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Never Stand Still

Week 2 notes

Week 2 Velocity, acceleration and relative motion

- Graphing displacement and velocity
- Acceleration – changing velocity but not necessarily changing speed
- Kinematics equations relating acceleration, velocity and displacement
- Relative motion and frames of reference

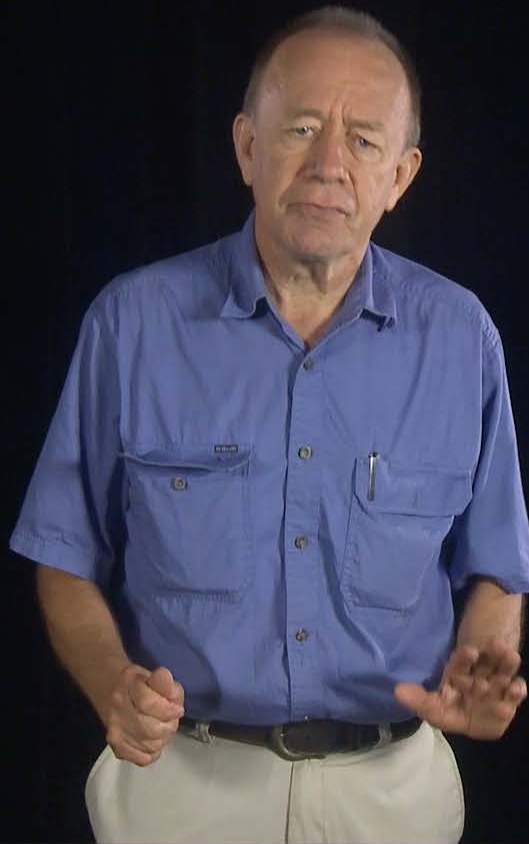
Vectors and scalars

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vectors

magnitude
& direction

displacement
velocity



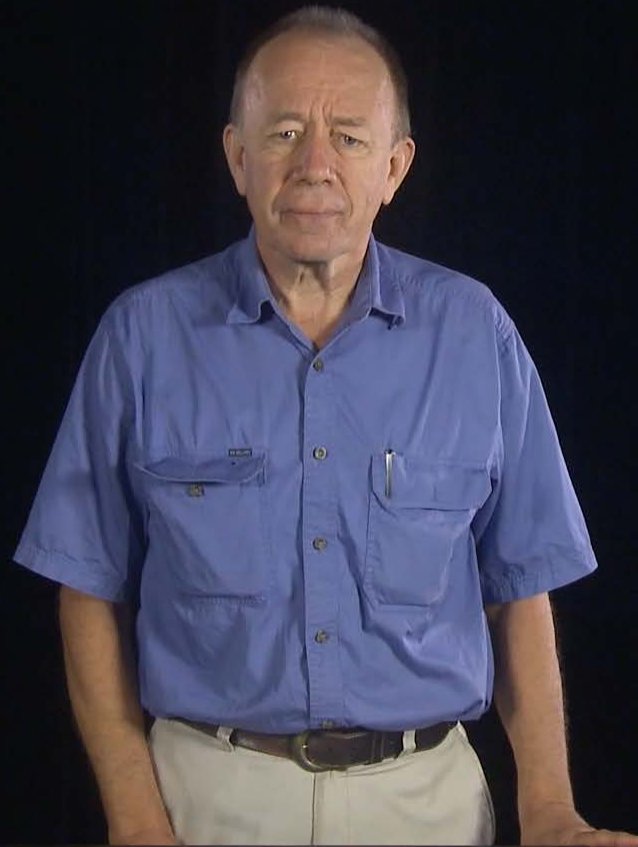
scalars

magnitude

distance
speed

Lesson 2.1
0.57

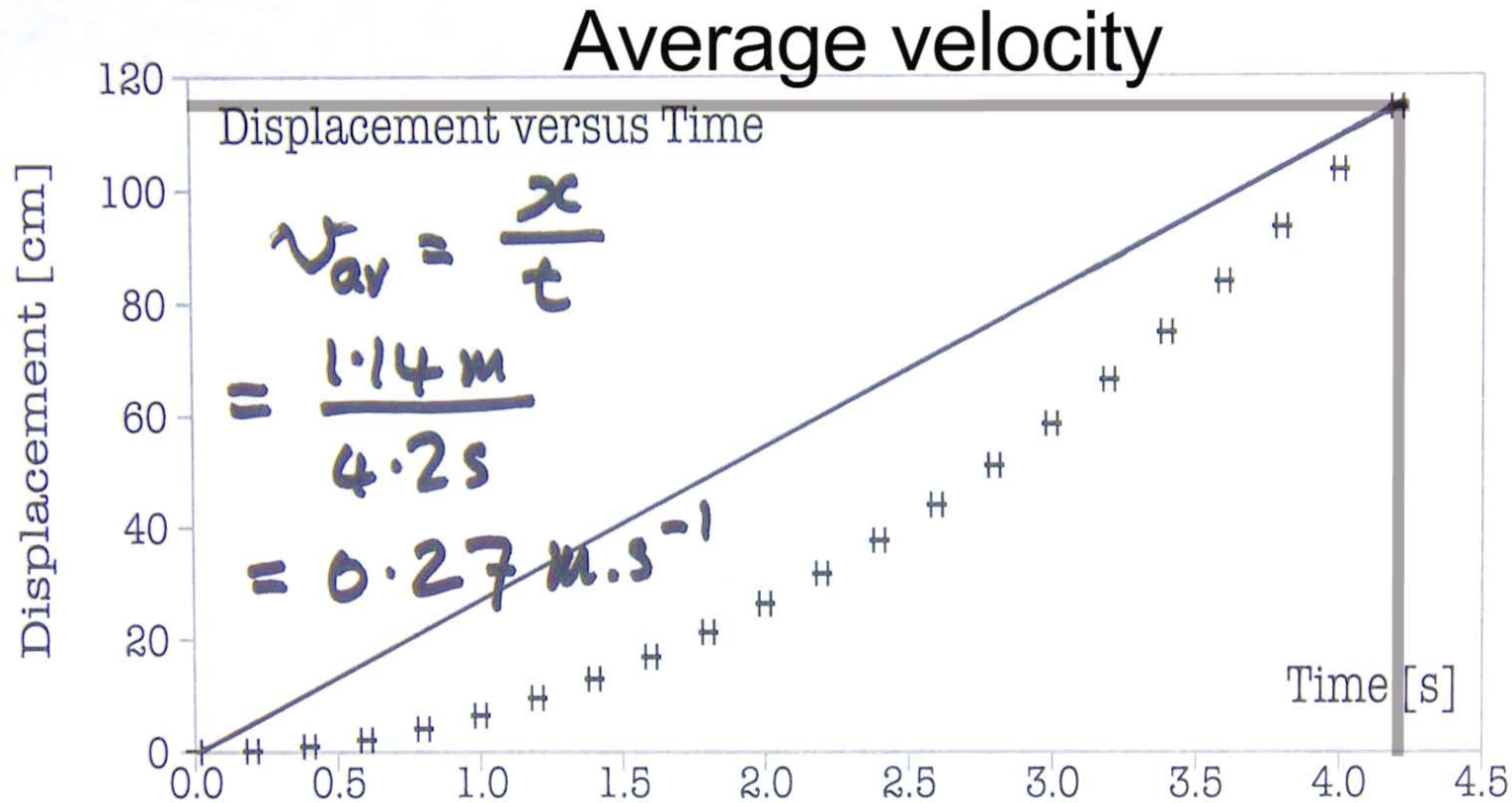
Any change in velocity is an acceleration



