

Kinematics Problem Solving

9/16/17

- Requirement - Need to have Uniform Acceleration

UAM Equations

① $v_f = v_i + at$

Different symbols

② $\Delta x = \frac{v_i + v_f}{2} t$

$v_i = v = v_0$

$v_f = v$

③ $\Delta x = v_i t + \frac{1}{2} at^2$

$\Delta x, s, \Delta d$

④ $v_f^2 = v_i^2 + 2a \Delta x$

Proofs: Derivatives of UAM Equations

① $a = \frac{v_f - v_i}{t}$

② $\bar{v} = \frac{\Delta x}{t}$

Avg vel. $\frac{1}{2}$ in between v_i & v_f

$v_f - v_i = at$

$\frac{v_i + v_f}{2} = \frac{\Delta x}{t}$

$v_f = v_i + at$

$\Delta x = \frac{(v_i + v_f)t}{2}$

③ Sub Eqn 1 in Eqn 2

$v_f = v_i + at$

$\Delta x = \frac{(v_i + v_f)t}{2}$

$\Delta x = \frac{(v_i + v_i + at)t}{2}$

$\Delta x = \left(\frac{2v_i + at}{2} \right) t$

$\Delta x = v_i t + \frac{1}{2} at^2$

④ Rearrange Eqn 1 for t & sub into Eqn 2

$v_f = v_i + at$

$\Delta x = \frac{(v_i + v_f)t}{2}$

$t = \frac{v_f - v_i}{a}$

FOIL

$\Delta x = \left(\frac{v_i + v_f}{2} \right) \left(\frac{v_f - v_i}{a} \right) = \frac{v_i v_f - v_i^2 + v_f^2 - v_f v_i}{2a}$

$\Delta x = \frac{v_f^2 - v_i^2}{2a}$

Cross Multiply $v_f^2 - v_i^2 = 2a\Delta x$

+v_i^2 +v_i^2

$$v_f^2 = v_i^2 + 2a\Delta x$$

Tips to Solve UAMs

- Believe in yourself, Persistent, Flexible
- List the gives & Make Diagram
- Need three ~~equations~~ gives w/ 1 unknown value

13:50 - Video Solves for v_f , d w/out Eqns

11:06 IB Quesn: Two bodies Fall fr Rest @ diffnt times
 From a high bridge. The second body starts to fall after the
 first has traveled 1 meter. Ignore Air resistance.



During the Fall ^(B) Distance between the bodies increases



Reason - Body Accel. for more time will have more speed
 Distance gap will inc.

Solve
 any way
 vs.
 UAM Eqn

20:12: IB Quesn A car moving @ 20 m/s applies the brakes and
 comes to a stop. If the car's deceleration is 4 m/s^2 , what
 will be its braking distance? © 50 meters

① Find time for car to stop $v_f = 0 \text{ m/s}$

$v_f = v_i + at$ Goes 20 m/s loses $\frac{4 \text{ m/s}}{\text{s}}$ to get to 0 m/s Ans. 5 sec

② $\bar{v} = \frac{\Delta d}{t}$ $v_{Avg} = \frac{20+0}{2} = 10 \text{ m/s}$ $\bar{v} = \frac{\Delta d}{t}$ $10 \text{ m/s} = \frac{\Delta d}{5 \text{ s}} = 50 \text{ m}$

Now Solve w/ UAM.