Lec12

Monday, October 19, 2020 7:59 AM

Lecture Objectives

- Reduction of distributed loading
- Equilibrium for a system of particles

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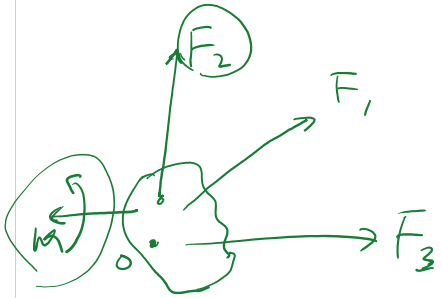


$$\vec{F}_R = \vec{F}_1 + \vec{F}_2 + \vec{F}_3$$

$$\vec{M}_{R_O} = \vec{M}_{1_O} + \vec{M}_{2O} + \vec{M}_{3O}$$

i-Clicker Time

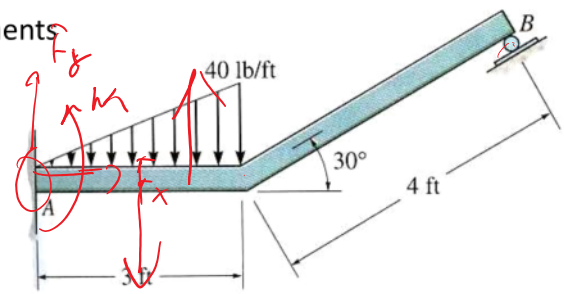
How many reaction support force components and couple moments are there in this problem?

A) Two force components, two couple moments

B) One force component, two couple moments

✓ C) Three force components, one couple moment

D) Three force components



i-Clicker Time

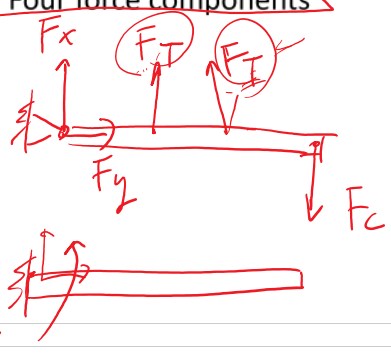
The beam and the cable (with a frictionless pulley at D) support an 80 kg load at C. In a FBD of the beam, how many unique force components and moments are there?

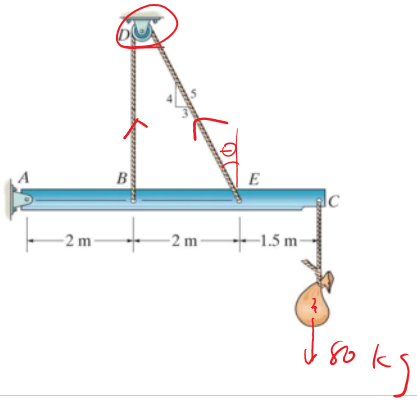
A) Two force components and one couple moment

B) Three force components and one couple moment

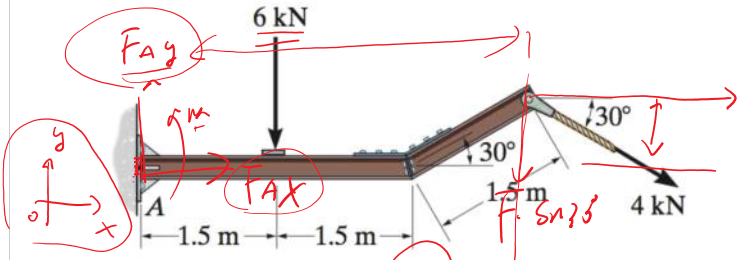
C) Three force components

D) Four force components





Determine the components of the support reactions at the fixed support *A* on the cantilevered beam.



