Virtual Learning

Physics

Rotation Angle & Angular Velocity

May 4, 2020

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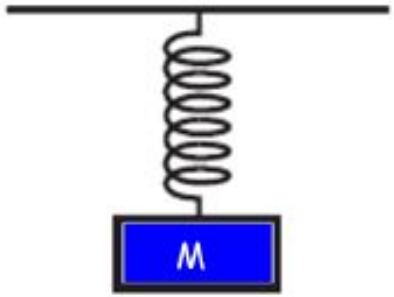
Objective/Learning Target:

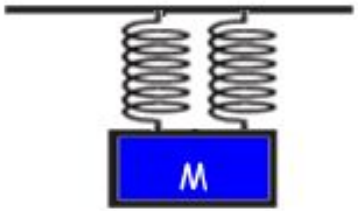
Students will examine the concepts of Rotation Angle and Angular Velocity and use them to solve some basic problems.

Quick Review

A certain spring stretches 1 cm for each kilogram it supports.

1. If the elastic limit is not reached, how far will it stretch when it supports a load of 8 kg?
2. Suppose the spring is placed next to an identical spring so the two side by side springs equally share the 8 kg load. How far will each spring stretch?



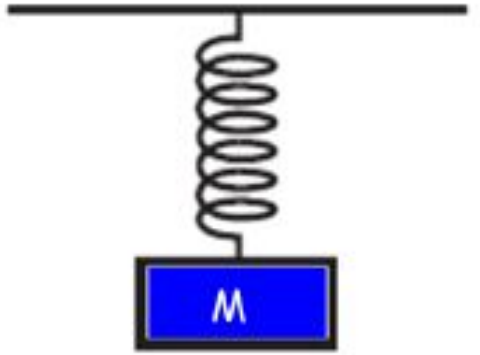


Quick Review 1 Answer

1. Common sense says 8 cm of stretch, but let's work it out.

We know: $F = kx$ $k = N/m \rightarrow 1\ kg/1cm\ given = 980N/m$

$1\ kg = 9.8N$ so… $8\ kg = 78.4\ N$



$F = kx$

$78.4N = 980N/m \times (x)$

$\frac{78.4N}{980N/m} = x = 0.08\ m$ or 8cm

Quick Review 2 Answer

Again Common sense says two identical springs then each shares half the load and will stretch half as far for a 4 cm stretch. Let's see.

We know: $F = kx$ $\quad$ $k = 980N/m$ for each spring

$1\ kg = 9.8N$ $\quad$ so… $\quad$ $8\ kg = 78.4\ N$

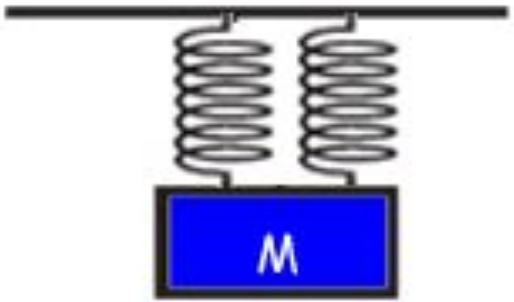
Also $\quad$ $k_{tot} = k1 + k2$ $\quad$ so... $\quad$ $k_{tot} = 980N/m + 980N/m$

$= 1960N/m$

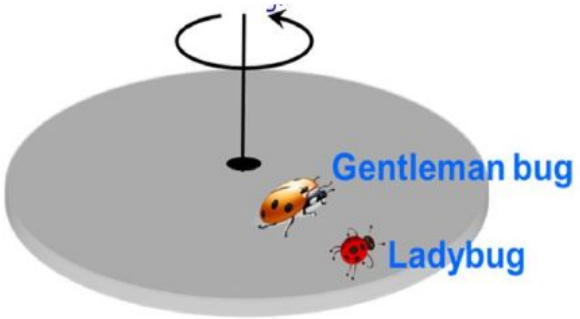
$F = k_{tot}(x)$

$78.4N = 1960N/m \quad (x)$

$\frac{78.4N}{1960N/m} = x = 0.04\ m$ or 4cm



Angular Velocity



Link: [Rotation Angle & Angular Velocity]

Directions:

- Read through Rotation Angle and Angular Velocity.
- Work through any examples on a separate piece of paper before you scroll down to the solution.
- On a separate piece of paper complete the practice problems on the following slides.
- Check your answers.
- For additional practice check out the conceptual questions and the problems and exercises in the table of contents for the online text linked above.

