

2011.-ISPIT (A)
ZADACI

1. NESNOKRETNI CARNOTOV [38. AUG.]

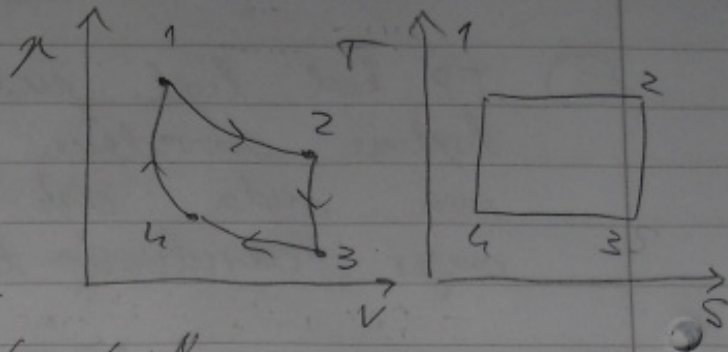
$$T_1 = T_2 = 1000 \text{ K}$$

$$T_3 = T_4 = 300 \text{ K}$$

$$m = 20 \text{ kg}$$

$$p_1 = 1400 \text{ kPa}$$

$$p_3 = 22 \text{ kPa}$$



a) $p_2, p_4, V_1, V_2, V_3, V_4 = ?$

$$\frac{p_2}{p_3} = \left(\frac{T_2}{T_3} \right)^{\frac{\kappa}{\kappa-1}}$$

$$p_2 = p_3 \left(\frac{T_2}{T_3} \right)^{\frac{\kappa}{\kappa-1}} = 31 \text{ kPa}$$

$$\frac{p_4}{p_1} = \left(\frac{T_4}{T_1} \right)^{\frac{\kappa}{\kappa-1}}$$

$$p_4 = p_1 \left(\frac{T_4}{T_1} \right)^{\frac{\kappa}{\kappa-1}} = 2.4 \text{ MPa}$$

$$pV = mRT$$

$$V_1 = \frac{mRT_1}{p_1} = 3.376 \text{ m}^3$$

$$V_2 = \frac{mRT_2}{p_2} = 185.16 \text{ m}^3 \quad V_3 = 78.27 \text{ m}^3$$

$$V_4 = \frac{mRT_4}{p_4} = 0.8145 \text{ m}^3$$

b) $Q_{\text{dov}}, Q_{\text{dav}} = ?$

$$q_{\text{dov}} = RT_1 \ln \frac{V_2}{V_1} = 1.15 \text{ MJ/kg}$$

$$Q_{\text{dov}} = m q_{\text{dov}} = 23 \text{ MJ}$$

$$q_{\text{dav}} = RT_3 \ln \frac{V_4}{V_3} = -404 \text{ kJ/kg}$$

$$Q_{\text{dav}} = -8 \text{ MJ}$$

c) $\cancel{W_{MEH}} = ?$
 $W_{MEH} = Q_{DOV} + Q_{DOV} = 15 \text{ MW}$

d) $\cancel{\eta_T} = ?$

$$\eta_T = \frac{W}{Q_{DOV}} = \frac{15 \text{ MW}}{23 \text{ MW}} = 0.652$$

2. [26. АУД]

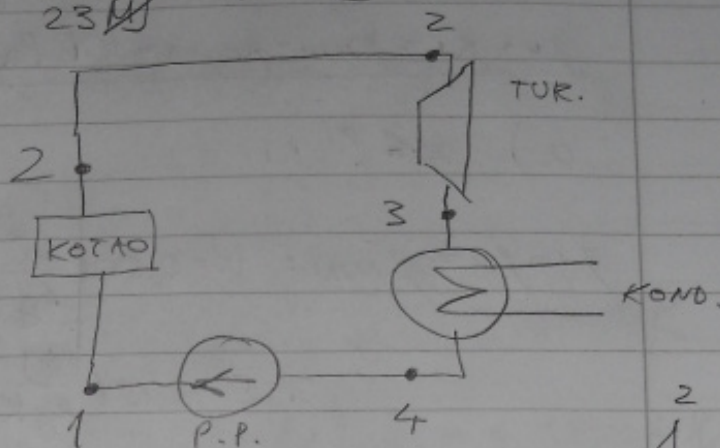
$P_e = 15 \text{ MW}$

$h_2 = 530 \text{ kJ/kg}$

$h_4 = 18.2 \text{ kJ/kg}$

$h_1 = 18.2 \text{ kJ/kg}$

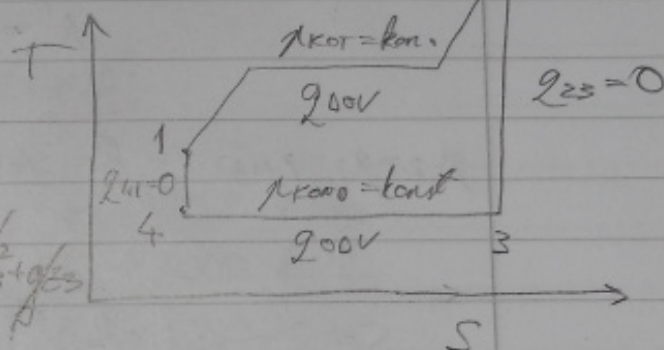
$\dot{m} = 250 \text{ kg/s}$



a) $h_3 = ?$

1. GST ZA TURBINU

$$q_{23} + h_2 + \frac{1}{2}c_2^2 + q_{22} = W_{23} + h_3 + \frac{1}{2}c_3^2 + q_{23}$$



