**8** The power for a space probe is to be supplied by the energy released when plutonium-236 decays by the emission of $\alpha$-particles.

The $\alpha$-particles, each of energy 5.75 MeV, are captured and their energy is converted into electrical energy with an efficiency of 24%.

**(a)** Calculate

**(i)** the energy, in joules, equal to 5.75 MeV,

energy = ..... J [1]

**(ii)** the number of $\alpha$-particles per second required to generate 1.9 kW of electrical power.

number per second = ..... $s^{-1}$ [2]

**(b)** Each plutonium-236 nucleus, on disintegration, produces one $\alpha$-particle.
Plutonium-236 has a half-life of 2.8 years.

**(i)** Calculate the decay constant, in $s^{-1}$, of plutonium-236.

decay constant = ..... $s^{-1}$ [2]

**(ii)** Use your answers in **(a)(ii)** and **(b)(i)** to determine the mass of plutonium-236 required for the generation of 1.9 kW of electrical power.

mass = ..... g [4]

**(c)** The minimum electrical power required for the space probe is 0.84 kW.

Calculate the time, in years, for which the sample of plutonium-236 in **(b)(ii)** will provide sufficient power.

time = ..... years [2]