7 **(a)** State the number of protons, neutrons of a single nuclide whose symbol is

$$^{12}_{6}C$$

number of neutrons = …….

number of protons = …….

[1]

(b) Define the terms

(i) decay constant,

……
…….....

……
…… [1]

(ii) half-life.

……
…….....

……
…… [2]

(c) Explain why the random nature of radioactive decay makes it difficult to measure the values of the terms in **(b)** to a high degree of accuracy.

……
……

……
……

……
……

……
…….. [2]

(d) Radiocarbon dating, or carbon-14 dating, is a scientific method that can estimate the age of organic materials. Measurements are made of the activity of a specimen of carbon from pieces of wood found in a fireplace at an archaeological site.

The specimen is found to contain one Carbon-14 atom per 8.6×10^{10} Carbon-12 atoms. In a similar wood specimen from a modern fireplace, the concentration of Carbon-14 atoms is greater at one Carbon-14 atom per 3.3×10^{10} Carbon-12 atoms.

(i) The difference between the concentrations of Carbon-14 to Carbon-12 atoms in the old pieces of wood and modern wood is because Carbon-14 is radioactive and some atoms have decayed over the years.

Show that the ratio of undecayed Carbon-14 atoms N to original amount of Carbon-14 atoms N_0 of the old specimen is 0.384. State any assumption(s) made.

Assumption(s): ……
……...

……
……..…

[2]

(ii) Hence, determine the age of the wood from the ancient fire. The half-life of Carbon-14 is 5700 years.

age of wood = …….. years [2]

[Total: 10 marks]