Princess Nourah Bint
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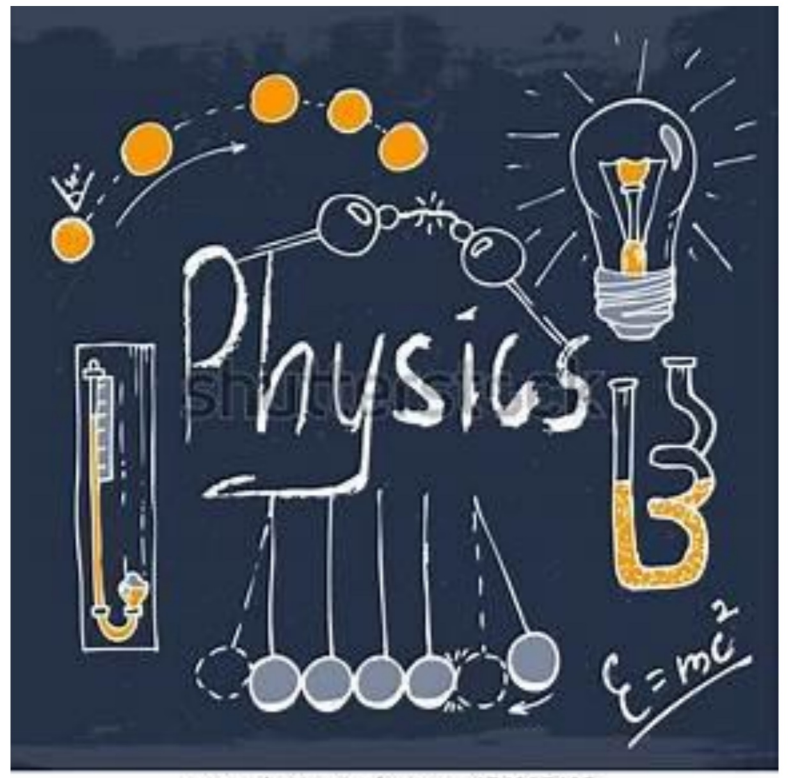


GENERAL PHYSICS LABORATORY 1

PHYS(101T)

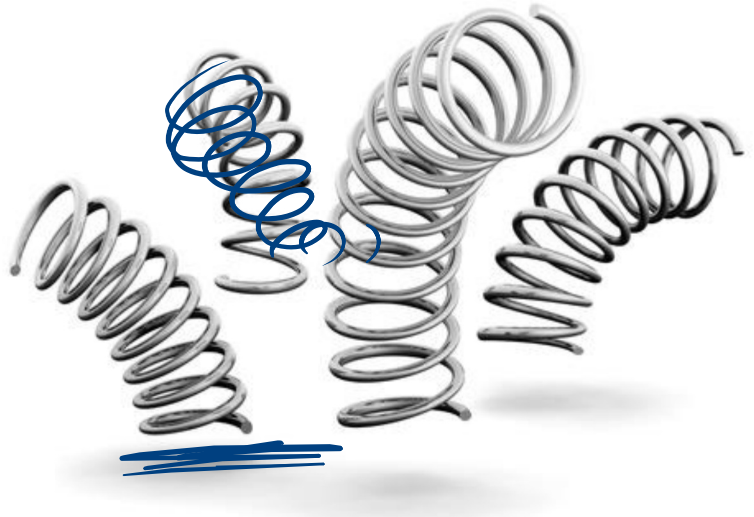
Experiment 1
Hook's Law

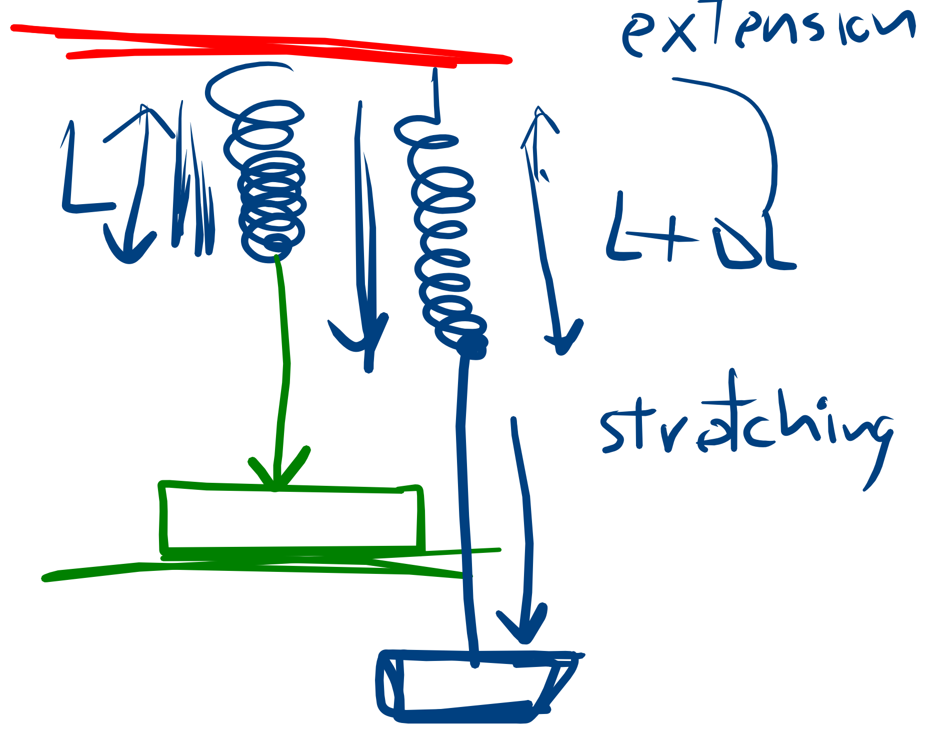
Physics 101 Lab Coordinator

Hook's Law

$F = K \Delta L$

spring constant

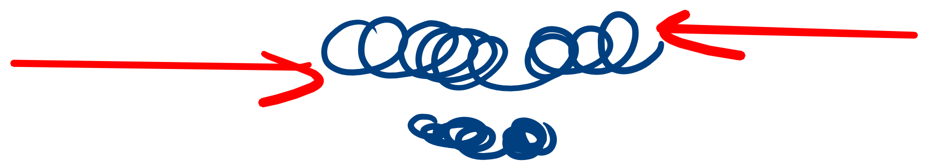




Objectives:

- Investigation of Hook's law of elasticity.
- Determination of the spring constant K.

The theory:



- A solid has a **definite volume** and a **finite shape**.
- The shape of a solid can only be changed **under the effect of force** either by stretching or compression.
- As you may know, springs are made from *coils* of metals and can be compressed or stretched if a force is applied to them when a vertically spring is supported at its upper end, and weights are added to its lower end the amount by which it is stretched is found to be proportional to the weight applied and as long as the spring **will return to its original length when the force (weight) is removed** .
- This is called Hooke's law Hook's law and the constant of proportionality called **the spring constant**.

