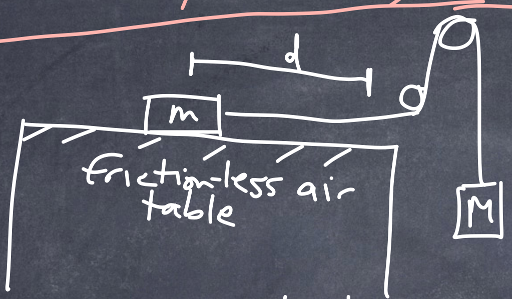
PHY 117 HS2024

Week 2, Lecture 2
Sept. 25, 2024
Prof. Ben Kilminster

Extra: Yesterday, we had this problem:



What is acceleration of block m ?

Neglect mass of string
Neglect friction of pulleys

There are 2 ways to solve this problem.

1) we look at the whole system
2) we look at each block

1) 

Consider that this is one object.
The total mass is $m+M$
It is accelerated by the force $F_g = Mg$

So $\Sigma F = (\text{mass of system})\, a$

$$Mg = (M+m)\, a$$

$$a = \frac{M}{(M+m)} g$$

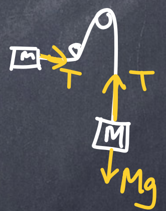
2) we look at the two blocks separately, and make equations for the forces on each.

block m: 

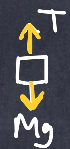
There is only one force on m.

So $\Sigma F = ma$ ①

$$\boxed{T = ma}$$



block M:



