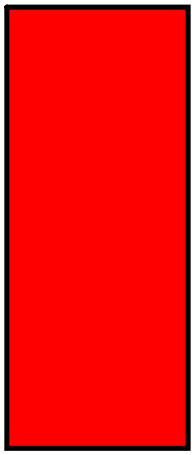
What are the variables (characteristics you can measure) of an object in motion?

d
t
v
a



dat $d = v_1 t + 1/2 a t^2$

vat $v_2 = v_1 + at$

vad $v_2^2 = v_1^2 + 2ad$

d$\overline{v}$t $d = \left(\frac{v_1 + v_2}{2}\right) t$

1) list data- do any conversions if needed
1a) draw diagram/picture if needed

2) "TM" type motion ...
list base formula ... simplify...

3) isolate variable

4) plug in measurements
-estimate
5) solve equation
-reasonableness
6) do unit analysis

A car goes from 2.5 m/s to 9.9 m/s in 3.7 seconds. What is its acceleration?

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What is its acceleration?

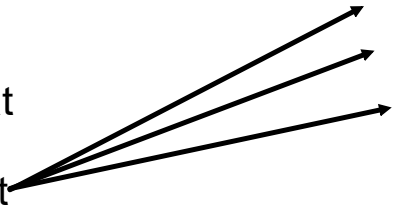
$v_1 = 2.5$ m/s

$v_2 = 9.9$ m/s

$t = 3.7$ s

$a = ?$

TM? *acceleration*



dat

vat

vad

dvt

$v_2 = v_1 + at$

isolate

$a = v_2 - v_1/t$

$a = (9.9 \text{ m/s} - 2.5 \text{ m/s})/3.7 \text{ s}$

$m/s^2 = (\quad m/s - \quad m/s)/s$

$m/s^2 = \quad m/s/s = m/s^2$

$a = 2.0 \text{ m/s}^2$

You drop a stone from a window and it hits the ground1.7 seconds later. How far off the ground is the window?

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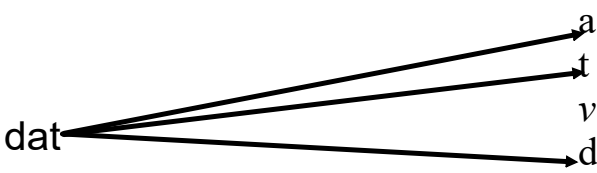

vat

vad

dvt

TM? *accel*

$d = v_1 t + 1/2\ at^2$

$v_1 = 0$ simplify

$\therefore d = 1/2\ at^2$

$d = 1/2\ (-9.8\ m/s^2)(1.7\ s)^2$

m = m/s² (s²)

m = m

d = -14 m

$\therefore$ the window is 14 m up

A car accelerates from rest to 120 mph in 6.6 seconds. How far does it go?

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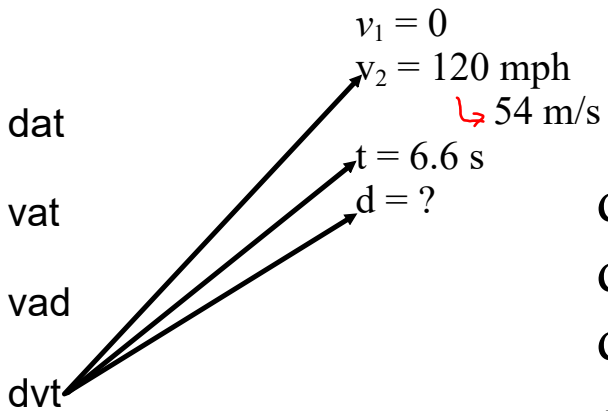
How far does it go?



$v_1 = 0$

$v_2 = 120$ mph

↳ 54 m/s

$t = 6.6$ s

$d = ?$

$$d = \bar{v}t$$

$$d = [(v_1 + v_2)/2]\ (t)$$

$$d = [(0 + 54\ m/s)/2]\ (6.6\ s)$$

m = m/s (s)

$$d = 180\ m$$

A runner accelerates from 1.25 m/s to 4.50 m/s in 1.20 seconds. How far did he go during the acceleration?

