(18.1) "Reference man" consists of 18%C, 66% H_2O, 0.2% of K per body weight. He may also have accumulated 10 pCi ^{226}Ra in the body; assume 0.3 decay for each of the following 5 daughters. Calculate for a body weight of 70 kg the number of radioactive decays per unit time from ^{3}H, ^{14}C, ^{40}K and ^{226}Ra. Assume 30 TU in water.

Units, constants and data:

$N_A := 6.022137\cdot 10^{23}\cdot mole^{-1}$ $\quad$ $Bq := sec^{-1}$ $\quad$ $kBq := 1000\cdot Bq$

$\rho_{water} := 1.0\cdot gm\cdot cm^{-3}$ $\quad$ $TU := 118\cdot Bq\cdot m^{-3}$ $\quad$ See §5.1.2 for definition

$m_{water} := 70\cdot\frac{66}{100}\cdot kg$ $\quad$ $m_{carbon} := 70\cdot\frac{18}{100}\cdot kg$ $\quad$ $m_{potassium} := 70\cdot\frac{0.2}{100}\cdot kg$

$M_K := 39.10\cdot gm\cdot mole^{-1}$ $\quad$ $x_{40K} := 0.0117\cdot\%$ $\quad$ From Table 5.2

(1) Tritium

$v_{water} := \frac{m_{water}}{\rho_{water}}$ $\quad$ $R_T := 30\cdot TU\cdot v_{water}$ $\quad$ $R_T = 163.5\cdot Bq$ $\quad$ Of ^{3}H

(2) ^{14}C (see §5.1.3 for specific activity)

$S_C := \frac{13.56}{60}\cdot Bq\cdot gm^{-1}$ $\quad$ $R_{14C} := m_{carbon}\cdot S_C$ $\quad$ $R_{14C} = 2.85\cdot kBq$

(3) ^{40}K

$t_{half40K} := 1.26\cdot 10^{9}\cdot yr$ $\quad$ $\lambda_{40K} := \frac{ln(2)}{t_{half40K}}$

$R_{40K} := \frac{m_{potassium}}{M_K}\cdot N_A\cdot x_{40K}\cdot\lambda_{40K}$ $\quad$ $R_{40K} = 4.40\cdot kBq$

(4) ^{226}Ra and daughters

$R_{Ra} := 10\cdot 10^{-12}\cdot 3.7\cdot 10^{10}\cdot Bq$ $\quad$ $R_{Ra} = 0.37\cdot Bq$ $\quad$ (*this value will be needed in 18.2*)

$R_{Ratot} := (1.0 + 5\cdot 0.3)\cdot R_{Ra}$ $\quad$ $R_{Ratot} = 0.93\cdot Bq$

$Total := R_T + R_{14C} + R_{40K} + R_{Ratot}$ $\quad$ $Total = 7.41\cdot kBq$