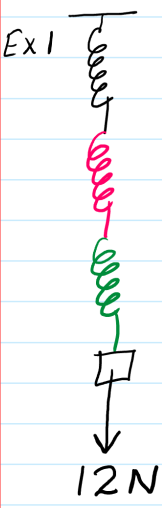
Non identical springs (Slide 4)

10 December 2020 08:23

Ex 1



$k = 2\,Nm^{-1}$, $F = 12\,N$ } $e = 6$

$k = 3\,Nm^{-1}$, $F = 12\,N$ } $e = 4$

$k = 6\,Nm^{-1}$, $F = 12\,N$ } $e = 2$

12 N

Calculate
(i) Total extension
(ii) combine Spring Const.

$e_T = 12$

$12 = k_c(12) \Rightarrow k_c = 1\,Nm^{-1}$

(i) $e_T = 6 + 4 + 2$
$e_T = 12\,m.$

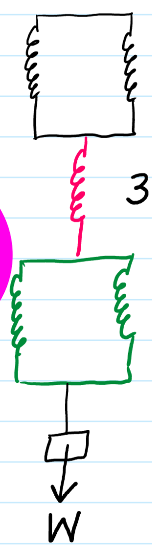
(ii) $k_c = ??$

$F = k_c e_T$

$12 = k_c(12)$

$k_c = 1\,Nm^{-1}$

Ex 2



$e = \frac{F}{K}$

$2k$, $\frac{W}{2}$, $e = \frac{W}{4K}$

$3k$, W, $e = \frac{W}{3K}$

$5k$, $\frac{W}{2}$, $e = \frac{W}{10K}$

W

Find in terms of W and k
(i) total extension
(ii) combine Spring Const.

(i) $e_T = ??$

$\frac{W}{10K} + \frac{W}{3K} + \frac{W}{4K}$

$e_T = \frac{41\,W}{60\,K}$ Ans

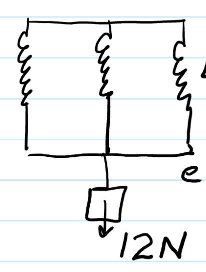
(ii) $k_c = ??$ $\quad k_c = \frac{60}{41}K$

$F = k_c \cdot e_T$

$W = k_c\left(\frac{41W}{60K}\right)$

$k_c = \frac{60}{41}K$ Ans.

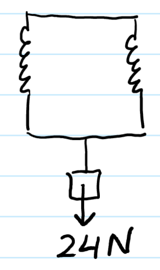
Ex. 3 Identical.



4N, $e = 3cm$, 12N

In the given diagram each spring extends by 3 cm.

middle Spring is Removed & weight is changed to 24N. Cal new extension



12 N, $e = ??$, 24N

$F = ke$

$4 = K(3)$

$K = \frac{4}{3}$ Ans

$F = Ke$

$12 = \frac{4}{3} \cdot e$

$\boxed{e = 9cm \text{ Ans}}$

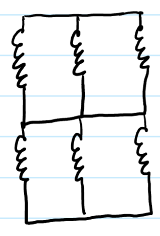
Short cut unitary method

$4N \longrightarrow e = 3$

$12N \longrightarrow e = ?$

$\boxed{e = 9cm}$

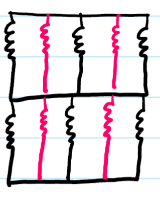
Ex 4



Identical

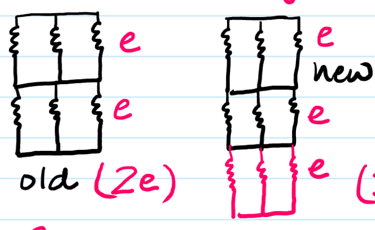
The diagram shows a spring arrangement. State what happens to total extension if the following changes are made independently

① Increase the # of springs per unit Area



force divided 3 ways.
now force divided 5 ways
Less force so less ext
e_T = reduces.

② Use more layers of Springs



e, e, old (2e)

e, new, e, e (3e)

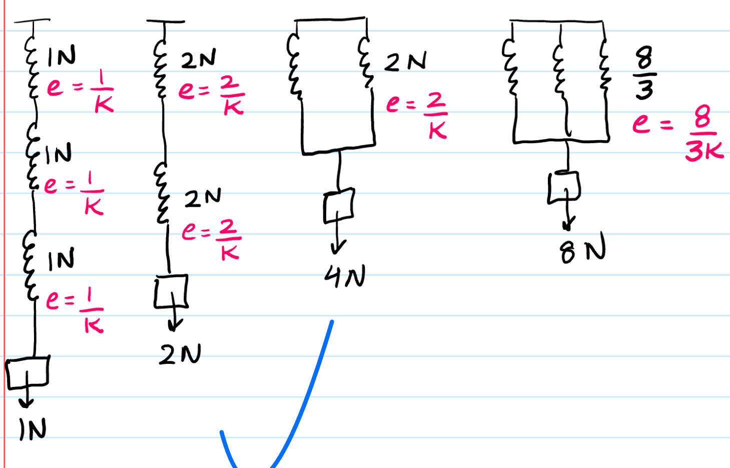
more series combination (2 vs 3) ∴ more extension hence e_T = increases.

③ Replace the old springs with the new ones which have a higher Spring constant

According to $F = ke$, $k \propto \frac{1}{e}$.

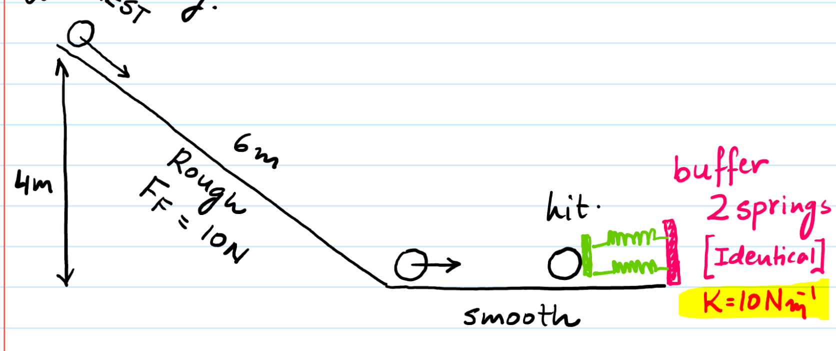
∴ k = high e = less hence e_T = decreases.

Ex 5 Which option gives the greatest extension [All springs are identical] spring Const = k



$e_T = \frac{3}{K}$ $\quad e_T = \frac{4}{K}$ ✓ $\quad e_T = \frac{2}{K}$ $\quad e_T = \frac{8}{3K}$

Q.



m = 2kg, REST, 4m, 6m, Rough FF = 10N, hit, smooth

buffer 2 springs [Identical] $K = 10Nm^{-1}$

Assuming all of its K.E is transformed into E.P.E / Strain Energy. Cal. the compression of each spring? Take g = 10

P.E at Start = mgh = (2)(10)(4) = 80J

W. done against friction = $F_F \times d$
= 10x6 = 60J

K.E at End / K.E with which the ball hits the springs = 80 − 60 = 20J.

20 = E.P.E of the 2 springs.

$20 = \left[\frac{1}{2}ke^2\right] \times 2$

$EPE \begin{cases} \frac{1}{2}Fe \\ \text{or} \\ \frac{1}{2}ke^2 \end{cases}$

$20 = \left[\frac{1}{2}(10) \cdot e^2\right] \cdot 2$

$\boxed{e = 1.4m}$