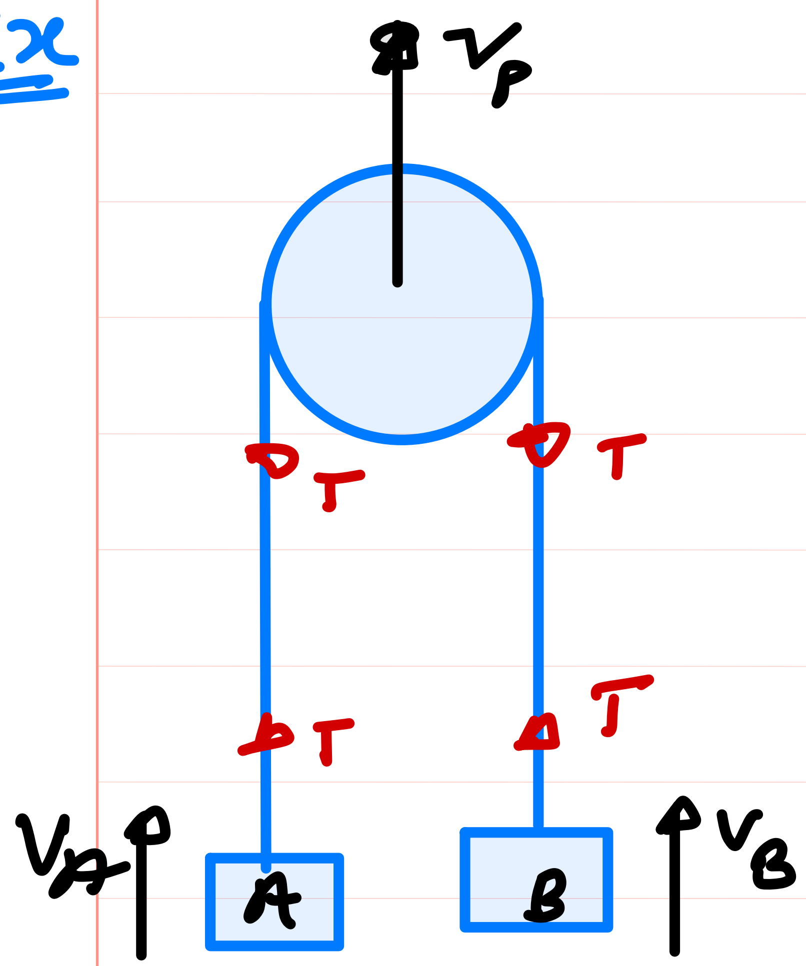
Ex



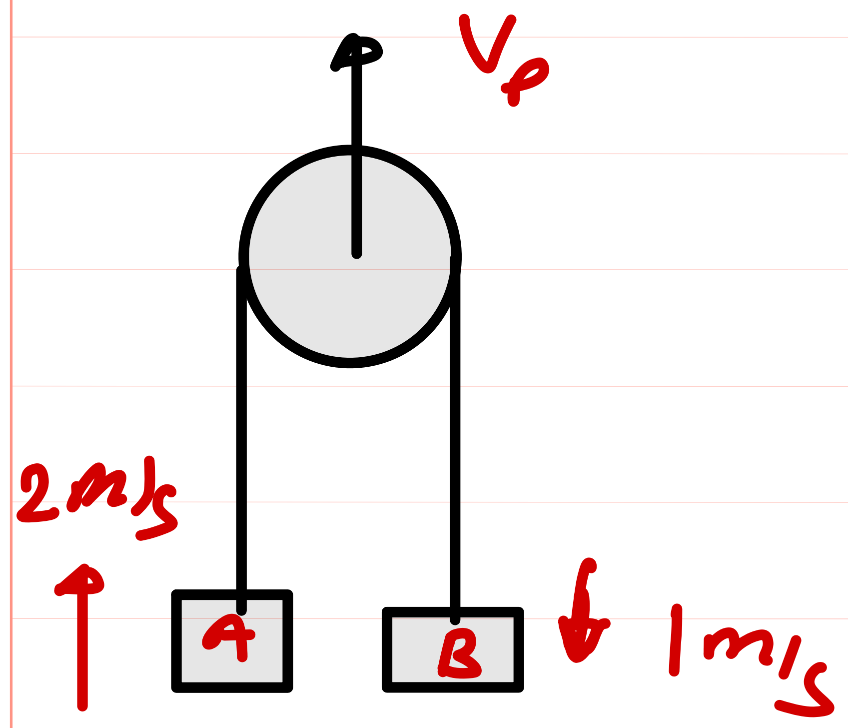
Relⁿ b/w velocities

$$T V_A + T V_B - 2T V_p = 0$$

$$\boxed{V_p = \frac{V_A + V_B}{2}}$$

Yaad Rakhe !!