Practice Problem #1 a Mini Lab

1. Roll a cylindrical can across a table. Note the path the rolling can takes.
2. Now roll an ordinary tapered drinking cup on the table. Does the cup roll straight across the table or does it curve?
3. Does the wide end of the cup cover more distance as it rotates?
4. Is the linear speed of the wider end of the tapered cup greater than the linear speed of the narrow end?

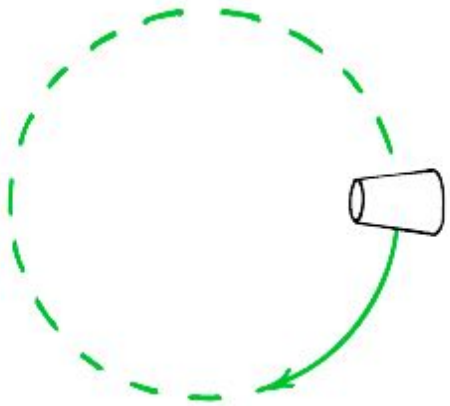
Practice Problem #1 a Mini Lab

1. The can rolls is a straight line.
2. The tapered cup rolls in a curved path
3. The wide end covers more distance.
4. The wide end of the cup covers more distance as it rotates so its linear speed is greater. Linear speed depends on radius.

Practice Problem #2

The diameter of the base of a tapered drinking cup is 6 cm. The diameter at the mouth is 9 cm. The path of the cup curves when you roll it on the top of a table as you saw in Problem 1.

1. Which end, the base or the mouth, rolls faster?
2. How much faster?



Practice Problem #2 Solution

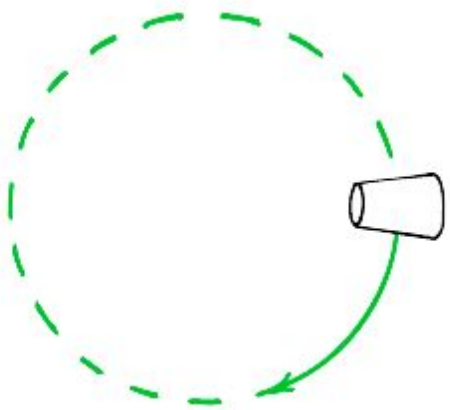
They both have the same angular velocity but the mouth travels a farther distance in the same time so it has a greater linear velocity. In 1 rev the bottom travels 2π*3cm, the mouth travels 2π*4.5cm.

$\omega = \frac{v_{base}}{r_{base}}$ also $\omega = \frac{v_{mouth}}{r_{mouth}}$

so.. $\frac{v_b}{r_b} = \frac{vm}{rm} = \frac{V_b}{6} = \frac{v_m}{9}$

So the ratio of radii equals the ratio of speeds

or $\frac{9}{6} = \frac{v_m}{v_b}$ 4.5/3 or 1.5 times faster



Practice Problem #3

What is the angular velocity of a 700mm diameter bicycle tire coasting down a hill at 13.0 m/s?

Practice Problem #3 Answer

$$\omega = \frac{v_{bike}}{r_{tire}}$$

$$= \frac{13\text{m/s}}{0.350\text{m}}$$

$$= 37.1\ \text{rad/s}$$

Additional Practice

For additional practice check out the conceptual questions and the problems and exercises in the table of contents from the online text linked above.