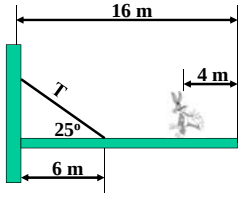
Shelves, Torque, and Forces

A 16 meter shelf (mass 100 kg) is supporting Bug's Bunny (mass 10 kg) as noted in the drawing below.

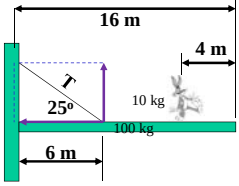


F_{wall} = ?

T = ?

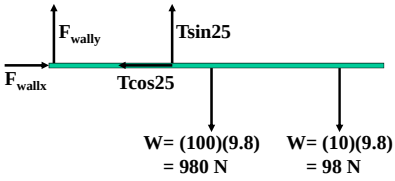
Steps for Solving

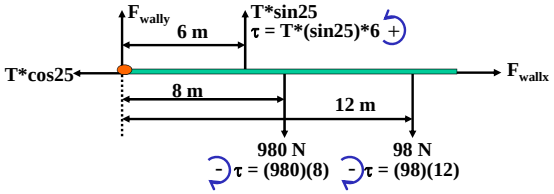
- Draw FBD.
- Write net force equations.
- Pick a place for the hinge.
- Determine relevant distances.
- Write net torque equations.
- Solve (Math)



F_{wall} = ?

T = ?





ΣF_x: $F_{wallx} - T^*\cos 25 = 0$

ΣF_y: $F_{wally} + T^*\sin 25 - (980) - (98) = 0$

$\Sigma\tau$: $T^*(\sin 25)^*(6) - (980)(8) - (98)(12) = 0$

$\Sigma\tau$: $T\sin 25(6) - (100)(9.8)(8) - (10)(9.8)(12) = 0$

$\Sigma\tau$: $T\sin 25(6) - 7840 - 1176 = 0$

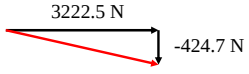
$\Sigma\tau$: $T\sin 25 = 1502.7$ **T = 3555.6 N**

ΣF_y: $F_{wally} + 3555.6\sin 25 - (100)(9.8) - (10)(9.8) = 0$

F_{wally} = - 424.7 N

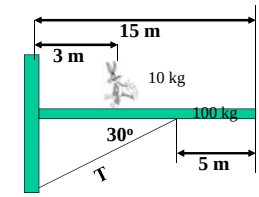
ΣF_x: $F_{wallx} - 3555.6\cos 25 = 0$

F_{wallx} = 3222.5 N



$$F_{wall} = \sqrt{424.7^2 + 3222.5^2}$$

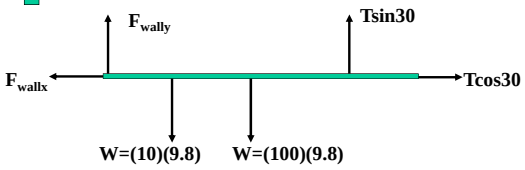
F_{wall} =3250 N

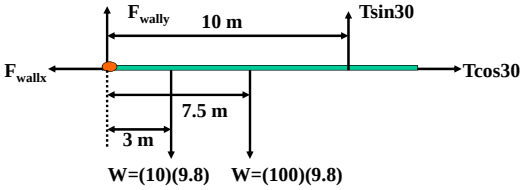


$F_{wallx} = ?$

$F_{wally} = ?$

$T = ?$





ΣF_x: $T\cos 30 - F_{wallx} = 0$

ΣF_y: $F_{wally} + T\sin 30 - (100)(9.8) - (10)(9.8) = 0$

$\Sigma\tau$: $T\sin 30(10) - (100)(9.8)(7.5) - (10)(9.8)(3) = 0$

$\Sigma\tau$: $T\sin 30(10) - (100)(9.8)(7.5) - (10)(9.8)(3) = 0$

$\Sigma\tau$: $T\sin 30(10) - 7350 - 294 = 0$

$\Sigma\tau$: $T\sin 30 = 764.4$

$T = 1528.8$ N

ΣF_y: $F_{wally} + 1528.8\sin 30 - (100)(9.8) - (10)(9.8) = 0$

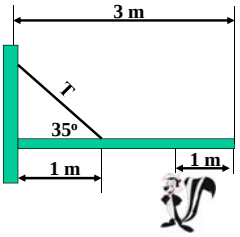
$F_{wally} = 313.6$ N

ΣF_x: $1528.8\cos 30 - F_{wallx} = 0$

$F_{wallx} = 1324$ N

Practice

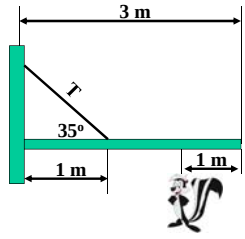
A 3 meter shelf (mass 20 kg) is supporting Pepe' Le Pew (mass 8 kg) as noted in the drawing below.



$F_{wallx} = ?$

$F_{wally} = ?$

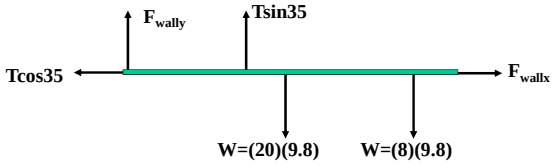
$T = ?$

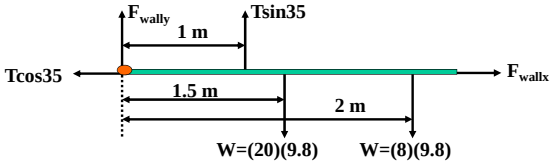


$F_{wallx} = ?$

$F_{wally} = ?$

$T = ?$





ΣF_x: $F_{wallx} - T\cos 35 = 0$

ΣF_y: $F_{wally} + T\sin 35 - (20)(9.8) - (8)(9.8) = 0$

$\Sigma\tau$: $T\sin 35(1) - (20)(9.8)(1.5) - (8)(9.8)(2) = 0$

$\Sigma\tau$: $T\sin35(1) - (20)(9.8)(1.5) - (8)(9.8)(2) = 0$

$\Sigma\tau$: $T\sin35(1) - 294 - 156.8 = 0$

$\Sigma\tau$: $T\sin35 = 450.8$

$\boxed{T = 785.95\ N}$

ΣF_y: $F_{wally} + 785.95\sin35 - (20)(9.8) - (8)(9.8) = 0$

$\boxed{F_{wally} = -176.4\ N}$

ΣF_x: $F_{wallx} - 785.95\cos35 = 0$

$\boxed{F_{wallx} = 643.81\ N}$