Ex



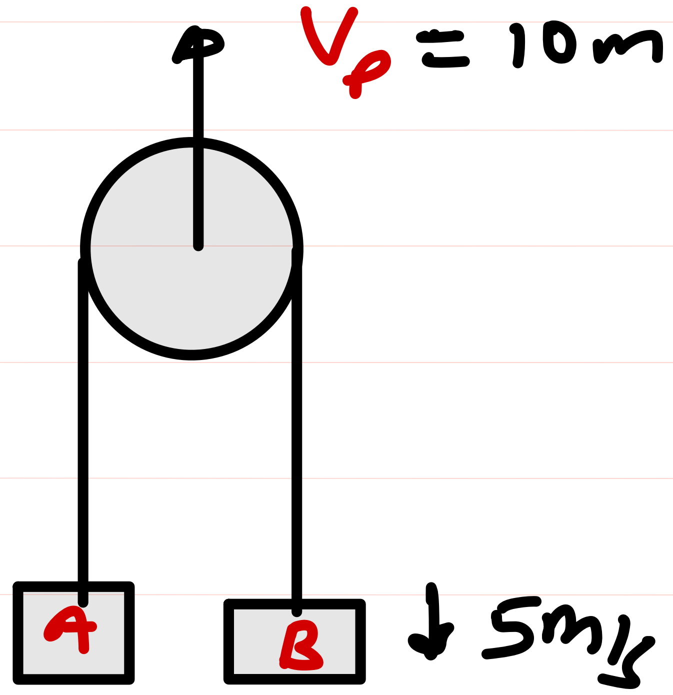
$V_p = ??$

$$V_p = \frac{+2 - 1}{2}$$

$$\boxed{V_p = \frac{1}{2}\ m/s \uparrow}$$

Ans

Ex



$V_A = ??$

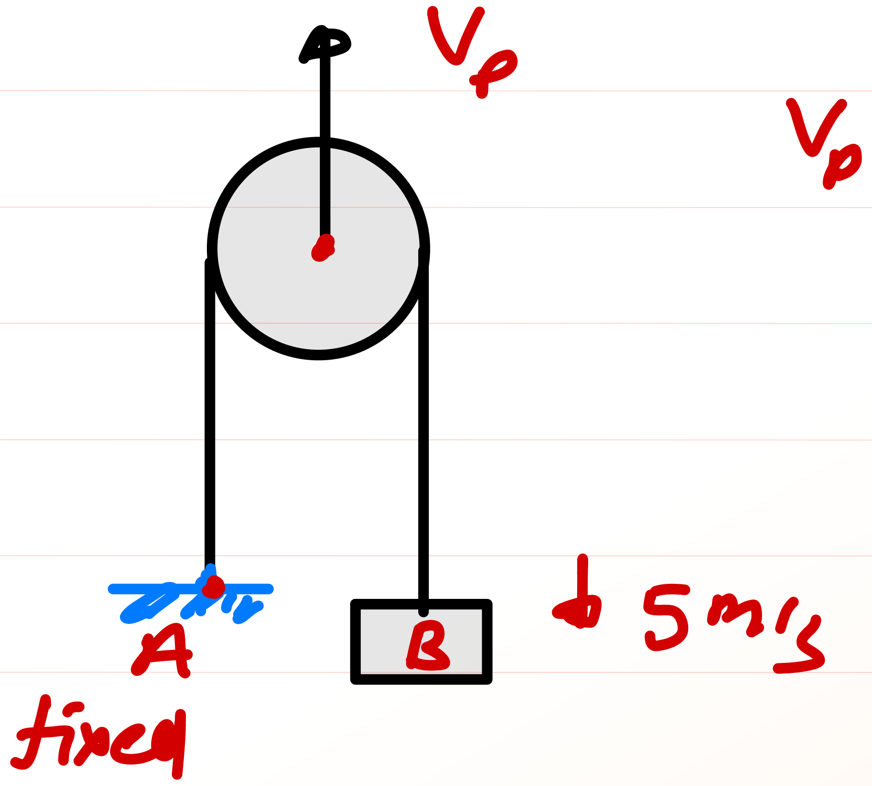
$$10 = \frac{V_A - 5}{2}$$

$$20 = V_A - 5$$

$$\boxed{V_A = 25\ m/s \uparrow}$$

Ans

Ex

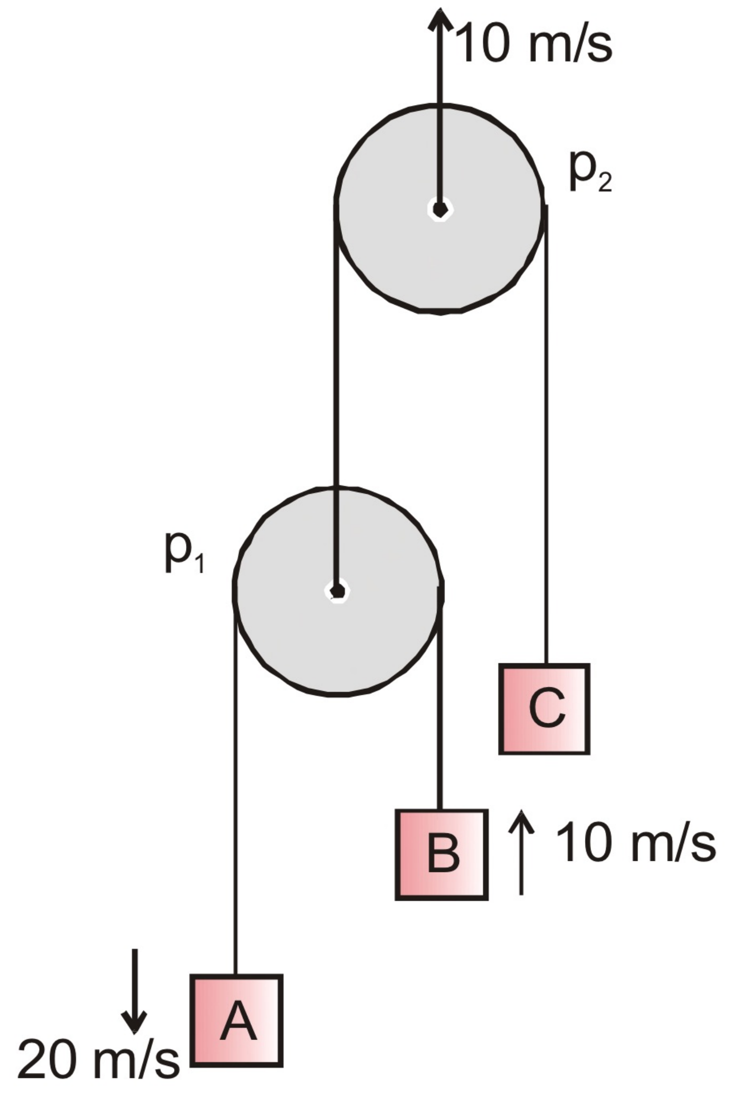


$V_p = ??$

$$V_p = \frac{0 - 5}{2}$$

$$\boxed{V_p = -2.5\ m/s} \downarrow$$

8. Velocities of blocks A, B and pulley p_2 are shown in figure. Find velocity of pulley p_1 and block C.

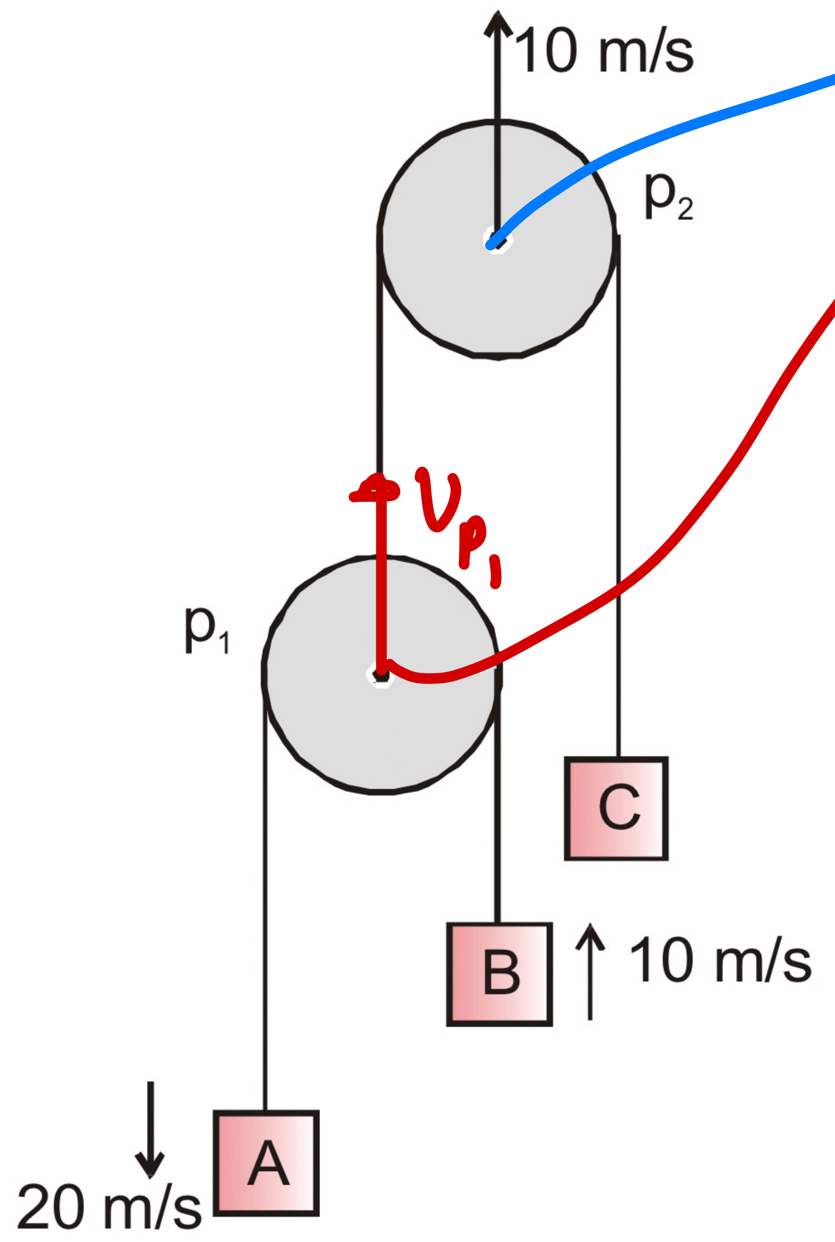


(A) $V_{P_1} = 10\ \text{m/s}\downarrow,\ V_C = 25\ \text{m/s}\uparrow$

(B) $V_{P_1} = 5\ \text{m/s}\uparrow,\ V_C = 25\ \text{m/s}\uparrow$

(C) $V_{P_1} = 5\ \text{m/s}\downarrow,\ V_C = 25\ \text{m/s}\downarrow$

