To do ...

- Quiz 3 – in class – next Monday Oct 2
- HW 9 ME due Thurs
- HW 10 PL due Tues

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

* 3 unknowns: $H_1, A_x, A_y$

Sum of forces:

$\Sigma F_x: \quad T \cos \theta - A_x = 0 \rightarrow (1) \quad A_x = T \cos \theta$

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

Sum of moments:
\[ \sum N_A = W(5 \cos(30)) + (T \sin(\theta))(7 \cos(30)) - (T \cos(\theta))(7 \sin(30)) = 0 \]

\[ T \left(7 \cos(30) \sin(20) - 7 \sin(30) \cos(20)\right) = 5 \cos(30) \text{ W} \]

\[ T = 1425 \text{ lb} \]

\[ A_x = T \cos(20) = 1339 \text{ lb} \]

\[ A_y = W + T \sin(20) = 887 \text{ lb} \]
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.

\[ F = k \Delta s = 20 \text{lb/in.} \times \frac{3}{2} \text{in.} = 30 \text{lb} \]

\[ x \text{ unknowns!} \]

**Sum of forces:**

\[ \sum F_x: \quad 20 + 30 - A_x = 0 \quad \therefore \quad A_x = 50 \text{ lb} \]

\[ \sum F_y: \quad A_y - F = 0 \quad \therefore \quad A_y = F = 16 \text{ lb} \]

**Sum of moments:**

\[ \sum \vec{M}_A = 5F - (1)(30) - (2.5)(20) = 0 \]

\[ F = \frac{30 + 50}{5} = 16 \text{ lb} \]
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

\[ \Sigma F_y: \quad A_y - mg - 1200 = 0 \]
\[ A_y = 1200 + (100)(9.8) = 2180 \text{ N} \]

\[ \Sigma \text{Sum moments:} \]
\[ \sum M_R: \quad M_A - (2m)(1200 \text{N}) - (3m)(100 \text{ kg} \cdot 9.8 \frac{\text{N}}{\text{kg}}) = 0 \]

\[ \vec{M}_A = 5340 \text{ N (CCW)} \]
Two-force members

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

- Any member with only two forces applied
- To be in equilibrium:
  - $\Sigma F_x = 0$
  - $\Sigma F_y = 0$
  - $\Sigma M_0 = 0$

- $|F_A| = |F_B|$
- $F_A + F_B = 0$
- Line of action is the same for $F_A$ and $F_B$

Therefore, you know the direction of $F_A$ and $F_B$. 

Line of action is the line connecting where the forces are applied.
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.

\[ \sum F_x: \quad A_x + C_x = 0 \]
\[ \sum F_y: \quad A_y + C_y - 4\text{kN} = 0 \]
\[ \sum M_A: \quad (1.5\text{m})C_y - (3\text{m})(4\text{kN}) = 0 \]

\[ \times 4 \text{ unknowns, } A_x, A_y, C_x, C_y \]
Cannot solve!!

Draw the FBD of the link DC

\[ \sum F_x: \quad C_x + D_x = 0 \]
\[ \sum C_y: \quad C_y = -D_y \]
\[ C_x = -D_x \]
\[ \Sigma F_x: \ C_x + D_x = 0 \quad \therefore \quad C_x = -D_x \]

\[ \Sigma F_y: \ C_y + D_y = 0 \quad \therefore \quad C_y = -D_y \]

\[ \Sigma M_B: \ (1.5\text{m})C_x - (1.5\text{m})C_y = 0 \quad \therefore \quad C_x = C_y \]

\[ \Rightarrow \quad C_x = C_y = -D_x = -D_y \]

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

It is a 2-force member!!

So you know direction, not magnitude!

Using \( \Sigma MA \) from above...

\[ \Sigma M_A: \ (1.5\text{m})F_c \sin(45) - 3(4\text{kN}) = 0 \]

\[ F_c = 11.3 \text{ kN} \]

\[ \Sigma F_x: \ A_x = -F_c \cos(45) = -8.00 \text{ kN} \]

\[ \Sigma F_y: \ A_y = 4 \text{kN} - F_c \sin(45) = -4.00 \text{ kN} \]

* negative sign means the sense is in
The final FBD is.

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