Foreword/premise

The first four exercise sets I completed for QEA were works of art. Beautifully typeset with Mathematica, I tried to find a way to make every problem interesting, even those I (honestly) didn't have much to learn from. Viewed one way, that approach is a great way to challenge myself. Viewed another, it is simply an experiment to see how *long* I can possibly spend working on this set of problems without falling over from boredom. Those experiments were quite successful, so it seems only fair to run the obvious mirror experiment now. My personal learning goal for this problem set is therefore:

"How little time can I spend working on this problem set without falling over from unsatisfied perfectionism?"

This mentality lasted until about problem ~6, at which point the available time was extended and I switched back to my normal mode. Experiment failed.

Statics

1. Cables

(a)

Something like $\sqrt{2}/2 * W_{block}$

(b)

Wider mounts = more tension

(c)

Strain gauge, pressure sensor in cylinder, ruler (cable stretches)

Actually downloading a datasheet is boring. Sorry, it's for the experiment.

2. hanging mass

$$\mu_k >= m_2 / m_1$$

3. cable mass

IF $6{\mu_s}^2+\mu_s>1$ ...

$\frac{1}{2}\sqrt{5}gm(cm)$ (tipping)

OTHERWISE

$\frac{5\sqrt{5}mg\mu_s}{2(2\mu_s+1)}(cm)$

4. block on ramp

(a)

$$\mu_{1s}>=tan(\theta)$$

$$\mu_{2s}\in R$$

(b)

Straight up, somewhere to the left of the center of the ramp, between the centroid of the triangle and the center of the block.

Its magnitude is $g(m_1+m_2)$

(c)

The force on the wedge from the ground has horizontal component $g\mu_{k1}\mathrm{m}_1\sin(\theta)\cos(\theta)+g\mathrm{m}_1\cos^2(\theta)+g\mathrm{m}_2$ and vertical component $g\mu_{k1}\mathrm{m}_1\cos^2(\theta)-g\mathrm{m}_1\sin(\theta)\cos(\theta)$. It is located slightly to the left of where it was before the block started sliding. I know how to calculate the position (solve the moment equation around the tip of the ramp) and actually working that out isn't worth my time.

5. Springs

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In[18]:= l0 = Sqrt[1.5 m ^2 + 2 m ^2]
         l = Sqrt[2 m ^2 + (1.5 m + d) ^2]
Out[18]= 2.5 m
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$$\text{Out[19]=}\ \sqrt{(d + 1.5\,\text{m})^2 + 4\,\text{m}^2}$$

```
In[23]:= F = k (l - l0);
         Fy = F (1.5 m + d) / l;

In[22]:= Fy /. d -> 2 m

Out[22]= k (1.32939 m)
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$k\times(1.32939m)$ where *k* is the spring constant

Assumptions: massless bar

6. Wing

(a)

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In[58]:= Fg = {0, -1600, 0} N;

         Rg  = {Sqrt[17] / 2, 0, 0} m;

         Flift = {0, 50 Sqrt[17] Pi, 0} N;

         Rlift = {4 Sqrt[17] / (3 Pi), 0, 0} m;

In[62]:= N @
          Solve[{Flift + Fg + {0, Freact, 0} == 0,
            {0, 0, Treact} + Rg × Fg + Rlift × Flift == 0}, {Freact, Treact}]

Out[62]= {{Freact → 952.344 N , Treact → 2165.15 J }}
```