Skill 24: Spring Force

162. A spring is stretched from an equilibrium length of 1.5m to 1.75m. What is the elongation of the spring?

$x_1 = 1.5m$
$x_2 = 1.75m$
$x = x_2 - x_1 = 1.75m - 1.5m = .25m$

163. A spring is compressed from an equilibrium length of 0.3m to 0.2m. What is the elongation of the spring?

$x_1 = .3m$
$x_2 = .2m$
$x = x_2 - x_1 = .2m - .3m = -.1m$

164. A spring with a spring constant of 45N/m is stretched 0.2m. What is the force applied to the spring?

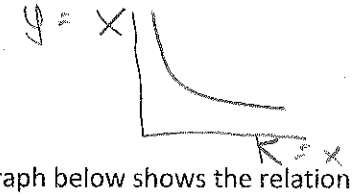
$K = 45N/m$
$x = .2m$
$F_s = ?$
$F_s = kx$
$= (45N/m)(.2m) = 9N$

165. A mass of 3kg is applied vertically to a spring causing it to stretch 0.25m. What is the spring constant of the spring?

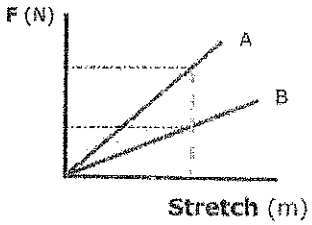
$m = 3kg$
$x = .25m$
$k = ?$
$F_s = F_g = mg$
$k = \frac{F_s}{x} = \frac{mg}{x} = \frac{(3kg)(9.8N/kg)}{.25m} = 117.72 N/m$

166. A 5kg weight is attached vertically to a series of springs with increasing spring constants. Draw the rough shape of the graph which shows how elongation ("x") responds to the increase in spring constant ("k"). Remember the responding variable is the dependent (y-axis) and the independent variable tells us the function that is being used (x-axis).

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



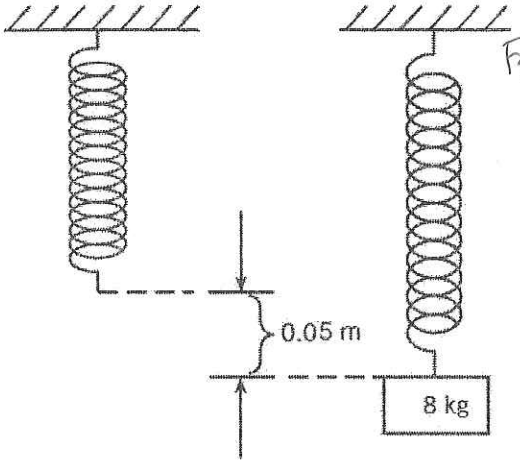
167. The graph below shows the relationship between spring force and change in equilibrium length of a two springs A and B.



A. What does the slope of the line represent? k $\frac{F_s}{x} = k$
B. Which spring A or B is more difficult to stretch? A higher k

Skill 24-Spring Force

168. The diagram above represents a spring hanging vertically that stretches 0.05 meter when an 8.0-kilogram block is attached. The spring-block system is at rest in the position shown.



$F_s = F_g = mg$
$= (8\text{kg})(9.8\text{m/s}^2)$

$K = \frac{F_s}{x} = \frac{(8\text{kg})(9.8)}{.05\text{m}}$

$K = 1570\text{ N/m}$

Determine the value of the spring constant. [Show all work, including equation, substitution and units (3pts)

169. An unstretched spring has a length of 10. centimeters. When the spring is stretched by a force of 16 newtons, its length is increased to18 centimeters. What is the spring constant of this spring?

A) 0.89 N/cm B) 2.0 N/cm
C) 1.6 N/cm D) 1.8 N/cm

$x = 8\text{cm} = .08\text{m}$
$F_s = 16\text{N}$

$K = \frac{16\text{N}}{8\text{cm}} = 2\text{N/cm}$

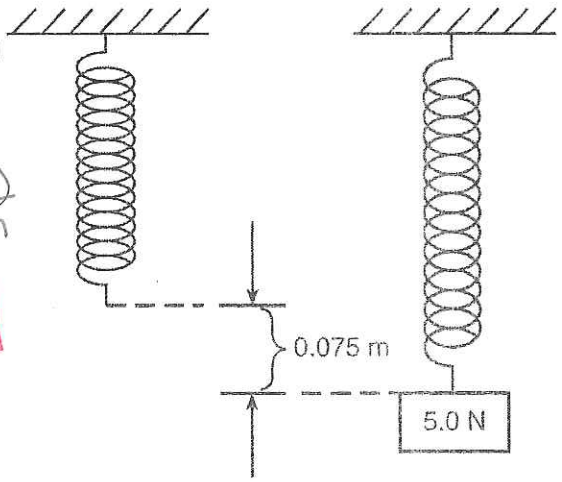
170. The spring in a scale in the produce department of a supermarket stretches 0.025 meter when a watermelon weighing 1.0×10^2 newtons is placed on the scale. The spring constant for this spring is

A) 3.2×10^5 N/m B) 4.0×10^3 N/m
C) 2.5 N/m D) 3.1×10^{-2} N/m

$x = .025\text{m}$
$F_s = 1 \times 10^2\text{N}$
$K = ?$

$K = 4000\text{N/m}$

171. The diagram above represents a spring hanging vertically that stretches 0.075 meter when a 5.0-newton block is attached. The spring-block system is at rest in the position shown.