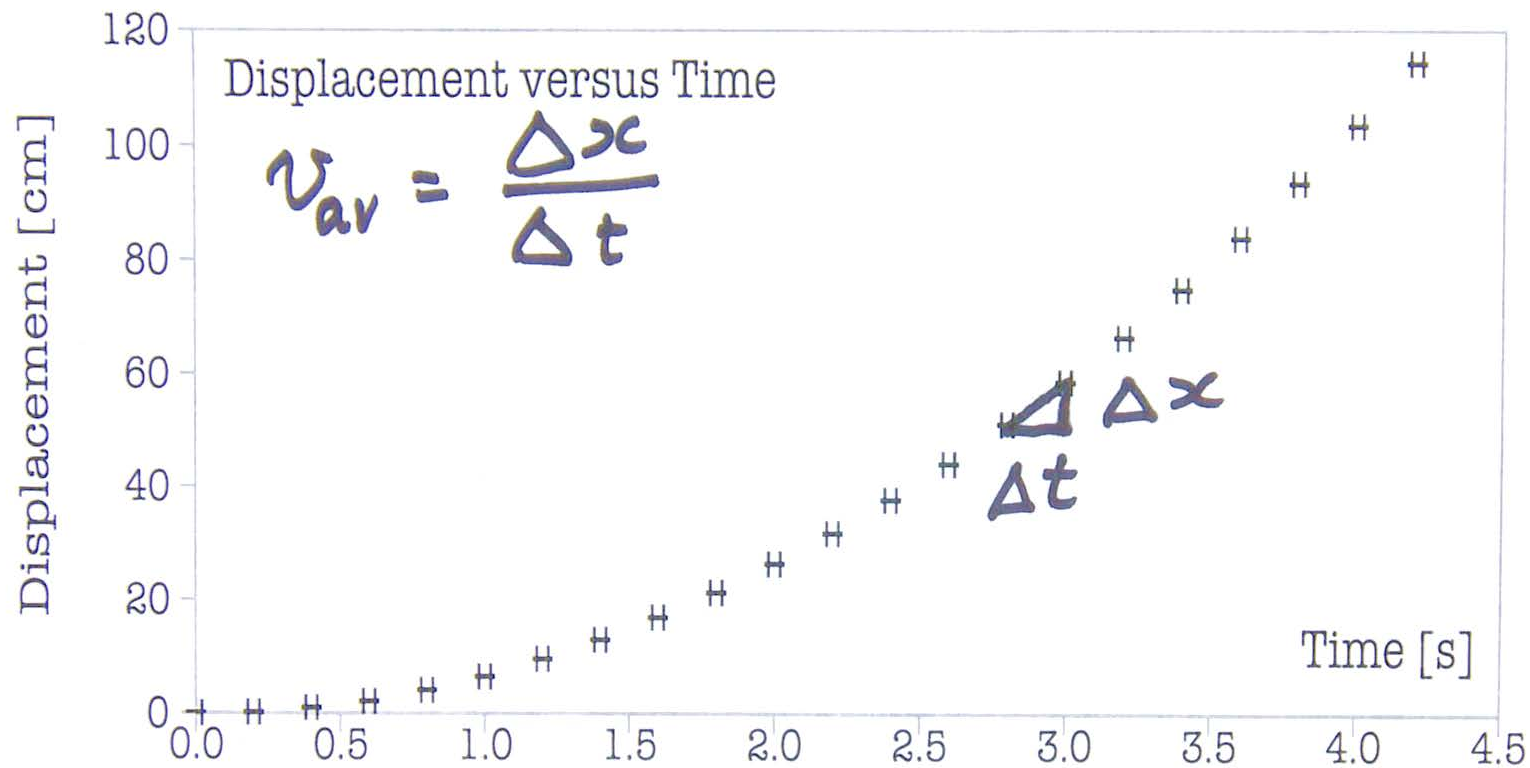
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