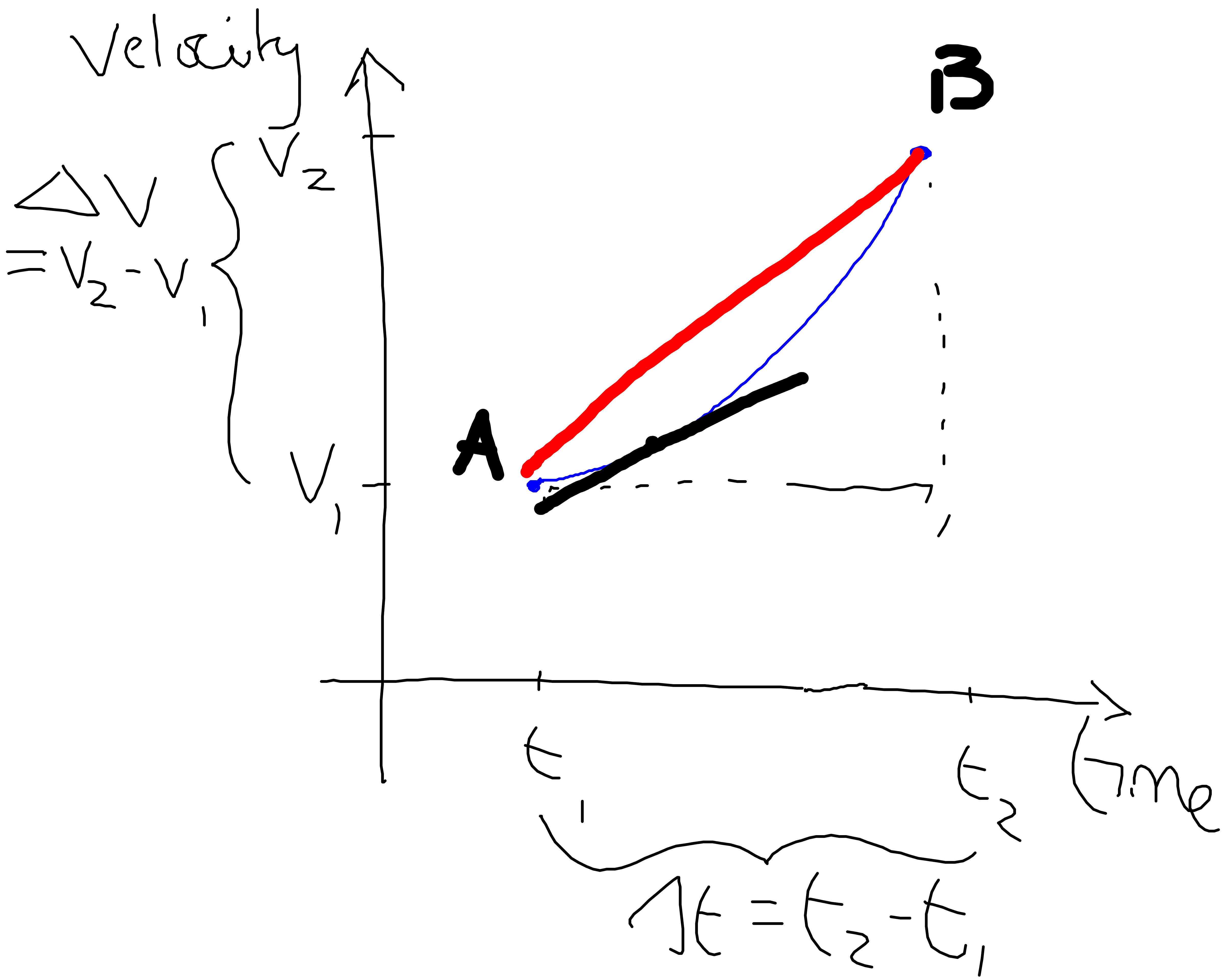
Acceleration

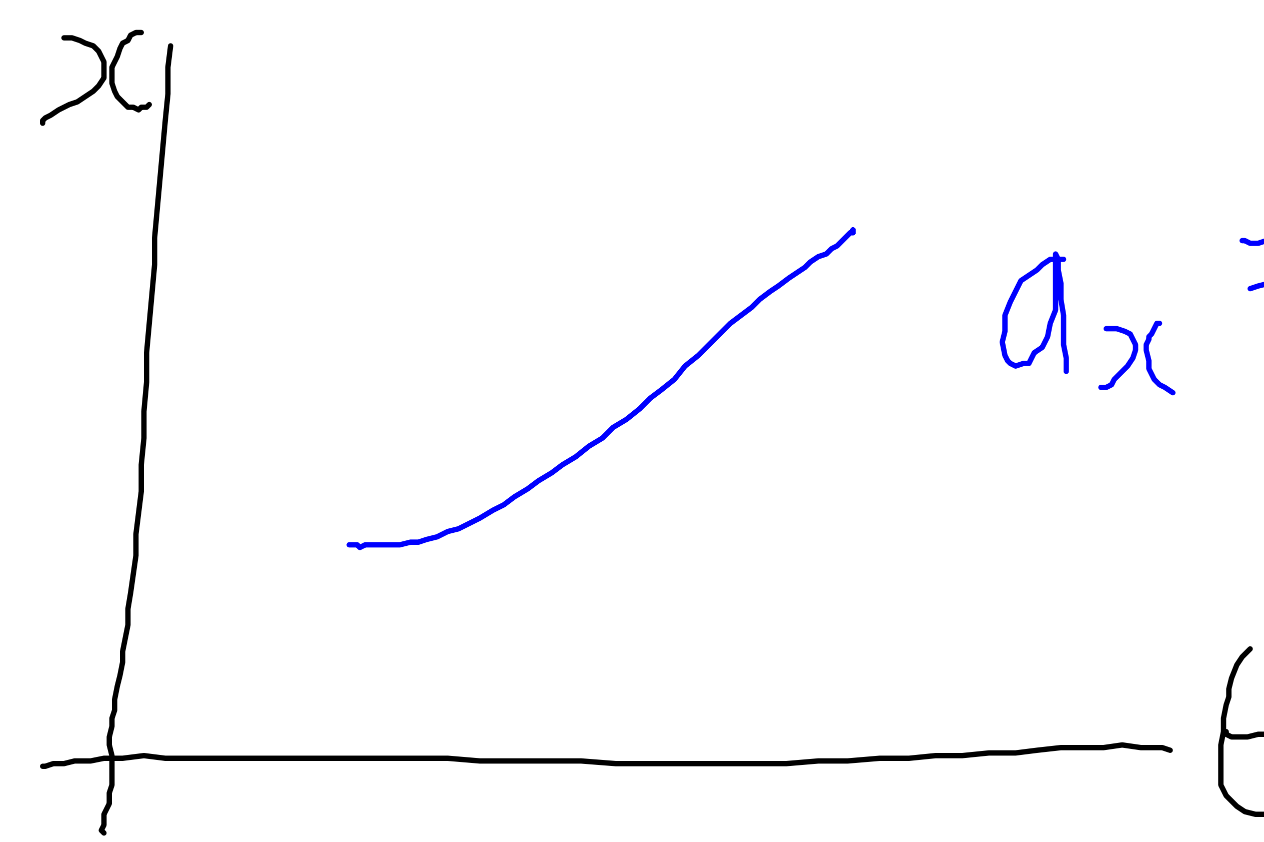


average

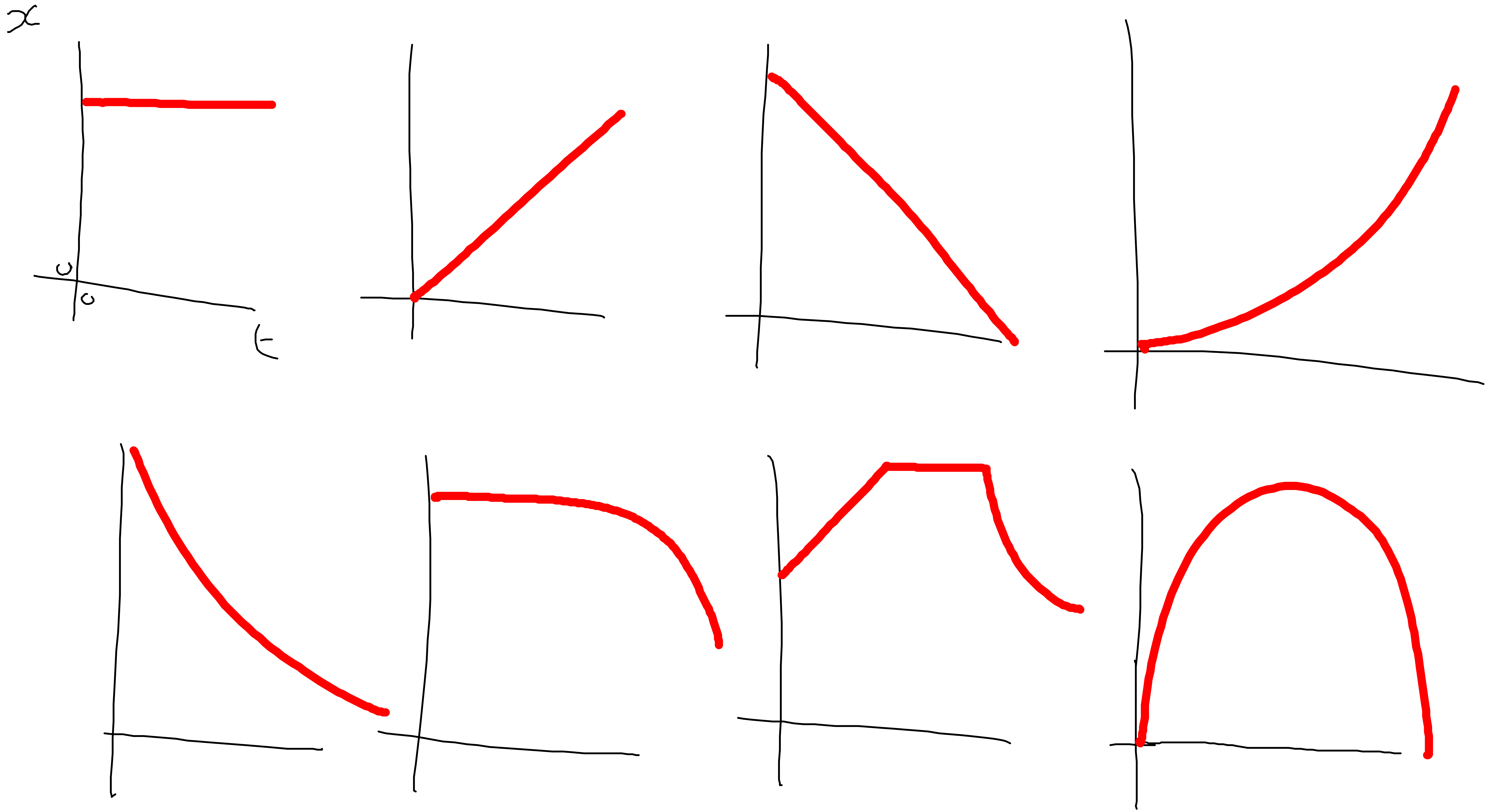
$$a_{x_{AVG}} = \frac{\Delta V}{\Delta t}$$

instantaneous

$$a_x = \frac{dV_x}{dt}$$



a_x = curvature


x
t

$$x_2 = x$$
$$x_1 = x_0$$

$$V_x = \frac{dx}{dt}$$

$$\boxed{x_2 - x_1 = \left[x\right]_{x_1}^{x_2} = \int_{x_1}^{x_2} 1\, dx = \int V_x\, dt}$$

$$a_x = \frac{dV_x}{dt}$$

$$\boxed{\int a_x\, dt = \int dV_x}$$

Special case a_x = constant (time-independent)

