Group Work 10.B.1 Solution

In this problem we are asked to decide which diagram illustrates the largest torques. The forces, and length of the rods are equal. I will consider anything the line of the beam to be the x-axis. Anything *to the right* of the pivot will be *positive*, and anything *to the left* of the pivot will be *negative*. All angles will be measured relative to the positive x-axis.

This is done because then all torques can then be written in the form:

$$\tau = (F\sin(\theta))(x) \tag{1}$$

1)

Using equation one, we find the sum of the torques is:

$$\sum \tau = F\sin(30^\circ)\left(\frac{L}{2}\right) + F\sin(210^\circ)\left(\frac{-L}{2}\right)$$

$$\sum \tau = \frac{FL}{2} \tag{2}$$

2)

In this case, equation one gives:

$$\sum \tau = (F\sin(90^\circ))\left(\frac{L}{2}\right) + F\sin(150^\circ)\left(\frac{-L}{2}\right)$$

$$\sum \tau = F\left(\frac{L}{2}\right) + F\left(\frac{1}{2}\right)\left(\frac{-L}{2}\right)$$

$$\sum \tau = F\left(\frac{L}{2}\right) - F\left(\frac{L}{4}\right)$$

$$\sum \tau = \frac{FL}{4} \tag{3}$$

3)

One last application of equation 1 gives:

$$\sum \tau = (F\sin(90^\circ))\left(\frac{L}{2}\right) + F\sin(180^\circ)\left(\frac{-L}{2}\right)$$

$$\sum \tau = (F)\left(\frac{L}{2}\right) + (F)(0)\left(\frac{-L}{2}\right)$$

$$\sum \tau = \frac{FL}{2} \tag{4}$$

Thus, by comparing equations 2,3, and 4 we conclude:

$$\tau_1 = \tau_3 > \tau_2$$