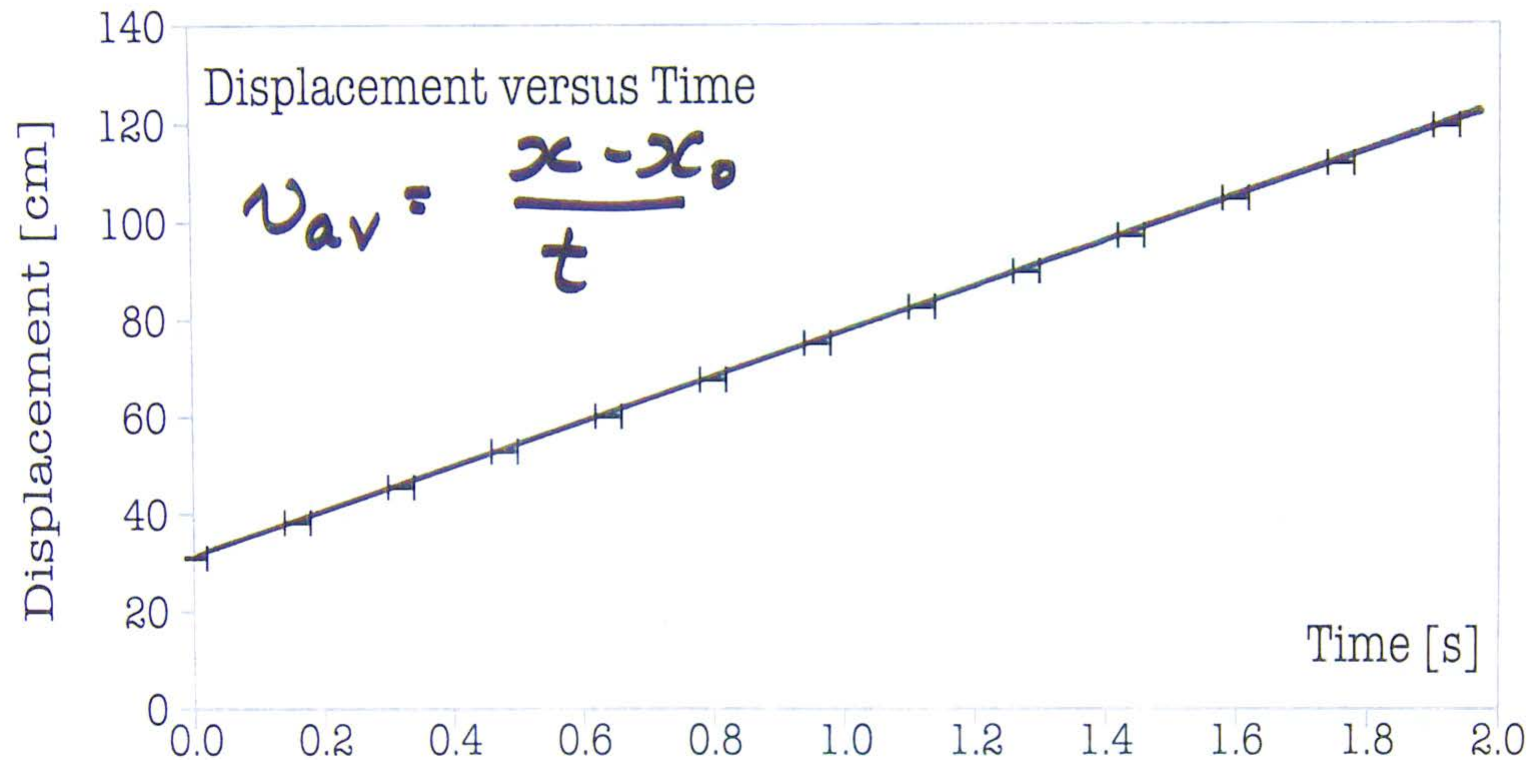
Average velocity



