7 Potassium-40 ($^{40}_{19}K$) is an isotope of potassium with a half-life of 1.25×10^9 years.

(a) (i) Explain the term isotopes.

.....

..... [1]

(ii) Define half-life of a radioactive isotope.

.....

..... [1]

(b) Most of the isotope potassium-40 undergoes beta decay to form the stable isotope calcium-40 ($^{40}_{20}Ca$).

(i) Complete the nuclear decay equation. Include all the decay products.

$$^{40}_{19}K \rightarrow$$

[3]

(ii) Data for the atomic masses are given in Table 7.1.

Table 7.1

	mass / *u*
$^{40}_{19}K$	39.963998
$^{40}_{20}Ca$	39.962591

Determine the energy released in each decay of potassium-40 to calcium-40.

energy released = ... MeV [4]

(c) 90% of the potassium-40 decays to form calcium-40 while the remaining 10% decays to form the stable isotope argon-40.

In a particular sample of rock, the ratio of the number of potassium atoms to the number of argon atoms is found to be 2:1.

Estimate the age of the rock. Assume that originally there was no argon present.

age of rock = ... years [3]

[Total: 12]