Answer on Question #40894 – Physics - Mechanics

A BLOCK SLIDES DOWN AN INCLINED PLANE OF SLOPE ANGLE THETA WITH A CONSTANT VELOCITY. IT IS THEN PROJECTED UP THE PLANE WITH AN INITIAL VELOCITY U. DISTANCE UPTO WHICH IT WILL RISE BEFORE COMING TO REST IS ?

Solution:

F_{fr} – friction force;
θ – angle of the inclined plane;
U – initial velocity;
t – time after the block stoped;
a – deceleration of the block;

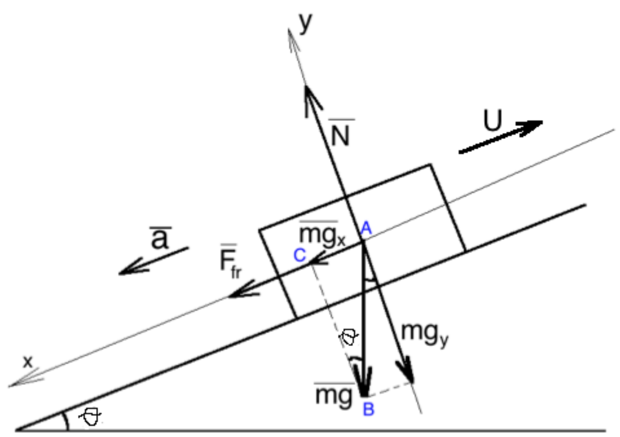
Newton's second law for the block when its moving down along the X-axis before it was projected ($V = const \Longrightarrow acceleration = 0$):

$x: F_{fr} - mg_x = 0$

$F_{fr} = mg_x \qquad (1)$

From te right triangle ABC:

$\sin\theta = \frac{mg_x}{mg} \Longrightarrow mg_x = mg\sin\theta \qquad (2)$



Newton's second law for the block when its moving up along the X-axis after it was projected. Force that acts of the block:

$x: F_{net} = F_{fr} + mg_x \qquad (3)$

$(1) and (2) in (3):$

$F_{net} = mg_x + mg_x = 2mg_x = 2mg\sin\theta \qquad (4)$

Loss of KE by block = work done by friction force + PE (final speed of the block = 0):

$$\frac{mU^2}{2} = F_{net} \cdot d + mgd \cdot \sin\theta \qquad (5)$$

$$(4) in (5):$$

$$\frac{mU^2}{2} = 2mgd\sin\theta + mgd \cdot \sin\theta$$

$$\frac{U^2}{2} = 3gd\sin\theta$$

$$d = \frac{U^2}{6g\sin\theta}$$

Answer: distance upto which block will rise before coming to rest is equal to $\frac{U^2}{6g\sin\theta}$.