Engineering Mechanics
AGE 2330

Lect 5: Equilibrium 2

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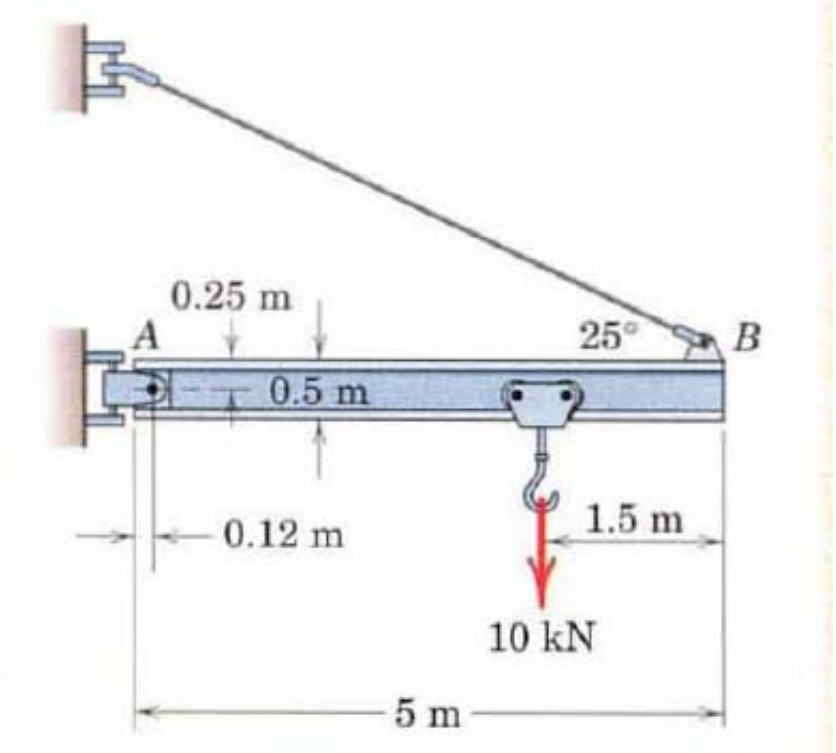
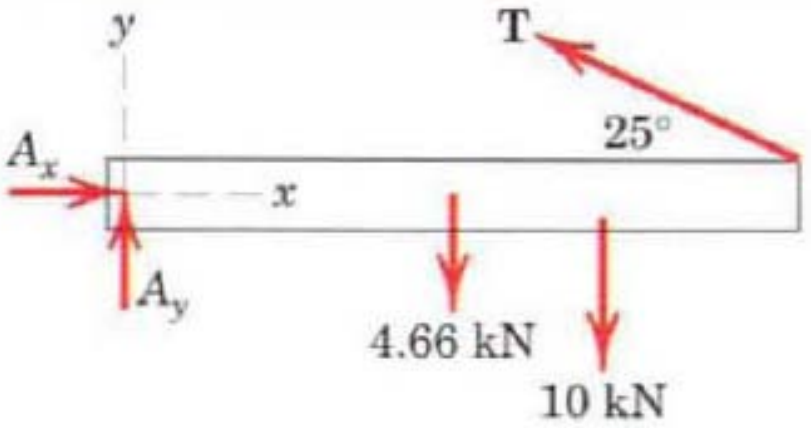
Sample Problem 3/4

Determine the magnitude T of the tension in the supporting cable and the magnitude of the force on the pin at A for the jib crane shown. The beam AB is a standard 0.5-m I-beam with a mass of 95 kg per meter of length.