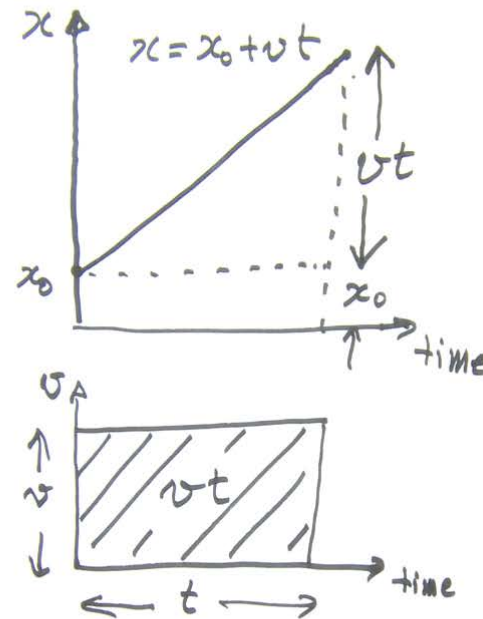
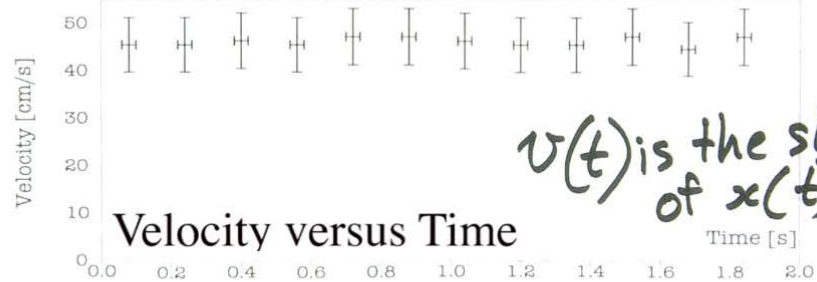
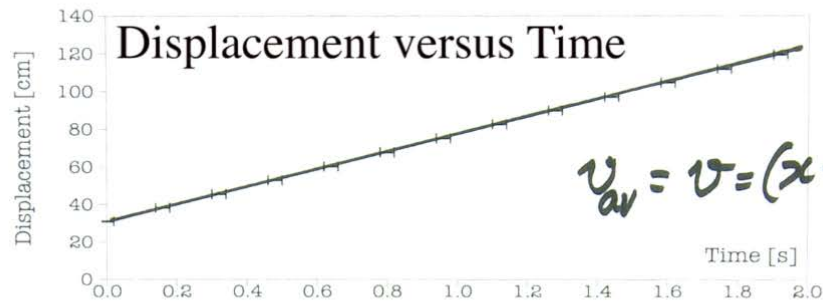
Change in velocity over change in time



