淡江大學99學年度碩士班招生考試試題

60-1

系別：化學工程與材料工程學系　　科目：化 工 熱 力 學

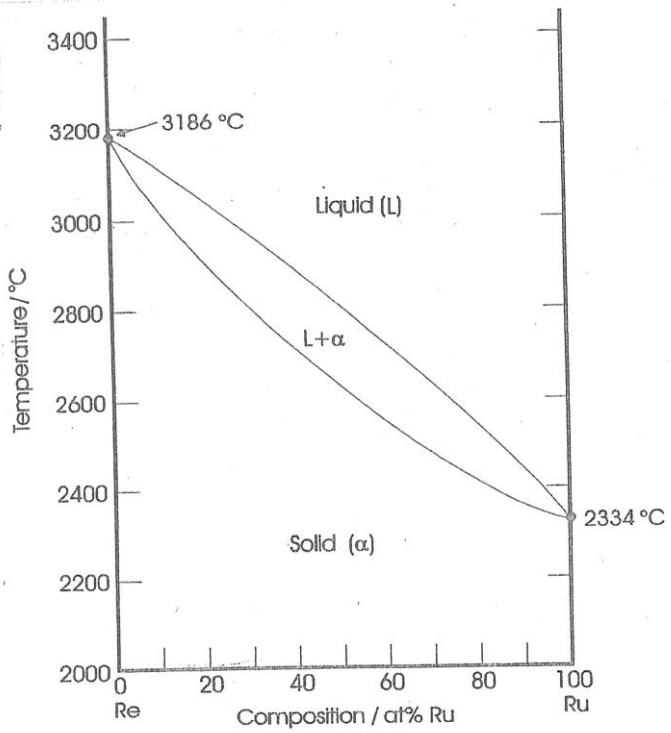
准帶項目請打「V」	
V	計 算 機

本試題共 2 頁，4 大題

Problem Four (25 points)

The phase diagram for ruthenium-rhenium (Ru-Re) is shown below. (i) What are the melting points of pure Re and pure Ru? (ii) A sample of composition 70 atomic % Ru is made up. What weights have to be added to prepare 100 g of sample? (iii) The alloy is held at 3000 °C. What phases are present and what are their compositions? Molecular weight of Ru = 101.07 and Re = 186.2

A sample of composition 60 atomic % Ru is made up and held at 2700 °C. (iv) What is the composition of the solid? (v) What is the composition of the liquid? (vi) What is the atomic % of each phase?



淡江大學99學年度碩士班招生考試試題

60 -2

系別：化學工程與材料工程學系　　科目：化 工 熱 力 學

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V	計 算 機

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Problem One (15 points)

A power plant generates steam at 350°C and discards heat to a river at 20°C. Calculate the maximum possible thermal efficiency of the power plant.

Problem Two (25points)

A rigid tank of 0.1 m^3 contains a mixture of saturated steam and saturated water at a pressure of 0.2 MPa. By volume the mixture is 10 % liquid. (i) What is the temperature (°C) of the saturate steam? (ii) What is the mass (Kg) of the saturated water? (iii) What is the internal energy (kJ) of the mixture (water+steam)? Heat is added to evaporate all the water so that the tank contains only saturated steam. (iv) What is the specific volume (m^3kg^{-1}) of the steam? (v)What is the pressure (MPa) in the tank? (vi) How much heat (kJ) has been added?

THERMODYNAMIC PROPERTIES OF SATURATED STEAM[a, b]

