The equations of motion

- The **equations of motion** can be used when an object is accelerating at a steady rate
- There are four equations relating five quantities

u initial velocity, **v** final velocity,

s displacement, **a** acceleration, **t** time

SUVAT equations

Beware!

- All quantities are vectors. These equations are normally done in one dimension, so a negative result means displacement/velocity/acceleration in the opposite direction.

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$v = u + at$

$0 = 10 + -2t$

$2t = 10$

$t = 5$ seconds

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$v^2 = u^2 + 2as$

$0^2 = 10^2 + 2x{-}2s$

$0 = 100 - 4s$

$4s = 100$

$s = 25m$, the car does not hit Jack. ☹

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$u = 24\ m.s^{-1}$ $a = -9.8\ m.s^{-2}$ $v = 12\ m.s^{-1}$

$v = u + at$

$12 = 24 + -9.8t$

$-12 = -9.8t$

$t = 12/9.8 = 1.2$ seconds

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$v = u + at$

$-12 = 24 + -9.8t$

$-36 = -9.8t$

$t = 36/9.8 = 3.7$ seconds

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$s = ut + \frac{1}{2}at^2 = 24x1.2 + \frac{1}{2}x-9.8x1.2^2$

s = 28.8 – 7.056 = <u>21.7 m</u>

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t = 3.7, v = 12, a = -9.8, u = 24 s = ?

$s = ut + \frac{1}{2}at^2 = 24x3.7 + \frac{1}{2}x-9.8x3.7^2$

s = 88.8 – 67.081 = 21.7 m (the same?!)

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v = u + at

v = 24 + -9.8x1.50 = <u>9.3 $m.s^{-1}$</u>

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$u = 24$, $a = -9.8$, $\underline{v = 0}$, $s = ?$

$v^2 = u^2 + 2as$

$0 = 242 + 2x-9.8xs$

$0 = 242 -19.6s$

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$u = 24$, $a = -9.8$, $\underline{v = 0}$, $s = ?$

$0 = 242 - 19.6s$

$19.6s = 242$

$s = 242/19.6 = \underline{12.3\ m}$