

(3) إيجاد $x(t)$: نضج

$$\alpha = \frac{\partial S}{\partial E}$$

$$\alpha = \frac{\partial S}{\partial E} = \int \frac{m}{\sqrt{2m(E - \frac{1}{2}m\omega^2 x^2)}} dx - t$$

$$\Rightarrow (\alpha + t) = m \int \frac{1}{\sqrt{2mE - m\omega^2 x^2}} dx$$

$$\int \frac{1}{\sqrt{a^2 - y^2}} dy = \arcsin\left(\frac{y}{a}\right) \quad \text{علمي}$$

$$y = m\omega x \quad \text{وسم : نضج}$$

$$\Rightarrow (\alpha + t) = \frac{m}{m\omega} \int \frac{1}{\sqrt{(2mE)^2 - y^2}} dy$$

$$\Rightarrow \omega(\alpha + t) = \arcsin\left(\frac{y}{\sqrt{2mE}}\right) + B$$

حيث B هو ثابت التكامل

$$(\omega\alpha + \omega t - B) = \arcsin\left(\frac{y}{\sqrt{2mE}}\right)$$

$$\Rightarrow \sin(\omega t + \varphi) = \frac{y}{\sqrt{2mE}} \quad \Rightarrow y = \sqrt{2mE} \cdot \sin(\omega t + \varphi)$$

$$\Rightarrow x = \frac{\sqrt{2mE}}{m\omega} \sin(\omega t + \varphi)$$

$$\Rightarrow x(t) = \sqrt{\frac{2E}{m\omega^2}} \sin(\omega t + \varphi)$$

$$\Rightarrow \boxed{x(t) = A \sin(\omega t + \varphi)} \quad (6)$$

A و φ ثوابت تحدد من الشروط الابتدائية