Example Physics Problem

Let's do a simple physics problem using the Symbolic Toolbox.

A pendulum swings back and forth. If the length of the pendulum is 0.5 meters, what is the period of the pendulum's swing in seconds? Use 9.8 m/s^2 for gravity.

We solve physics problems in 3 steps:

1. Write down the equation.
2. Replace variables in the equation with real values.
3. Solve for the answer.

Write down the equation

The equation for a pendulum looks like this:

$$\text{period} = 2\pi\sqrt{\frac{l}{g}}$$

We can capture this equation in the Symbolic Toolbox

```
syms l g period
pendPer = period == 2*pi * sqrt(l / g)
```

```
pendPer =
```

$$\text{period} = 2\pi\sqrt{\frac{l}{g}}$$

Now we substitute the values for the variables.

Substitute Numbers

We now substitute the values from the problem into the formula.

$$\text{period} = 2\pi\sqrt{\frac{0.5m}{9.8\,\frac{m}{s^2}}}$$

period = 1.42s

Now we can get the same answer using MATLAB

```
u = symunit;
answer = solve(pendPer, l == .5 * u.m, g == 9.8 * (u.m/(u.s^2)))
```

```
answer = struct with fields:
         g: (49/5)*([m]/[s]^2)
         l: (1/2)*[m]
    period: 2*pi*((5/98)*[s]^2)^(1/2)
```

The Symbolic ToolBox gives us the equation for the period with the numbers plugged in. Now we convert this result to a real-world *variable precision arithmetic* number using `vpa() and simplify() to get a final number.`

`The vpa() solution coverts most of the equations to numbers, but does not take the square root, so we still have an equation.`

```
vpa(answer.period,2)
```

ans = $6.3\sqrt{0.051\mathrm{s}^2}$

By itself, `simplify()` creates a simpler equation, but does not provide numbers.

```
simplify(answer.period)
```

ans =

$$\frac{\pi\sqrt{10}}{7}\,\mathrm{s}$$

So we can combine `vpa()` and `simplify()` to get the final answer.

```
result = vpa(simplify(answer.period),2)
```

result = $1.4\mathrm{s}$

And we have our answer. 1.4s