Forces, motion and movement

International Baccalaureate · IB Diploma · Sports, Exercise and Health Science · HL

Scope and prerequisites

This handout covers selected HL topics for the course first assessed in 2026; it is not the whole syllabus.

Prerequisites: read the stated quantities and units, and use arithmetic and the model conditions below.

The examples are original and fictional: they are not real measurements or real student investigations.

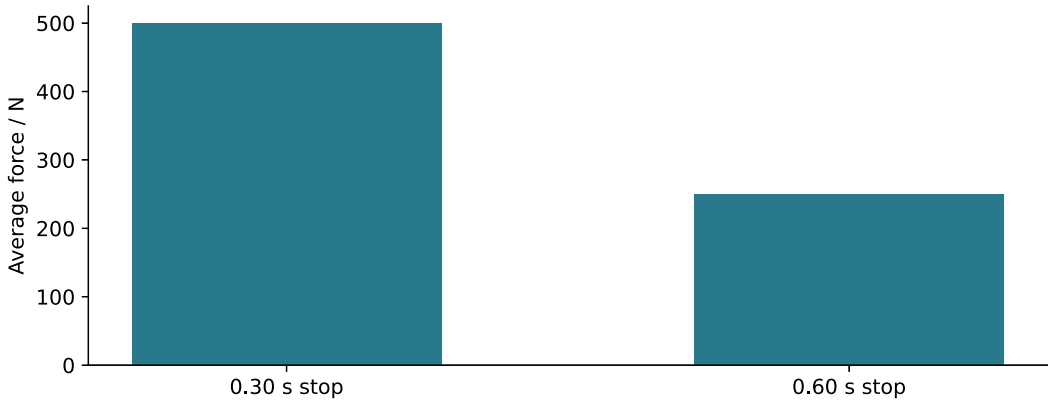
Forces, motion and movement

What would explain this observation?

- A racket slows a ball from 30 to 20 metres per second in five milliseconds. What changed the ball's motion was **impulse** : force integrated over time, equal to the momentum change.

Build the model

- Impulse = average net force x elapsed time = change in momentum.
- A biomechanical analysis must define the segment, the direction and the phase of movement.
- Net force and a single muscle force are not interchangeable.
- A longer **lever arm** changes **torque** without changing the applied force.
- impulse: Force integrated over time; equal to the momentum change.



Choose evidence that can test it

- Use teacher-approved video of a safe movement with consent.
- Calibrate distance and time (a visible reference length); identify frames consistently.
- Avoid medical claims from a two-dimensional recording.

In the lab: Camera perspective can bias apparent joint angles: film perpendicular to the plane of movement and state the camera position.

Work from known quantities

- Known: ball mass 0.058 kg; velocity change 10 m per s over 0.005 s.
- Momentum change = 0.058 x 10 = 0.58 kg m per s.
- Average force = impulse over time = 0.58 / 0.005 = 116 N.
- Torque check: the same 10 N grip force at twice the lever arm doubles the torque about the wrist.

Your turn: The contact time doubles to 0.010 s for the same momentum change. What happens to the average force?

Check the conclusion and its limits

- Video gives apparent two-dimensional motion; out-of-plane components are invisible.
- A net force found from motion cannot be assigned to one muscle.

Not true: The follow-through shows a bigger muscle force. A longer contact time delivers the same momentum change with a smaller average force: the follow-through changes impulse time, not muscle effort alone.

Key:

- Impulse = average net force x elapsed time = momentum change.
- Define segment, direction, phase before any analysis.
- Watch for: joint angles read from a skewed camera.