Order-of-Magnitude Physics – Problem Set 9

Problem 1. Walk the Plank

"Yo ho, yo ho, the frisky Plank!
You walks along it so,
Till it goes down, and you goes down
To Davy Jones below,"

says Captain Hook to the captive children as he forces them to walk the pirate's plank.

Estimate the minimum thickness that the plank must have not to snap under a child's weight.

Problem 2. Jumping

(a) Estimate the world record for the running long jump.

(b) Estimate the world record for the standing broad jump.

Problem 3. Earth Song

There is a giant tuning fork in the traffic median between Shattuck Avenue and Center Street.[1] Estimate its natural frequency using order-of-magnitude structural physics.

Problem 4. Planet Formation

Consider two identical spheres of silicate having radius s, elastic modulus M, density ρ, and surface tension γ. Solids have surface tension, too, because there are unsaturated bonds on the surface looking for partners to bind with. Laboratory measurements give a surface tension for silicate similar to that of water. The spheres collide with speed v.

Use energy considerations to derive an approximate formula for the critical speed v_{crit} below which the spheres stick and above which they bounce. Evaluate your formula for $s = 1\mu\text{m}$, $s = 1\,\text{cm}$, and $s = 1\,\text{m}$ and thereby develop a sense for how far particle-particle sticking by chemical bonds can take you down the road to planet formation.

Problem 5. Ask Your Own Question

Ask an OOM question of your own. You don't have to answer it.

[1] It took me a few years after moving to Berkeley to even notice it.