Example Real World Problems for SCALE-UP

Some involve student interests:

1. You are at a Durham Bulls baseball game, waiting for another home run by the Bulls so you can see the giant "bull board" flash its red eyes, blow smoke through its nose, and swing its tail. You have been watching the digital display that shows the speed of each pitch as measured by the radar gun behind the catcher. That gets you wondering how fast the ball travels off the bat when one of the players hits a home run over the 8-foot outfield wall. You notice the distance markers at the end of the left, center, and right-field lines: respectively 305, 326, and 400. With this information, you realize that you can use the physics you have learned to answer your own question.

Some relate to technical jobs:

2. You have a job with a semiconductor processing lab that uses MBE (molecular beam epitaxy) to make transistors and other multi-layer electronic devices. A quartz crystal oscillator is used to measure the thickness of a thin film being deposited on a sample in the vacuum chamber. The crystal monitor is vibrated by a frequency generator and operates essentially like a mass on a spring so that the 6 MHz characteristic resonant frequency of the crystal is reduced as more material is deposited on its surface, which is exposed to the same conditions as the sample. The crystal has an exposed diameter of about 1 cm and a mass of about 0.1 g. The digital display for the instrument shows 4 digits. What is the resolution (smallest change in thickness) of this instrument? (Hint: How does a change in mass correspond to a change in the frequency of oscillation?)

Some are just fun:

3. You are a technical advisor to the David Letterman Show. Your task is to design a circus stunt in which Super Dave Osbourne, who weighs 170 pounds, is shot out of a cannon that is elevated 40 degrees from the horizontal. The "cannon" is actually a 3-foot diameter tube that uses a stiff spring and a puff of smoke rather than an explosive to launch Super Dave. According to the manufacturer, the spring constant of the cannon is 1800 N/m. A motor compresses the spring until its free end is level with the bottom of the cannon tube, which is 5 feet above the ground. A small seat is attached to the free end of the spring for Super Dave to sit on. When the spring is re- leased, it extends 9 feet up the tube. The seat does not touch the sides of the 12-foot long tube. After a drum roll, the spring is released and Super Dave will fly through the air amidst sound effects and smoke. There is a giant airbag 3-feet thick and 10 feet in diameter for Super Dave to land on. Where should this airbag be placed for a safe landing?

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