A meter stick is placed flat on a table, and one end of the meter stick is attached to the table. The other end of the meter stick can thus rotate freely around this attached end (the axis) over the surface of the table. Two forces, both parallel to the tabletop, are applied to the stick in such a way that the net torque is zero. One force has a magnitude of 4.00 N and is applied perpendicular to the stick at the free end. The other force is applied on the opposite side of the above perpendicular force, but it has a magnitude of 6.00 N and acts at a 60.0 degree angle with respect to the stick. Where along the stick is the 6.00 N force applied? Express this distance with respect to the axis of rotation.

a. 0.667 m
b. 0.770 m
c. 0.834 m
d. 0.725 m
e. 0.783 m

Solution :

Torque on the meter stick due to force acting on it = r X F = rF sin@
Where r (radius vector) the magnitude of which is the distance from axis to the point of application of force on the stick and @ is the angle between the direction of force and radius vector.
For force of magnitude 4N torque generated = rFsin@ = 1*4*sin90 = 4 J
For force of magnitude 6N torque generated = rFsin@ = r*6*sin60 = r * 6 * √3 / 2 = 3r√3
For total torque to be zero we have
3r√3 = 4
r = 4 / (3√3) = (4√3) / 9 = 0.77 m
thus distance w.r.t axis of the rotation = 0.77m