Constrained relations :- When motion of 1 body affects the motion of the other then we call it a constrained motion

→ String constraint

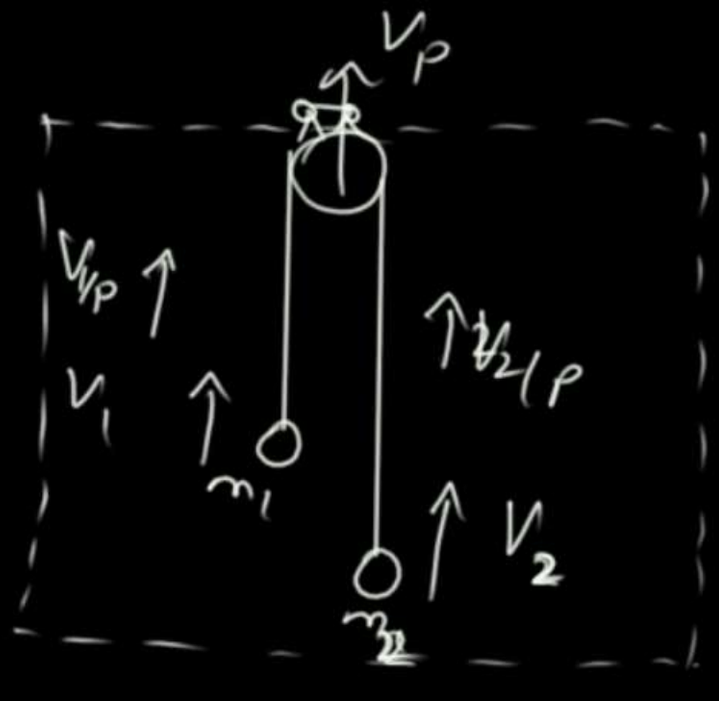
→ Wedge constraint

String constraint

→ String is massless / light

→ String is smooth

→ String is inextensible [length of string is constant]



$$l_1 + l_2 = l$$

$$\frac{dl_1}{dt} + \frac{dl_2}{dt} = \frac{dl}{dt}$$

$$v_{1/p} = v_1 - v_p \qquad v_{2/p} = v_2 - v_p$$

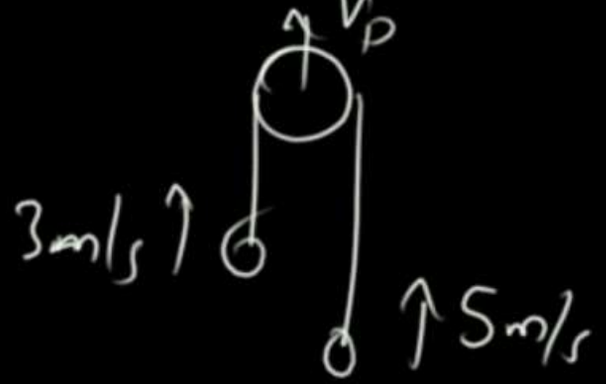
$$v_{1/p} = -v_{2/p} \Rightarrow v_1 - v_p = -(v_2 - v_p)$$

$$v_1 - v_p = -v_2 + v_p$$

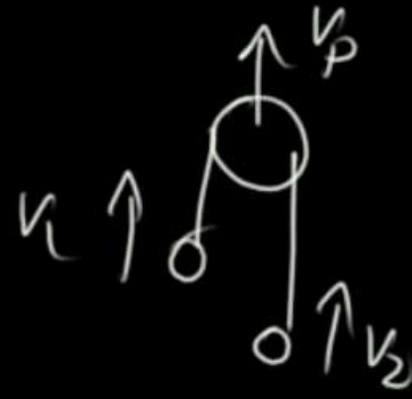
$$2v_p = v_1 + v_2 \Rightarrow \boxed{v_p = \frac{v_1 + v_2}{2}}$$

