

Traffic Lights

Introduction

This is a variation on the *Blue Bottle experiment* which featured in Bulletins 204 [1] and 210 [2]. Here the methylene blue is replaced by indigo carmen.

What you will need

Chemicals

sodium hydroxide solution, 250 cm³ of 0.5M (corrosive)
glucose powder, 7.5 g
indigo carmine indicator, 5 cm³ (made up by dissolving 0.1 g of the powder in 100 cm³ of distilled water)

Equipment

flask, conical, 500 cm³ + stopper (or large bottle)

Preparing the solution

1. Place the sodium hydroxide, the glucose and the 10 cm³ of the indigo carmine dye in the conical flask or bottle and **stopper it tightly**.
2. Shake the mixture to dissolve the glucose. It will go green.
3. Allow the mixture to stand until it turns yellow, passing through an intermediate stage in which the solution is a red/ orange colour.

References

1. <http://www.sserc.org.uk/members/SafetyNet/bulls/204/chemistry.htm#Magic%20Bottle>
2. <http://www.sserc.org.uk/members/SafetyNet/bulls/210/chemistry.htm>

The Demonstration

Shake the flask gently. The solution will turn from yellow to red/orange. Now shake the flask vigorously (hold in the stopper) and see the solution turn green (Figure 2).

Allow the flask to stand and the contents will turn red/orange and then yellow again.

This process can be repeated a number of times before the colour changes slow down. This slowing down is caused by the glucose being consumed. The reaction can be refreshed by the addition of more glucose powder.

The Reaction

Indigo carmine undergoes a reversible reaction:

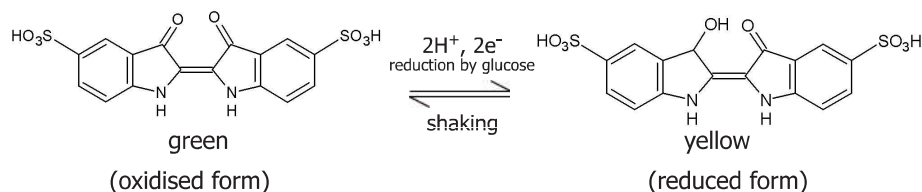


Figure 1 - Reversible reaction

Shaking the flask brings more oxygen into the solution, provoking the formation of the oxidised (green) form. This indigo carmine will slowly be reduced by the glucose to its yellow form. The intermediate colour is due to the formation of a red semiquinone intermediate.

Chemical	Main Hazard	Control Measures
Sodium hydroxide	Corrosive	Wear gloves and indirect vent goggles
Indigo carmine	Harmful if inhaled or absorbed through the skin.	Avoid raising dust and wear gloves and goggles while preparing the solution
Hold the stoppers in when you shake the flasks during preparation or demonstration.		

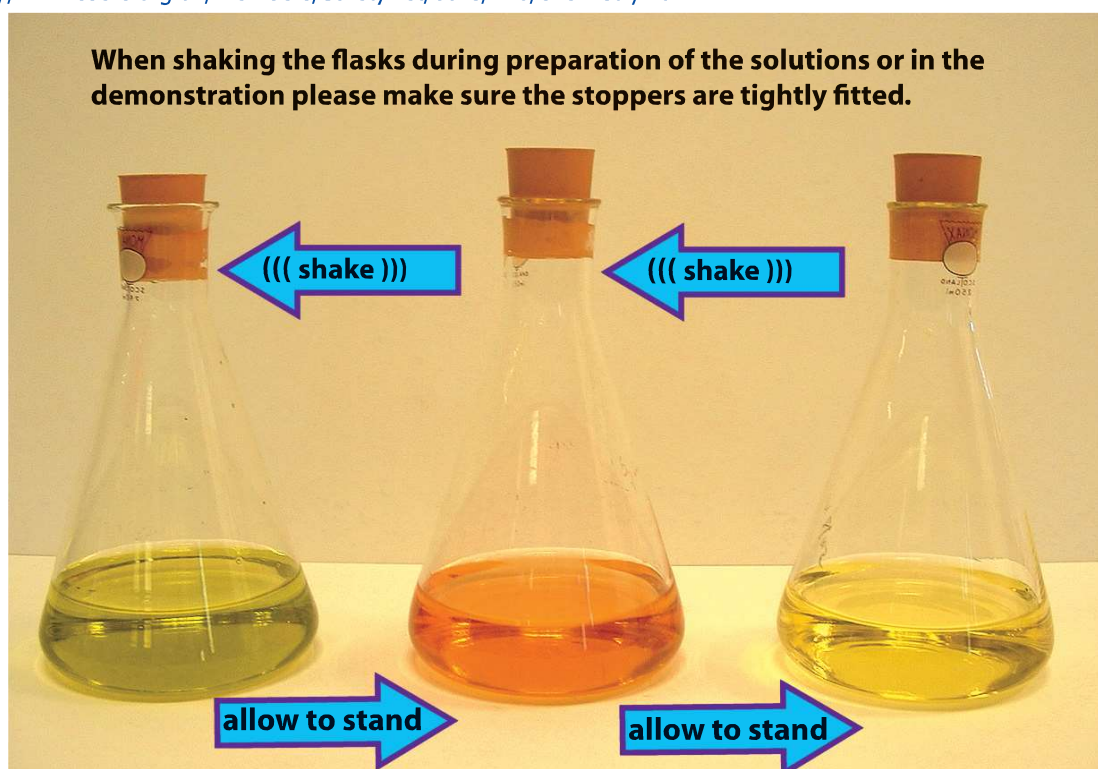


Figure 1 - Colour changes as indicator solution is shaken then allowed to stand.