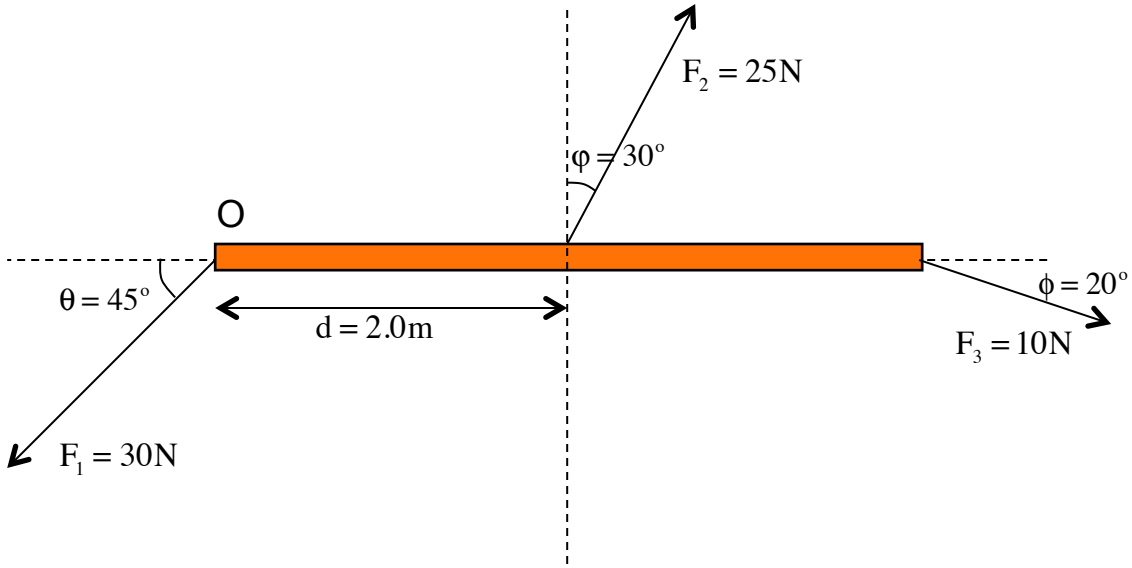
Problem 8.3

For the system:

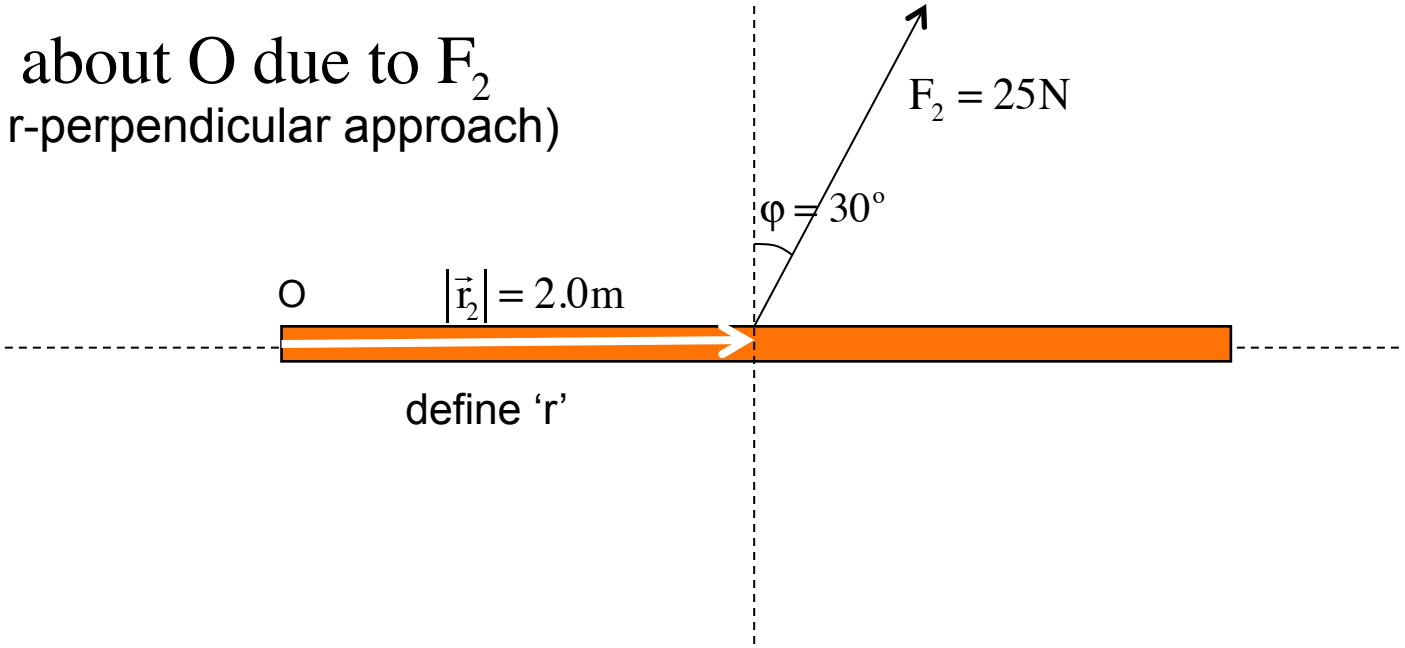
a.) Derive an expression for the net torque about "O" about an axis perpendicular to the page.

