Part I 觀念題 58 points

Identifying critical points, triple lines (points), single phases, two phases regions on figures (a) 4%, (b) 4%, and (c) 4%. Which figure(s) is (are) for a substance that contracts on freezing. 3%

Determine the phase for the following refrigerant R-22 states: (a) 1.0 MPa, 20℃ (b) -20℃, 200 kPa. Place these two states in P-v diagram and T-v diagram, respectively. 10%
Explain briefly (1) why solid carbon dioxide is commonly known as dry ice? (2) can solid water be dry ice at room pressure and temperature? 4%

Why is Helium a gas and why are most metals solids, at the room temperature and pressure conditions? 4%

What is the "internal energy" of the mass? Derive it. 12%. Why tables of thermodynamic properties contain the "internal energy" not the "energy"? 3%

Clearly state the first law for a control mass system undergoing the following thermodynamic cycle. State clearly the processes comprising this cycle. 10%

Part II 計算題 每題 12 分 五題中擇四題作答 48 points

A piston/cylinder arrangement shown in Fig.1 initially contains air at 150 kPa, 400℃. The setup is allowed to cool to the ambient temperature of 20℃.
a. Is the piston resting on the stops in the final state? What is the final pressure in the cylinder?
b. What is the specific work done by the air during this process?

Ammonia at 10℃ with a mass of 10 kg is in a piston cylinder arrangement with an initial volume of 1 m^3. The piston initially resting on the stops has a mass such that a pressure of 900 kPa will float it. The ammonia is now slowly heated to 50℃. Find the work in the process.

A rigid tank is divided into two rooms by a membrane, both containing water, shown in Fig.2. Room A is at 200 kPa, v = 0.5 m^3/kg, VA = 1 m^3, and room B contains 3.5 kg at 0.5 MPa, 400℃. The membrane now ruptures and heat transfer takes place so the water comes to a uniform state at 100℃. Find the heat transfer during the process.

A vertical cylinder fitted with a piston contains 5 kg of R-22 at 10℃, shown in Fig.3. Heat is transferred to the system, causing the piston to rise until it reaches a set of stops at which point the volume has doubled. Additional heat is transferred until the temperature inside reaches 50℃, at which point the pressure inside the cylinder is 1.3 MPa.

a. What is the quality at the initial state?

b. Calculate the heat transfer for the overall process.

A piston/cylinder has nitrogen gas at 750 K and 1500 kPa. Now it is expanded in a polytropic process with n = 1.2 to P = 750 kPa. Find the final temperature, the specific work and specific heat transfer in the process.

