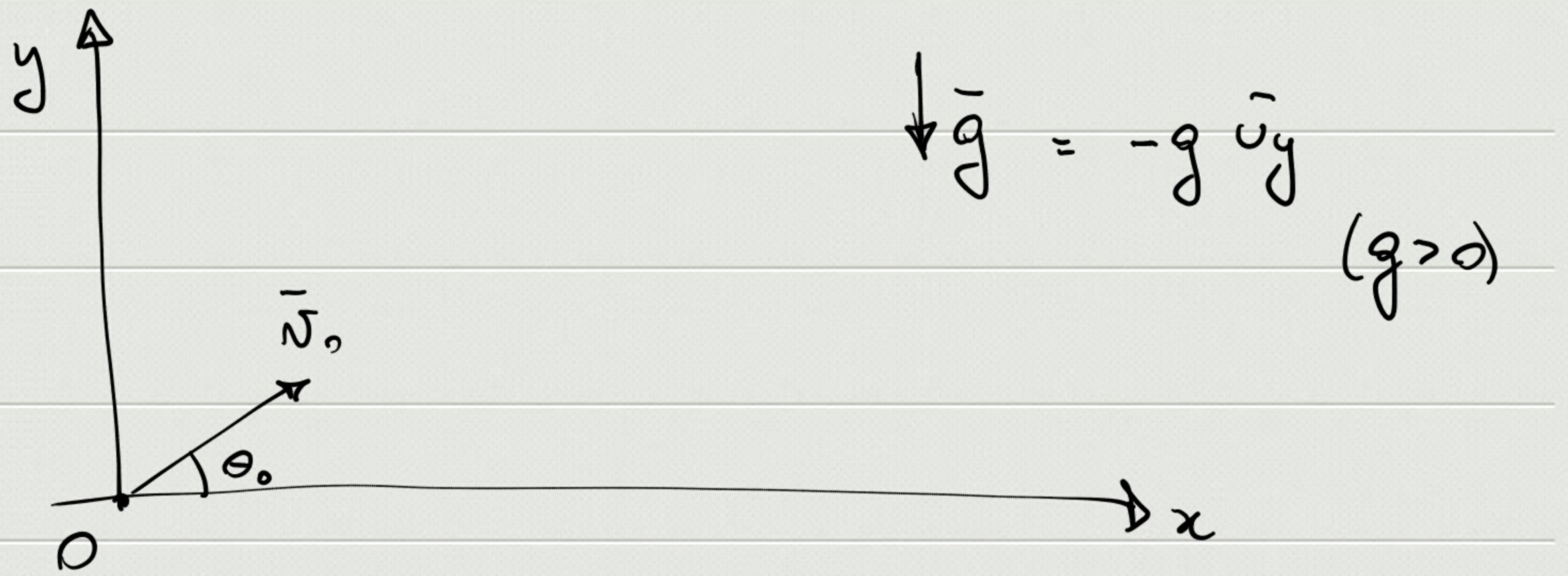



$$\bar{g} = -g\,\bar{u}_y \qquad (g>0)$$

$$\bar{a} = \frac{d\bar{v}}{dt} \Rightarrow \int_{\bar{v}_0}^{\bar{v}(t)} d\bar{v} = \int_0^t \bar{a}\,dt \Rightarrow \boxed{\bar{v}(t) = \bar{v}_0 + \bar{g}\,t}$$

($\bar{g}$ constante)

$$x: \quad v_x(t) = v_{0x} = v_0 \cos\theta_0 \qquad (= \text{cost})$$

$$y: \quad v_y(t) = v_{0y} - gt = v_0 \sin\theta_0 - gt$$

$$\bar{v}(t) = v_x\,\bar{u}_x + v_y\,\bar{u}_y = (v_0\cos\theta_0)\,\bar{u}_x + (v_0\sin\theta_0 - gt)\,\bar{u}_y$$

$$\bar{r}(t) = \bar{r}_0 + \int_0^t \bar{v}(t)\,dt = \qquad \bar{v}(t) = \frac{d\bar{r}}{dt} \Rightarrow \dots$$