$v_1 \uparrow \quad v_2 \uparrow \quad v_p \uparrow$

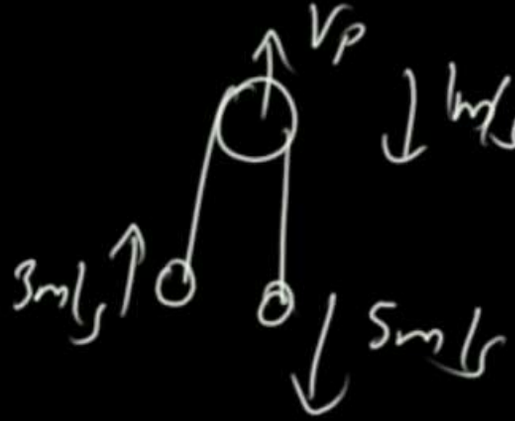
Here v_1, v_2 & v_p are w.r.t ground



$$v_p = \frac{3+5}{2} = 4\ m/s$$



$$v_p = \frac{v_1 + v_2}{2}$$

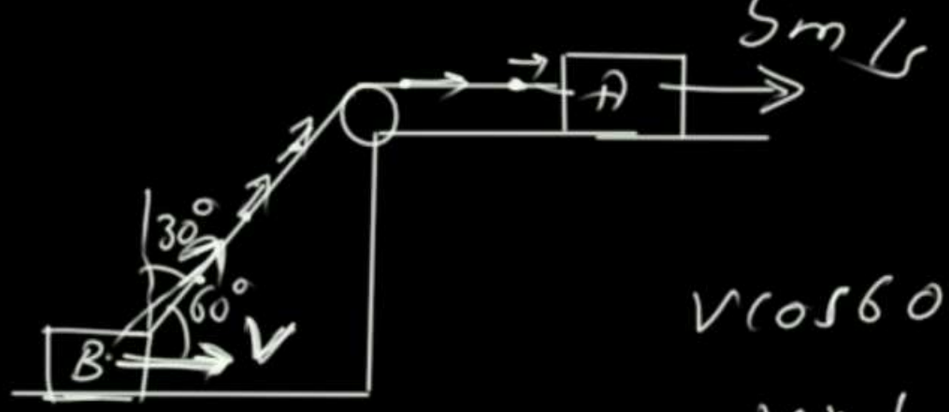


$$v_p = \frac{3 + (-5)}{2} = -1\ m/s$$

$$v_p = \frac{v_1 + v_2}{2} \Rightarrow -2 = \frac{8 + v_2}{2}$$

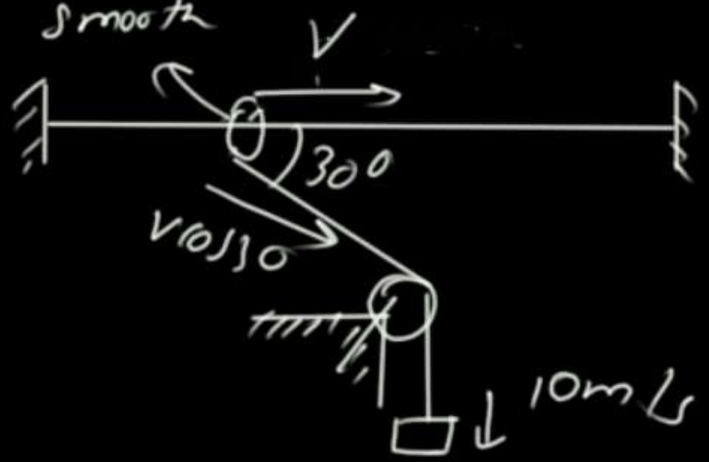
$$v_2 = -4 - 8 = \boxed{-12}$$

→ Speed of string along the length is always constant



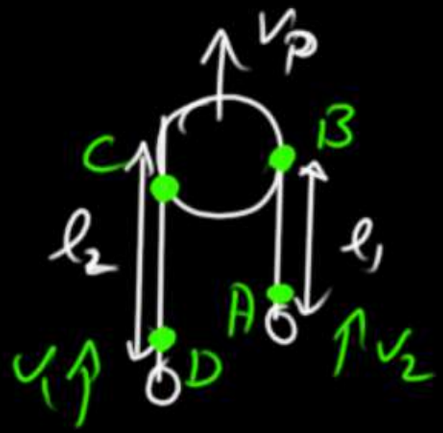
$V\cos 60 = 5$

$V \times \frac{1}{2} = 5 \Rightarrow V = 10 \text{ m/s}$



$V\cos 30 = 10$

$V \times \frac{\sqrt{3}}{2} = 10 \Rightarrow V = \frac{20}{\sqrt{3}} \text{ m/s}$

