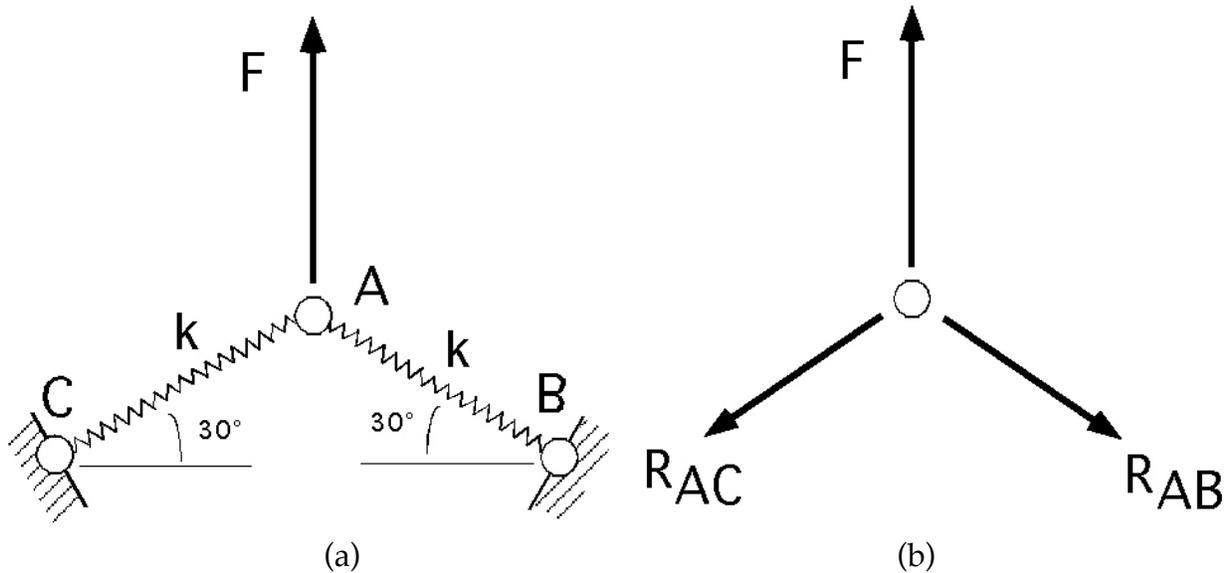


Problem M1 (Materials and Structures)

The figure (a) below shows a 2-dimensional structure consisting of a pair of springs, CA and AB joined at point A. A force F is applied in a symmetric manner so that angles FAC and FAB are both 120° . Angle CAB is also 120° . The springs are joined or attached by hinges at A, B and C which can rotate freely. Your task is to determine the displacement of point A. You can assume that the springs are sufficiently stiff that the deflections and the displacements are small, so that the geometry of the structure will not change significantly due to the loading.



- (i) Determine the *forces* in the springs. Assume that the springs can be replaced by reaction forces, R_{AB} and R_{AC} acting in the same directions as the springs (i.e at angles of 30° to the line AC) as shown in figure (b). Apply equilibrium to calculate the forces R_{AB} and R_{AC} .
- (ii) Calculate the *extension* of each spring. You can assume that the extension of the each of the springs is determined by the spring constant, k , and the force in the spring R , such that the spring will elongate by an amount, δ , according to: $R = k\delta$
- (iii) Calculate the *deflection* (displacement) of point A. Use the results from part (b) as the extension of the springs. Use trigonometry, and the knowledge that the springs each remain attached at C and B and are joined at A, to calculate how much point A displaces.