$$= \bar{r}_0 + \int_0^t (\bar{v}_0 + \bar{g}\,t)\,dt =$$

$$= \bar{r}_0 + \bar{v}_0 t + \frac{1}{2}\bar{g}\,t^2 \qquad (\bar{r}_0 = 0)$$

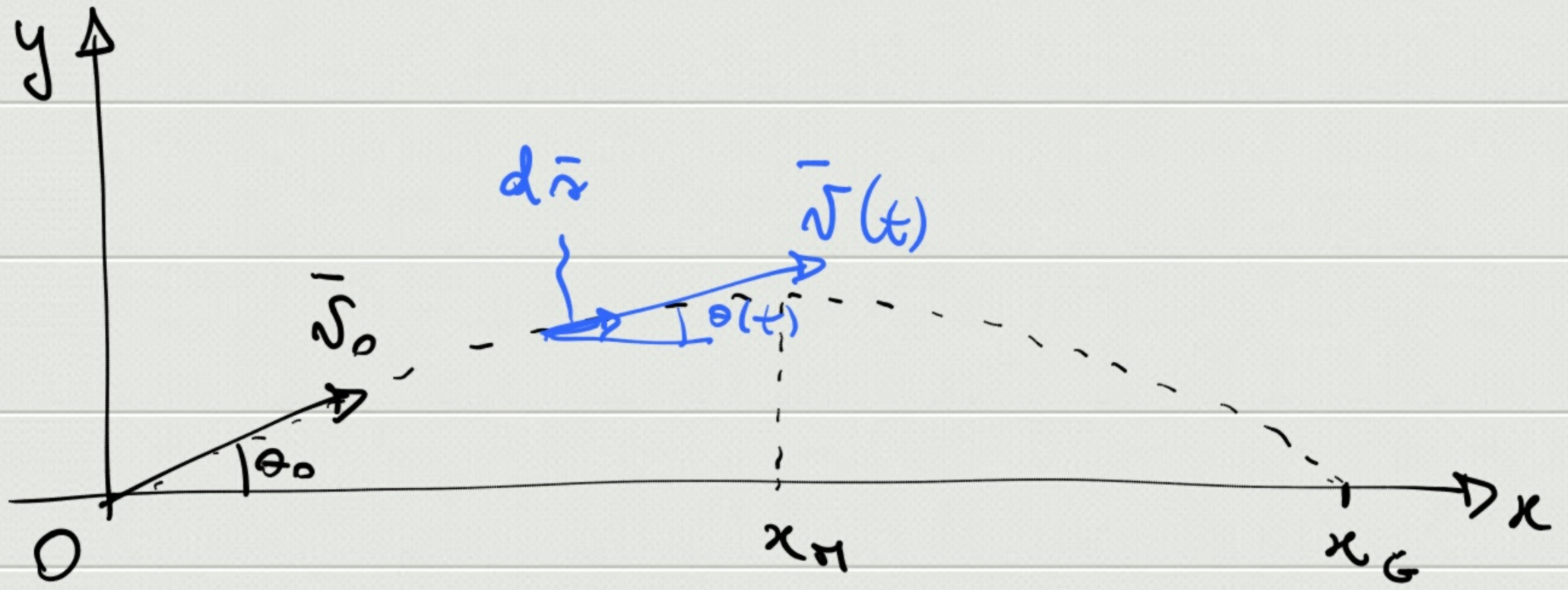
$$\begin{cases} x(t) = v_0\cos\theta_0 \cdot t \\ y(t) = v_0\sin\theta_0 \cdot t - \frac{1}{2}gt^2 \end{cases}$$

$$\bar{r}(t) = (v_0 \cos\theta_0 \cdot t)\,\bar{\imath} + \left(v_0 \sin\theta_0 \cdot t - \frac{1}{2} g t^2\right)\bar{\jmath}$$

$$x(t) \Rightarrow \quad t = \frac{x}{v_0 \cos\theta_0}$$

$$\Rightarrow y[x(t)] = y(x) = \cancel{v_0 \sin\theta_0} \frac{x}{\cancel{v_0 \cos\theta_0}} - \frac{1}{2} g \frac{x^2}{v_0^2 \cos^2\theta_0} =$$