(D) $V_{P_1} = 5\ \text{m/s}\downarrow,\ V_C = 25\ \text{m/s}\uparrow$



$V_{P_1} = \frac{-20+10}{2}$

$= -\frac{10}{2}$

$\boxed{V_{P_1} = -5\ \text{m/s}\downarrow}$

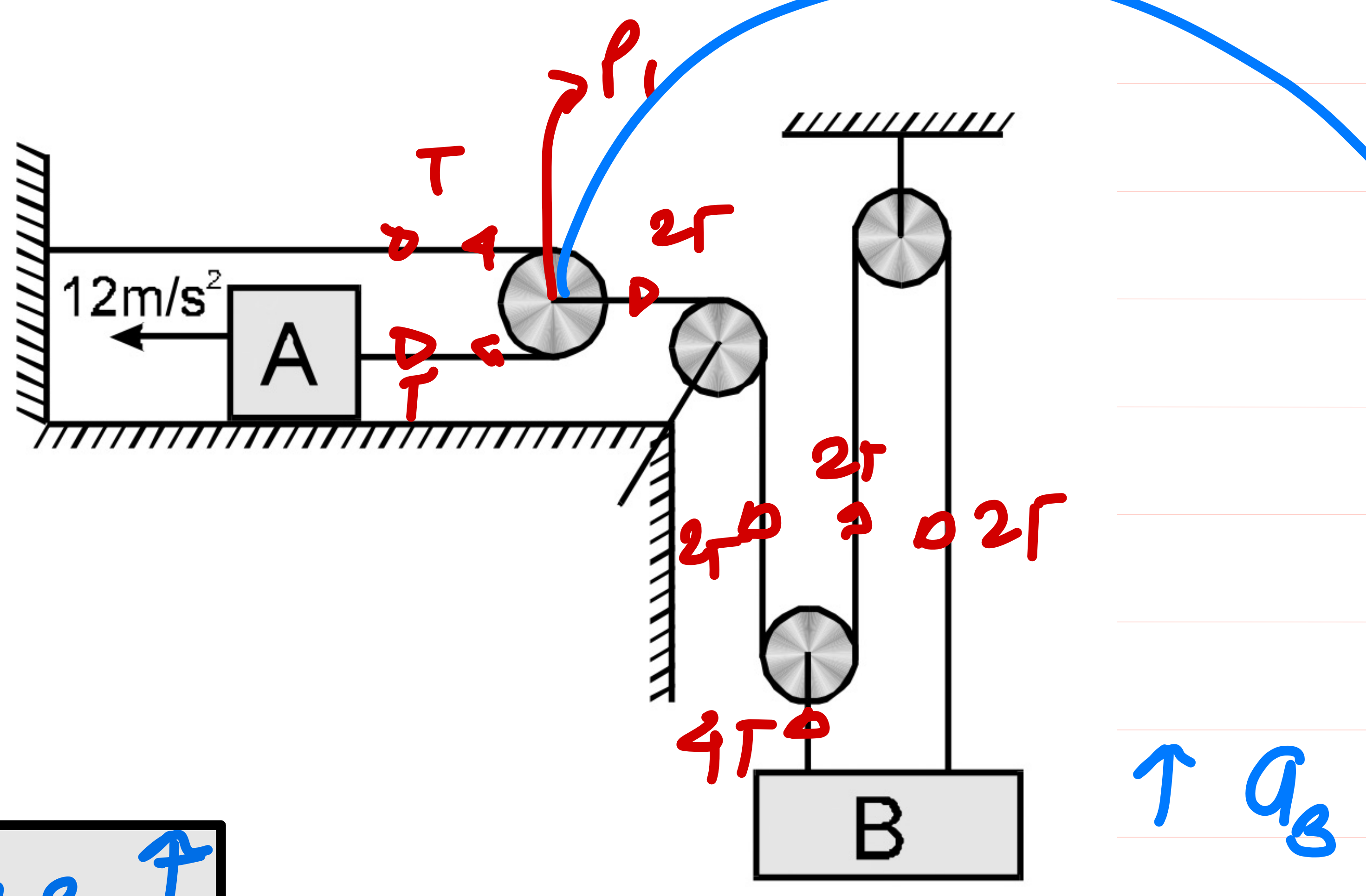
$V_{P_2} = \frac{V_4 + V_3}{2}$

$10 = \frac{-5 + V_C}{2}$

$20 = -5 + V_C$

$\boxed{V_C = 25\ \text{m/s}\uparrow}$

6. Find the acceleration of B.



Acc. of P_1 is

$a_{P_1} = \frac{-12+0}{2}$

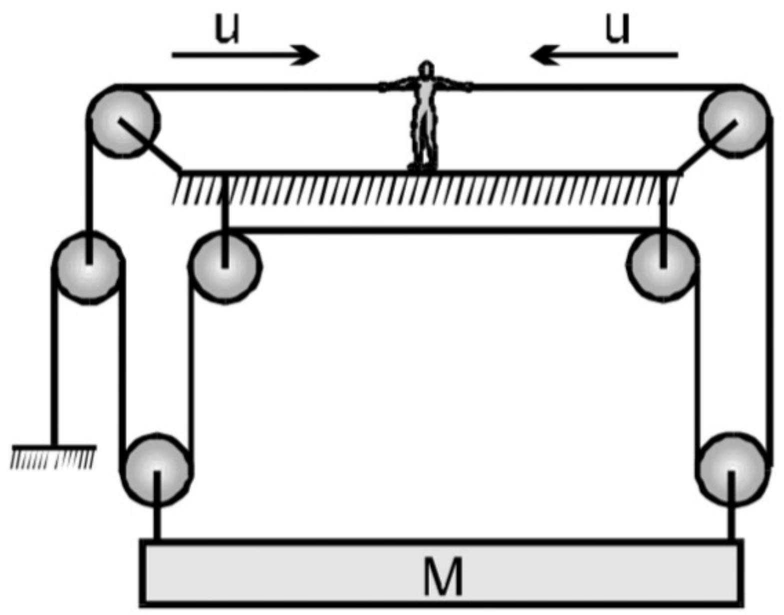
$\boxed{a_{P_1} = -6\ m/s^2}$

leftward.

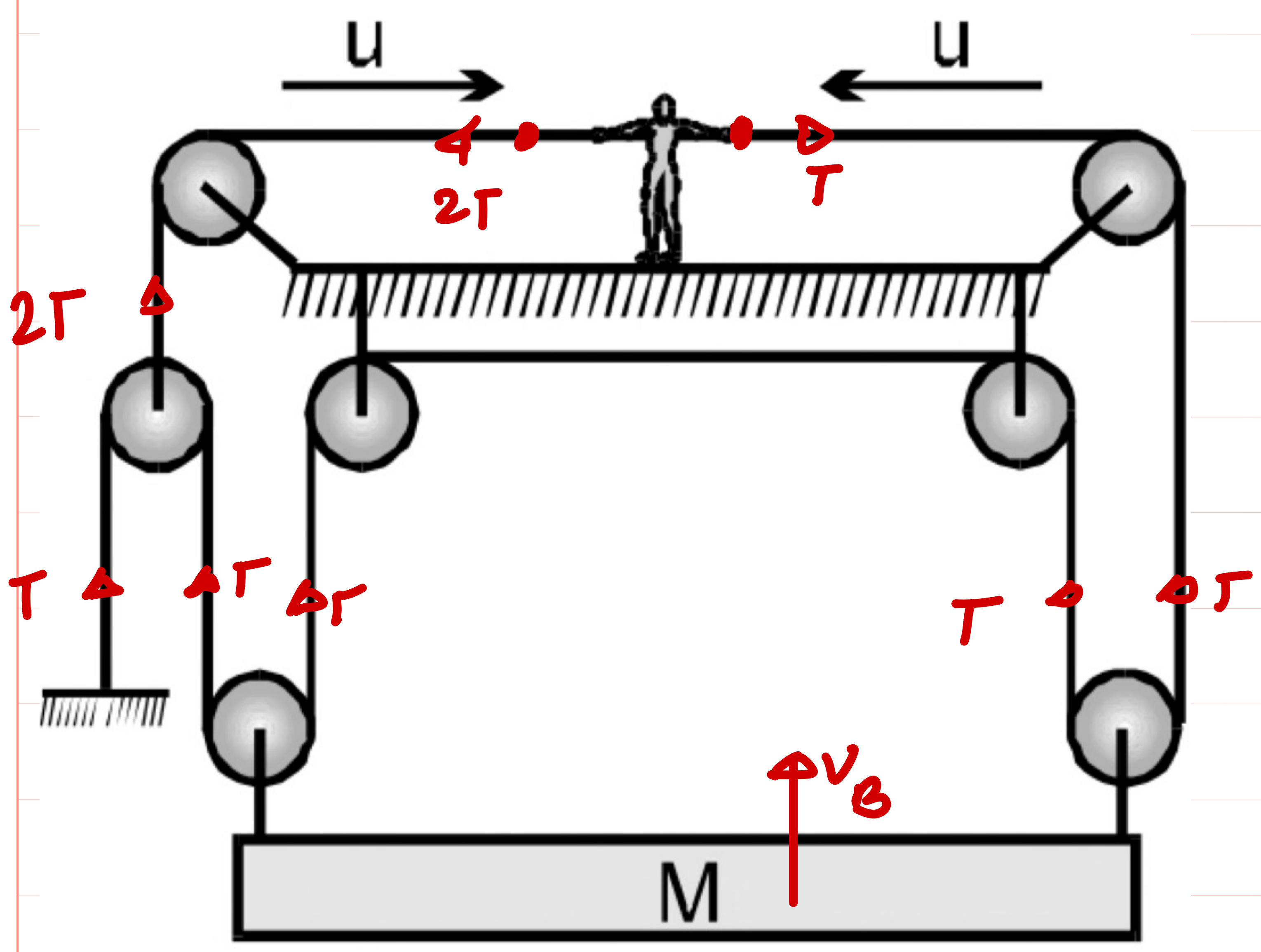
$-T \times 12 + 6T a_B = 0$

$12 = 6 a_B \Rightarrow \boxed{a_B = 2\ m/s^2 \uparrow}$ Ans

8. System is shown in the figure and man is pulling the rope from both sides with constant speed 'u'. Then the velocity of the block will be