Properties of solids

Hooke's law can be written as:

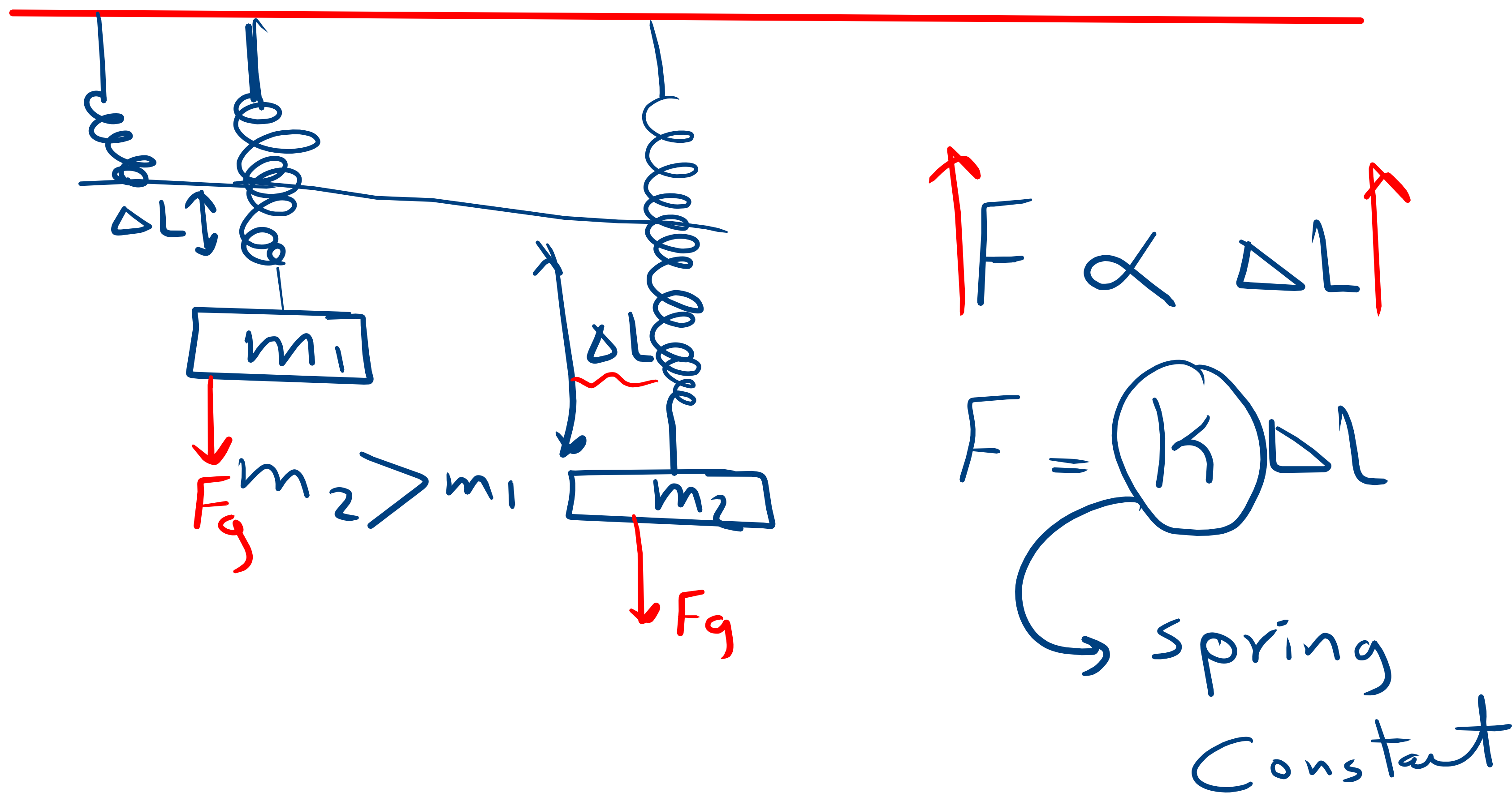
$$F \propto \Delta \ell \qquad\qquad F = k\,\Delta \ell$$

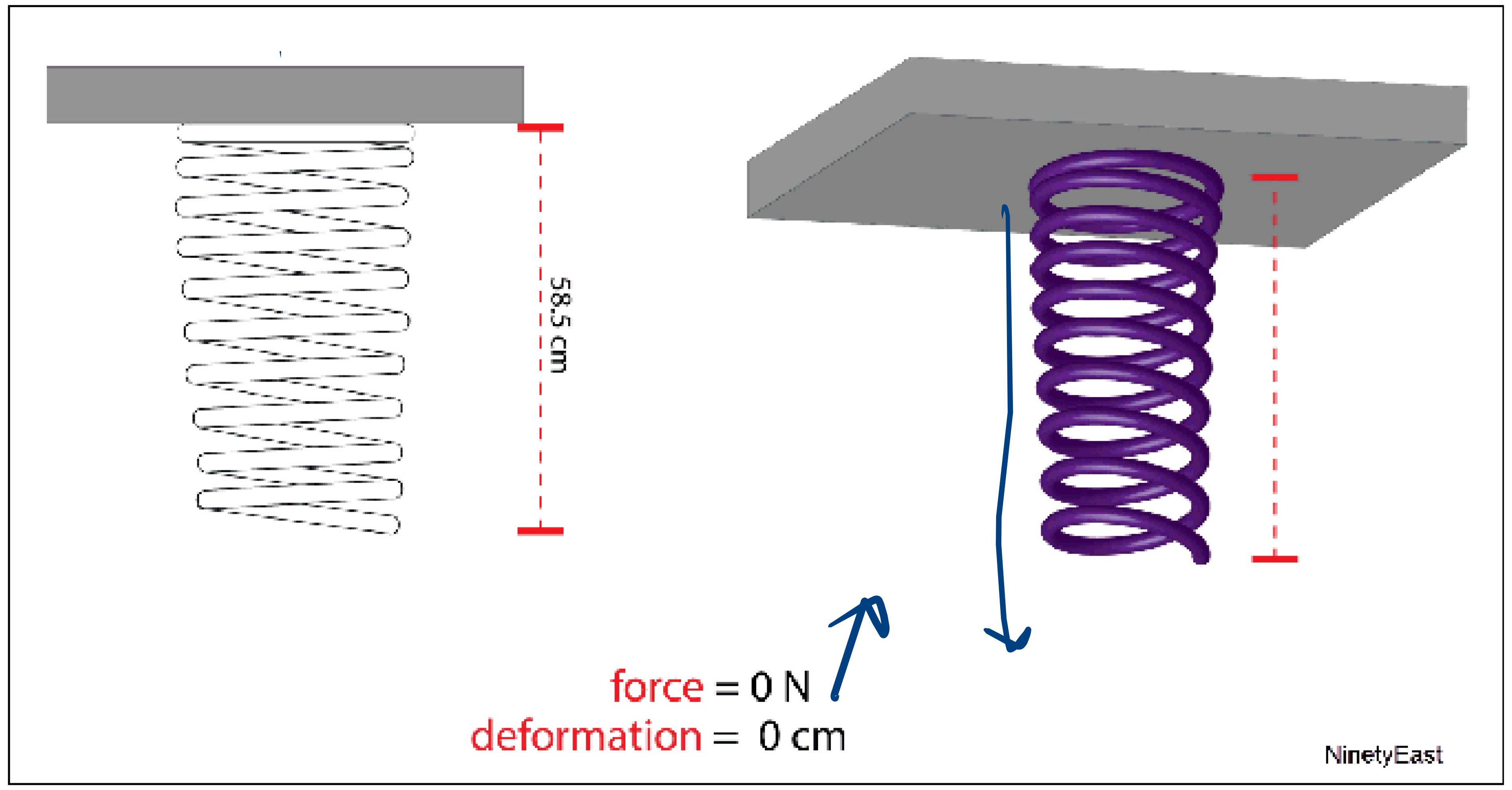
Where K is **the spring constant, F is the force and ℓ is the extension of the spring.**

