13 (a) (i) Define radioactive *decay constant*.

.....

.....

.....[2]

(ii) Show that the decay constant λ is related to the half-life $t_{\frac{1}{2}}$ of a radioactive isotope by the expression

$$\lambda t_{\frac{1}{2}} = \ln 2$$

[2]

(b) A small volume of solution containing the radioactive isotope sodium-24 ($^{24}_{11}Na$) has an initial activity of 3.8×10^4 Bq. Sodium-24, of half-life 15 hours, decays to form a stable daughter isotope.

All of the solution is poured into a container of water. After 36 hours, a sample of water of volume 5.0 cm^3, taken from the container, is found to have an activity of 1.2 Bq.

Assuming that the solution of the radioactive isotope is distributed uniformly throughout the container of water, calculate the volume of water in the container.

volume = ... cm^3 [4]

[Total: 8]