Student #1

Problem:

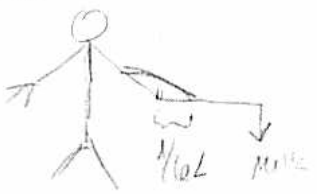
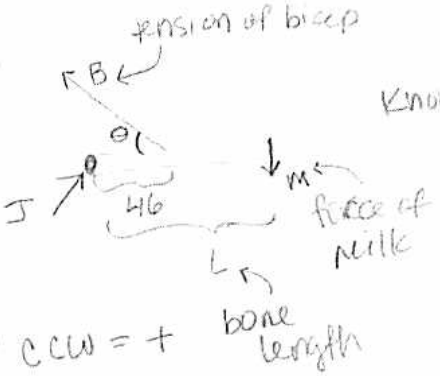
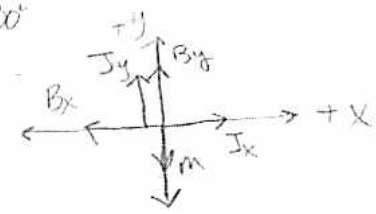


Diagram:



Know: M, θ = 120°, L

Force Diagram:



Approach:

use forces $\Sigma F = 0$

use torque: $\Sigma \tau = 0$

ignore bone weight

By Newtons 3rd Law the force of the joint on the bone is equal to the force of the bone on the joint

$B_x = B\cos\theta$ $\quad J = \sqrt{J_x^2 + J_y^2}$

$B_y = B\sin\theta$

$\tan\theta = B_y / B_x$

$\Sigma F_x = J_x - B_x = 0$

$\Sigma F_y = J_y + B_y - M = 0$

$\Sigma \tau = B_y \frac{L}{6} - ML = 0$ or $B\sin\theta = \frac{L}{6} - ML$

Student # 2

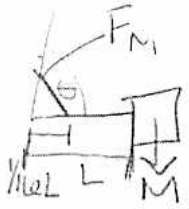
KNOWN:

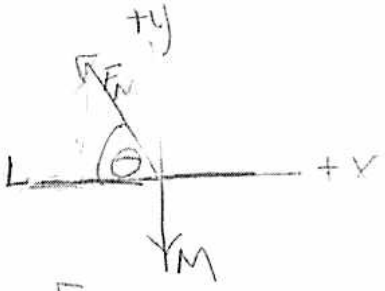
M - 3.76 LITERS.

θ - 80°

$L_2 = 1/10\ L_1$

WEIGHT OF BONE NEGLIGIBLE.





F_m = FORCE OF MUSCLE

APPROACH.

Q: HOW STRONG A FORCE SHOULD THE PROTIPICLE JOINT BE MADE

USE FORCES NEGLECT BONE MASS

$\sum_x = L_x \cos\theta - M_x = 0$ $\sum = F_{my} \sin\theta - L_y - 0$

$\tau = rF_\perp$ $\sum\tau = F_{m} \cos\theta - m = 0$

FORCE OF MUSCLE $F_{M_x} = M_x - L_x$

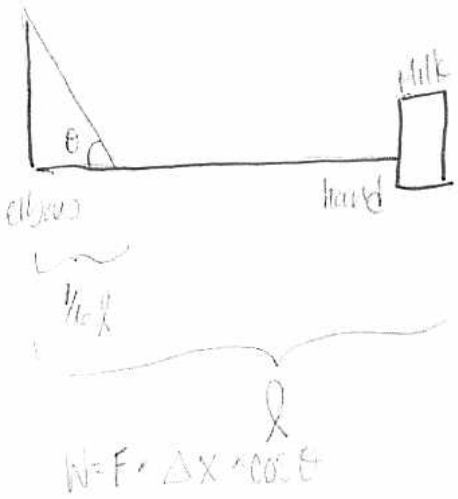
Student #3

Known

- bicep muscle attached to bone at distance 1/6 bone length away from elbow joint
- $\theta = 80°$

Find

Force



$W = F \cdot \Delta x \cdot \cos\theta$

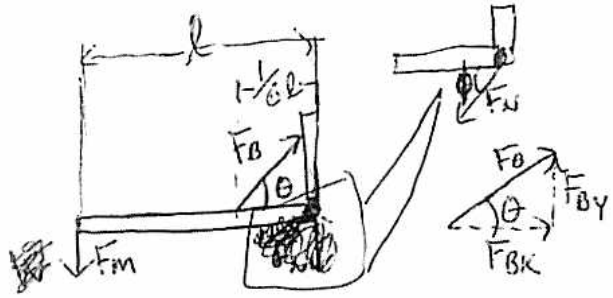
$W_{muscle} \geq -W_{gravity}$

$F \times \Delta x \times \cos\theta \geq -mg \times \Delta x$

milk = 5.76 liters

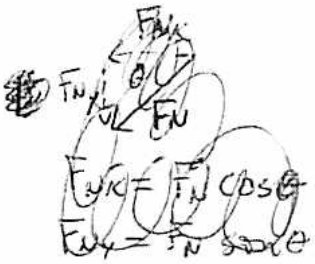
*don't know how to convert liters to grams...

