
b+c. To raise students' interests in general physics experiments, to facilitate general physics education and furthermore, to cultivate scientific knowledge of students' and assist them to familiarize software applications to physics.

C. Prerequisites for General Experiments

Any experiment process should include preview, observation, measurements, record analysis and exercise discussion. In the process of operating computerized experiments, because sensors, interfaces and computer facilities will be frequently used, therefore, students should possess basic knowledge of computers and WINDOWS operating system. Pre-class experimental approaches and materials preview can not only prevent students from damaging the instruments, but raise their learning efficiency.

D. Experiment Instruments

Every experiment on computerized general physics will use SW750 interface (see the figure above) and other computer instruments.

Below are their introductions.

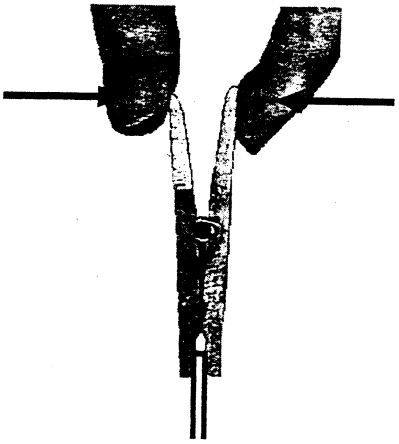
a. P05 FreeFall：

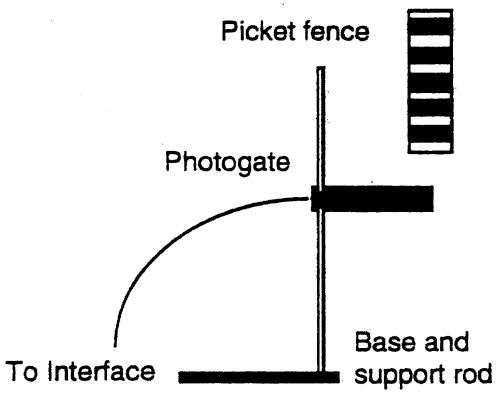
Photogate (with holder and seat)	picket fence
	

E. Experiment Introduction

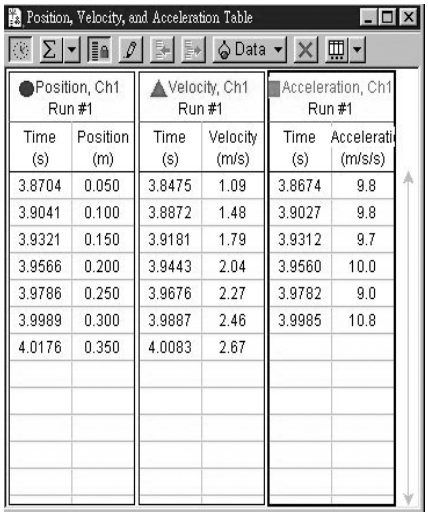
a. Experiments on Free Fall：

1. A photogate can help record and calculate the corresponding relation between average velocity and time when an still object is passing through it in free fall, and can further acquire the gravitational acceleration (value g)
2. The instruments used include an Interface, a Photogate and a Picket Fence.
3. Illustration for Devices to be used in the experiment：



