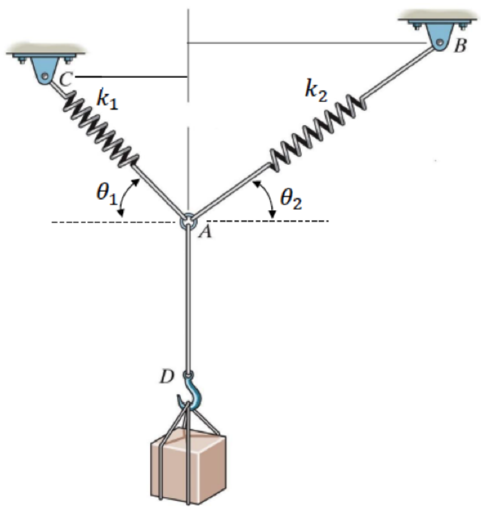
Name: ________________
Group members: ______________________ ______________________ ______________________

TAM 210/211 - Worksheet 3

Objectives:

- Use free body diagrams and equilibrium equations to determine forces in cables and springs.

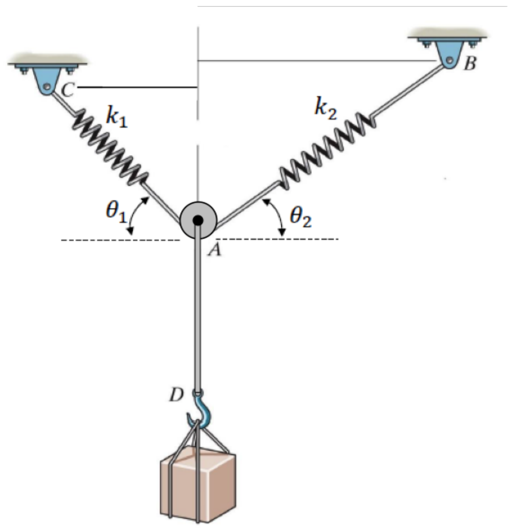
1) A box of weight W is supported by two springs, as illustrated below.



a) Next to spring-mass figure above, draw a free body diagram for ring A. Denote the force in spring AC as F_{AC} and the force in spring AB as F_{AB}.

b) Use the equilibrium equations $\sum \mathbf{F} = \mathbf{0}$ to determine F_{AC} and F_{AB}. Your answers should be functions of W, θ_1 and θ_2.

2) In this next setup, the two identical springs are fixed at uneven positions (different heights) again, but the springs are no longer connected to each other via a ring. Instead, connect the springs using a piece of string, to model the cable that goes through the pulley at A.

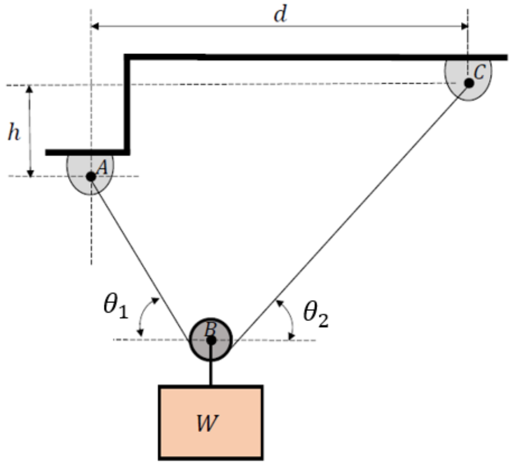


a) Before doing any calculations, predict if angle θ_1 would be be greater than, less than, or equal to θ_2. Explain your reasoning.

b) The tension in the cable over a pulley is constant everywhere for a static system. Show that if spring constants k_1 and k_2 are equal, θ_1 and θ_2 must also be equal.

c) Express the magnitude of the forces in the springs as a function of W, θ_1, and θ_2.

3) Another setup is illustrated below with string ABC of length L.



a) What happens to angles θ_1 and θ_2 when the weight W is changed by changing the object? Why?

b) How do angles θ_1 and θ_2 relate to each other? Express the angles **in terms of the given symbolic variables and dimensions** (neglect the size of the frictionless pulley B). How does your theoretical expression validate your conclusions in part (a)?

c) Express the forces along AB and BC as Cartesian vectors in terms of the given symbolic variables and dimensions.

d) If the string ABC were shorter, how would angles θ_1 and θ_2 and the forces along AB and BC change?

e) What implications does part (d) have on the design of systems with different string lengths in terms of the required strengths of the strings?