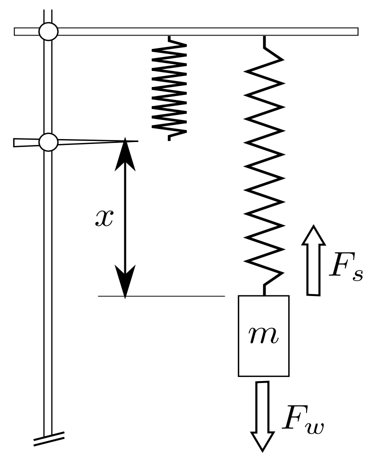
Worksheet: Weights and springs

Name: ____ Group name: ______________________

In this lab you will measure you will study the static (= nothing moves or will move) and dynamic (= something's moving) properties of springs and relate them to the measurement of weight, distance, and period.



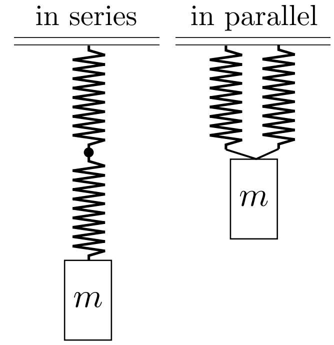
1. Build the experiment on the right (you don't have to use two springs, this is just to illustrate elongation). Attach a mass *m* to the spring, and you will find that the spring elongates by a distance *x*.
   - Does the spring react to the mass or the weight of the object you attached, or both?
   - There are two forces acting on the mass: the ___________ (F_w) and the restoring force of the spring (F_s). How are they related?

2. Attach different masses to the spring.
   - For the different masses, graph the strength of the restoring force (F) over the elongation of the spring (x) on the graph paper provided.
   - How are these two quantities related? (see prelab)

     F = __________________

   - This relationship between F is x is known as **Hooke's law**. The constant of proportionality *k* is called the **spring constant**.
   - Physical unit of *k*: ____________________ (look at the units of your equation)
   - Determine *k* of the spring from the slope in your graph: k = __________________ ______
   - How could you build a scale from this setup?

3. Determine *k* for two springs, when put in parallel or in series (see picture on the right) by following point 2.

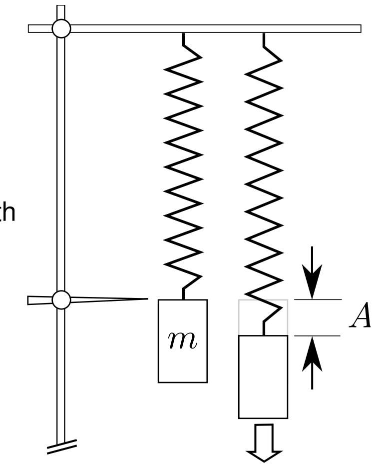


   - Single spring (copy from 2) *k* = __________________ _____
   - Two springs in series *k* = __________________ _____
   - Two springs in parallel *k* = __________________ _____
   - Study this data. Try to explain the behaviour of the spring constant in terms of the geometry: the **length of the spring** and the total **cross section** (the amount of spring material per length).

4. Use your insights from points 2 and 3 to make a **prediction** (don't run the experiment just yet!):
   - "For a ideal spring, if you double the force pulling on the spring but also use a second identical

     spring in parallel, the elongation ____ ."
   - Test your prediction in experiment by first attaching a mass of m = 400 g on a single spring and then doubling the mass as well as putting a second spring in parallel.

5. Create a harmonic oscillator as shown on the right.



- Use a mass m = 350 g. Pull the weight A = 2 cm down and let go.

  Period of oscillation: T = ____________________ _____

- Graph the dependence of the period T on the amplitude A. Start with small amplitudes. What is the relationship between T and A?

- Graph the dependence of the period T on the weight F. What is the relationship between T and F?

