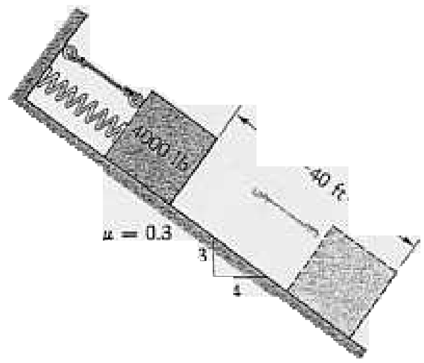
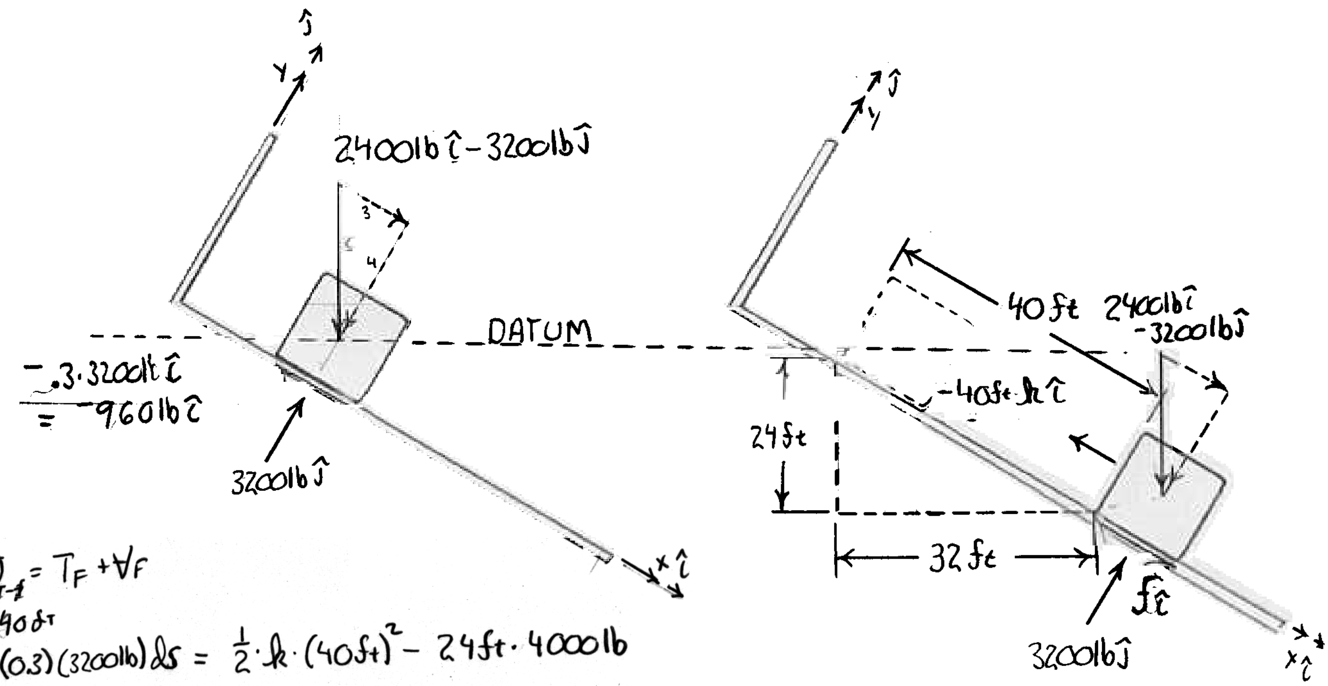
NAME: SOLUTION

PROBLEM 1: The weight shown is prevented from sliding down the inclined plane by a cable. An engineer wishes to lower the weight to the dashed position by inserting a spring and then cutting the cable. Find the modulus of a spring that will accomplish this task without allowing the block to move back up the incline after it stops (Hint: You are free to specify the initial stretch - try zero.)