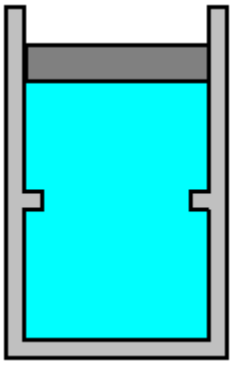

Fig.1

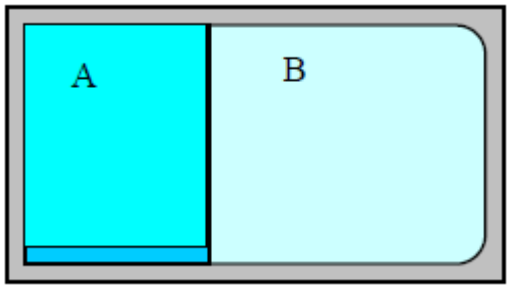

Fig.2

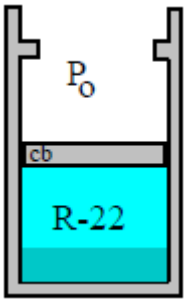

Fig.3

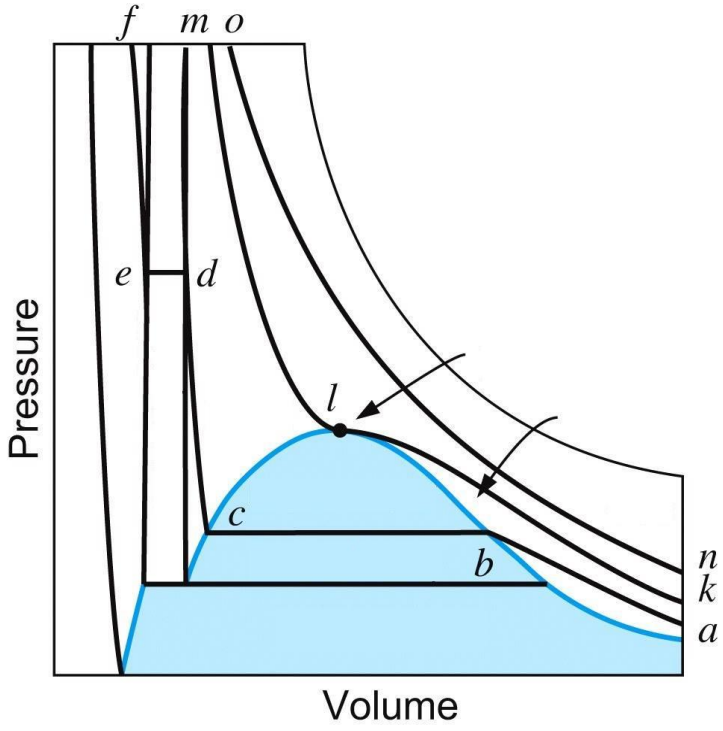

Figure 2.8b

(a)

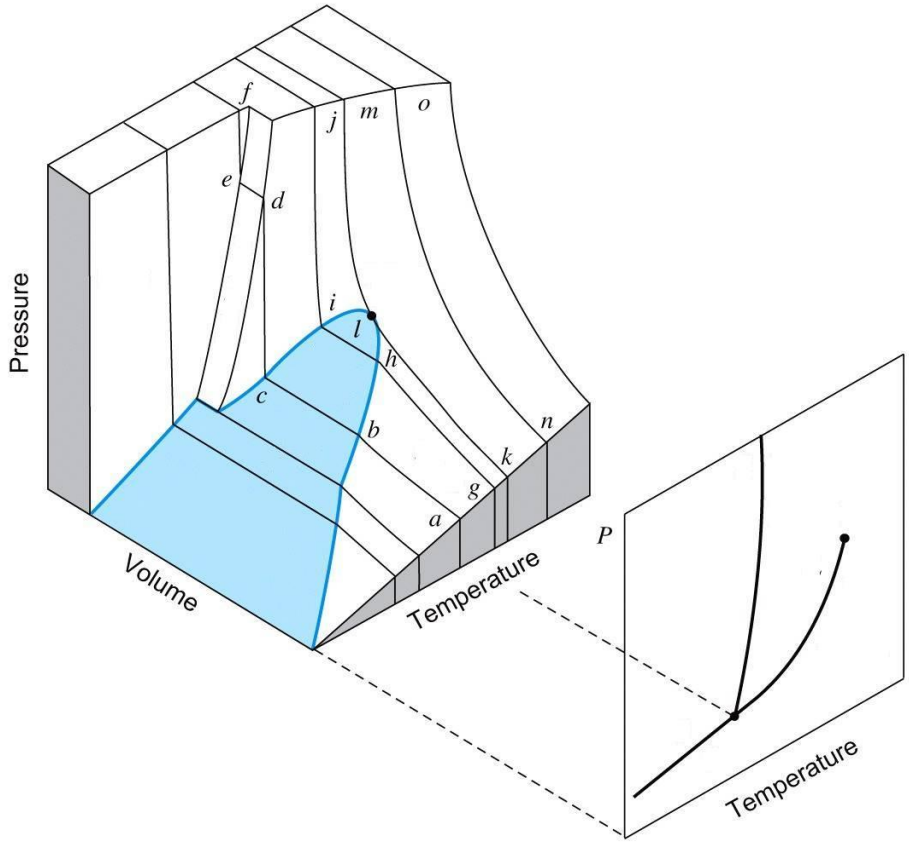

Figure 2.8a

(b)

