Student's code (e.g. RUS 1) B G R 1 Problem number (e.g. ☑) T1☑ T2☐ T3☐ Page number/Total (e.g. 5/8) 1 / 6

Let us consider the problem in a reference frame that is stationary with respect to the centre of mass (M). There are no external forces => the reference frame is inertial.

Due to Newton's third law of mechanics the momentum is conserved.

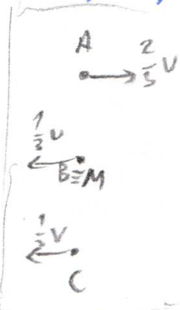
The forces between A and B and B and C are radial, therefore the angular momentum is conserved.

The forces are radial and the rods are not deformable therefore the kinetic energy is conserved.

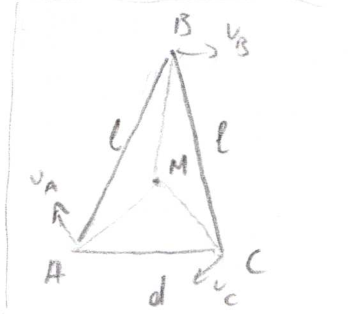
~~At the beginning~~ Suppose v is the speed given to ball A. In the ~~ret~~ reference frame of ~~p = mv = mv let us denote the initial speed of A~~ v. the centre of mass at the beginning

$|\vec v_A| = \frac{2}{3}v$; $|\vec v_B| = \frac{1}{3}v$; $|\vec v_C| = \frac{1}{3}v$; $\vec p = m\vec v_A + m\vec v_B + m\vec v_C = 0$; $|\vec L| = |m\vec v_A\times\vec r_A + m\vec v_B\times\vec r_B + m\vec v_C\times\vec r_C| =$

$= m\cdot\frac{2}{3}v\cdot l + m\cdot\frac{1}{3}v\cdot l = mvl$; $E = \frac{m}{2}\cdot\left(\frac{4}{9}v^2+\frac{1}{9}v^2+\frac{1}{9}v^2\right) = \frac{mv^2}{3}$.




At the moment when $d_{AC} = d$, $d_{AC}$ is minimal => its derivative is 0 => $d_{AC}$ is locally constant.
=> the angular velocity of A, B and C is equal. Let us denote it by ω.




$BM = \frac{2}{3}\cdot\sqrt{l^2-\left(\frac{d}{2}\right)^2}$; $AM = CM = \sqrt{\frac{1}{9}l^2+\frac{8}{9}\left(\frac{d}{2}\right)^2}$

$L = I\omega = m\cdot(AM^2+CM^2+BM^2)\omega = m\omega\left(\frac{2}{3}l^2+\frac{1}{3}d^2\right) = mvl$

$E = \frac{I\omega^2}{2} = \frac{mv^2}{3} \Rightarrow \omega = \frac{2}{3}\frac{v}{l} \Rightarrow m\cdot\frac{2}{3}\frac{v}{l}\left(\frac{2}{3}l^2+\frac{1}{3}d^2\right) = mvl$

$\frac{4}{9}l^2+\frac{2}{9}d^2 = l^2$

$d^2 = \frac{5}{2}l^2$

$\boxed{d = \sqrt{\frac{5}{2}}\cdot l}$