When applying a weight to the spring then removing the weight the spring **returns to its original length**, we say that it shows **"Elastic behavior"**. التصرف المرن

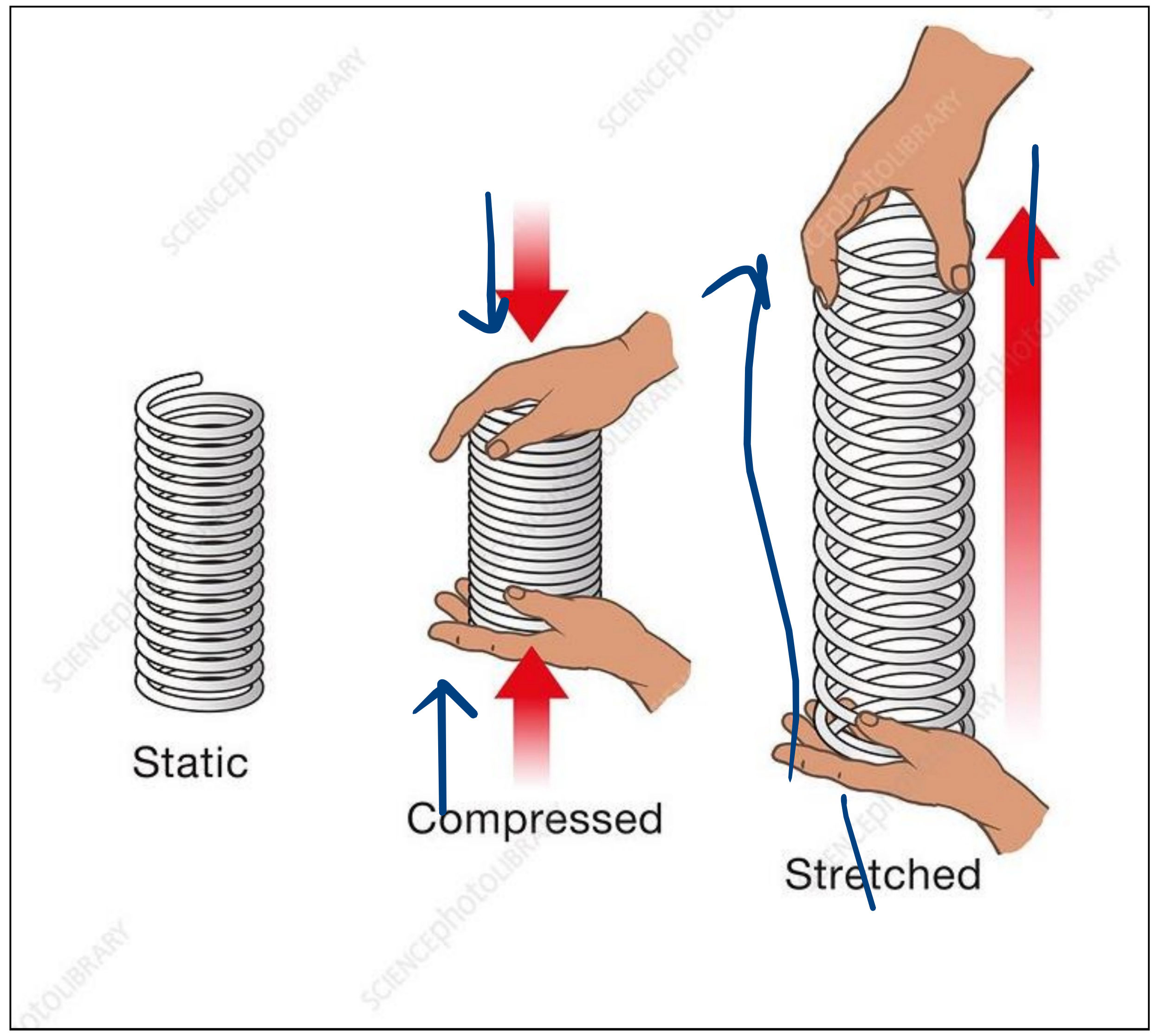
When applying a weight to the spring then removing the weight the spring **does not returns to its original length**, we say that it shows **"Inelastic behavior"**.

