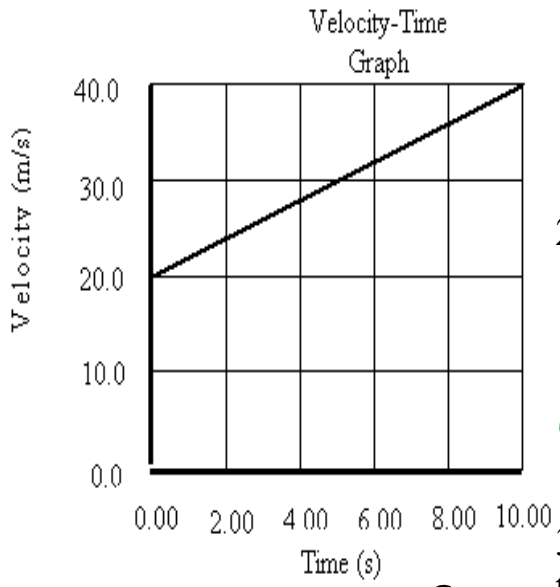
The physics of a moving car and the velocity-time graph.

4. The following graph shows a car changing in velocity over time.



$\bar{v} = \frac{v_1 + v_2}{2}$

$\bar{v} = 30$

1. What is the displacement of the car?

$x_1 = 0$ $t = 10$

$x_2 = ?$

$v_1 = 20$

v_2 40

$x_2 = x_1 + \bar{v}t$

$x_2 = 0 + 30 \times 10$

$x_2 = 300\ m$

2. Find the acceleration of the car.

$a = \frac{v_2 - v_1}{t}$ $a = \frac{20}{10}$

$a = \frac{40 - 20}{10}$ $a = 2\ m/s^2$

3. did the acceleration change during the time it was moving?

Graph is a straight line = constant acceleration

A spacecraft is initially at rest with respect to a space station when it fires its rockets. These rockets make it accelerate at a rate of 10.0 m/s^2. What is the new velocity of the spacecraft after is has moved a distance of 2.15 x 10^5 m?

$v_1 = 0$

$x_1 = 0$ *

$a = 10\ m/s$

$x_2 = 2.15 \times 10^5$

$215{,}000\ m$

$= \Delta x$

$t = \frac{\Delta x}{\bar{v}}$ $\quad t = \frac{\Delta v}{a}$ $\quad \bar{v} = \frac{v_1 + v_2}{2}$

$t = t$

$\frac{x_2 - x_1}{\bar{v}} = \frac{v_2 - v_1}{a}$

$\frac{2(x_2 - x_1)}{v_1 + v_2} = \frac{v_2 - v_1}{a}$

$v_1^2 = v_2^2 - 2a\Delta x$

$v_2^2 = v_1^2 + 2a\Delta x$ *

$a = \frac{v_2^2 - v_1^2}{2\Delta x}$

$2a(x_2 - x_1) = (v_2 + v_1)(v_2 - v_1)$

$2a\Delta x = v_2^2 - v_1^2$

$\Delta x = \frac{v_2^2 - v_1^2}{2a}$

$v_2^2 = 0^2 + 2(10)(2.15 \times 10^5)$

$\sqrt{v_2^2} = \sqrt{4{,}300{,}000}$

$v_2 = 2073.64\ m/s$

A car travelling at 10.0 m/s accelerates at a rate of 3.0 m/s^2 to a speed of 25.0 m/s.

What is the displacement of the car during the acceleration?

$v_1 = 10$ m/s

$a = 3$ m/s^2

$v_2 = 25$ m/s

$x_1 = 0$

$t = \frac{\Delta v}{a}$ $t = \frac{v_2 - v_1}{a}$

$t = \frac{25-10}{3}$ $t = 5$ s

$\Delta x = \bar{v} t$

$\bar{v} = \frac{v_1 + v_2}{2}$

$\bar{v} = \frac{10+25}{2}$

$\bar{v} = 17.5$

$\Delta x = 17.5 \times 5$

$\Delta x = 87.5$ m

$$\Delta x = \frac{v_2^2 - v_1^2}{2a}$$

$$\Delta x = \frac{25^2 - 10^2}{2(3)}$$

$$\Delta x = \frac{625 - 100}{6}$$

$$\Delta x = \frac{525}{6}$$

$$\Delta x = 87.5 \text{ m}$$