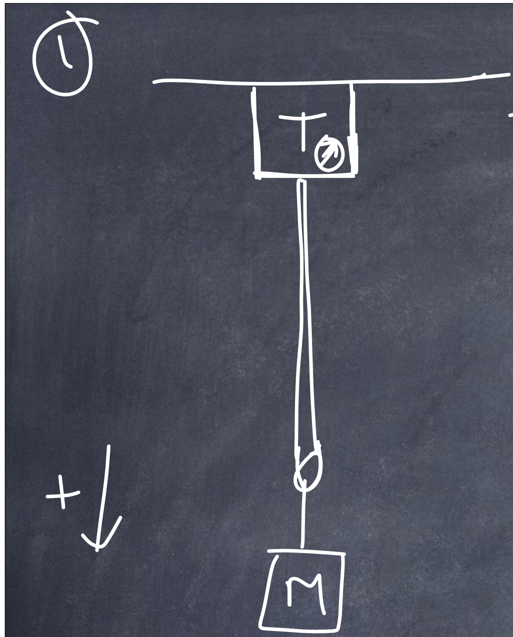
Here $\Sigma F = Ma$ ②

$$\boxed{Mg - T = Ma}$$

Adding ① + ②, we get $Mg - T + T = ma + Ma$

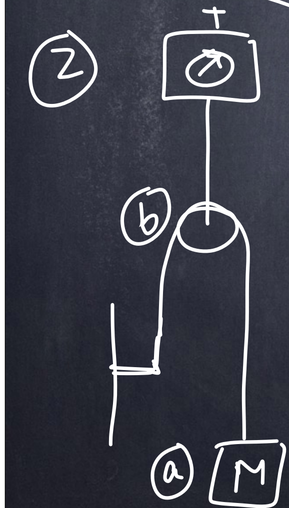
Notice that T cancels out

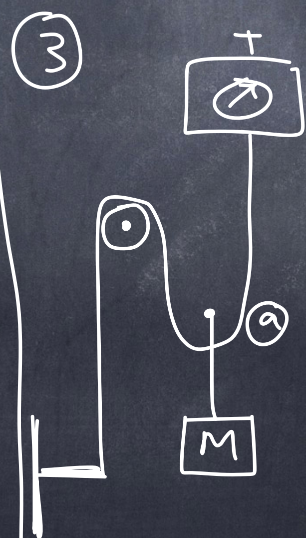
So $a = \left(\frac{M}{M+m}\right) g$



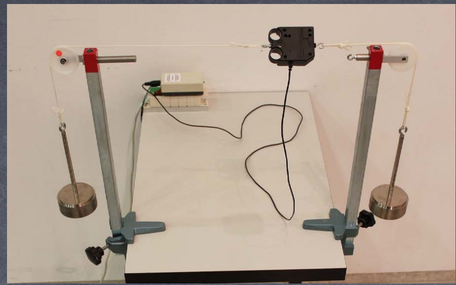
Tension measurement

$M = 1$ kg





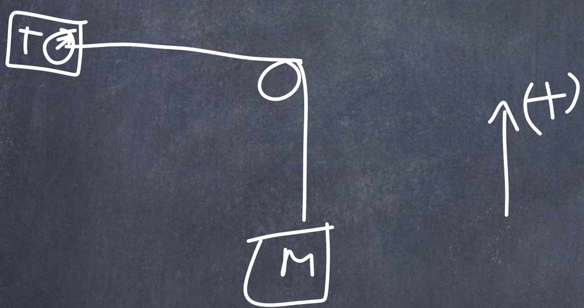
$M = 1\,kg \Rightarrow Mg = 10\,N$



M= 2kg

Mg= 20N

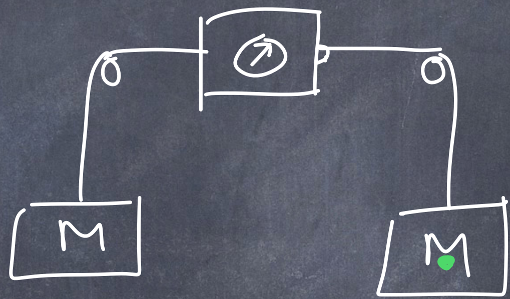
④



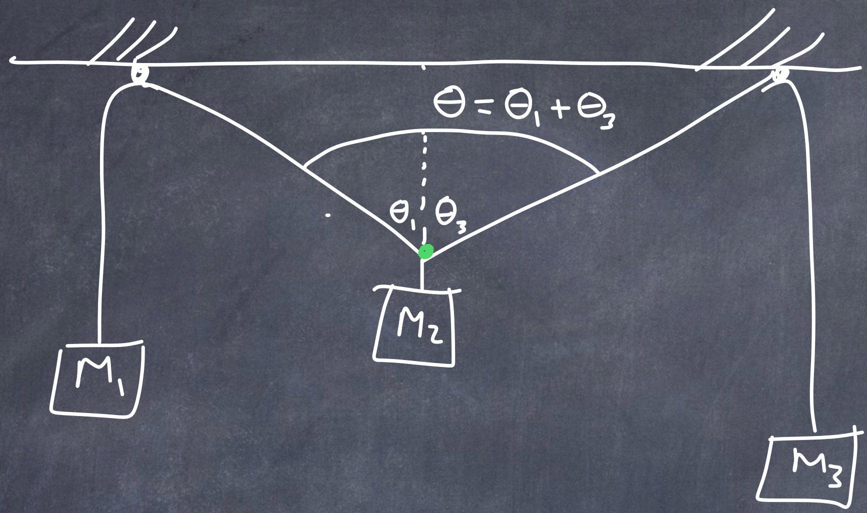
M= 2kg

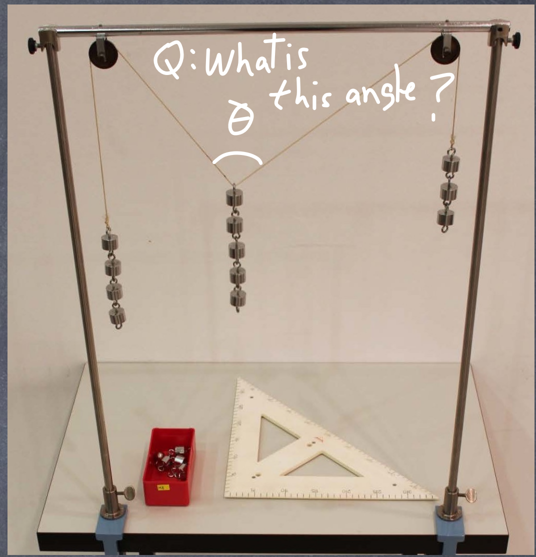
Mg= 20N

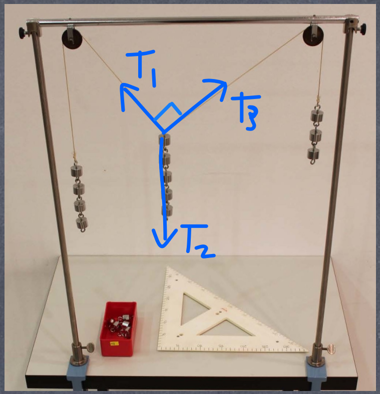
⑤



In equilibrium → $\Sigma F = 0$





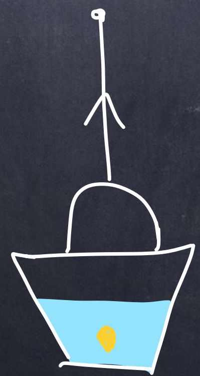

T_1
T_3
T_2

What about the force on a spring?

What are the forces on the water?

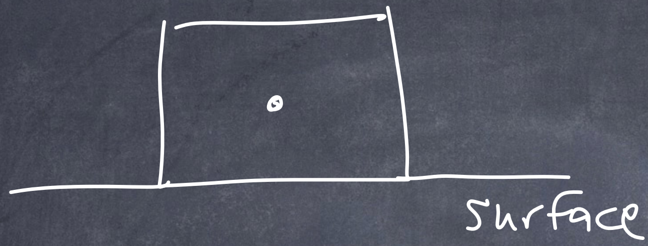
At top:

At bottom:

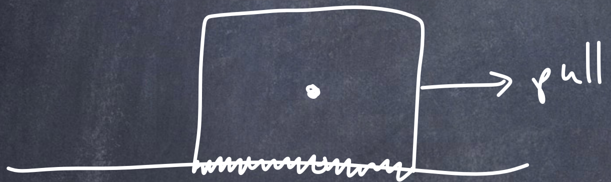


What is the minimum speed (V_{min}) necessary to keep the water in the bucket?

