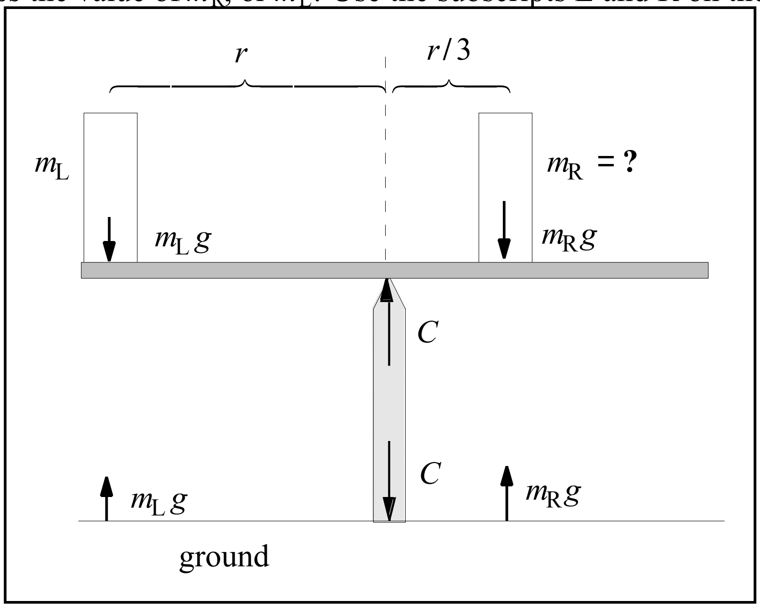
Homework 7

(**Do not guess** the value of m_R, or m_L! Use the subscripts L and R on the masses)



1. The weights are $W_L = m_L g$ and $W_R = m_R g$
2. The compression forces are $C_L = m_L g$ and $C_R = m_R g$ The directions (*are*) the same.
The forces acting on the board and on the earth are drawn on the Figure.
3 The force angles are 90°
4. Magnitude of torques about the pivot point are: $\tau_L = m_L gr$ and, $\tau_R = m_R gr/3$
5. The torque vectors try to rotate the board in the (*opposite*) directions
6. Mass m_L generates the torque <u>vector</u> , $\tau_L = -m_L gr$
7. Mass m_R generates the torque <u>vector</u> , $\tau_R = +m_R gr/3$
8. Net torque <u>vector</u> , acting on the board, $\tau_{Net} = -m_L gr + m_R gr/3$
9. The net torque on the board must be, $\tau_{Net} = 0$, if the board is balanced.
10 The right mass, $m_R = 3m_L$

$$-m_L gr + m_R gr/3 = 0$$
$$m_R/3 = m_L$$
$$m_R = 3m_L$$

11. The net force on the board must be, $\mathbf{F}_{Net} = 0$, if it is balanced.
12. The net force acting on the board, ($\mathbf{C}_L = -m_L g,$ $\mathbf{C}_R = -m_R g = -3m_L g$)

$$\mathbf{F}_{Net}, = \mathbf{C}_L + \mathbf{C}_R + \mathbf{C} = (-m_L g) + (-3m_L g) + (+C) = 0 \text{ (balanced)}$$

13. The magnitude $C = 4m_L g$.
The forces acting on the ground (*do*) balance
14. If the masses are hung from the board, the C's change to T's and <u>nothing else</u>.

15. The net force and net torque must be set equal to zero to determine the forces acting on a *balanced* beam

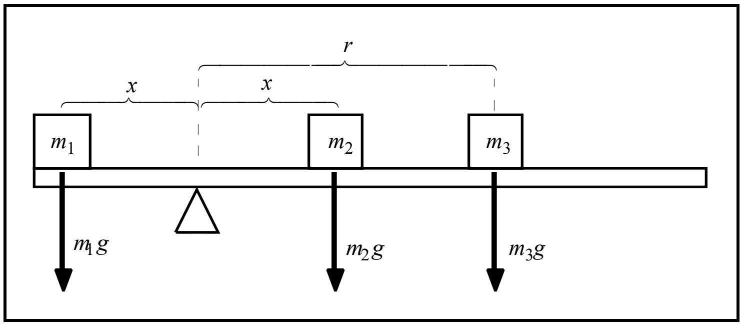


Figure for Problems 16-20: Three masses on a massless board.

