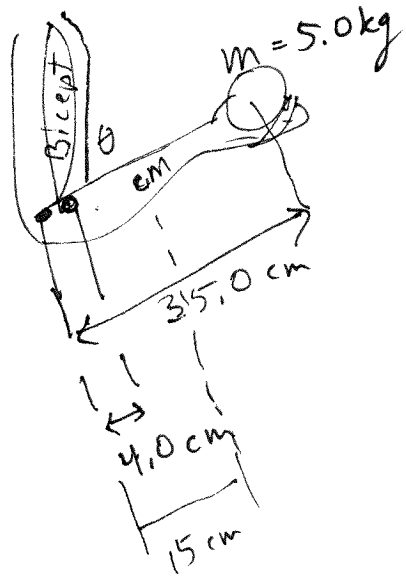
Chapter 12 Problem 39

$m = 5.0\,kg$ $r = 35.0\,cm$

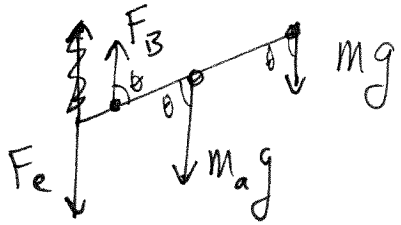
$m_{arm} = 3.0\,kg$ $r_a = 15.0\,cm$

~~$r_{arm} = 15.0\,cm$~~ $r_b = 4.0\,cm$



a) If $\theta = 60°$, what is the force of the bicept?

F_e - force of elbow
F_b - force of bicept
F_a - force of arms weight
F - force of weight



Chose the elbow as the pivot.

$$\Sigma \tau = 0 \quad 0 \cdot F_e + r_B F_B \sin\theta - r_a F_a \sin\theta - r F \sin\theta = 0$$

$$0 = 0 + r_B F_B - r_a F_a - rF$$

$$r_a F_a + rF = r_B F_B \rightarrow F_B = \frac{r_a F_a + rF}{r_B}$$

$$F_B = \frac{(15\,cm)(3.0\,kg)(9.8\,m/s^2) + (35\,cm)(5.0\,kg)(9.8\,m/s^2)}{4.0\,cm}$$

Notice cm cancels both on the numerator + denominator (No need to convert to meters)

$$\boxed{F_B = 539\,N}$$

b) Force on the elbow

$$\Sigma F_y = 0 \rightarrow -F_e + F_B - m_a g - mg = 0$$

$$F_e = -m_a g - mg + F_B$$

$$= -(3.0\,kg)(9.8\,m/s^2) - (5.0\,kg)(9.8\,m/s^2) + 539\,N$$

$$\boxed{F_e = 461\,N}$$

c) Angle is not important.