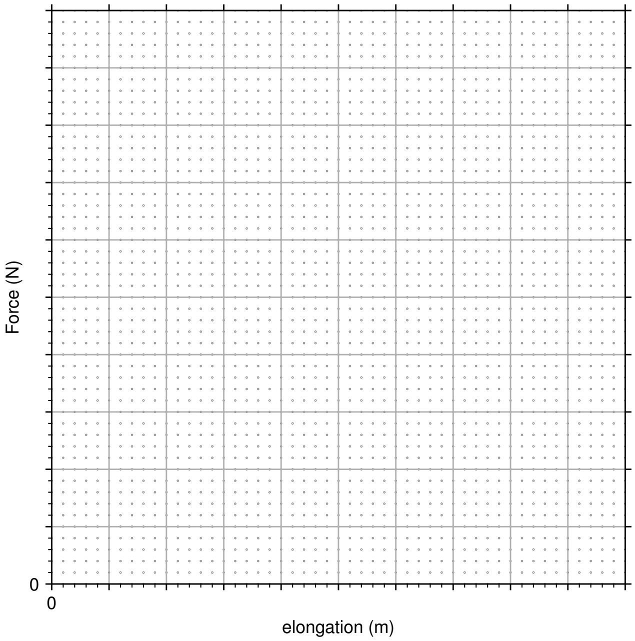
- What mass m and amplitude A would you have to use to get a period of T = 1 s ?

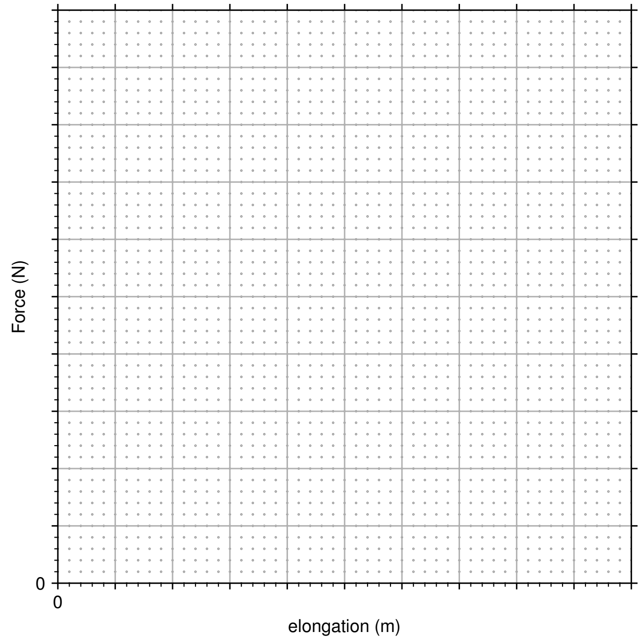
  m = _________________ _____ A = _____________________ ______

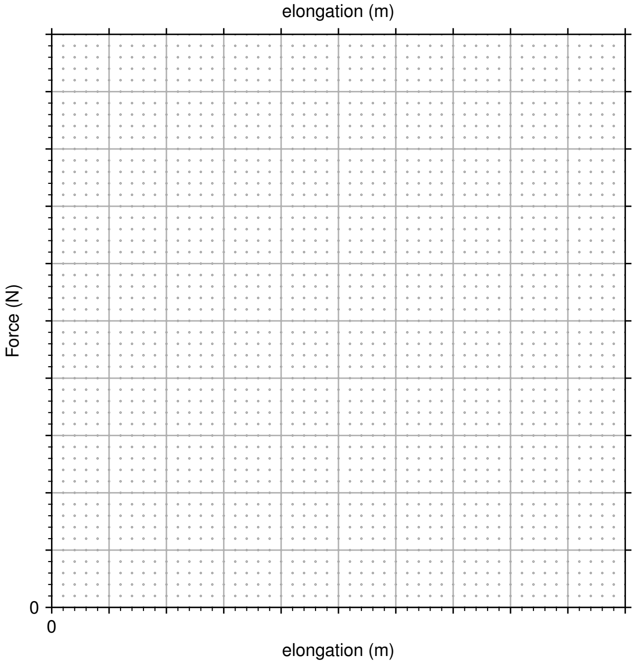
- Could you build a clock using a mass and a spring? How?

