-0.5 pro math error!

Radioactive decay

1 i) $N(t) = N_0 \, 2^{-t/t_{1/2}}$ 0.5

$N(t_{now}) = 0.1\, N_0 \Rightarrow 0.1\, N_0 = N_0\, 2^{-t/t_{1/2}}$

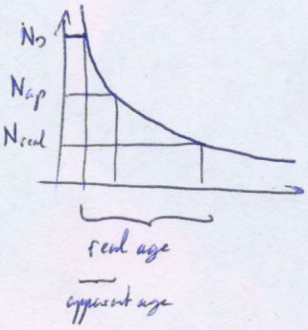
$\sim \boxed{t} = - \dfrac{\ln(0.1)}{\ln(2)} \cdot t_{1/2}$

$\approx \boxed{19'034 \text{ years}}$ 0.5

$t_{1/2} = 5730$

full points in the range 19'000 ± 200

1.5 ii) a) Qualitatively:



Since the sample now contains more ^{14}C, we have the impression that the ^{14}C has decayed less (there is a higher percentage of N_0), i.e. the sample appears to be younger.

good enough explanation or plot 0.5

b) Quantitatively
- $\gamma = 5\%$ of the sample is contaminated
- $p = 10\% = N/N_0$: real proportion of the decayed ^{14}C
- $p_c = 100\% = N_c/N_0$: real proportion of the (modern) decayed ^{14}C (none of it has decayed!)

$\Rightarrow$ "New proportion" $\dfrac{N}{N_0}$: $p(1-\gamma) + p_c \cdot \gamma = 0.1(1-0.05) + 0.05 = \underline{14.5\,\%}$ 0.5

$\boxed{t} = - \dfrac{\ln(0.145)}{\ln(2)} \cdot 5730 \sim \boxed{15'963 \text{ years}}$ 0.5

16'000 ± 200 : full points

1.5 iii)
- ~25% of the body made of C
- $m = 70\,kg$: average mass
- 10^{-12} : ratio of ^{14}C
- $12 \cdot 10^{-3}\,kg = 1\,mol$ of C

0.5 # of ^{14}C atoms: $\dfrac{70}{4} \cdot 10^{-12} \cdot \dfrac{1}{12 \cdot 10^{-3}} \cdot 6 \cdot 10^{23} \sim 10^{15}$

0.5 $A = -\dfrac{dN}{dt} = + \dfrac{N_0}{t_{1/2}} \cdot \ln(2)\, 2^{-t/t_{1/2}} = + \dfrac{N(t)\ln(2)}{t_{1/2}}$

0.5 $\sim \dfrac{10^{15} \cdot \ln(2)}{5730 \cdot (3 \cdot 10^7)} \sim \boxed{3.85\,kBq}$