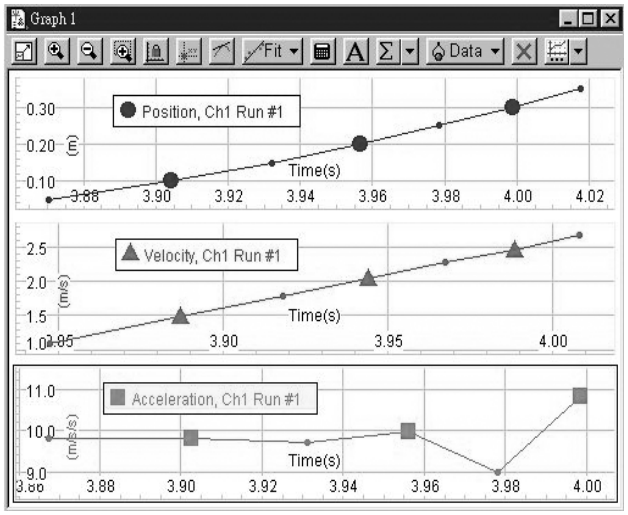


4. Experiment data and figures：



Position, Velocity, and Acceleration Table

Position, Ch1 Run #1		Velocity, Ch1 Run #1		Acceleration, Ch1 Run #1	
Time (s)	Position (m)	Time (s)	Velocity (m/s)	Time (s)	Accelerati (m/s/s)
3.8704	0.050	3.8475	1.09	3.8674	9.8
3.9041	0.100	3.8872	1.48	3.9027	9.8
3.9321	0.150	3.9181	1.79	3.9312	9.7
3.9566	0.200	3.9443	2.04	3.9560	10.0
3.9786	0.250	3.9676	2.27	3.9782	9.0
3.9989	0.300	3.9887	2.46	3.9985	10.8
4.0176	0.350	4.0083	2.67		



1. Free Fall

A. Section Purpose：

To apply a picket fence and a photogate to measuring gravitational acceleration, and to familiarize the operation of the computer softwares and hardwares related to computerized general physics

B. Principle(s)：

If air resistance is ignored, the velocity of the free-falling speed of picket fence will be increasingly faster under the impact of gravity. When the falling picket fence goes through a phtogate, the light beam of the photogate will be blocked by the black grids on the picket fence. The time that it takes for the intervals between every black grid (about 5 cm) to go through the photogate will be shortened as the velocity of falling speeds up. Thus, by recording the time of different sections on the picket fence going through the photogate, you can calculate its corresponding velocity and the relation between acceleration and different durations of time. The Science Workshop (SW) will calculate the average falling velocity of each adjacent black grids' intervals, and acquire the relation of its slope and time by drawing a graph of average velocity in contrast with time intervals (i.e. gravitational acceleration).

C. Instruments Required：

SW705interface, picket fence (transparent Acrylic sheet with black stripes), photogate (with seat).

D. Steps to the Experiment：

a. Turn on the power of SW750 interface, and check if the power light on the left side is on. And turn on the computer (Please make sure the orders as indicated).

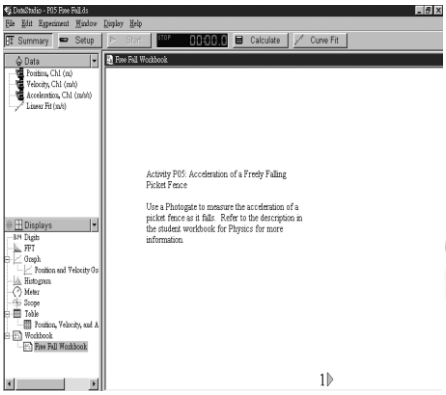


Figure 1

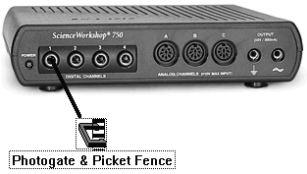


Figure 2

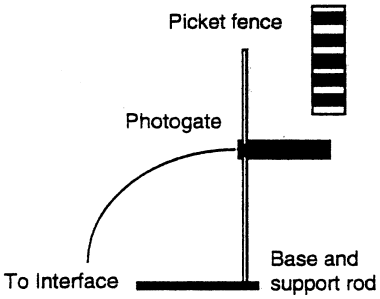


Figure 3

b. Plug the adaptor of the photogate into “Digital Channel 1” on SW750 interface, and click “Free Fall” on the screen. An English manual file will appear on the screen by this time (as shown in Figure 1), and then press the function button on the top of the screen, and you’ll see an image as shown in Figure 2.

c. Set up a photogate (as shown in Figure 3).

d. Double-click Position and Velocity Graphs under “Displays” (as shown in Figure 4) on the lower left corner of the screen to check the figure (as shown in Figure 5). By Clicking the Position, Velocity, and .Acceleration Table under the Table of the Display window, you’ll see 3 different forms for data recording.

