Topic 2A: Accelerated Motion – Single Axis Continued

Skill 13: Kinematics Equations and Head Problems

Term	Variable	units
average velocity or speed	$\bar{v}$	m/s
initial velocity (speed)	v_i	m/s
final velocity (speed)	v_f	m/s
change in velocity	Δv	m/s
acceleration	a	m/s^2 or m/s/s
displacement (distance)	d	m
time	t	s

Equation to find average velocity for an object with or without uniform acceleration is

$\bar{v} = \frac{\text{total distance}}{\text{total time}}$ so $d = \bar{v}t$

all equations below assume zero or uniform (constant) acceleration

$\bar{v} = \frac{v_i + v_f}{2}$ $\quad v_f = v_i + \Delta v$ $\quad \Delta v = v_f - v_i$

$a = \frac{\Delta v}{t}$ $\quad \Delta v = at$

For "Head problems"
use simple equations above to solve for goal (unknown) along with grid to keep track of variables

Δv	$\bar{v}$	v_i	v_f	d	a	t
		often left off when v_i is zero				

Remember you still must show work with all smaller steps

Kinematics Equations

$v_f = v_i + at$

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

$v_f^2 = v_i^2 + 2ad$

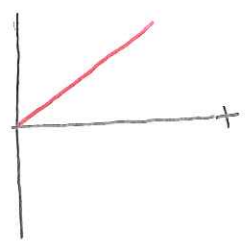
When $v_i = 0$

$v_f = at$ or $\Delta v = at$

$d = \frac{1}{2}at^2$ $\quad t = \sqrt{\frac{2d}{a}}$

$v_f = \sqrt{2ad}$

You can also solve displacement & acceleration from a velocity vs. time graph



d = area under line

Since area is a triangle

area $= \frac{1}{2}bh$ or $\frac{1}{2}hb$

or $= \frac{1}{2}(\Delta y)(\Delta x)$

$d = \frac{1}{2}(\Delta v)(t)$ [since $\Delta v = at$]

$d = \frac{1}{2}(at)(t)$

$d = \frac{1}{2}at^2$

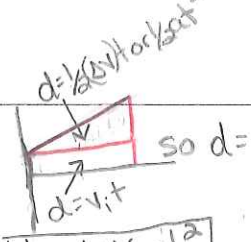
$a = \frac{\Delta v}{t}$ which is $\frac{\Delta y}{\Delta x}$ or slope

acceleration is slope of v vs t graph

If v_i is not zero, the graph would be

① Find areas for each shape

② Add areas together



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