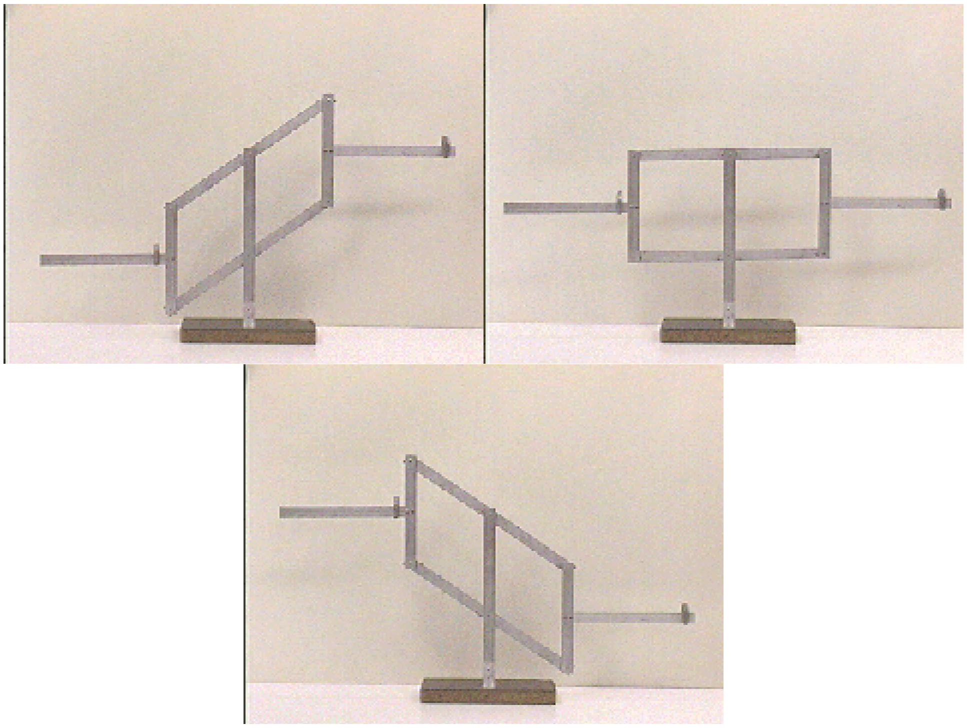
Answer #1

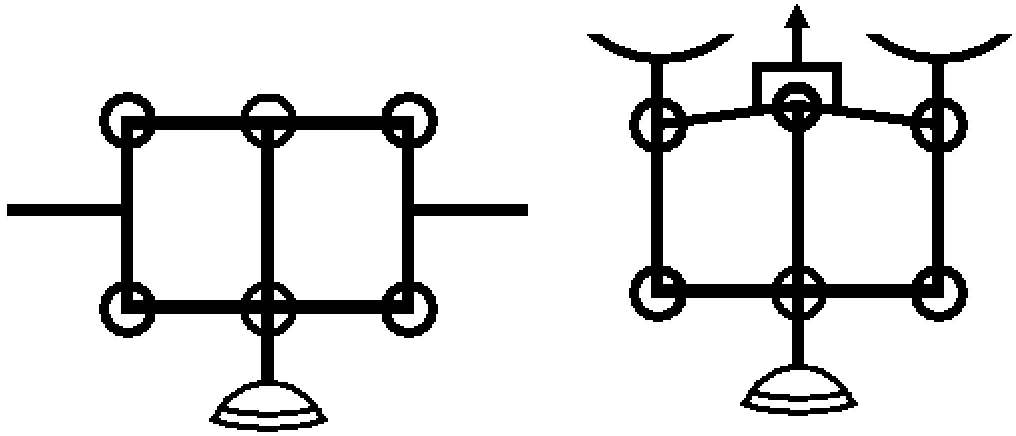
The answer is (c): the device will not move. In fact, as seen in the pictures below, if it is moved to any possible position it will remain at that position when released.



The reason that it remains in any position is that the system is in neutral equilibrium at any position of the arms. That is, the vertical height of the center of mass does not change as the arm configuration is changed if *equal* weights are placed *anywhere* on the two arms.

This device, the "Roberval balance," is used in a slightly modified form in the standard pan balance. A pan balance, sketched below, has the pans rigidly attached above the outer vertical beams rather than on extended arms. The arm configuration used in the Roberval balance was selected only to confuse the reader into believing that the device acts like a teeter-totter.

A pan balance achieves a stable horizontal equilibrium position with equal weights in the pans by sloping the two segments of the top horizontal beam slightly downward from the center support beam. Use your vast knowledge of trigonometry to see that in this case. When you move the system from equilibrium one pan moves down less than the other pan moves up, so the vertical position of the center of mass is lowest when the top arm is horizontal. Hence, stable equilibrium.



It should be noted that this system cannot be solved mathematically. If you write out the equations for forces and torques about all of the movable joints, all of the equations *are the same*!! Thus the name "Roberval paradox" has been given to the mathematical system.

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