b.) Derive an expression for the net torque about "C" (the center of mass) about an axis perpendicular to the page.

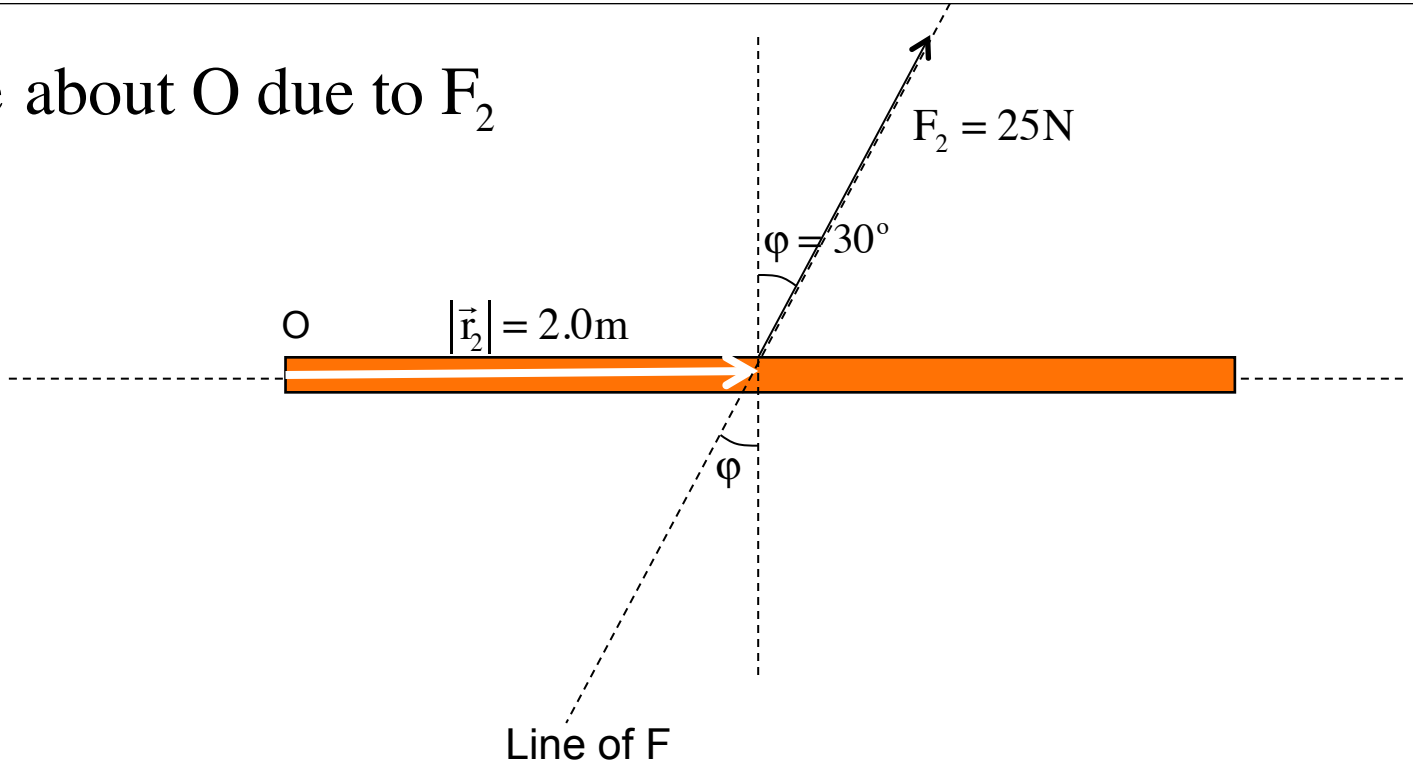


Torque about O due to F_2

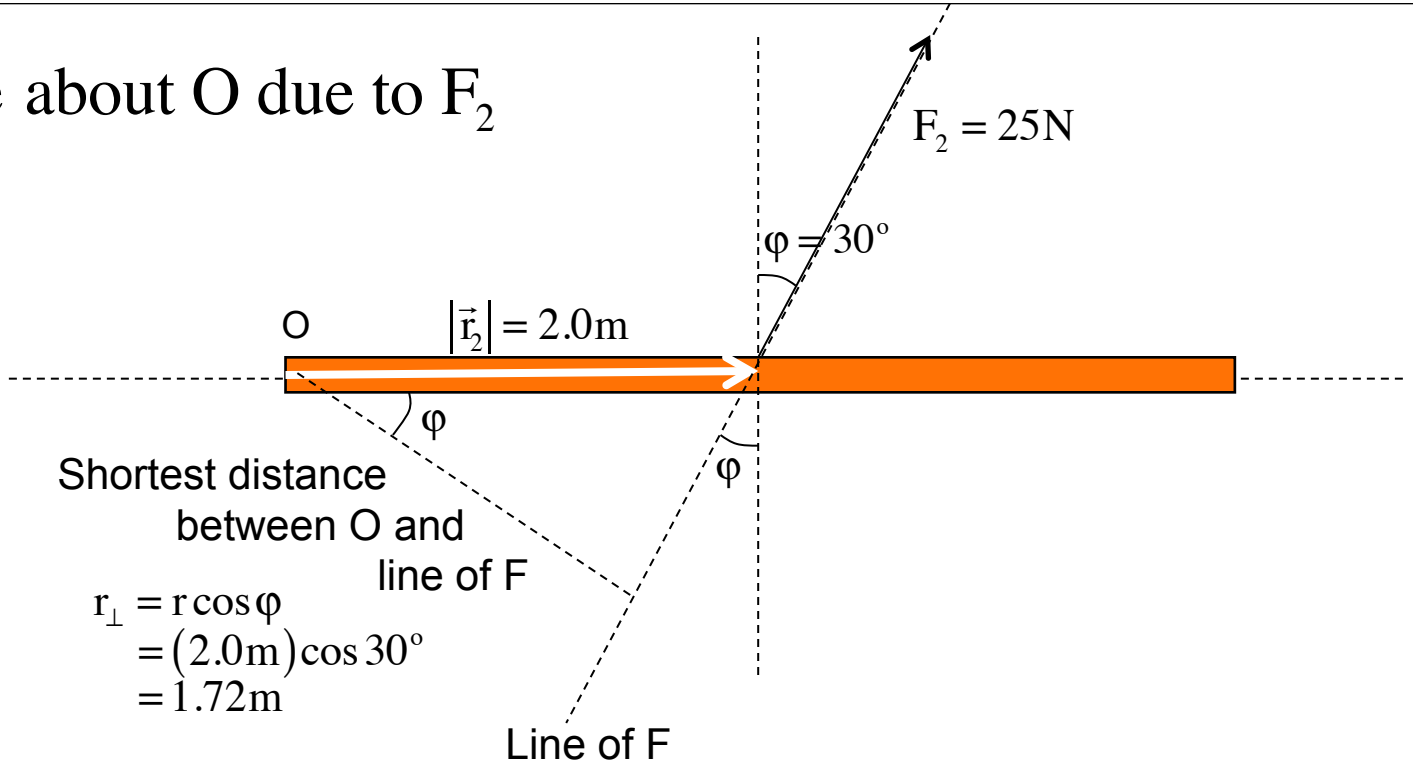
(using r-perpendicular approach)



