Name:____________________________ Instructor:____________ Section:__________ ENGR 222 - Quiz 4

Allowed Materials: *pencils and/or pens.*

ExamForm := 45

Honor Statement: *On my honor, I promise that I have not received any unauthorized assistance on this exam (I didn't look at another student's paper, I didn't view any unauthorized written materials, I didn't talk or listen to another student, I didn't use an unauthorized calculator, I didn't use any electronic device, any visual or auditory signals, or any other techniques of exchanging information with others.) I have maintained the highest standards of academic integrity while completing this exam.*

*Signed:*____

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1. *(2 point deduction for failure to complete this problem!)*

Bubble:
01
02
03

For Course Section:	
001	Hollins
002	Reeves
003	Reis

- Write in all of the indicated information in the boxes of your response form.
- Darken the appropriate circles to encode the corresponding information.
- Write your name on this exam and sign the Honor Statement.

Notes:

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- **"F.I."** and **"M.I."** are your first and middle initials, respectively
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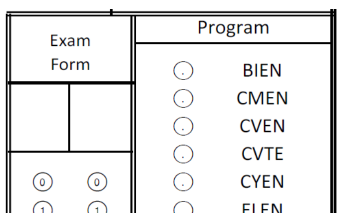
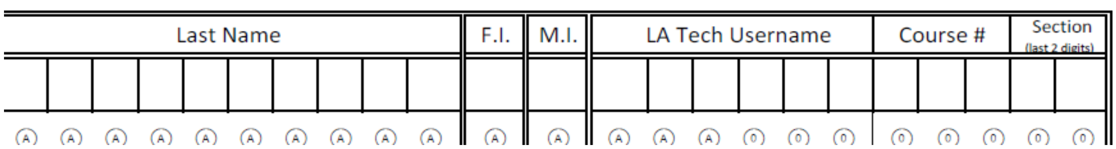




$$\text{Choices} = \begin{pmatrix} \text{"A"} & \text{"I properly completed all required items in problem 1, so I will not lose these points"} \\ \text{"B"} & \text{"I did not properly complete problem 1 because I am fine with losing these points."} \end{pmatrix}$$

Please put your final answers on the answer sheet that was given to you. You must show your work to receive full credit.

The words "steam" and "water" may be used interchangably. Check the tables to determine the phase of the system.

Unless the problem states otherwise, assume that the atmospheric pressure is 101.325 kPa or 14.7 psia.

Read the questions carefully and CHECK YOUR UNITS.

You may write on the exam. There is additional space on the back if you need it.

If you made any marks in your steam table, please erase them before turning in your packet.

Good luck!

2. (10 points) Which of these devices can be used to greatly increase the pressure of a gas?

$$\text{Choices} = \begin{pmatrix} \text{"A"} & \text{"throttling valve"} \\ \text{"B"} & \text{"fan"} \\ \text{"C"} & \text{"pump"} \\ \text{"D"} & \text{"compressor"} \\ \text{"E"} & \text{"nozzle"} \\ \text{"F"} & \text{"turbine"} \end{pmatrix}$$

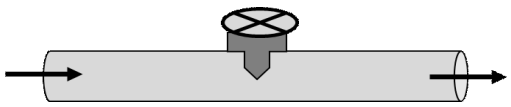
3. (10 points) A device commonly used in air conditioners and refrigerators to significantly drop the temperature of a fluid without the aid of another fluid or work input is a _____.

$$\text{Choices} = \begin{pmatrix} \text{"A"} & \text{"compressor"} \\ \text{"B"} & \text{"nozzle"} \\ \text{"C"} & \text{"pump"} \\ \text{"D"} & \text{"throttling valve"} \\ \text{"E"} & \text{"fan"} \\ \text{"F"} & \text{"heat exchanger"} \end{pmatrix}$$

4. (10 points) A volume balance can be performed on an open system if the flow is _____.

