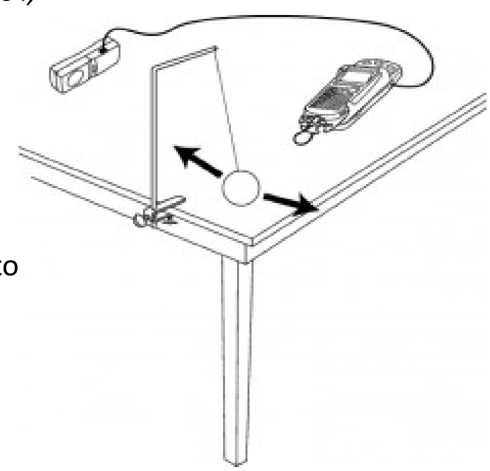
Motion of A Pendulum

1) Imagine you are using a setup as shown in the figure below to measure the d-t, v-t, and a-t graphs of a pendulum.

What would they look like? Construct rough sketches of these graphs based on your observations in the activity earlier. The period is *T,* the length of the string is *l,* the maximum angle is θ_{max}, and the mass of the bob is *m.* Assume that the motion starts at maximum angle.



In constructing the graphs, answering the following questions first will help you considerably.

- What fraction of the period does it take for the bob to return to equilibrium from θ_{max} ?
- What maximum angle does the bob go to when it has passed the equilibrium and what fraction of the period does it take to get there? Assume that there is no friction.
- Now that the bob is on the opposite side of where it started, what fraction of the period does it take to get back to equilibrium?
- How long does it take to get back to the starting point during from the last step?

2) Describe in words how the potential energy and kinetic energy transfer to each other during a full period. Specifically, at what points is the potential energy maximum? When is the kinetic energy maximum? Derive a formula for the total sum of the potential and kinetic energy.

3) By using the given parameters, find a formula for the maximum velocity of the mass.

4) Do you expect the period to increase, decrease, or stay the same when mass is increased? Explain.

5) Do you expect the period to increase, decrease, or stay the same when θ_{max} is increased? Explain.

6) Do you anticipate the period to increase, decrease, or stay the same when *l* is increased.

7) If we were to use the same mass, the same length string and the same θ_{max}, but this time on the moon, would you expect the period to be longer, shorter, or the same? Elaborate. The gravitational acceleration is about a sixth of that on Earth.

8) Write down four more examples of oscillatory periodic motion that you can think of.