J3 Nuclear Decay with Time

Complete the questions in the table:

	Initial number of unstable nuclei	Initial Activity /Bq	Half-life	Decay constant /s^{-1}	Number of unstable nuclei left after 6 hours	Activity after 6 hours /Bq
J3.1	(a)	3000	6.0 h	(b)	(c)	(d)
J3.2	2.0×10^{21}	(a)	3.0 h	(b)	(c)	(d)
J3.3	(a)	23 000	(b)	1.28×10^{-4}	(c)	(d)
J3.4	(a)	700	(b)	(c)	(d)	200

J3.5   Tritium has a half life of about 12 years. If you put $3.0\,\mu g$ of tritium into a luminous sign, how much will still be there 50 years later?

J3.6   If a substance has a half life of 100 s, how long do you have to wait for 25% of the nuclei to decay?

J3.7   A substance has a half life of 100 s, and starts with 10^{20} unstable nuclei.

   a) Calculate the initial activity, and from this work out the time taken for all of the nuclei to decay if the activity did not decrease with time.

   b) Calculate what fraction of the nuclei remain after the time calculated above.

J3.8   Carbon-14 has a half life of about 5700 years. What fraction of the original amount of carbon-14 would you expect to find in the timbers of a boat built 8000 years ago?

J3.9   Uranium-238 has a half life of 4.47×10^9 years and decays to thorium-234. The thorium decays (by a series of further nuclear processes which are relatively brief) to lead. Assuming that a rock was originally entirely uranium, and that at present, 1.5% of the nuclei are now lead, calculate the age of the rock.