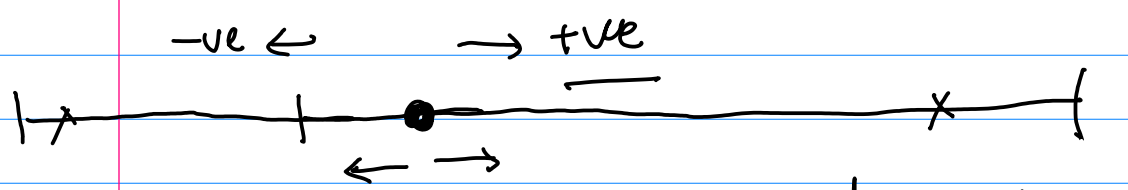
Kinematics

motion ⟷ measurement



v → speed (+v)

time t

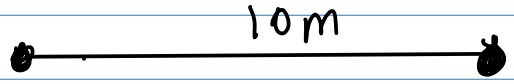
vt

velocity (includes the direction) -v

$v = +5\ m/s$

$t = 2s$

dist = Speed x time interval



$V = 5 + 2t$ m/s

$t = 2s$

$5 + 2 \times 0.5$

$5\ m/s \times 1s$

$5 \times 0.5 = 2.5$

distance / displacement

t	v	s
0	5	0
1	7	5
2	9	7

d = 1

+5 → 12m

0.5

t	v	s
0	5	0
0.5	6	2.5
1.0	7	3
1.5	8	3.5
2.0	9	4

d = 0.5

+4 → 13m

$v = 5 + 2t$

$t = 28$

$d = 0.25$

t	v	s
0	5	0
0.25	5.5	1.25
0.5	6	1.375
0.75	6.5	1.5
1.0	7	1.625
1.25	7.5	1.75
1.5	8	1.875
1.75	8.5	2
2.0	9.0	2.125

0.1 0.01 ⋮ 0.0 → better answer

15.75 m

$d \to 0$

LEIBNIZ / ISAAC NEWTON

$dt = 0.5$

t	$v = 5 + 2t$	s
0	5	0
d	$5 + 2d$	$5d$
$2d$	$5 + 2(2d) = 5 + 4d$	$(5 + 2d)d = 5d + 2d^2$
$3d$	$5 + 2(3d) = 5 + 6d$	$(5 + 6d)d = 5d + 6d^2$
$4d$	$5 + 8d$	$5d + 8d^2$
$5d$	$5 + 2(5d) = 5 + 10d$	$(5 + 10d)d = 5d + 10d^2$
$6d$	$5 + 2(6d) = 5 + 12d$	$(5 + 12d)d = 5d + 12d^2$

a, $2a$

$$s = 5d + (5d + 2d^2) + (5d + 4d^2) + (5d + 8d^2) + \dots$$

Δt | 2 s | $\rightsquigarrow$ $\left(\frac{2}{\Delta t}\right)$ many times we are creating a table entry.

T

0.5

$\left(\frac{2}{\Delta t}\right) \rightarrow \frac{2}{0.5} \rightarrow \frac{2}{1/2} = 4$

0.25 $\rightarrow \frac{2}{0.25} \rightarrow \frac{2}{1/4} = 8$

$\left(\frac{T}{\Delta t}\right) \rightsquigarrow$ no. of table entries

$1+2+3=6$

$3+4=6 \Rightarrow 6$

$1+2+3+4=10$

$4 \times 5 = 10$

$\left(5\Delta t \times \frac{T}{\Delta t}\right)$

$(1+2+3+\ldots\ldots n)$

$\left[\frac{n(n+1)}{2}\right]$

$S = 5T + \left[2d^2 + 4d^2 + 6d^2 + 8d^2 + 10d^2 + 12d^2 + \ldots\ldots\right]$ (T/d) times

S = distance = speed × time

$2d^2 + 4d^2 + 6d^2 + 8d^2 + 10d^2 + 12d^2 \ldots$

$2d^2 (1 + 2 + 3 + 4 + \ldots\ldots (T/d))$ (T/d) times

$2d^2 \times \frac{1}{2}\left(\frac{T}{d}\right)\left(\frac{T}{d}+1\right)$ $d\left(T\right)\left(\frac{T}{d}+d\right)$

$S = 5T + T(T+d)$

$= \frac{5\times 2}{2s} + \frac{2(2+1)}{2s\ \ 2}$

$= 16$

$S = 5T + T(T+d)$

$d = 1 \mid T = 2s$

$S = 5\times 2 + \frac{2(2+1)}{2}$

$= 12$

$d = 0.5 \mid T = 2s$

$S = 5\times 2 + \frac{2(2+0.5)}{3}$

$= 12.5 \mid 15$

13

$2d^2\left(\left(\frac{T}{d}-1\right)\left(\frac{T}{d}\right)\right)$

$2d^2\left(\frac{T-d}{}\right)T$

$d = 0.25 \mid T = 2s$

$S = 5\times 2 + 2(2-0.25)$

$= 10 + 2(1.75)$

$10 + 3.5$

13.5

speed at time t = initial speed + acceleration $\times$ t

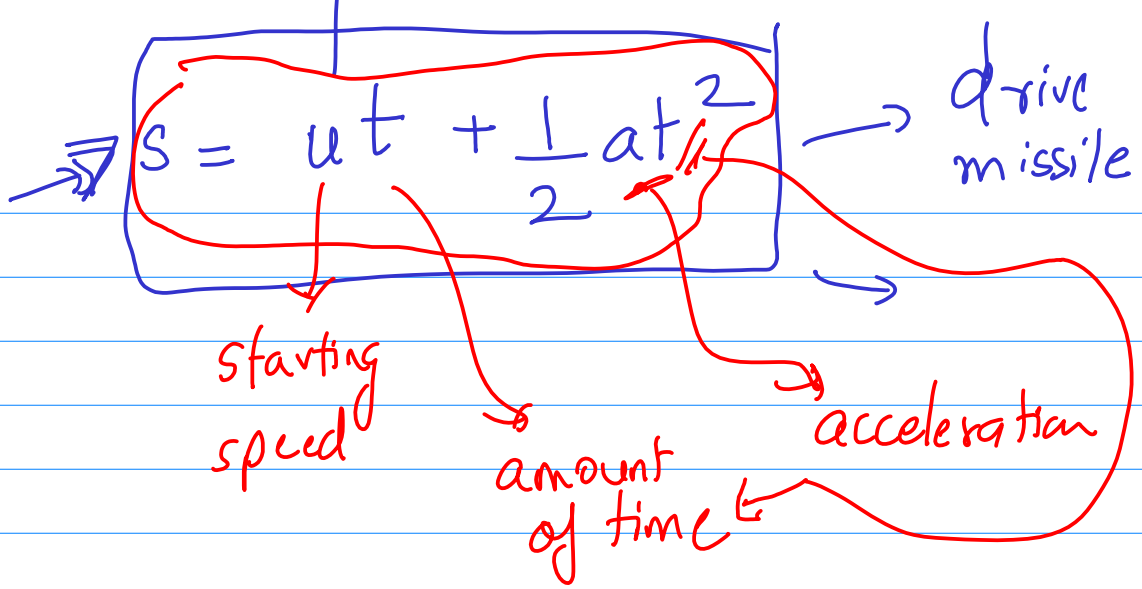
$v = u + at$

$(v = 5 + 2t)$

$S = 5T + T(T-d)$

displacement / distance

interval between frames of animation


$S = ut + \frac{1}{2}at^2$
drive missile
starting speed
amount of time
acceleration