UNIT 5·2 Acceleration

context The sudden changes in speed and direction of a rollercoaster give us the sensations and thrill that we are after. The culprit responsible for all this fun is **acceleration**: the rate at which speed or velocity changes.

Acceleration

Imagine two cars taking off at traffic lights. Both reach 60 km/h, but their accelerations are not necessarily the same unless you are told how long each took. If one took 6 seconds, while the other took 16 seconds, it becomes perfectly obvious which one is accelerating the fastest!

$$\text{Acceleration} = \frac{\text{change in speed}}{\text{time taken for the change}}$$

or $$a = \frac{(v - u)}{t}$$

where

- v is the final speed
- u is the initial or starting speed
- t is the time taken for the change in speed to occur.

Physics facts

Acceleration

Symbol in formulas: a
Unit: metres per second squared
Unit abbreviation: m/s^2 or $m\ s^{-2}$

Acceleration is measured in speed units per time unit. The most common unit for acceleration is metres per second per second, m/s^2 or $m\ s^{-2}$.

If an object slows, it is **decelerating**. Deceleration is **negative acceleration**.

Calculating acceleration

If the speed of a car changes from 0 to 60 km/h in 6 seconds, then its acceleration is:

$$a = \frac{(60 - 0)}{6} = 10$$

Acceleration is one factor that makes the rollercoaster a thrill. *Fig 5.2.1*

The unit here would be speed units (km/h) per time unit (s) or k/h/s: the car gained an extra 10 km/h every second.

For an athlete, speed is better measured in m/s. For example, a runner is jogging along at 2 m/s but then slows her speed over the next 5 seconds until she is running at 1 m/s. Her acceleration would be:

$$a = \frac{(1 - 2)}{5} = \frac{-1}{5} = -0.2$$