Introductory mathematics for Kf & Kb, 2000.

Project 1 - matematical modelling

1. Seek formulas for the stress, that is the reaction force y, in a (stretched) rubber band as a function of its a) length l, b) strain x. Plot $y(l)$ and $y(x)$.

2. Build using a straw, a rubber band, and a paper-clip, a tool for measuring force.

3. Consider a rubber band fixed at its two endpoints and a) somewhat stretched b) straight but unstrained. Seek the relation between the force y and corresponding displacement x as in figure 1. First discuss what should be the principle behaviour of the stress-displacement relation. Then seek a plausible matematical model/formula for $y(x)$ using your force measureing tool and/or geometry and matematical analysis. The fact that $\sqrt{1+\epsilon} \approx 1+\frac{\epsilon}{2}$ for small ϵ may be useful here.

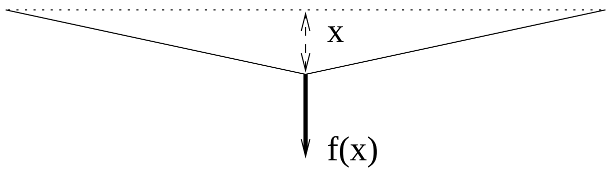

Figure 1:

4. Consider a mechanical system as in figure 2 with two bars connected at a joint supported by a rubber band. Find the reaction force y in the rubber band as a function of a displacement x as indicated. Again, first discuss what should be the principal behaviour of the stress-displacement relation, then seek a reasonable model/formula for it.

5. Seek the principles and possible realizations of an "optimal catapult" (sling-shot) design. Take into account that the force you can provide to charge the catapult is limited and has a limited range (limited finger/arm capacity and armlength).

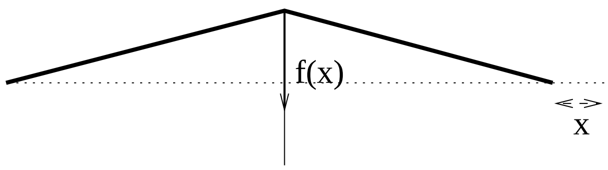

Figure 2: