Static Equilibrium

How do we analyze a system that remains at rest?

A long rod that is free to rotate about one end is being held horizontal by an upward force exerted at the opposite end of the rod. This upward force is measured by a spring scale. Sketch the free-body diagram for this situation. What rule(s) does your free-body diagram have to satisfy?

The reading on the spring scale is _____ N. This shows us the force exerted at the far end of the rod. What is the weight of the rod itself?

The place where the spring scale is attached will now be moved toward the hinge. What, if anything, happens to the reading on the spring scale? Explain why.

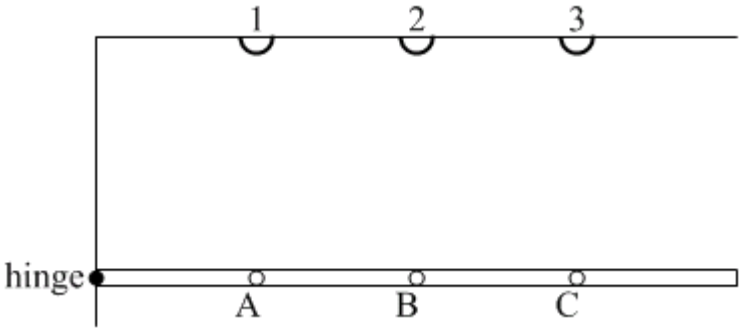
Draw a new free-body diagram for the situation in which the spring scale is quite close to the hinge, ¼ of the way along the rod as measured from the hinge.

At equilibrium $\vec{a} = 0$ and $\vec{\alpha} = 0$. This means that $\sum \vec{F} = 0$ and $\sum \vec{\tau} = 0$.

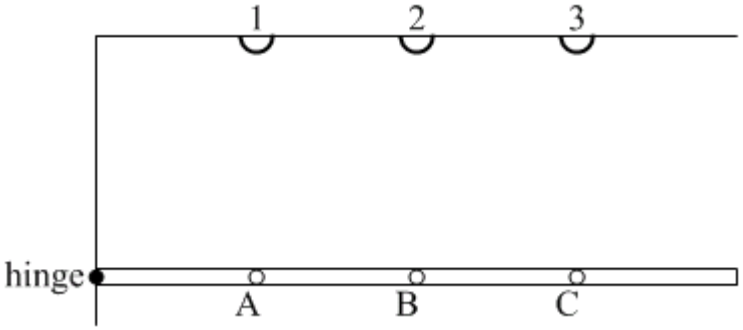
A rod with a length *L* and a mass *m* is attached to a wall by means of a hinge at the left end. The rod's mass is uniformly distributed along its length. A string will hold the rod in a horizontal position; the string can be tied to one of three points, lettered A-C, on the rod. The other end of the string can be tied to one of three hooks, numbered 1-3, above the rod. This system could be a simple model of a broken arm you want to immobilize with a sling. The rod represents the lower arm, the hinge represents the elbow, and the string acts as the sling.

For each case below, draw a line (and only one line) from one lettered point to one numbered hook representing the string you would use to achieve the desired objective. If you think it is impossible to achieve the objective explain why.

How would you attach a string so the rod is held in a horizontal position but the **hinge exerts no force at all on the rod**?



How would you attach a string so the rod is held in a horizontal position while the force exerted on the rod by the hinge **has no horizontal component, but has a non-zero vertical component directed straight up**?



How would you attach a string so the rod is held in a horizontal position while the force exerted on the rod by the hinge **has no vertical component, but has a non-zero horizontal component**?