10 **(a)** Radioactive decay is a spontaneous process.

State the meaning, in this context, of the term spontaneous.

.....

..... [1]

(b) Two radioactive isotopes X and Y each decay to form a stable isotope.
A sample initially contains only atoms of isotope X. At this time, its activity is $4A$.
Another sample initially contains only atoms of Y. At this time, its activity is A.

Fig. 10.1 shows the variation of the activity of each sample with time t between $t = 0$ and $t = 6T$.

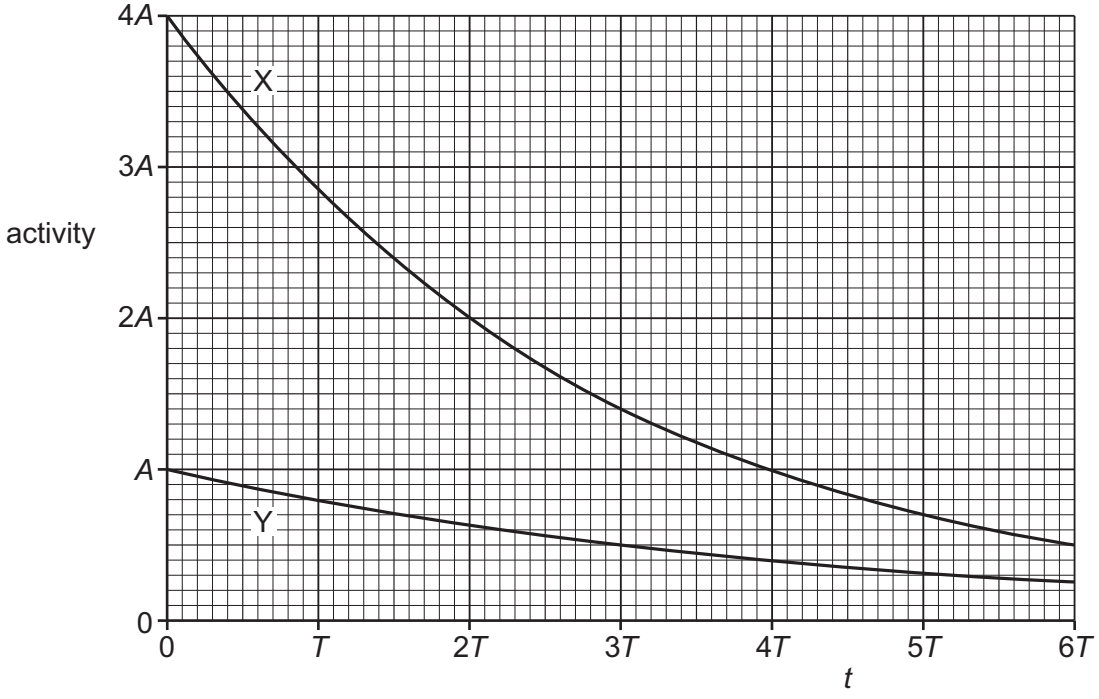

Fig. 10.1

(i) Complete Table 10.1 to give expressions, in terms of either or both of A and T, for the quantities indicated for each of the samples.

Table 10.1

sample	half-life	decay constant	initial activity	initial number of nuclei
X			$4A$	
Y			A	

[3]

(ii) Determine, in terms of T, the time at which the two samples will have equal activities.

time = ... T [3]

(c) A radiation detector is placed near to one of the samples in **(b)**.

Explain why the count rate measured by the detector is less than the activity of the sample.

.....

.....

..... [2]

[Total: 9]