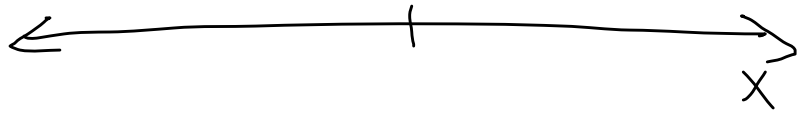
Phys 2110-4 1/20/12

Note Title 1/20/2012

Chap 2 1-D motion

x, v, a



$$v = \frac{dx}{dt} \qquad a = \frac{dv}{dt}$$

velocity

speed $= |v|$ (positive)

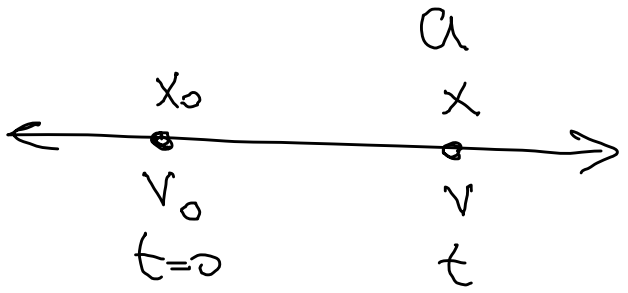
Constant acceleration, $a = \left(m/s^2\right)$

$$v = v_0 + at$$

$$x = x_0 + v_0 t + \frac{1}{2} a t^2$$

$$v^2 = v_0^2 + 2a(x - x_0)$$

$$x = x_0 + \frac{1}{2}(v + v_0)t$$

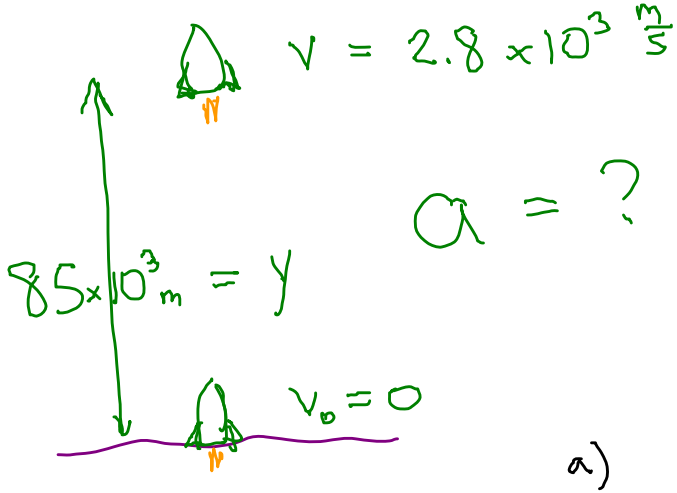


2.22 A giant eruption on the Sun propels solar matl from rest to $450 \frac{km}{s}$ over period of 1 h. Find avg accel.

$$\bar{a} = \frac{\Delta V}{\Delta t} = \frac{450 \times 10^3 \frac{m}{s}}{3600 s}$$

$$= 130 \frac{m}{s^2}$$

2.31 A rocket rises w/ constant acceleration to altitude of 85 km at which point its speed is 2.8 $\frac{km}{s}$. a) What's its acceleration b) How long does the ascent take?



$$v^2 = v_0^2 + 2a(y - y_0)$$

$$a = \frac{v^2 - v_0^2}{2(y - y_0)} = \frac{(2.8 \times 10^3 \frac{m}{s})^2 - 0^2}{2(85 \times 10^3 m)}$$

a) $= 46 \frac{m}{s^2}$

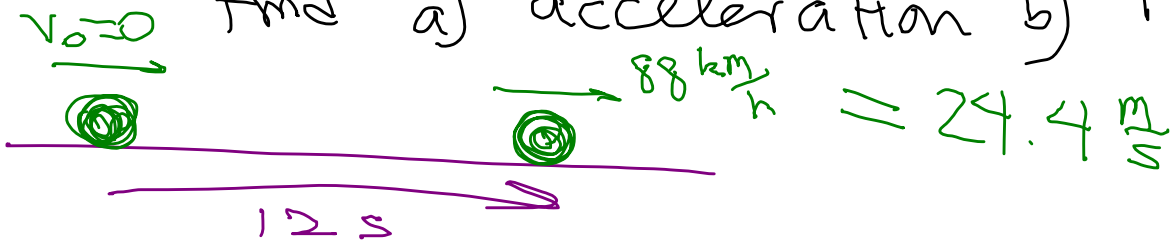
b) $v = v_0 + at$

$$t = \frac{v - v_0}{a} = \frac{2.8 \times 10^3 \frac{m}{s} - 0}{46 \frac{m}{s^2}}$$

$$= 61 \text{ s}$$

2.32 Starting from rest a car accelerates at a constant rate reaching 88 km/h in 12 s.

Find a) acceleration b) How far it goes.

