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MET 350

Test 1

Problem 1) Purpose: Because the generator is ineffective in the original design for an automobile engine with the Brayton cycle with regeneration, we must determine why it is ineffective by finding Network, heat addition, rejection, thermal efficiency, and regenerator effectiveness for the different cases.

Design Assumptions.

$P_1 = 100\ kPa$, cold air stream leaving regenerator exits 10°C below temp of hot air stream entering regenerator, isentropic ($T_3 = T_5 - 10°C$)

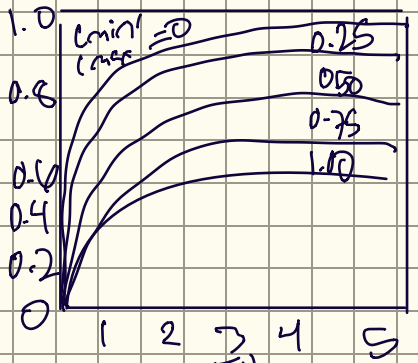
$r_p = 10$

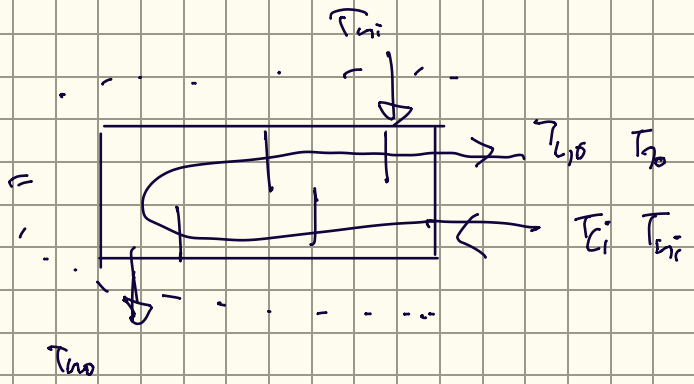
$T_{max} = 600°C = 873.15K$

$T_1 = 30°C = 303K$

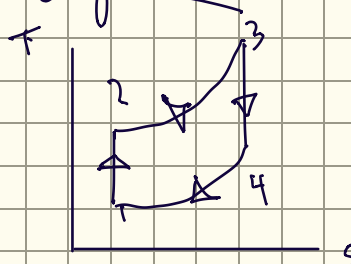
air at 300K: $c_p = 1.0054 \frac{kJ}{kgK}$ (from A-2 Approximate table)

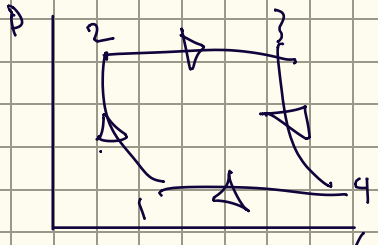
$k = 1.4$



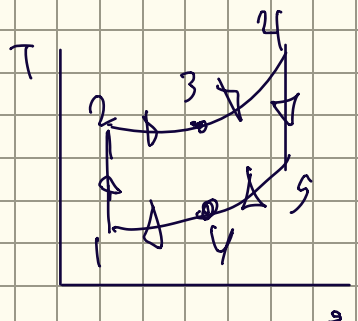


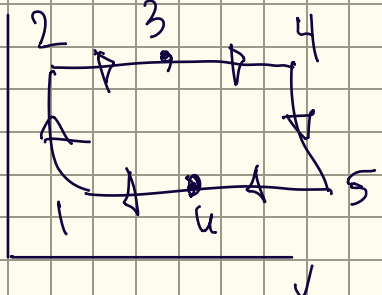
Diagrams





Brayton (No regeneration)





Brayton (Regeneration)

a) $T_2 = T_1 r_p^{\frac{\kappa-1}{\kappa}}$, $T_2 = 303K(10)^{\frac{1.4-1}{1.4}}$ $T_2 = 565.0K$

$T_5 = T_4\left(\frac{1}{r_p}\right)^{\frac{\kappa-1}{\kappa}}$, $T_5 = 1073.15K\left(\frac{1}{10}\right)^{\left(\frac{1.4-1}{1.4}\right)}$ $T_5 = 555.4K$

regeneration should only be used if turbine exhaust is higher.
$T_2 > T_5$, turbine exhaust is not hotter than compressor exit air