

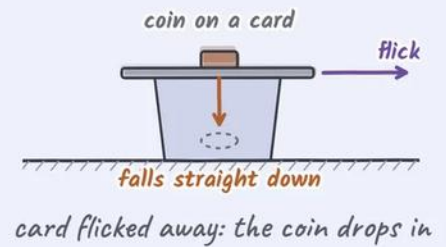
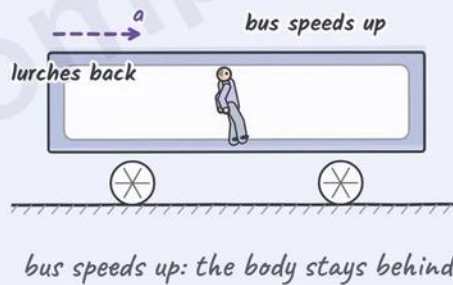
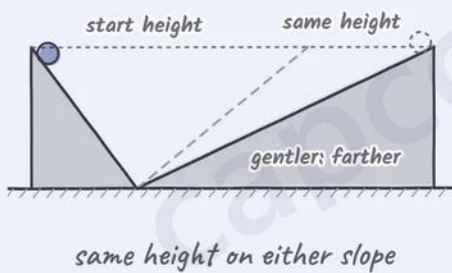


three laws, one free body diagram, and the two forces that turn a corner



The three laws, and what each one is for

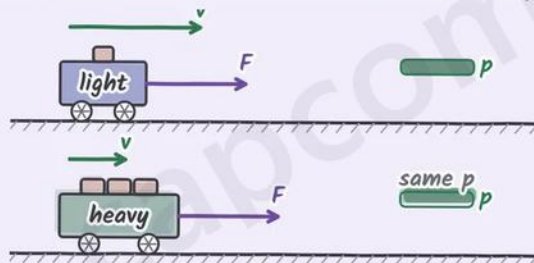
- first law: no net force, no change in motion; it defines force and inertia
- second law: $F = dp/dt$; for constant mass $F = ma$, a vector equation
- third law: equal and opposite, on different bodies, so they never cancel
- the syllabus derives the third law from conservation of momentum



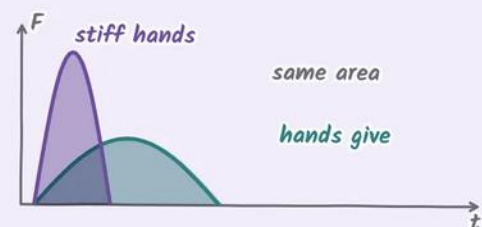
$F = ma$ is the special case, not the law

asked rarely, scores big

- the law is $F = dp/dt$; the $v dm/dt$ term vanishes for constant mass
- near c , mass is not constant: $m = m_0/\sqrt{1-v^2/c^2}$, so $F = ma$ is classical
- impulse $Ft = \Delta p$: a longer collision means a smaller force
- quoting $F = ma$ as the law loses marks: call it the special case



same push, same time: same p gained



stiff or giving hands: same area

The quantities, and their units

Quantity	Definition	SI unit	Dimensions
momentum p	mv	kg m s^{-1}	$[MLT^{-1}]$
force F	dp/dt	newton, N	$[MLT^{-2}]$
impulse	Ft , equals Δp	N s	$[MLT^{-1}]$
weight	mg	newton, N	$[MLT^{-2}]$

impulse and momentum share a unit and a dimensional formula because impulse IS a change of momentum