Chapter 5. Forces and Matter

Contents:

New word list:

Core

1 Know that forces may produce changes in the size and shape of an object

2 Sketch, plot and interpret load–extension graphs for an elastic solid and describe the associated experimental procedures

3 Determine the resultant of two or more forces acting along the same straight line

Supplement

9 Define the spring constant as force per unit extension; recall and use the equation

$$k = \frac{F}{x}$$

10 Define and use the term 'limit of proportionality' for a load–extension graph and identify this point on the graph (an understanding of the elastic limit is **not** required)

11 Recall and use the equation $F = ma$ and know that the force and the acceleration are in the same direction

1.8 Pressure

Core

1 Define pressure as force per unit area; recall and use the equation

$$p = \frac{F}{A}$$

2 Describe how pressure varies with force and area in the context of everyday examples

3 Describe, qualitatively, how the pressure beneath the surface of a liquid changes with depth and density of the liquid

Supplement

4 Recall and use the equation for the change in pressure beneath the surface of a liquid

$$\Delta p = \rho g \Delta h$$

5.1 Forces acting on solids

Forces can change the ( ) and ( ) of an object.

stretched	compressed	bent	twisted
（拉长）	（压缩）	（弯折）	（扭转）

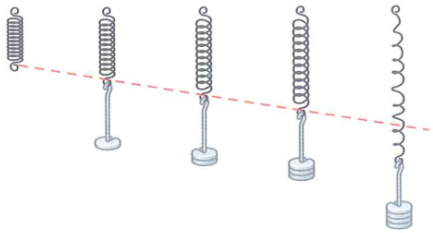
What will the object do when the external forces are removed?

1. Plastic materials (less springy):

2. Elastic materials (springy):

5.2 Stretching springs: Hooke's Law

What will happen when I add loads on the spring balance and then remove them? What will the length change when I keep adding loads on the spring?



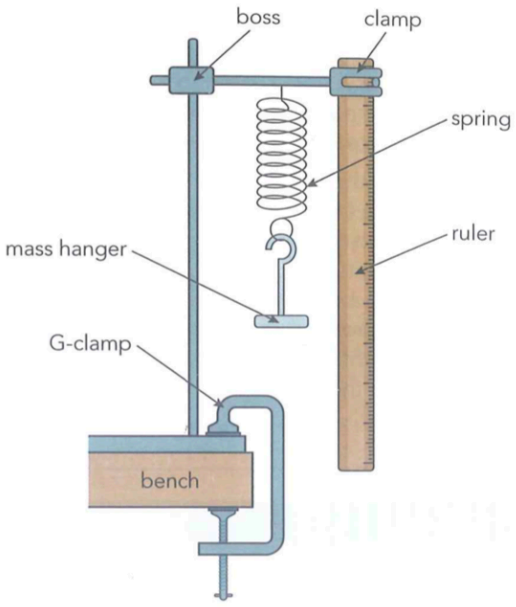
Experiment: Investigating springs

- Extension of a spring:

- Apparatus:

You will need:

- eye protection
- clamp stand, boss and clamp
- spring
- hanger with slotted masses
- G-clamp
- ruler
- plumb line (a piece of thread with a lump of metal on the end).



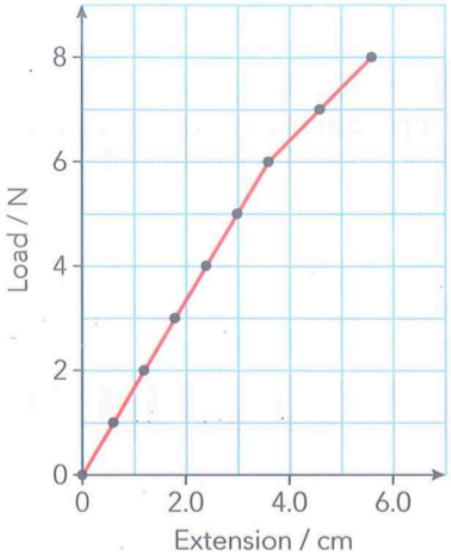
- What is independent(input) and dependent(output) variables?

