18 Oganesson (Og) can be produced by firing calcium (Ca) ions at a target of californium (Cf) atoms. Oganesson and a number of neutrons are produced in the nuclear reaction.

(a) Complete the equation for the reaction

(1)

$$^{48}_{20}\text{Ca} + {}^{249}_{98}\text{Cf} \rightarrow {}^{294}_{118}\text{Og} + \ldots\ldots \times {}^{\ldots\ldots}_{\ldots\ldots}\text{n}$$

(b) The calcium ions were accelerated to an energy of 245 MeV.

(i) State how ions of this energy could be produced.

(1)

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(ii) It is claimed that calcium ions with an energy of 245 MeV are travelling at relativistic speeds.

Assess the validity of this claim.

mass of calcium ion = 47.95 u

(5)

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(c) The isotope Og-294 is extremely unstable and decays via alpha decay.

After 2.5 ms, a sample contains 500 atoms of Og-294.

Calculate the original number of Og-294 atoms in the sample.

half-life of Og-294 = 0.89 ms

(3)

Original number of atoms = ...

(d) Explain a precaution necessary when handling a sample of an alpha emitting isotope.

(2)

(Total for Question 18 = 12 marks)