Lecture 13

Wednesday, September 27, 2017 12:08

To do ...

- Quiz 3 – in class – next Monday Oct 2

- HW 9 ME due **Thurs**
- HW 10 PL due **Tues**

HAPPY Birthday!

Page 2

Wednesday, September 27, 2017 12:08

To do ...

- Quiz 3 – in class – next Monday Oct 2

- HW 9 ME due **Thurs**
- HW 10 PL due **Tues**

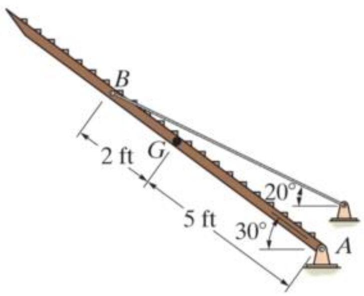
BBC NEWS

BBC Trending

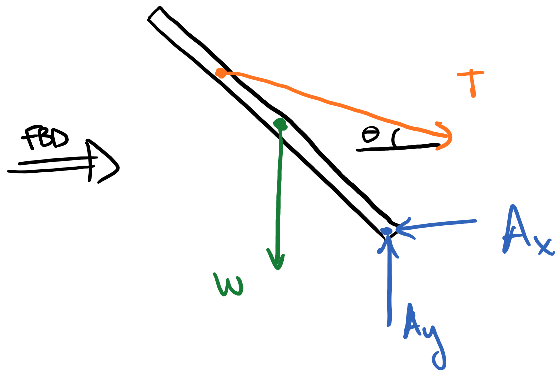
Rapper B.o.B. raising funds to check if Earth is flat

Monday, September 19, 2016 10:49

The uniform truck ramp has weight 400 lb and is pinned to the body of the truck at each side and held in the position shown by the two side cables. Determine the reaction forces at the pins and the tension in the cables.



idealized model



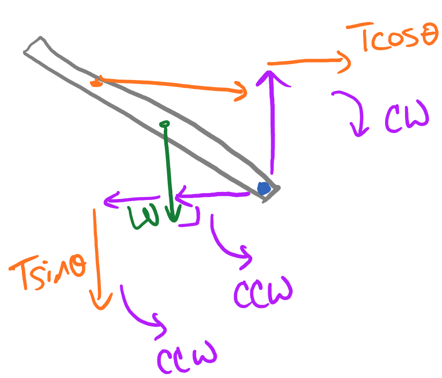
* 3 unknowns: |T|, A_x, A_y

Sum of forces:

ΣF_x: $T\cos\theta - A_x = 0 \rightarrow$ (1) $A_x = T\cos\theta$

ΣF_y: $A_y - W - T\sin\theta = 0 \rightarrow$ (2) $A_y = W + T\sin\theta$

Sum of moments:



$$\sum \vec{M}_A = W(5\cos(30)) + (T\sin\theta)(7\cos(30)) - (T\cos\theta)(7\sin(30)) = 0$$

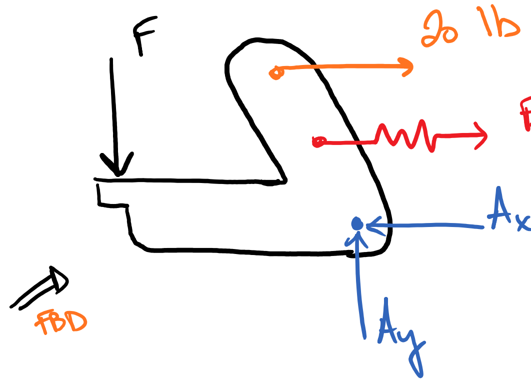
$$T(7\cos(30)\sin(20) - 7\sin(30)\cos(20)) = 5\cos(30)W$$

$$\boxed{T = 1425 \text{ lb}}$$

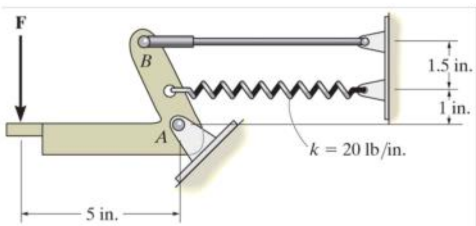
$$A_x = T\cos(20) = \boxed{1339 \text{ lb}}$$

$$A_y = W + T\sin(20) = \boxed{887 \text{ lb}}$$

The operator applies a vertical force to the pedal so that the spring is stretched 1.5 in. and the force in the short link at B is 20 lb. Determine the vertical force applied to the pedal.



$F_s = k\Delta s = 20\,\frac{lb}{in} \cdot \frac{3}{2}\,in = 30\,lb$



idealized model

× 3 unknowns!