(A) $\frac{3u}{4}$ (B) $\frac{3u}{2}$ (C) $\frac{u}{4}$ (D) None of these

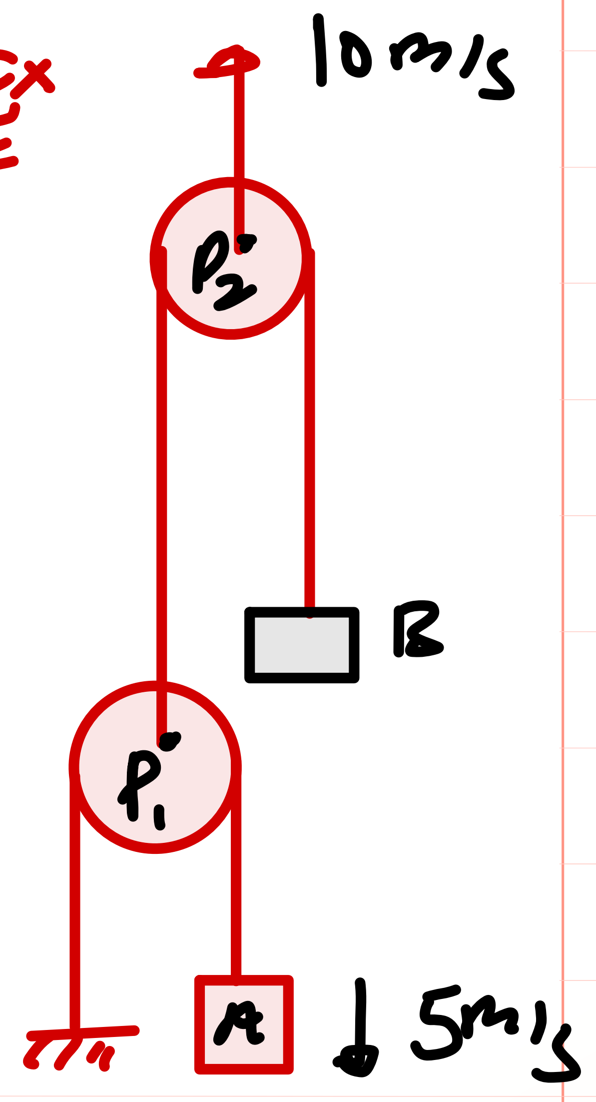


$-2Tu - Tu + v_B \times 4T = 0$

$3u = 4v_B$

$\boxed{v_B = \frac{3u}{4}}$

Ex



$v_B = ??$

$v_{P_1} = \frac{0-5}{2} = -2.5$ m/s

$v_{P_2} = \frac{-2.5 + v_B}{2}$

$10 = \frac{-2.5 + v_B}{2}$

$\boxed{v_B = 22.5 \text{ m/s}} \uparrow$ Ans

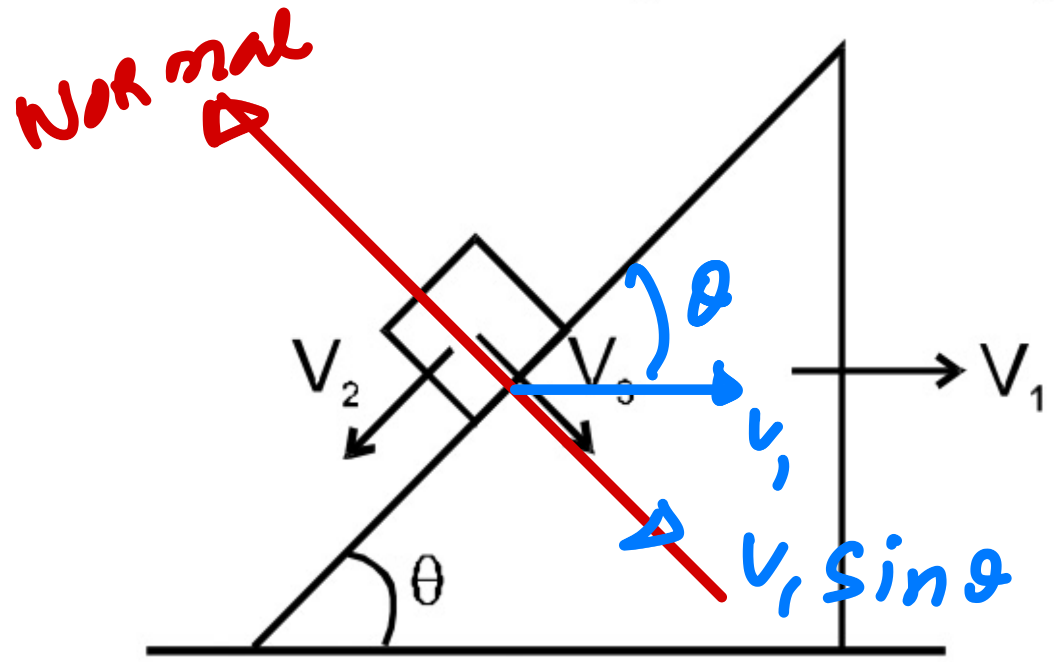
Wedge Constraint: →

Conditions :→

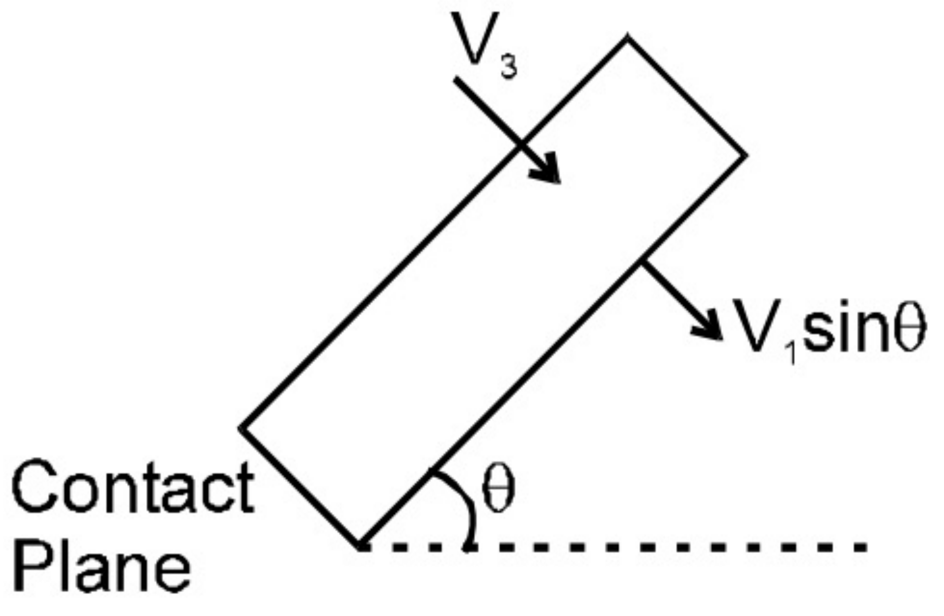
(i) There is a regular contact between two objects.

(ii) Objects are rigid.

The relative velocity perpendicular to the contact plane of the two rigid objects is always zero if there is a regular contact between the objects. Wedge constraint is applied for each contact.



$\boxed{V_3 = V_1 \sin\theta}$



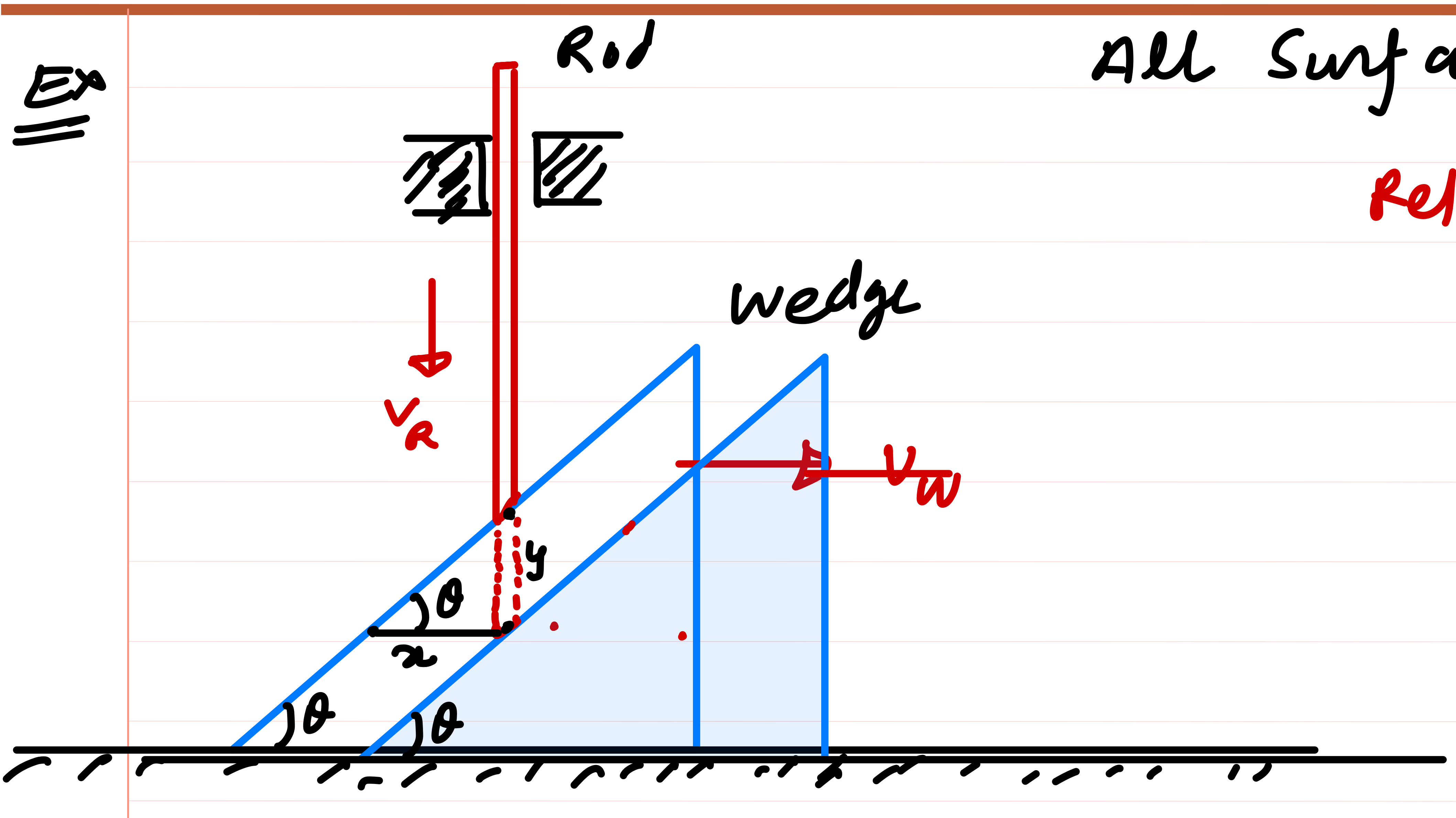
In other words,

Components of velocity along perpendicular direction to the contact plane of the two objects is always equal if there is no deformations and they remain in contact.