Torque about O due to F_2

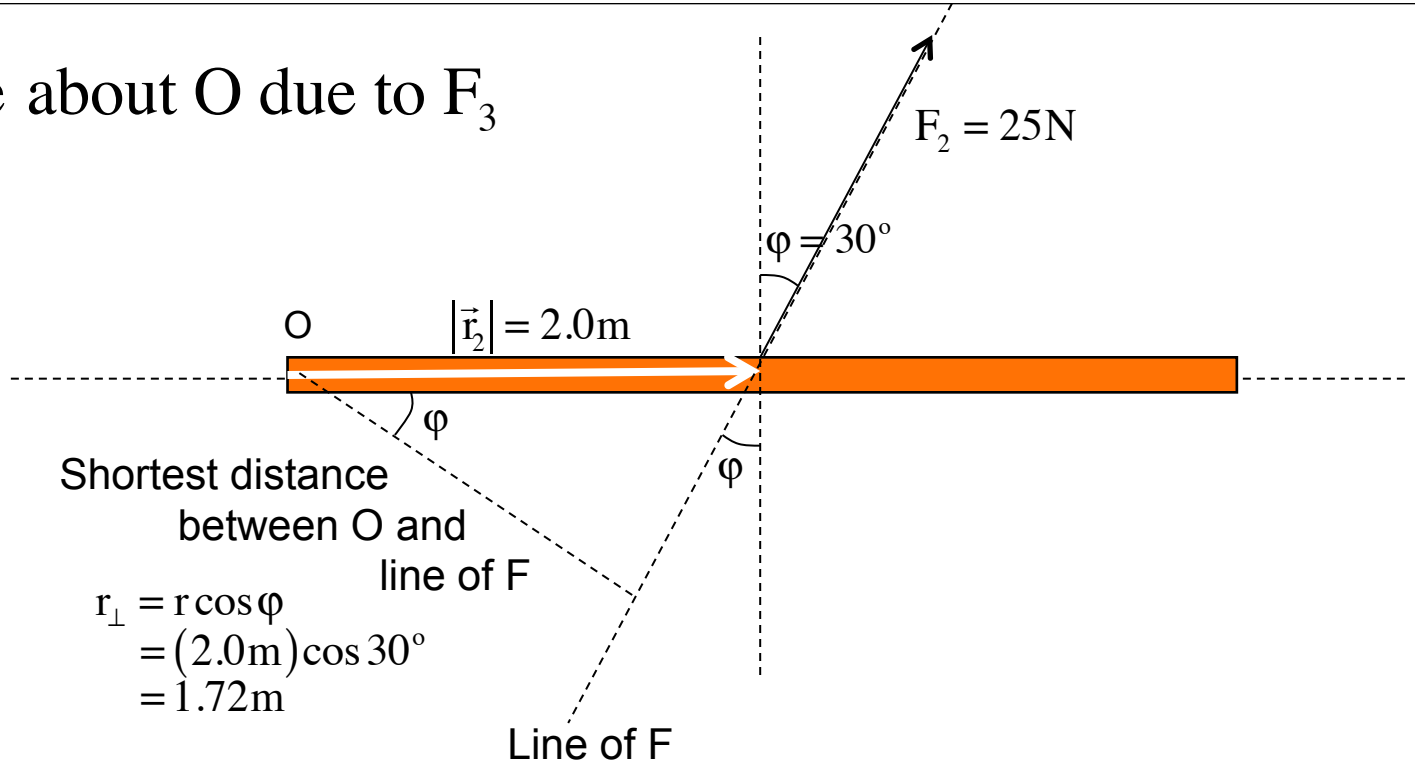


Torque about O due to F_2



$$r_\perp = r\cos\varphi$$
$$= (2.0\text{m})\cos 30^\circ$$
$$= 1.72\text{m}$$

Torque about O due to F_3

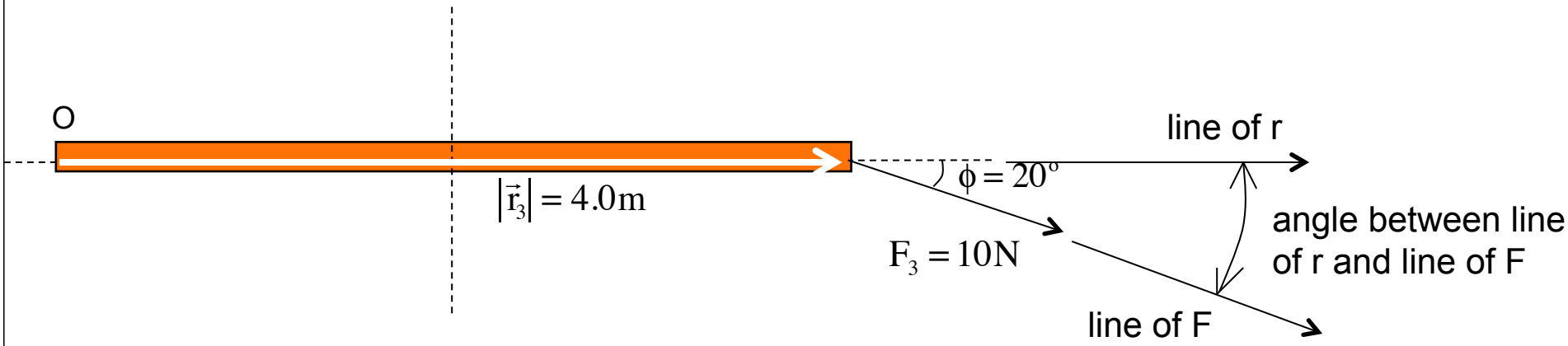


$$r_\perp = r\cos\varphi$$
$$= (2.0\text{m})\cos 30^\circ$$
$$= 1.72\text{m}$$

$$|\Gamma_{F_2}| = (r_{2,\perp})F_2$$
$$= (r\cos\varphi)(F_2)$$
$$= [(2.0\ \text{m})\cos 30^\circ](25\ \text{N})$$
$$= 43.0\ \text{N}\cdot\text{m}$$

And because this force is motivating the beam to rotate counterclockwise around Point O, the torque is POSITIVE.

