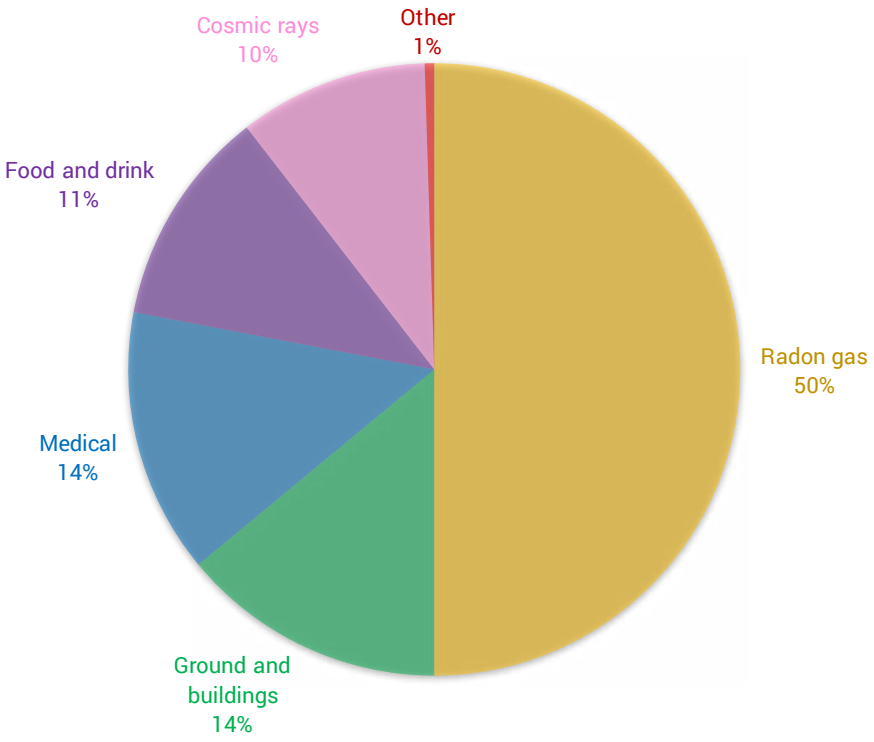
0 1

The below pie chart shows the contribution to the total background radiation dose which the average person in the UK receives from a number of different sources.



0 1 . 1

Explain the meaning of the term background radiation.

Radiation which is always present in our environment [1] to which we are constantly exposed [1] such as that from radon gas, ground and buildings, medical procedures, food and drink, and cosmic radiation [1]. (Any TWO)

0 1 . 2

As shown, radon gas is the single largest contributor to the background radiation dose which the average person in the UK receives. Explain the origin of radon gas.

Radon gas is released by (the decay of radioactive nuclei which are naturally present in) certain types of rock [1].

0 1 . 3

Radon decays by alpha emission. Explain why radon gas is harmless outside the body, but can be quite dangerous when inhaled.

Alpha particles are very weakly-penetrating. They can be absorbed by a piece of paper, and so outside the body, would be unable to penetrate the skin [1]. When radon gas is breathed into the lungs however, the alpha particles it emits can do a lot of damage, because alpha particles are very strongly-ionising (and so deposit a lot of energy in cells within the lungs) [1].

0 1 . 4

Roughly 1% of the background radiation dose which the average person receives comes from 'Other' sources. Suggest what one of these sources might be.

Dose which we receive from the fallout of historical nuclear weapons tests and nuclear accidents, dose from the radioactive waste which is disposed of my a normally-functioning nuclear reactor etc [1].

0 2

In an A-level Physics class, Bilal is investigating the decay of a gamma source using a Geiger-Muller tube which has been connected to a ratemeter. He obtains the below data.

Time (minutes)	0	30	60	90	120
Count rate (counts per second)	104	75	54	39	29

When he places the source back into a lead box and hands it back to his teacher (who then stores it safely in another room), he notices that the count rate is still 4 per second.

0 2 . 1

Explain why the reading on the ratemeter was still 4 per second after the source was removed.

These counts were due to background radiation.

0 2 . 2

Why did Bilal place the source into a lead box when he had finished taking measurements?

Because gamma rays are absorbed / attenuated by lead OR to minimise the dose which he and anyone else present received. [1].

0 2 . 3

Calculate the half-life of the source used.
Show all your working clearly in the space below.

Corrected count rate = Count rate – background count rate
Corrected count rate = Count rate – 4

New table or calculations as below.

Time (minutes)	0	30	60	90	120
Corrected count rate (counts per second)	100	71	50	35	25

Time taken for *corrected* count rate to fall from 100 to 50 = 60 minutes
Time taken for *corrected* count rate to fall from 50 to 25 = 60 minutes

Hence, half-life = **60 minutes**.