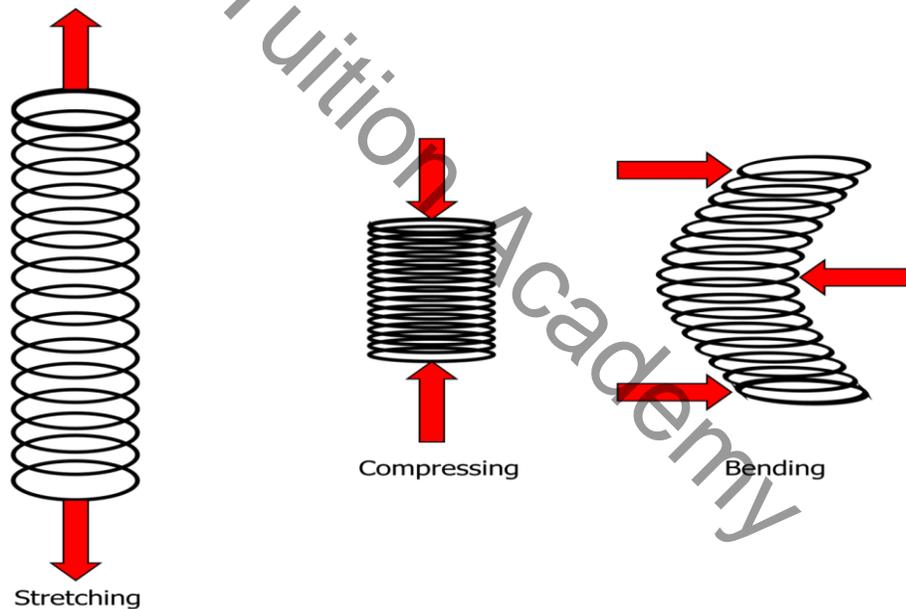


Forces and Elasticity

- Elasticity and forces are closely related because forces can cause objects to change shape, and the ability of an object to return to its original shape after being deformed by a force is related to its elasticity
- When forces applied to an object may be stretching, compressing or bending.
- To change the shape there are more than one forces that applied on the object, otherwise with one force only object can move in the direction of applied force.
- Work is done when a force stretch or compress the object which cause energy transfer to **elastic potential energy**



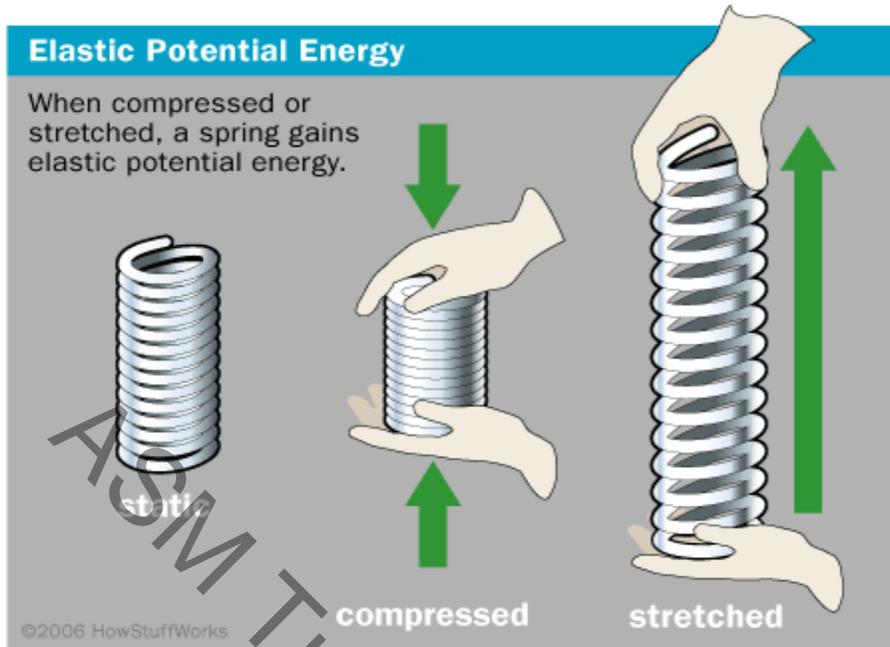
Types of Deformation of object:

- 1- Elastic Deformation
- 2- In elastic Deformation

1- Elastic Deformation:

- This is the temporary deformation of material's shape. When force is removed, material gets back to its original shape.

