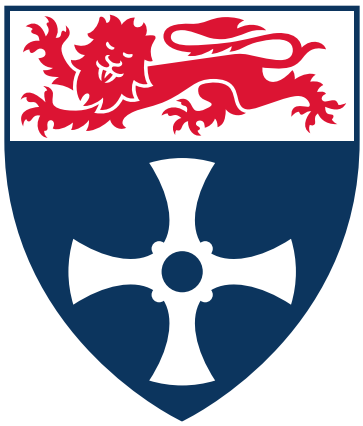
Newcastle University

School of Maths, Stats, and Physics



Cloud Chambers

Worksheet

Task 1

Question 1

Watch carefully for the trails of cloud left by the alpha particles. You should see that they are fairly short, around 5 cm long. Why do they stop?

Question 2

The number of radioactive nuclei remaining in a sample decreases exponentially. If we know the initial number of atoms N_0, we can work out the number remaining after a given time t using the equation

$$N(t) = N_0 e^{-\lambda t},$$

where λ is the **decay constant**. This is related to the **half life** $t_{\frac{1}{2}}$ (the time it takes for the number of particles to halve) by the equation

$$\lambda = \frac{\ln(2)}{t_{\frac{1}{2}}}.$$

We can define the **activity** as the number of particles decaying per second, or the rate of change of the number of particles. This is given by

$$A = -\frac{dN}{dt} = \lambda N.$$

Watch your cloud chamber for 10 seconds, and count the number of trails you see in this time. Repeat this three times, and fill in the table below:

Time (s)	Number of Trails

Average: _____

What is the activity of the source? $A =$ _____ s^{-1}

Question 3

The half-life of Americium-241 is $432.2\,\mathrm{yr}$. How many atoms of Americium-241 are there in your source?

$N =$ _____

The atomic mass of Americium-241 is $241.057\,\mathrm{u}$. What is the mass of your source? (you may use $1\,\mathrm{u} = 1.66 \times 10^{-27}\,\mathrm{kg}$, $N_A = 6.02 \times 10^{23}\,\mathrm{mol}^{-1}$)

$m =$ ____ g