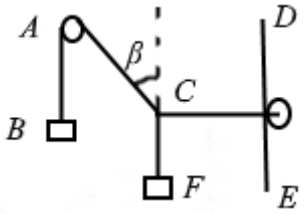
Section 1: Resolving forces

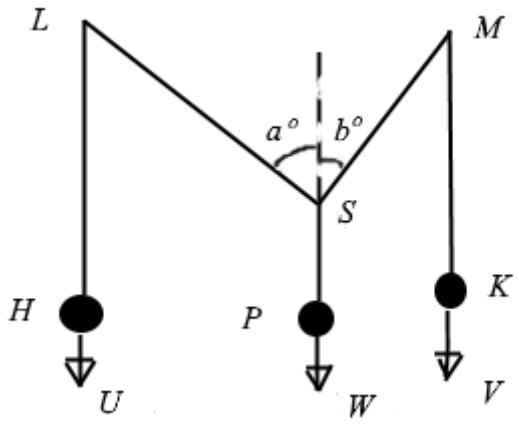
Exercise level 3 (Extension)

1. A string hangs over a smooth pulley A. On one end B is suspended a weight of W N. The other end C is knotted to a second string attached to a frictionless light wheel constrained to move on a smooth vertical rail DE. From the knot is suspended a weight F of X N.
The inclined section of string makes an angle β ($\neq 0$) with the vertical.



(i) How does the fact that the pulley is smooth affect the way you model this set-up?
(ii) Explain why the string section attached to the wheel must be horizontal.
(iii) Explain why there cannot be equilibrium if $W = X$.
(iv) Express W in terms of X and β.

2. Peter (P), Huan (H) and Katie (K) are experimenting with an apparatus. It consists of three weights connected by strings. One string passes over a smooth peg L. It has a weight of U N under Huan's supervision on one end, and is knotted at the other end S to a second string which passes over a second smooth peg M at the same horizontal level as L to a weight of V kg under Katie's supervision. From the knot hangs a third weight of W N under Peter's supervision. L, M, N, H, P and K are all in the same vertical plane. LS is inclined at a^o to the vertical and MS at b^o. The distance LM is 4 metres.



(v) Initially they set it up so that $a = b = 30$, $W = 10$. Calculate U and V in terms of W. How far is S below the horizontal level LM?

(vi) Peter takes a break. Meanwhile, Huan and Katie investigates what happens when they vary U and V. They manage to shorten SM by 10 cm without changing the length LS. What values do they make U and V to achieve that?

Edexcel A level Maths Forces in 2D 1 Exercise

3. A small chandelier (modelled as a particle) is suspended by four equal length wires from a ceiling. The suspension points of the wires form a square on the ceiling. The wires each make an angle of 30^o with the vertical. The chandelier has weight 40 N.

   (i) What is the tension in each wire?

   The arrangement of four wires is replaced by one with three wires, again equal in length, but this time with their points of suspension arranged in an equilateral triangle.

   (ii) The wires each make an angle of 30^o with the vertical. What is the tension in each wire?

   In the three-wire arrangement each wire has length 1 metre. Two of the wires are now replaced by one suspended from the mid-point between suspension points of those which were replaced. The new wire is of the correct length to maintain the chandelier in exactly the same position.

   (iii) What is the length of the replacement wire?
   (iv) What is the tension in that wire?
   (v) What is the new tension in the wire which was not replaced?