Kinematics Equation Sheet

The five Kinematics Variables:

$v_i =$

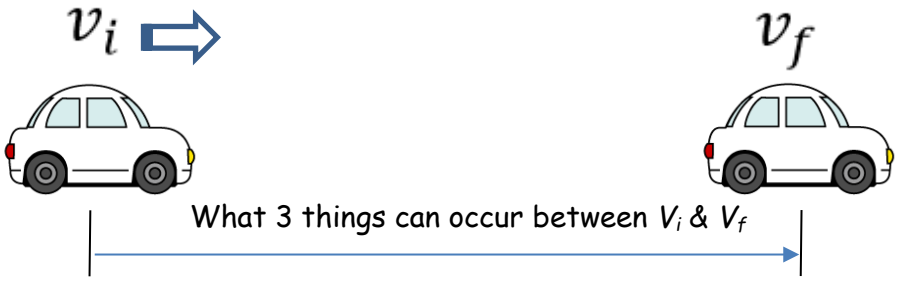
$v_f =$

$d =$

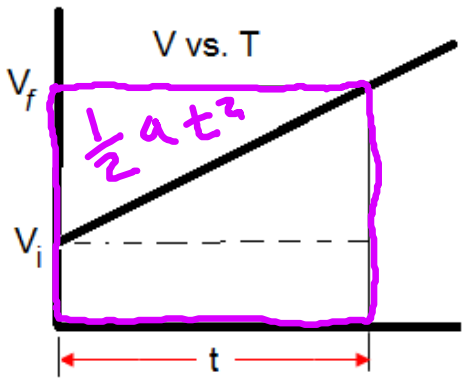
$a =$

$t =$

Equation Number	Unused variable	Equation
1	d	$Vf = vi + a \cdot t$
2	a	$d = \frac{(Vi + Vf)}{2} \cdot t$ $\quad d = Vavg \cdot t$
3	Vf	$d = Vi \cdot t + \frac{1}{2} a \cdot t^2$
4	V_i	$d = V_f \cdot t - \frac{1}{2} a t^2$
5	+	



Another Area under the curve:



Consider the V-t graph below, what is another way of finding area under the curve?

Find area of Rectangle $V_f \cdot t$ then subtract The Triangle.

Write another distance equation in terms of

$$d = V_f \cdot t - \frac{1}{2}at^2$$

The Last Equation (Number 5)

a. Using your Kinematics equation sheet, which of the 5 variables hasn't been listed as the "unused variable"?

time

b. Rearrange Equation 1 to solve for time.

$$V_f = V_i + at$$
$$V_f - V_i = at$$
$$t = \left(\frac{V_f - V_i}{a}\right)$$

c. Substitute your answer from "c" into equation 2 and simplify, this will be equation 5.

$$d = \frac{(V_f + V_i)}{2}\frac{(V_f - V_i)}{a}$$

$$2ad = (V_f + V_i)(V_f - V_i)$$
$$2ad = V_f^2 - V_i^2$$

#5

$$\boxed{V_f^2 = V_i^2 + 2ad}$$

V_iV_f-dat Example Problems

E1. A student on a bicycle starting from rest has a constant acceleration of 3.0 m/s^2.

$V_i = 0$ 0
$V_f = *$?
$d = ?$ 24
$a = 3.0$ 3
$t = 4.0$ 4

a. After 4.00 seconds how far have they gone?

$d = V_i t + \frac{1}{2} a t^2$

$d = \frac{1}{2}(3)(4)^2 = 24\text{m}$

b. After 4.00 seconds how fast are they traveling?

$V_f = V_i + at$

$V_f = (3)(4) = 12\text{ m/s}$

c. What is the average velocity during the first 4.00 seconds?

$\bar{V} = \frac{V_i + V_f}{2} = \frac{12}{2} = 6\text{ m/s}$

d. How far have they traveled by the time its velocity is 20.0 m/s?

$V_i = 0$
$V_f = 20$
$d = ?$
$a = 3$
$t = *$

$V_f^2 = V_i^2 + 2ad$

$20^2 = 2(3)d$

$400 = 6d$

$d = 66.7\text{ m}$

E2. A car is moving down the road with a velocity of 20 m/s when the driver decides to speed up. It takes the car 167 m to reach 30 m/s.

a. What is the acceleration of the car?

$V_f^2 = V_i^2 + 2ad$

$30^2 = 20^2 + 2(a)167$

$900 = 400 + 334a$

$334a = 500$

$a = 1.5\text{ m/s}^2$

$V_i = 20$
$V_f = 30$
$d = 167$
$a = ?$
$t = *$ 1.5 ?

b. How long did it take to go from 20 m/s to 30 m/s?

$V_f = V_i + at$

$30 = 20 + 1.5t$

$10 = 1.5t$

$t = 6.67\text{ sec}$

Kinematics Problem Sheet

Given the variables in each problem, decide which equation to use and solve. Write the "equation number" used in the blank. Remember all your answers need units!

Show your work below each problem!

	Given			Find	Not Used	Equation #
1	t = 6.0 s	V_i = 2.0 m/s	V_f = 14 m/s	a= 2.0 $\frac{m}{s^2}$	d	1
2	t = 4.00 s	a = 6.00 m/s^2	V_i = 3.00 m/s	V_f=		
3	Vi = 0.0 m/s	V_f = -25 m/s	a = -5.0 m/s^2	t=		
4	Vi = 3.0 m/s	V_f = 21 m/s	t = 8.0 s	d=		
5	V_i = 0 m/s	d = 16 m	t = 4.0 s	V_f=		
6	t = 200 s	V_i = -8.0 m/s	d = 700 m	V_f=		
7	V_i = 3.00 m/s	a = 3.00 m/s^2	t = 3.00 s	d=		
8	t = 4.0 s	V_f = 48 m/s	d = 40 m	a=		
9	a = 2.0 m/s^2	V_f = 10. m/s	d = 24 m	V_i=		
10	V_f = 6.0 m/s	a = 4.0 m/s^2	t = 3.0 s	V_i=		

$V_f = V_i + at$ $6a = 12$

$14 = 2 + 6a$ $a = 2.0$

1) 2.0 m/s^2 2) 27m/s 3) 5.0 s 4) 96.m 5) 8 m/s 6. 15 m/s 7) 22.5 m 8) 19. m/s^2 9. 2) 2.0 m/s 10. -6 m/s