Free-body diagram

① tion. In applying the moment equation about A, it is simpler to consider the moments of the x- and y-components of **T** than it is to compute the perpendicular distance from **T** to A. Hence, with the counterclockwise sense as positive we write

② $[\Sigma M_A = 0]$ $(T \cos 25°)0.25 + (T \sin 25°)(5 - 0.12)$

$$- 10(5 - 1.5 - 0.12) - 4.66(2.5 - 0.12) = 0$$

from which $T = 19.61$ kN *Ans.*

Equating the sums of forces in the x- and y-directions to zero gives

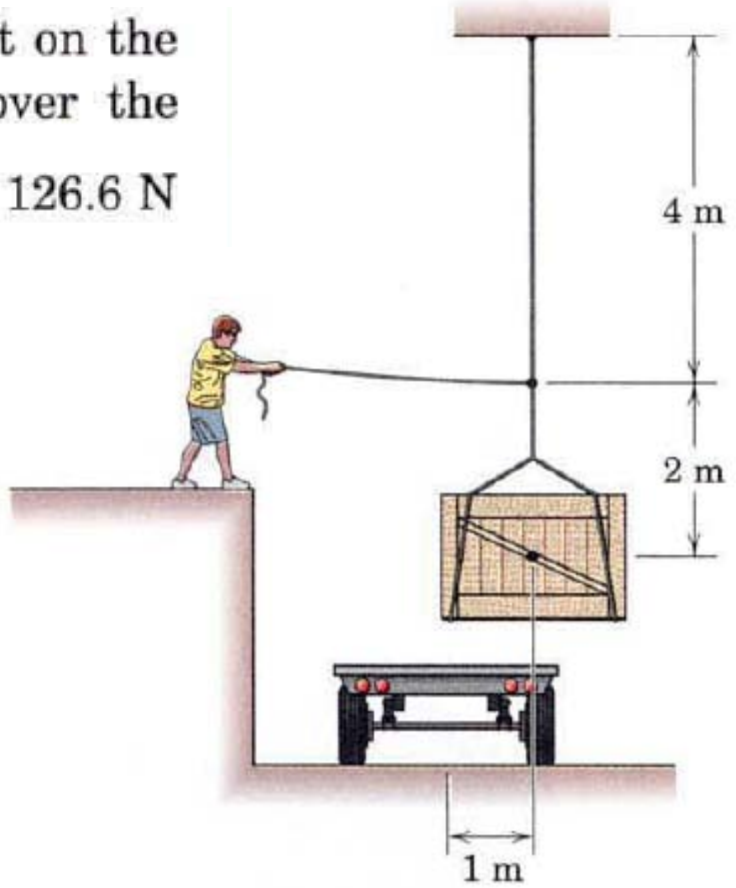
$[\Sigma F_x = 0]$ $A_x - 19.61 \cos 25° = 0$ $A_x = 17.77$ kN

$[\Sigma F_y = 0]$ $A_y + 19.61 \sin 25° - 4.66 - 10 = 0$ $A_y = 6.37$ kN

③ $[A = \sqrt{A_x^2 + A_y^2}]$ $A = \sqrt{(17.77)^2 + (6.37)^2} = 18.88$ kN *Ans.*

3/7 What horizontal force P must a worker exert on the rope to position the 50-kg crate directly over the trailer?

Ans. $P = 126.6$ N



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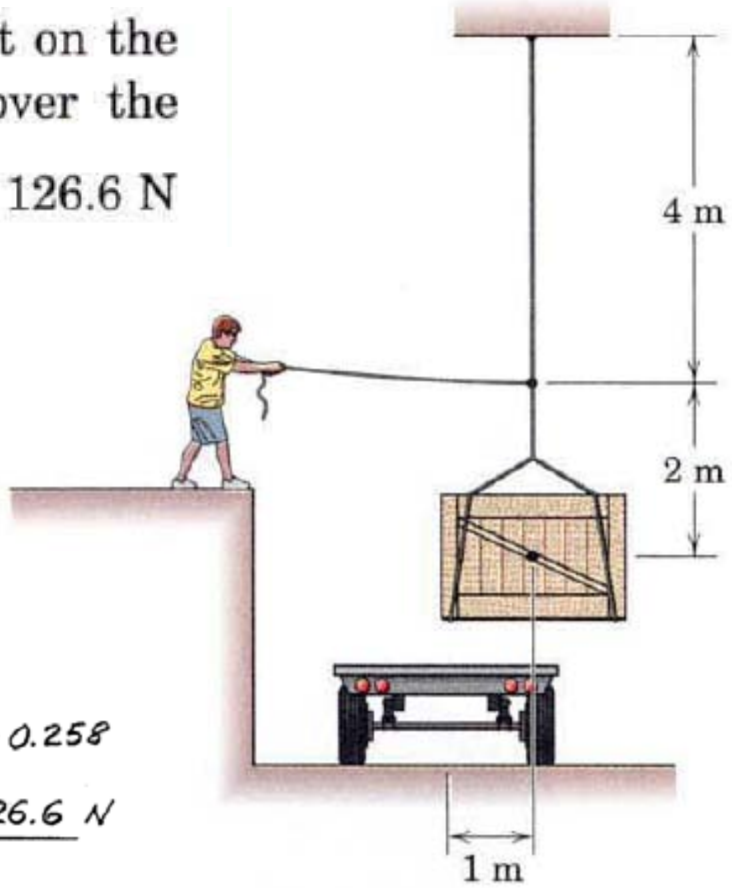

