Skill 13 – Quantitative Problem Solving

This chart summarizes two different strategies for quantitative problem solving.

HEAD PROBLEM METHOD	KINEMATICS EQUATIONS
Series of simple steps involving basic equations used to link variables. Use this grid to keep track of variables and solve step by step.	Make a list of known variables and the unknown "goal". Find the equation which includes the "goal" and the other givens. Solve with attention to units and mathematical reasoning.
$\bar{v} = \frac{d}{t}$ $\quad \bar{v} = \frac{v_i + v_f}{2}$ $\Delta v = at \quad a = \frac{\Delta v}{t} \quad t = \frac{\Delta v}{a}$ $\Delta v = v_f - v_i \quad a = \frac{v_f - v_i}{t}$	$d = v_i t + \frac{1}{2} a t^2$ $v_f{}^2 = v_i{}^2 + 2ad$ $v_f = v_i + at$

Δv	v_i	v_f	$\bar{v}$	d	a	t

Example: An otter starting from rest and accelerates uniformly for 4s down a frictionless ramp with a length of 32m. What is the acceleration of the otter?

"Head Problem" Method

Step One List the givens and unknown in the grid of possible variables.

Δv	v_i	v_f	$\bar{v}$	d	a	t
	0			32m	?	4s

Determine which other variable you can calculate from this starting point:

$$\bar{v} = \frac{d}{t} = \frac{32m}{4s} = 8m/s$$

Δv	v_i	v_f	$\bar{v}$	d	a	t
	0		8m/s	32m	?	4s

Keep working with simple equation until goal is reached:

$$\bar{v} = \frac{v_i + v_f}{2} \quad 8\frac{m}{s} = \frac{0 + v_f}{2} \quad v_f = 16m/s$$

$\Delta v = v_f - v_i$ so $\Delta v = 16$ m/s

Δv	v_i	v_f	$\bar{v}$	d	a	t
16m/s	0	16m/s	8m/s	32m	?	4s

$$a = \frac{\Delta v}{t} = \frac{16\frac{m}{s}}{4s} = 4\frac{m}{s^2}$$

Kinematics Equation Method:

Givens:	**Unknown**
v_i=0	a=?
t=6s	
d=20m	

Equation and Substitution:

$d = v_i t + 1/2 a t^2$

$32m = 0t + 1/2 a(4s)^2$

$32m = 1/2 a(16s^2)$

$$a = \frac{32m}{8s^2} = 4\frac{m}{s^2}$$