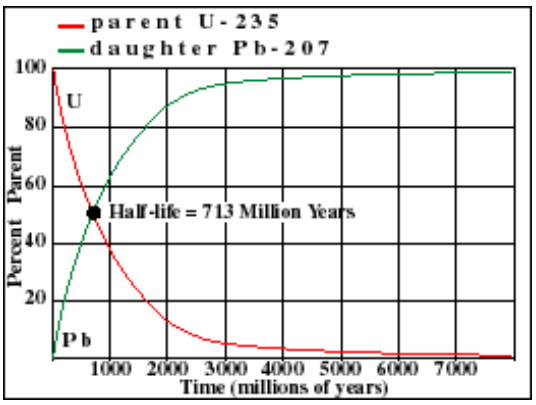
Rutherford, radioactive atoms and mathematics

Ernest Rutherford showed that some atoms did decay into other types of atoms. He measured how long it took to decay and developed the term **half life** i.e. the time it takes for half of the radioactive sample to decay. The diagram below shows that when uranium (U) 235 decays, lead (Pb) 207 is formed.



Question 1 Complete the following table for U-235

Half life number	1	2	3	4
Millions of years	713		2139	
Amount of U-235 left	One half	One quarter		

Question 2 Complete the table showing fractions, percentages and decimals

Amount of U-235 left	One half		One eighth	
Fraction		1/4		
Percentage	50%			6.25%
Decimal			0.125	

Question 3 Complete the following table for U-238 and Pb-207

Half life number	1	2	3	4
Amount of U-235 in sample	0.5		0.125	
Amount of Pb-207 in sample	0.5	0.75		

Question 4 Numbers of atoms

If a radioactive sample of 4000 atoms has a half life of 100 years how many atoms will be left after

a) 100 years
b) 200 years
c) 300 years
d) 400 years
e) 500 years

Question 5 Extension questions

a) At the start there were 6000 atoms. Four hours later there are 1500 atoms left. What is the half life?
b) If half of a radioactive sample of atoms is left after 3 hours, what fraction will be left after 9 hours?
c) The half life of a sample of radioactive atoms has a half life of 5 days. If 200 atoms are left after 20 days, how many atoms were there to begin with?
d) If 75% of a sample of radioactivity has decayed in 12 minutes, what is the half life?

Finally, a slightly random cartoon to figure out:

Answers for Rutherford, radioactive atoms and mathematics

Question 1 Complete the following table for U-235

Half life number	1	2	3	4
Millions of years	713	**1426**	2139	**2852**
Amount of U-235 left	One half	One quarter	**One eighth**	**One sixteenth**

Question 2 Complete the table showing fractions, percentages and decimals

Amount of U-235 left	One half	**One quarter**	One eighth	**One sixteenth**
Fraction	**1/2**	1/4	**1/8**	**1/16**
Percentage	50%	**25%**	12.5%	6.25%
Decimal	**0.5**	**0.25**	0.125	**0.0625**

Question 3 Complete the following table for Pb-207

Half life number	1	2	3	4
Amount of U-235 in sample	0.5	**0.25**	0.125	**0.0625**
Amount of Pb-207 in sample	0.5	0.75	**0.875**	**0.9375**

Question 4 Numbers of atoms

If a radioactive sample of 4000 atoms has a half life of 100 years how many atoms will be left after

a) 100 years **2000**
b) 200 years **1000**
c) 300 years **500**
d) 400 years **250**
e) 500 years **125**

Question 5 Extension questions

a) At the start there were 6000 atoms. Four hours later there are 1500 atoms left. What is the half life? **2 hours**
b) If half of a radioactive sample of atoms is left after 3 hours, what fraction will be left after 9 hours? **1/8**
c) The half life of a sample of radioactive atoms has a half life of 5 days. If 200 atoms are left after 20 days, how many atoms were there to begin with? **3200**
d) If 75% of a sample of radioactivity has decayed in 12 minutes, what is the half life? **6 minutes**