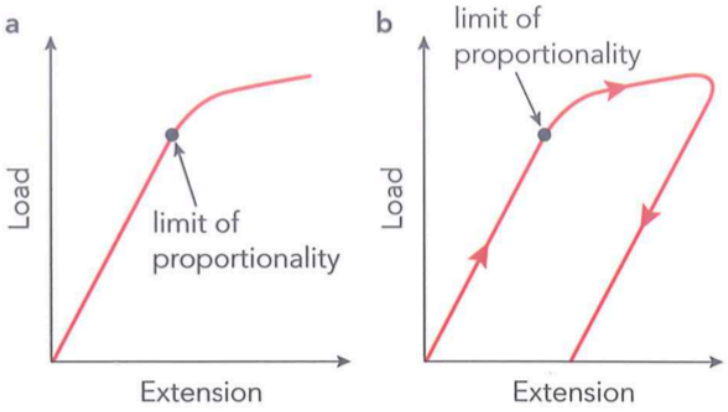
- Recoding table:

Load on hanger / N	Ruler reading / cm	Spring extension / cm	Does the spring return to original length when unloaded? Y/N

- How to plot the graph?

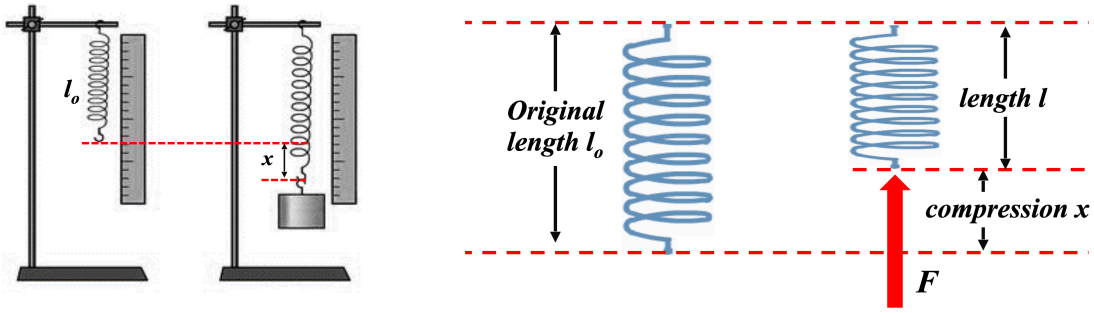
At least 6 sets of readings
Draw axes and choose suitable scales
Plot points shown as crosses
Draw a best-fit line
(The points should be scattered equally about the line)
Find the intercept and gradient of the graph





Limit of proportionality:

Elastic limit:



Within the limit of proportionality: **Hooke's Law:**

k:

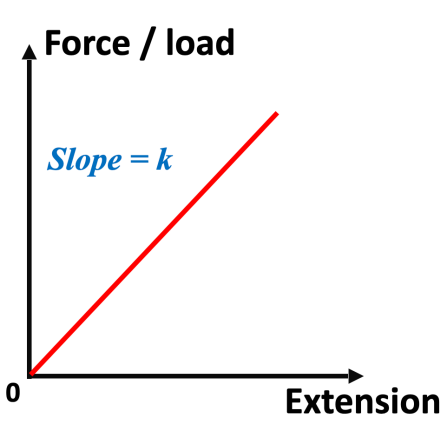
Exercise 5.a

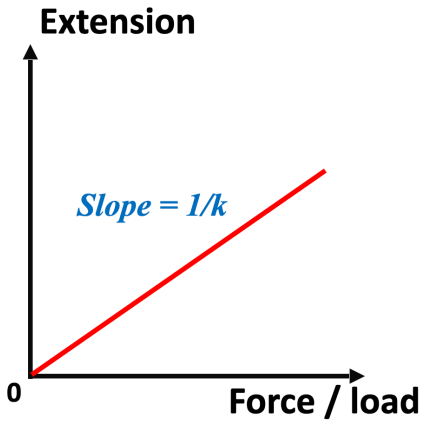
A spring with a natural height of 57 mm is compressed by a 300 g mass to a new height of 51 mm. (g=10 m/s2)
(a) Find the spring constant.
(b) Find the length of the spring if the 300 g mass were replaced by a 400 g mass.