The value of the spring constant is

A) 38 N/m B) 67 N/m
C) 130 N/m D) 650 N/m

$F_s = 5\text{N}$
$x = .075\text{m}$
$K = ?$

$K = \frac{F_s}{x} = \frac{5\text{N}}{.075\text{m}} = 66.6\text{ N/m}$

172. A vertical spring 0.100 meters long is elongated to a length of 0.119 meters when a 1.00-kilogram mass is attached to the bottom of the spring. The spring constant of this spring is

A) 9.8 N/m B) 82 N/m
C) 98 N/m D) 520 N/m

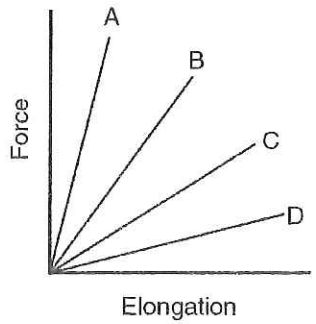
$x = .019\text{m}$
$m = 1\text{kg}$ so $F_g = 9.8\text{N} = F_s$
$K = ?$

$K = \frac{F_s}{K} = \frac{9.8\text{N}}{.019\text{m}} = 516\text{N/m}$

Skill 24-Spring Force

173. The graph below represents the relationship between the force applied to a spring and spring elongation for four different springs.

Force vs. Elongation

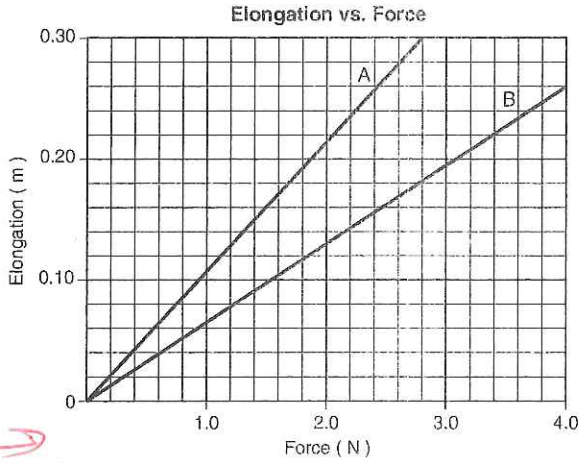


Which spring has the greatest spring constant?

A) *A* B) *B* C) *C* D) *D*

$K = \frac{F_s}{x}$ = slope

174. The graph below shows elongation as a function of the applied force for two springs, *A* and *B*.



axis are switched

Compared to the spring constant for spring *A*, the spring constant for spring *B* is

A) smaller B) larger

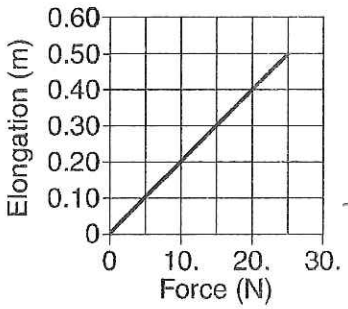
C) the same

$\frac{x}{F_s} = \frac{1}{k}$ so lowest slope = highest k

inverse of k

175. The graph below shows the relationship between the elongation of a spring and the force applied to the spring causing it to stretch.

Elongation vs. Applied Force



$\frac{x}{F_s} = \frac{1}{k}$

flip $\frac{F_s}{x} = k$

$\frac{20}{.4} = 50\ N/m$

What is the spring constant for this spring?

A) 0.020 N/m B) 2.0 N/m

C) 25 N/m D) 50. N/m

Skill 25: Centripetal Motion

176. Determine the centripetal acceleration of a 4kg mass moving at a speed of 3m/s in a circle with a radius of 0.5 m.

$a_c = ?$
$m = 4kg$
$V = 3m/s$
$r = .5m$

$a_c = \frac{V^2}{r} = \frac{(3m/s)^2}{.5m} = 18 m/s^2$

177. Determine the centripetal force acting on a 3kg mass which is moving at 2m/s around a circle with a radius of 1 m.

$F_c = ?$
$m = 3kg$
$V = 2m/s$
$r = 1m$

$F_c = \frac{mv^2}{r} = \frac{(3kg)(2m/s)^2}{1m} = 12N$

178. Determine the centripetal acceleration of a 5kg mass that completes a rotation around a circle with a radius of 0.75 m every 2 seconds.

$a_c = ?$
$m = 5kg$
$T = 2s$
$r = .75m$

$V = \frac{2\pi r}{T} = \frac{2\pi(.75m)}{2s} = 2.36 m/s$

$a_c = \frac{V^2}{r} = \frac{(2.36m/s)^2}{.75m} = 7.43 m/s^2$

179. Name the type of relationship for each of the following pairs.

$a_c = \frac{V^2}{r}$

$F_c = \frac{mv^2}{r}$

a. Centripetal force and mass direct

b. Centripetal acceleration and mass none

c. Centripetal force and radius inverse

d. Centripetal acceleration and velocity direct square

e. Centripetal force and velocity direct square

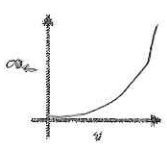
180. If the radius of a circle is doubled and all other factors are held constant, the centripetal acceleration will halved. $r \times 2$ means $a_c \div 2$

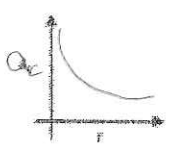
181. If the speed of an object is a circular path is tripled and all other factors are held constant, the centripetal acceleration will $\times 9$ $V \times 3$ means $a_c = 3^2$

182. If the mass of an object traveling in a circular path is doubled and all other factors are held constant, the centripetal force will double

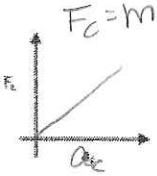
183. If the radius of a circular path is halved and all other factors are held constant the force required to keep the object on the circular path will be double.

184. Sketch the relationship between the variables for the following axes.





$F_c = ma_c$



$F_c = ma_c$