تصرف غير مرن





Relation between force and deformation



Compression and Stretching

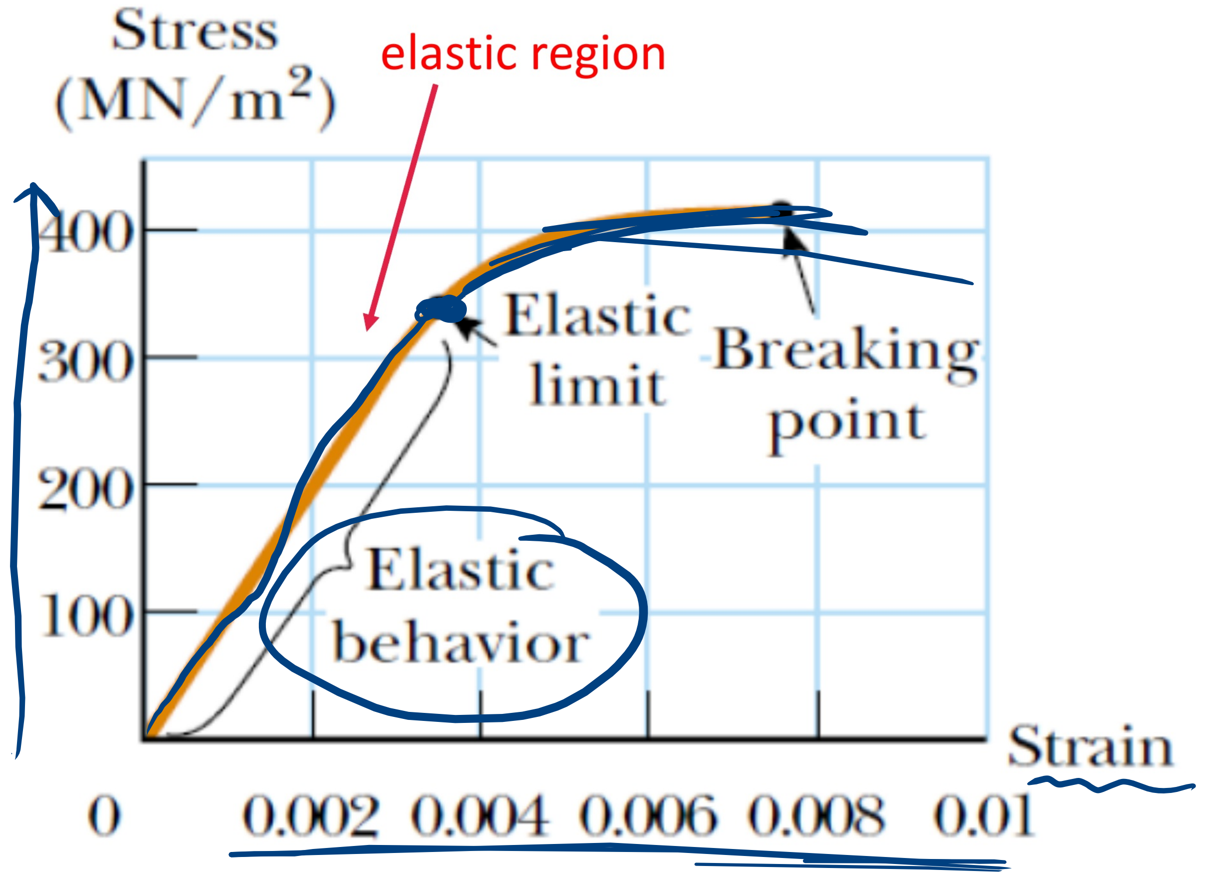
pressure → Amount of deformation

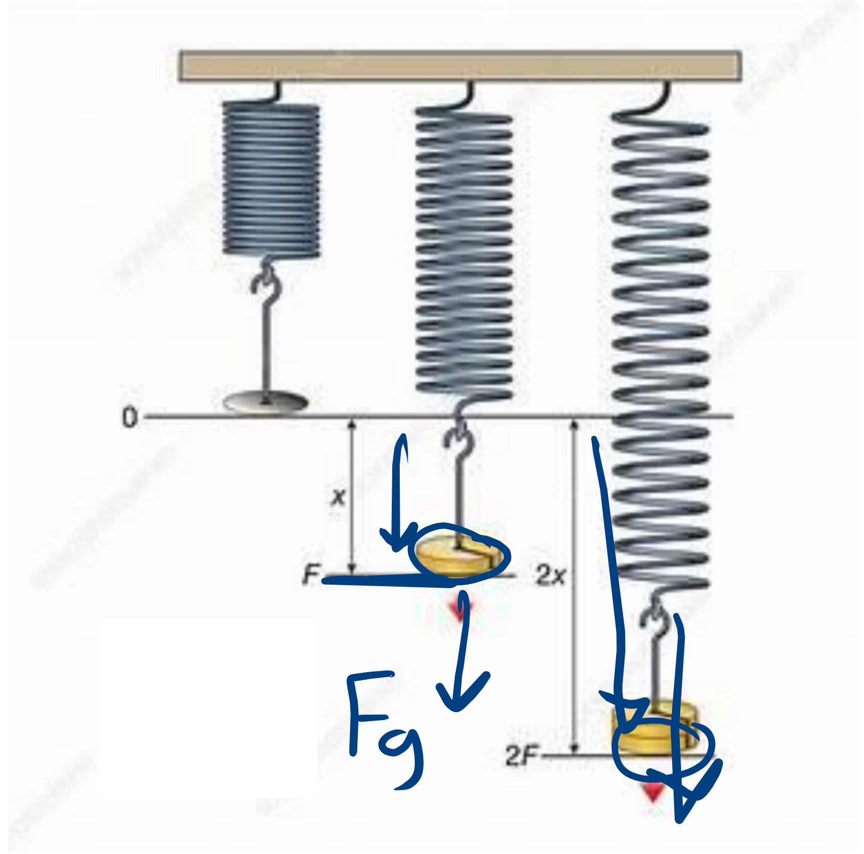
Stress = F / A, strain = $\Delta\ell / \ell 0$

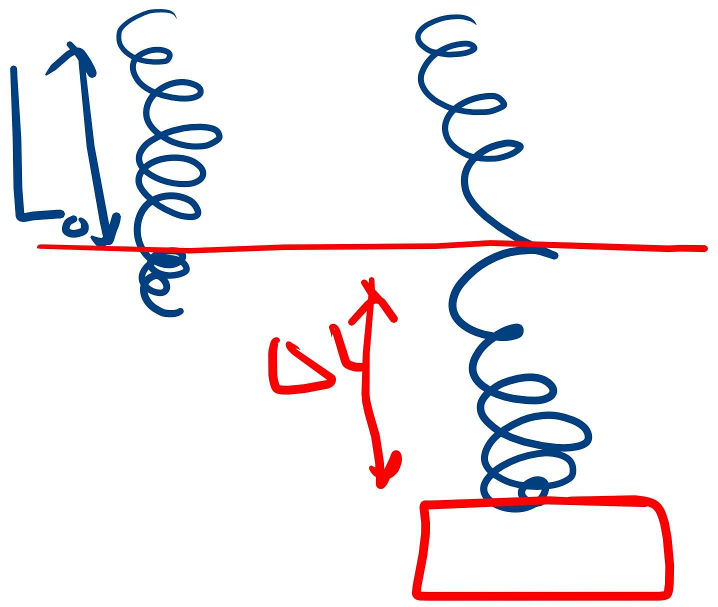
Hook's law (applied only in the elastic region):
"The Force (F) exerted by the string is proportional to the displacement (ℓ) of the free end from its position when the spring is in the relaxed state". =F

$$mg = k\,\Delta\ell$$

This is a straight line equation. **If plotting a relation between m (Y-axis) and $\Delta\ell$ (X-axis) and it becomes** a straight line **then Hooke's law will be verified.**



