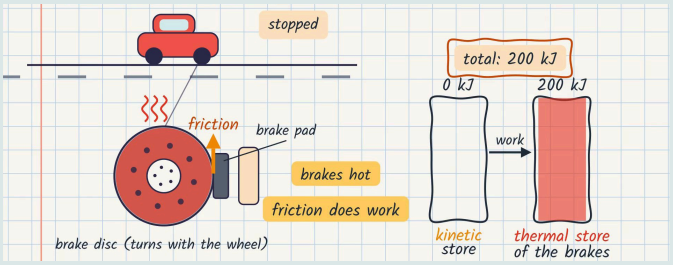
Braking and Safety

braking energy; force and speed; dangers; estimates

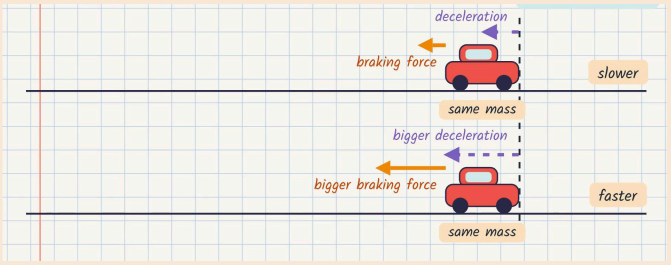
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Summary sheet

1 Where the energy goes



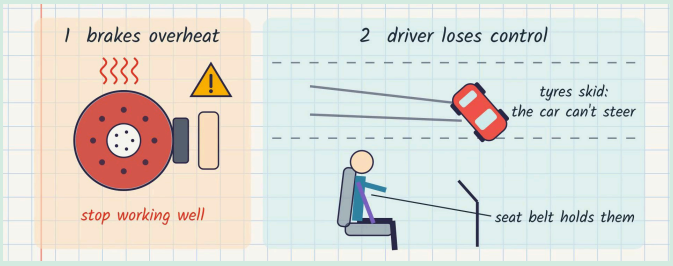
- When a car brakes, **friction between the brake pads and the wheels does work**.
- The work moves energy from the **kinetic store** to the **thermal store of the brakes**: the car slows down and the brakes get hot.

2 Braking force and speed



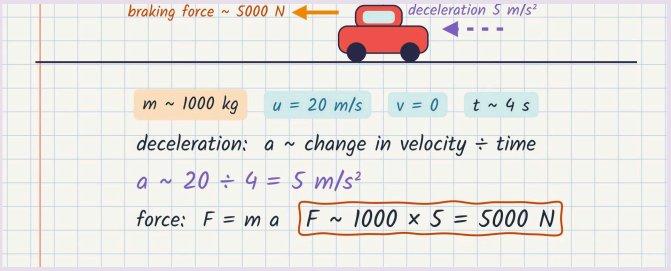
- A faster car has **much more kinetic energy**, so to stop in the **same distance** the brakes must do more work: it needs a **bigger braking force**.
- A bigger braking force on the same mass gives a **bigger deceleration** (F = m a).

3 Big decelerations



- Danger 1: **the brakes may overheat** and stop working well.
- Danger 2: **the driver may lose control of the vehicle**: tyres skid so the car can't steer, and people are thrown forward (seat belts hold them).

4 Estimating the force (Higher)



- Car m ~ 1000 kg, 20 m/s to 0 in ~4 s: **a ~ 20 ÷ 4 = 5 m/s²**, so **F ~ 1000 × 5 = 5000 N**.
- Energy check: ½ × 1000 × 20^2 = **200 000 J**; distance = 10 × 4 = 40 m, work = 5000 × 40 = **200 000 J**. It matches.

$$F = m\ a$$

resultant force = mass × acceleration

Exam tip

Dangers of large decelerations: write "the brakes may overheat" and "the driver may lose control of the vehicle".

Check yourself

- 1 Into which energy store does a car's kinetic energy go when it brakes?
- 2 Why does a faster car need a bigger braking force to stop in the same distance?

Answers: 1. The thermal store of the brakes 2. More kinetic energy, so more work must be done in the same distance