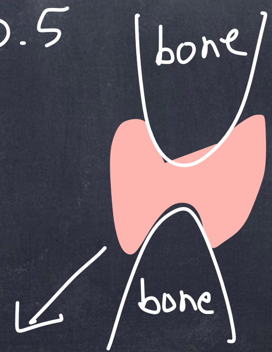
block

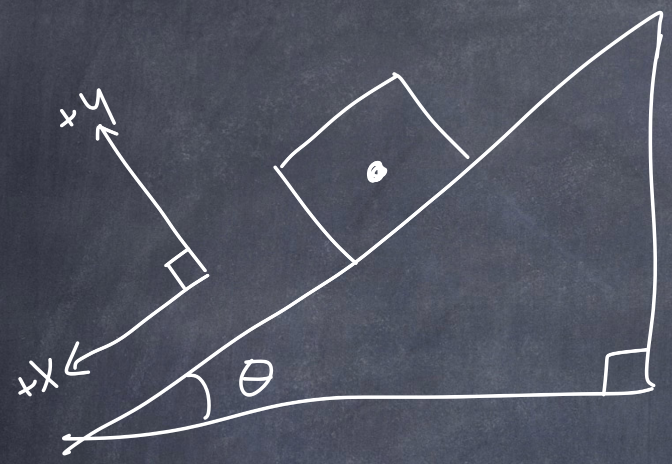


we push or pull the block:



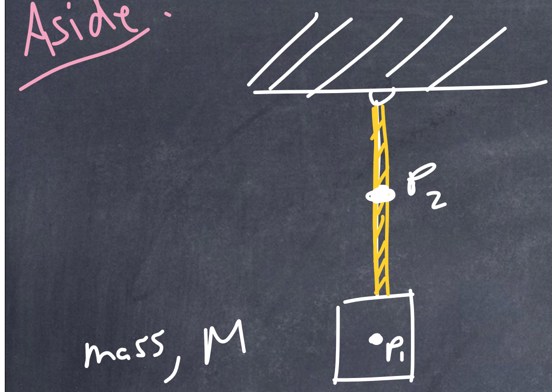
2 materials	μ_k	μ_s
wood on wood	0.2	0.25-0.5
teflon on steel	0.04	0.04
ice on ice	0.03	0.1
steel on steel	0.57	0.74
synovial joint	0.003	0.01





+y
+x
θ

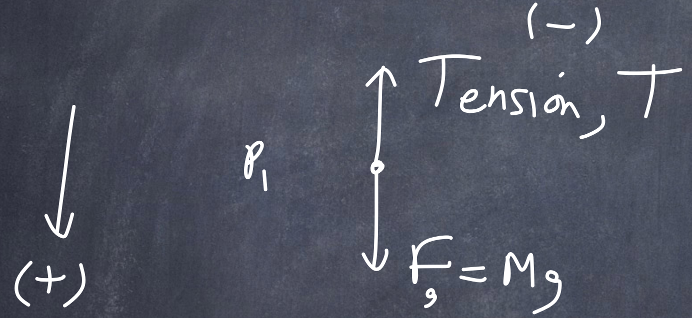
Aside:



Exercise:

A mass M hangs from a string to the ceiling.

Draw the forces acting at P_1.



If we use T and F_g as scalars, then we need to keep track of negative signs. We state T is in (−) direction

$$\Sigma F = F_g - T = 0 = ma$$

and $T = F_g$

But we must specify the direction

$F_g = Mg$ in (+) direction

$T = Mg$ in (−) direction

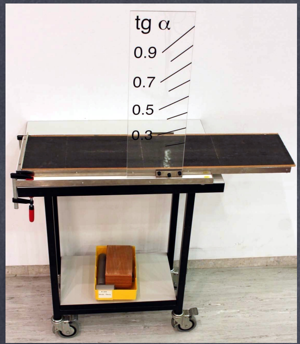
If we use vectors for $\bar{F}_g$ and $\bar{T}$, then we don't need to explicitly put negative signs in our sum, $\Sigma \bar{F}$.

$$\Sigma \bar{F} = \bar{F}_g + \bar{T} = 0$$

then $\bar{T} = -\bar{F}_g$

since $\bar{F}_g = M\bar{g}$,
then $\bar{T} = -M\bar{g}$

In both cases F_g points down & T points up.


tg α
0.9
0.7
0.5