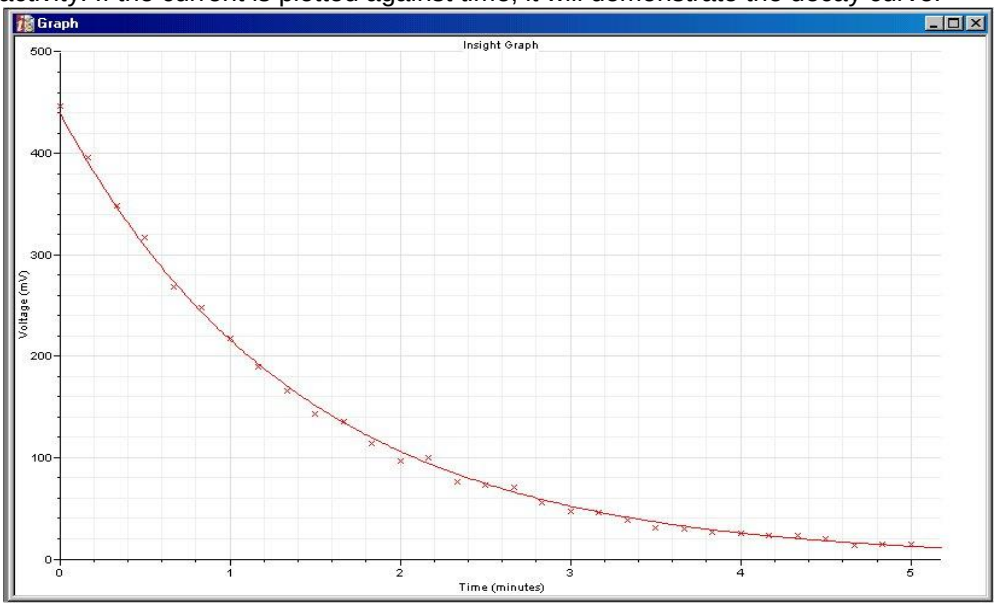
COOKNELL ELECTRONICS LTD

Using a few gas mantles to demonstrate half-life.

The national curriculum double science key stage 4 programme of study includes radioactivity and the meaning of the term half-life. The concept of half-life is also required in most A2 level physics courses, including its determination from a decay curve.

The CP3-IC is a development by Cooknell Electronics Ltd, of a prototype ionisation chamber built by Ralph Whitcher to investigate the use of thoriated gas mantles for demonstrating and measuring the half-life of radon-220 in school science. Some brands of gas mantle use a small quantity of thorium oxide because when hot it is incandescent and gives a brilliant white light. Although thorium is radioactive, it has a low radiological risk because of its relatively low specific activity.

If a few gas mantles are put into a bottle, a small quantity of radon-220 will collect in it, reaching equilibrium - as much decays as escapes from the gas mantles. If the radon gas is puffed into an ionisation chamber, the air will be ionised and a very small current will flow. The current will be proportional to the radon-220 activity. If the current is plotted against time, it will demonstrate the decay curve.



For A2 level physics, the half-life can be determined from the equation of the best fit exponential curve (eg from Logotron Insight trial fit, or Microsoft Excel spreadsheet trendline). Choose an equation of the form $y=ae^{-bx}$. From the value of b the half-life is calculated from 0.693/b. Alternatively, a graph of LogI against time can be plotted, and a straight line of best fit drawn through the points. The half-life is -0.693/gradient.

The apparatus allows the benefit of direct demonstration and measurement of the half-life of a radioactive material, and at negligible risk in normal use.

In the unlikely case that the apparatus failed and released dust and radon 220, the effective dose amounts to no more than approximately 120 µSv Put another way, should the equipment fail, it is about the difference in average exposure from naturally occurring radiation between a week in Sussex and a week in Cornwall.