

### Q1

A school minibus, carrying just the driver, slams on its brakes to avoid driving off a cliff. The brakes do 800 000 J of work.

- If the minibus and driver were travelling at 20 m/s, what was their combined mass? (Assume all the minibus's kinetic energy was absorbed by the brakes.)
- The minibus picks up 6 cloned teachers weighing exactly 90 kg each. How much energy will the brakes need to absorb to stop from 20 m/s now?
- The maximum amount of kinetic energy the brakes can absorb without falling to bits is 1 016 000 J. How many cloned teachers can the minibus carry and still be able to stop from 20 m/s?

### Q2

The 05:30 flight to Malaga takes off with a mass, including fuel, passengers, luggage and crew, of 300 000 kg. The gravitational field strength is 10 N/kg.

- It climbs to an altitude of 1200 m. If the runway was at an altitude of 220 m, how much gravitational potential energy has it gained (to the nearest kilojoule)?
- By lunchtime, the plane has used up some fuel and is now 50 000 kg lighter. How much gravitational potential energy has the plane lost? (It's still at 1200 m.)
- To avoid the in-flight meal, a passenger climbs 2 m up into an overhead luggage locker. He gains 1700 J of gravitational potential energy compared to when he was sat down. How heavy must he be?
- An air stewardess finds a toupee lying on the floor. When it fell to the floor, it lost 1.25 J of gravitational potential energy. It has a mass of 0.05 kg. Work out if it must have fallen off a man who is sat down, or the man in the overhead locker.

### Q3

- A bucket of pig swill is lifted by 1.5 m to get it over a fence. It's mass is 14 kg. To the nearest joule, how much gravitational potential energy has it gained?
- Having studied the physics of the bucket, a piglet jumps 1.5 m over the fence, and gains twice as much gravitational potential energy as the bucket did. What must be the piglet's mass?
- A small cow, with the same mass as the piglet, jumps over the Mune (a local river). At the top of its leap, it has gained the same gravitational potential energy as the bucket did. How high did it jump?
- A passing research physicist wrongly calculates that a 2.3 kg duck thrown 50.5 m into the air would gain 2206.85 J of gravitational potential energy. What wrong value of  $g$  was used?