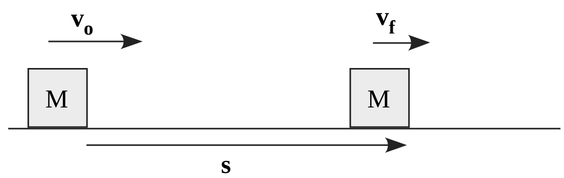
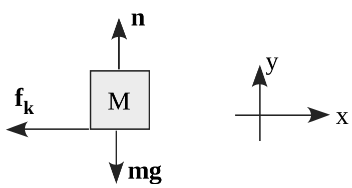
Work-KE Relation Involving Friction

Consider a block that that is given an initial velocity V_o on a surface where $\mu = \mu_k$.





$$\sum F_x = -f_k = ma$$
$$-f_k s = mas$$

Since a = constant,

$$v_f^2 = v_o^2 + 2as$$
$$as = \frac{1}{2}\left(v_f^2 - v_o^2\right)$$

Thus,

$$-f_k s = \frac{1}{2}m\left(v_f^2 - v_o^2\right)$$
$$-f_k s = \Delta K$$

Note that $-f_k s$ is not the work done by f_k on the block because s represents the displacement of the block and NOT the displacement of f_k.

1. f_k is not localized on a single point but distributed over the entire contact surface of block.
2. since f_k is not localized on a single point, then the block cannot be treated as a particle-like object and thus the Work-KE Theorem does not apply in this case.

However, the equation $-f_k s = \Delta K$ still describes the decrease in KE due to the friction force. If there are other forces besides friction acting on the object, the change in KE is the sum of that due to friction plus the other forces acting on the object (from the Work-Energy Theorem).

$$\boxed{\Delta K = -f_k s + W_{other\ forces}}$$ Work-KE relation involving friction