Question 35633

Let the ox axis of the coordinate system be parallel to the inclined plane of the ramp. Position of bar as a function of time is $x_b(t)=\frac{a_b t^2}{2}$, where $a_b=1.2\frac{m}{s^2}$ is the given acceleration. Since bowling ball is pushed down $t_1=10s$ later, its position as a function of time is $x_{bb}(t)=v_0(t-t_1)+\frac{a_{bb}(t-t_1)^2}{2}$, where $v_0=5\frac{m}{s^2}$ is the initial velocity of the bowling ball and $a_{bb}=1.5\frac{m}{s^2}$ is the acceleration of the bowling ball. When bar and bowling ball meet each other, $x_b(t)=x_{bb}(t)$.

This yields an equation for time: $v_0(t-t_1)+a_{bb}\frac{t^2}{2}-a_{bb}t\,t_1+a_{bb}\frac{t_1^2}{2}=\frac{a_b t^2}{2}$, which might be rewritten as $\frac{t^2}{2}(a_{bb}-a_b)+t(v_0-a_{bb}t_1)-[v_0 t_1-a_{bb}\frac{t_1^2}{2}]=0$. This is simple quadratic equation and has solutions $t_1=2.6s; t_2=64.07s$. One should choose solution t_1 (for closest approach).

Finally, plugging in t_1 into $x_b(t)$ or $x_{bb}(t)$ finds the distance $L=x_b(t)|_{t=2.6s}=4.06m$.