		Specific volume		Internal energy			Enthalpy			Entropy		
Press. MPa P	Temp. °C T	Sat. liquid v^L	Sat. vapor v^G	Sat. liquid u^L	Evap. Δu	Sat. vapor u^G	Sat. liquid h^L	Evap. Δh	Sat. vapor h^G	Sat. liquid s^L	Evap. Δs	Sat. vapor s^G
MPa		m^3/kg	m^3/kg	kJ/kg		kJ/kg	kJ/kg		kJ/kg	kg/(kg·K)		
0.100	99.63	0.001 043	1.6940	417.36	2088.7	2506.1	417.46	2258.0	2675.5	1.3026	6.0568	7.3594
0.125	105.99	0.001 048	1.3749	444.19	2069.3	2513.5	444.32	2241.0	2685.4	1.3740	5.9104	7.2844
0.150	111.37	0.001 053	1.1593	466.94	2052.7	2519.7	467.11	2226.5	2693.6	1.4336	5.7897	7.2233
0.175	116.06	0.001 057	1.0036	486.80	2038.1	2524.9	486.99	2213.6	2700.6	1.4849	5.6868	7.1717
0.200	120.23	0.001 061	0.8857	504.49	2025.0	2529.5	504.70	2201.9	2706.7	1.5301	5.5970	7.1271
0.225	124.00	0.001 064	0.7933	520.47	2013.1	2533.6	520.72	2191.3	2712.1	1.5706	5.5173	7.0878
2.25	218.45	0.001 187	0.088 75	933.83	1668.2	2602.0	936.49	1865.2	2801.7	2.5035	3.7937	6.2972
2.5	223.99	0.001 197	0.079 98	959.11	1644.0	2603.1	962.11	1841.0	2803.1	2.5547	3.7028	6.2575
3.0	233.90	0.001 217	0.066 68	1004.78	1599.3	2604.1	1008.42	1795.7	2804.2	2.6457	3.5412	6.1869
3.5	242.60	0.001 235	0.057 07	1045.43	1558.3	2603.7	1049.75	1753.7	2803.4	2.7253	3.4000	6.1253
4	250.40	0.001 252	0.049 78	1082.31	1520.0	2602.3	1087.31	1714.1	2801.4	2.7964	3.2737	6.0701
5	263.99	0.001 286	0.039 44	1147.81	1449.3	2597.1	1154.23	1640.1	2794.3	2.9202	3.0532	5.9734
6	275.64	0.001 319	0.032 44	1205.44	1384.3	2589.7	1213.35	1571.0	2784.3	3.0267	2.8625	5.8892
7	285.88	0.001 351	0.027 37	1257.55	1323.0	2580.5	1267.00	1505.1	2772.1	3.1211	2.6922	5.8133
8	295.06	0.001 384	0.023 52	1305.57	1264.2	2569.8	1316.64	1441.3	2758.0	3.2068	2.5364	5.7432
9	303.40	0.001 418	0.020 48	1350.51	1207.3	2557.8	1363.26	1378.9	2742.1	3.2858	2.3915	5.6772
10	311.06	0.001 452	0.018 026	1393.04	1151.4	2544.4	1407.56	1317.1	2724.7	3.3596	2.2544	5.6141
11	318.15	0.001 489	0.015 987	1433.7	1096.0	2529.8	1450.1	1255.5	2705.6	3.4295	2.1233	5.5527
12	324.75	0.001 527	0.014 263	1473.0	1040.7	2513.7	1491.3	1193.6	2684.9	3.4962	1.9962	5.4924
13	330.93	0.001 567	0.012 780	1511.1	985.0	2496.1	1531.5	1130.7	2662.2	3.5606	1.8718	5.4323
14	336.75	0.001 611	0.011 485	1548.6	928.2	2476.8	1571.1	1066.5	2637.6	3.6232	1.7485	5.3717
15	342.24	0.001 658	0.010 337	1585.6	869.8	2455.5	1610.5	1000.0	2610.5	3.6848	1.6249	5.3098
16	347.44	0.001 711	0.009 306	1622.7	809.0	2431.7	1650.1	930.6	2580.6	3.7461	1.4994	5.2455
17	352.37	0.001 770	0.008 364	1660.2	744.8	2405.0	1690.3	856.9	2547.2	3.8079	1.3698	5.1777

Problem Three (35 points)

One kmol of an ideal gas of constant heat capacity (C_p = 30 $kJ{\cdot}kmol^{-1}K^{-1}$) at 10 bar and 295 K enters a Ranque-Hilsch tube which is thermally and mechanically insulated from the surroundings. One-half of the gas leaves the tube at 355 K and 1 bar (hot stream), while the other half leaves the tube at 235 K and 1 bar (cold stream). (i) Calculate the enthalpy change (kJ) and the entropy change (kJK^{-1}) of this adiabatic process. (ii) What is the entropy change of the universe (kJK^{-1})? (iii) Assuming that the process can be operated reversibly with the same feed condition and exiting gas pressure, determine the temperatures (K) of the hot and cold streams.

本試題雙面印製

◀注意背面尚有試題▶