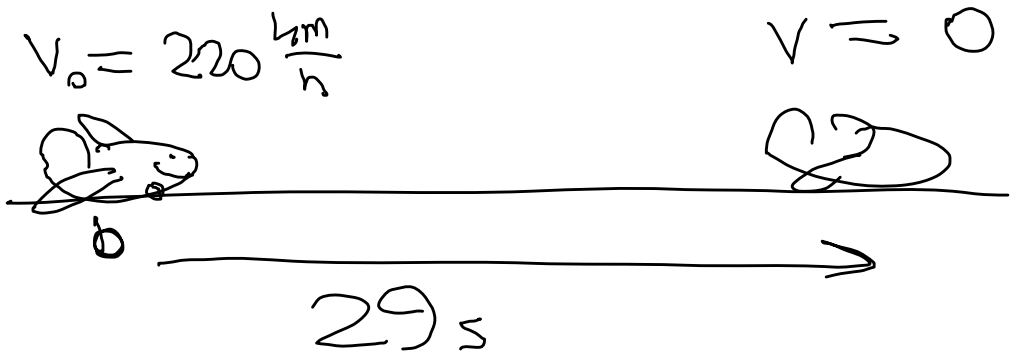


$$a = \frac{\Delta v}{\Delta t} = \frac{24.4\,\frac{m}{s}}{12\,s} = 2.0\,\frac{m}{s^2}$$

$$x = x_0 + v_0 t + \frac{1}{2} a t^2$$

$$= 0 + 0 + \frac{1}{2}\left(2.0\,\frac{m}{s^2}\right)(12\,s)^2 = 150\,m$$

2.57 A jetliner touches down at $220\,\frac{km}{h}$ & comes to a halt 29 s later. What is shortest runway on which this aircraft can land?



$a = const$

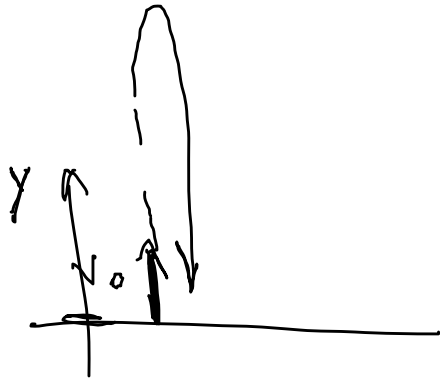
assume

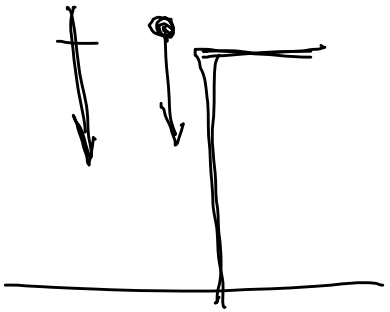
$$x = x_0 + \frac{1}{2}(v + v_0)\,t$$

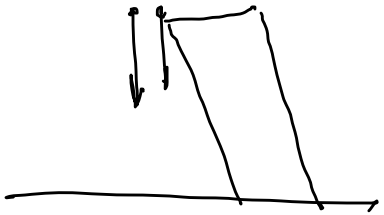
$$= 0 + \frac{1}{2}\left(0 + 220 \frac{km}{h}\right)(29\,s)$$

