(3.)

$T_z = 285\ K$

$R_s = 4{,}65 \cdot 10^{-3}\ AU$

$R = 1\ AU$

$T_s = ?$

izsevana moč sonca: $P_s = 4\pi R_s^2 \cdot \sigma T_s^4$ 1/8

toplotni tok na mestu zemlje: $j_s = \frac{P_s}{4\pi R^2} = \frac{R_s^2}{R^2} \sigma T_s^4$ 2/8

absorbcija ~~t~~oplotnega toka: $P_{ab} = j_s \left(\pi R_z^2\right)$

↑ prečni presek

izsevani tok zemlje: $P_{izs} = 4\pi R_z^2 \cdot \sigma T_z^4$ 1/8

$$P_{ab} = P_{izs}$$

$$\frac{R_s^2}{R^2} \sigma T_s^4 \pi R_z^2 = 4\pi R_z^2 \sigma T_z^4$$

$$T_s = \sqrt{\frac{2R}{R_s}}\, T_z = 5{,}9 \cdot 10^3\ K$$ 1/8

$$\frac{dj}{d\lambda} = \frac{2\pi h c^2}{\lambda^5} \frac{1}{e^{\frac{hc}{k_B T \lambda}} - 1}, \quad \lambda_{min} = 0{,}5\ mm$$

$$\frac{hc}{\lambda_{min}} = ~~1{,}99 \cdot 10^{-21}~~\ J \simeq 4 \cdot 10^{-22}\ J \ll k_B T \simeq 4 \cdot 10^{-21}\ J$$

$$\simeq \frac{2\pi h c^2}{\lambda^5} \frac{1}{\left(1 + \frac{hc}{k_B T \lambda} + \dots\right) - 1}$$

$$= \frac{2\pi c k_B T}{\lambda^4}$$

$$j(\lambda > \lambda_{min}) = \int_{\lambda_{min}}^{\infty} d\lambda \, \frac{2\pi c k_B T_z}{\lambda^4}$$

$$= 2\pi c k_B T_z \left. \frac{1}{3\lambda^3} \right|_{\infty}^{\lambda_{min}} = \frac{2\pi c k_B T_z}{3\lambda_{min}^3}$$

$$\text{delež} = \frac{j(\lambda > \lambda_{min})}{\sigma T_z^4} = \frac{2\pi c k_B}{3\sigma \lambda_{min}^3 T_z^3}$$

$$= 5{,}3 \cdot 10^{-5}$$ 3/8

4.

$$W_F = \frac{h^2}{2m_e}\left(\frac{3n_e}{8\pi}\right)^{2/3}$$ n_e = volumska gostota elektronov

$$n_e = 3n_{Al} = 3\rho_{Al}\frac{N_A}{M_{Al}} = 1{,}81 \cdot 10^{29}/m^3$$

$W_F = 11{,}7\ eV$ 3/8 , $v_F = \sqrt{\frac{2W_F}{m_e}} = 2{,}03 \cdot 10^6\ m/s$ 1/8

$$\langle v \rangle = \frac{3}{4} v_F = 1{,}52 \cdot 10^6\ m/s$$ 2/8

$$c_V = \frac{3R}{M}\,\frac{\pi^2}{6}\,\frac{k_B T}{W_F} = 3{,}4\ \frac{J}{kg\,K}$$ 2/8

$$\frac{dN}{dW} = \frac{3}{2} N W_F^{-3/2} \frac{W^{1/2}}{e^{(W-W_F)/k_B T} + 1}$$

$$= \frac{3}{2} N W_F^{-3/2} W^{1/2} \quad \text{za} \quad W < W_F$$

$$\text{in} \quad T \ll T_F$$

$$\langle v \rangle = \frac{3}{4} v_F$$

$$W(\langle v \rangle) = \frac{1}{2} m_e \langle v \rangle^2 = \frac{1}{2} m_e \frac{9}{16} v_F^2 = \frac{9}{16} W_F$$