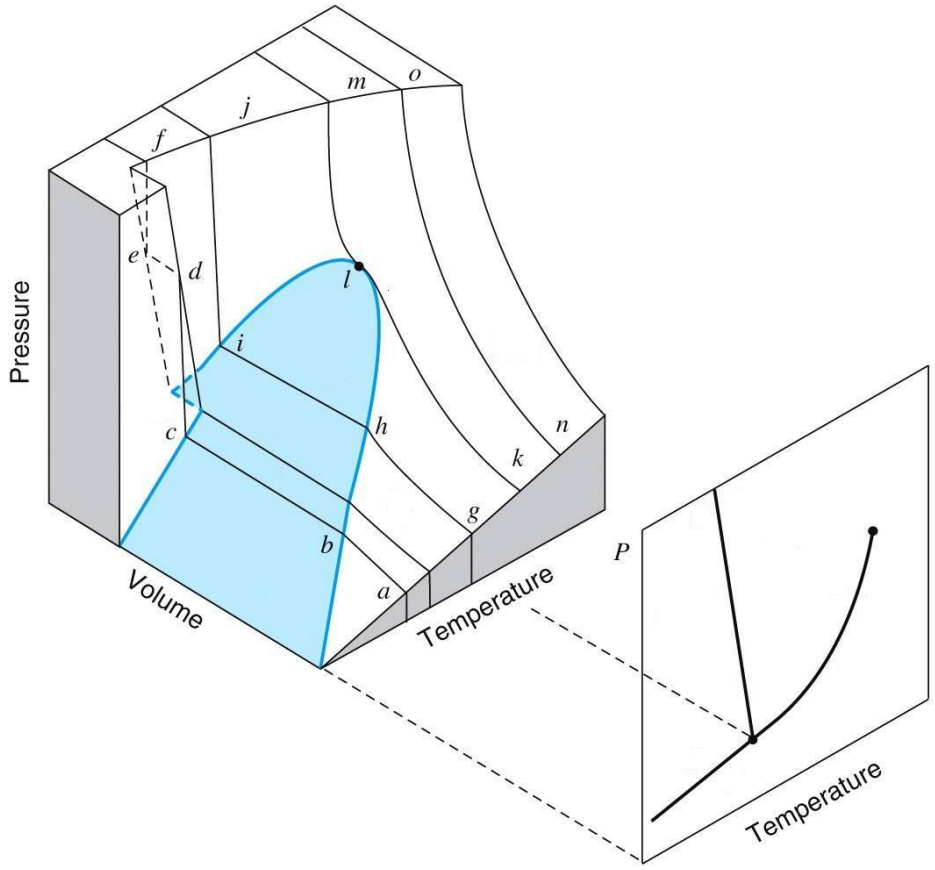

Figure 2.7a

(c)

Thermodynamics first midterm, Engineering Science, 20151026

1 A rigid vessel contains saturated ammonia vapor at 20C. Heat is transferred to the system until the temperature reaches 40C. What is the final pressure? 10%

2 What is the percent error in specific volume if the ideal gas model is used to represent the behavior of superheated ammonia at 40C, 500 kPa? What if the generalized compressibility chart, Fig. D.1, is used instead? 10%

3 A vessel having a volume of 5 m3 contains 0.05 m3 of saturated liquid water and 4.95 m3 of saturated water vapor at 0.1 MPa. Heat is transferred until the vessel is filled with saturated vapor. Determine the heat transfer for this process. See Fig. 1 10%

4 A piston cylinder contains air at 600 kPa, 290 K and a volume of 0.01 m3. A constant pressure process gives 54 kJ of work out. Find the final volume, the temperature of the air and the heat transfer. 10%

5 A cylinder fitted with a piston has an initial volume of 0.1 m3 and contains nitrogen at 150 kPa, 25C. The piston is moved, compressing the nitrogen until the pressure is 1 MPa and the temperature is 150 C. During this compression process heat is transferred from the nitrogen, and the work done on the nitrogen is 20 kJ. Determine the amount of this heat transfer. 15%

6 The piston/cylinder in Fig. 2 contains 0.1 kg water at 500C, 1000 kPa. The piston has a stop at half the original volume. The water now cools to 25C (a) Sketch the process in a P-v diagram. (b) Find the final pressure and volume (c) Find the heat transfer and work in the process. 15%

7 A piston cylinder contains air at 1000 kPa, 800 K with a volume of 0.05 m3. The piston is pressed against the upper stops, and it will float at a pressure of 750 kPa. Now the air is cooled to 400 K. What is the process work and heat transfer? See Fig. 3. 15%

8 What is the “internal energy” of the mass? Derive it. 12%. Why tables of thermodynamic properties contain the “internal energy” not the “energy”? 3%