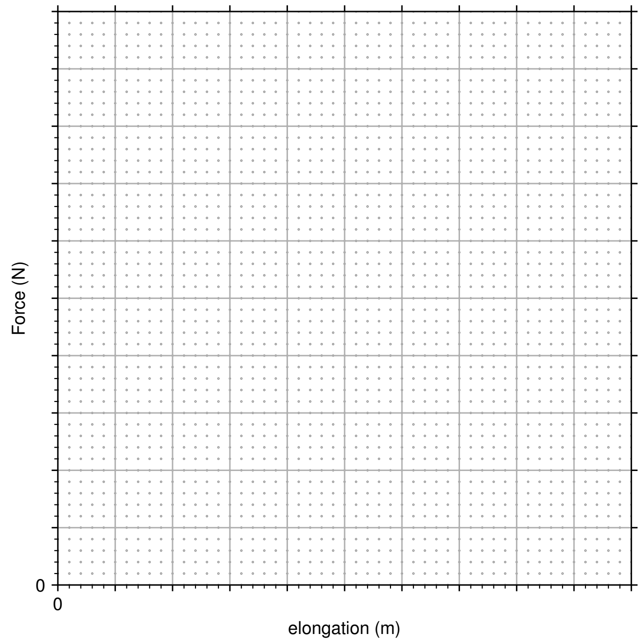
6. (Bonus) Determine the spring constant for the spring you brought with you. Start with **small masses** to avoid damaging the spring.

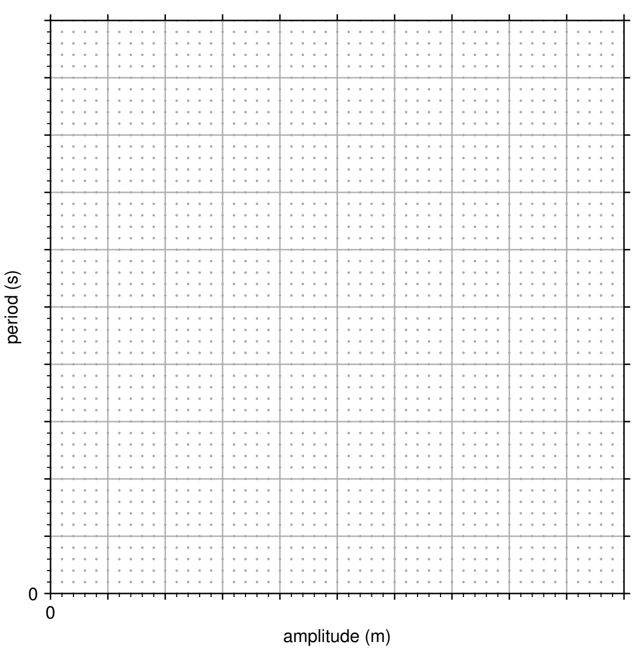
   k = _________________ _____


Force (N)
0
0
elongation (m)

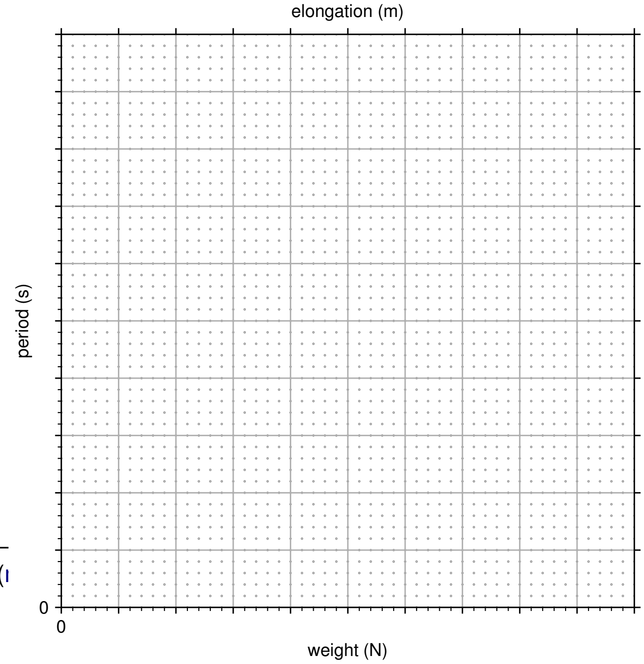

Force (N)
0
0
elongation (m)


Force (N)
0
0
elongation (m)


Force (N)
0
0
elongation (m)


period (s)
0
0
amplitude (m)

er (


period (s)
0
0
weight (N)