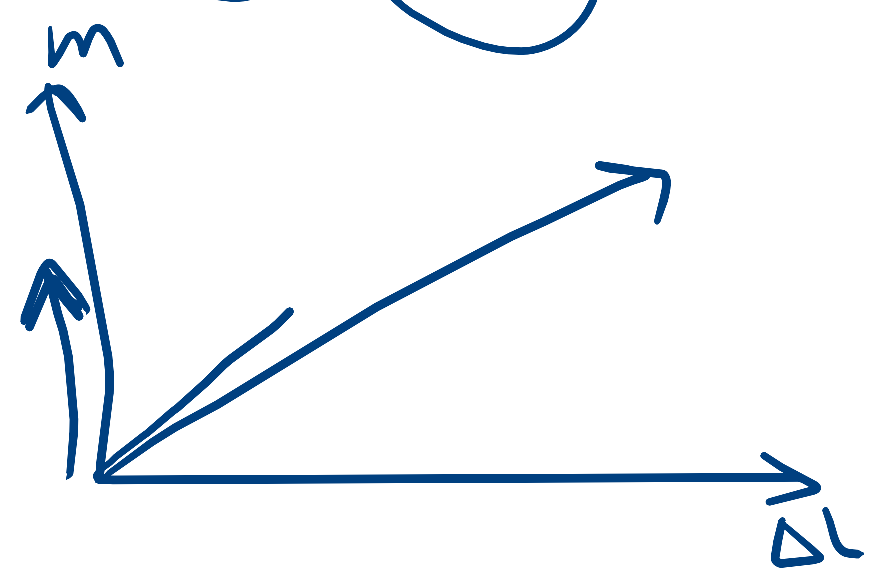




strain = $\frac{\Delta L}{L_o}$

$F_g = K\Delta L$

$mg = K\,\Delta L$



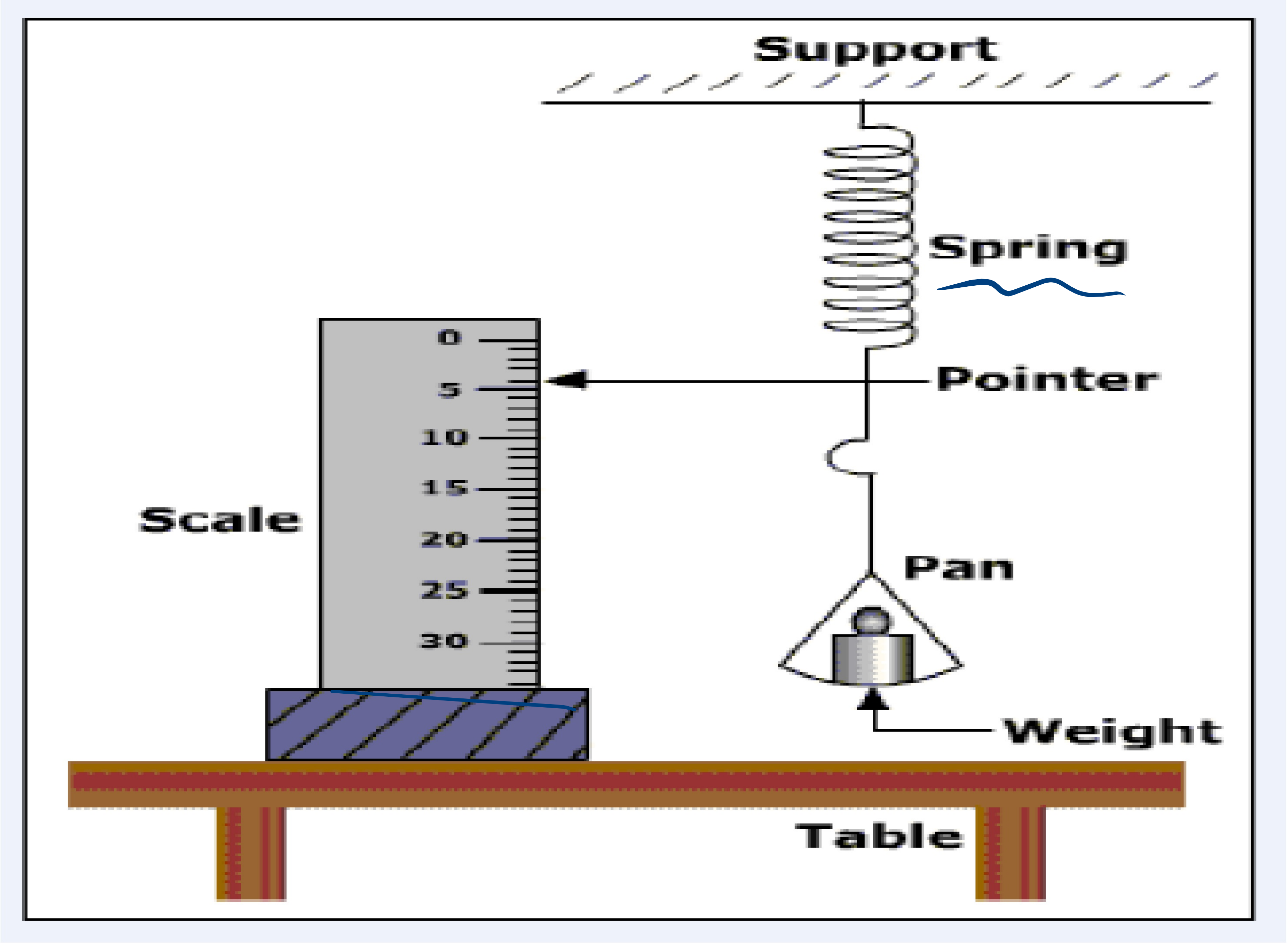
Open the link below to watch an interactive hooks’s law simulation.

https://phet.colorado.edu/sims/html/masses-and-springs/latest/masses-and-springs_en.html

Apparatus

Spiral spring- different weight masses - ruler -stand

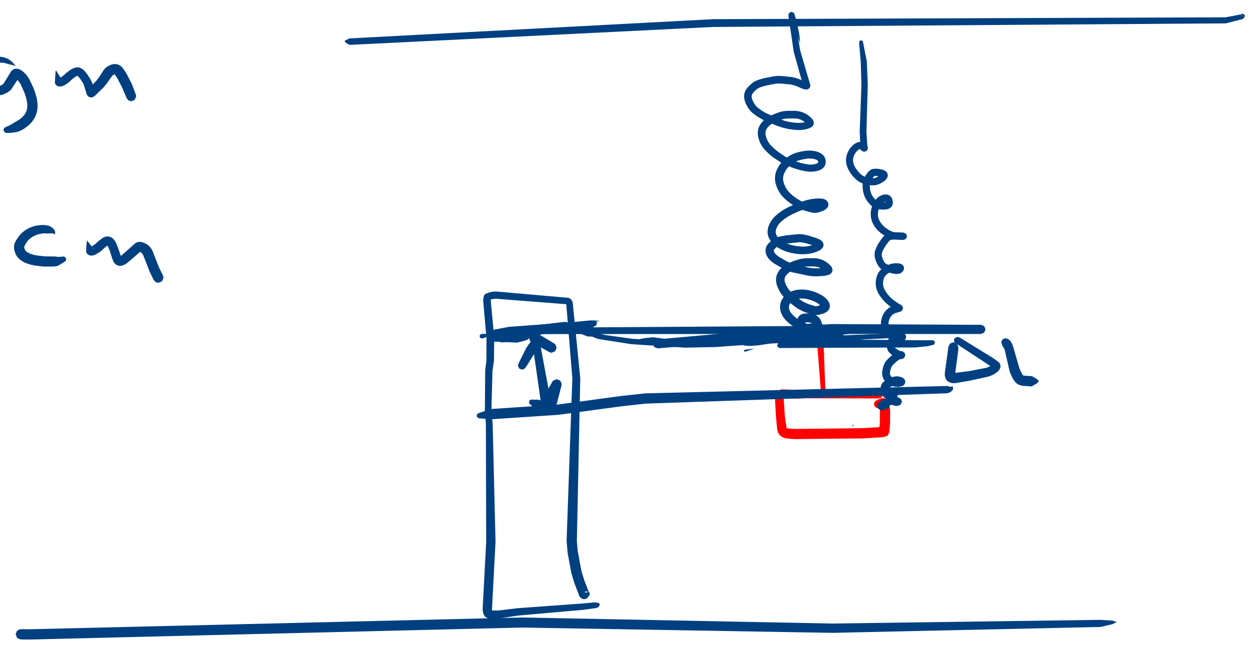
Scale - table ..



