$$S_0(y) = \int \frac{1}{-2m^2g}\,(-2m^2g)\sqrt{2m(\epsilon - mgy)}\,dy$$

$$= -\frac{1}{2m^2g}\left[\frac{[2m(\epsilon - mgy)]^{3/2}}{3/2} + cst\right].$$

$$S_0(y) = -\frac{1}{3m^2g}[2m(\epsilon - mgy)]^{3/2} + A$$

يثبت : $A = cst$

$$\Rightarrow S(y, \epsilon, t) = S_0(y) - Et$$

$$\boxed{S = -\frac{1}{3m^2g}[2m(\epsilon - mgy)]^{3/2} + A - Et}$$

④ المعادلات الزمنية :

$$\alpha_i = \frac{\partial S}{\partial \epsilon}$$

$$\Rightarrow \alpha = \frac{\partial S}{\partial \epsilon} = cst.$$

$$\alpha = -\frac{1}{mg}[2m(\epsilon - mgy)]^{1/2} - t$$

$$(\alpha + t) = -\frac{1}{mg}[2m(\epsilon - mgy)]^{1/2}.$$

الهدف هو ايجاد $y(t)$:

$$\Rightarrow -mg(\alpha + t) = \sqrt{2m(\epsilon - mgy)}$$

$$\Rightarrow m^2g^2(\alpha^2 + t^2 + 2\alpha t) = 2m\epsilon - 2m^2gy$$

$$\Rightarrow 2m^2gy = -m^2g^2(\alpha^2 + t^2 + 2\alpha t) + 2m\epsilon$$

$$y = -\frac{g}{2}(\alpha^2 + t^2 + 2\alpha t) + \frac{2m\epsilon}{2m^2g}.$$