Deformation of solid 2

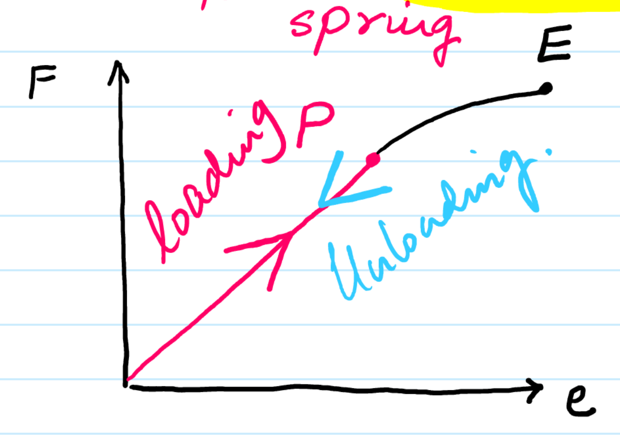
09 December 2020 08:29

Behaviour of Springs beyond the Limit of proportionality (P)

- Hooke's Law only applicable till the Limit of proportionality ∴ graph will no longer be a straight Line
- The graph will start bending towards the extension axis which indicates that after the Limit of proportionality is exceeded, a small force produces a much larger extension
- If the material is stretched further, a point known as Elastic Limit (E) is reached. Elastic Limit is the furtherest point until which the material exhibits ELASTIC DEFORMATION i.e it regains its true size once the force is removed; but if the material goes past the Elastic Limit (E), it experiences a permanent extension known as "plastic deformation". This term implies that even if the force is removed completely, the material is no longer able to achieve its original size

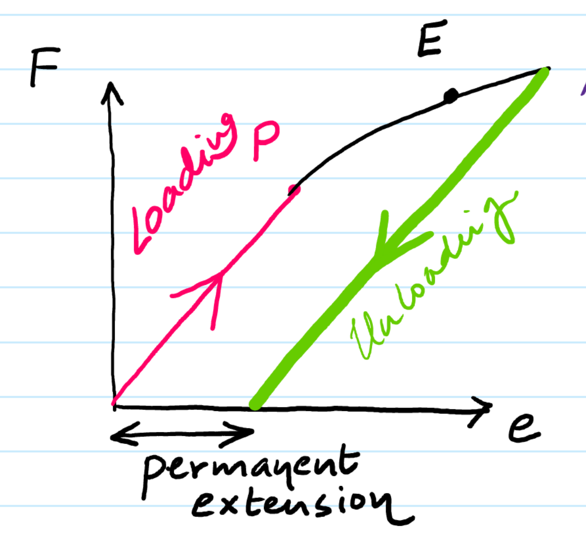
LOADING :: We use the term "Loading" to signify that force is applied on a spring.

Unloading or Deloading [reverse] :: when force is Removed from a spring



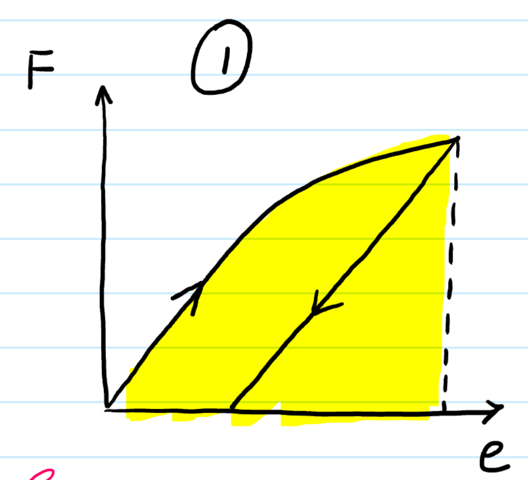
ELASTIC DEFORMATION

Loading & Deloading follows the same pattern b/c. there is "no" permanent extension