Ex

All Surfaces are Smooth

Reln b/w velocities and acc. of objects

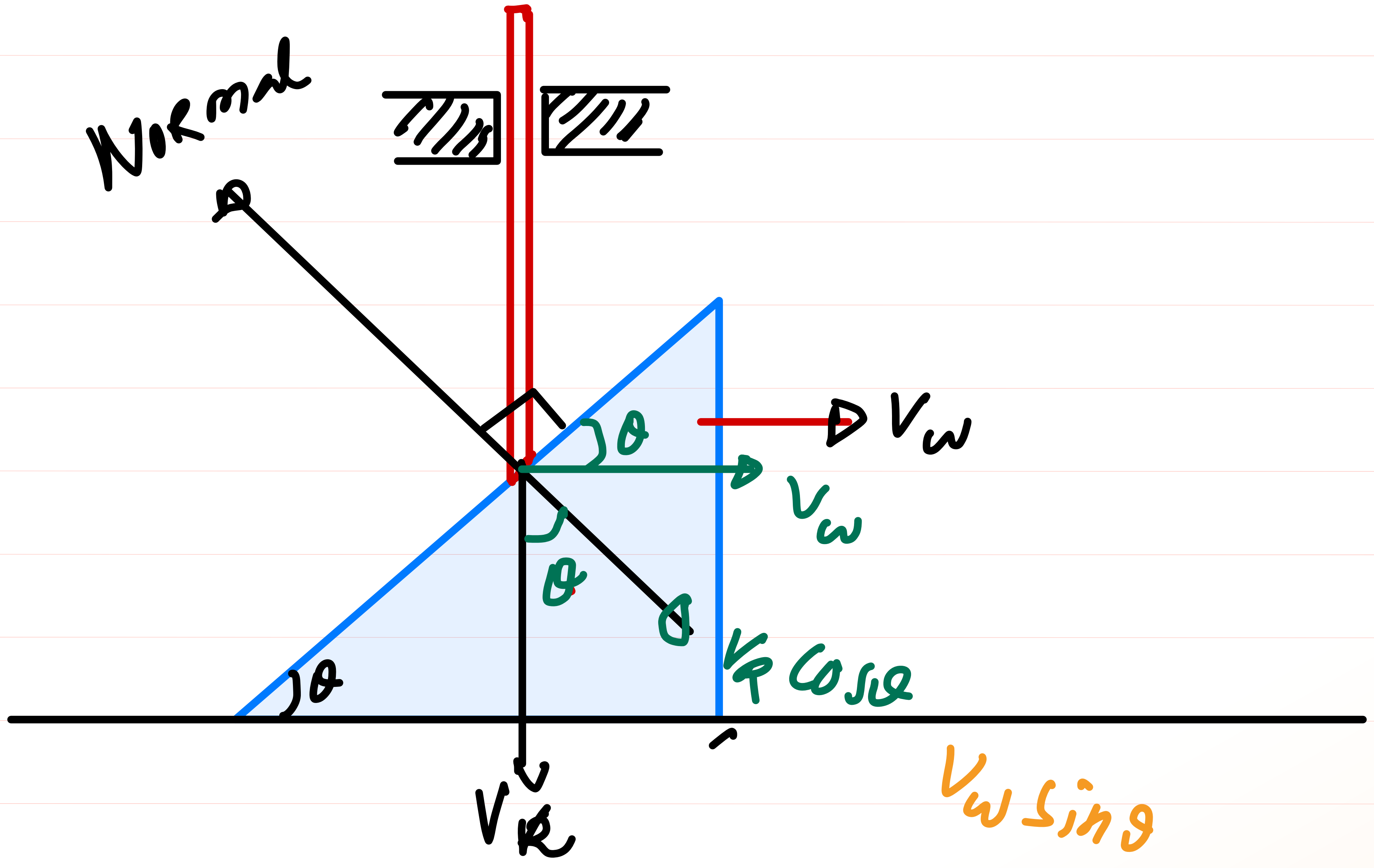


$\tan\theta = \frac{y}{x}$

$y = x\tan\theta$

$\frac{dy}{dt} = \frac{dx}{dt}\cdot\tan\theta$

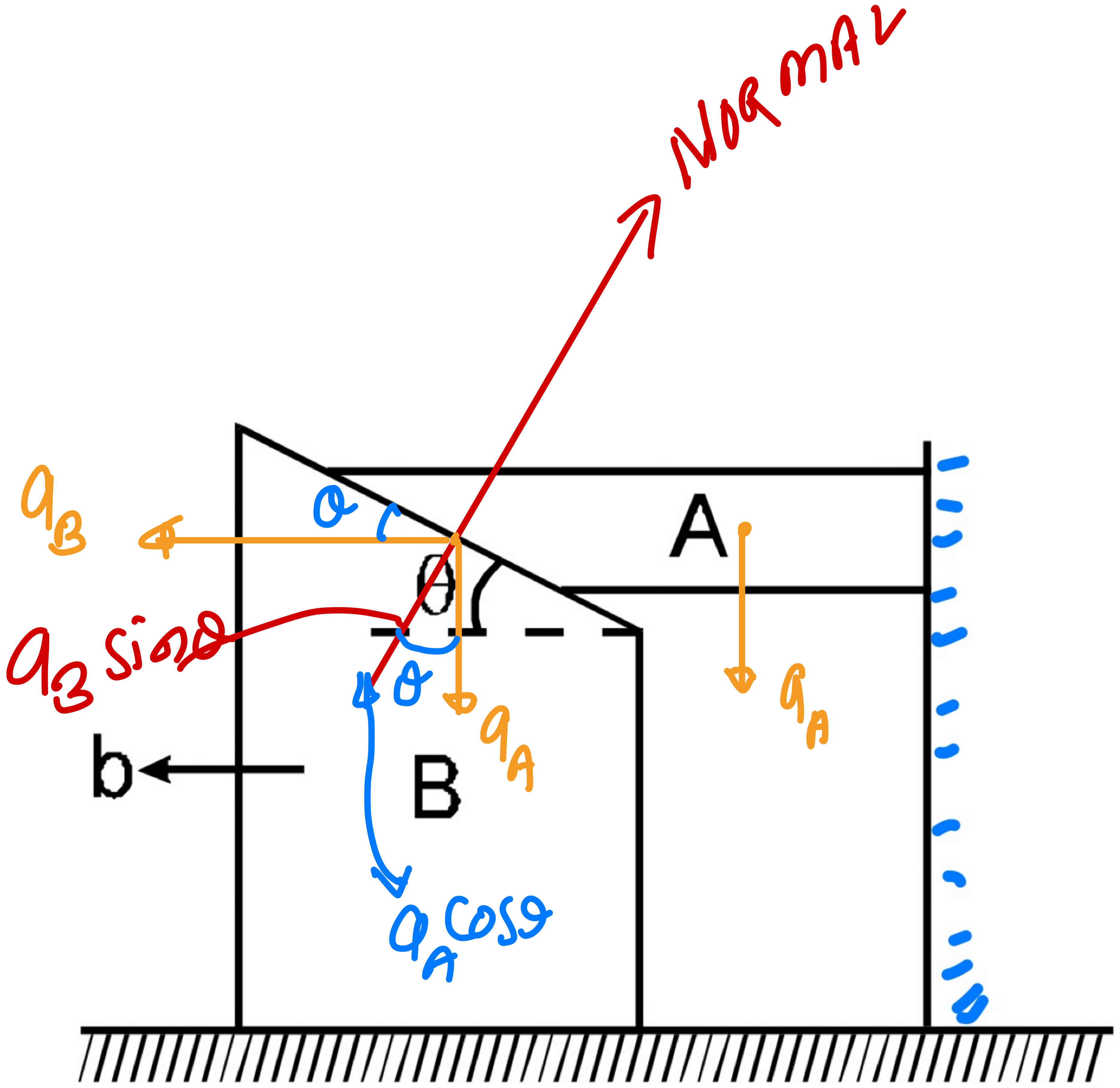
$$\boxed{\begin{aligned} V_R &= V_w \tan\theta \\ a_R &= a_w \tan\theta \end{aligned}}$$

