

7 (a) Define

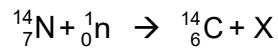
(i) half-life,

[1]

(ii) decay constant.

[1]

(b) The presence of radioactive carbon-14 ( $^{14}_6\text{C}$ ) is caused by the collision of neutrons with nitrogen-14 ( $^{14}_7\text{N}$ ) in the upper atmosphere. The equation for the reaction is:



Data for some masses are given in Fig. 7.1.

nucleus	mass / $u$
carbon-14	14.003242
nitrogen-14	14.003158
neutron	1.008665

Fig. 7.1

- (i) Use the data from Fig. 7.1 to determine the mass of the particle X in  $u$ , given that the amount of energy released in one such reaction is 0.7060 MeV.

mass = .....  $u$  [3]

(ii) The mass of carbon-14 produced by this reaction in one year is 7.5 kg. The molar mass of carbon-14 is 14 g. The half-life of carbon-14 is  $5.7 \times 10^3$  years.

1. Determine the number of carbon-14 atoms produced each year.

number of atoms = ..... [1]

2. Determine the probability of decay of a carbon-14 nucleus in a time of 1.0 year.

probability = ..... [1]

## **Section B**

Answer **one** question from this Section in the spaces provided.