Chemical Demos
October 10, 2012

Two Chemical Demos

(From David K. Campbell, UK16. From Irving Epstein)

I. Briggs-Rauscher reaction (whole solution oscillates through blue-yellow-colorless sequence)

Make three solutions:

A. 0.1 M KI03 (potassium iodate)

B. 3.2 M H202 (hydrogen peroxide) - you'll need to start from the 30 % solution - most stuff is too dilute (3% or 10%)
0.17 M HC104 (perchloric acid)

C. 0.15 M malonic acid (CH2 (C00H)2)
0.024 M MnS04 (manganous sulfate)
10 grams/liter soluble starch - best thing is to dissolve the starch first in boiling or very hot water, then add the other stuff after it cools. The malonic acid will decompose if it gets too hot.

Mix equal volumes of A, B, and C, then stir. This one is quite robust. Fairly immune to minor errors in making up the solutions or in measuring out amounts. Try making about 500 m1 or each solution and mixing 25-50 m1 of each for practice runs. Probably a good idea to do it in an Erlenmeyer flask.. and put a cork or stopper in, because the iodine fumes that may evolve will stain your clothes and possible your insides.

11. Belousov-Zhabotinskii reaction (red-blue target patterns)

Four solutions are required:

A. 0.6 M NaBr03 (sodium bromate)
0.6 M H2S04 (sulfuric acid) ferrous phenanthroline sulfate

B. 0.48 M malonic acid

C. 1 gram NaBr (sodium bromide) per 10 m1 of water

D. 0.025 M ferroin (ferrous phenanthroline - a redox indicator - make sure it's not the chloride - sulfate is OK.
You may have trouble getting all the ferroin to dissolve. If so, just filter out the junk and use a little extra of D when you mix them - some trial and error may be

required here.)

Mix 14 m1 of A with 7 m1 of B and 2m1 of C in a covered flask
(a 25 m1 Erlenmeyer is good) and stir until all the orange color disappears from the solution and from the gas above it. Then add 1 m1 of D (or a bit more - see above) and stir again until the solution is a homogeneous red. Don't worry if it goes through one or two blue bulk oscillations along the way. You should have enough solution to cover the bottoms of two standard petri dishes with a thin layer. Pour the mixture into the petri dishes and watch for blue dots to appear, then grow into concentric cirlces. If the pattern is fuzzy or gets wiped out by homogeneous red-blue oscillations, try swirling the dish. The patterns should start again. This one is a little bit less dependable than the Briggs-Rauscher and requires a bit more practice. It's also somewhat sensitive to temperature and dust particles (they serve as nucleation sites for the patterns).

For a recent survey of the theory plus other possible demos
See The Journal of Chemical Education, vol. 66 #3 (March, 1989)

11.

Pulsating Mercury Demo (From TIm Sullivan)

My Chem friend has yet to do the B-Z reaction, but we did get together on what is called the mercury beating heart demo. You cover a blob of mercury on a watch glass with dilute sulfuric acid and K_2Cr_2O_7. The chemistry robs the mercury of electrons and causes the surface tension to diminish flattening the mercury slightly. If you then place an iron nail such that the flattened mercury contacts it, it will replenish the electrons to the mercury causing the mercury to contract, giving rise to oscillations. Nothing particularly nonlinear, but it looks neat, oscillating about 1 Hz, either in radial motion, or as a triangular shape whose lobes change direction by 60 degrees in each oscillation period.

A reference for the mercury beating heart is: David Avner, J. Chem Edu. 66, 211 (1989). Its apparently pretty well known among the chemists as
judged by the response I got from the USENET when I asked about it.

Will be in touch,

Tim