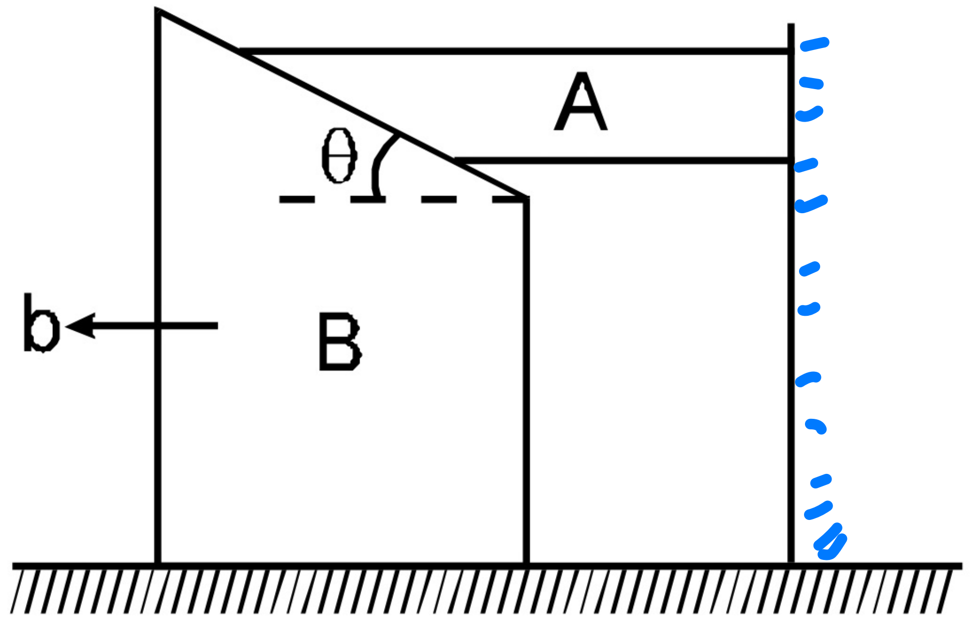


$V_R\cos\theta = V_w\sin\theta$

$$\boxed{\begin{aligned} V_R &= V_w \tan\theta \\ a_R &= a_w \tan\theta \end{aligned}}$$

7. Find the acceleration of wedge A



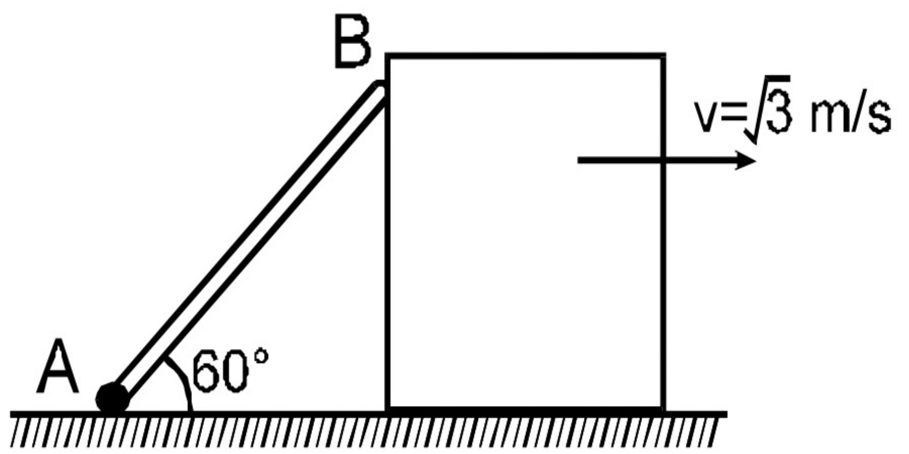


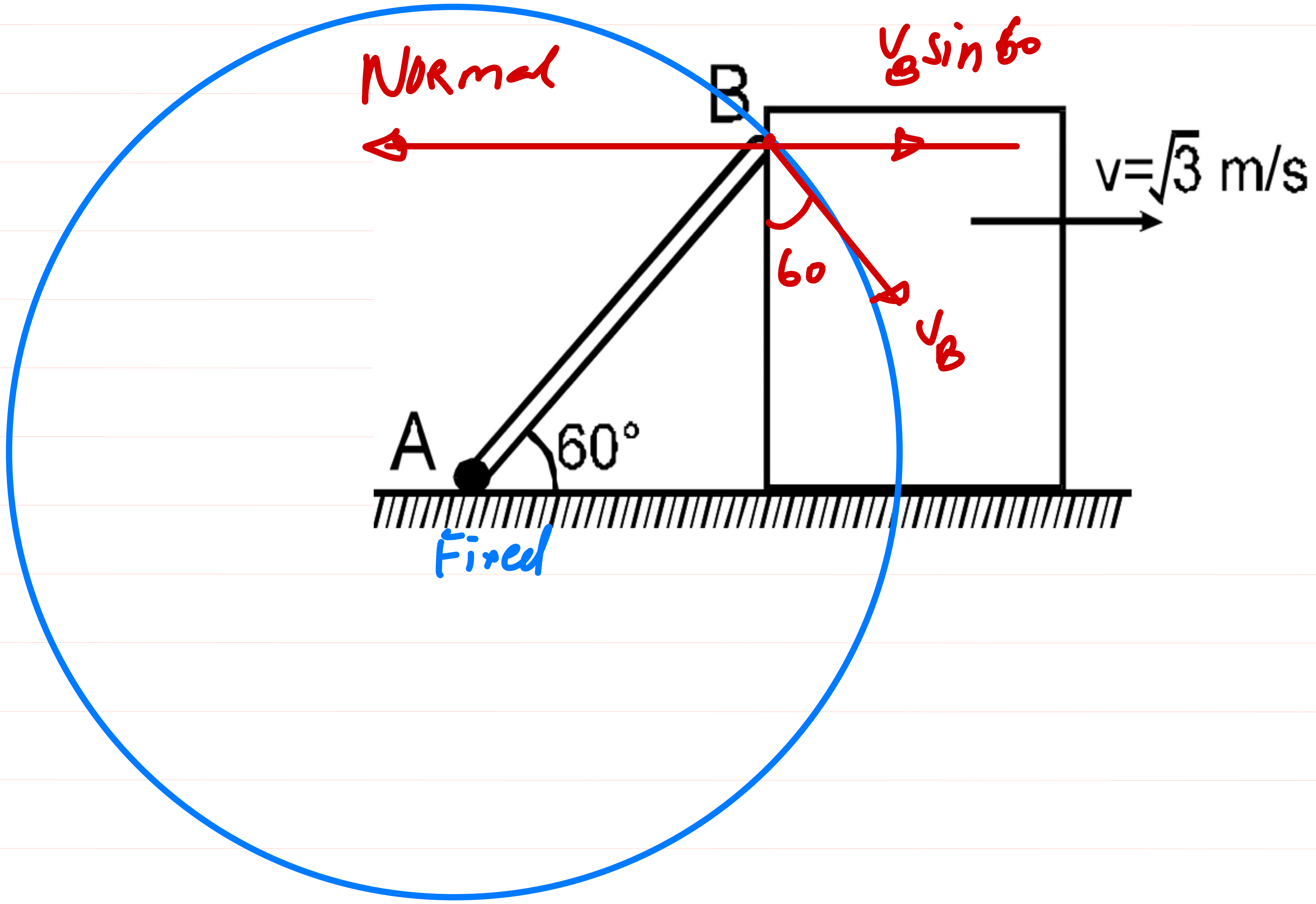
$$a_A \cos\theta = a_B \sin\theta$$

$$a_A = a_B \tan\theta$$

$$\boxed{a_A = b\tan\theta}$$ Ans

6. A rod AB is shown in figure. End A of the rod is fixed on the ground. Block is moving with velocity $\sqrt{3}$ m/s towards right. Find the velocity of end B of rod when rod makes an angle of 60° with the ground.