To simultaneously check Positions and Velocity

The window sizes of the charts and forms above can be adjusted respectively.

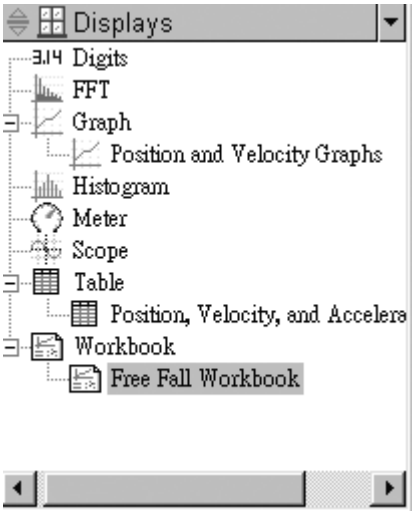


Figure 4

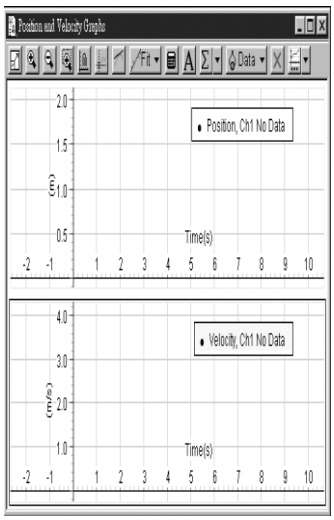


Figure 5

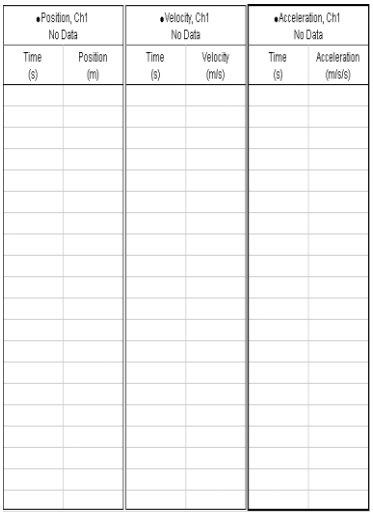


Figure 6

e. Click START, RUN#1 will appear in column Data and get ready to record 3 data: Positions, Velocity, and Acceleration. Drop the picket fence right through the photogate from the opening of it without contact. When the black grids of picket fences go through the photogate, data reading will be auto-activated. Click the STOP button after the data reading process ends to stop recording (the data of RUN#1).

f. Click the velocity data chart (the texts will be highlighted in yellow), and click the scale to fit on the upper left side of the chart window to enlarge.

g. Check "Linear fit" in the Fit above the chart. At this time, the data form will pop out, and the m(slope) in it indicates the acceleration.

h. Print the results: Click "print" in the "file".

i. Click the▼ button of the Σ on the up side of the window to show the drop-down function list, and check Show all. The statistical results will appear in the form, where the average value in Column Acceleration indicates the acceleration.

j. Print out this form and compare it with the Positions printed earlier.

k. Click "Quit" in the "File", and then click "No" (not to save the data).

E. Questions

a. Try analyzing the factors affecting the errors of picket fence's gravitational acceleration in the experiment. And try to find the solution.

b. Please use the Velocity vs Time printed to calculate and analyze the relation between its slope and gravitational acceleration.

c. Please explain which equation help acquire the value g in the experiment.

d. Assume the intervals between the black panels of the picket fences in the experiment are all s. If we increase or decrease s, how will it affect value g?

e. If we throw down the picket fence hard in the experiment (through the photogate), how will it affect the measurement of the value g?

f. If a naughty student changes the setup of the computer in the experiment (Periodic Sample = Fast at 50 Hz), how will the results of the g value measurement change? Explain why.

g. Will the mass of the picket fences affect the gravitational acceleration? Try to explain it.

h. How will the distance from the start of the free-falling picket fence to the photogate affect the results of the value g measurement?