Pendulums

Q: Anyone know the oscillation frequency of a simple pendulum?

$\sqrt{g/L}$

Let's derive that two ways.

Dimensional analysis: the frequency has units $1/s$ and the only parameters are m, L & g.

How do we make s^{-1} out of

$m: kg$ $L: m$ $g: m/s^2$? Inspection says $\sqrt{g/L}$.

This is an excellent way to eliminate wrong answers & check work.

Forces: For a small θ, $\sin\theta \approx \theta$.

Trigonometry says that the component of F_T along the path $F_{T\theta} = F_T \sin\theta \simeq F_T\,\theta$,

with $F_T \simeq -F_g$. So, $F_{T\theta} \simeq -F_g\,\theta = -F_g\,s/L$.

This is a restoring force, since $F(s) \propto -s$.

Thus, using Hooke's Law: $F = -kx \Rightarrow \omega = \sqrt{k/m}$.

So, our $k = mg/L \Rightarrow$ $\omega = \sqrt{\frac{mg/L}{m}} = \sqrt{g/L}$.