How to read a metric scale?

$m = 10gm$, $m = 20gm$

$\Delta l = 1cm$, $\Delta L = 2cm$



Method:

1. Adjust the index to the zero of the scale.
2. Suspend a mass *m* from the spring; determine the extension of the spring.
3. One after another suspend more masses, each time determining the new extension.
4. Record the extension $\Delta \ell$ each time.
5. Plot the relation between the extension (change of length) $\Delta \ell$ (x axis) and the mass *m* (y axis) then calculate the spring constant **k**, where:

$$k = g \,.\, slope$$

Results

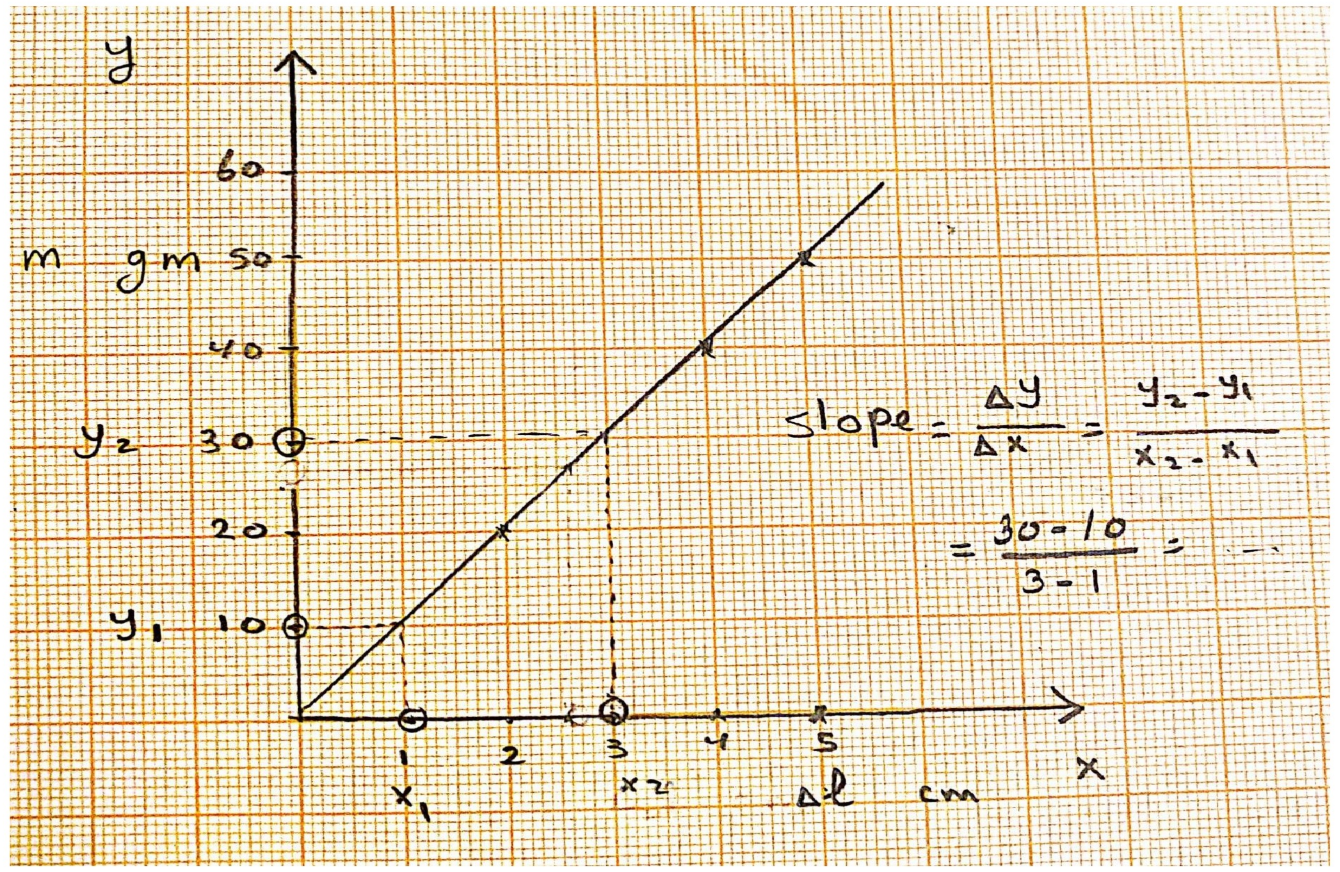
Zero reading ℓ_0 = ..3..... cm

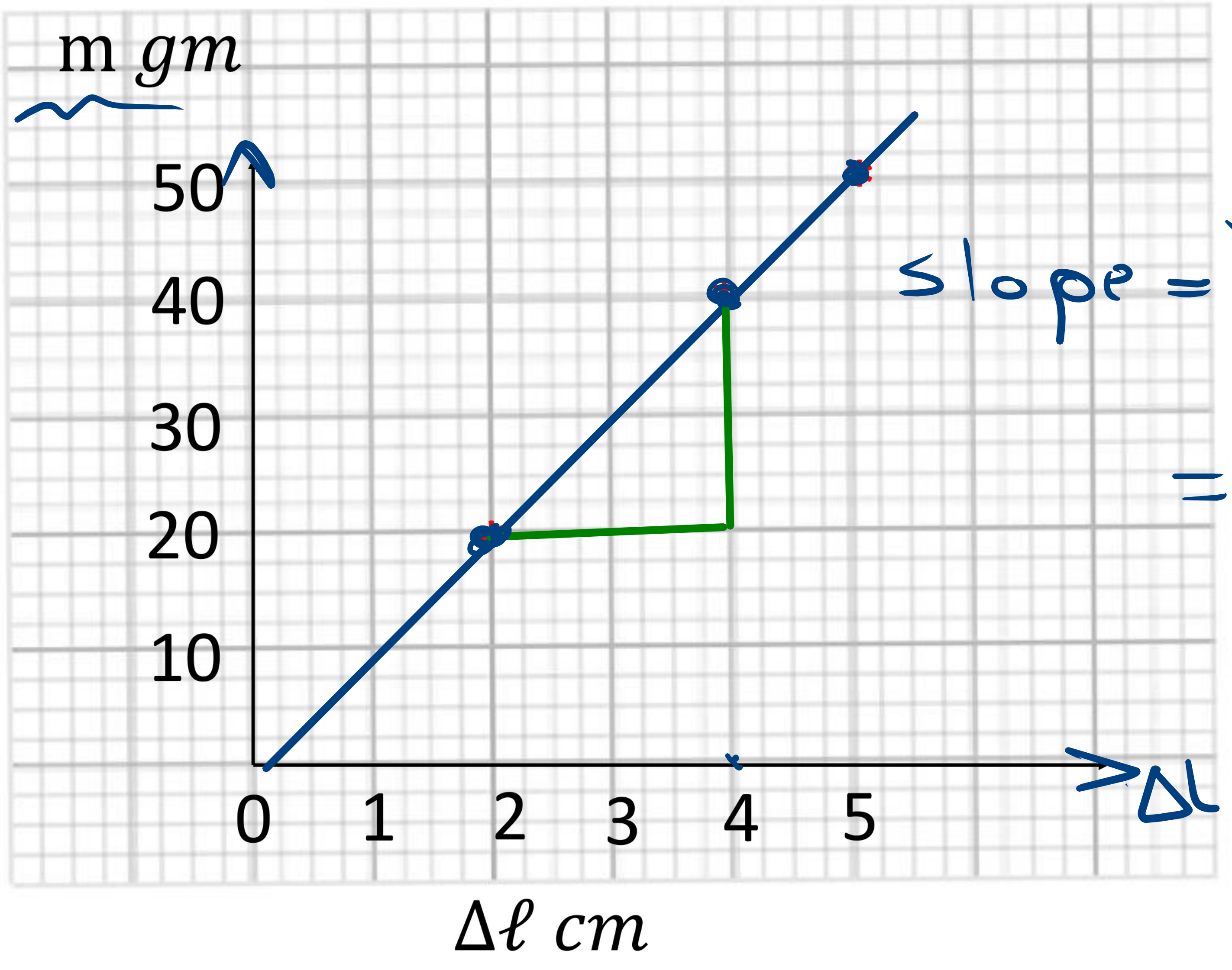
Slope = ...

