**‘Seven Beakers’ Demonstration and Instructions**

**SEVEN BEAKERS**

This needs to be set up **before** the pupils see it. DON’T MIX THE BEAKERS/CHEMICALS UP. Be aware what you’re doing with the droppers. Keep everything clean and tidy. The demo needs eight 600ml beakers:

The small beaker is empty.

1: 20 drops 2 M NaOH solution

2. 15 drops phenolphthalein

3. 13 drops 37% H2SO4

4. spatula tip of KMnO4 solid (a tiny amount into a DRY beaker or they’ll spot it!)

5. 40 drops acidified iron(II) sulphate heptahydrate (47.55 g in 100ml water. Add 8ml conc. H2SO4)

6. 15 drops 10% potassium thiocyanate solution

7. 10 drops 2% potassium hexacyanoferrate(III)

Make sure they all *appear* empty. Have them standing ready on a bench top.

To start the demonstration, fill the empty beaker with 500ml of water from a tap. Don’t prepare this in advance; do it while they watch (so they know it’s only water). Tell them to memorise (or note down) their observations. Pour the water into beaker 1 (no colour change). Pour the contents of beaker 1 into beaker 2 (turns bright pink). Then pour beaker 2 into beaker 3 (turns colourless). Then into beaker 4 (goes purple). Then into beaker 5 (goes colourless/pale yellow). Then into beaker 6 (goes orange). Then into beaker 7 (goes green/blue). After it’s done, ask them to explain. You will have to help a lot!. They may not know many of the chemicals, but they’ll be familiar with ‘indicators’ (if not with phenolphthalein. But it’s fun to teach them how to say it). They may have met potassium permanganate before. Or not!

**Explanation**:

**Beaker 1**: NaOH – so colourless.

**Beaker 2**: phenolphthalein – so in alkali it goes pink

**Beaker 3**: neutralisation of NaOH with H2SO4, so phenolphthalein indicator goes back to colourless

**Beaker 4:** dissolving purple KMnO4­ in neutral solution – MnO42- ions are intense purple in solution

**Beaker 5**: Redox Reaction: MnO4- + 8H+ + 5Fe2+ 🡪 Mn2+ + 5Fe3+ + 4H2O.

Some may not be familiar with this chemistry but should vaguely understand ‘the permanganate is reduced to manganese(II) ions, and they’re almost colourless in solution.’ Actually they’re pale pink! They’re reduced *by* iron(II) ions, which are oxidised to iron(III) ions (pale yellow at this concentration). This explanation may be beyond most of them unless they’ve done some transition metal chemistry at A2 level..

**Beaker 6**: thiocyanate ions complex with the iron(III) ions produced in the last reaction.

[Fe(H2O)6]3+ + SCN- 🡪 [Fe(H2O)5SCN]2+ + H2O

This gives a blood red/orange complex of iron thiocyanate. The idea of transition metal complex ions is only encountered at sixth form level, but just tell them that this stuff, when very concentrated, looks like blood and can be used as fake blood in ‘dracula’ capsules in the theatre (it really can) and they’ll be happy!

**Beaker 7**: formation of Prussian blue – a pigment used in paint. Turquoise colour. Can be used to ‘blueprint’. Formula is a mixed oxidation state complex of iron(II) and iron(III): Fe4[Fe(CN)6]3