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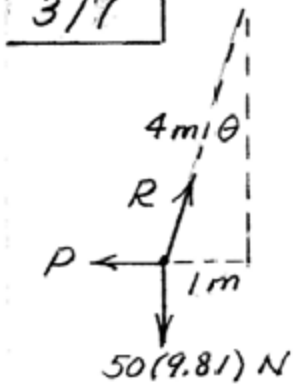
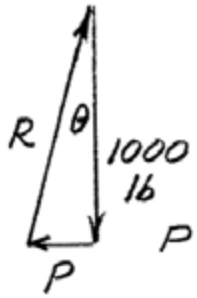




$P = 50(9.81)\tan\theta$

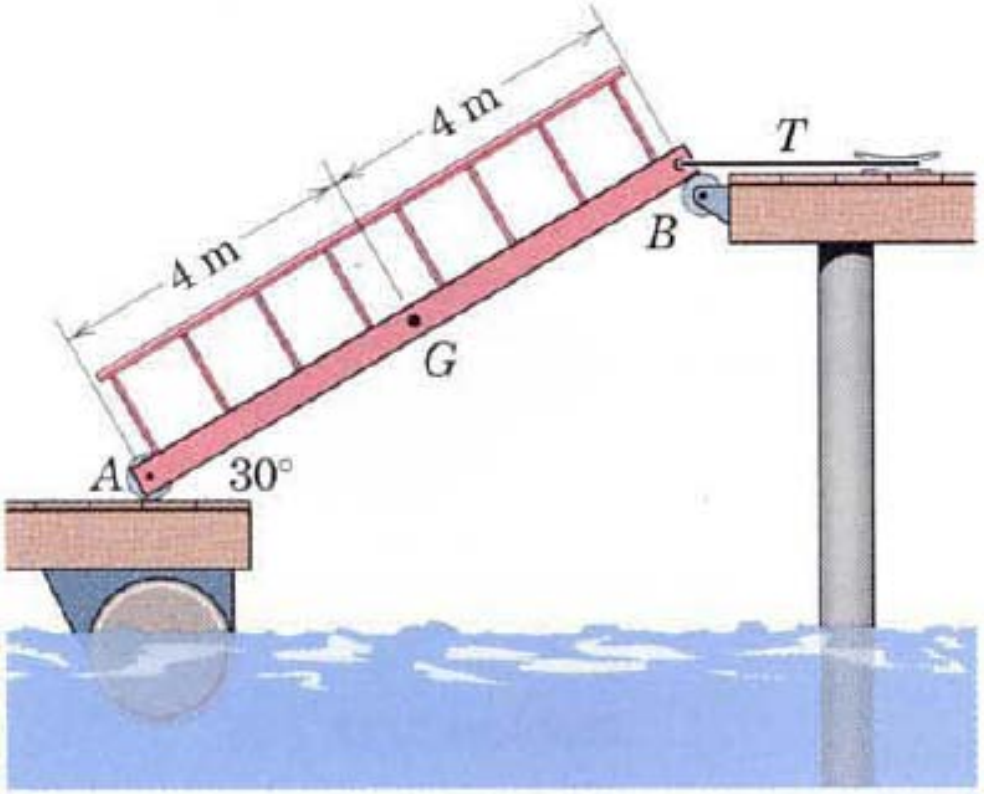
$\sin\theta = 1/4$

$\tan\theta = 1/\sqrt{4^2 - 1^2} = 0.258$

$P = 50(9.81)(0.258) = \underline{126.6\ N}$

3/17 To accommodate the rise and fall of the tide, a walkway from a pier to a float is supported by two rollers as shown. If the mass center of the 300-kg walkway is at G, calculate the tension T in the horizontal cable which is attached to the cleat and find the force under the roller at A.