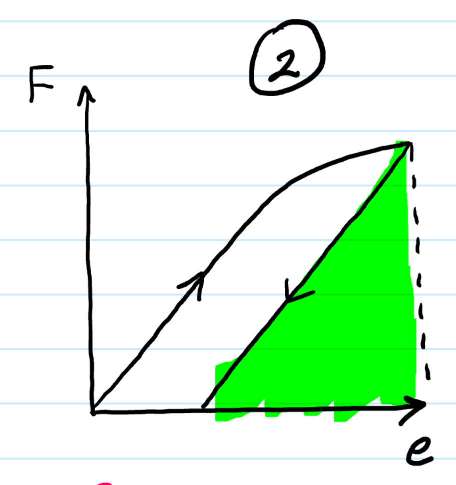


PLASTIC DEFORMATION

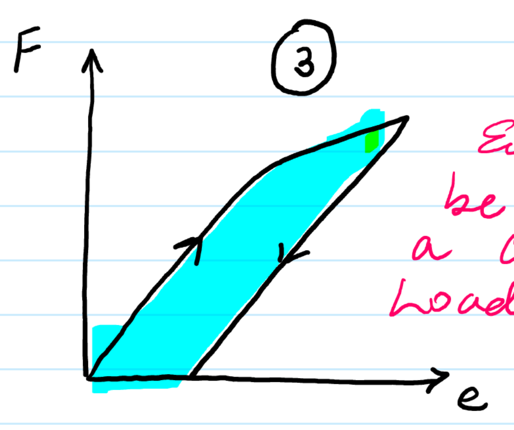
Loading & Deloading follows different pattern b/c there is permanent extension



Energy stored in the material during Loading.



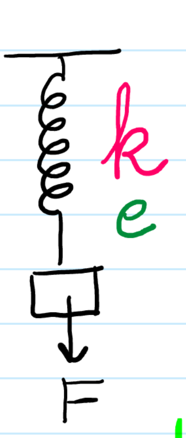
Energy recovered during Deloading.



Energy that cannot be recovered during a complete cycle of Loading-Deloading / Energy dissapated as heat / Energy Lost etc.

Arrangement of Springs (identical) in SERIES & PARALLEL COMBINATION

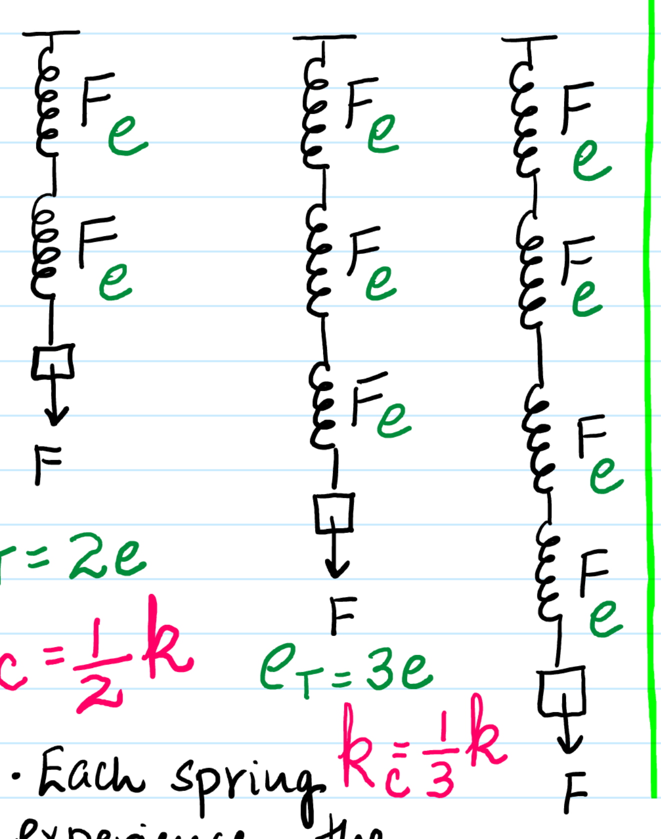
Reference



$F = ke$

e & k are Inversely prop.

Series



$e_T = 2e$

$k_c = \frac{1}{2}k$

$e_T = 3e$

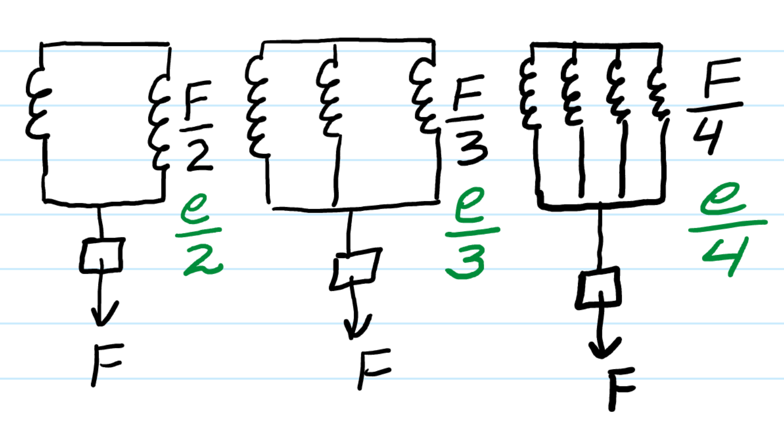
$k_c = \frac{1}{3}k$

$e_T = 4e$

$k_c = \frac{1}{4}k$

- Each spring experiences the same force
- Total extension in Series is always the sum of the individual extensions

