I. Class Notes, Examples and Quizzes
Review all class notes, examples and quizzes. Do you understand all of the concepts that were presented and discussed? Could you solve the examples and quizzes without looking at the solutions?

II. Homework Problems
Be able to solve all of the homework problems without having to look at the solutions.

III. Old Exams
The ME 200 website (https://engineering.purdue.edu/ME200/) has a previous exam (Exam 1). Try to solve the exam in the time normally allotted for this 1.5-hour exam. You can review the exams solutions but it would better if you tried to solve problems without looking at the solution.

IV. Some Additional Practice Problems

1. Answer the following short questions:

A. Which assumptions are required in order to apply the equation \( W_{12} = P (V_2 - V_1) \) to a system? Circle all that apply.
   a) ideal gas, b) incompressible, c) constant pressure process, d) quasi-equilibrium process

B. A quantity of water is being stored at 20 bar and 50°C. Which choice is closest to the specific internal energy of the water in kJ/kg?
   a) 906.44, b) 2600.3, c) 209.33, d) 2443.5
   Which choice is closest to the specific enthalpy of the water in kJ/kg?
   a) 209.33, b) 2592.1, c) 908.79, d) 211.2

C. Water at a pressure of 500 kPa and temperature of 500°C is contained in the piston-cylinder arrangement shown. There is a heat transfer from the water and the piston begins to move when the pressure reaches 100 kPa. There is an additional heat transfer until the temperature is 20°C. Depict the process that the water undergoes on a \( P-v \) diagram with respect to saturation lines and indicate which phases are present at the beginning of the process, when the piston begins to move, and at the end of the process. Show appropriate isothermal lines.

D. Fill in the blanks in the following table for the properties of water.

<table>
<thead>
<tr>
<th></th>
<th>( P, \text{kPa} )</th>
<th>( T, \text{C} )</th>
<th>( x, % )</th>
<th>( v, \text{m}^3/\text{kg} )</th>
<th>( u, \text{kJ/kg} )</th>
<th>Table used</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>300</td>
<td>200</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>b</td>
<td>300</td>
<td>65</td>
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<td></td>
<td></td>
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<tr>
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<td></td>
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</tr>
</tbody>
</table>
E. Air treated as an ideal gas is expanded to a lower pressure in a closed piston cylinder device and heat transfer occurs from the surroundings so that temperature remains constant. What happens to the internal energy of the air as it is expanded? a) increases, b) decreases, c) remains the same, d) not enough information. Justify using appropriate equations.

2. A small, un-insulated closed cylinder with a freely moving piston contains air and is accidentally dropped into a lake and falls slowly to the bottom at 100 m below the surface. Initially, the air in the cylinder is at atmospheric pressure of 100 kPa with a volume of 0.1 m$^3$ and a temperature of 20°C. The lake is also at a uniform and constant temperature of 20°C. As the cylinder falls, the air is compressed and there is a heat transfer for the air so that its temperature remains nearly constant at 20 C. Since air can be treated as an ideal gas this implies that the product of pressure and volume is constant ($PV = \text{constant}$).

Neglect the mass of the piston, friction, air leakage from the cylinder, potential energy and kinetic energy effects for the air and determine the following:

a) Final pressure (kPa) of the air at the lake bottom.
b) Final volume (m$^3$) of the air at the lake bottom.
c) Work done (kJ) by the air in the device for entire process.
d) Heat transfer (kJ) to the air.

3. A used refill container for an automotive air conditioner contains 250 g of R134a. The container is made of steel and has an internal volume of 500 cm$^3$. Initially the container is in the house at a temperature of 20°C. However, the owner brings the bottle outside in the hot sun and the container and R134a temperature rises to 52°C. Do the following:

a) Determine the initial pressure (kPa) of the R134a at the initial temperature.
b) Determine the final pressure (kPa) of the R134a at the final temperature.
c) Depict the process for the R134a on a $P$-$V$ diagram with respect to saturation lines showing appropriate isothermal lines.
d) Determine the work done (kJ) by the R134a.
e) Determine the heat transfer (kJ) to the R134a.

4. Given the three processes below for a gas noting that the process $3 \rightarrow 1$ returns the closed system to the original state:

1$\rightarrow$2: $PV = \text{constant}$, $U_2 - U_1 = 0$ (isothermal), $P_1 = 1$ bar, $V_1 = 1.6$ m$^3$, $V_2 = 0.2$ m$^3$
2$\rightarrow$3: $P_3 = P_2$, $V_3 = V_1$
3$\rightarrow$1: $V = \text{constant}$, $U_1 - U_3 = -3549$ kJ

a) Draw the process on a $P$-$V$ diagram.
b) Determine work and heat transfer (kJ) for each process.
5. Water in a piston cylinder with piston having negligible mass, sitting on stops & exposed to ambient pressure as shown with the following conditions: \( V_1 = 1 \text{ m}^3 \), \( m_{\text{water}} = 5 \text{ kg} \), \( T_1 = 50^\circ \text{C} \), \( P_{\text{atm}} = 100 \text{ kPa} \)

a) Determine \( P_1 \) and \( u_1 \).

b) The mixture is then heated until the piston just begins to move. Determine \( P_2 \), \( u_2 \), and \( Q_{12} \). Show the process on a \( P-v \) diagram.

c) The process continues until all the water is a saturated vapor. Show the process on a \( P-v \) diagram. Determine \( P_3 \), \( u_3 \), and \( Q_{23} \).

d) There is a heat transfer until the water temperature is 200 C. Show the process on a \( P-v \) diagram. Determine \( u_4 \) and \( Q_{34} \).

6. An insulated tank is divided into two parts by a partition. One part of the tank contains 2.5 kg of compressed liquid water at 60°C and 600 kPa while the other part is evacuated. The partition is now removed, and the water expands to fill the entire tank. The final pressure is 10 kPa.

a) Determine the final temperature (°C) of the water.

b) Determine the volume (m³) of the tank.

7. A balloon is filled with air and initially occupies a volume of 10 cm³ at a pressure of 150 kPa and temperature of 20°C. The balloon is then moved to warmer environment of 40°C and comes into thermal equilibrium with a final volume of 10.5 cm³. Assuming ideal gas behavior and a polytropic process for the air (\( P_v^n = \text{constant} \)) then determine the: a) work done by the air (J), b) heat transfer to the air (J).