Ans. $T = 850$ N, $A = 1472$ N



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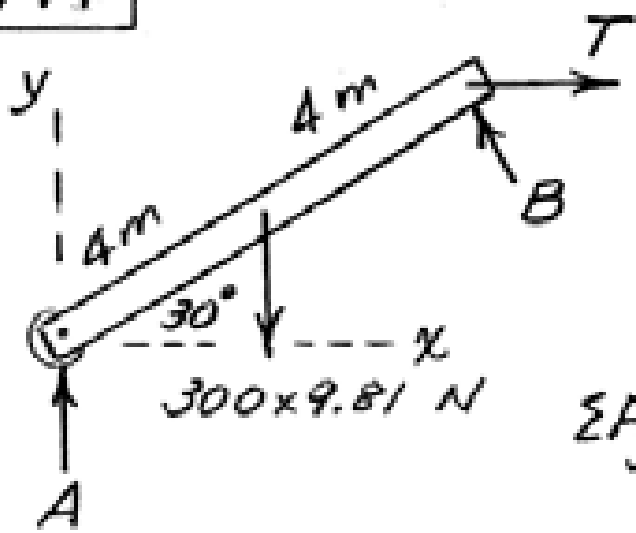


$\Sigma M_B = 0;$

$300(9.81)\,4\cos 30° - 8A\cos 30° = 0,$

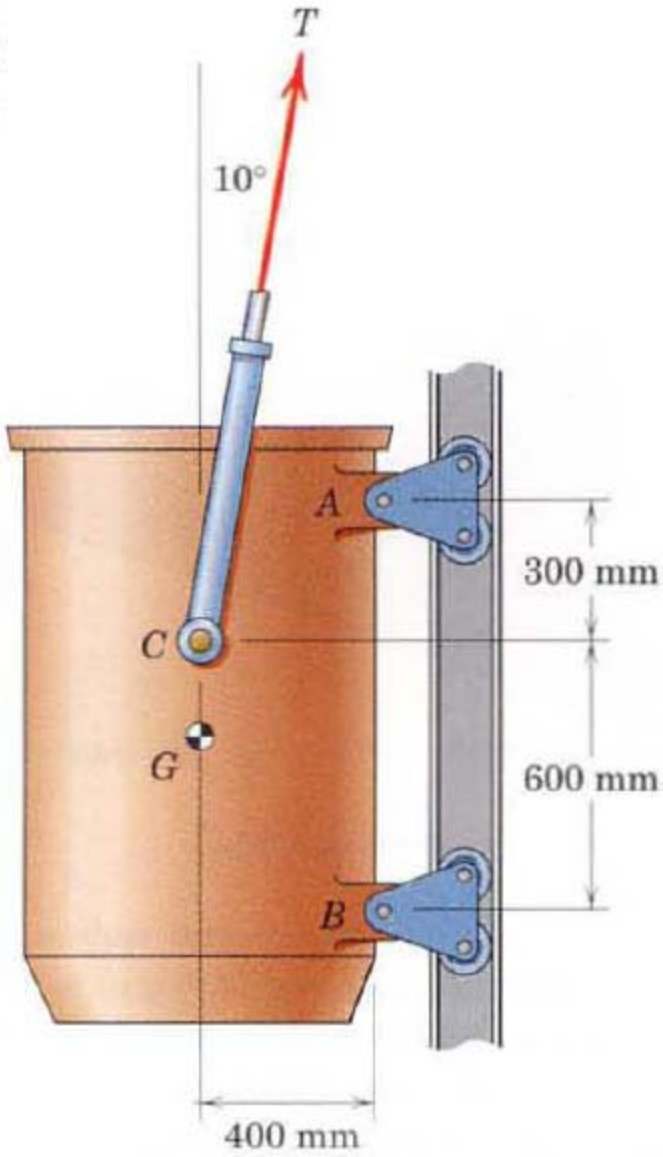
$A = 1472\ N$

$\Sigma F_y = 0;\ B\cos 30° + 1472 - 300(9.81) = 0$

$B = 1699\ N$

$\Sigma F_x = 0;\ T - 1699\sin 30° = 0,\quad T = 850\ N$

3/36 The concrete hopper and its load have a combined mass of 4 metric tons (1 metric ton equals 1000 kg) with mass center at G and is being elevated at constant velocity along