XII...The Simple Harmonic Oscillator (Part 1)

Introduction:

As you will quickly notice, although the mirror sensor card has no pendular motion, it does oscillate from side to side in the horizontal plane. This motion can be studied by the students to learn about oscillation in the horizontal plane, as opposed to the pendular oscillation in the vertical plane. Note also that perpendicular forces do not affect each other so although gravity is pulling on the magnet, this force does not disturb the horizontal motion.

Procedure:

There are two components to the motion, its oscillation period and its amplitude.

Oscillation Period:

1) Construct a table with one column giving the swing number and the second column giving the elapsed time since the start of the measurement series.

2) Set the magnet into a smooth oscillation mode in the horizontal plane, but with little vertical pendular motion. This makes the measurement process easier.

3) Have the students measure with a stop watch the time it takes the light spot to return to its most extreme left-wards or right-wards point in its swing. One student will call out the elapsed time since the measurements began, and a second student will record the time.

4) From the table, construct a third column that gives the difference in time between the current time and the previous time. This is the period of the oscillation of the current cycle.

5) You may either plot the periods against the cycle number or work with the table directly.

Materials:

1) The Magnetometer
2) Stop watch

Extension Activity:

Change the type of string or thread being used to suspend the magnet in the magnetometer and repeat this experiment for each one.

You might chose nylon thread, a synthetic thread, fine wire, etc.

Questions:

1) How does the period of the oscillation change depending on the kind of substance the string is made from?

2) Can you predict from the other properties of the material how fast or slow the sensor will oscillate?

An Example.

Students can measure the oscillation period in several ways which we will describe here. The idea is to measure the periods for 10-20 oscillation cycles of the magnet to see whether the period changes as the swing is damped.

The hardest part is to do the rapid-fire timing measurements. This can either be done with a stop watch or with a metronome. In each case, you will need three students. Student 1) sets the oscilaltion going. Student 2 watches the stopwatch or counts the metronome clicks. Student three writes down the times/clicks called out by student 2. The timing is simply a running time. Do not have the students compute the period in 'real time'.

The stopwatch is started at some convenient time before Student 1 starts the oscillation. Let 1 cycle go by before you start the reading.

If you use a metronome, you will need to calculate how many seconds elapse between clicks. Take a 1-minute time period, count the number of clicks that occur, then divide the 60.0 seconds by the number of clicks to find the interval. A setting of 'Alegro' seems to give about 0.3 second intervals which is adequate.

Below is an example of the metronome method, and a result obtained from two separate trials with the same magnetometer used in previous activities in this Lesson.

Cycle	Trial 1 Clicks	Trial 2 Clicks
1	9	9
2	9	9
3	9	9
4	9	8
5	8	9
6	8	9
7	9	9
8	8	8
9	9	8
10	8	9
11	8	8
12	8	8

The metronome produced 173 clicks in 60 seconds, so the interval between clicks was 0.35 seconds.

Trial 1:

Average clicks per swing = (102)/12
= 8.5

The time between swings
= 8.5 x 0.35 seconds
= 3.0 seconds

Trial 2:

Average clicks per swing = (103)/12
= 8.6

The time between swings
= 8.6 x 0.35 seconds
= 3.0 seconds