16. The *force* vectors applied to the board are shown on the Figure and generate torques:

17 $\tau_1 = -m_1gx$, $\tau_2 = +m_2gx$, and , $\tau_3 = +m_3gr$ (+, clockwise)

18. Net torque vector $\tau_{Net} = \tau_1 + \tau_2 + \tau_3 = -m_1gx + m_2gx + m_3gr$

19. A balanced board has a net torque vector = 0 = $-m_1gx + m_2gx + m_3gr$

$$m_3gr = (m_1g - m_2g)x$$

$$r = [(m_1 - m_2)/ m_3]x$$

20. The location, r , of m_3 that will balance the board is a) $r = [(m_1 - m_2)/ m_3]x$

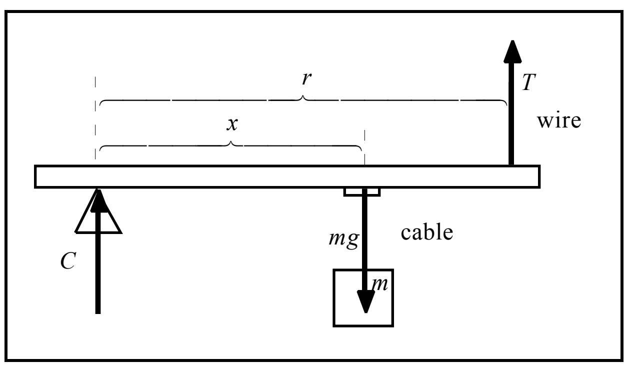


Figure for problems 22-25

21. $r = 10$ m , $m = 100$ kg, , $x = 7$ m ,

(**C** at the pivot, **F** in the cable (use m) , and **T** in the wire) are drawn on the Figure.

22. The torque *vectors* acting on the board are: $\tau_{pivot} = 0$, $\tau_{cable} = mgx$, $\tau_{wire} = -Tr$.

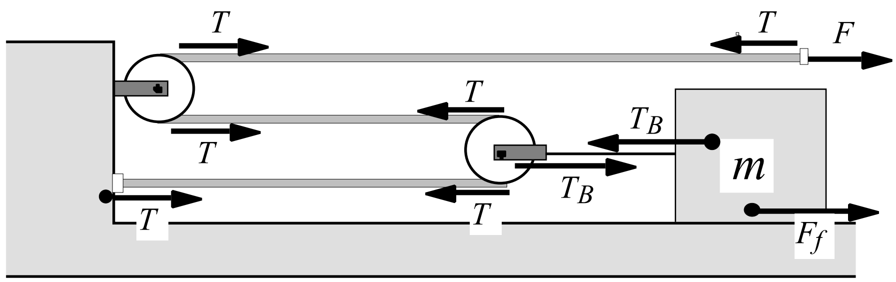
$\tau_{Net} = mgx - Tr = 0$ $\underline{T = mgx/r}$

23. The tension in the wire is, $T = mgx/r$= (100 kg)(10 N/kg)(7 m)/(10 m) = 700 N

$\mathbf{F}_{Net}$, = $\mathbf{C} + \mathbf{T} + \mathbf{F} = (+C_{pivot}) + (+mgx/r) + (-mg)$ $C_{pivot} = mg(1 - x/r)$

24. $C_{pivot} = mg(1 - x/r)$ = (1000 N)[1– (7 m)/(10 m)] = (1000 N)(0.3) = 300 N

Homework 7



$\underline{T = F}$ (balance at the handle)

$T_B = 2T = 2F$ (balance at the pulley)

$F_f = T_B = 2F$ (balance at the mass)

$\underline{\mathbf{F}_f = +2F}$ (same direcion as **F**)

$F_{wall} = 3T = 3F$ (same direction as **F**)

$\underline{\mathbf{F}_{wall} = +3F}$

25. The tension in the rope is: a) F
26. The frictional force vector is: e) $\mathbf{F}_f = +2F$
27. The net rope force, $\mathbf{F}_R$, on the wall is: e) $\mathbf{F}_R = +3F$