its vertical guide by the cable tension T. The design calls for two sets of guide rollers at A, one on each side of the hopper, and two sets at B. Determine the force supported by each of the two pins at A and by each of the two pins at B.



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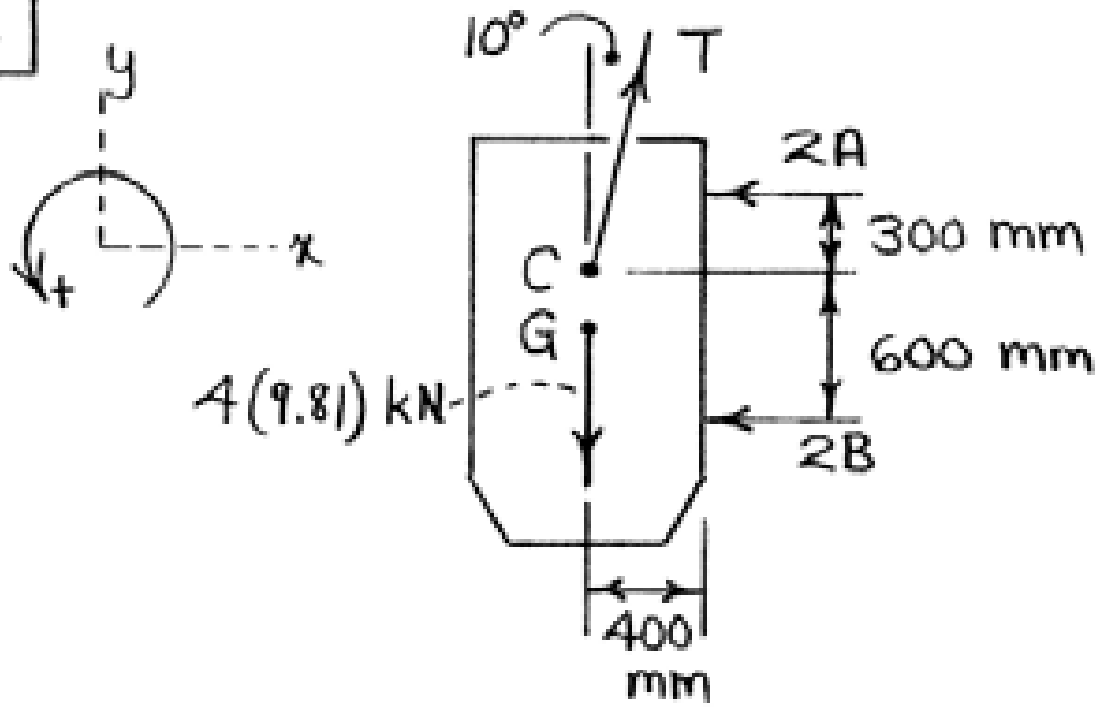

$\Sigma F_y = 0$: $T\cos 10° - 4(9.81) = 0$, $T = 39.8$ kN

$\Sigma M_C = 0$: $2A(300) - 2B(600) = 0$, $A = 2B$

$\Sigma F_x = 0$: $39.8 \sin 10° - 2(2B) - 2B = 0$

$B = 1.153$ kN

$A = 2B = 2(1.153) = 2.31$ kN