$^{15}/_{18}$

J2 Activity and Decay

A 'mole' of nuclei contains 6.02×10^{23} nuclei. The mass of one mole of nuclei (the 'molar mass') is approximately equal to 0.001 kg $\times$ the mass number of the nucleus. Use this approximation wherever a question does not give the molar mass explicitly.

Complete the questions in the tables:

	Half life	Decay constant /s^{-1}	Half life	Decay constant /s^{-1}
J2.1	53 s	(a)	12 years	(b)
J2.2	(a)	3.2×10^{-10}	(b)	1.2×10^{-4}

	Decay constant /s^{-1}	Activity /Bq	Number of nuclei	Mass of sample /kg	Molar mass /kg
J2.3	0 (isotope stable)	(a)	(b)	2.4×10^{-4}	0.012
J2.4	0.0138	230	(a)	(b)	0.085
J2.5	3.42×10^{-11}	5600	(a)	(b)	0.239
J2.6	1.83×10^{-9}	(a)	(b)	3.0×10^{-5}	0.003

J2.7
a) How many nuclei are there in 5.0 mg of ^{14}C?
b) What is the activity of the sample, if the half life is 5700 years?

J2.8
a) ^{238}U has a half life of 4.47×10^9 years. How many ^{238}U nuclei are needed for an activity of 5000 Bq?
b) What is the mass of the ^{238}U sample?

J2.9 Long half lives are measured using the principle of activity. If 3.0 mg of ^{239}Pu has an activity of 6.9×10^6 Bq, calculate the half life of ^{239}Pu.

J2.10 A 'radioactive battery' for a long range space probe uses a radioisotope with a decay constant of 4.4×10^{-12} s^{-1}, and a molar mass of 0.236 kg. Each time one nucleus decays, 2.5×10^{-12} J of electrical energy is output by the generator. Calculate the mass of the radioactive sample if the spacecraft requires 200 W of electricity.