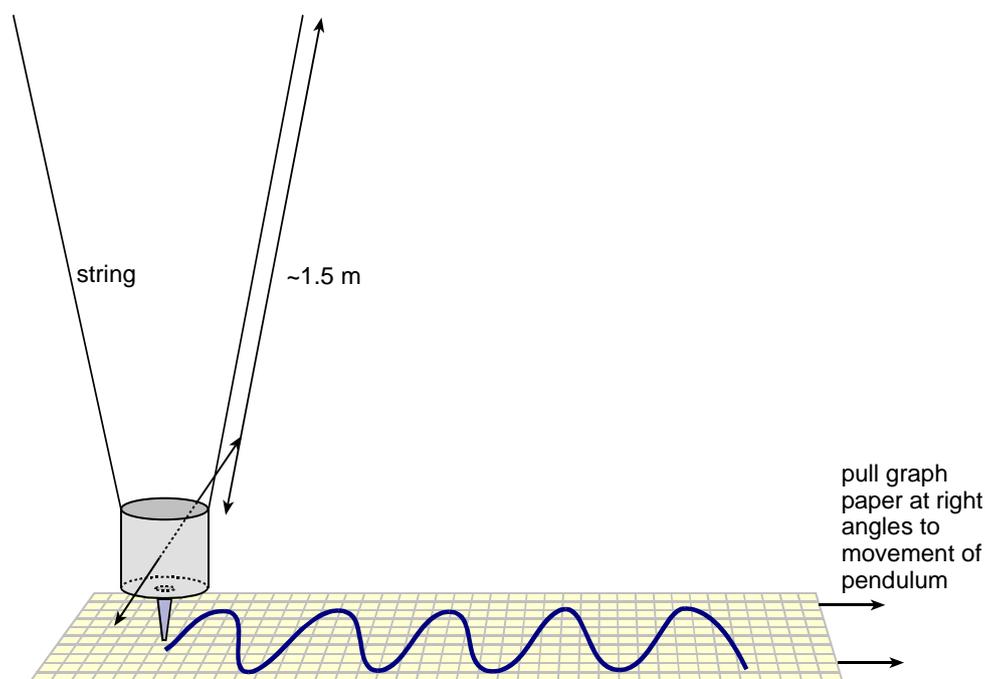


TAP 305- 1: The water pendulum

As inky water runs out of a hole in the bottom of a can, it can create a trace on paper slowly moved underneath. Although this is a 'rough and ready' way of recording the oscillation, it can give you useful information.

You will need

- ✓ water pendulum
- ✓ four sheets of graph paper taped together, or light-coloured sugar paper cut to size
- ✓ two retort stands, bosses and clamps
- ✓ two G clamps, approximately 5 cm jaw
- ✓ ink
- ✓ hand-held stopwatch



What to do

You want the pendulum to swing with an amplitude of half the width of the graph paper. As it is swinging, you are going to drag the paper underneath the dribbling water to create a time trace. To do this you will need to pull the paper with constant velocity, so do a few 'dry runs' before putting water in the can.

Make sure the end of the tube is as near as possible to the paper at the bottom of the swing.

1. Put your finger over the hole and put about 2 cm of water in the can. Now add 10 drops of ink and allow it to mix.
2. Set the pendulum swinging and slowly pull the graph paper under the water. This will give you a time trace. Let it dry and add axes to the line or make a good copy on another sheet of graph paper.

Now you have done the experiment, think how to answer these questions:

- How can you mark time values on the graph?
- Does the periodic time of the oscillation change as the water runs out?
- What is the maximum velocity of the pendulum?

You have seen

1. The pendulum reaches its maximum velocity when it travels through its mean position.
2. The time trace is a displacement–time graph so velocity at any instant can be found by taking the gradient at that instant.

Practical Advice

If a little care is taken, this activity will yield a reasonable time trace. The aim of this activity is getting your students to think more carefully about the nature of oscillators. Producing a time trace should encourage students to observe more carefully. The graph obtained should be clear enough for them to consider how the gradient varies over the cycle.

The ‘water pendulum’ needs to be made up. At its simplest it is just a can with a 1 mm hole in the centre. A more reliable effect is produced when a glass tube is inserted into a bung and then the bung in the bottom of the can.

The supporting strings should be about 1.5 m long.

Safety

If the paper is on the bench, the string supports are roughly 2.5 m from the floor. This requires two persons; one to hold the ladder or steps and the other to fix the string supports. If the paper is on the floor, the retort stands can be on two tables; ensure that they cannot move.

External reference

This activity is taken from Advancing Physics chapter 10, 200P