(15.6) A γ-dose rate of 1 Sv is assumed to inactivate (kill) human cells. The body contains $6*10^{13}$ cells in a cell weight of 42 kg for a 70 kg man. (a) What average energy (in eV) has to be deposited in a cell to kill it? (b) Calculate the number or kidney cells destroyed for the dose received in exercise 14.5. For simplicity assume the cells to be cubic with a side length of about 11 μm.

$eV := 1.6021773 \cdot 10^{-19}$ $\quad MeV := 10^6 \cdot eV$

$H_{kill} := 1 \cdot m^2 \cdot sec^{-2}$ $\quad w_r := 1$ $\quad m_{cells} := 42 \cdot kg$ $\quad m_{body} := 70 \cdot kg$

$D_{kill} := \frac{H_{kill}}{w_r}$ $\quad m_{cell} := \frac{m_{cells}}{6 \cdot 10^{13}}$

(a) $D_{tot} := m_{cells} \cdot D_{kill}$ $\quad d_{cell} := \frac{D_{tot}}{6 \cdot 10^{13}}$ $\quad d_{cell} = 7 \cdot 10^{-13} \cdot joule$ $\quad \frac{7 \cdot 10^{-13}}{MeV} = 4.369$

(b) For α w_r is 20.

$range := \frac{4.197 \cdot 10^6}{140 \cdot 10^3} \cdot 10^{-6} \cdot m$ $\quad range = 2.998 \cdot 10^{-5} \cdot m$ $\quad l_{cell} := 11 \cdot 10^{-6} \cdot m$

Answer 4.37 MeV $\quad n_{cells} := \frac{range}{l_{cell}}$ $\quad n_{cells} = 2.725$

$e_{cell} := \frac{4.197 \cdot 10^6}{3}$ $\quad e_{cell} \cdot 20 = 2.798 \cdot 10^7$ $\quad$ thus 1 alpha kills 3 cells with margin.

$Decays := 2.326 \cdot 10^8$ $\quad Killed := 3 \cdot Decays$ $\quad Killed = 6.978 \cdot 10^8$