國立臺北科技大學 102 學年度碩士班招生考試

系所組別：3510 化學工程研究所甲組

第二節　化工熱力學與反應工程　試題

注意事項：

1.本試題共六題，配分共 100 分。
2.請標明大題、子題編號作答，不必抄題。
3.全部答案均須在答案卷之答案欄內作答，否則不予計分。

一、The off gas from a boiling water nuclear power reactor contains a whole variety of radioactive trash, one of the most troublesome being Xe-133 (half-life = 5.2 days). This off gas flows continuously through a large holdup tank in which its mean residence time is 30 days, and where we can assume that the contents are well mixed. Find the fraction of activity removed in the tank. (15%)

二、Pure gaseous A at about 3 atm and 30°C (120 mmol/liter) is fed into a 1-liter mixed flow reactor at various flow rates. There it decomposes by A→3R, and the exit concentration of A is measured for each flow rate. From the following data find a rate equation to represent the kinetics of the decomposition of A. Assume the reactant A alone affects the rate. (15%)

v_o, liter/min	0.06	0.48	1.5	8.1
C_A, mmol/liter	30	60	80	105

三、Consider the autocatalytic reaction A→R, with $-r_A = 0.001 C_A C_R$ mol/liter·s. We wish to process 1.5 liters/s of a C_{A0} = 10 mol/liter feed to the highest conversion possible in the reactor system consisting of four 100-liter mixed flow reactors connected as you wish and any feed arrangement. Sketch your recommended design and feed arrangement and determine C_{Af} from this system. (20%)

四、When a system is taken from state *a* to *b* in Fig 1 along the path *acb*, 100J of heat flows into the system and the system does 40 J of work.

(a) How much heat flows into the system along path *aeb* if the work done by the system is 20J? (5%)

(b)The system returns from *b* to *a* along path *bda*. If the work done on the system is 30J, does the system absorb or liberate heat? How much? (10%)

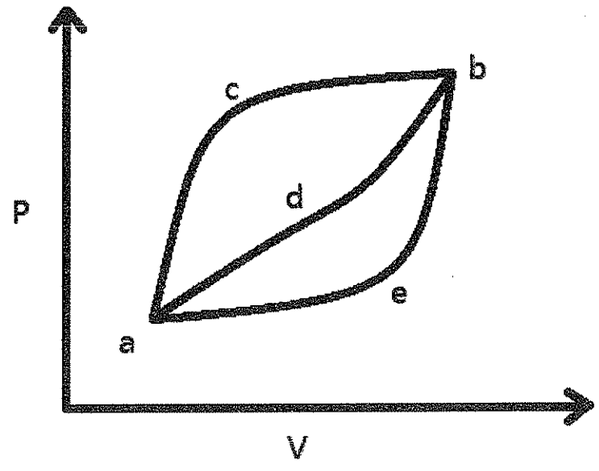

Fig. 1

五、Air at 1 bar and 25°C enters a compressor at low velocity, discharges at 3 bar, and enters a nozzle in which it expands to a final velocity of 600 m/sec at the initial conditions of pressure and temperature. If the work of compression is 240 kJ per kilogram of air, how much heat must be removed during compression? (15%)

六、A 40-kg steel casting (Cp=0.5 kJ kg^{-1} K^{-1}) at a temperature of 450°C is quenched in 150 kg of oil (Cp=2.5 kJ kg^{-1} K^{-1}) at 25°C. If there are no heat losses, what is the change in entropy of (a) the casting, (b) the oil, and (c) both considered together? (8%, 8%, 4%)