Parallel



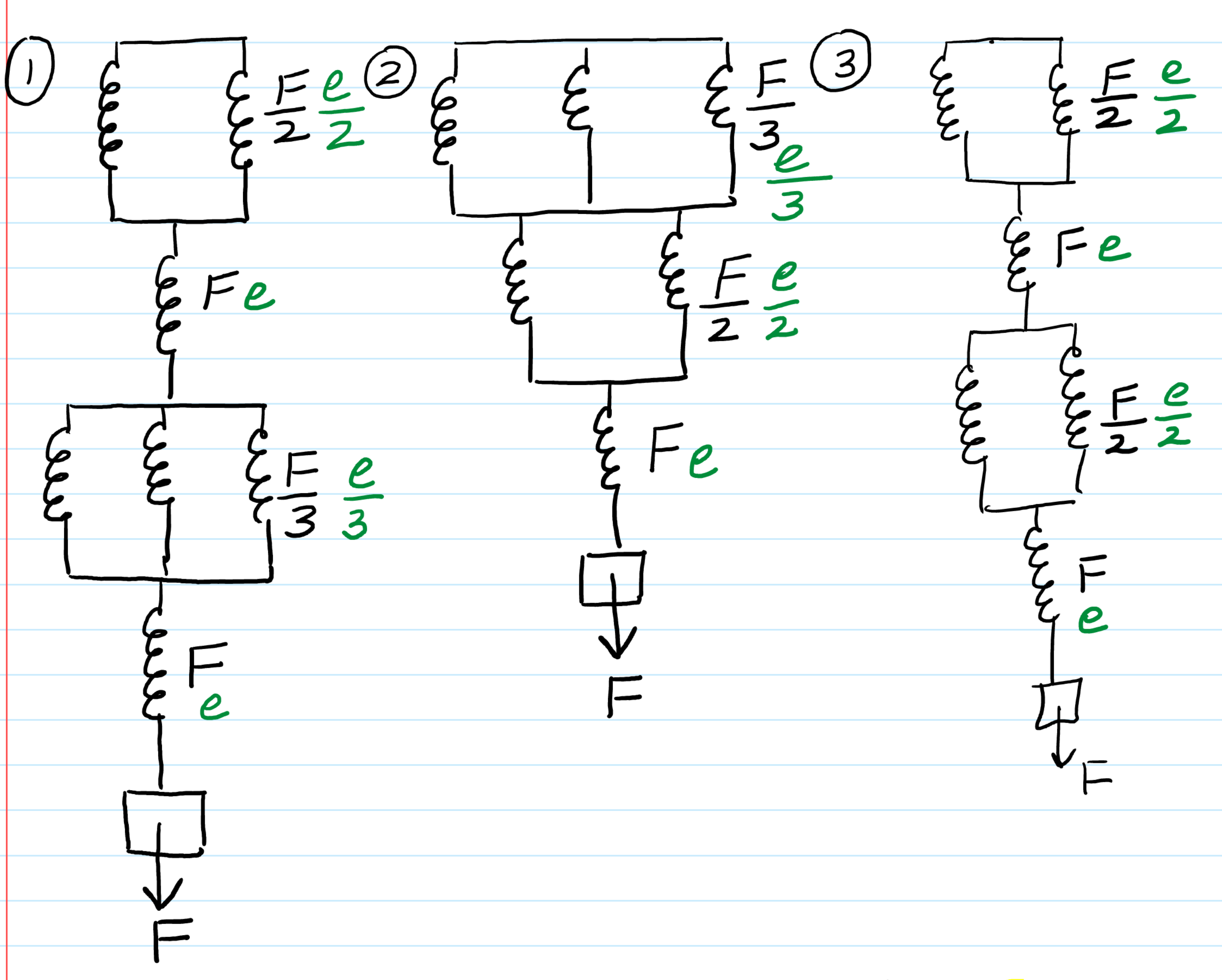
$e_T = \frac{e}{2}$ $k_c = 2k$

$e_T = \frac{e}{3}$ $k_c = 3k$

$e_T = \frac{e}{4}$ $k_c = 4k$

Force in Parallel gets divided equally

- Total extension is the same as the extension of any one spring



Find total extension and combine Spring constant for the following arrangements. (giving your answer in terms of e & k).