- Example: Spring



2- In Elastic Deformation:

- Inelastic deformation (also called plastic deformation), occurs when a material is deformed so much that it cannot return to its original shape.
- Example: Crumpling of paper sheet



Forces and Elasticity

➤ Extension is directly proportional to the applied force → more force applied get more extension. $F \propto e$

➤ Equation: $F = kE$ Where $F =$ force, $K =$ spring constant and $E =$ extension

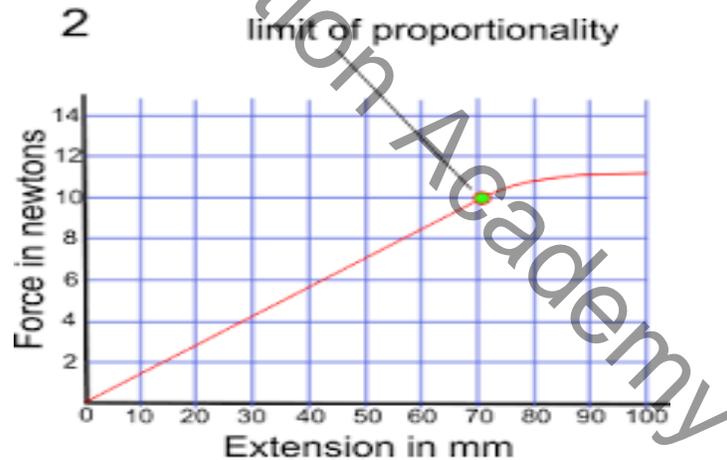
➤ K spring constant depend on material stretch ability.

Stiffer object = more Extension

➤ This equation works same for compression. More force = more compression

➤ **But it stops working when force is much enough. As shown in diagram**

➤ The maximum force above which graph curve showing extension is no more proportional to force → this point called **limit of proportionality**

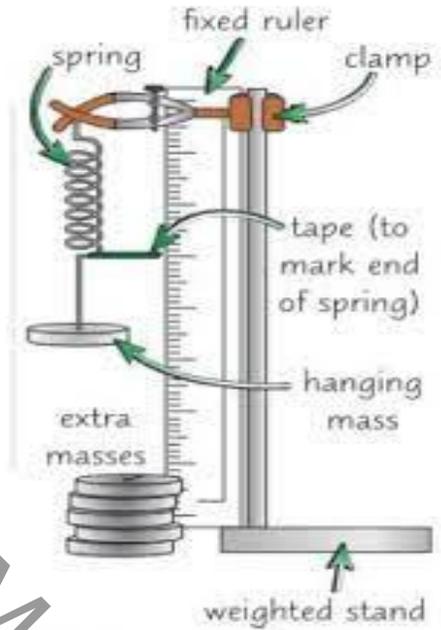




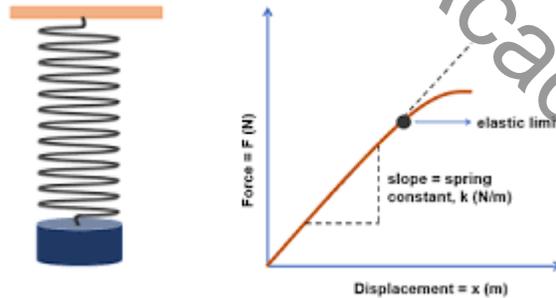
Relationship between force and extension

Method:

1. Set up the apparatus as shown in the diagram. Hang a spring from the clamp and boss and secure it so that it will not fall off
2. Secure the meter rule vertically to the clamp, using the set square to ensure it is straight and place it adjacent to the spring
3. Record the meter rule reading at the bottom of the spring and place a fiducial marker on this point. This is its original length before any masses are hanging from it (no load)
4. Hang a mass hanger from the bottom of the spring. Record the new metre rule reading, the number of masses and the extension of the spring
5. Add another mass. Record the new metre rule reading, the number of masses, and the total extension of the spring from its original length
6. Repeat this until after the spring has become permanently stretched
7. Repeat the experiment for the rubber band and the polythene strip.



Plot a graph of force and extension results



- When force is direct proportional to extension there is a straight line shown in graph → linear relationship between force and extension
- After elastic limit (when excess force applied) there is bending of graph shown in graph → non-linear relationship between force and extension.

Calculate the work out energy stored for linear relationships

- For elastic deformation: Using the Formula we can calculate the energy store in **spring elastic potential energy**

$$E = \frac{1}{2} ke^2$$

- The energy store in spring elastic potential energy of stretched spring is equal area under the force extension graph

