**Name:** ____________________________

**Date:** ____________________________

**Mr. Rawson • Y9 MYP Physics**

# 1.2 – Hooke's Law

*Unit 1: Oscillations & Waves*

---

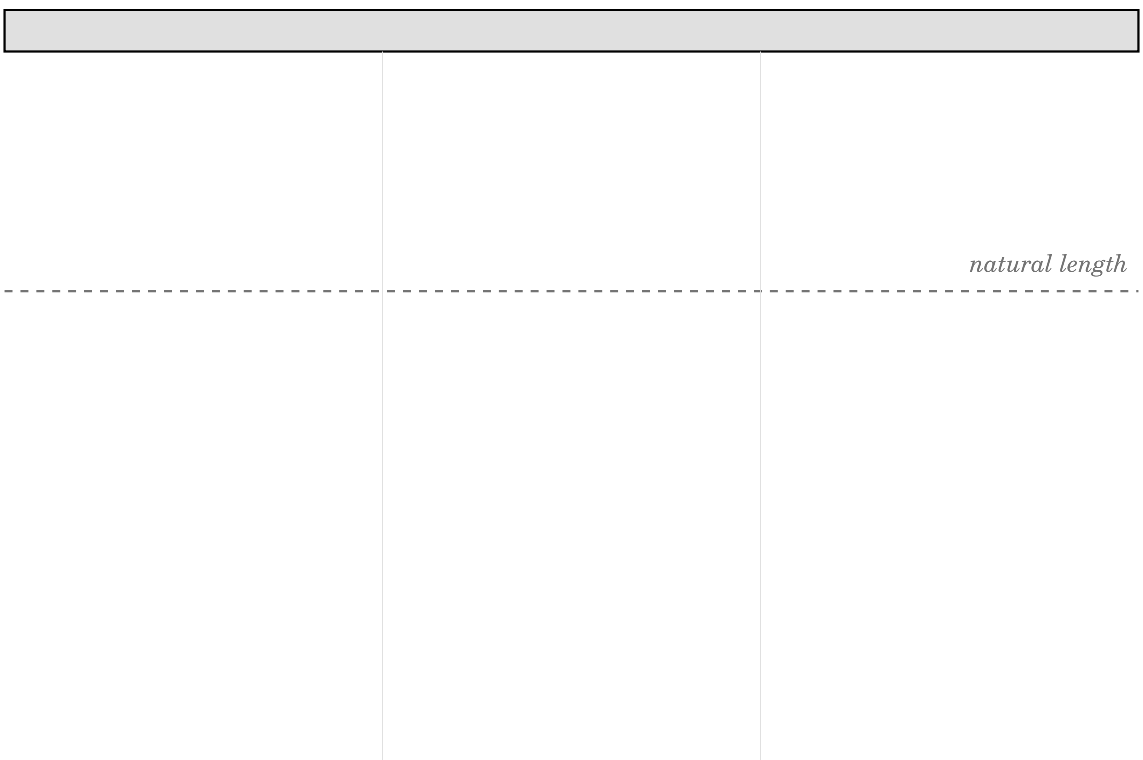
**The question:** *can we predict how far a spring stretches before we pull it?* Last lesson you learned to **model** — you drew the pendulum and made the physics visible on paper. Today the model is the starting point, not the finish. You will draw the spring in front of you, then go and **collect the data** that turns your drawing into a rule you can trust: measure, tabulate, plot. Nobody is going to tell you the answer — your data is the answer.

## Part 1 — Model the spring

**1)** **Draw** the *same* spring in each of the three lanes: with no mass on it, with one mass, and with three masses. The ceiling and the dashed line are printed for you — everything hanging below them is yours to draw. Show the spring, the hanger and the masses, and the force arrows acting on the mass, each labelled.

The dashed line is the **natural length** — where the bottom of the spring sits with nothing on it. Every extension you measure today is counted from that line, not from the ceiling and not from the bench. Mark on your drawing *exactly* where on the spring you will read from, and read from the same place every time.

| 1 | 2 | 3 |
|---|---|---|




| **no mass** | **one mass** | **three masses** |
|---|---|---|
| extension = _________ cm | extension = _________ cm | extension = _________ cm |

**Name:** ______________________________ **Date:** ______________________

## Part 2 — Variables

Every investigation has three kinds of variable. Name yours before you touch the apparatus.

