CM Box _____

Rose-Hulman Institute of Technology

Foundation Coalition Sophomore Engineering Curriculum

ES202 – Fluid & Thermal Systems Winter 2003-2004

Circle one:

Lui – 01 Lui – 02 Name _____

Sanders – 03 Sanders – 04

Mayhew – 05 Mayhew – 06

Richards – 07 Richards – 08

Exam 1

Jan. 13, 2004

Problem 1	_____/ 40
Problem 2	_____/ 40
Problem 3	_____/ 20
Total	_____/ 100

Show all work for full credit.

Open book, one page of notes, computer use for computational purposes.

EES is NOT allowed

DO NOT INTERPOLATE – USE CLOSEST TABULATED VALUE

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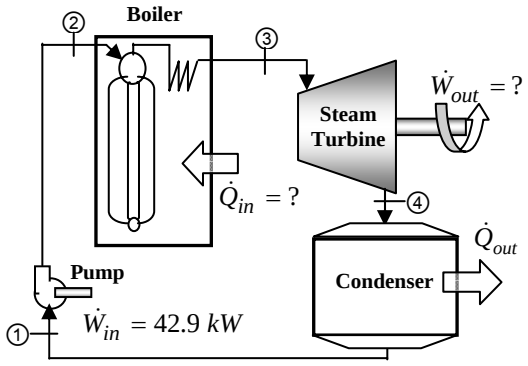
1. (40 pts) The STEAM cycle below operates at the states indicated in the table at the right. The mass flow rate is 10 kg/s. Also the power input to the pump is 42.9 kW.

state	P [kPa]	T [°C]	u [kJ/kg]	h [kJ/kg]	s [kJ/(kg-K)]	x
1	15	53.97	225.92	225.94	0.7549	0.00
2	16000	55	230.19	230.20	0.7679	NA
3	15000				6.3443	NA
4	20	60.06	2280.3	2421.04	7.342	0.92



a) Compute the power output from the turbine in kW.
b) Compute the heat transfer input to the boiler in kW.
c) Compute the thermal efficiency of the power cycle.
d) Compute the turbine adiabatic efficiency.

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2. (40 pts) Analyze the AIR turbine in the diagram at the right. Standard assumptions for a turbine apply.

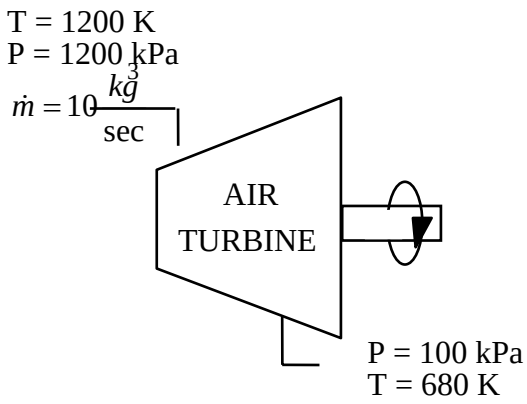
   Also ASSUME AIR IS AN IDEAL GAS and use the AIR TABLE VALUES. .

   (a) Compute the <u>volumetric flow rate</u> at the turbine inlet.

   (b) Compute the <u>power output in kW.</u>

   (c) Compute the <u>turbine efficiency</u>.

   (d) Compute the <u>rate of entropy generation</u> for the turbine.



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Problem 3. (20 Points) Use water (i.e. H_2O) for the following problems.

a. Given: p=3 bar, x=0.4
Find: phase, T, v

b. Given: p=1.5 bar, T=60°C
Find: phase, v, h

c. Given: p=5 bar, h=3356 kJ/kg
Find: phase, T, v

d. Plot and label these 3 points on the p-v diagram below.