


$F = (-) k x$



- **F - Force** - required to stretch the spring, or restoring force. Often the weight (N)
- **k - Spring Constant** - How "tough" the spring is. (N/m)
- **x - Stretch** - a change in length (m)

The diagram shows a vertical spring-mass system against a blue background. A wooden ruler is on the left, with a yellow box highlighting the displacement  $x = 0.047\text{m}$  from the 24 cm mark to the 24.47 cm mark. A coiled spring is attached to a ceiling at the top and a mass at the bottom. The mass is a small cylinder with a yellow box highlighting the weight  $w = 0.35(9.8) = 3.43\text{N}$ . To the right, text describes the setup: "A 350 g mass is placed on a 20 cm spring causing it to stretch out to 24.7cm." Below this, it says "Find the spring constant of this spring." At the bottom right, a white box contains the calculations:  $F = kx$ ,  $3.43\text{N} = k(0.047\text{m})$ , and  $k = 72.97\text{ N/m}$ .

**DIRECT CALCULATION**

A 350 g mass is placed on a 20 cm spring causing it to stretch out to 24.7cm.

Find the spring constant of this spring.

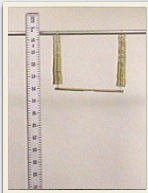
$F = kx$

$3.43\text{N} = k(0.047\text{m})$

$k = 72.97\text{ N/m}$

# SPRINGS IN PARALLEL

- The same force is supported by two springs so neither has to stretch as far...
- ...or, it is harder to stretch two springs so the constant is increased



The photograph shows two yellow coiled springs hanging side-by-side from a horizontal metal rod. To the left of the springs is a vertical ruler with markings in centimeters. The springs are at rest, and the ruler provides a scale for their length.

$$k_{\text{total}} = k_1 + k_2 + \dots$$

WHAT WOULD THE TOTAL CONSTANT BE FOR....

$k_1 = 20 \text{ N/m}$

$k_2 = 60 \text{ N/m}$

$k_3 = 90 \text{ N/m}$

$60 + 20 = 80$

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SPRINGS IN SERIES

- Both springs support the same amount of weight (not split in two like before)
- So... it is *easier* to stretch

$1/k = 1/k_1 + 1/k_2$

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WHAT WOULD THE TOTAL CONSTANT BE FOR....

$k_1 = 20 \text{ N/m}$

$k_2 = 60 \text{ N/m}$

$k_3 = 90 \text{ N/m}$

$1/60 + 1/90 = 1/k_{\text{tot}}$   
on your calculator type:  
 $60 (x^{-1}) + 90 (x^{-1}) =$   
then:  $(x^{-1}) =$   
 $k_{\text{tot}} = 36 \text{ N/m}$

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HOOKE'S LAW LAB

Which Spring:

#	Mass	Weight	Length
1			
2			
3			
4			
5			
6			

4 TRIALS; 2 SPRINGS,  
& SERIAL, & PARALLEL

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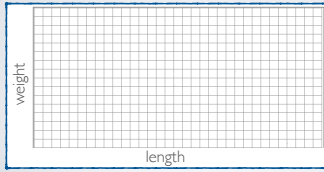
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## HOOKE'S LAW LAB

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Pick 2 of your springs and graph your results. Plot weights on the y axis and length on the x axis. Find the slope of each graph to calculate the spring constant.



k  
= \_\_\_\_\_

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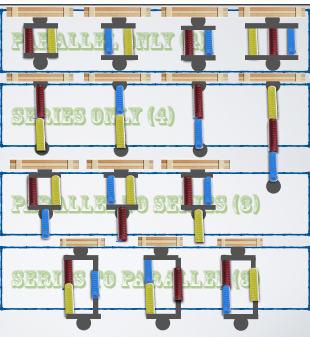
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HOW MANY COMBINATIONS?

$k_1$   
= 20 N/m

$k_2$   
= 60 N/m

$k_3$   
= 90 N/m



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