Student #4



$F_{BY} = F_B \sin\theta$

$F_{BK} = F_B \cos\theta$



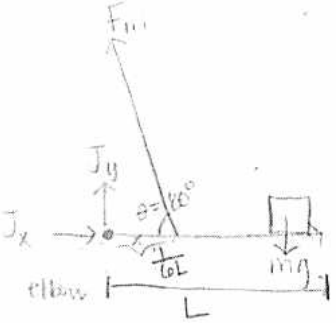
① $\sum F_x = F_{Bx} + F_{NK} = 0 = F_B \sin\theta + F_N \cos\theta = 0 \Rightarrow F_B \frac{\cos}{\sin}\theta = F_{NK}$ (1)

② $\sum F_y = F_{By} + (F_m - F_{Ny}) = 0 = F_B \frac{\sin}{\cos}\theta + (F_m - F_N \cos\theta) = 0 \Rightarrow F_{Ny} = F_m + F_B$

③ $\sum \tau = (F_m \cdot l) + (F_{By} \cdot \frac{l}{6}) = F_m l + F_B \frac{\sin}{\cos}\theta \cdot \frac{l}{6} = 0$ (2)

Student # 5

The objective of the problem is to determine the force of the elbow joint so that it can support 3.7 L while lower arm is in horizontal



$\cos\theta = \frac{x}{F_m}$

$\sin\theta = \frac{J_x}{F_m}$

$T = F \cdot d \sin\theta$

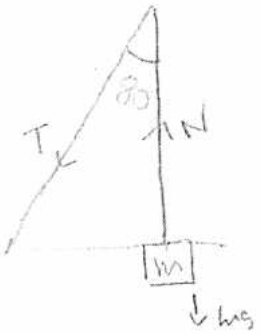
$3.7\text{L water}\left(\frac{10^{-3}\,m^3}{1\text{ liter}}\right)\left(\frac{10^3\,kg}{m^3}\right) = 3.7\text{L kg}$

$T_{joint} = 0$

$T_{muscle} = F_m \cdot \frac{1}{6}L \sin 80$

$F_{elbow} = mg$

Student #6



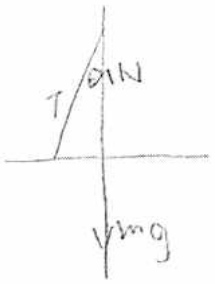
$\theta = 80°$

$m = 3.76$ liters.

$F = mg$

question 7

how strong a force should your design the artificial joint?

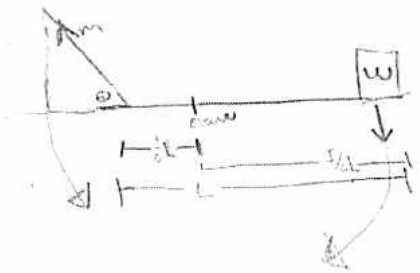


$\Sigma F_x = 0$

$\Sigma F_y = N + T\cos\theta - mg$

$N + T\cos\theta = mg.$

Student #7



Knowns

$\tau = rF\sin\theta$

w 3.76 Lbs

$\theta = 80°$

1 return approximately 8 lbs

Approach: Find m as a factor of the angle it attaches to the board to which the patient must hold.

Question: How much should m be?

Targeted Quantity: m

F_x

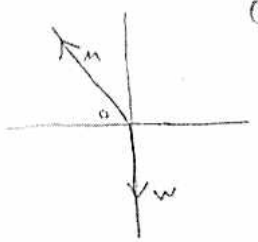
$m\cos\theta$

$F_y = 0$

$m\sin\theta$

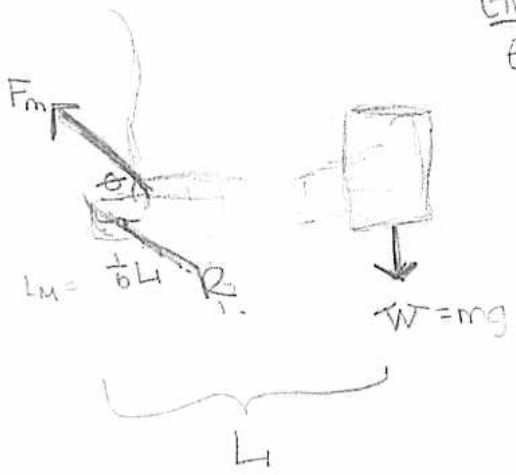
$-w$

$m\sin\theta - w = 0$



Student # 8

Diagram:



Given:

$\theta = 80°$

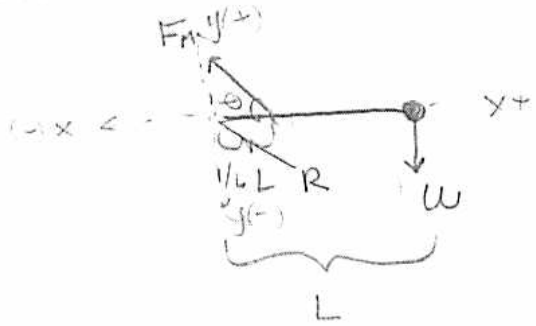
$L_M = \frac{1}{6}L$

m = 3.76 liters

W = 36.8 N

Goal: Determine the force of the joint R using forces and torque equilibrium

Free Body Diagram



Convert

3.76 liters = 3.76 kg

Force Equilibrium: $\sum F = \emptyset$

Torque: $\tau = Fd\sin\theta$

$\sum \tau = \emptyset$