Acceleration of a Block against Friction.
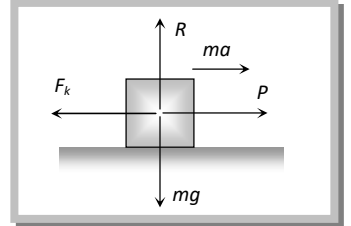
(1) **Acceleration of a block on horizontal surface**

When body is moving under application of force P, then kinetic friction opposes its motion.

Let a is the net acceleration of the body

From the figure

$$ma = P - F_k$$
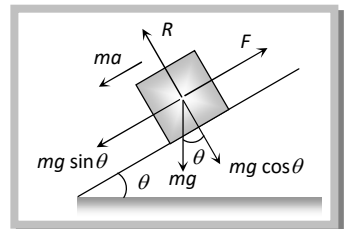
$$\therefore \quad a = \frac{P - F_k}{m}$$

(2) **Acceleration of a block down a rough inclined plane**

When angle of inclined plane is more than angle of repose, the body placed on the inclined plane slides down with an acceleration a.

From the figure $ma = mg \sin\theta - F$

$\Rightarrow \qquad ma = mg \sin\theta - \mu R$

$\Rightarrow \qquad ma = mg \sin\theta - \mu mg \cos\theta$

$\therefore$ Acceleration $a = g[\sin\theta - \mu \cos\theta]$

Note: For frictionless inclined plane $\mu = 0 \therefore a = g \sin\theta$.
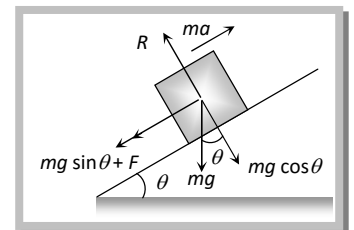
(3) **Retardation of a block up a rough inclined plane**

When angle of inclined plane is less than angle of repose, then for the upward motion

$ma = mg \sin\theta + F$

$ma = mg \sin\theta + \mu mg \cos\theta$

Retardation $a = g[\sin\theta + \mu \cos\theta]$

Note: For frictionless inclined plane $\mu = 0 \therefore a = g \sin\theta$