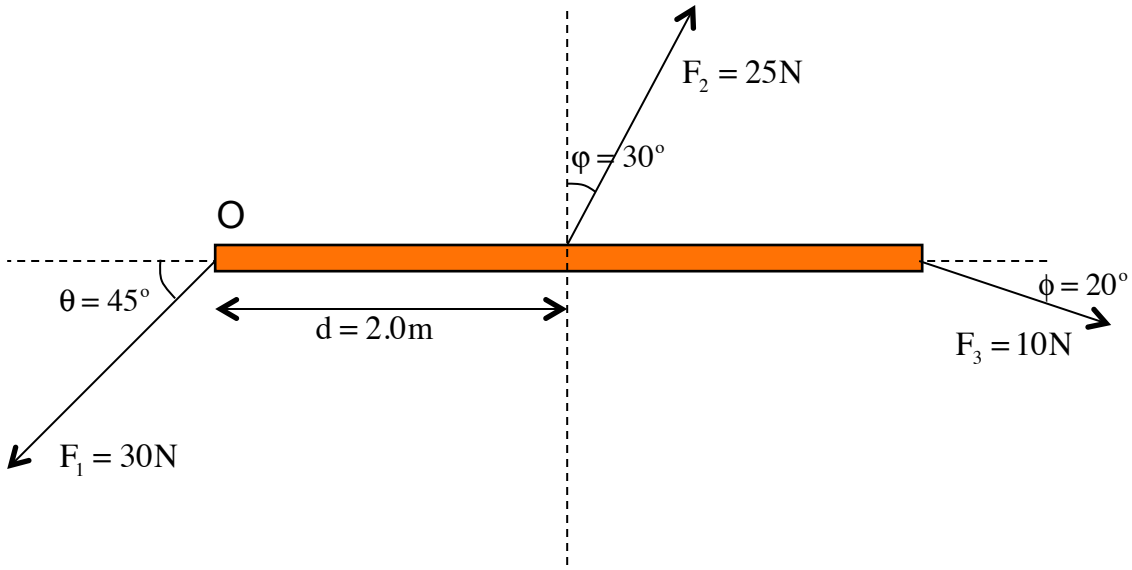
Torque about O due to F_3
(using definition approach)



$$\left|\Gamma_{F_3}\right| = |r_3||F_3|\sin\xi$$
$$= (4\ \text{m})(10\ \text{N})\sin 20^\circ$$
$$= 13.7\ \text{N}\cdot\text{m}$$

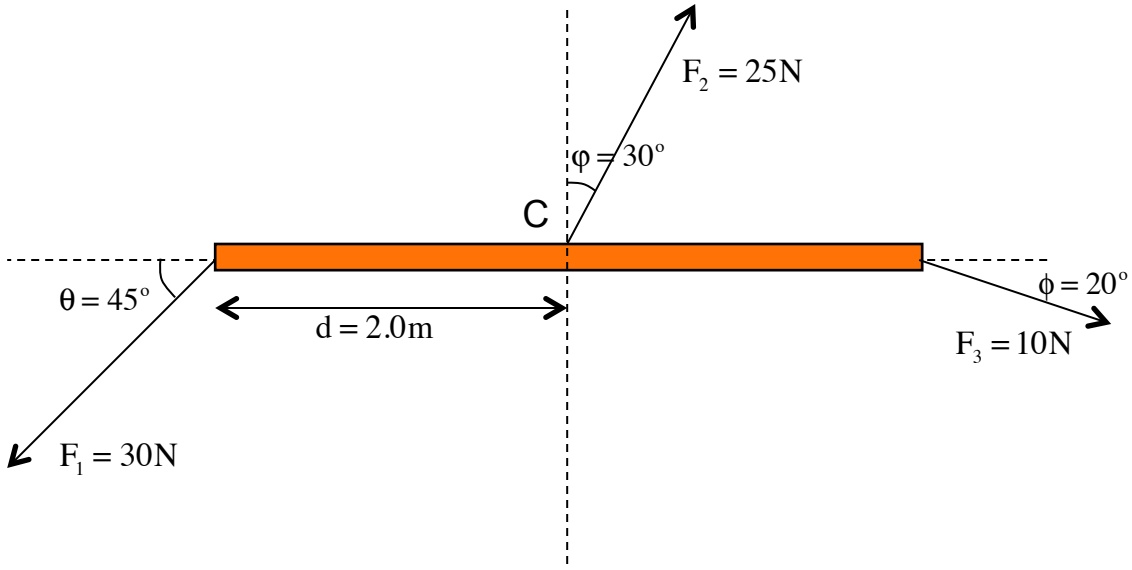
And because this force is motivating the beam to rotate clockwise around Point O, the torque is NEGATIVE.

NET SUM OF TORQUES ABOUT "O" ARE:



Just add the individual torques together . . .

b.) Derive an expression for the net torque about "C" (the center of mass) about an axis perpendicular to the page.



The only things that's different about this will be the definition of "r." Know how to do that and you're home free.