Sum of forces:

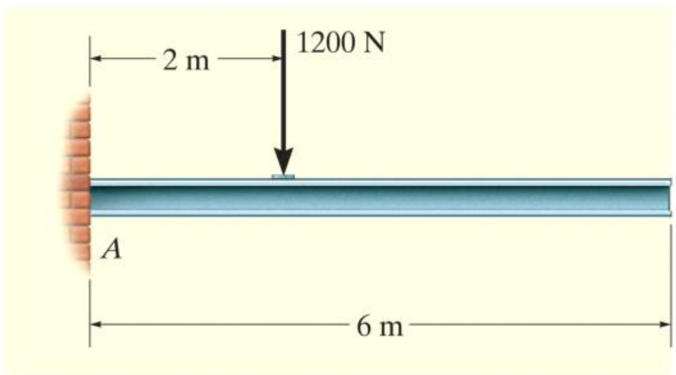
$\Sigma F_x: \; 20 + 30 - A_x = 0 \quad \therefore \quad \boxed{A_x = 50\ lb}$

$\Sigma F_y: \; A_y - F = 0 \quad \therefore \quad \boxed{A_y = F = 16\ lb}$

Sum of moments:

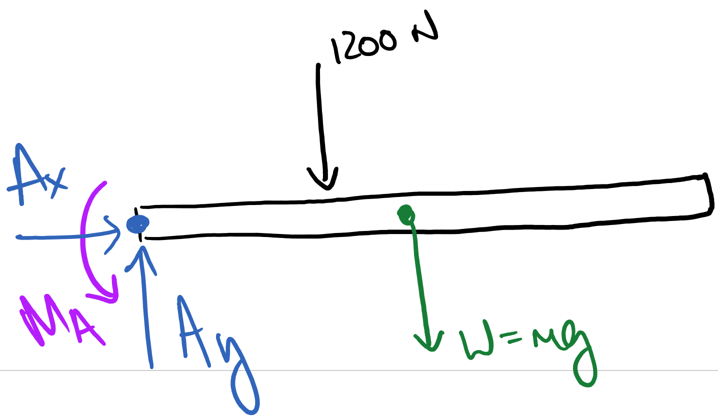
$$\Sigma \vec{M}_A = 5F - (1)(30) - (2.5)(20) = 0$$

$$F = \frac{30 + 50}{5} = \boxed{16\ lb}$$



The beam has a mass of 100 kg and experiences a load of 1200 N. Find the support reactions at A.

- fixed support
- DRAW FBD



Sum forces

ΣF_x: $A_x = 0$

ΣF_y: $A_y - mg - 1200 = 0$

$A_y = 1200 + (100)(9.8) = 2180\ N$

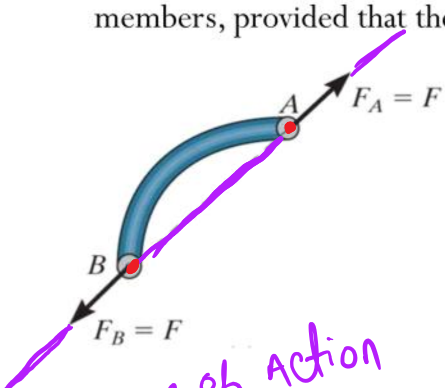
Sum moments:

$$\sum M_R: \quad M_A - (2\,m)(1200\,N) - (3\,m)\left(100\,kg \cdot 9.8\,\frac{m}{s^2}\right) = 0$$

$$\vec{M}_A = 5340\,N \quad (CCW)$$

Two-force members

In the cases above, members AB can be considered as two-force members, provided that their weight is neglected.



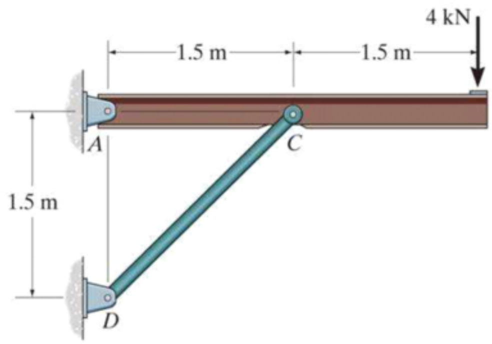
Line of Action is the line connecting where the forces Are Applied.