Average velocity



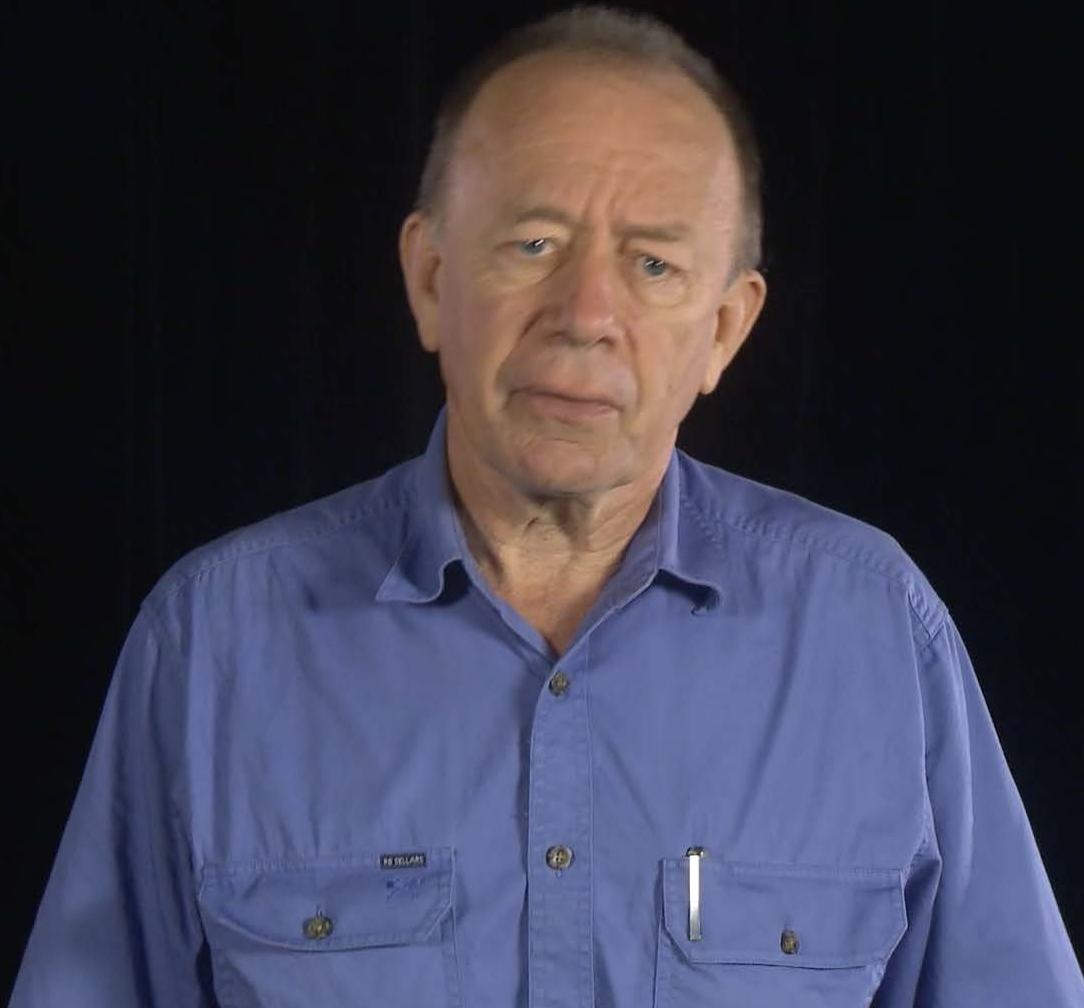
From displacement to velocity and back



$$v = \frac{x - x_0}{t}$$

$$x = x_0 + vt$$

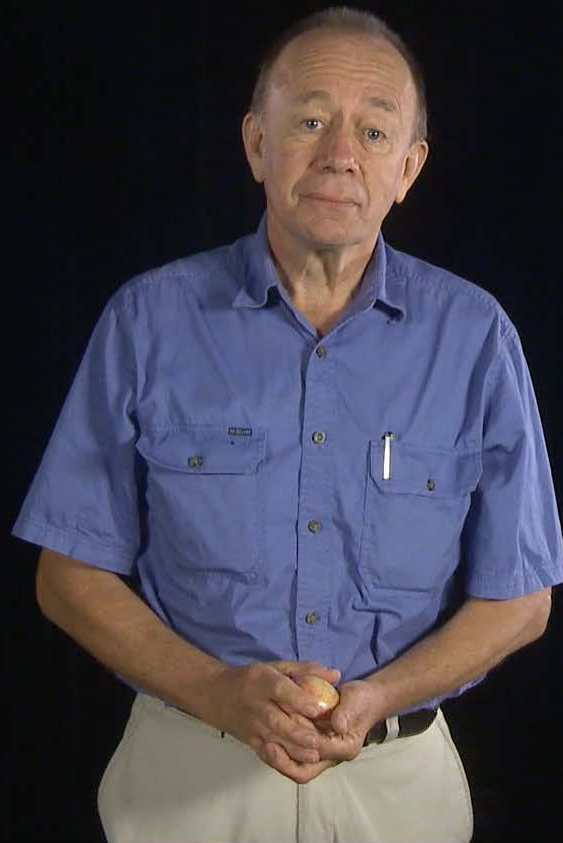