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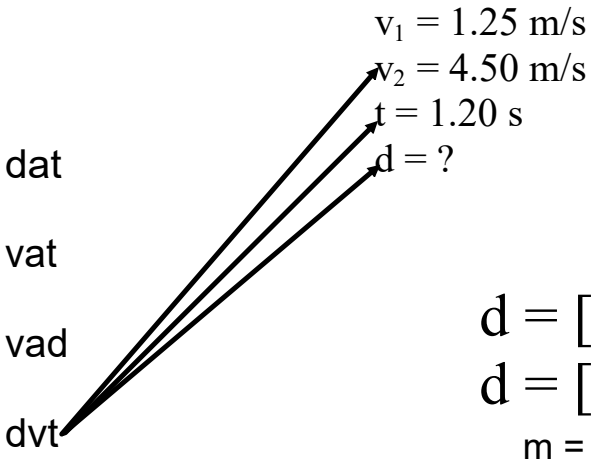

$$d = [(v_1 + v_2)/2]\ (t)$$

$$d = [(1.25 + 4.50\ m/s)/2]\ (1.20\ s)$$

m = m/s (s)

m = m

$$d = 3.45\ m$$

Little Katie throws a rock straight upward at 22 m/s.
a) How high does it go?
b) How long does it take to go to the top of its path?
c) What speed does it hit the ground at on its return?

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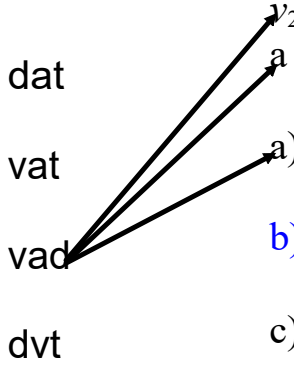

$v_1 = 22$ m/s
$v_2 = 0$ (at top)
$a = -9.8$ m/s^2

a) $d_t = ?$

b) $t_t = ?$

c) $v_{2b} = ?$

a)

$v_2^2 = v_1^2 + 2ad$

$d = v_2^2 - v_1^2 / 2a$

$d = 0 - (22 \text{ m/s})^2/[2(-9.8 \text{ m/s}^2)]$

$d = 25$ m

b)

$v_2 = v_1 + at$

$t = (v_2 - v_1)/a$

$t = [0 - (22 \text{ m/s})]/-9.8 \text{ m/s}^2$

$t = 2.2$ s

c) $t_t = 2.2$ s (½ trip)

$\therefore t_b = 4.4$ s

$v_2 = v_1 + at$

$v_2 = 22 \text{ m/s} + (-9.8 \text{ m/s}^2)(4.4 \text{ s})$

$v_2 = -21$ m/s (should be -22 m/s, but we rounded the time.)

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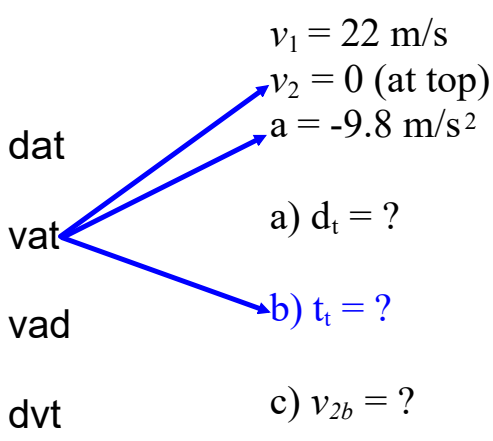

$v_1 = 22$ m/s
$v_2 = 0$ (at top)
$a = -9.8$ m/s^2

a) $d_t = ?$

b) $t_t = ?$

c) $v_{2b} = ?$

a)

$v_2^2 = v_1^2 + 2ad$
$d = v_2^2 - v_1^2 / 2a$
$d = 0 - (22 \text{ m/s})^2/[2(-9.8 \text{ m/s}^2)]$
$d = 25$ m

b)