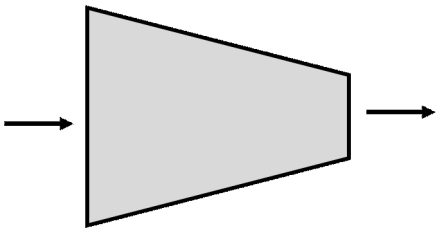
$$\text{Choices} = \begin{pmatrix} \text{"A"} & \text{"heated"} \\ \text{"B"} & \text{"insulated"} \\ \text{"C"} & \text{"incompressible"} \\ \text{"D"} & \text{"isothermal"} \\ \text{"E"} & \text{"gaseous"} \\ \text{"F"} & \text{"isobaric"} \end{pmatrix}$$

5. (10 points) R-134a flows through a throttling valve at a rate of 7.5 lbm/s. The refrigerant enters the throttling valve at 80 psia and $\text{temperature} = 40 \cdot °\text{F}$ and leaves at 30 psia. The quality of the R-134a at the exit is closest to:



$$\text{Choices} = \begin{pmatrix} \text{"A"} & 0.0711 \\ \text{"B"} & 0.0801 \\ \text{"C"} & 0.0891 \\ \text{"D"} & 0.0981 \\ \text{"E"} & 0.1071 \\ \text{"F"} & 0.1160 \\ \text{"G"} & \text{"there is no quality"} \\ \text{"H"} & \text{"not enough information"} \end{pmatrix}$$

6. (10 points) Air passes through a nozzle at a $\text{rate} = 0.067 \cdot \frac{\text{kg}}{\text{s}}$. The air exits through the nozzle, which has an (exit) $\text{area} = 71 \cdot \text{mm}^2$, at 800 kPa and 350 K. The velocity of air at the exit is closest to:

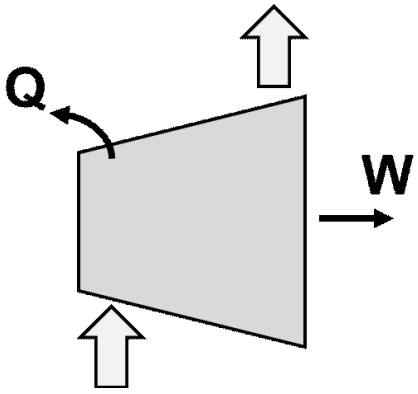


$$\text{Choices} = \begin{pmatrix} \text{"A"} & 79.16 \\ \text{"B"} & 92.30 \\ \text{"C"} & 105.37 \\ \text{"D"} & 118.49 \\ \text{"E"} & 131.62 \\ \text{"F"} & 144.72 \\ \text{"G"} & 157.92 \\ \text{"H"} & \text{"not enough information"} \end{pmatrix} \cdot \frac{\text{m}}{\text{s}}$$

7. (10 points) A rigid tank $\text{contains} = 2.8 \cdot \text{m}^3$ of air $\text{at} = 210 \cdot \text{kPa}$ and 22°C. The tank is connected through a valve to an air supply line carrying air at 600 kPa and 22°C. The valve is opened long enough for the air inside the tank to reach a pressure of 600 kPa and then the valve is closed. At the end of the process, a thermometer inside the tank reads the final air temperature at 77°C. Assuming constant specific heats (at 300K), the heat transfer out of the tank is closest to:

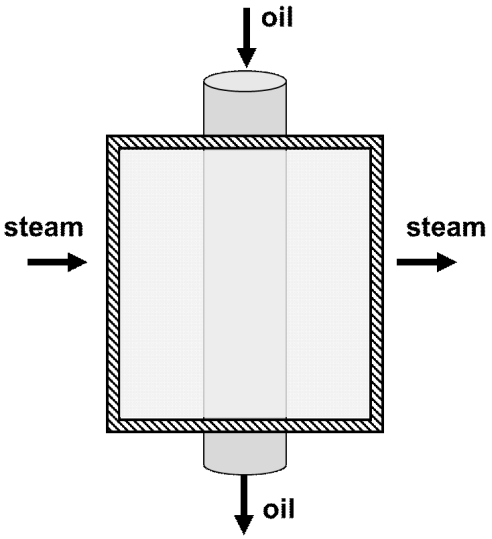
$$\text{Choices} = \begin{pmatrix} \text{"A"} & 167.9 \\ \text{"B"} & 183.2 \\ \text{"C"} & 198.3 \\ \text{"D"} & 213.7 \\ \text{"E"} & 228.8 \\ \text{"F"} & 244.0 \\ \text{"G"} & 259.2 \\ \text{"H"} & \text{"not enough information"} \end{pmatrix} \cdot \text{kJ}$$

8. (10 points) Steam enters a turbine at a $\text{rate} = 72 \cdot \frac{\text{kg}}{\text{s}}$ at 1.4 MPa and 800°C. It leaves the turbine at 150 kPa and with a quality of $x = 0.97$. The turbine also $\text{loses} = 550 \cdot \frac{\text{kJ}}{\text{kg}}$ of heat. Assuming any changes in kinetic and potential energy are negligible, the rate of work output from the turbine is closest to:



$$\text{Choices} = \begin{pmatrix} \text{"A"} & 63.33 \\ \text{"B"} & 70.41 \\ \text{"C"} & 77.51 \\ \text{"D"} & 84.62 \\ \text{"E"} & 91.73 \\ \text{"F"} & 98.79 \\ \text{"G"} & \text{"not enough information"} \end{pmatrix} \cdot \text{MW}$$

