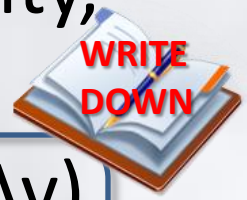
Acceleration

0 to 100 km/h

- Whether we are working, playing, or dreaming of the future, it seems we're obsessed with getting there fast.
- It's no wonder our commercials boast of vehicles that can get you from 0 to 100 in 5 seconds or less.
- This boast is not about speed. It is about acceleration.

A Definition

- When a car goes faster, we think of it as “accelerating”.
- When a car slows down, it is also accelerating.
- Slowing down and speeding up are similar because velocity is changing.
- Even changing direction changes the velocity, so it is also acceleration.
- Acceleration (a) is the change in velocity (Δv) over time (t).



Examples

- Examples of acceleration include:
  - speeding up
  - slowing down (negative acceleration *or* deceleration)
  - changing direction

Calculating Acceleration

- Acceleration = $\frac{\text{change in velocity}}{\text{time}}$ *or*
  - *Acceleration* = $\frac{\textit{final velocity} - \textit{initial velocity}}{\textit{time}}$ *or*
  - $a = \frac{\Delta v}{t} = \frac{v_f - v_i}{t}$ *or* $a = \frac{s_f - s_i}{t}$

- So $v_f = at + v_i$

Sample Problems

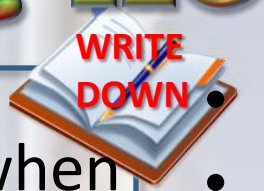
- **Problem 1**: A car travelling at 10 $^{km}/_{h}$ accelerates to 100 $^{km}/_{h}$ in 15 s. What is its acceleration?

$$a = \frac{v_f - v_i}{t} = \frac{100\ ^{km}/_{h} - 10\ ^{km}/_{h}}{15\ s} = \frac{90\ ^{km}/_{h}}{15\ s} = 6\ ^{km}/_{h}/_{s}$$

- **Problem 2**: A pot falls from a window and accelerates at a rate of 9.8 m/s^2. What is its speed after 4 s?

$$v_f = at + v_i = (9.8\ ^{m}/_{s^2})(4\ s) + 0\ ^{m}/_{s} = 39.2\ ^{m}/_{s}$$

Graphing Acceleration

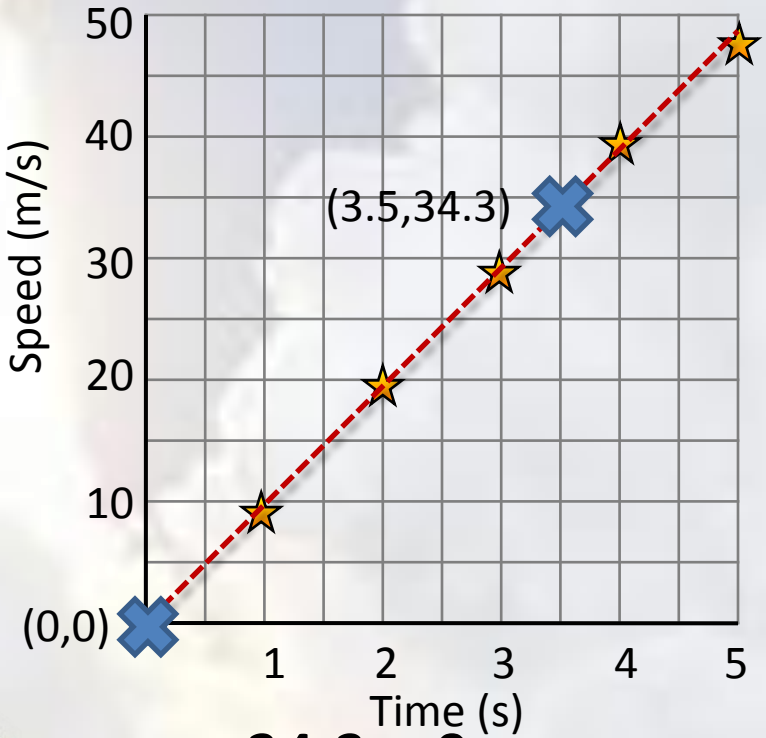


- A time-speed graph shows acceleration, when acceleration is constant.

Time (s)	Speed (m/s)
1	9.7
2	19.7
3	29.4
4	39.6
5	48.8

- With time on the X-axis, and speed on the Y-axis, the slope is the acceleration.

- Plot the points.
- Draw the best line.
- Determine the slope



- $m = \frac{34.3 - 0}{3.5 - 0} = 9.8\ {}^{m}/_{s^2}$