MAE 110A - Homework Assignment Requirements

Homework assignments have the following requirements. **Any homework not following these requirements will be returned ungraded**.

1. All homework must be done **neatly** on $8\frac{1}{2} \times 11$ paper (single-sided on clean, new paper, stapled together, no frayed edges) with each problem and final solution **clearly indicated**. The following information must appear on the **first/cover page**:

   - Name and Date
   - Course number
   - Homework number

   Illegible homework will be returned ungraded.

2. The following is the **standard format** for organizing and presenting the solution to each homework problem† (See sample solution on next page):

   (a) **Problem Description** - include the following (* very important):
   - Basic description and given information
   - *Sketch of problem/geometry and **system** considered (use dashlines for system)
   - Initial state (knowns and unknowns)
   - Final state (knowns and unknowns)
   - *Appropriate property diagrams (indicate state points, process lines)
   - What is to be determined

   (b) **Engineering Model** - list all required simplifying assumptions and idealizations.

   (c) **Basic Equations** - general form of relevant fundamental laws, equations, definitions.

   (d) **Analysis**
   - clear description of procedure to reduce basic equations to give solution.
   - keep equations in variable form (no numbers) for as long as possible.
   - identify all tables and charts needed for additional data, property values (e.g., "..from Table B.1.1").
   - substitute numerical values into final equations. be sure to specify all units and unit conversions.
   - clearly indicate final answer(s) with underline or box.
   - check solution - correct sign, reasonable numerical values?)

   (e) **Discussion of Solution** - as needed (what you learned, key aspects of solution, etc).

   † Note: Some of the problems (e.g., Ch 1 problems) may not require all the above items. Follow the standard format as best as you can or as appropriate.

3. Grades will be determined by student's:

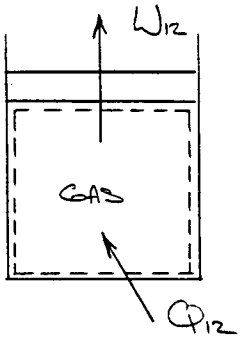
   - Understanding of the problem.
   - Identification of necessary procedure to obtain solution.
   - Clear and precise description of solution.
   - Correct numerical answers.

MAE 110A - Sample Homework Solution

1.1

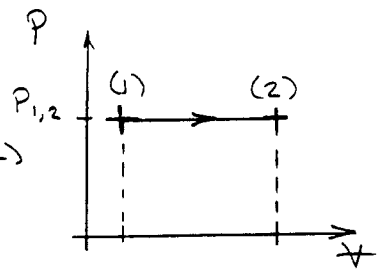
PROBLEM DESCRIPTION:

A FRICTIONLESS PISTON IS RAISED SLOWLY BY HEATING THE GAS CONTAINED IN THE CYLINDER.



GIVEN:

$p_1 = 0.2$ MPa
$p_2 = p_1$ (CONSTANT PRESSURE)
$\forall_1 = 1.0\ m^3$
$\forall_2 = 2.0\ m^3$
$Q_{12} = 2000$ kJ $= 2$ MJ



DETERMINE: CHANGE IN INTERNAL ENERGY, ΔU_{12}

ENGINEERING MODEL:
1. QUASI-EQUILIBRIUM PROCESS
2. SYSTEM IS THE GAS ONLY.
3. NEGLIGIBLE KINETIC AND POTENTIAL ENERGY EFFECTS.

BASIC EQUATIONS:

1ST LAW FOR CLOSED SYSTEM: $Q_{IN} + W_{IN} = Q_{OUT} + W_{OUT} + \Delta KE + \Delta PE + \Delta U$ (1)

WORK: $W_{12} = \int_1^2 p\,d\forall$ (2)

STEPS:

APPLY 1ST LAW TO SYSTEM:

$$Q_{IN,12} = W_{OUT,12} + \cancel{\Delta KE}^{\,(3)} + \cancel{\Delta PE}^{\,(3)} + \Delta U_{12}$$

SOLVING FOR ΔU_{12}: $\Delta U_{12} = Q_{IN,12} - W_{OUT,1,2}$ (3)

TO DETERMINE $W_{OUT,12}$, USE EQU. (2):

$$W_{OUT,12} = |W_{12}| = \left| \int_1^2 p\,d\forall \right|$$

$$W_{OUT,12} = |p(\forall_2 - \forall_1)| \quad (4)$$

SUBSTITUTING (4) INTO (3):

$$\Rightarrow \Delta U_{12} = U_2 - U_1 = Q_{IN,12} - |p(\forall_2 - \forall_1)| \quad (5)$$

NUMERICAL SUBSTITUTION:

EQU (4) $\rightarrow$ $W_{OUT,12} = 0.2\ \text{MPa}(2. - 1.)\ m^3 \left(\frac{1\ N/m^2}{1\ Pa}\right)\left(\frac{1\ J}{1\ N\cdot m}\right) = 0.2$ MJ

EQU (5) $\rightarrow$ $\Delta U_{12} = 2 - 0.2 = \boxed{1.8\ \text{MJ}}$