The problem setup is as follows:

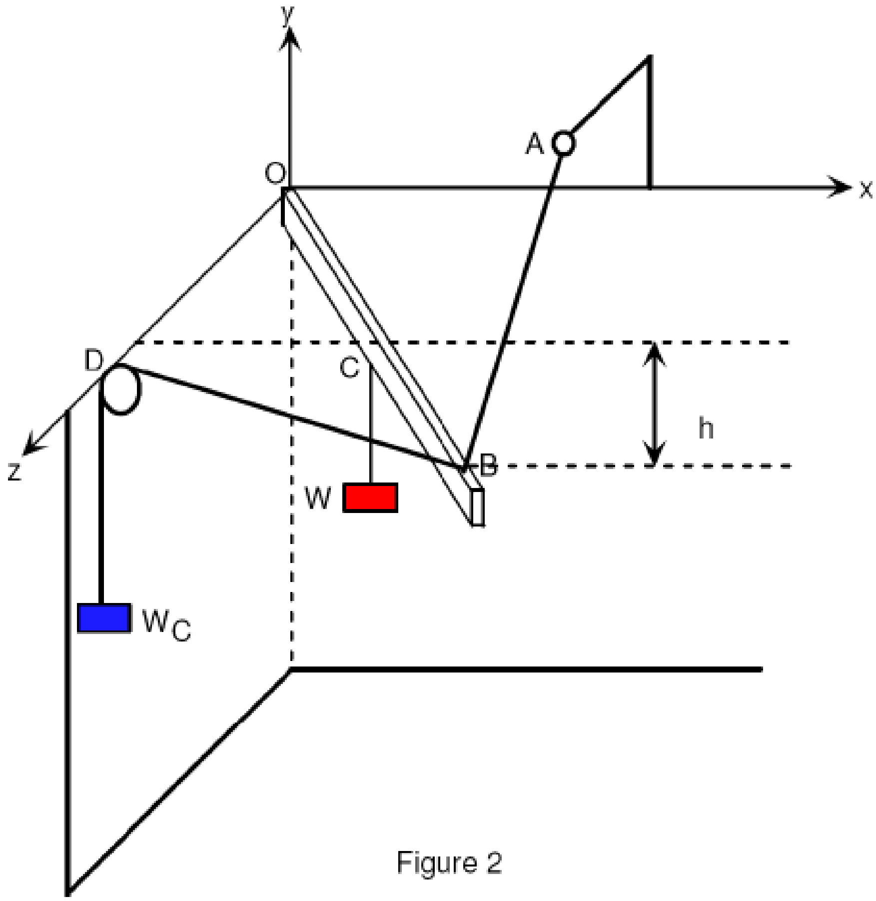


Figure 2

Given:

| | | |
|---|---|---|
| A (+0.80, +0.05, +0.24) | $\Vert \overrightarrow{r_{BA}} \Vert = 0.600\ m$ | m = 0.500 kg |
| D (0, 0, +1) | $\Vert \overrightarrow{r_{OB}} \Vert = 0.800\ m$ | $m_C$ = 0.500 kg |
| B (x, y, z) | $\Vert \overrightarrow{r_{OC}} \Vert = 0.500\ m$ | $W_C = m_C * g$ |
| $\Vert \overrightarrow{r_{BD}} \Vert = d$ | $m_{ruler}$ = 0.125 kg | $W = (m_{ruler} + m) * g$ |

**We are asked to find h.**

**My attempt at a solution:**

There are five unknowns which are the coordinates of B (x,y,z), d and $T_{BA,}$ where d is the distance between points B and D; and $T_{BA}$ is the tension in the string along BA.

I first start by using the problem's geometry and so I obtain my first three equations as follows:

$(x_A - x)^2 + (y_A - y)^2 + (z_A - z)^2 = (\| \overrightarrow{r_{BA}} \|)^2$ (1)

$(x)^2 + (y)^2 + (z)^2 = (\| \overrightarrow{r_{OB}} \|)^2$ (2)

$(x_D - x)^2 + (y_D - y)^2 + (z_D - z)^2 = (d)^2$ (3)

For the final two equations, I use equilibrium related equations with respect to moments about O. Before using moments, I find an expression for the vectors $T_{BA}$ and $T_{BD}$.

$$\overrightarrow{T_{BD}} = \left( \frac{\overrightarrow{r_{BD}}}{\| \overrightarrow{r_{BD}} \|} \right) T_{BD} \qquad , where\ T_{BD} = W_C$$

$$\Leftrightarrow \overrightarrow{T_{BD}} = \left( \frac{g m_C}{d} \right) \left( (-x)\vec{\imath} + (-y)\vec{\jmath} + (1 - z)\vec{k} \right)$$

$$\overrightarrow{T_{BA}} = \left( \frac{\overrightarrow{r_{BA}}}{\| \overrightarrow{r_{BA}} \|} \right) T_{BA}$$

$$\Leftrightarrow \overrightarrow{T_{BA}} = \left( \frac{T_{BA}}{\| \overrightarrow{r_{BA}} \|} \right) \left( (x_A - x)\vec{\imath} + (y_A - y)\vec{\jmath} + (z_A - z)\vec{k} \right)$$

Using

$$\sum \overrightarrow{M_O} = \vec{0} \Leftrightarrow \sum (\vec{r}\ x\ \vec{F}) = \vec{0}$$

$$\Leftrightarrow \left(\overrightarrow{r_{OB}}\ x\ \overrightarrow{T_{BD}}\right) + \left(\overrightarrow{r_{OB}}\ x\ \overrightarrow{T_{BA}}\right) + \left(\overrightarrow{r_{OC}}\ x\ \overrightarrow{W}\right) = \vec{0}$$

$$\Leftrightarrow \left(\overrightarrow{r_{OB}}\ x\ \overrightarrow{T_{BD}}\right) + \left(\overrightarrow{r_{OB}}\ x\ \overrightarrow{T_{BA}}\right) + \left(\frac{5}{8}\overrightarrow{r_{OB}}\ x\ \overrightarrow{W}\right) = \vec{0}$$

To obtain the last two equations, I use :

$$\sum M_y = 0 \quad (4)\ et \sum M_z = 0 \quad (5)$$

Which yields :

$$-\frac{z g m_c x}{d} - \frac{x g m_c (1 - z)}{d} + \frac{z T_{BA}(x_A - x)}{\|r_{BA}\|} - \frac{x T_{BA}(z_A - z)}{\|r_{BA}\|} = 0 \quad (4)$$

$$\frac{x T_{BA}(y_A - y)}{\|r_{BA}\|} - \frac{y T_{BA}(x_A - x)}{\|r_{BA}\|} - \frac{5}{8} x (m + m_{ruler}) g = 0 \quad (5)$$

When I plug the given data, I obtain the following:

$$\{d = 0.6046550850, x = 0.4346684629, y = -0.2122367536, z = 0.6371961141, GT_{BA} = 5.218165899\}$$

Which I have been told by my TA that the results are wrong. He has informed me that the y value should be closer to -0.300. But I do not know where I have gone wrong. Any help would be greatly appreciated.