Name:_____ **Thermo no.**_____

ME 200

Summer 2011

Final Exam

Friday 5 August

READ THESE INSTRUCTIONS

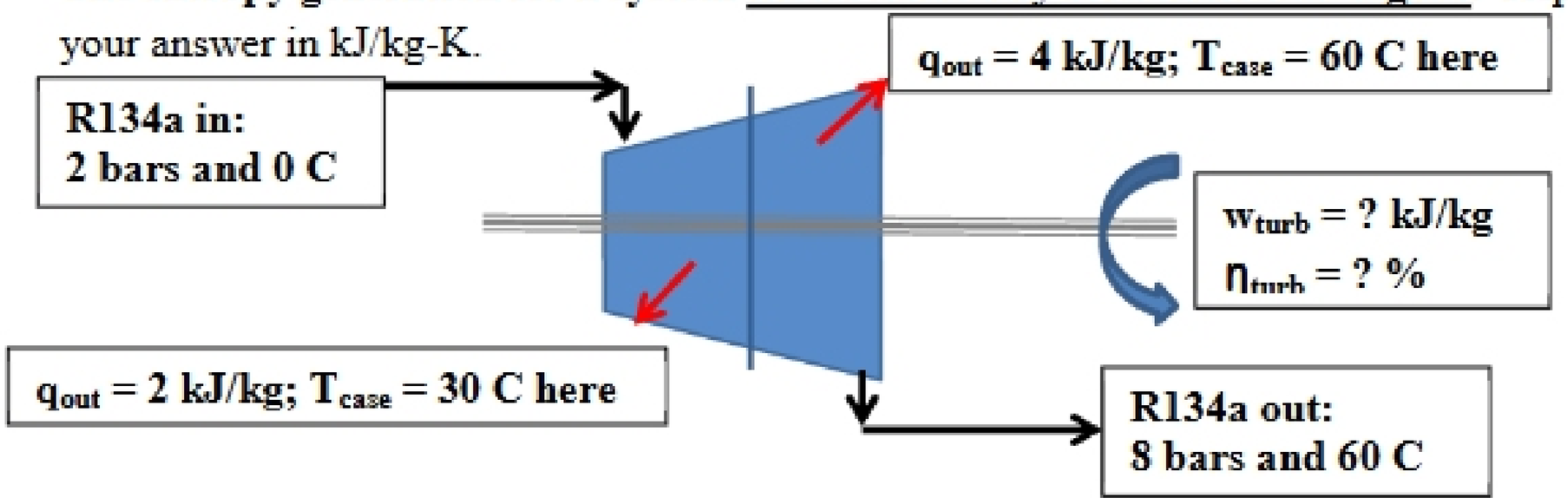
1. This is a closed book examination. All needed property tables, equation sheets and units conversions are provided as attachments to this exam.
2. Do not hesitate to ask questions if you do not understand a problem statement.
3. Start each problem on the same page as the problem statement. Write on only one side (the front) of each page. Material on the back side of any page **will not** be graded. Additional paper will be provided upon request.
4. Put only one problem on each page. A second problem on the same page **will not** be graded.
5. Follow the Problem Solution Format given in class in order to be eligible for full credit.
6. If you provide multiple solutions, you will receive only partial credit even if one of the solutions is correct. Delete the solution(s) you do not want.
7. For your own benefit, please write clearly and legibly.
8. After you have completed the exam, **at your seat**, put your papers in order. This may mean that you have to remove the staple and then re-staple at the front of the room. Regardless, **do not turn in loose pages**.
9. Once time is called you must stop writing **immediately**. Points will be subtracted from those writing after this time (**not kidding** on this one—it's a pet peeve of mine).

