



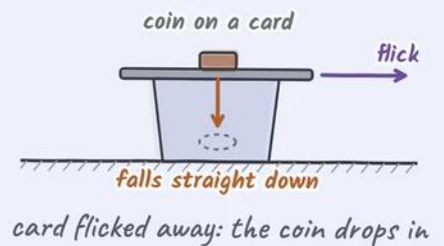
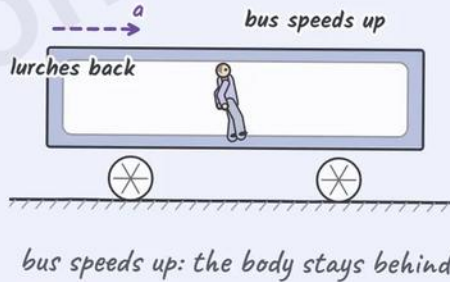
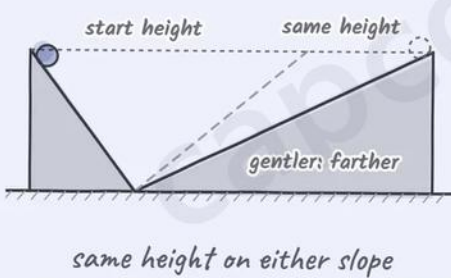
Laws of Motion

why things stay put, why they move, and why every push pushes back

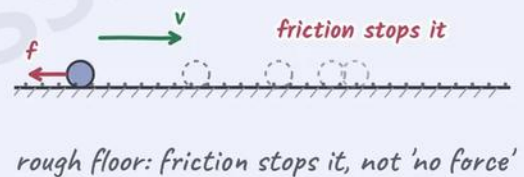
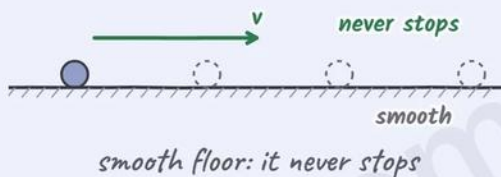


Newton's first law, inertia

- a body keeps its state unless a net external force acts
- that stubbornness is inertia: mass is its measure
- Galileo: the ball reaches the same height, farther on a gentler slope
- bus starts, you lurch back; it brakes, you lurch forward
- no net force means no change in motion, not no motion



Why a ball stops



Newton's second law, impulse

net force and rate of change of momentum

for constant mass

momentum, defined

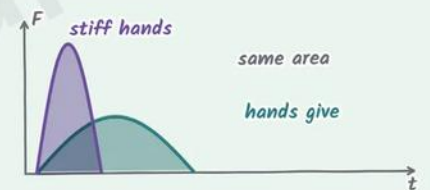
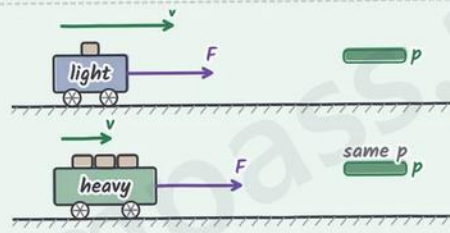
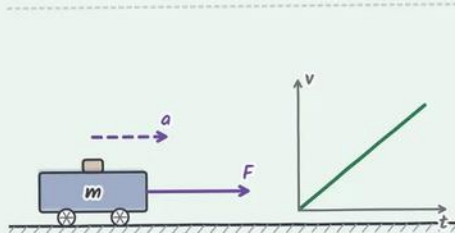
impulse, a large force for a short time

$$F = \frac{dp}{dt}$$

$$F = ma$$

$$p = mv$$

$$J = F\Delta t = \Delta p$$



stiff or giving hands: same area

$F = ma$ is a special case, the real law is about momentum. a longer catch means a smaller force