$$N(v > \langle v \rangle) = \int_{9/16 W_F}^{W_F} dW \frac{dN}{dW} = \int_{9/16 W_F}^{W_F} dW \cdot \frac{3}{2} N W_F^{-3/2} W^{1/2}$$

$$= \frac{3}{2} N W_F^{-3/2} \cdot \frac{2}{3} W^{3/2} \Big|_{9/16 W_F}^{W_F}$$

$$= N W_F^{-3/2} W_F^{3/2} \left(1 - \left(\frac{9}{16}\right)^{3/2}\right)$$

$$= N \left(1 - \frac{27}{64}\right) = \frac{37}{64} N$$

$$\frac{N(v > \langle v \rangle)}{N} = \frac{37}{64} = 0{,}58$$

2/8

(2.) $^{65}_{28}Ni \rightarrow ^{65}_{29}Cu \; e^- \; \bar{\nu}_e$, $t_1 = 5\,h$

$$\frac{dN}{dt}(t) = \frac{dN}{dt}(t=0) \cdot 2^{-t/\tau_{1/2}}$$

$$\frac{\frac{dN}{dt}(t=t_1)}{\frac{dN}{dt}(t=0)} = 2^{-t_1/\tau_{1/2}}$$

$$\frac{2{,}53 \cdot 10^{10}}{1 \cdot 10^{11}} = 0{,}253 = 2^{-t_1/\tau_{1/2}}$$

$$\log_2 0{,}253 = -\frac{t_1}{\tau_{1/2}}$$

$$\frac{\ln 0{,}253}{\ln 2} = -\frac{t_1}{\tau_{1/2}}$$

$$\tau_{1/2} = -\frac{\ln 2}{\ln 0{,}253} t_1 = 2{,}52\,h$$ 3/8

$$\frac{dN}{dt} = -\frac{N}{\tau} = -\frac{\ln 2}{\tau_{1/2}} N$$

ob $t=0$: $N(t=0) = \frac{\tau_{1/2}}{\ln 2} \left| \frac{dN}{dt}(t=0) \right|$

$$= 1{,}31 \cdot 10^{15}$$

$$m(t=0) = N(t=0) \cdot m_{Ni} = 1{,}41 \cdot 10^{-10}\,kg$$ 3/8

največja energija elektrona

$p_{Ni} = p_{Cu} + p_e + p_\nu$ četverci

$(p_{Ni} - p_e)^2 = (p_{Cu} + p_\nu)^2$

$m_{Ni}^2 c^2 + m_e^2 c^2 - 2 m_{Ni} c \frac{E_e}{c} = m_{Cu,\nu}^2 c^2$

$$E_e = \frac{c^2 \left(m_{Ni}^2 + m_e^2 - m_{Cu,\nu}^2\right)}{2 m_{Ni}}$$

$E_e^{(max)} \leftrightarrow m_{Cu,\nu}^{(min)} = m_{Cu} + m_\nu$

$= m_{Cu}$

$$E_e \simeq \frac{c^2 \left(m_{Ni}^2 - m_{Cu}^2\right)}{2 m_{Ni}} = 2{,}1 \text{ MeV}$$ ~~3~~/8

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1. Cd transmisivnost $t = e^{-\mu x}$, $\mu = \frac{\sigma \rho N_A}{M}$ 1/8 ~~2~~/8

$$x = -\frac{\ln t}{\mu} = -\frac{M}{\sigma \rho N_A} \ln t$$ 2/8

$= 0{,}265$ mm 1/8

geom. presek jedra $\sigma_g = \pi r_j^2 = \pi (r_1 A^{1/3})^2$ 1/8

$r_1 = 1{,}1$ fm $= \pi r_1^2 A^{2/3} = 88{,}3 \text{ fm}^2$

$x' = \frac{\sigma}{\sigma_g} x = 732$ mm 1/8