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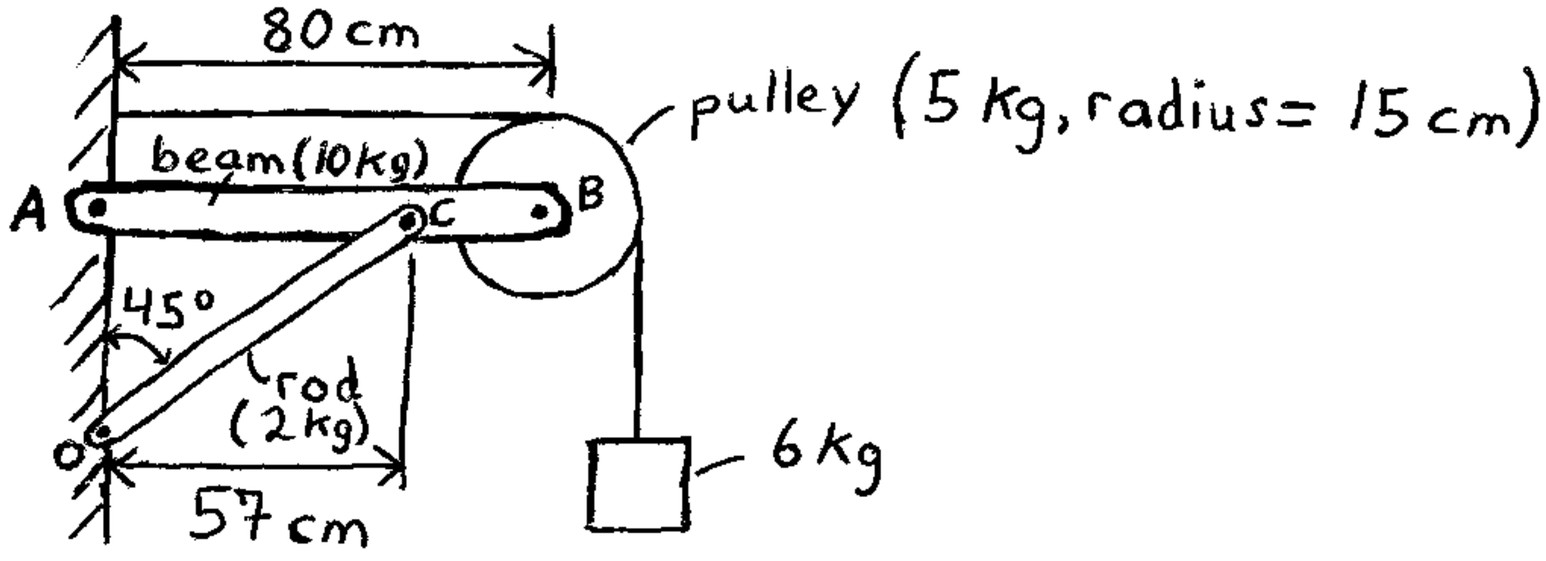
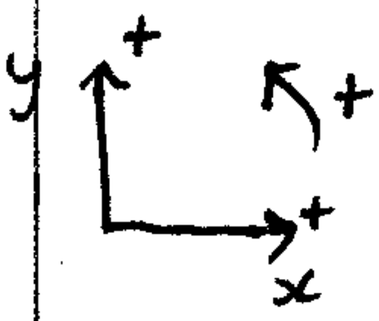
Nov. 13, 2020

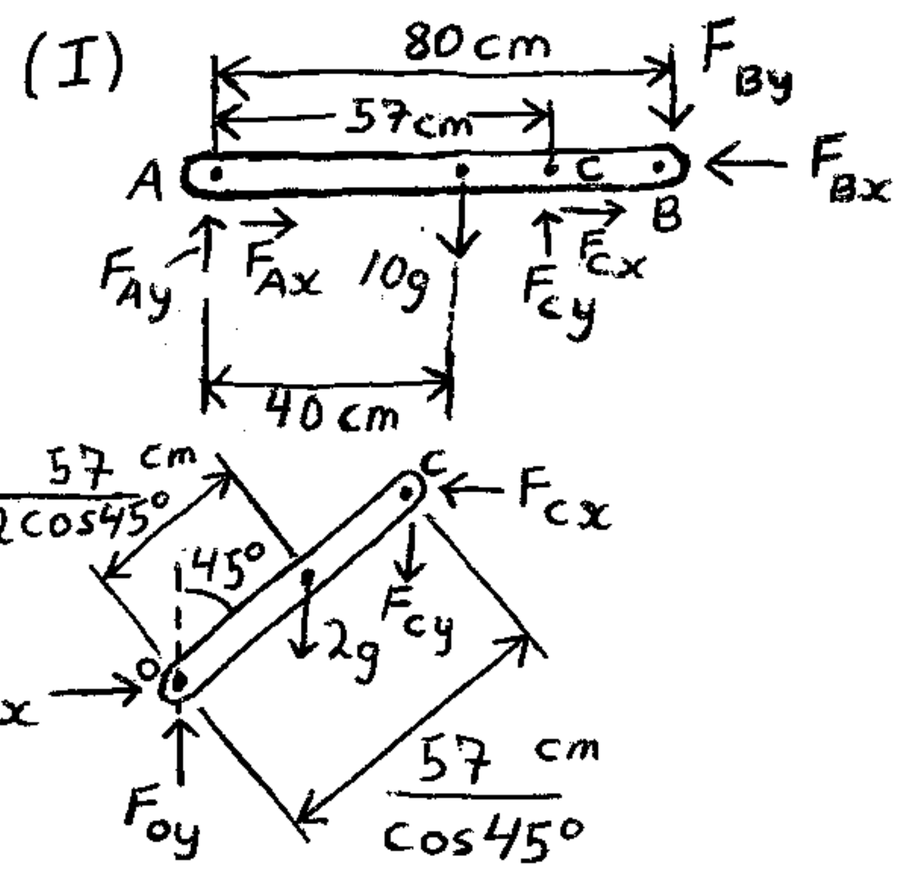
This is a problem involving statics.

