Physics · Revision

Forces Revision Notes

How forces work at GCSE, from resultant forces through to momentum.

Scalars and vectors

Scalar: size only	Vector: size and direction
distance, speed, mass, time, energy	displacement, velocity, force, weight, acceleration, momentum

A force is either **contact** (friction, air resistance, tension, normal contact) or **non-contact** (gravity, magnetic, electrostatic).

Resultant force

The single force that has the same effect as all the forces acting together. If 20 N acts right and 5 N acts left, the resultant is 15 N to the right. If it is zero, the forces are balanced.

Newton's laws

Law	In plain English
First	With no resultant force, an object stays still or keeps moving at a constant velocity.
Second	F = m × a. A resultant force makes an object accelerate.
Third	When two objects interact, they exert equal and opposite forces on each other.

> **Common slip:** third law pairs act on *different* objects, so they never cancel out on one object.

Worked example: F = m × a

A 3 kg trolley has 20 N pulling it right and 5 N of friction. Find its acceleration.

F = 20 − 5 = 15 N
Find the resultant force first.

a = F ÷ m = 15 ÷ 3
Rearrange F = m × a.

a = 5 m/s²
Include the unit.

Weight and mass

Mass (kg) is how much matter there is, and it stays the same everywhere. Weight (N) is the force of gravity on that mass, and it changes with g. A 5 kg object on Earth weighs 5 × 9.8 = 49 N.

Terminal velocity

- At first, weight is greater than air resistance, so the skydiver accelerates.
- As speed increases, air resistance increases, so the resultant force and acceleration fall.
- When air resistance equals weight, the resultant is zero and speed is constant.

Stopping distance

Stopping distance = thinking distance + braking distance.

Thinking distance is increased by	Braking distance is increased by
higher speed, tiredness, alcohol, drugs, distractions	higher speed, wet or icy roads, worn tyres, worn brakes

Moments

Moment = force × perpendicular distance from the pivot. 10 N acting 0.5 m from a pivot gives 5 Nm. When balanced, total clockwise moments equal total anticlockwise moments.

Springs: Hooke's law

F = k × e, as long as the limit of proportionality is not passed. A spring with k = 50 N/m stretched by 0.04 m needs a force of 50 × 0.04 = 2 N.

> **Common slip:** e is the *extension* (the change in length), not the total length, and it must be in metres.

Momentum

Momentum = mass × velocity. A 1000 kg car at 20 m/s has 20 000 kg m/s. In a closed system, total momentum before an event equals total momentum after it.