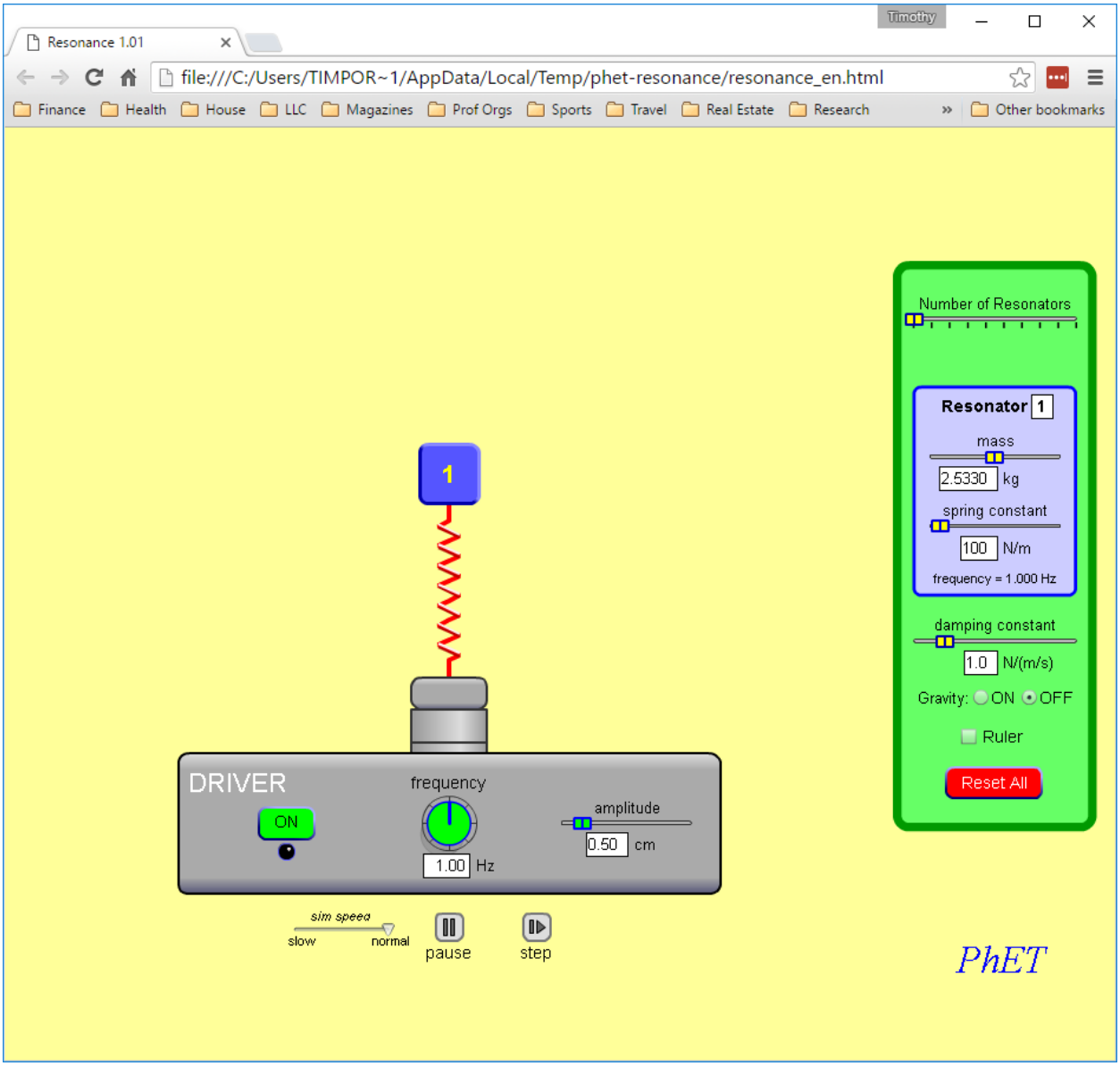
Oscillations and Resonance

Lab Procedure – Answer questions in red.

Download and run the Java application “resonance_en”.



1. Try out the application, changing the frequency and amplitude of the driving force applied to the mass on the spring. Select “ruler” and observe how you can make measurements of the oscillations.

   Reset the app back to original values (Press “reset all” button”. Set the spring constant to 300 n/m. Show the ruler.

a) Draw a free body diagram for the mass (you do not need to include drawing with this lab). Explain the vectors that you have included in your free body diagram in the box below.

b) Now set gravity to "on", and wait for the mass to settle down. Describe how you can calculate the spring constant of the spring from these measurements. What value do you calculate?

c) From the above calculation, can you calculate a predicted value for the resonant frequency of this mass? Ignore damping. Explain how you did this and give the result.

d) Click the driver to on. Click and drag the frequency dial to change the driving frequency. How can you find the resonant frequency doing this? What value do you get?

2. Turn off the driver and allow the mass to come to a rest. Set the lower ruler to the midpoint of the mass (its equilibrium position). Make sure gravity is set to off. Set spring constant to 300.

   Start the mass oscillating again and adjust its driving frequency to get it oscillating as close to resonance as you can.

   Move the other ruler line to as close to the midpoint of the mass as you can as the mass reaches its highest point.

   a) What is the amplitude of the oscillation of the mass you observe? Remember, this is just the distance from the equilibrium position and the maximum displacement.

   b) Draw a free body diagram for the mass when it is at its equilibrium position (do not turn in with lab). Describe the force vectors in your diagram in the box below.

   c) Draw a free body diagram for the mass when it is at its maximum height position (do not turn in). Describe the force vectors in your diagram in the box below.

d) When the mass is at its maximum displacement, what is its kinetic energy (mass)? What is its potential energy (spring)? What is the total energy of the system of mass plus spring? Remember, gravity is "off" for his part of the lab.

e) When the mass is at its equilibrium position (still oscillating), what is its kinetic energy? What is its potential energy (spring)? What is its total energy of the system?

f) What can you say about the total energy of the oscillating mass and spring system in this case?