Weaseling out of things is important to learn. It’s what separates us from the animals ... except the weasel.

A damped harmonic oscillator (mass $m$, spring constant $k$, damping constant $b$) is driven by a periodic rectangular force pulse. The pulses have amplitude $f$, each has a duration $\Delta \tau$, and they repeat with period $\tau$.

1. Find the Fourier series of the periodic force. [I like to use the exponential version of the series, but you can use trigonometric functions if you wish.]

2. Find the long-time response of the harmonic oscillator (i.e. the particular solution $x_p(t)$).

I’m better than dirt. Well, most kinds of dirt, not that fancy store-bought dirt... I can’t compete with that stuff.

Find the geodesics on a cone whose equation in cylindrical polar coordinates is $z = \lambda \rho$, where $\lambda$ is a constant. [Let the required curve have the form $\phi = \phi(\rho)$].

I’ve been muscled out of everything I’ve ever done, including my muscle-for-hire business.

A simple pendulum (mass $m$, length $l$) whose point of support P is attached to the edge of a wheel (center O, radius R) that is forced to rotate at a fixed angular velocity $\omega$. At $t = 0$, the point P is level with O on the right. Write down the Lagrangian and find the equation of motion for the angle $\phi$. [See Figure.]

Nacho, nacho man. I want to be a nacho man...

Find the gravitational self-energy (energy of assembly piecewise from infinity) of a sphere of mass $M$ and radius $R$.

Lisa, remember me as I am - filled with murderous rage.

Consider a pair of particles, each of mass $m$, which interact via a potential energy $U = kr^n$.

1. What does the condition $kn > 0$ tell us about the force?
2. Sketch the effective potential for $n = 2, -1, -3$.

3. Find the radius at which the particles (with fixed angular momentum $\ell$) can orbit at a fixed radius.

4. For which values of $n$ is the orbit stable?

5. For the stable case, show that the period of small oscillations about the circular orbit is 

$$\tau_{osc} = \frac{\tau_{orb}}{\sqrt{n + 2}}$$