Exercise 5.b

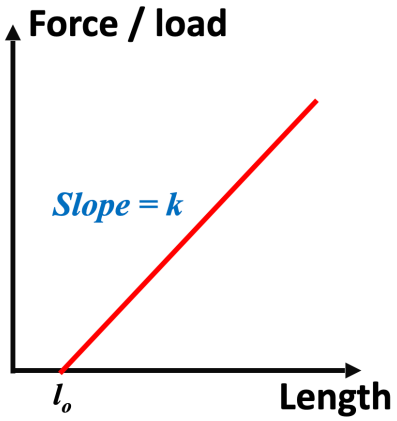
Exercise book structure questions(sq): P104 4

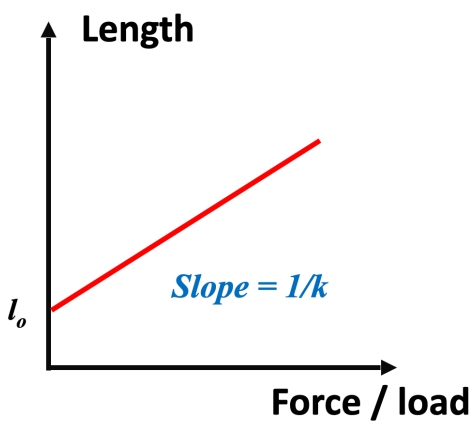
Other graphs:
Load-extension:





Load-length:





5.3 Pressure

Definition of **pressure**:

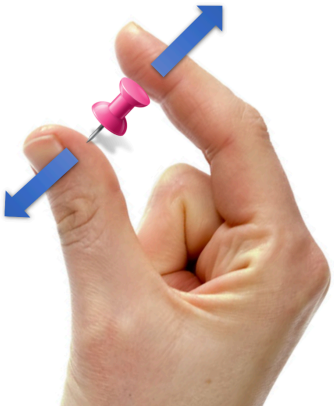
Equation:

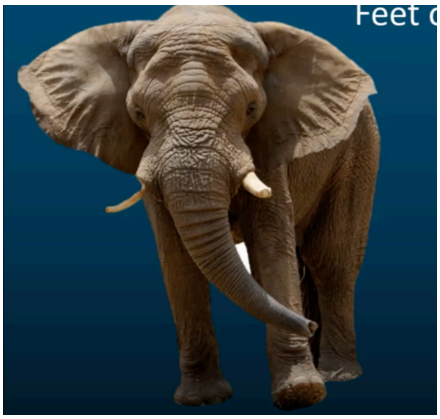
Unit:

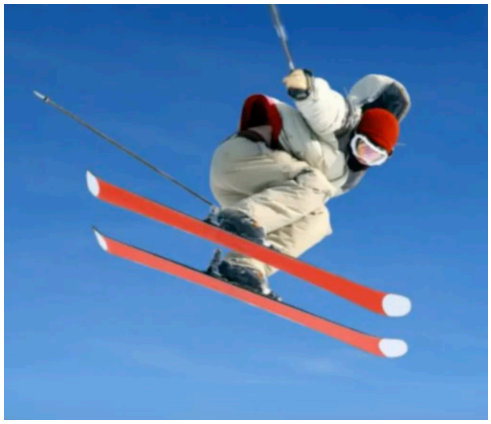
Factors that affect the pressure acting on a surface:

directly proportional vs **inversely proportional**

Which of the situations in everyday life are the applications of **high pressure**? Which are applications of **low pressure**?