$W_{23} = W_{TURB} = h_2 - h_3 \Rightarrow h_3 = h_2 - W_{TURB} = 470 \text{ kJ/kg}$

$P_e = P_{TURB} = \dot{m} W_{TURB} \Rightarrow W_{TURB} = \frac{P_{TURB}}{\dot{m}} = 60 \text{ kJ/kg}$

b) $\eta_T = \frac{W_{TURB} - |W_P|}{q_{DOV}} = \frac{60 \text{ kJ/kg} - 3 \text{ kJ/kg}}{511.8 \text{ kJ/kg}} = 0.11$

$\cancel{\eta_T} = ?$

$W_P = h_4 - h_1 = -3 \text{ kJ/kg}$

$q_{DOV} = h_2 - h_1 = 511.8 \text{ kJ/kg}$

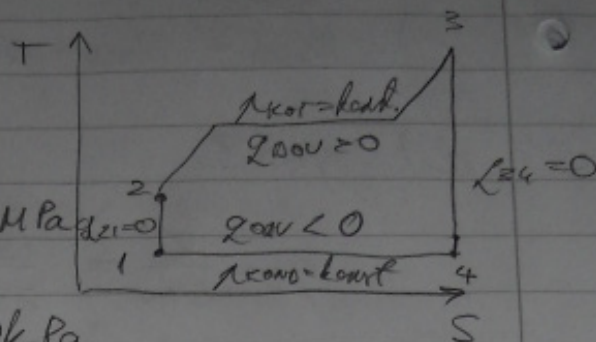
③ [34. AUD]

$$P_c = 45 \text{ MW/e}$$

$$p_2 = p_3 = p_{\text{MAX}} = p_{\text{TURB}} = 7 \text{ MPa}$$

$$T_{\text{MAX}} = T_3 = 773.15 \text{ K}$$

$$p_4 = p_1 = p_{\text{MIN}} = p_{\text{COND}} = 10 \text{ kPa}$$



a) $x = ?$

$$p_1 = p_4 = p_{\text{MIN}}: v' = 0.001 \frac{\text{m}^3}{\text{kg}} \quad s' = 0.649 \frac{\text{kJ}}{\text{kgK}}$$

$$s'' = 8.151 \frac{\text{kJ}}{\text{kgK}} \quad h' = 191.8 \frac{\text{kJ}}{\text{kg}}$$

$$h'' = 2584.0 \frac{\text{kJ}}{\text{kg}}$$

$$p_2 = p_3 = p_{\text{MAX}}: h = 3410 \frac{\text{kJ}}{\text{kg}}, \quad s = 7 \frac{\text{kJ}}{\text{kgK}}$$

$$s = s' + x(s'' - s') \Rightarrow x = \frac{s - s'}{s'' - s'} = 0.847$$

b) $\eta_f = ?$

$$\eta_f = \frac{W_{\text{TURB}} - |W_P|}{Q_{00V}}$$

$$h_1 = 191.8 \frac{\text{kJ}}{\text{kg}}$$

$$h_2 = 198.8 \frac{\text{kJ}}{\text{kg}}$$

$$h_3 = 3410 \frac{\text{kJ}}{\text{kg}}$$

$$h_4 = 2218 \frac{\text{kJ}}{\text{kg}}$$

$$W_P = v_1(p_1 - p_2) = 0.001 \frac{\text{m}^3}{\text{kg}} (10 \text{ kPa} - 7 \text{ MPa})$$

$$W_P = -7 \text{ kJ/kg} \quad Q_{00V} = h_3 - h_2 = 3218.2 \frac{\text{kJ}}{\text{kg}}$$

$$h_4 = h' + x(h'' - h') = 2218 \frac{\text{kJ}}{\text{kg}}$$

$$W_P = h_1 - h_2 \Rightarrow h_2 = h_1 - W_P = 198.8 \frac{\text{kJ}}{\text{kg}}$$

$$W_{TURB} = h_3 - h_4 = 1192 \text{ kJ/kg}$$

$$\eta = \frac{W_T - |W_P|}{\dot{Q}_{OAV}} = \frac{1192 - 7}{3218.2} = 0.368 \sim 0.37$$

c) $\Delta T_{KOND} = ? \quad \dot{m} = 2000 \text{ kg/s} \quad c_p = 4.18 \text{ kJ/kg}$

$$P_{KOND} = \dot{m} c_p \Delta T_{KOND}$$

$$\Delta T_{KOND} = \frac{P_{KOND}}{\dot{m} c_p} = \frac{4.0524 \text{ MW}}{2000 \cdot 4.18} = 484.74 \text{ K}$$