- Any member with only two forces Applied

- To be in equilibrium: → $\Sigma F_x = 0$, $\Sigma F_y = 0$, $\Sigma M_o = 0$

- $|\vec{F_A}| = |\vec{F_B}|$
- $\vec{F_A} + \vec{F_B} = 0$
- line of Action is the SAME for $\vec{F_A}$ And $\vec{F_B}$

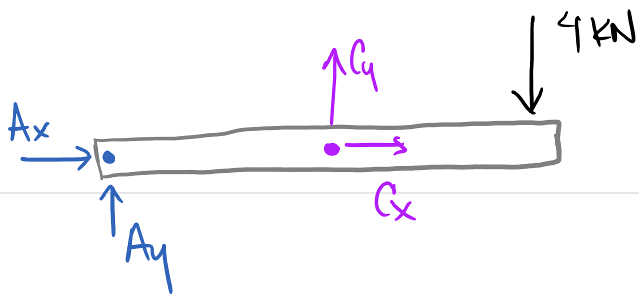
↳ therefore you know the Direction of $\vec{F_A}$ And $\vec{F_B}$



Given the 4 kN load at B of the beam is supported by pins at A and C. Find the support reactions at A and C.

- idealized model
- identify 2-force and 3-force members
- DRAW FBD
  - Determine the number of unknowns.

FBD of BEAM AB



ΣF_x: $A_x + C_x = 0$

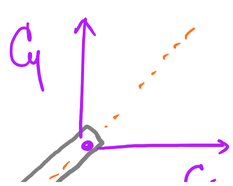
ΣF_y: $A_y + C_y - 4kN = 0$

ΣM_A: $(1.5m)\,C_y - (3m)(4\,kN) = 0$

* 4 unknowns, A_x, A_y, C_x, C_y

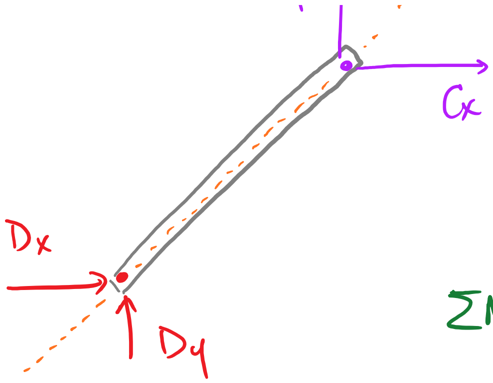
cannot solve!!

DRAW the FBD of the link DC



ΣF_x: $C_x + D_x = 0$ $\therefore$ $C_x = -D_x$

$C_y = -D_y$



ΣF_x: $C_x + D_x = 0$ $\quad$ $C_x = -D_x$

ΣF_y: $C_y + D_y = 0$ $\quad \therefore \quad$ $C_y = -D_y$

ΣM_D: $(1.5m)C_x - (1.5m)C_y = 0 \quad \therefore \quad C_x = C_y$

$\Rightarrow \quad C_x = C_y = -D_x = -D_y$

- $|\vec{C}| = |\vec{D}|$
- $\vec{C} + \vec{D} = 0$
- $\theta = \tan^{-1}\left(\frac{C_y}{C_x}\right) = \tan^{-1}\left(\frac{D_y}{D_x}\right) = \pm 45°$

It is A 2-force MEMBER!!

So you know direction, not magnitude!

using ΣM_A from Above...

ΣM_A: $(1.5m) F_c \sin(45) - 3(4kN) = 0$

$$\boxed{F_c = 11.3 \text{ kN}}$$

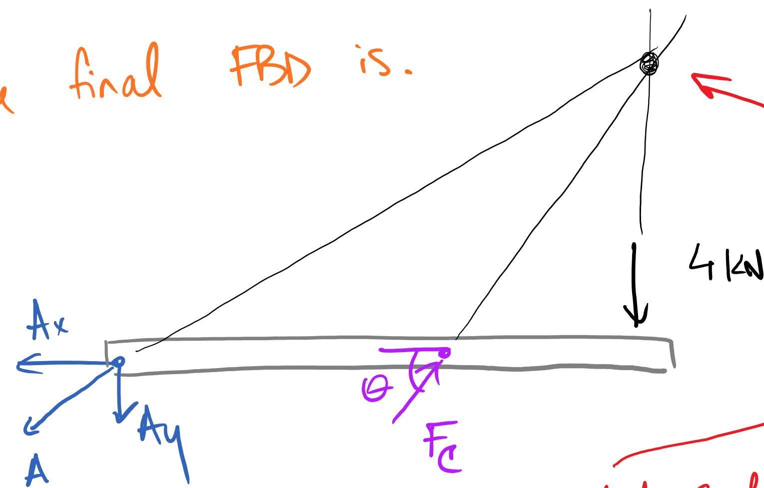
ΣF_x: $A_x = -F_c \cos(45) = \underline{-8.00 \text{ kN}}$

ΣF_y: $A_y = 4kN - F_c \sin(45) = \underline{-4.00 \text{ kN}}$

* negative sign means the sense is in

the other direction:

the final FBD is.



* A 3-force member in EM has all lines of action meet at a point!