To start, we will use the Taylor series expansions for sine and cosine:

$sin(\theta) = \theta - \frac{\theta^3}{3!} + \frac{\theta^5}{5!} - \cdots$

$cos(\theta) = 1 - \frac{\theta^2}{2!} + \frac{\theta^4}{4!} - \cdots$

We can then differentiate these series to obtain:

$sin'(\theta) = 1 - \frac{\theta^2}{2!} + \frac{\theta^4}{4!} - \cdots = cos(\theta)$

$cos'(\theta) = -\theta + \frac{\theta^3}{3!} - \frac{\theta^5}{5!} + \cdots = -sin(\theta)$

We can also use the fact that we are assuming small oscillations, i.e., that is small. We can therefore write:

$sin(\theta) \approx \theta + o(\theta^2)$

$cos(\theta) \approx 1 + o(\theta^2)$

where the notation $o(\theta^2)$ means "smaller than or equal to θ^2".

Using these Taylor series expansions and the small-o notation, we can rewrite the two given equations as:

$-(\theta - o(\theta^2))\theta' + (1 + o(\theta^2))\theta'' = (-g/l)(\theta + o(\theta^2))(1 + o(\theta^2))$

$(1 + o(\theta^2))\theta' + (\theta - o(\theta^2))\theta'' = (-g/l)(\theta + o(\theta^2))^2$

We can then simplify these equations by neglecting terms that are smaller than ^2:

$-\theta\theta' + \theta'' = (-g/l)\theta + o(\theta^2)$

$\theta' + \theta'' = (-g/l)\theta + o(\theta^2)$

Finally, we can add these two equations to eliminate θ':

$$\theta'' + (g/l)\theta = o(\theta^2)$$

Since the small-o notation means that the right-hand side is smaller than or equal to θ^2, we can neglect this term for small θ, and we obtain the simple harmonic oscillator equation:

$$\theta'' + (g/l)\theta = 0.$$