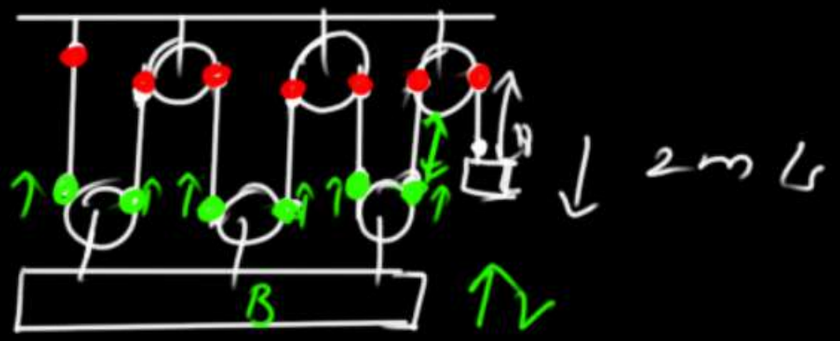


$$\frac{V_1 + V_2}{2} = V_p \quad \Longleftrightarrow \quad 2V_p = V_1 + V_2$$

$$-V_2 + V_p + V_p - V_1 = 0$$

$$V_p = \frac{V_1 + V_2}{2}$$

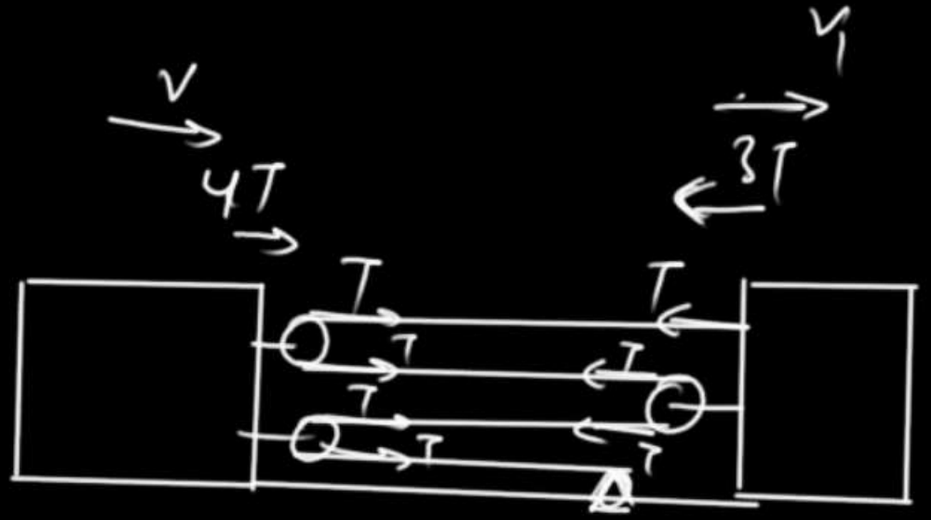
$$V_A + V_B + V_C + V_D = 0$$



$+2 + 0 - v - v - v - v - v - v = 0$

$2 - 6v = 0$

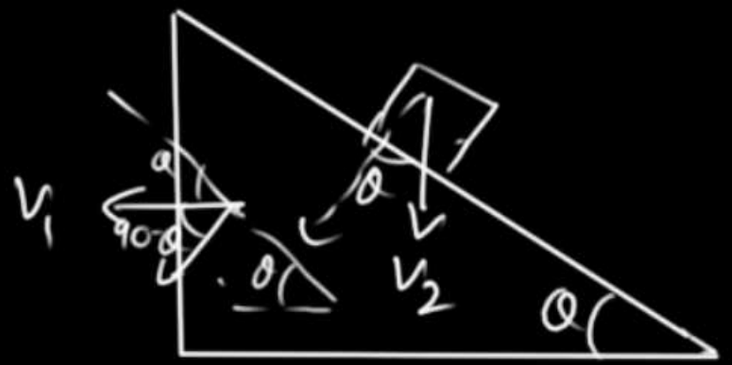
$v = \frac{2}{6} = \frac{1}{3}$