$$T_I + V_I - U_{I-F} = T_F + V_F$$

$$0 + 0 + \int_0^{40\,ft} (0.3)(3200lb)\,ds = \tfrac{1}{2}\cdot k\cdot(40ft)^2 - 24ft\cdot 4000lb$$

$$-(0.3)(3200lb)\cdot(40ft) = \tfrac{1}{2}(40ft)^2 k - 24ft\cdot 4000lb$$

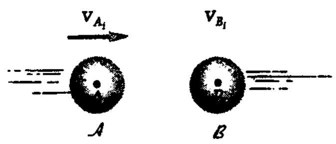
$$\boxed{k = 72\ lb/ft}$$

CHECKING EQUILIBRIUM IN THE FINAL POSITION, SINCE THE BLOCK SHOULD BE AT REST

$\Sigma F_x = 0 = f - 40ft\cdot 72lb/ft + 2400lb \Rightarrow \underline{f = 480lb} < \underline{\mu N = 960\,lb}$

μN IS THE MAXIMUM FORCE THAT f CAN BE AND STILL SUSTAIN THE STATIONARY POSITION OF THE BLOCK. SINCE $f < \mu N$ THE BLOCK WILL REMAIN STATIONARY.

PROBLEM 2: Two identical elastic balls A and B move toward each other. Find the approach velocity ratio v_A / v_B, That will result in A coming to rest following the collision. The coefficient of restitution is e.



CONSERVATION OF MOMENTUM

$$m_A \cdot v_{Ai} + m_B \cdot v_{Bi} = m_A \cdot \cancel{v_{Af}}^{\,0} + m_B v_{Bf}$$

m_B

$$+ v_{Bi} = v_{Bf} \quad (1)$$

ALSO KNOW

$$\frac{v_{Bf} - \cancel{v_{Af}}^{\,0}}{v_{Ai} - v_{Bi}} = \frac{v_{Bf}}{v_{Ai} - v_{Bi}}$$

$$e \cdot (v_{Ai} - v_{Bi}) = v_{Bf}$$

FROM (1)

