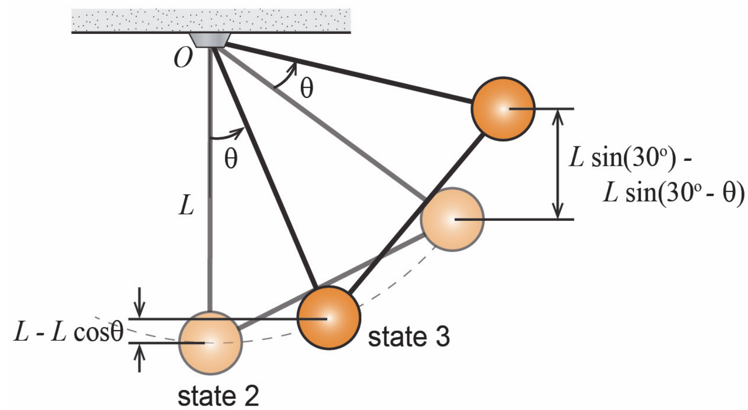
Conservation of energy



Once the external force F is released, the only forces acting on the pendulum are either conservative (the weights) or do no work (the reaction forces). Therefore, energy is conserved as the pendulum swings upward following the application of the impulsive force. Furthermore, the kinetic energy at state 3, when the pendulum reaches its maximum height, is zero since the system momentarily comes to rest. As with angular momentum, the energy of a system of particles (kinetic and potential) is simply the sum of the energies of the individual particles.

$$T_2 + \cancel{V_2} = \cancel{T_3} + V_3$$

$$\frac{1}{2}m_A v_{A,2}^2 + \frac{1}{2}m_B v_{B,2}^2 = m_A g\Delta h_{A,2-3} + m_B g\Delta h_{B,2-3} = m_A gL(1-\cos\theta) + m_B gL(\sin 30^o - \sin(30^o - \theta))$$

Employing the kinematic relationship, $v = r\omega$ and the value for angular velocity at state 2 solved for earlier, we can solve for the maximum angle θ. To solve the resulting nonlinear equation for θ you can use numerical techniques (e.g. a graphing calculator). Be careful to determine whether or not your software expects the angle to be in radians or not. The program I used needed the angle to be in radians so 30 degrees in the above equation was changed to $\pi/6$ radians before the solver was implemented.

$$\frac{1}{2}m_A L^2\omega_2^2 + \frac{1}{2}m_B L^2\omega_2^2 = m_A gL(1-\cos\theta) + m_B gL(\sin(\pi/6) - \sin((\pi/6) - \theta))$$

$$\cos\theta - \sin(\pi/6) + \sin((\pi/6) - \theta) + \frac{L\omega_2^2}{g} - 1 = 0$$

$$\boxed{\theta = 0.3742 \text{ rad} = 21.4^o}$$