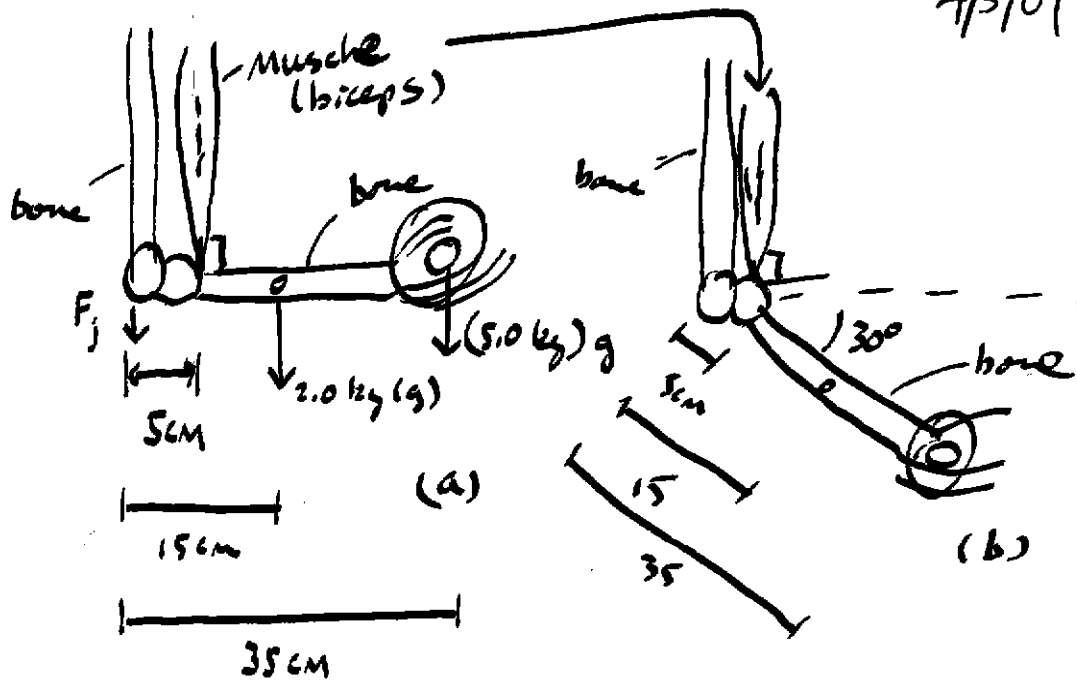


Similar example ... Weight lifter

P121 Lecture
4/3/01



Assume mass of forearm + hand = 2.0 kg and cog as shown
Find force exerted by biceps muscle in config (a) and
in config. (b)

(a) $\sum \tau$ about Elbow joint = 0

$$(.05 \text{ m}) F_M - \frac{(.15 \text{ m})}{(.15 \text{ m})} (2.0 \text{ kg}) g - (.35 \text{ m}) (5.0 \text{ kg}) g = 0$$

$$F_M \approx 400 \text{ N}$$

(b) $\sum \tau$ abt elbow joint = 0

lever arm of all 3 forces in torque sum
Shrinks by $\cos \theta$
 $\cos 30$ factor

$$\therefore F_M = \frac{.15 \cos 30 (2) g + .35 \cos 30 (5.0) g}{.05 \cos 30} = 400 \text{ N} !$$

$F_M \gg$ mass of barbell

Insertion point of muscle with ~~Makela~~

Suppose your insertion point of muscle is 6cm from joint instead of average 5

$$F_M = \frac{(0.15 \times 2)(9.8) + (0.35 \times 5.0)(9.8)}{(0.06)} = 335 \text{ N}$$

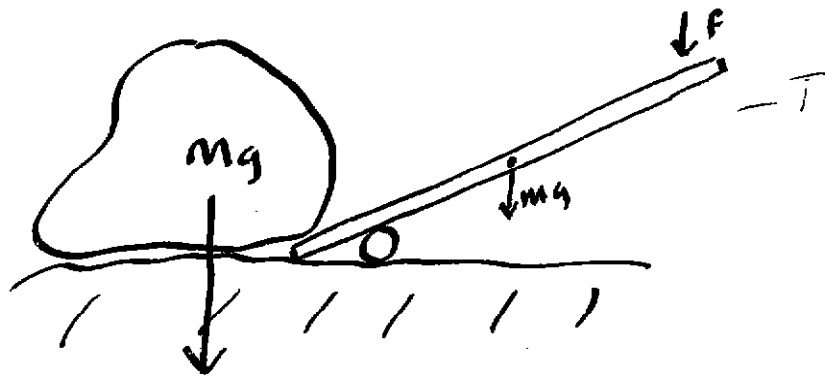
So when you go to the gene splicer to design your child . . . if you want an athlete, give them muscle insertion points a little further from the joint than average!