Problem	Possible score	Your score
1		
2		
3		
Total	**200**	

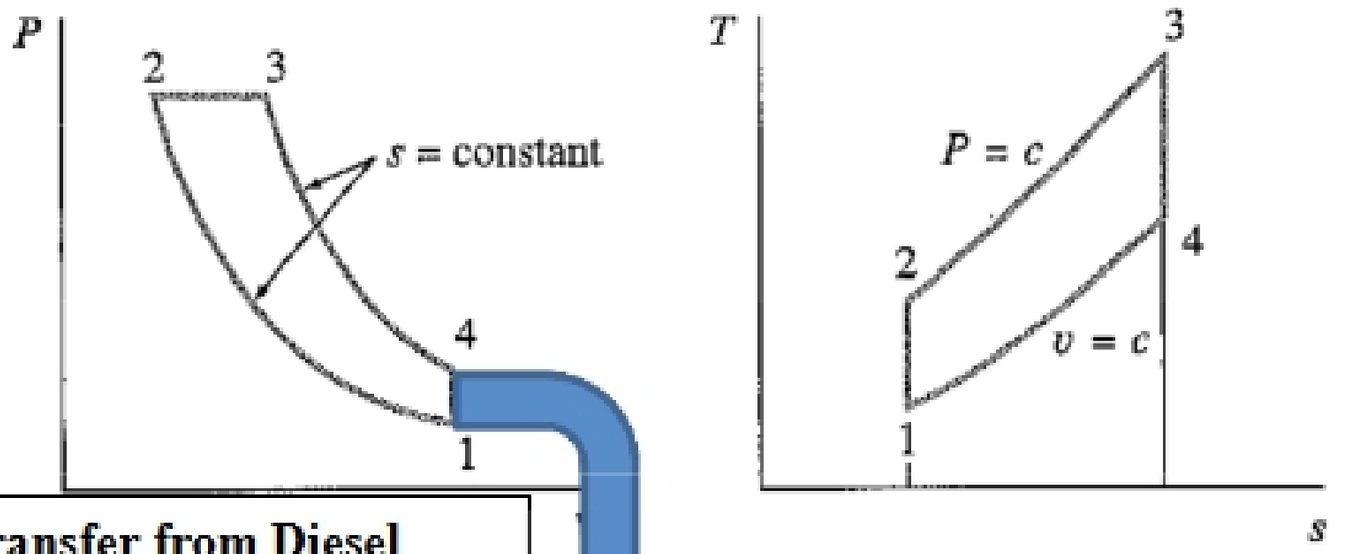
[?? points] A vapor compression refrigeration system uses R134a as the working fluid. The compressor has inlet and outlet conditions of 1.8 bar/-10 C and 8 bar/60 C, respectively.

The compressor loses heat to the surroundings (25 C) as follows: 2 kJ/kg crosses the compressor case at 30 C before entering the surroundings while 4 kJ/kg crosses the compressor case at 60 C before entering the surroundings. Find the following:

- **The work supplied to the compressor.** Report your answer in kJ/kg.
- **The compressor isentropic (2nd Law) efficiency.** Report your answer in %.
- **The entropy generation for a system whose boundary is the compressor case**. Report your answer in kJ/kg-K.
- **The entropy generation for a system whose boundary is the surrounding air**. Report your answer in kJ/kg-K.



[?? Points] Combined cycles come in many guises. One is shown below where an ideal air standard Diesel engine is mated to an ideal Rankine steam cycle power plant. In this case the Diesel engine exhaust is used as the heat source for the Rankine cycle boiler. See the figure below. Information for Diesel and Rankine cycle states is contained in the corresponding table.



The Diesel engine has a compression ratio of 10.0 and 842 kJ/kg is added to the air during the combustion process (2 to 3). The steam turbine produces 2 MW of power.

Diesel cycle		*Rankine cycle*		*State*
h, kJ/kg	**T, K**	**p, bar**	**T, K**	
300.19	300	20	500	1
?	?	0.1	s2 = s1	2
?	?	0.1	sat.liq	3
?	?	20	comp. liq	4

Use this information to compute the following:

- **The temperature for each state in the Diesel cycle, along with its corresponding enthalpy**. Report the former in K and the latter in kJ/kg.
- **The Diesel engine cycle thermal efficiency.** Report your answer in %.
- **The enthalpy for each Rankine cycle state, along with its temperature.** Report the former in kJ/kg and the latter in K.
- **The Rankine cycle thermal efficiency.** Report your answer in %.
- **The thermal efficiency for the combined (Diesel + Rankine) cycle.** Report your answer in %.