UNIT #1 KINEMATICS

The Big 5

Uniform Acceleration

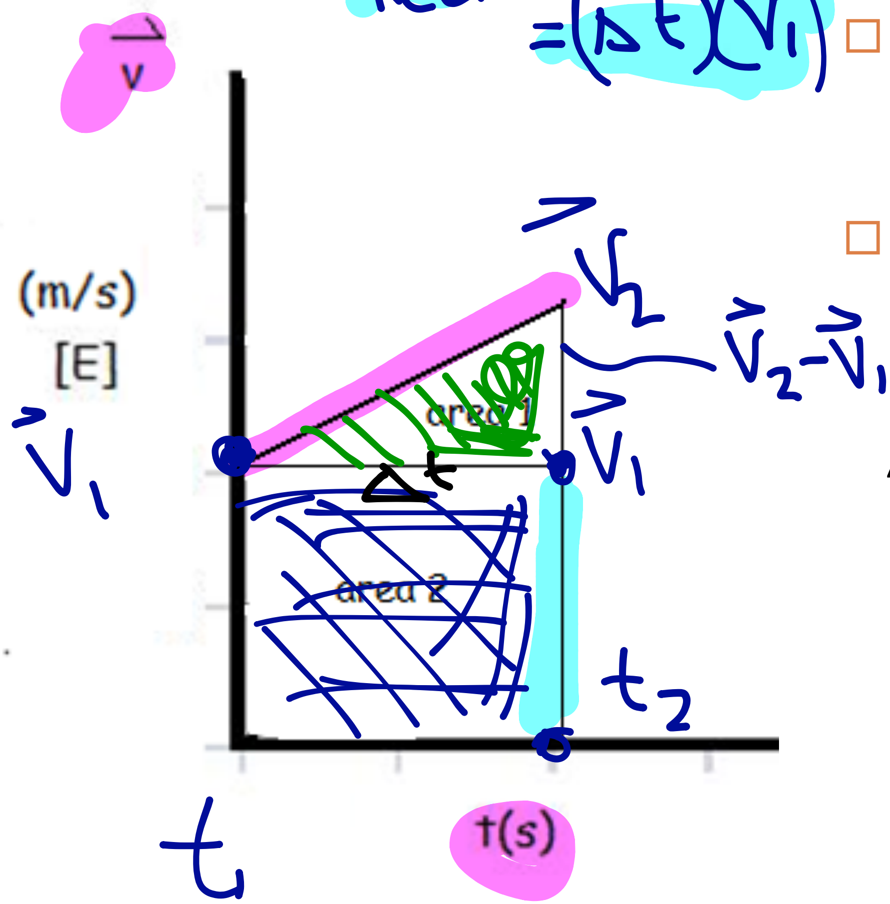
- acceleration is constant
- 5 Kinematic equations...much easier than graphical analysis!

Equation #1

$A_{triangle} = \frac{bh}{2} = \frac{\Delta t(\vec{v}_2 - \vec{v}_1)}{2}$

$A_{Rect} = bh = (\Delta t)(\vec{v}_1)$

- v-t graph, straight line (uniform acceleration)
- Δd = area under graph



$$\Delta d = A_{triangle} + A_{rectangle}$$

$$\overrightarrow{\Delta d} = \left(\frac{\vec{v}_2 + \vec{v}_1}{2}\right)\Delta t$$

$$A_{Total} = A_{Triangle} + A_{rectangle}$$

$$= \frac{\Delta t(\vec{v}_2 - \vec{v}_1)}{2} + \Delta t(\vec{v}_1)$$

$$= \frac{\Delta t(\vec{v}_2 - \vec{v}_1)}{2} + \frac{2\Delta t(\vec{v}_1)}{2}$$

$$= \frac{\Delta t(\vec{v}_2 - \vec{v}_1) + 2\Delta t\vec{v}_1}{2}$$

$$= \frac{\Delta t(\vec{v}_2 - \vec{v}_1 + 2\vec{v}_1)}{2}$$

$$= \frac{\Delta t(\vec{v}_2 + \vec{v}_1)}{2}$$

$$\Delta\vec{d} = \frac{(\vec{v}_2 + \vec{v}_1)\Delta t}{2}$$

Equation #2

- we know that $\vec{a} = \frac{\vec{v}}{\Delta t}$
- we can say, $\vec{a} = \frac{\vec{v}_2 - \vec{v}_1}{\Delta t}$
- rearranging, we get

$$\overrightarrow{v_2} = \overrightarrow{v_1} + \vec{a}\Delta t$$

Equation #3

- we can use equations (1) and (2) to derive equation (3)

$$\overrightarrow{\Delta d} = \left(\frac{\vec{v}_2 + \vec{v}_1}{2}\right)\Delta t \quad \textbf{(1)}$$

$$\overrightarrow{v_2} = \overrightarrow{v_1} + \vec{a}\Delta t \quad \textbf{(2)}$$

substitution

$$\overrightarrow{\Delta d} = \left(\frac{\overrightarrow{v_1} + \vec{a}\Delta t + \overrightarrow{v_1}}{2}\right)\Delta t$$

$$\overrightarrow{\Delta d} = \vec{v}_1\Delta t + \frac{1}{2}\vec{a}\Delta t^2$$

The Big Five

	Equation	Missing Variable
(1)	$\overrightarrow{\Delta d} = \left(\frac{\vec{v}_2 + \vec{v}_1}{2}\right)\Delta t$	$\vec{a}$
(2)	$\overrightarrow{v_2} = \overrightarrow{v_1} + \vec{a}\Delta t$	Δd
(3)	$\overrightarrow{\Delta d} = \vec{v}_1\Delta t + \frac{1}{2}\vec{a}\Delta t^2$	$\vec{v}_2$
(4)	$\vec{v}_2^2 = \vec{v}_1^2 + 2\vec{a}\Delta d$	Δt
(5)	$\overrightarrow{\Delta d} = \vec{v}_2\Delta t - \frac{1}{2}\vec{a}\Delta t^2$	$\vec{v}_1$

Examples

1. A car accelerates at $3 m/s^2$ from rest for 10s. How far does it travel?

2. A car is moving at 100km/h. It stops in 5.0s. What is the car's acceleration?

$v_1 = 0$

Given: $\vec{v}_1 = 0$

$\vec{a} = 3 m/s^2$

$\Delta t = 10 s$

Required: d = distance

Analysis:

Homework

- Read 1.5
- p.39#1-6