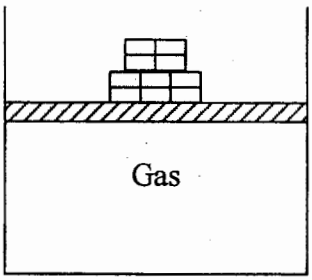
※ 考生請注意：本試題可使用計算機。 請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

I. Explain the following terms: (40%)

(1) State
(2) specific volume
(3) Work
(4) Thermal efficiency
(5) Enthalpy
(6) Constant-pressure specific heat
(7) Second law of thermodynamics
(8) Carnot cycle
(9) Inequality of Clausius
(10) Reversible process

II. Consider as a system the gas contained in the cylinder shown in the following figure which is fitted with a piston on which a number weights are placed. The initial pressure is 200 kPa and the initial volume of the gas is 0.04 m^3. (15%)



(a) Let a Bunsen burner be placed under the cylinder, and let the volume of the gas increase to 0.1 m^3 while the pressure remains constant. Calculate the work done by the system during the process.

(b) Consider the same system and initial conditions, but at the same time that Bunsen burner is under the cylinder and the piston is rising, let weights be removed from the piston at such a rate that, during the process, the relation between pressure and volume is given by the expression $PV = \text{constant} = P_1V_1 = P_2V_2$. Let the final volume be again be 0.1 m^3. Calculate the work done by the system during the process.

(c) Consider the same system, but during the heat transfer let the weights be removed at such a rate that the expression $PV^{1.3}$ = constant describes the relation between pressure and temperature during the process. Again the final volume is m^3. Calculate the work.

III. The mass rate of flow into a steam turbine is 1.5 kg/s, and the heat transfer from the turbine is 8.5 kW. The following data are known for the steam entering and leaving the turbine.

	Inlet	Exit
Pressure	2.0 Mpa	0.1 Mpa
Temperature	350 °C	
Quality		100%
Velocity	50 m/s	200 m/s
Elevation above reference plane	6 m	3 m

Determine the power output of the turbine. (10%)

Hint: g = 9.8066 m/s^2. The enthalpy at the inlet (h_i) is 3137.0 kJ/kg and the enthalpy at the exit (h_e) is 2675.5 kJ/kg.

IV. Consider the simple steam power plant, as shown in the following figure. The following data are for such a power plant. (16%)

	Location	Pressure	Temperature or quality
(1)	Leaving boiler	2.0 Mpa	300 °C
(2)	Entering turbine	1.9 Mpa	290 °C
(3)	Leaving turbine, entering condenser	15 kPa	90%
(4)	Leaving condenser, entering pump	14 kPa	45 °C
Pump work = 4 kJ/kg			

（背面仍有題目，請繼續作答）

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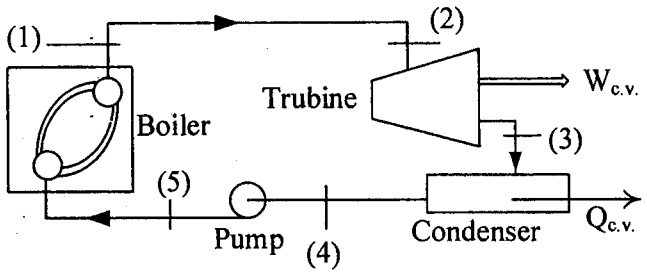
Determine the following quantities per kilogram flowing through the unit.

1. Heat transfer in line between boiler and turbine.
2. Turbine work.
3. Heat transfer in condenser.
4. Heat transfer in boiler.

Hint: $h_1 = 3023.5$ kJ/kg, $h_2 = 3002.5$ kJ/kg, $h_3 = 2361.8$ kJ/kg and $h_4 = 188.5$ kJ/kg.



V. Carbon dioxide is compressed in a reversible polytropic process from an initial state of 750 kPa and 30 °C to a final pressure 120 kPa. The polytropic exponent is n = 1.3. Calculate the change in entropy per kg-mass of carbon dioxide. The constant-pressure specific heat (Cp) and gas constant (R) are 0.8418 kJ/kg·K and 0.18892 kJ/kg·K. (10%)

VI . Make a comparison between point and path functions. Give an example. (9%)