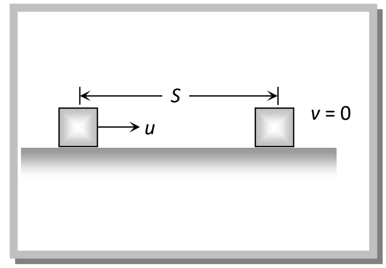
Stopping of Block Due to Friction.

(1) **On horizontal road**

(i) **Distance travelled before coming to rest:** A block of mass m is moving initially with velocity u on a rough surface and due to friction it comes to rest after covering a distance S.



Retarding force $F = ma = \mu R$

$$\Rightarrow ma = \mu mg$$

$\therefore\ a = \mu g$.

From $v^2 = u^2 - 2aS \Rightarrow 0 = u^2 - 2\mu g S$ [As $v = 0,\ a = \mu g$]

$$\therefore\ S = \frac{u^2}{2\mu g}$$

or $S = \dfrac{P^2}{2\mu m^2 g}$ [As momentum $P = mu$]

(ii) **Time taken to come to rest**

From equation $v = u - at \Rightarrow 0 = u - \mu g t$ [As $v = 0, a = \mu g$]

$$\therefore t = \frac{u}{\mu g}$$

(iii) **Force of friction acting on the body**

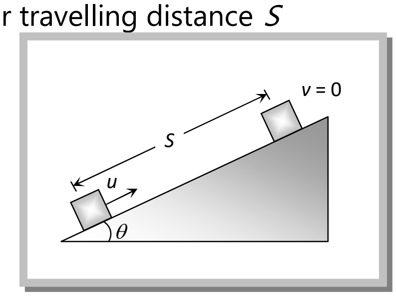
We know, $F = ma$

So, $F = m\dfrac{(v-u)}{t}$

$F = \dfrac{mu}{t}$ [As $v = 0$]

$F = \mu mg$ $\left[\text{As } t = \dfrac{u}{\mu g}\right]$

(2) **On inclined road :** When block starts with velocity u its kinetic energy will be converted into potential energy and some part of it goes against friction and after travelling distance S it comes to rest *i.e.* $v = 0$.



And we know that retardation $a = g[\sin\theta + \mu\cos\theta]$

By substituting the value of v and a in the following equation

$$v^2 = u^2 - 2aS$$

$$\Rightarrow \qquad 0 = u^2 - 2g[\sin\theta + \mu\cos\theta]S$$

$$\therefore S = \frac{u^2}{2g(\sin\theta + \mu\cos\theta)}$$