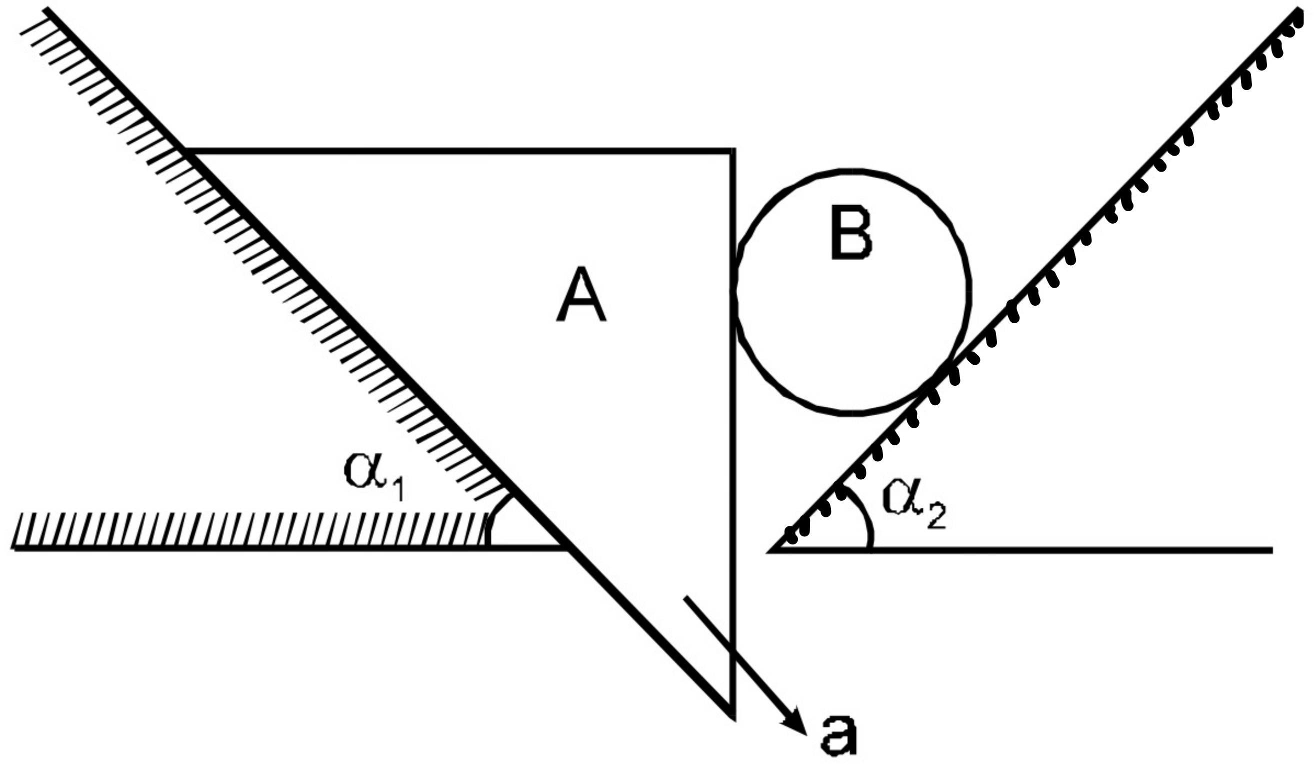


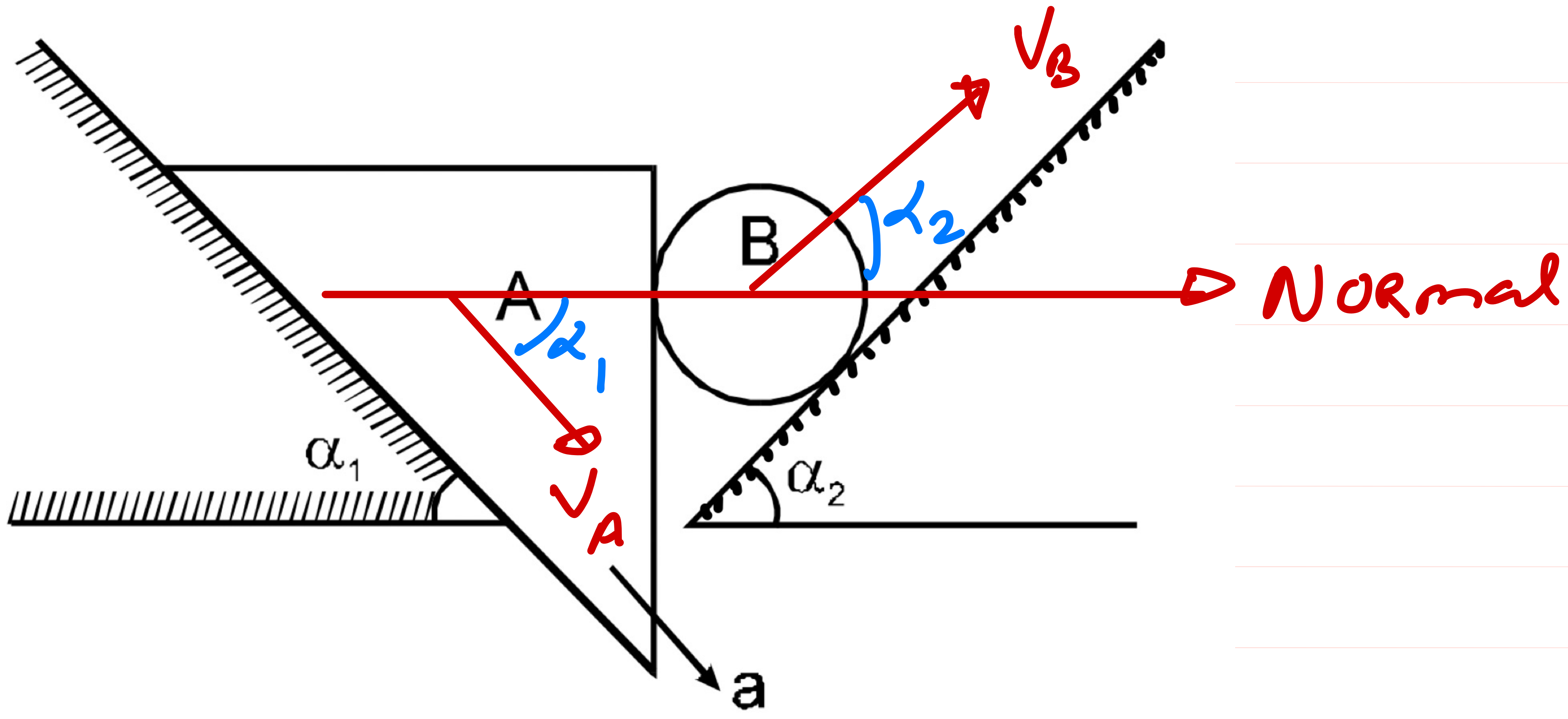
$V_B \sin 60 = \sqrt{3}$

$V_B \frac{\sqrt{3}}{2} = \sqrt{3}$

$\boxed{V_B = 2 \text{ m/s}}$ Ans

9. Find the acceleration of B.





$$V_A \cos\alpha_1 = V_B \cos\alpha_2$$

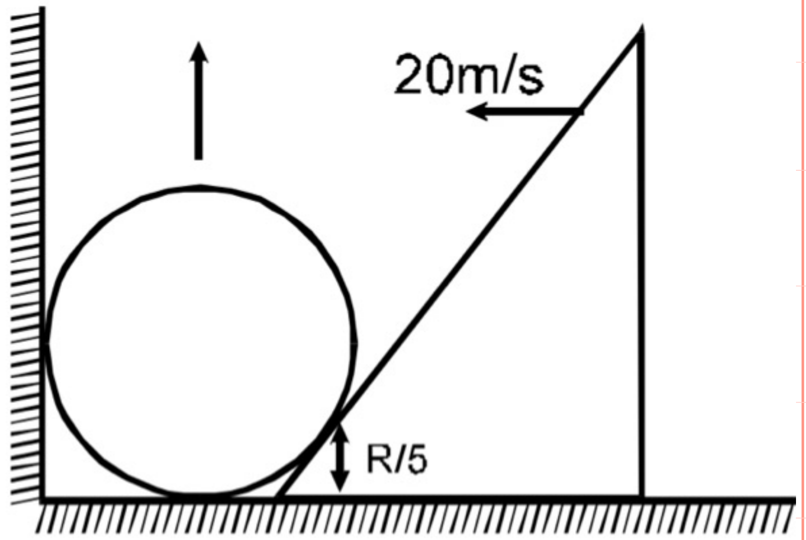
$$a_A \cos\alpha_1 = a_B \cos\alpha_2$$

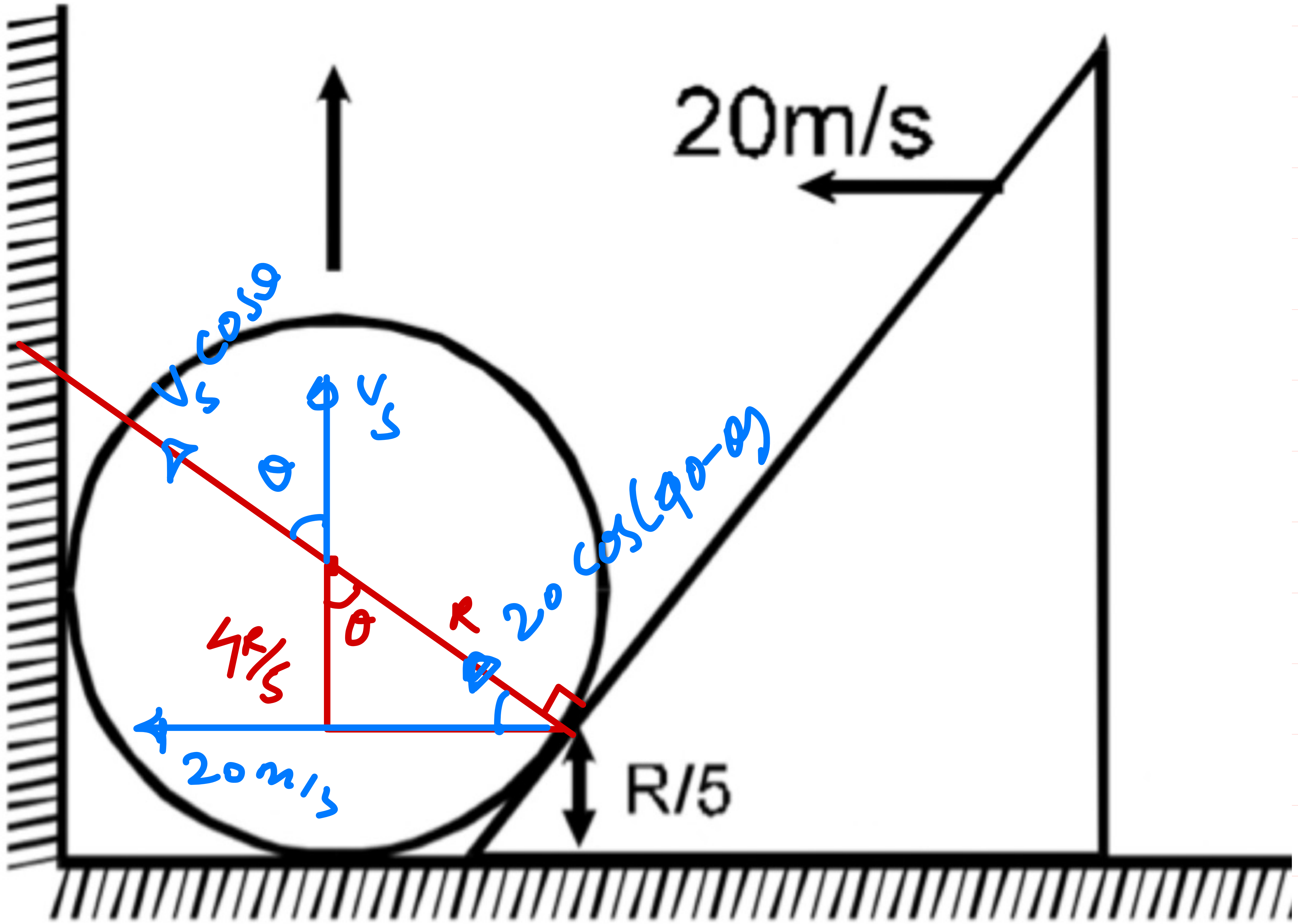
$$\boxed{\frac{a \cos\alpha_1}{\cos\alpha_2} = a_B}$$