Defining acceleration



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1.26

Constant acceleration



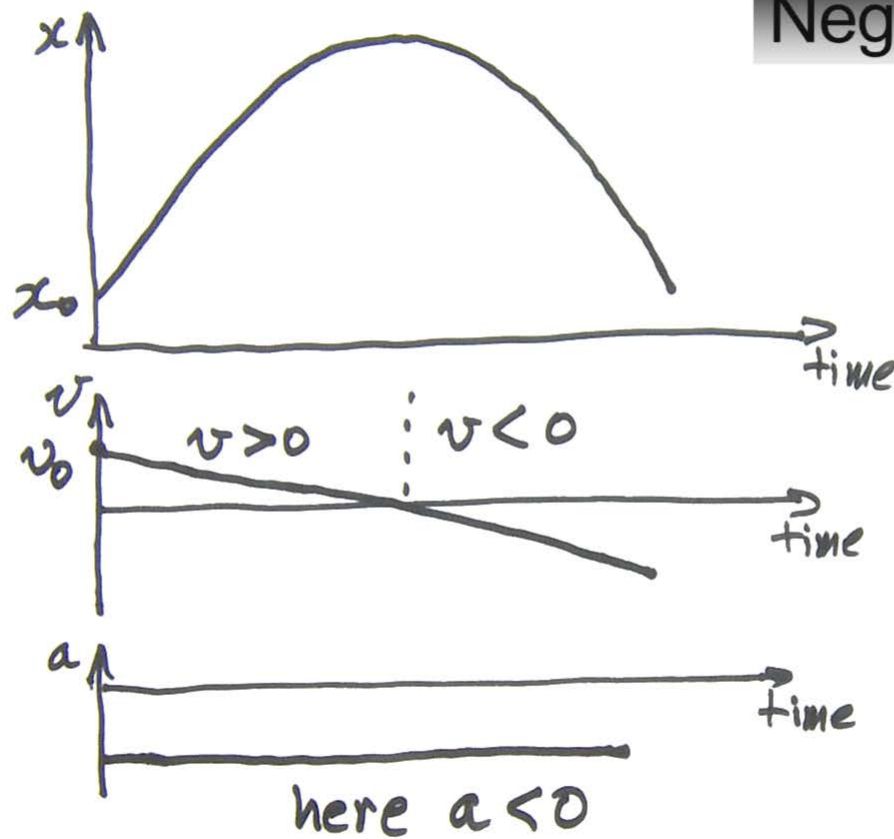
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2.00