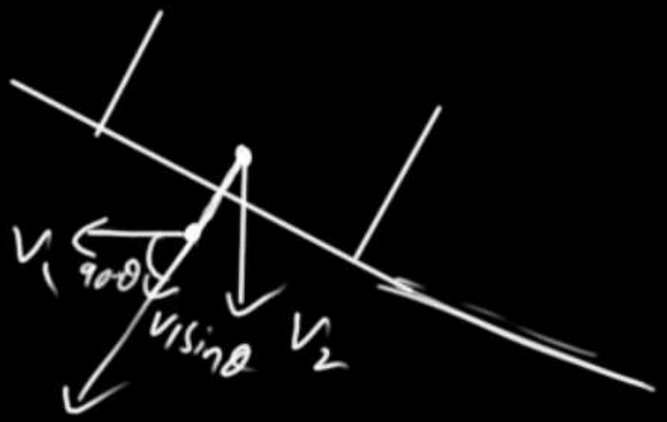


$(4\times)\, v = (3\times)(v_1)$

$v_1 = \frac{4v}{3}$

V_2 is speed of block with respect to the wedge



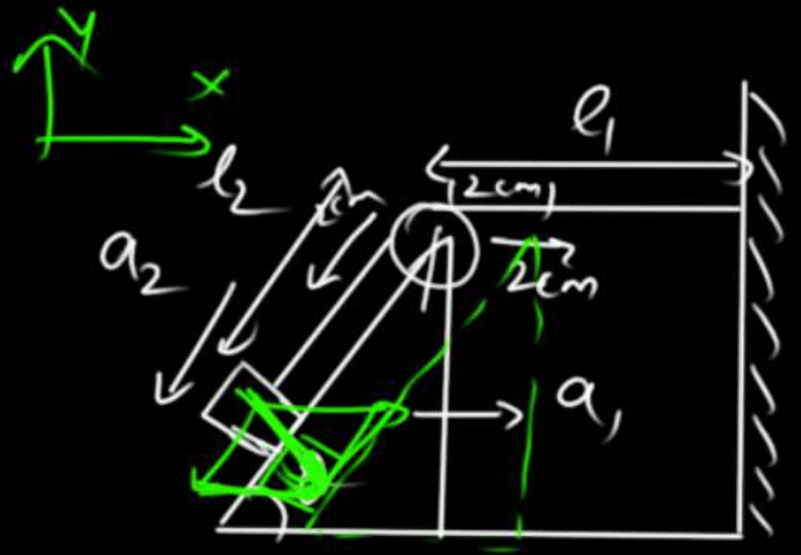


$V_2 \cos\theta$

$V_1 \cos\theta = V_2 \cos\theta_2$

$V_1 \sin\theta = V_2 \cos\theta$

$V_1 \tan\theta = V_2$



a_2 w.r.t wedge

$l_1 + l_2 = \text{constant}$

$a_1 = a_2$