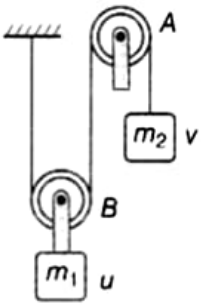
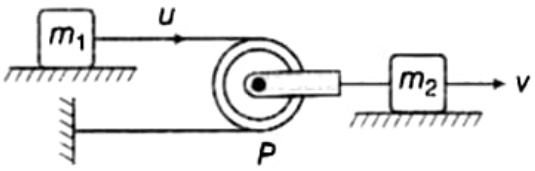
PROBLEMS ON CONSTRAINTS

1. Find the relation between u and v in following cases.

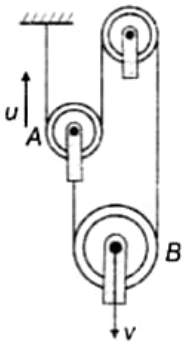
i. The pulley A is smooth and fixed. The pulley B is free to move. The velocity of block m_1 is u in downward direction and velocity of m_2 is v.



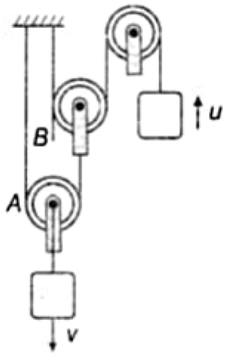
ii. Movable pulley P is smooth and light.



iii. Pulley A and B are movable. The velocity of pulley B is v and velocity of A is u.

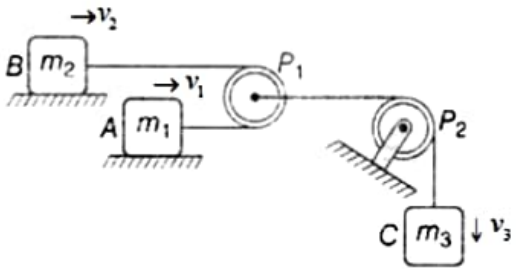


iv. Pulley A and B are light movable.

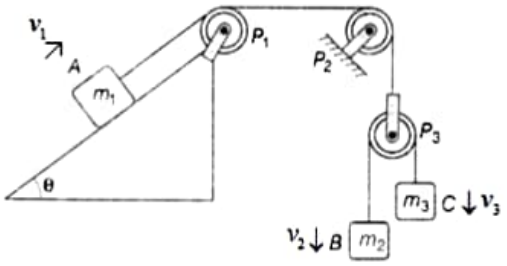


2. Find the relation among v_1, v_2 and v_3 in the following cases.

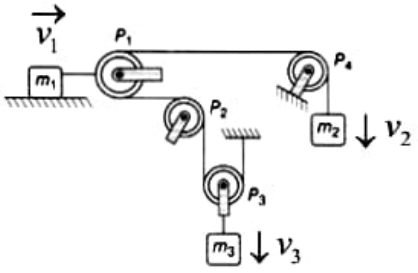
i. Blocks A and B are placed on the smooth horizontal table. A smooth light pulley P_1 is movable but smooth pulley P_2 is fixed. The velocities of blocks A, B and C are v_1, v_2 and v_3 respectively.



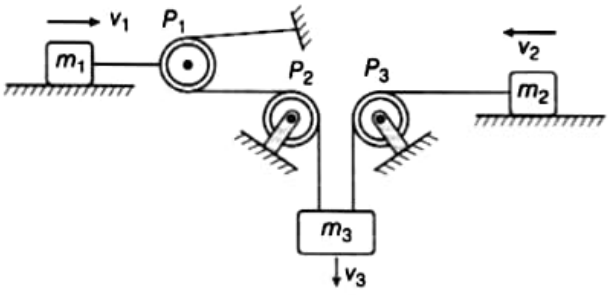
ii. All ideal pulleys are fixed excepts pulley P_3. The velocities of A, B and C are v_1, v_2 and v_3, respectively.



iii. All ideal pulleys are fixed except pulleys P_1 and P_3. The velocities of masses m_1, m_2 and m_3 are v_1, v_2 and v_3, respectively.

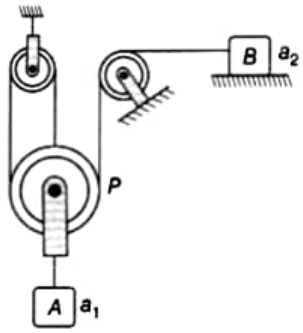


iv. For the situation shown in figure, blocks are connected through light strings. Light pulley P_1 is movable while other smooth pulleys are fixed.

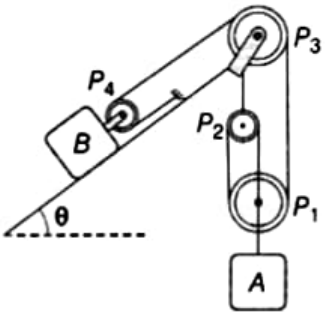


3. Find the relation between a_1 and a_2 in the following cases.

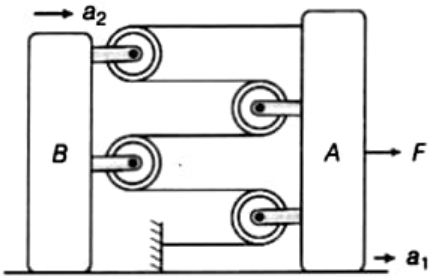
i. The smooth and light pulley P is movable. The acceleration of blocks A and B are a_1 and a_2, respectively.



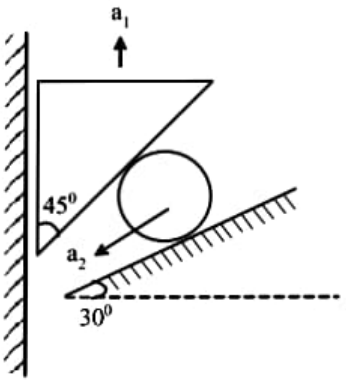
ii. All pulleys are smooth and light. The pulleys P_2 and P_3 are fixed, but P_1 and P_4 are movable.



iii. Block A and B are connected through light string passing through light smooth pulleys as shown in figure.



iv. Find relation between acceleration of triangular block and sphere.



ANSWER KEY

1. (*i*) $v = 2u$, (*ii*) $u = 2v$, (*iii*) $u = 2v$, (*iv*) $u = 4v$

2. (*i*) $v_1 + v_2 = 2v_3$, (*ii*) $v_2 + v_3 = 2v_1$, (*iii*) $2v_1 = v_2 + 2v_3$, (*iv*) $v_2 = v_3 = 2v_1$

3. (*i*) $a_2 = 3a_1$, (*ii*) $3a_1 = 2a_2$, (*iii*) $5a_1 = 4a_2$, (*iv*) $a_1 \sin 45^0 = a_2 \sin 15^0$