$$e \cdot (v_{Ai} - v_{Bi}) = v_{Ai} + v_{Bi}$$

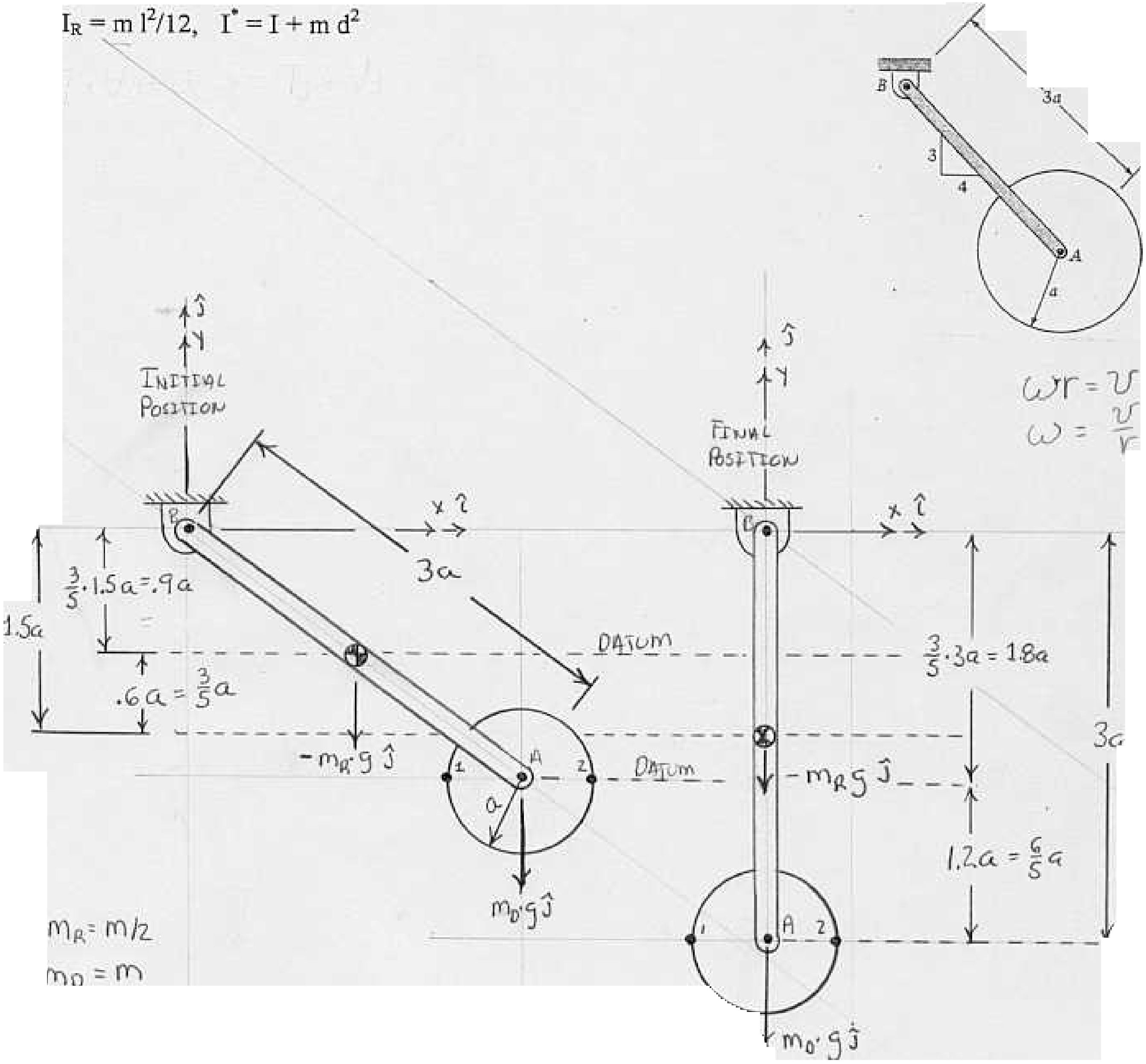
$$v_{Ai}(e-1) = v_{Bi}(e+\ )$$

$$\frac{v_{Ai}}{v_{Bi}} = \frac{e+1}{e-1} = -\frac{1+e}{1-e}$$

$$\boxed{\left|\frac{v_{Ai}}{v_{Bi}}\right| = \frac{1+e}{1-e}}$$

PROBLEM 3: A thin disk of mass m and radius a is pinned smoothly at a to a thin rod of mass m/2 and length 3a. The rod is then pinned at B. If the body is held in equilibrium in the configuration shown, then released from rest, find the velocity of point a as the system passes through the vertical. (Note: The disk does not rotate it only translates)

$I_R = m\,l^2/12, \quad I^* = I + m\,d^2$



$$T_i + V_i + U_{1\to 2} = T_f + V_f$$

$$0 + 0 + 0 = \frac{1}{2}\underbrace{\left[\frac{m}{2}\cdot(3a)^2\cdot\frac{1}{12} + \frac{m}{2}\cdot\left(\frac{3\cdot a}{2}\right)^2\right]}_{\frac{3}{2}ma^2}\left(\frac{v_A}{3a}\right)^2 + \frac{1}{2}\cdot m\, v_A^2$$

$$\frac{m\cdot g}{2}\cdot\frac{3}{5}a - m\cdot g\cdot\frac{2\cdot 6}{2\cdot 5}a$$

$$0 = \frac{1}{2}\cdot\frac{\cancel{3}}{2}\cdot m\cdot \cancel{a^2}\cdot\frac{v_A^2}{\cancel{9}_3\cdot\cancel{a^2}} + \frac{1}{2}\, m\cdot v_A^2 \quad \frac{15}{10}\cdot m\cdot g\cdot a$$

$$0 = \frac{1}{12}\cancel{m}\cdot v_A^2 + \frac{6\cdot 1}{6\cdot 2}\cancel{m}\cdot v_A^2 \quad \frac{3}{2}\cancel{m}\cdot g\cdot a$$

$$0 = \frac{7}{12}v_A^2 - \frac{3}{2}\, g\cdot a$$

$$v_A^2 = \frac{\cancel{12}^{\,6}}{7}\cdot\frac{3}{\cancel{2}}g\cdot a = \frac{18}{7}g\cdot a \implies \boxed{v_A = \sqrt{\frac{18}{7}\cdot g\cdot a}}$$

$$\sqrt{2{,}57ga}$$

$$= 1.60\sqrt{ga}$$