# **1** Nuclear Physics

## 1.1 Formulas

Check chapter 15 formulas

# 1.2 Half-Life of Radioactive Substance Problem

Suppose that you start with 1.23 g of a pure radioactive substance and determine 4 h later that only 0.076875 g of the substance is left undecayed.

What is the half-life of this substance? Answer in units of h.

## 1.3 Radioactive Sample Activity Problem

A sample of radioactive isotope is found to have an activity of 115 Bq immediately after it is pulled from the reactor that formed the isotope. Its activity 2 h, 15 min later is measured to be 85.2 Bq.

(a) Find the decay constant of the sample. Answer in units of  $h^{-1}$ .

(b) Find the half-life of the sample. Answer in units of h.

(c) How many radioactive nuclei were there in the sample initially?

#### 1.4 Rubidium Isotope Problem

The rubidium isotope  $^{87}\text{Rb}$  is a  $\beta$  emitter with a half life of  $4.9\times10^{10}$  y that decays into  $^{87}\text{Sr}$ . It is used to determine the age of rocks and fossils. Rocks containing the fossils of early animals contain a ratio of  $^{87}\text{Sr}$  to  $^{87}\text{Rb}$  of 0.01.

Assuming that there was no  $^{87}$ Sr present when the rocks were formed, calculate the age of these fossils. Answer in units of y.

#### 1.5 Reduced Activity of Sample Problem

A 200 mCi sample of a radioactive isotope is purchased by a medical supply house.

If the sample has a half-life of 14 d, how long will it keep before its activity is reduced to 20 mCi?

Answer in units of d.

#### 1.6 Carbon Dating Charcoal Problem

A piece of charcoal used for cooking is found at the remains of an ancient campsite. A 1 kg sample of carbon from the wood has an activity of 2000 decays per minute.

Find the age of the charcoal. Living material has an activity of 15 decays/minute per gram of carbon present and the half-life of  $^{14}$ C is 5730 y.

Answer in units of y.