1. $2r = 10{,}67\ m$

$m_{K+U} = 8{,}3\ kg$

$\rho_Z = 1{,}16\ kg/m^3$

$\rho_{HE} = \frac{1}{7}\rho_Z$

$m_T = ?$

$m_B = \rho_{HE} \cdot V = \rho_{HE} \cdot \frac{4}{3} r^3 \pi = 105{,}4\ kg$

$m_{UK} = m_T + m_{K+U} + m_B$

$m_T = m_{UK} - m_{K+U} - m_B$

$m_T = 737{,}82 - 8{,}3 - 105{,}4$

$m_T = 624{,}12\ kg$

$m_{UK} \cdot g = \rho_Z \cdot g \cdot V$

$m_{UK} = \rho_Z \cdot V = 1{,}16 \cdot 636{,}05 = 737{,}82\ kg$

2. $2r = 16,6\,m \Rightarrow r = 8,3\,m$

$m_U = 13,5\,kg$

$m_T = 204\,kg$

$a = ?$

$$mg = ma + \rho g V \Rightarrow a = g\left(1 - \frac{\rho_Z \cdot V}{m_{UK}}\right)$$

$$V_B = \frac{4}{3} r^3 \pi = 2395,1\,m^3$$

$$m_B = \rho_{HE} \cdot V_B = 396,9\,kg$$

$$m_{UK} = m_B + m_T + m_U = 614,4\,kg$$

$$a = 9,81\left|1 - \frac{1,16 \cdot 2395,1}{614,4}\right|$$

$$a = 34,55\,m/s^2$$

3. $T_1 = T_2 = 483°C = 756,15\ K$

$T_3 = T_4 = 57°C = 330,15\ K$

$p_3 = 0,11\ MPa$

$\varkappa = 1,4$

$p_2 = ?$

$\frac{T_2}{T_3} = \left(\frac{p_2}{p_3}\right)^{\frac{\varkappa-1}{\varkappa}} \Rightarrow p_2 = p_3 \cdot \left(\frac{T_2}{T_3}\right)^{\frac{\varkappa}{\varkappa-1}} = 2\ MPa$

4. $dq = du + dw$, $du = 0$ ($\Delta T = 0$) $\quad (T_1 = T_2 = 469°C;\ T_3 = T_4 = 64°C)$

$p_1 = 8\,MPa,\ p_3 = 0{,}1\,MPa$

$q_{12} = w_{12} = RT_1 \ln \frac{v_2}{v_1}$

$p_1 v_1 = RT_1 \Rightarrow v_1 = \frac{RT_1}{p_1}, \quad v_2 = \frac{RT_2}{p_2}$

$\frac{T_2}{T_3} = \left(\frac{p_2}{p_3}\right)^{\frac{\kappa-1}{\kappa}} \Rightarrow p_2 = p_3 \cdot \left(\frac{T_2}{T_3}\right)^{\frac{\kappa}{\kappa-1}} = 3\,MPa$

$q_{12} = RT_1 \cdot \ln \frac{p_1}{p_2} = 208913{,}7374 \frac{J}{kg}$

$q_{23} = 0$

$q_{34} = RT_3 \ln \frac{p_3}{p_4}$

$\frac{T_4}{T_1} = \left(\frac{p_4}{p_1}\right)^{\frac{\kappa-1}{\kappa}} \Rightarrow p_4 = p_1 \cdot \left(\frac{T_4}{T_1}\right)^{\frac{\kappa}{\kappa-1}} = 0{,}51\,MPa$

$q_{34} = RT_3 \cdot \ln \frac{p_3}{p_4} = -94690{,}44$

$P = \dot{Q} = \dot{m}(q_{12} + q_{23} + q_{34} + q_{41}) = \dot{m}(q_{12} + q_{34})$

$= 18 \cdot (208913{,}7374 - 94690{,}44)$

$P = 2{,}1\,MW$

5. POSTUPAK JE ISTI KAO U 4. ZADATKU!

6. f = factor precalentador

$$f = \frac{Q_{dov}}{W_{ST}} = \frac{T_{dov}}{T_{dov} - T_{odv}} = \frac{342,15}{74,6} = 4,58$$

$$T_{dov} = 69°C$$

$$T_{odv} = -5,6°C$$

7. $T_1 = 385°C = 658{,}15\ K$

$T_2 = 55°C = 328{,}15\ K$

$\eta = ?$

$\eta = 1 - \frac{T_2}{T_1} = 0{,}5$

9. $A = 2,3\,mm^2$

$p = 65\,kPa$

$m = ?$

$p = \frac{F}{A} \Rightarrow F = p \cdot A = m \cdot g$

$m = \frac{p \cdot A}{g}$

$m = 65 \cdot 10^3 \cdot 2,3 \cdot 10^{-6} / 9,81$

$m \approx 15,24\,g$

10. $V = 0,8 \cdot 0,196 \cdot 0,195 = 0,030576\ m^3$

$\dot{V} = 0,60\ m^3/min = 0,60 \frac{m^3}{min} \cdot \frac{1}{60} \frac{min}{s} = 0,01\ m^3/s$