g = 9.8 m/s2=980 cm/s2

k = g slope = ... dyne/cm

m (gm)	20	40	50							
$\Delta\ell$ (cm)	2	4	5							





$$slope = \frac{Y_2 - Y_1}{X_2 - X_1} = \frac{40 - 20}{4 - 2} = 10$$

Results

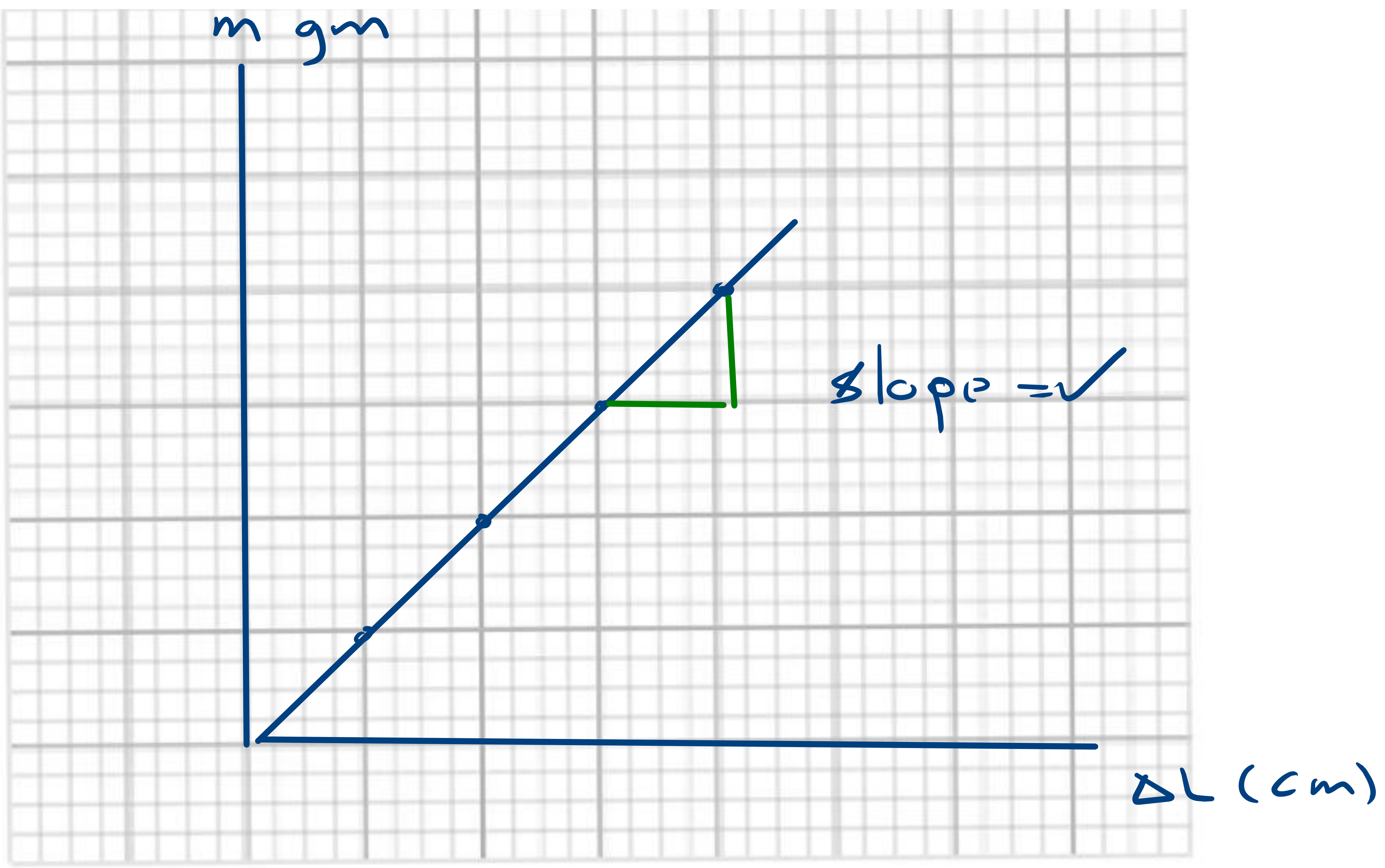
Zero reading $\ell 0$ = ……… cm

Slope = …………

g = 9.8 m/s2=980 cm/s2

k = g .slope = ……………dyne/cm

m (gm)									
$\Delta\ell$ (cm)									



