

- 6 In nuclear physics, a *decay chain* refers to a sequence of radioactive decays where an element undergoes a series of decays until eventually a stable isotope is reached.

Fig 6.1 shows a decay chain where radium-224 decays into a stable isotope of lead through a series of alpha and beta decays.

isotope	decay product	decay mode	half life
$^{224}_{88}\text{Ra}$ radium-224	radon-220	alpha	3.63 days
radon-220	polonium-216	alpha	55.6 seconds
polonium-216	lead-212	alpha	0.145 seconds
lead-212	bismuth	beta	10.6 hours
bismuth	thallium	alpha	60.6 minutes
thallium	lead (stable)	beta	3.05 minutes

**Fig. 6.1**

- (a) State the number of protons and neutrons for the final stable nuclide of lead.

number of protons = .....

number of neutrons = ..... [2]

- (b) A sample of 12 mg of pure radium-224 is prepared for a decay chain experiment.

- (i) Calculate the initial activity,  $A_0$  of the sample of radium-224.

initial activity  $A_0$  = .....  $\text{s}^{-1}$  [4]



- (ii) Calculate the mass of radium-224 remaining after 6.0 days.

mass = ..... mg [2]

- (iii) After some time, an analysis of the radioactive sample shows that the concentration of lead-212 in the sample is much higher than the concentration of radon-220 in the sample.

Explain this observation.

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[2]