$$x = x_0 + V_{x_0} t + \frac{1}{2} a_x t^2$$

$$V_x = V_{x_0} + a_x t$$

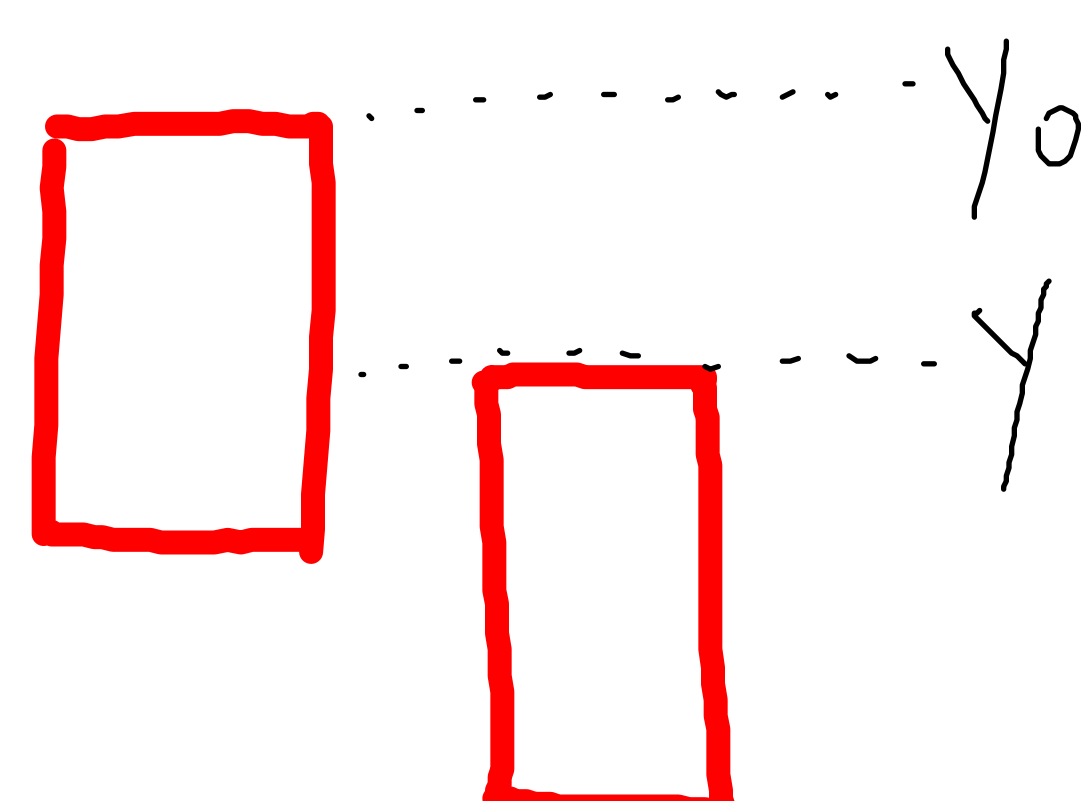
FREE FALL

+y $\uparrow$ $a_y = -9.8\ m/s^2$

time for dollar to fall half length?