$$P_{KOND} = W_{KOND} \dot{m} = (h_4 - h_1) \dot{m} = 4.0524 \text{ MW}$$

④ MEDUPREGRIJANJE [28. AUD]

$$p_2 = 8 \text{ MPa}$$

$$T_2 = 773.15 \text{ K}$$

$$p_3 = 2 \text{ MPa}$$

$$T_4 = 773.15 \text{ K}$$

$$p_5 = 100 \text{ kPa}$$

$$P_T = 50 \text{ MW}$$

$$h_1 = 3398 \text{ kJ/kg}$$

$$h_2 = 3000 \text{ kJ/kg}$$

$$h_3 = 3567 \text{ kJ/kg}$$

$$h_4 = 2802 \text{ kJ/kg}$$

a) $\dot{m} = ? \quad P_T = W_T \cdot \dot{m}$

$$\dot{m} = \frac{P_T}{W_T} = \frac{50 \text{ MW}}{1263 \text{ kJ/kg}} = 39.59 \text{ kg/s}$$

$$W_T = h_1 - h_2 + h_3 - h_4 = 1263 \text{ kJ/kg}$$

b) $\dot{Q}_{OAV} = ? \quad \dot{Q}_{OAV} = \dot{m} \cdot (-34.25 \text{ MJ})$

$$\dot{Q}_{OAV} = h_4 - h_3 = -865 \text{ kJ/kg}$$

c) $P_T = \dot{m} W_T \quad W_T = 0.88 \cdot 1263 = 1111.44 \text{ kJ/kg}$
 $\dot{m} = \frac{P_T}{W_T} = 45 \text{ kg/s}$

5. [30. AUA.]

$$p_1 = 7 \cdot 10^5 \text{ Pa}$$

$$T_1 = 273.15 \text{ K}$$

$$p_2 = 10^5 \text{ Pa}$$

$$T_2 = 573.15 \text{ K}$$

$$p_{0K} = 10^5 \text{ Pa}$$

$$T_{0K} = 298.15 \text{ K}$$

$$g_{0K} = 8 \text{ kJ/kg}$$

a) $\Delta s_{ZR} = ?$

$$\Delta s_{ZR} = c_p \ln \frac{T_2}{T_1} - R \ln \frac{p_2}{p_1} = 135.41 \frac{\text{J}}{\text{kgK}}$$

b) $\Delta s_{0K} = ?$

$$\Delta s_{0K} = c_p \ln \frac{T_2}{T_{0K}} - R \ln \frac{p_2}{p_{0K}} = 656.82 \frac{\text{J}}{\text{kgK}}$$

c) $W_{pov} = ?$

$$W_{pov} = \Delta u + \frac{p_{0K}}{\rho_{0K}} \Delta \rho_{0K} - T_{0K} \Delta s_{0K}$$

$$\Delta \rho_{0K} = \rho_1 - \rho_{0K}$$

$$\rho_1 = \frac{RT_1}{p_1} = 0.358 \text{ m}^3$$

$$\rho_{0K} = \frac{RT_{0K}}{p_{0K}} = 0.855 \text{ m}^3$$

$$\Delta \rho_{0K} = -0.497 \text{ m}^3$$

$$\Delta u = u_1 - u_{0K} = c_v (T_2 - T_1)$$

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OVOJ FORMULI

OVAJ ZADATAK

(INACE BI MOGLI

DA SMO DOBILI

ICU)

$$W_{pov} = h - h_{0K} - T_{0K} (s - s_{0K})$$

$$W_{pov} = \Delta h - T_{0K} \Delta s_{0K} = 382 \text{ kJ/kg}$$

$$\Delta h = g_{0K} = c_p \Delta T = 577.875 \text{ kJ/kg}$$

$$\Delta T = T_1 - T_{0K} = 375 \text{ K}$$

d) $\cancel{W_{\text{GUB}}} = ?$

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OD ΔS_{OK} KI ΔS_{ZR}

$$W_{\text{GUB}} = \text{ENERGIJA} = T_{\text{OK}} \Delta S_{\text{ZR}} = 40.37 \text{ kJ/kg}$$

6.

$$P_p = 6 \text{ kW}$$

$$\dot{m} = 80 \text{ kg/s}$$

$$p_1 = 6 \text{ kPa}$$

a) $\cancel{p_2} = ?$

$$P_p = \dot{m} W_p$$

$$W_p = \frac{P_p}{\dot{m}} = 75 \text{ J/kg}$$

$$W_p = h_2 - h_1 = v \Delta p = v (p_1 - p_2)$$

$$\underline{W_p} = v (\underline{p_1} - \underline{p_2})$$

$$W_p = v p_1 - v p_2$$

$$p_2 = \frac{v p_1 - W_p}{v} = 69 \text{ kPa}$$

b) DOPRIZDIO MI JE A I NETRIBA
MI TOLIKO BODOVA 😊

ZA TEORIJU SE SWAITE - NOSI 12 B
MIN 8 SKUPIT 1