Collected terms

$$\begin{aligned} \text{If } a &= \text{constant} && \text{(with calculus)} \\ v &= v_0 + at && = \int a \, dt \\ x &= x_0 + v_0 t + \frac{1}{2} at^2 && = \int v \, dt \end{aligned}$$

Negative acceleration



Negative acceleration

$$x = x_0 + v_0 t + \frac{1}{2} a t^2$$

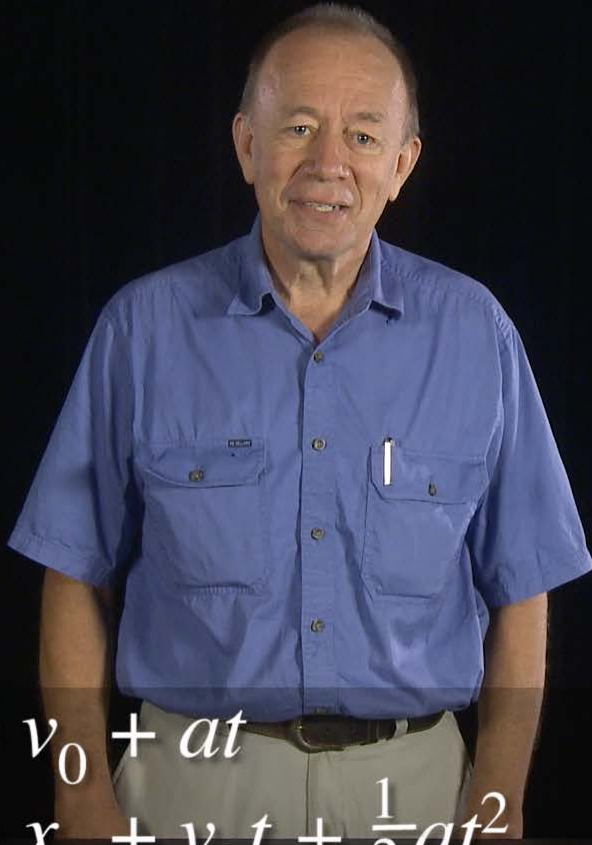
$$v = v_0 + at$$

$$a = \text{constant}$$

$$a < 0$$

Useful equations

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$$v = v_0 + at \quad (1)$$
$$x = x_0 + v_0 t + \frac{1}{2}at^2 \quad (2)$$

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Relating acceleration, displacement and final velocity

$$(1) v = v_0 + at \rightarrow t = \frac{v - v_0}{a}$$

$$\text{Substitute in (2): } x = x_0 + v_0 t + \frac{1}{2}at^2$$

$$x - x_0 = v_0 \frac{v - v_0}{a} + \frac{a}{2} \left(\frac{v - v_0}{a} \right)^2$$

$$\begin{aligned} 2a(x - x_0) &= 2v_0(v - v_0) + (v - v_0)^2 \\ &= \cancel{2vv_0} - \cancel{2v_0^2} + v^2 - \cancel{2vv_0} + \cancel{v_0^2} \end{aligned}$$

