# Dynamics problem 2     11/11/18



The diagram shows pulleys with velocity $v$, lengths $L_1$ and $L_2$, angle $\theta$, gravity $g$ pointing down, and mass $m$ that winds up, rate $\dot{w}$ ($\ddot{w} \neq 0$), with mass $M$.
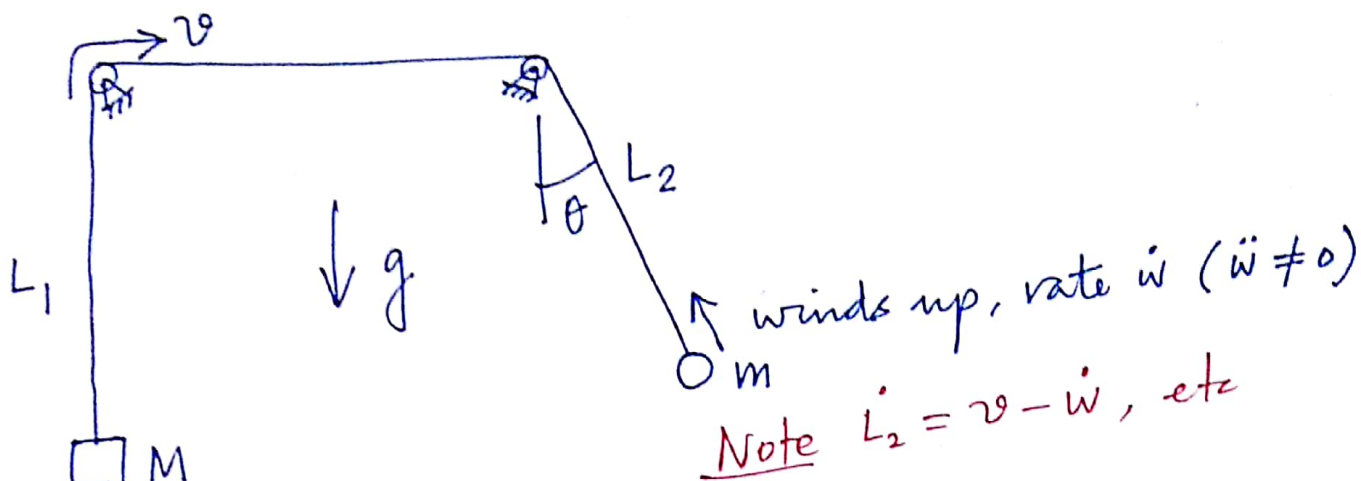
Note $\dot{L}_2 = v - \dot{w}$, etc

- The pulleys are small, light, frictionless.
- Lengths $L_1$ & $L_2$ are instantaneous values.
- Mass $M$ hangs straight down. The string passes over the pulleys at a speed $v$.
- Mass $m$ winds up the string (pulls the string into itself) at a rate $\dot{w}$ (with $\ddot{w} \neq 0$, given).

At some instant, $L_1, L_2, v, \dot{w}, \ddot{w}, \theta, \dot{\theta}$ are given.

Find (a) The tension in the string (T)
   (b) $\dot{v}$
   (c) $\ddot{\theta}$

I find (a) $T = \dfrac{Mm}{M+m} \left( L_2 \dot{\theta}^2 + g + \ddot{w} + g\cos\theta \right)$

   (b) $\dot{v} = \dfrac{m(L_2 \dot{\theta}^2 + \ddot{w} + g\cos\theta) - Mg}{M+m}$

   (c) $\ddot{\theta} = -\dfrac{(g\sin\theta + 2(v - \dot{w})\dot{\theta})}{L_2}$

Do you agree?