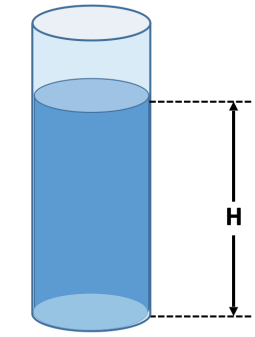






5.3.1 Pressure in the liquid

Where does pressure in liquid come from? Calculate the pressure exerted by water to the bottom



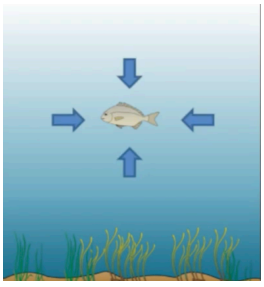
Basal area is A

Pressure in liquid:

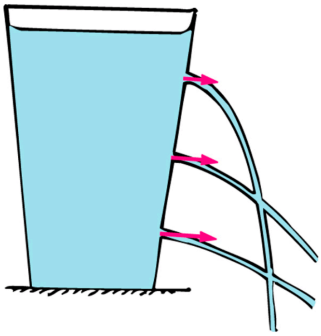
Change in pressure:

1. Pressure in liquid doesn't depend on the shape of the container

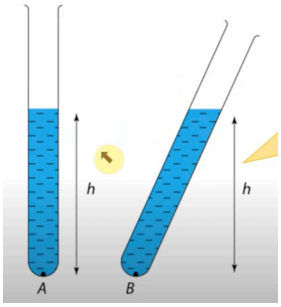
2. Pressure at any same-depth point in liquid acts equally in all directions.



3. The pressure in liquid increases with depth.



4. The pressure depends on the vertical depth of the liquid.



Liquid pressure summary

Pressure increases with depth
Pressure depends on the density of liquid
Pressure doesn't depend on the shape of the container
Pressure acts in all directions
Pressure at a given depth is the same in all directions

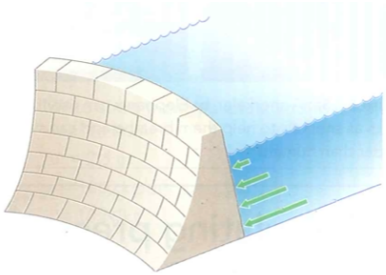
Exercise 5.c

Explain the following situations

a. Why submarine needs to be made by extra tough materials?
b. Why the dam is thickest near its base?

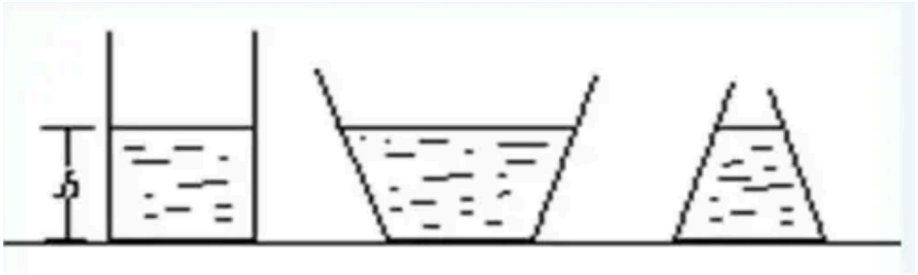
Exercise 5.d

Calculate the pressure on the bottom of a swimming pool that is 2.5 meters deep. How does the pressure compare with atmospheric pressure 100000Pa?



Exercise 5.e

Which of the following liquid has the largest pressure on the bottom?
Which of the following container has the largest pressure on the table?



5.3.2. Pressure in the air:
Where do you think atmospheric pressure comes from? How can you prove it exist?

The atmospheric pressure changes accordingly to the **altitude**. Altitude is the height above the ( ).
The greater the altitude, the ( ) the atmospheric pressure.
The atmospheric pressure acts on every object in the atmosphere. It acts ( ) in ( ) directions.