$$2a(x - x_0) = v^2 - v_0^2$$

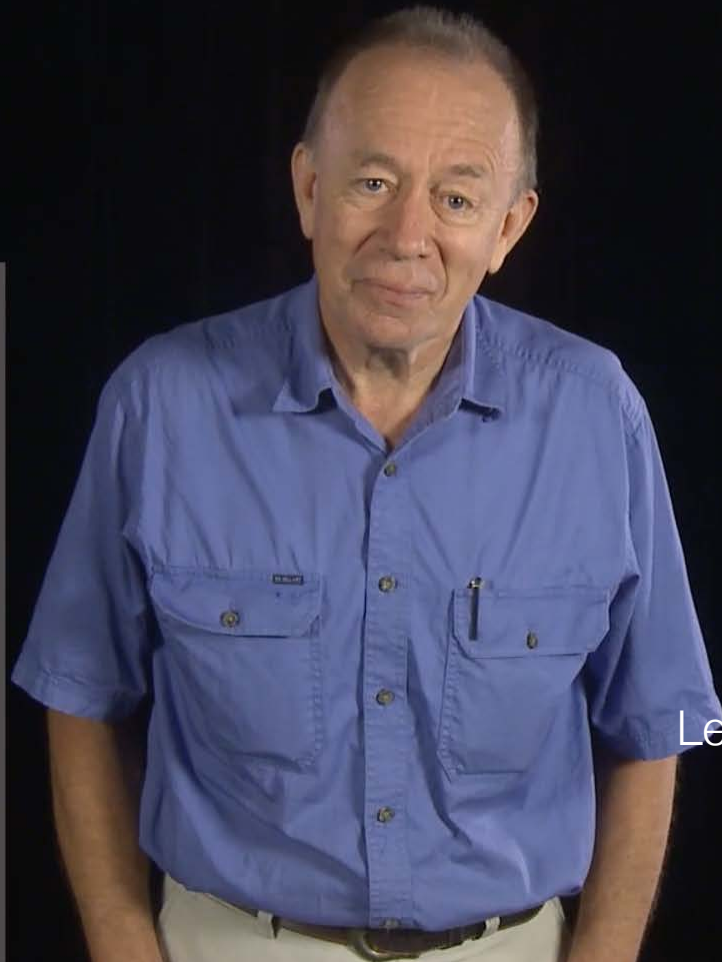
Equations to memorise

If $a = \text{constant}$

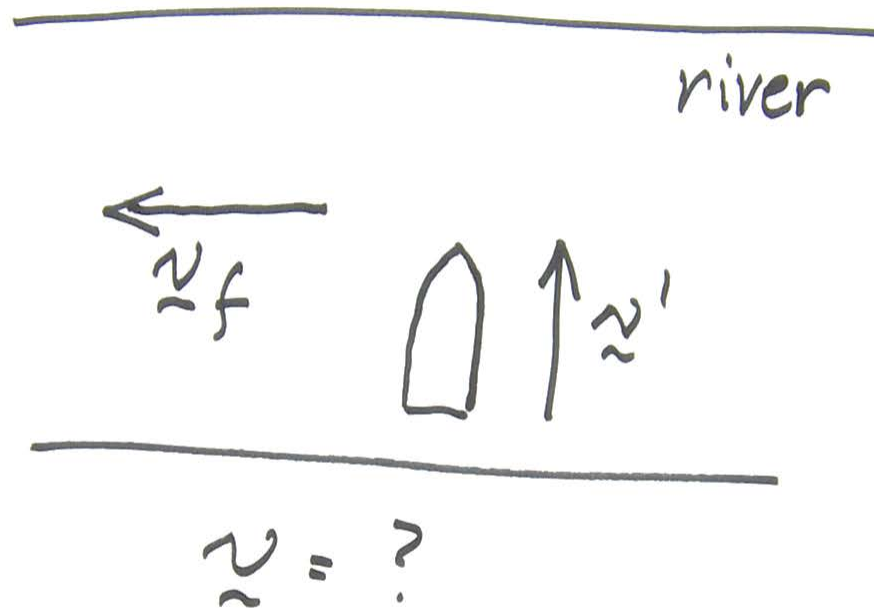
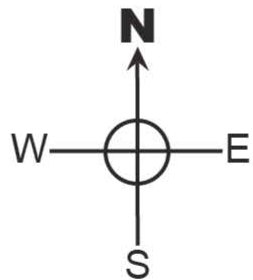
$$v = v_0 + at \quad (1)$$

$$x = x_0 + v_0 t + \frac{1}{2} at^2 \quad (2)$$

$$2a(x - x_0) = v^2 - v_0^2 \quad (3)$$



Relative velocity



Relative displacement

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A middle-aged man with short, light-colored hair is standing against a solid black background. He is wearing a short-sleeved, button-down blue shirt with two chest pockets and light-colored trousers. He has a neutral expression and is looking directly at the camera.

Relative displacements

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Notes

Notes