$T_{ULAZ} = 29,4°C = 302,55\ K$

$T_{IZLAZ} = 41,3°C = 314,45\ K$

$W = ?$

$Q = m c_p \Delta T$

$= 421,128\ J$

$m = \frac{p_{ul} V}{R T_{ul}} = \frac{100 \cdot 10^3 \cdot 0,030576}{287 \cdot 302,55}$

$= 0,03521\ kg$

$W = \frac{Q}{t} = 137,73$

$\dot{V} = \frac{V}{t} \Rightarrow t = \frac{V}{\dot{V}} = \frac{0,030576\ m^3}{0,01 \frac{m^3}{s}} = 3,0576 s$

11.

$n_K = 3$
$P_{1K} = 6.0\,kW$

$P_K = n_K \cdot P_{1K} = 3 \cdot 6 = 18\,kW$

$n_{RT} = 59$
$P_{1RT} = 32\,W$

$P_{RT} = n_{RT} \cdot P_{1RT} = 59 \cdot 32 = 1888\,W$

$\dot{Q} = 16228\,kJ/h$

$\dot{Q}_1 = 362\,kJ/h$

$\vartheta = 21.0°C$

$N = ?$

$\dot{Q} + \dot{Q}_1 \cdot N = P_K - P_{RT}$

$16228\,k\frac{J}{h} \cdot \frac{1}{3600}\frac{h}{s} + N \cdot 362\,k\frac{J}{h} \cdot \frac{1}{3600}\frac{h}{1} = 18 - 1{,}888$

$N \cdot \frac{362}{3600}\,kW = (16{,}112 - 4{,}51)\,kW$

$N = 115$ osoba

12. $T_1 = 1492\ K$

$p_1 = 483\ kPa$

$T_2 = 681\ K$

$p_2 = 100\ kPa$

$P = 370\ kW$

$v = ?$

$$W = c_p \cdot \Delta T = 1130 \cdot (1492 - 681) = 916430\ W$$

$$P = \frac{W \cdot m}{t} = W \cdot \dot{m} \Rightarrow \dot{m} = \frac{P}{W} = 0{,}40374\ \frac{kg}{s}$$

$$p_1 \cdot V_1 = m \cdot R \cdot T_1 \Rightarrow \frac{V_1}{m} = \frac{RT_1}{p_1} = 0{,}9267\ m^3/kg$$

$$v\ [m^3/s] = \dot{m} \cdot \frac{V_1}{m} = 0{,}40374\ \frac{kg}{s} \cdot 0{,}9267\ \frac{m^3}{kg} = 0{,}374\ m^3/s$$

13. $V = 3\,m^3$

$T_1 = 303\,K$

$\rho_1 = 165\,kPa$

$T_2 = 351\,K$

$\rho_2 = 567\,kPa$

$R = 287\,J/kgK$

$\Delta m = ?$

$\Delta m = m_2 - m_1$ $\qquad m = \frac{\rho V}{RT}$

$\Delta m = \frac{V}{R}\left(\frac{\rho_2}{T_2} - \frac{\rho_1}{T_1}\right)$

$\Delta m = 11,19$

14. $c_p(T_2 - T_1) = -\frac{1}{2}(c_2^2 - c_1^2)$

$T_2 = 733{,}71\ K$

$T_1 = 759\ K$

$c_1 = 24\ m/s$

$c_2 = 338\ m/s$

$c_p = 2247\ J/kg\,K$

15. $m = 1190$ kg

$v_1 = 7$ km/h $= 1,94$ m/s

$v_2 = 100$ km/h $= 27,78$ m/s

$W = ?$

$W = 0,5 \cdot m \cdot (v_2^2 - v_1^2)$

$W = 0,5 \cdot 1190 (27,78^2 - 1,94^2)$

$W = 456,87$ kJ

16. $m = 1737\ kg$

$v_1 = 14\ km/h \approx 3,89\ m/s$

$v_2 = 106\ km/h = 29,44\ m/s$

$P_M = 77\ kW$

$t = ?$

$W = \frac{1}{2} m v^2$

$P \cdot t = \frac{1}{2} m (v_2^2 - v_1^2)$

$t = 0,5 \cdot m (v_2^2 - v_1^2) / P_M$

$t = 0,5 \cdot 1737 (29,44^2 - 3,89^2) / 77 \cdot 10^3$

$t = 9,61\ s$