Trevor Fox – DIY Mass Spectrometer Assignment

1. The most important pieces of the makeshift mass spectrometer are the copper piping, rubber stoppers, sewing needles, copper tape, razor blades, and a tungsten filament. To get the best vacuum possible, a basic vacuum pump to pull a low but not perfect vacuum, then a turbomolecular pump to pull the rest of the air out. For the signal acquisition and processing, a copper cup was hooked up to a pre-amplifier integrated chip, powered by two 9V batteries. This then output to a low pass filter and oscilloscope for reading the output. Last, two power supplied are needed to run the instrument - one DC and one AC. This is for constant power that is slightly frequency modulated by the AC output.
2. To provide a pass-through for conduction without compromising the vacuum seal required for the system to run. The sewing needles provide the electrical interface between the power source and the tungsten filament, and also between the copper cup detector and the pre-amplifier circuit.
3. The vacuum system is required to remove the chance that the ionized analyte will not collide with a gas molecule during its flight. Collisions would render the instrument useless, as nothing would be detected!
4. The ion source is responsible for producing electrons with high enough energy to ionize your analyte. In a conventional, rich-man’s mass spectrometer, this would be an electron beam! For this one, it was a tungsten wire with analyte deposited on it, to ensure that any high energy electrons emitted by the filament would be able to ionize a molecule.
5. The main problem with the setup is the throughput. After a run, which only lasts for 10 minutes of signal acquisition, the entire system must cool down and equilibrate, be loaded, and brought back up to temperature and vacuum. This process takes much too long. Another problem is that the spray of ionized sample molecules is not directed by any means, meaning that the inside of the sample chamber gets coated with salt that is not being directed down the instrument - drastically reducing the output signal.
6. It works, as in it is able to get a signal for potassium. It doesn’t work, as in it is probably systematically inaccurate in its readings. I believe that, with some severe brainstorming, the problem can be found and rectified!