**2) Independent** — the one you **change on purpose**, one step at a time. What will you change?

**3) Dependent** — the one you **measure** each time you change the independent variable. What will you measure?

**4) Control** — the ones you **keep the same** so the test stays fair. Name two, and say why each one would spoil your results if it changed.

Name: ______________________________ Date: ______________________

## Part 3 — Collecting the data

**Method**

1. Measure the spring's **natural length** — nothing hanging on it — and write it above its table.
2. Add masses **one at a time**; each 100 g pulls with about **1 N**. Measure the **total length** each time and work out **extension** = **total length** − **natural length** straight away.
3. Six readings, then **change spring**. Row 1 is your check — no mass, no extension. **Stop adding masses** if the coils stay apart.

**Safety:** eye protection on; feet clear of the masses.

**Spring 1** natural length = __________ cm

| Mass added / g | Force / N | Total length / cm | Extension / cm |
|---|---|---|---|
| 0 | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

**Spring 2** natural length = __________ cm

| Mass added / g | Force / N | Total length / cm | Extension / cm |
|---|---|---|---|
| 0 | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

**Spring 3** natural length = __________ cm

| Mass added / g | Force / N | Total length / cm | Extension / cm |
|---|---|---|---|
| 0 | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Name: ______________________________ Date: ______________________

## Part 4 — The graph

**5) Plot all three springs on the same grid** — force on the horizontal axis, extension on the vertical axis. Choose scales that use most of the grid and write your values along each axis. Use a different mark for each spring ($\times$, $\bullet$, $+$) and label them 1, 2, 3, then draw a straight **line of best fit** through each set with a ruler — do not join the dots.


**Extension**

Your springs are a Pasco *Equal Length Spring Set*. The maker states that each spring is **25**, **30**, **35**, **40** or **50** N/m, accurate to within $\pm 5\,\%$.

**Does your data prove it?**

## Part 5 — Homework: the same model, built by a machine

**HOMEWORK**

You built a line of best fit by eye. Now make a spreadsheet build one from the same numbers, and see whether the machine agrees with you.

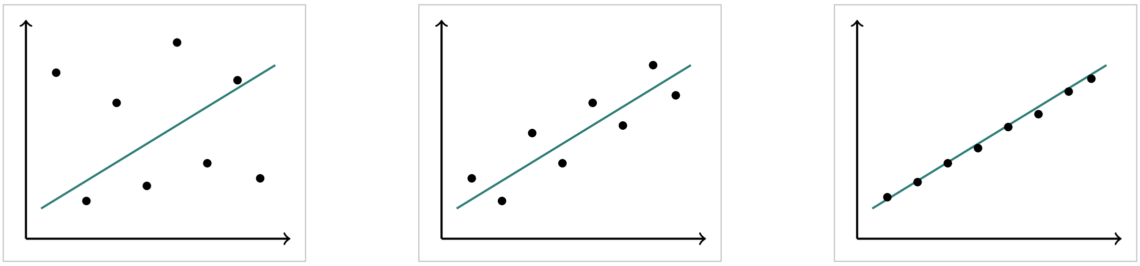
1. Open a new spreadsheet. Type two column headings: `Force (N)` and `Extension (cm)`, and type in the readings for **one** of your three springs.
2. Select both columns and **insert a chart**. Choose a **scatter** chart — points only, no joining lines.
3. Add a **trendline** — the spreadsheet's name for a line of best fit.
4. Write one sentence: does the trendline agree with the line you drew by hand? If it does not, which do you trust, and why?

**Hand in:** the chart, with your sentence underneath it.

## Part 6 — Conclusion

**Describe:** Give a detailed account or picture of a situation, event, pattern or process.

**Correlation** is how closely the points follow the line. It is not the same as the steepness — a gentle line can be followed very closely, and a steep one can be a mess. These three sets of data all have a line through them; only the last one has the points *sticking to* it.



**weak** **moderate** **very strong**

**6) Describe** the mathematical relationship between force and extension for an ideal spring. Say what *shape* the relationship is, what happens to the extension when the force doubles, and how strong the correlation is — use your own graph as the evidence.

**7) Predict** the extension for a force you did *not* test, using your line of best fit. Show on the graph how you read it off.

**8) Compare** your three lines. What is the same about all three, and what is different? What does the *steepness* of a line tell you about that spring?