(1) 何謂汽電共生 (Cogeneration)？請繪圖說明汽電共生廠的相關設備及相互間關係。(15%)

(2) 何謂空氣標準鄂圖循環 (Air-Standard Otto Cycle)，請以 P-V圖和T-S圖來表示說明。(15%)

(3) 何謂濕度計 (Psychrometer)？繪圖說明其工作原理。(10%)

(4) 何謂熱力學第三定律 (The Third Law of Thermodynamics)？(10%)

(5) A 5-kg piston in a cylinder with diameter of 100 mm is loaded with a linear spring and the outside atmospheric pressure of 100 kPa. The spring exerts no force on the piston when it is at the bottom of the cylinder and for the state shown the pressure is 400 kPa with volume 0.4 L. The valve is opened to let some air in, causing the piston to rise 2 cm. Find the new pressure. (10%)
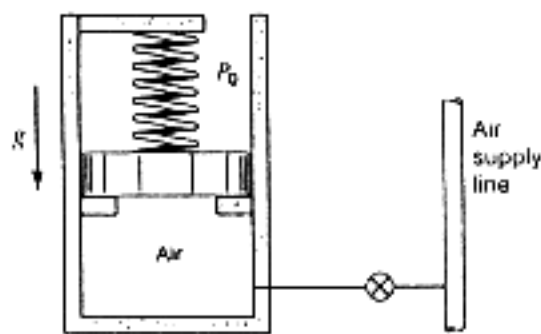
(6) An initially deflated and flat balloon is connected by a valve to a storage tank containing helium gas at 1 MPa at ambient temperature of 20°C. The valve is opened and the balloon is inflated at constant pressure, 100 kPa, equal to ambient pressure until it becomes spherical at $D_1 = 1$ m. If the balloon is larger than this, the balloon material is stretched giving a pressure inside as

$$P = P_0 + C\left(1 - \frac{D_1}{D}\right)\frac{D_1}{D}$$

The balloon is slowly inflated to a final diameter of 4 m, at which point the pressure inside is 400 kPa. The temperature remains constant at 20°C.

(a) Determine the minimum volume required of the helium tank to inflate the balloon. (10%).

(b) What is the maximum pressure inside the balloon at any time during this inflation process? (10%)   What is the pressure inside the helium storage tank at this time? (10%)

(c) For a control volume that consists of the space inside the balloon, determine the work done during the overall process? (10%)