$$y = \operatorname{tg}\theta_0 \cdot x - \frac{g}{2 v_0^2 \cos^2\theta_0} x^2$$




$$\operatorname{tg}(\vartheta) = \frac{dy}{dx} = \operatorname{tg}\theta_0 - \frac{g}{v_0^2 \cos^2\theta_0} x$$

$$x_M: \ \frac{dy}{dx} = 0 \Rightarrow x_M = \operatorname{tg}\theta_0 \frac{v_0^2 \cos^2\theta_0}{g} = \frac{v_0^2}{g} \sin\theta_0 \cos\theta_0$$

$$t_M: \ x_M = x(t_M) \Rightarrow \cancel{v_0 \cos\theta_0} \cdot t_M = \frac{v_0^2}{g} \sin\theta_0 \cancel{\cos\theta_0}$$

$$t_H = \frac{v_0}{g}\sin\theta_0$$

$$y_H = y(t_H) = v_0\sin\theta_0 \cdot \frac{v_0}{g}\sin\theta_0 - \frac{1}{2}g\,\frac{v_0^2}{g^2}\sin^2\theta_0 =$$

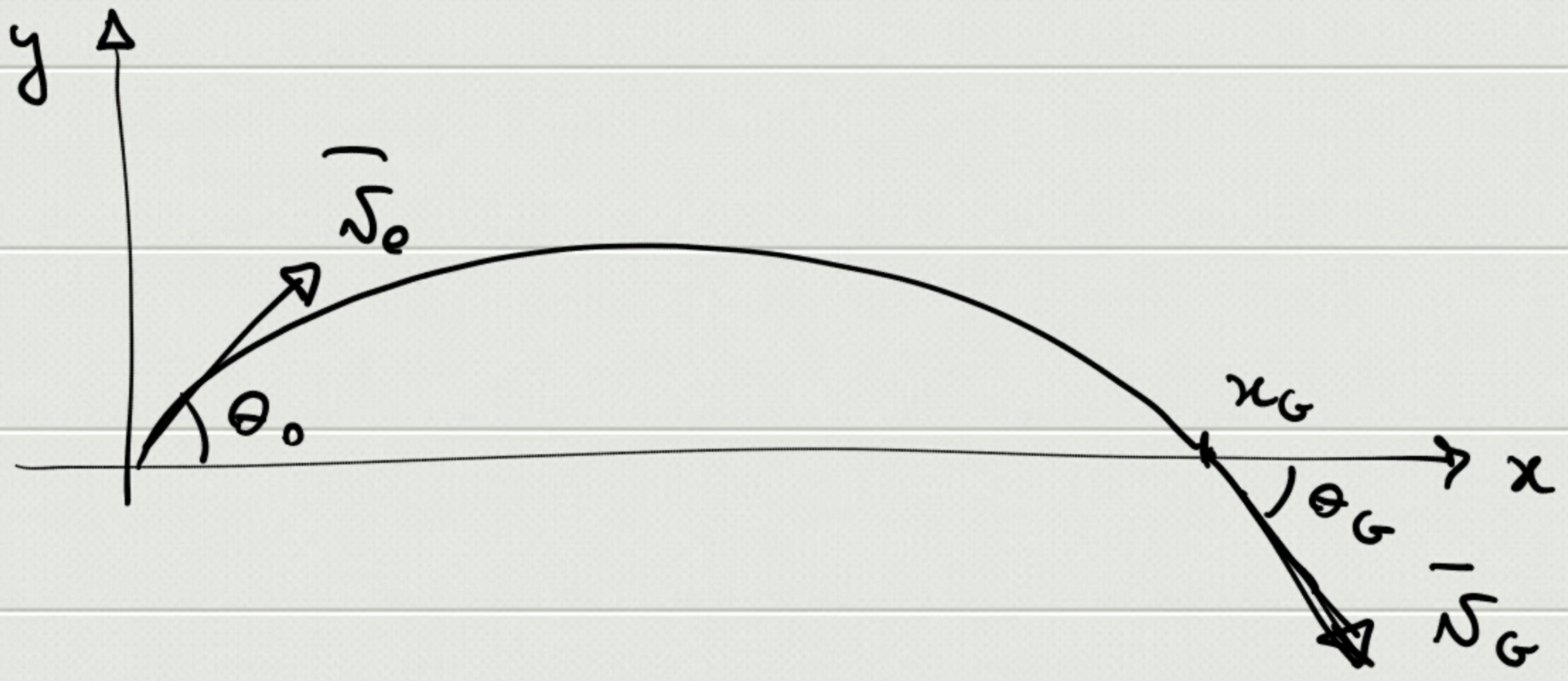
$$= \frac{1}{2}\,\frac{v_0^2}{g}\sin^2\theta_0$$

