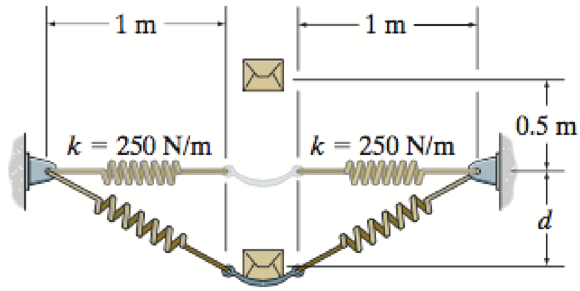
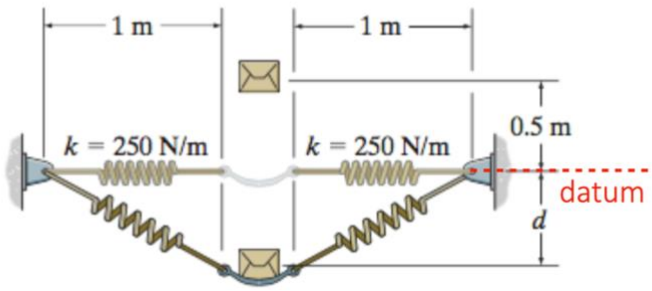
Quiz 06: Chapter 14 Due: Tuesday 13 Feb 24

Examine the solved problem below. There are four errors in the solution below. Your task is to locate and identify those errors, then correct them and calculate the proper result. If the same error occurs more than once, only count it as a single error, even if you have to correct it in more than one instance.

Each correctly identified error is worth 4 points, and the re-calculated result is worth 4 points as well. You must save your work in pdf format and submit via the Quiz 06 Assignment in the Chapter 14 folder in the Quizzes folder of the Online Classroom in Blackboard. Please do not use any other file format than pdf.

The pan of negligible mass is attached to two identical springs with stiffness $k = 250\frac{\text{N}}{\text{m}}$. If a box with $m = 10\text{kg}$ is dropped from a height $h = 0.5\text{m}$ above the pan, determine the maximum vertical displacement d. Each spring has an initial tension $F_o = 50\text{N}$.





A) Calculate the rest length l_o of the spring.

$$F_o = kl_o$$

$$50\text{N} = \left(250\frac{\text{N}}{\text{m}}\right) l_o$$

$$l_o = \frac{50\text{N}}{250\frac{\text{N}}{\text{m}}} = 0.20\text{m}$$

B) Write the expression for the total energy E_1 at the instant the box is released:

$$T_1 = 0$$

$$U_1 = mgh$$

$$E_1 = T_1 + U_1$$

$$E_1 = mgh$$

C) Write the expression for the final energy E_2 at the instant the box comes to rest:

$$T_2 = 0$$

$$U_2 = \frac{1}{2}k(\Delta l)^2 + mgd$$

$$E_2 = T_2 + U_2$$

$$E_2 = \frac{1}{2}k(\Delta l)^2 + mgd$$

D) Calculate the stretch of the spring Δl in the final position:

$$\Delta l = l - l_o = \sqrt{d^2 + 1}\text{m} - 0.20\text{m}$$

$$(\Delta l)^2 = (d^2 + 1) + 2\left(\sqrt{d^2 + 1}\right)(-0.20) + 0.04$$

E) Conserve energy frompoint 1 to 2:

$$E_1 = E_2$$

$$mgh = \frac{1}{2}k(\Delta l)^2 + mgd$$

$$mgh = \frac{1}{2}k\left[(d^2 + 1) - 0.4\left(\sqrt{d^2 + 1}\right) + 0.04\right] + mgd$$

F) Use Wolfram or Symbolab to solve for d:

$$mgh = \frac{1}{2}k\left[(d^2 + 1) - 0.4\left(\sqrt{d^2 + 1}\right) + 0.04\right] + mgd$$

$$(10\text{kg})\left(9.8\frac{\text{m}}{\text{s}^2}\right)(0.5\text{m}) = \left(125\frac{\text{N}}{\text{m}}\right)\left[(d^2 + 1) - 0.4\left(\sqrt{d^2 + 1}\right) + 0.04\right] + (10\text{kg})\left(9.8\frac{\text{m}}{\text{s}^2}\right)d$$

$$49 = 125\left[(d^2 + 1) - 0.4\left(\sqrt{d^2 + 1}\right) + 0.04\right] + 98d$$

$$d = \text{no solution!}$$

If the equation does not have a real solution, it means that the spring constant is insufficient, and the spring will snap before the system reaches equilibrium. Or, it might mean that the supports need to be moved closer together so that the spring won't stretch as much as the block falls.