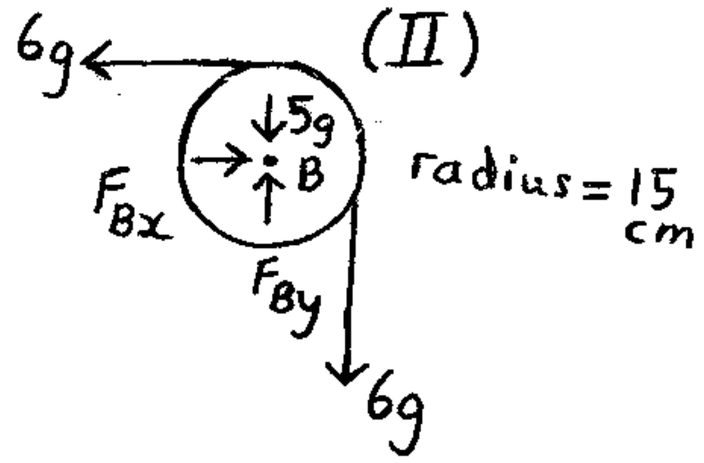


In the system shown, determine the forces acting on the rod at point O, and the beam at point A.

Solution:







pivots A, B, C, O are assumed frictionless and do not support a torque.

beam:

(I) $\Sigma \tau_A = 0 \Rightarrow -10g(40) + F_{Cy}(57) - F_{By}(80) = 0$ (1)

pulley:

(II) $\Sigma F_x = 0 \Rightarrow F_{Bx} - 6g = 0 \Rightarrow F_{Bx} = 6g$ (2)

$\Sigma F_y = 0 \Rightarrow F_{By} - 5g - 6g = 0 \Rightarrow F_{By} = 11g$ (3)

rod:

(III) $\Sigma \tau_o = -2g\sin 45°\left(\frac{57}{2\cos 45°}\right) - F_{cy}\sin 45°\left(\frac{57}{\cos 45°}\right)$

$+ F_{cx}\cos 45°\left(\frac{57}{\cos 45°}\right) = 0$ (4)

From equations (1) – (4) solve for $F_{Bx}, F_{By}, F_{cx}, F_{cy}$:

$F_{Bx} = 58.8\ N$

$F_{By} = 107.8\ N$

$F_{cx} = 229.87\ N$

$F_{cy} = 220.07\ N$

beam:

(I) $\Sigma F_x = 0 \Rightarrow F_{Ax} + F_{cx} - F_{Bx} = 0$

$\Rightarrow F_{Ax} = F_{Bx} - F_{cx} = 58.8N - 229.87\ N$

$= -171.07\ N$

$F_{Ax} = 171.07\ N \leftarrow$ (ans.)

$\Sigma F_y = 0 \Rightarrow F_{Ay} - 10g + F_{cy} - F_{By} = 0$

$\Rightarrow F_{Ay} = 10g + F_{By} - F_{cy} = 98\ N + 107.8\ N - 220.07\ N$

$= -14.27\ N$

$F_{Ay} = 14.27\ N \downarrow$ (ans.)

rod:

(III) $\Sigma F_x = 0 \Rightarrow F_{ox} - F_{cx} = 0 \Rightarrow F_{ox} = 229.87\ N \rightarrow$ (ans.)

$\Sigma F_y = 0 \Rightarrow F_{oy} - 2g - F_{cy} = 0 \Rightarrow F_{oy} = 2g + F_{cy} = 19.6N + 220.07N$

$F_{oy} = 239.67\ N \uparrow$ (ans.)