$v_2 = v_1 + at$
$t = (v_2 - v_1)/a$

$t = [0 - (22 \text{ m/s})]/-9.8 \text{ m/s}^2$
$t = 2.2$ s

c) $t_t = 2.2$ s (½ trip)
$\therefore t_b = 4.4$ s
$v_2 = v_1 + at$
$v_2 = 22 \text{ m/s} + (-9.8 \text{ m/s}^2)(4.4 \text{ s})$
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Little Katie throws a rock straight upward at 22 m/s.
a) How high does it go?
b) How long does it take to go to the top of its path?
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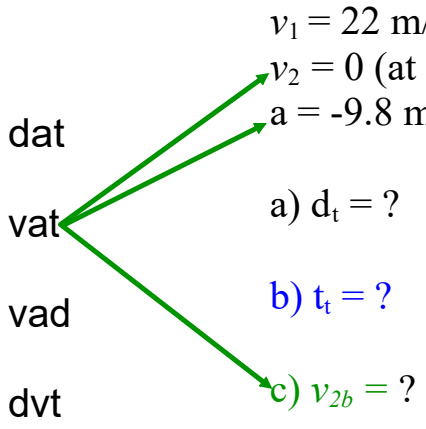
a)
$v_2^2 = v_1^2 + 2ad$
$d = v_2^2 - v_1^2 / 2a$
$d = 0 - (22\ m/s)^2/[2(-9.8\ m/$
$d = 25\ m$

b)
$v_2 = v_1 + at$
$t = (v_2 - v_1)/a$

$t = [0 - (22\ m/s)]/-9.8\ m/s^2$
$t = 2.2\ s$



$v_1 = 22$ m/s
$v_2 = 0$ (at top)
a = -9.8 m/s²

a) $d_t = ?$

b) $t_t = ?$

c) $v_{2b} = ?$

c) $t_t = 2.2$ s (½ trip)

$\therefore t_b = 4.4$ s

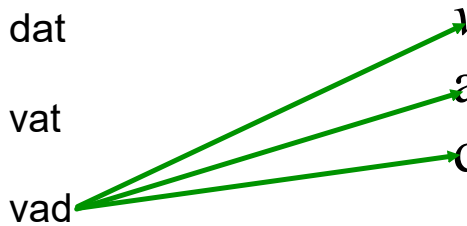
$v_2 = v_1 + at$

$v_2 = 22\ m/s + (-9.8\ m/s^2)(4.4\ s)$

$v_2 = -21$ m/s (should be -22 m/s, the time.)

While deer hunting (from a tree) you shoot an arrow downward at 25 m/s. What velocity does it hit the ground at if you're 20. feet up?

While deer hunting (from a tree) you shoot an arrow downward at 25 m/s. What velocity does it hit the ground at if you're 20. feet up?



$v_1 = -25$ m/s

20.ft (1m/3.28ft) = 6.1 m

$v_2 = ?$

$a = -9.8$ m/s^2

$d = -20.$ m → -6.1 m

$$v_2^2 = v_1^2 + 2ad$$

$$v_2 = \sqrt{v_1^2 + 2ad}$$

$$v_2 = \sqrt{(-25\text{m/s})^2 + 2(-9.8\ \text{m/s}^2(-6.1\ \text{m})}$$

$$v^2 = -27\ \text{m/s}$$

A gun can accelerate a bullet from rest to 350. m/s in a 1.10 m barrel.
a) What is the bullets acceleration?
b) How long is the bullet in the barrel?

A gun can accelerate a bullet from rest to 350. m/s in a 1.10 m barrel. a) What is the bullets acceleration? b) How long is the bullet in the barrel?

$v_1 = 0$ m/s
$v_2 = 350.$ m/s
d = 1.10 m

a) a = ?

b) t = ?

a)

$v_2^2 = v_1^2 + 2ad$

$a = v_2^2 / 2d$

$a = (350.\ m/s)^2/(2 \times 1.10\ m)$

$a = 55{,}700\ m/s^2$

b)

$d = v_1 + v_2/2\ (t)$

$t = d/[(v_1 + v_2)/2]$

$t = 1.10\ m\ (350\ m/s\ /2)$

$t = .00629\ s$