Skip Stress, strain, elasticity

We will come back to Periodic Motion

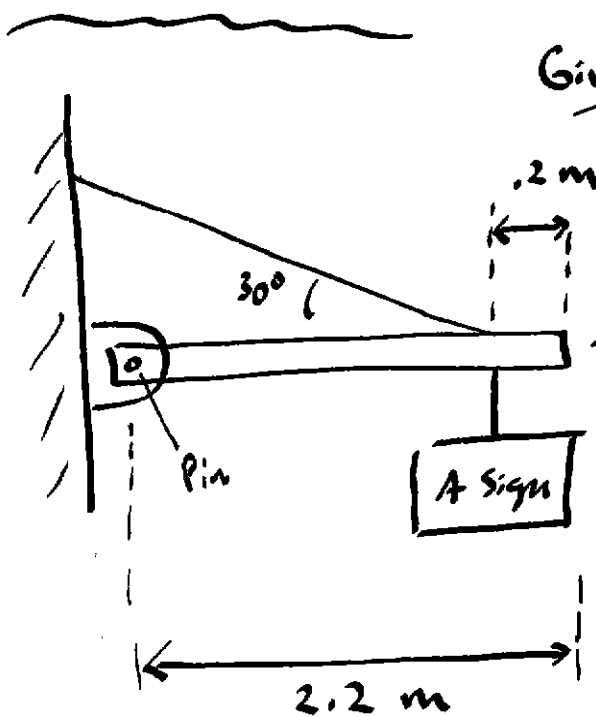
⇒ Fluid dynamics (chapt 14)





Small F can move a big Mg
 How does this work?

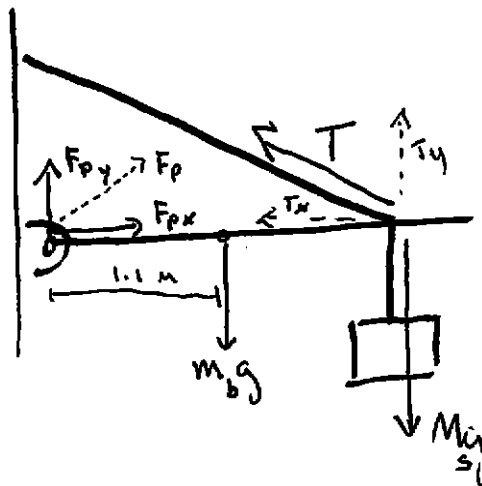
Give me a sign example



mass of beam = 30 kg

cable will snap if
 $T > 8000 \text{ N}$

How heavy ~~can~~ ~~the~~
~~sign~~ be a sign
 can one hang safely?
 What is force on pin?



Free body diagram



In static equilibrium, SET $T = 8000$ N, Solve for M_s .

I $\Sigma F_y = 0 = \boxed{F_{py}} + T_y - M_b g - \boxed{M_s g}$

II $\Sigma F_x = 0 = \boxed{F_{px}} - T_x$

III $\Sigma \text{Torques} = 0 = (1.1) M_b g + (2.0) \boxed{M_s g} - T_y (2.0)$
(About Pin)

3 eqns, 3 unknowns

F_{py}, F_{px}, M_s

~~F_{py}, F_{px}, M_s~~

} \Rightarrow Do algebra

II $\rightarrow F_{px} = 8000 \cos 30 = 6928$ N

III $\rightarrow M_s = \frac{T_y(2.0) - (1.1)M_b g}{(2.0)g} = \frac{8000 \sin 30 - 1.1(30)9.8}{(2.0)9.8}$

$M_s = 188$ kg

I $\rightarrow F_{py} = (30)(9.8) + (188)(9.8) - (8000) \sin 30$

$F_{py} = -1864$ N

what does "-" mean?

Then we went to fluids

\rightarrow NOT on exam III