$$= 0.89\,km$$

Free fall



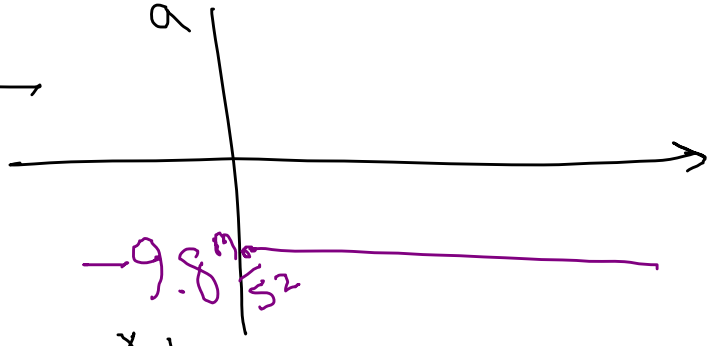


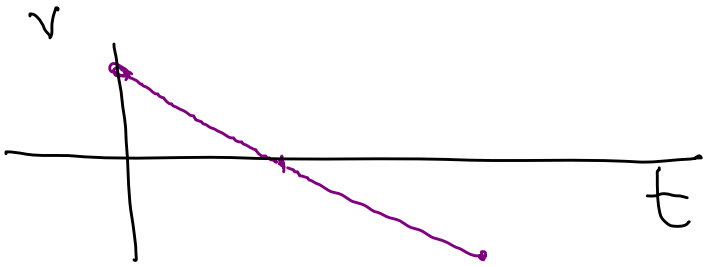


Galileo:

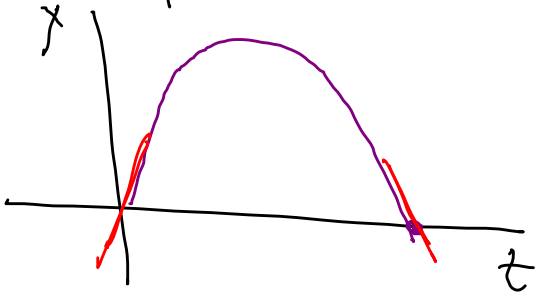
Acceleration

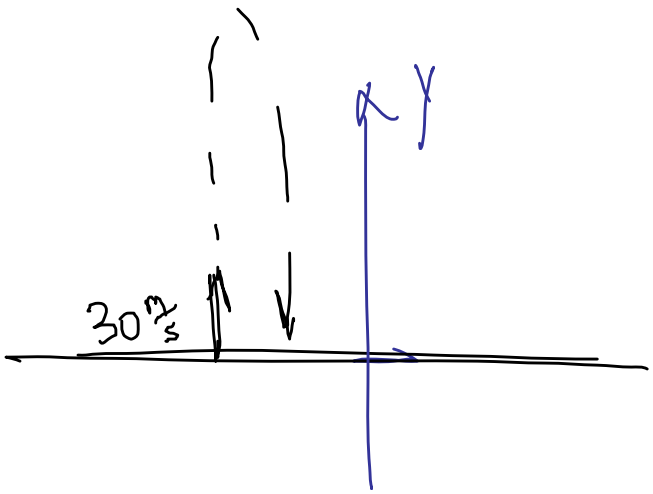
Same for all objects





velocity always decreases





$v_0 = 30\ \frac{m}{s}$

$a = -9.8\ \frac{m}{s^2}$

$= -g$

$g = 9.8\ \frac{m}{s^2}$

$$y = \left(30\ \tfrac{m}{s}\right)t - \tfrac{1}{2}\left(9.8\ \tfrac{m}{s^2}\right)t^2$$

$$v = 30\ \tfrac{m}{s} - 9.8\ \tfrac{m}{s^2}\,t$$

$t = 0$ $\quad y = 0$ $\quad v = 30\ \frac{m}{s}$

$t = 2s$ $\quad y = 40.4\ m$ $\quad v = 10.4\ \frac{m}{s}$

$t = 3s$ $\quad y = 45.4\ m$ $\quad v = 0.60\ \frac{m}{s}$

$t = 4s$ $\quad y = 41.6\ m$

$v = -9.20\ \frac{m}{s}$

When does rock reach max ht

$$v = 0 = 30\,\tfrac{m}{s} - 9.8\,\tfrac{m}{s^2}\,t$$

$$t = 3.06\ s$$

What was max ht.?

$$y = (30\,\tfrac{m}{s})(3.06\ s) + \tfrac{1}{2}(-9.8\,\tfrac{m}{s^2})(3.06\ s)^2$$

$$= 45.9\ m$$

$$v^2 = v_0^2 + 2a(y - y_0)$$

$$y - y_0 = \frac{v^2 - v_0^2}{(2)\,a}$$

$$= \frac{0 - (30)^2}{2(-9.8)} = 45.9\ m$$