$e_T = e + \frac{e}{3} + e + \frac{e}{2}$

$e_T = \frac{17}{6}e$

$k_c = \frac{6}{17}k$

$e_T = e + \frac{e}{2} + \frac{e}{3}$

$e_T = \frac{11}{6}e$

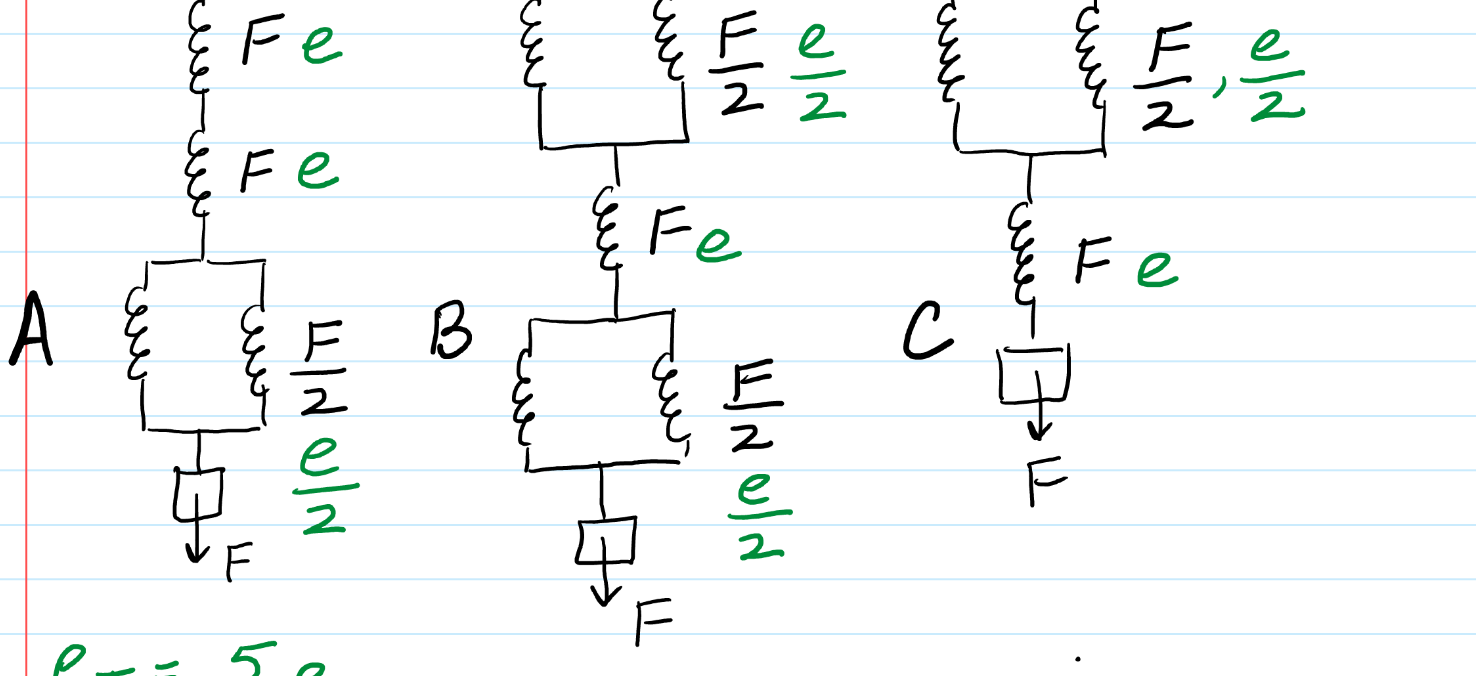
$k_c = \frac{6}{11}k$

$e_T = e + \frac{e}{2} + e + \frac{e}{2}$

$e_T = 3e$

$k_c = \frac{1}{3}k$

Ex. Arrange the following diagrams in ascending order of extension



$e_T = \frac{5}{2}e$

$e_T = 2e$

$e_T = \frac{3}{2}e$

① A B C
② A C B
③ B A C
④ B C A
⑤ C A B
⑥ C B A