$$x_G = \frac{2v_0^2}{g}\sin\theta_0\cos\theta_0 = \frac{v_0^2}{g}\sin 2\theta_0$$

$\theta_0 : x_{G,max}$ ? $\quad \frac{dx_G}{d\theta_0} = 0 \qquad 2\cos 2\theta_0 = 0$

$$2\theta_0 = \frac{\pi}{2} \Rightarrow \boxed{\theta_0 = \frac{\pi}{4}}$$

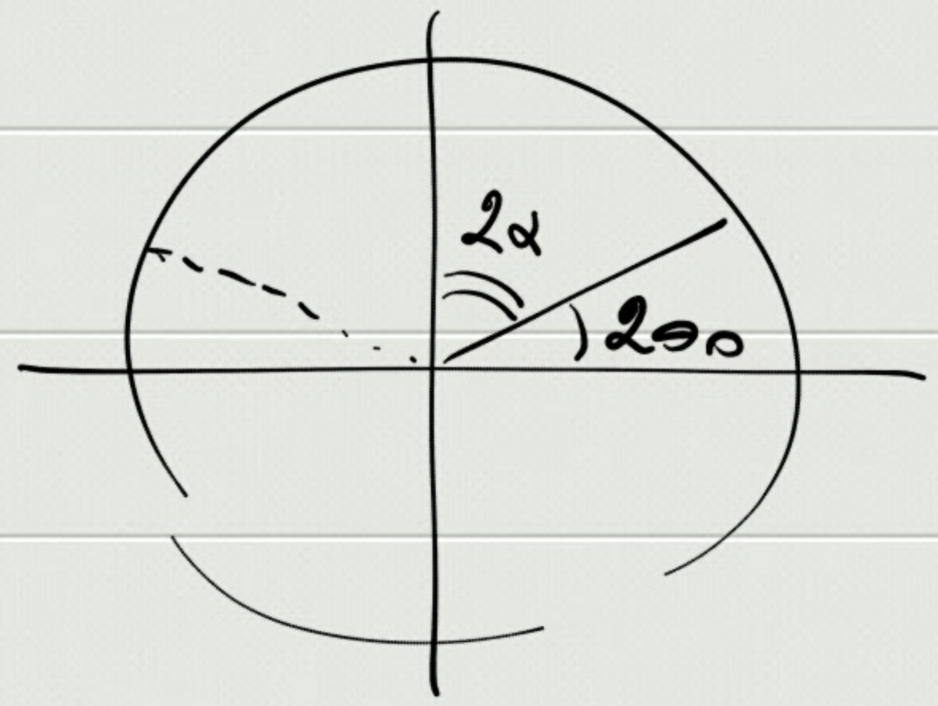
$t_G = \ldots$




$|\vec{v}_G| = |\vec{v}_0| \qquad \theta_G = -\theta_0$

$$\boxed{x_G = \frac{2}{3} l_0 \sin 2\theta_0}$$

$$0 < \theta_0 < \frac{\pi}{2}$$




$$2\theta_0 = \frac{\pi}{2} \pm 2\alpha$$

$$\Rightarrow \boxed{\theta_0 = \frac{\pi}{4} \pm \alpha}$$