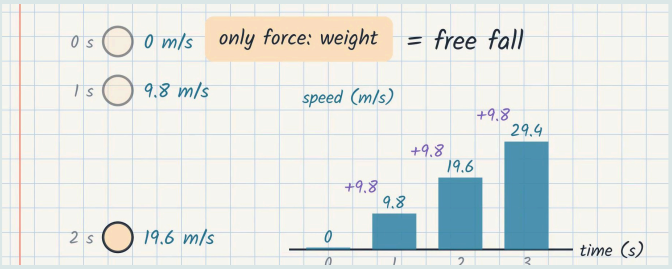
Terminal velocity

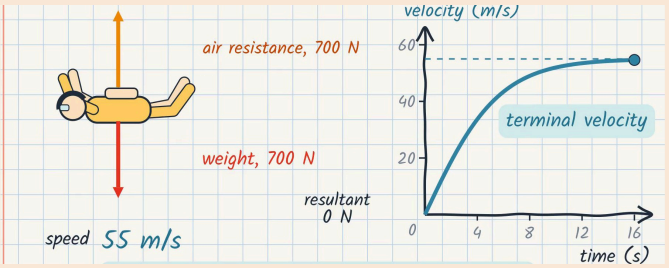
Free fall, falling through air, the parachute, and $v^2 - u^2 = 2\,a\,s$

1 Free fall



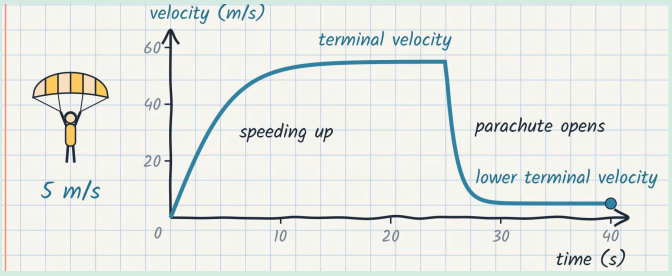
- If the **only force** on a falling object is its **weight**, it is in **free fall**.
- Near the Earth's surface, free-fall acceleration is about **9.8 m/s²**: it gets about 9.8 m/s faster **every second** (0, 9.8, 19.6, 29.4 m/s).

2 Falling through air



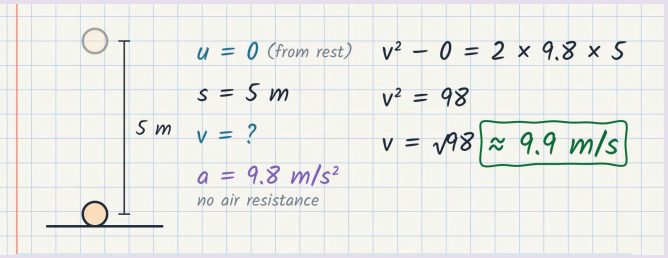
- Air is a fluid, so a falling object also feels **air resistance**, which **grows with speed**. At first weight > air resistance: a big **downward resultant**, so it accelerates; as it speeds up, the resultant gets smaller.
- When **air resistance** = **weight**, the resultant force is **zero**: it falls at a steady speed, its **terminal velocity**. Zero resultant force means **no change in velocity**, not stopped.

3 The parachute



- Opening the parachute: its **big area** makes air resistance much **larger than the weight**. The resultant is **upwards**, so she **decelerates**.
- As she slows, air resistance falls until it **equals her weight** again: a new, much **lower terminal velocity**. On a v–t graph: curve up, flat, sudden drop, lower flat.

4 $v^2 - u^2 = 2\,a\,s$



- For **uniform acceleration**: (final velocity)² − (initial velocity)² = 2 × acceleration × distance. Use it when **no time** is given.
- Ball dropped from rest, falls 5 m: u = 0, so $v^2 = 2 \times 9.8 \times 5 = 98$; $v = \sqrt{98} \approx$ **9.9 m/s**. Remember to **square root** at the end.

$v^2 - u^2 = 2\,a\,s$

(final velocity)² − (initial velocity)² = 2 × acceleration × distance

Exam tip

In a terminal velocity answer, compare the forces at each stage: which is bigger, what the resultant force is, and what that does to the speed.

Check yourself

1. What is the resultant force on a skydiver at terminal velocity?
2. A car accelerates from 10 to 20 m/s over 75 m. What is its acceleration?

Answers: 1. Zero (air resistance = weight) 2. $a = (20^2 - 10^2) \div (2 \times 75) = 300 \div 150 = 2$ m/s²