Ans

25. A sphere of radius R is in contact with a wedge. The point of contact is R/5 from the ground as shown in the figure. Wedge is moving with velocity 20 m/s, then the velocity of the sphere at this instant will be:

(A) 20 m/s
(B) 15 m/s
(C) 5 m/s
(D) 10 m/s





$\cos\theta = \frac{4R}{5R} = 4/5$

$\sin\theta = \frac{3}{5}$

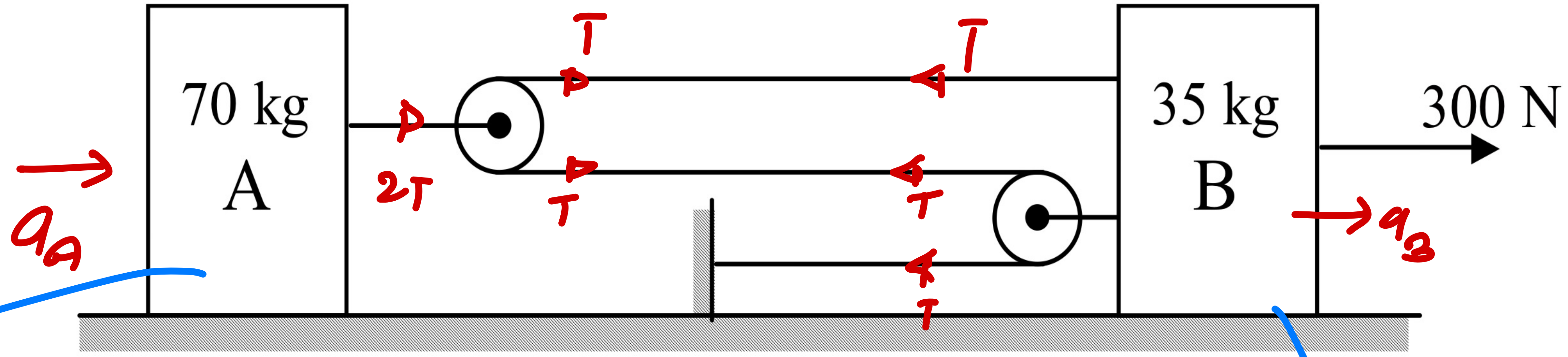
$V_s \cos\theta = 20\cos(90-\theta)$

$V_s \cos\theta = 20\sin\theta$

$V_s \times 4/\cancel{5} = 20 \times \frac{3}{\cancel{5}}$

$\boxed{V_s = 15\ m/s}$

3. Find accelaration of block B. Assume the pulleys and string to be ideal and neglect any friction.



$2T = 70 a_A$

$T = 35 a_A \quad \text{—(1)}$

$25 a_A - 35 a_B = 0$

$2a_A = 3a_B \quad \text{—(1)}$

$300 - 3T = 35 a_B$

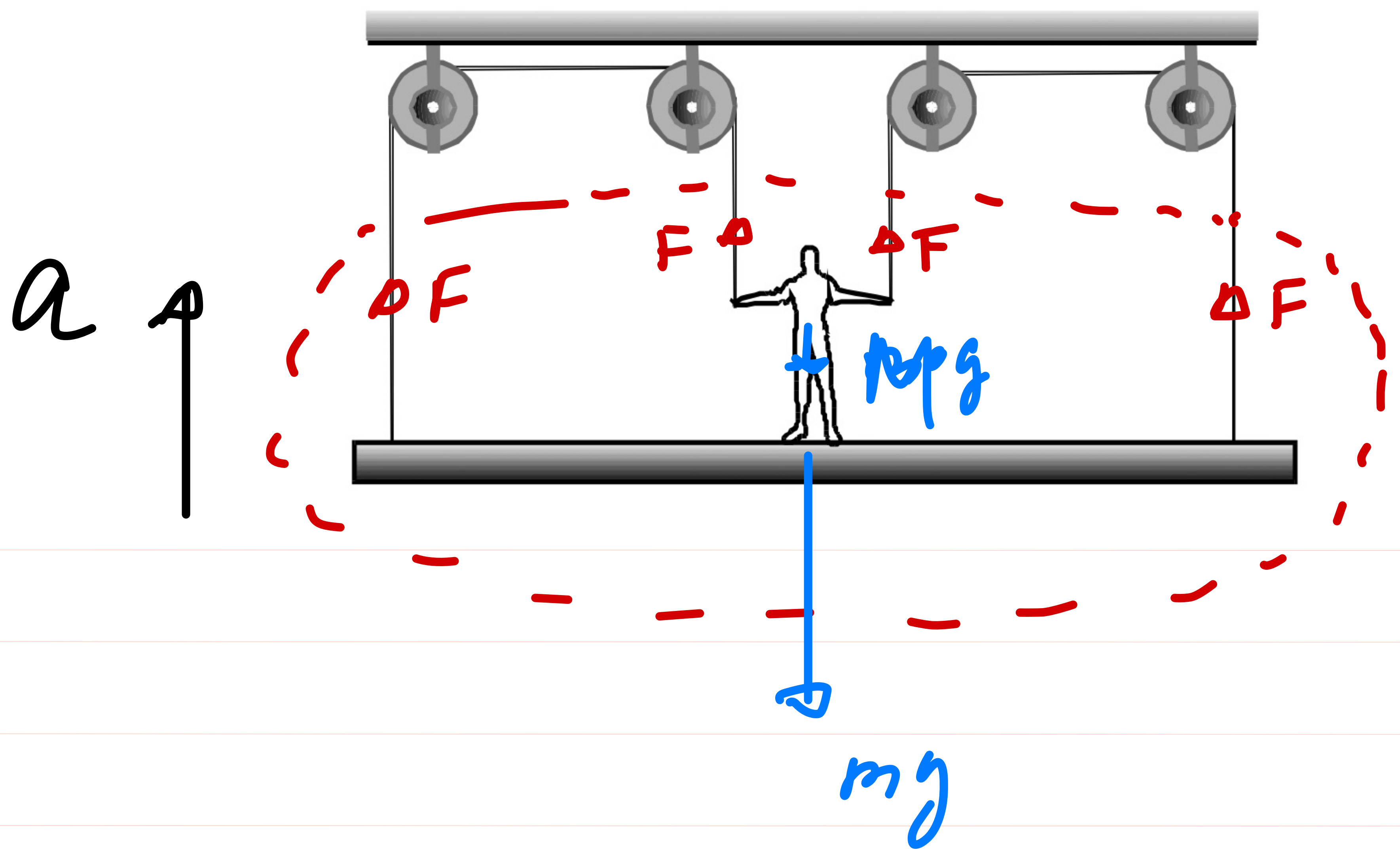
$300 - 3 \times 35 a_A = 35 a_B$

$300 - 3 \times 35 \times \frac{3a_B}{2} = 35 a_B$

$300 = \frac{9}{2} \times 35 a_B + 35 a_B$

$300 = \frac{11}{2} \times 35 a_B \Rightarrow \boxed{a_B = \frac{600}{35 \times 11}}$

6. A painter of mass M stand on a platform of mass m and pulls himself up by two ropes which hang over pulley as shown. He pulls each rope with the force F and moves upward with uniform acceleration 'a'. Find 'a' (neglecting the fact that no one could do this for long time).



$4F = (M+m)a$ (No g)

$a = \frac{4F}{M+m}$

$4F - (M+m)g = (M+m)a \Rightarrow a = \frac{4F - (M+m)g}{M+m}$