Forces and Newton's laws of motion (AS)

R1 Understand the concept of a force; understand and use Newton's first law.

R2 Understand and use Newton's second law for motion in a straight line (restricted to forces in two perpendicular directions or simple cases of forces given as 2-D vectors).

R3 Understand and use weight and motion in a straight line under gravity; gravitational acceleration, g, and its value in S.I. units to varying degrees of accuracy. (The inverse square law for gravitation is not required and g may be assumed to be constant, but students should be aware that g is not a universal constant but depends on location.)

R4 Understand and use Newton's third law; equilibrium of forces on a particle and motion in a straight line (restricted to forces in two perpendicular directions or simple cases of forces given as 2-D vectors); application to problems involving smooth pulleys and connected particles.

For a brief commentary on this content go to the MEI outline SoW.

Pre-requisites

- Simple linear and simultaneous equations.

Common student errors

- Inconsistency in identifying which direction is positive when applying Newton's 2nd law.
- When drawing force diagrams, omitting forces (e.g. normal reaction) or adding non-existent forces (e.g. a propulsive force on a ball that has already been kicked).
- Not appreciating that the two forces described by Newton's 3rd law apply to *different* objects.
- Incorrectly thinking that the particle model implies no air resistance.

Teaching it!

- A series of videos designed to support students on this topic. (Coming soon)
- Teacher guidance on some simple experiments and demonstrations that will help students to understand forces.
- This interactive simulation from the PhET Colorado project is useful for exploring the link between force and motion.
- Falling cone: A suggested practical activity from the Teaching Mechanics 1 course.
- A set of multiple-choice questions related to Newton's third law.

Getting them thinking

- Why might the particle model be inappropriate for a lorry driving around a tight bend?
- If the gravitational force between the Earth and the Moon is equal on both bodies, why is the effect on each so different?
- Draw separate force diagrams for two people on opposing sides in a tug-of-war competition, where one team is winning. Make it clear which forces have equal magnitudes.