$\Sigma F_x = 0$

$\Sigma F_y = 0$ $\Rightarrow$

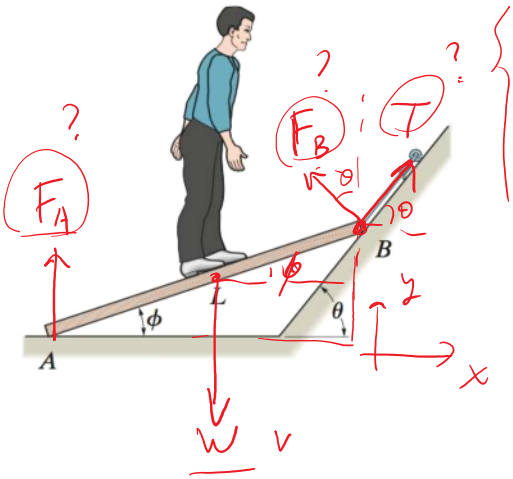
$\Sigma M_A = 0$

$F_{Ax} + F\cos 30^\circ = 0$

$F_{Ay} - F\sin 30^\circ - 6 = 0$

$M_A - 6\times 1.5 - F\sin 30^\circ(3 + 1.5\cos 30^\circ) - F\cos 30^\circ \cdot 1.5\sin 30^\circ = 0$

The man has a weight *W* and stands at the center of a plank with negligible weight. If the planes at *A* and *B* are smooth, determine the tension in the cord in terms of *W* and ϑ.



$$\begin{cases} \Sigma F_x = 0 \\ \Sigma F_y = 0 \\ \Sigma M_B = 0 \end{cases} \Rightarrow \begin{cases} T\cos\theta - F_B \sin\theta = 0 \\ F_A + T\sin\theta + F_B\cos\theta - W = 0 \\ W\cdot\frac{L}{2}\cos\phi - F_A\, L\cos\phi = 0 \end{cases}$$

i-Clicker Time

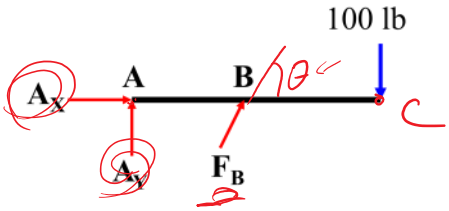
Which equation of equilibrium allows you to determine F_B right away?

A) $\sum F_X = 0$

B) $\sum F_Y = 0$

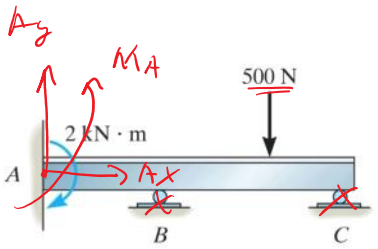
C) $\sum M_A = 0$

D) Any one of the above.



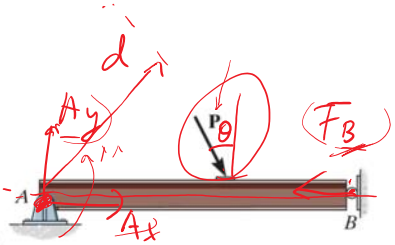
Constraints

To ensure equilibrium of a rigid body, it is not only necessary to satisfy equations of equilibrium, but the body must also be properly constrained by its supports

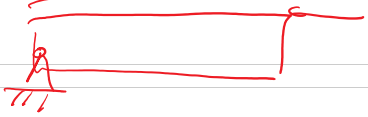


- **Redundant constraints**: the body has more supports than necessary to hold it in equilibrium; the problem is STATICALLY INDERTERMINATE and cannot be solved with statics alone

- **Improper constraints:** In some cases, there may be as many unknown reactions as there are equations of equilibrium. However, if the supports are not properly constrained, the body may become unstable for some loading cases.



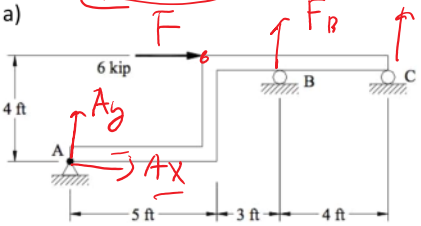
$\Sigma M_A = 0 \Rightarrow P \cdot d \neq 0$



Constraints

Proper, redundant, or improper constraints

a)



$\Sigma F_x = 0$

$\Sigma F_y = 0$

$\Sigma M_A = 0$