9. (10 points) An insulated heat exchanger uses steam to heat up a liquid stream of (light) oil. The steam enters the heat exchanger at a $\text{rate} = 3.1 \cdot \frac{\text{kg}}{\text{s}}$ and at 500°C and 1 MPa. The steam leaves the heat exchanger as a saturated liquid at the same inlet pressure. Oil enters the heat exchanger at a rate of 100 kg/s and at an initial $\text{temperature} = 25 \cdot °\text{C}$. Assuming that the specific heat of oil is constant (and does not experience any phase change), the temperature of the oil when it leaves is closest to:



$$\text{Choices} = \begin{pmatrix} \text{"A"} & 64.5 \\ \text{"B"} & 68.2 \\ \text{"C"} & 71.8 \\ \text{"D"} & 75.4 \\ \text{"E"} & 79.1 \\ \text{"F"} & 82.7 \\ \text{"G"} & \text{"not enough information"} \end{pmatrix} \cdot °\text{C}$$

10. (10 points) Water enters an insulated chamber in two streams (1 and 2) and leaves the chamber in a single stream. Some values are given below. Neglecting changes of kinetic and potential energy, determine the velocity of the outlet stream.

$T_1 = 900 \cdot °C$ $P_1 = 400 \cdot kPa$ $P_2 = P_1 = P_{out}$ $D_{out} = 42 \cdot cm$

$m_{dot1} = 0.3 \frac{kg}{s}$ $m_{dot2} = 0.6 \frac{kg}{s}$ $x_2 = 36 \cdot \%$

$$Choices = \begin{pmatrix} "A" & 2.27 \\ "B" & 2.50 \\ "C" & 2.73 \\ "D" & 2.96 \\ "E" & 3.18 \\ "F" & 3.41 \\ "G" & 3.64 \\ "H" & 3.86 \end{pmatrix} \frac{m}{s}$$

11. (10 points) Air flows through an adiabatic compressor; the inlet conditions and some exit conditions are listed below. The mechanical power input is $W_{dot} = 4.2 \cdot kW$. Find the mass flow rate of the air.

Tip: Do not assume a constant specific heat.

$T_1 = 210\,K$ $P_1 = 100 \cdot kPa$ $P_2 = 750 \cdot kPa$ $v_2 = 0.336747 \frac{m^3}{kg}$

$$Choices = \begin{pmatrix} "A" & 3.88 \\ "B" & 4.30 \\ "C" & 4.72 \\ "D" & 5.14 \\ "E" & 5.57 \\ "F" & 5.99 \\ "G" & 6.42 \\ "H" & 6.84 \end{pmatrix} \cdot 10^{-3} \frac{kg}{s}$$

END OF EXAM

Bubble:
01
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For Course Section:	
001	Hollins
002	Reeeves
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ExamForm = 45

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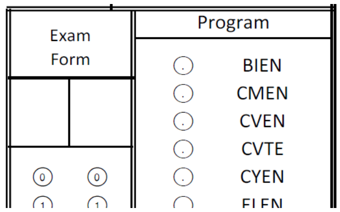

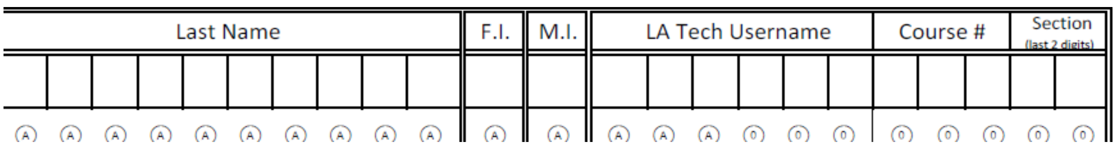

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Unless the problem states otherwise, assume that the atmospheric pressure is 101.325 kPa or 14.7 psia.

Read the questions carefully and CHECK YOUR UNITS.

If a question does not contain enough information to solve, please select the appropriate answer "not enough information".

You may write on the exam. There is additional space on the back if you need it.

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Good luck!

ExamForm = 45

Key =

	1
1	"A"
2	"D"
3	"D"
4	"C"
5	"C"
6	"D"
7	"A"
8	"B"
9	"C"
10	"B"
11	"F"
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