(1) Answer the following questions in details : (3% for each subproblems)

(a) A can of soft drink at room temperature is put into the refrigerator so that it will cool. Would you model the can of soft drink as a close or open system ? Explain.

(b) What is the difference between gage pressure and absolute pressure ?

(c) What is the physical significance of h_{fg} ? Can it be obtained from a knowledge of h_f and h_g ?

(d) What is the physical significance of the compressibility factor Z in ideal gas analysis ?

(e) In what forms can energy across the boundaries of a system ?

(f) A fixed mass of ideal gas is heated from 50 to 80°C at a constant pressure of (a) 1 atm and (b) 3 atm. For which case do you think the energy required will be greater ?Why ?

(g) Under what conditions can an unsteady-flow process be approximated as a uniform-flow process ?

(h) What is a thermal energy reservoir ? Give some examples.

(i) A heat pump that is used to heat a house has a COP of 2.5. That is, the heat pump delivers 2.5 kWh of energy to the house for each 1 kWh of electricity it consumes. Is this a violation of the first law of thermodynamics ? Explain.

(j) How does mass transfer affect the entropy of a control volume ?

(2) A frictionless piston-cylinder device, shown in Fig. 1, initially contains 0.01 m^3 of argon gas at 400 K and 350 kPa. Heat is now transferred to the argon from a furnace at 1200 K, and the argon expands isothermally until its volume is doubled. No heat transfer takes place between the argon and the surrounding atmospheric air which is at T_0 = 300 K and P_0 = 100 kPa. Determine (a) the useful work output (6%), (b) the reversible work (7%), and (c) the irreversibility for this process (7%).

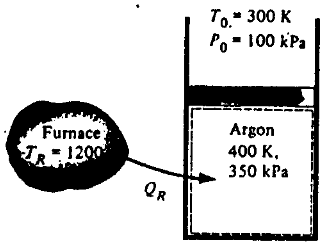

Fig 1.

3. Define adiabatic flame temperature. What influence does excess air have on its value? What effect does dissociation have on its value? (8%)

4. An ideal Stirling cycle uses 1kg of nitrogen as a working fluid. The N_2 begins its isothermal-expansion process at 1000 K and 500 kPa, and during the expansion process the volume of the nitrogen increases by a factor of 5. The temperature of the low-temperature reservoir is 20°C. Draw the $P-v$ process diagram for the cycle. Calculate the following:

(a) the heat transfer with the regenerator per cycle

(b) the net work per cycle

(c) the heat transfer with both reservoirs per cycle

(d) the thermal efficiency of the cycle

(e) the irreversibility of the cycle ($T_L = T_0 = 20°C$)

Assume the specific heats are constant and $R = 0.296\ KJ/Kg{\cdot}K$, $C_p = 1.039 KJ/Kg{\cdot}K$. (20%)

5. An air-water vapor mixture is contained in a rigid, closed vessel with a volume of 35 m^3 at 1.5bar, 120°C, and 10% relative humidity. The mixture is cooled until its temperature is reduced to 20°C. Determine (a) the dew point temperature corresponding to the initial state, in °C, (b) the temperature at which condensation begins, in °C, and (c) the amount of water condensed, in kg. (22%)

TABLE Specific volume of Saturated Water (Liquid-Vapor)

Temp. °C	Press. bars	Specific volume cm³/g Sat. liquid v_f	Sat. vapor v_g
15	0.01705	1.0009	77926
16	0.01818	1.0011	73333
17	0.01938	1.0012	69044
18	0.02064	1.0014	65038
19	0.02198	1.0016	61293
20	0.02339	1.0018	57791
21	0.02487	1.0020	54514
22	0.02645	1.0022	51447
23	0.02810	1.0024	48574
24	0.02985	1.0027	45883
35	0.05628	1.0060	25216
36	0.05947	1.0063	23940
38	0.06632	1.0071	21602
40	0.07384	1.0078	19523
45	0.09593	1.0099	15258
50	.1235	1.0121	12032
55	.1576	1.0146	9568
60	.1994	1.0172	7671
65	.2503	1.0199	6197
70	.3119	1.0228	5042
100	1.014	1.0435	1673.
110	1.433	1.0516	1210.
120	1.985	1.0603	891.9
130	2.701	1.0697	668.5
140	3.613	1.0797	508.9

Press. bars	Temp. °C	Specific volume cm³/g Sat. liquid v_f	Sat. vapor v_g
.04	28.96	1.0040	34800
.06	36.16	1.0064	23739
.08	41.51	1.0084	18103
0.10	45.81	1.0102	14674
0.20	60.06	1.0172	7649
0.30	69.10	1.0223	5229.
0.40	75.87	1.0265	3993.
0.50	81.33	1.0300	3240.
0.60	85.94	1.0331	2732.
0.70	89.95	1.0360	2365.