Homework 1

$\Delta L = 25 cm = 25 \times 10^{-2} m$

$F = ?$

1. How much force is needed to pull a spring with a spring constant of 20 N/m a distance of 25 cm?

$F = K . \Delta L = 20 \times 25 \times 10^{-2} = 5 N$

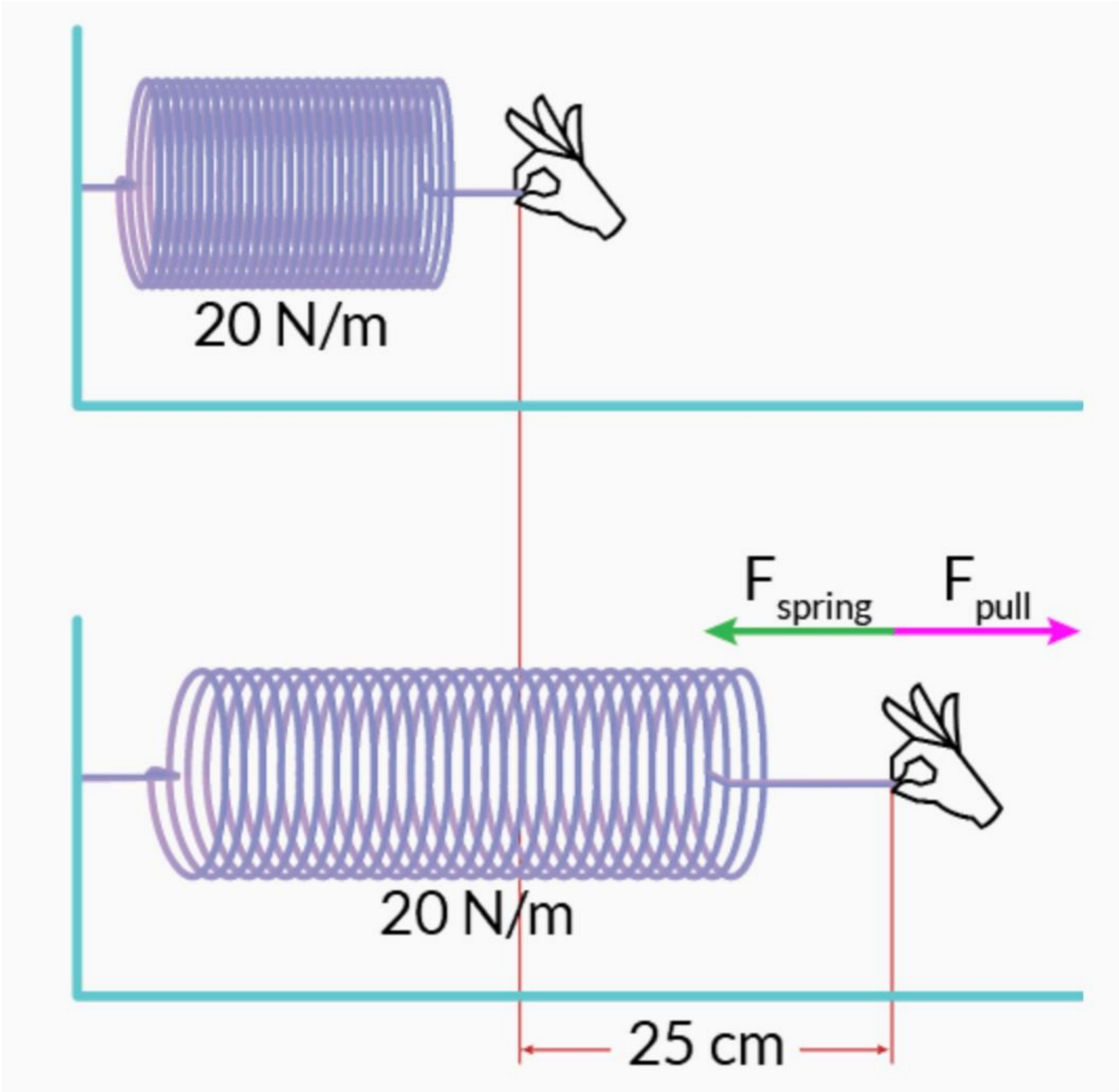
F = ...

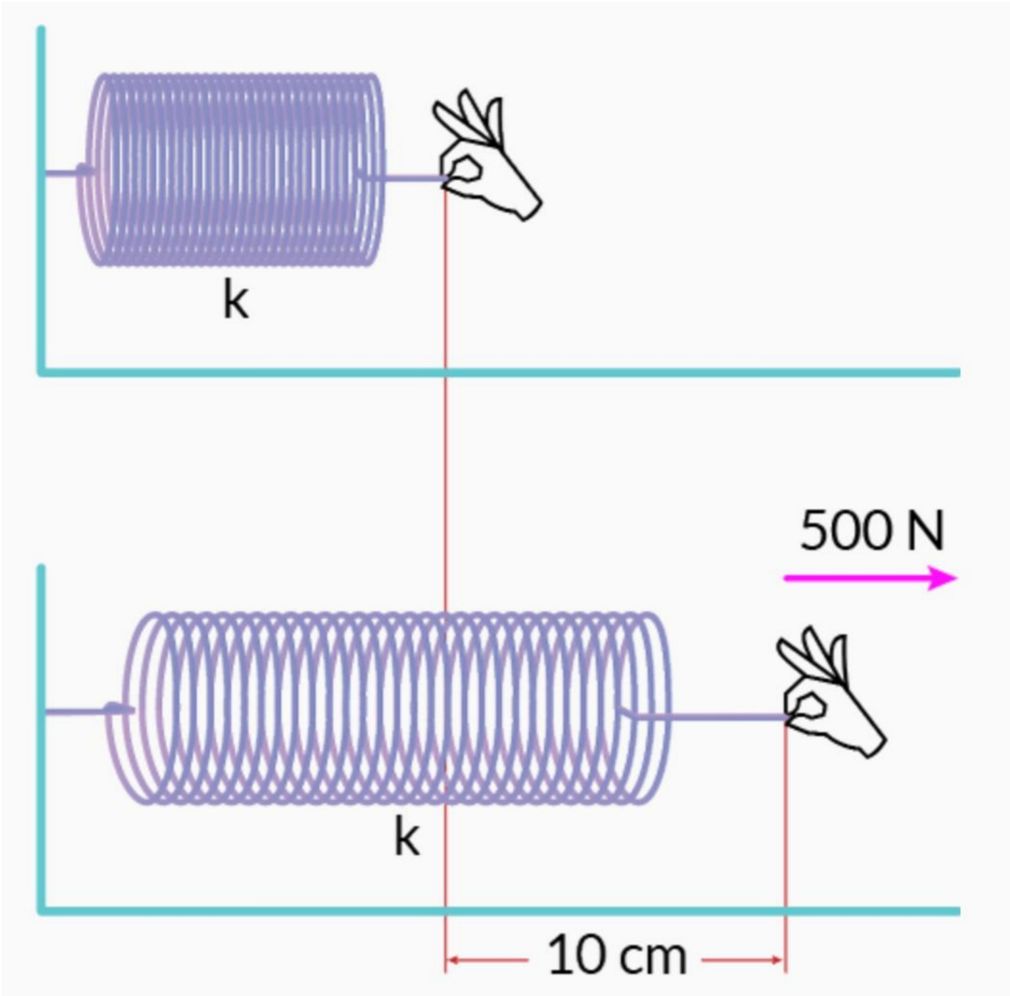
$F = 500 N$ $\Delta L = 10 cm = 10 \times 10^{-2} m$

2. A spring is pulled to 10 cm and held in place with a force of 500 N. What is the spring constant of the spring?

$\div \Delta L$: $F = K . \Delta L$ $\div \Delta L$

K = ... $K = \frac{F}{\Delta L} = \frac{500}{10 \times 10^{-2}} = 5 \times 10^{3} N/m$





IQ ACADEMY

Add here the recording experiment !!!

End of Hook’s law Experiment ..