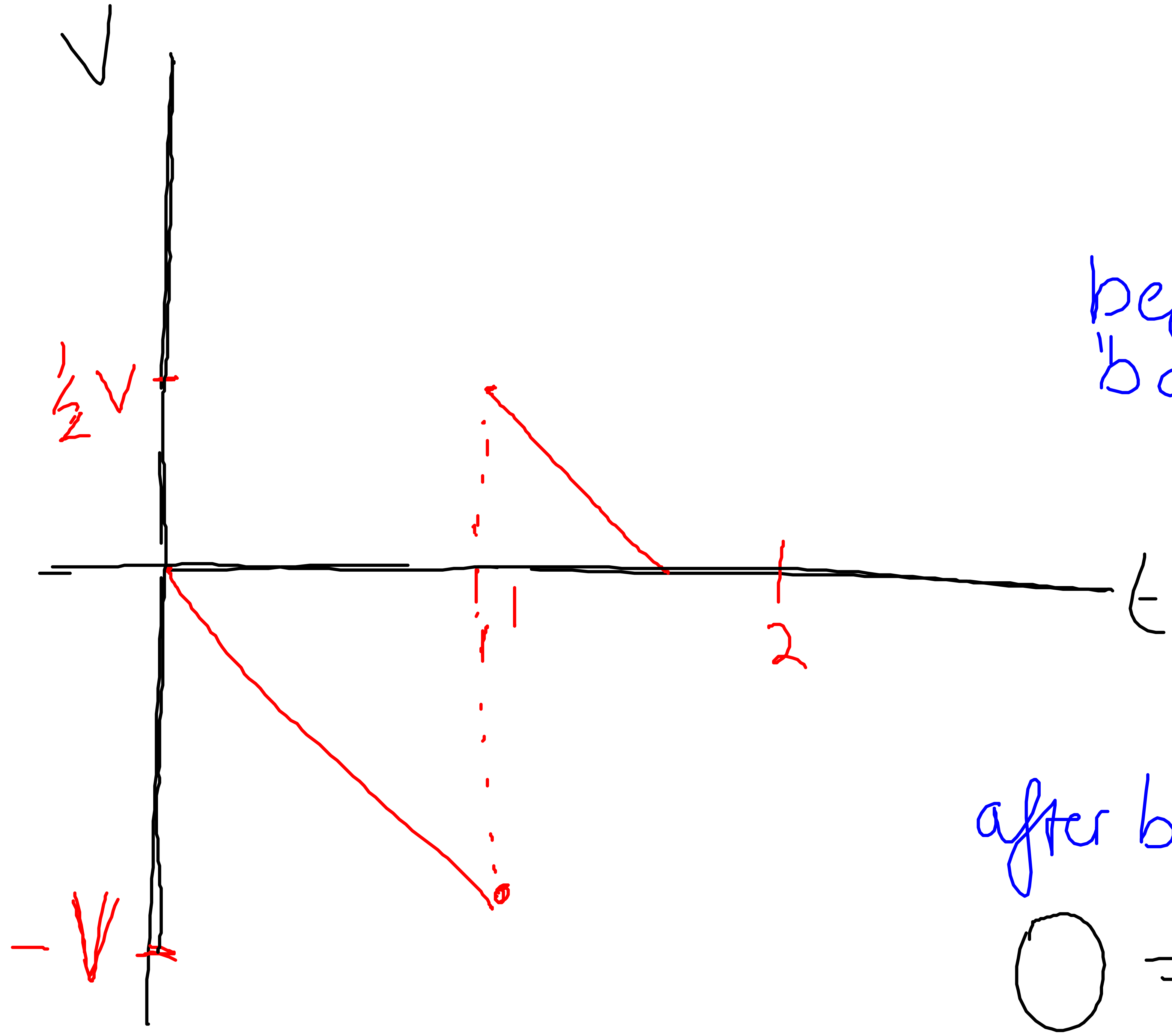
length of dollar 16 cm

$V_{0y} = 0$ m/s



$y - y_0 = -8.0$ cm

$y = y_0 + V_{0y}t + \frac{1}{2}a_y t^2$



$$y = y_0 + v_{0y}t + \frac{1}{2}a_y t^2$$

before bounce

$$y - y_0 = 0 - \frac{1}{2}10(1)^2$$

$$= -5m$$

after bounce

$$0 = v_y^2 = v_{0y}^2 + 2a_y(y - y_0)$$

$$v_y = v_{0y} + a_y t$$

before bounce $v_y = -10$ m/s

after bounce $= +5$ m/s $\Rightarrow 0 = 5^2 + 2(-10)(y - y_0)$

$\Rightarrow y - y_0 = 1.25$ m

Distance $5 + 1.25$
$= 6.25$ m

Displacement $= (5 - 1.25)$
$= -3.75$ m

$$y = y_0 + \frac{1}{2} a_y t^2$$

$$y - y_0 = \frac{1}{2} a_y t^2$$

$$-0.080 = \frac{1}{2}(-9.8)\, t^2$$

$$t^2 = \frac{2 \times 0.080}{9.8}$$

$$t = \sqrt{\frac{2 \times 0.080}{9.8}} = 0.127$$

$$= 0.135$$