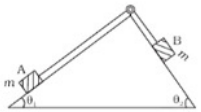
QUES 03

In Figure, a body A of mass m slides on plane inclined at angle θ_1 to the horizontal and μ_1 is the coefficent of friction between A and the plane. A is connected by a light string passing over a frictionless pulley to another body B, also of mass m, sliding on a frictionless plane inclined at angle θ_2 to the horizontal. Which of the following statements are true?



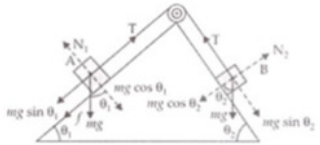
a. A will never move up the plane.

b. A will just start moving up the plane when $\mu = \frac{\sin\theta_2 - \sin\theta_1}{\cos\theta_1}$

c. For A to move up the plane, θ_2 must always be greater than θ_1

d. B will always slide down with constant speed.

Sol. In question, it is mention that plane below block A has μ co-efficient of friction also block B lying on a frictionless surface.



Let's consider two cases

Case 1: When A just start i.e. f = μ N_1 = μ mg cos θ_1

m g sin θ_1 + f = mg sin θ_2

Body A moves up and B down the plane

m g sin θ_1 + μ mg cos θ_1 = mg sin θ_2

mg will cancel out

sin θ_1 + μ cos θ_1 = sin $\theta_2$or μ cos θ_1 = sin θ_2 - sin θ_1

Or $\mu = \frac{\sin\theta_2 - \sin\theta_1}{\cos\theta_1}$ so option (b) is correct.

Case 2: When A moves upward and B downward

$\Rightarrow$ m g sin θ_2 -m g sin θ_1 > 0

$\Rightarrow$ sin θ_2 - sin θ_1 > 0

$\Rightarrow$ sin θ_2 > sin θ_1

Or $\theta_2 > \theta_1$ from this we can say option (a) is wrong and option (c) is correct.

Now if B moves upward and A downward then

$\Rightarrow$ m g sin θ_1 - f > mg sin θ_2

$\Rightarrow$ m g sin θ_1 - μ m g cos θ_1 > mg sin θ_2

$\Rightarrow$ sin θ_1 - μ cos θ_1 > sin θ_2

$\Rightarrow$ sin θ_1 - sin θ_2 > μ cos θ_1

So from here, we can say that as θ_1 increases sin θ_1 also increases but cos θ_1 decreases also sum of θ_1 and θ_2 is 90° so $\theta_1 > \theta_2$ and $\sin\theta_1 > \sin\theta_2 > \mu\cos\theta_1$ also right.

Hence from here body B can move up that means option (d) is wrong.