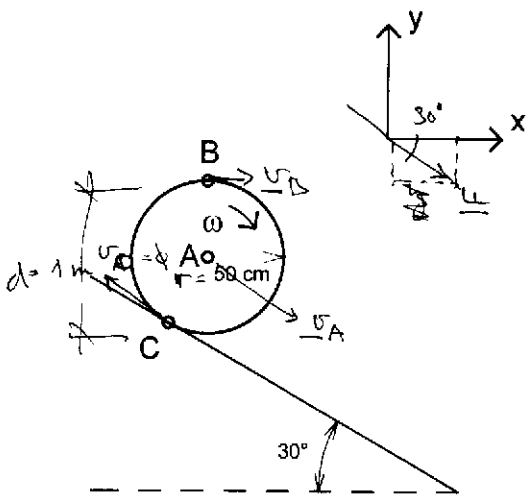


4) A ball is rolling with angular velocity $\omega = 2 \text{ rad/s}$. The velocity of point C is zero. What is the velocity of the centre (point A) and point B?



Slope direction vector: $\underline{u} = \begin{pmatrix} \cos 30^\circ \\ \sin 30^\circ \end{pmatrix} = \begin{pmatrix} \sqrt{3}/2 \\ 0,5 \end{pmatrix}$

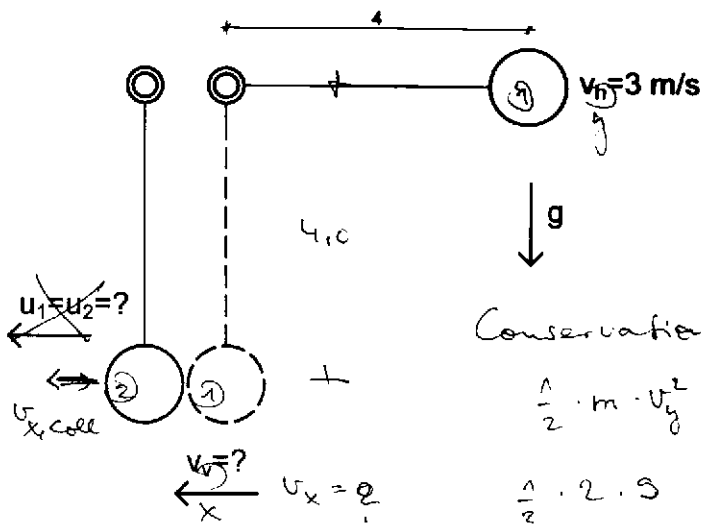
Normal " " " : $\underline{n} = \begin{pmatrix} 0,5 \\ \sqrt{3}/2 \end{pmatrix}$

Velocity in point C:

$$\underline{v}_C = \begin{pmatrix} 0 \\ 0 \end{pmatrix} = \underline{v}_A + \underbrace{\omega \cdot r}_{v} (-\underline{u}) = \underline{v}_A + 2 \cdot 0,5 \begin{pmatrix} -\sqrt{3}/2 \\ +0,5 \end{pmatrix}$$

$$\underline{v}_A = \begin{pmatrix} \sqrt{3}/2 \\ -0,5 \end{pmatrix}$$

$$\underline{v}_B = \underline{v}_A + \underbrace{\omega \cdot r}_1 \begin{pmatrix} 1 \\ 0 \end{pmatrix} = \begin{pmatrix} \sqrt{3}/2 \\ -0,5 \end{pmatrix} + \begin{pmatrix} 1 \\ 0 \end{pmatrix} = \begin{pmatrix} 1,566 \\ -0,5 \end{pmatrix}$$



5) The mass of the balls is 2 kg. The starting velocity is $v_n = 3 \text{ m/s}$. What will be the velocity (v_x) when the ball passes through the vertical position? The impact with the second ball is perfectly plastic. What will be their common after impact velocity ($u_1 = u_2$)? What is the energy lost to the collision?

Conservation of energy:

$$\frac{1}{2} \cdot m \cdot v_n^2 + m \cdot g \cdot 4 = \frac{1}{2} m \cdot v_x^2$$

$$\frac{1}{2} \cdot 2 \cdot 9 + 2 \cdot 10 \cdot 4 = \frac{1}{2} \cdot 2 \cdot v_x^2 \rightarrow v_x = \sqrt{89} = 9,43 \text{ m/s}$$

Plastic Collision: Conservation of linear momentum:
↓ velocity after collision ($m \cdot v$)

$$m \cdot v_x = 2m \cdot v_{x, \text{coll}}$$

$$v_{x, \text{coll}} = \frac{1}{2} \cdot v_x = 4,717 \text{ m/s}$$

After impact kinetic energy:

$$T = \frac{1}{2} (2m) \cdot v_{x, \text{coll}}^2 = \frac{1}{2} \cdot 2 \cdot 2 \cdot 4,717^2 = 44,5 \text{ J}$$

Before impact kinetic energy:

$$\frac{1}{2} m v_x^2 = \frac{1}{2} \cdot 2 \cdot 9,43^2 = 89 \text{ J}$$

Energy loss:

$$89 - 44,5 = 44,5 \text{ J}$$