

Thermodynamics (MEL2020)
Indian Institute of Technology Jodhpur

Quiz-5B

Maximum points: 7

Instructions:

Date: 9th March 2022

Time: 5:10 to 5:35

- Each question carries **1 point**, there are 7 questions
- Please write your final short answers in A4 type sheet and upload within 25 mins
- No extra time is given for Scanning and uploading.
- **-1 negative marking for each minute of late submission**
- No Step wise marks are provided here (Each question carries 1 point)

Part 2: Write only final values or expressions or draw in A4 sheet.

1. Draw the correct T-v diagram if steam at $v_1 = 0.00001 \text{ m}^3/\text{kg}$ is heated to $v_2 = 8 \text{ m}^3/\text{kg}$ while maintaining $P = 10 \text{ kPa}$. The dots are states 1 and 2 with 1 being on the left. **(1P)**

TABLE A-5

Saturated water—Pressure table

Press., P kPa	Sat. temp., T _{sat} °C	Specific volume, m ³ /kg		Internal energy, kJ/kg			Enthalpy, kJ/kg			Entropy, kJ/kg·K		
		Sat. liquid, v _f	Sat. vapor, v _g	Sat. liquid, u _f	Evap., u _{fg}	Sat. vapor, u _g	Sat. liquid, h _f	Evap., h _{fg}	Sat. vapor, h _g	Sat. liquid, s _f	Evap., s _{fg}	Sat. vapor, s _g
1.0	6.97	0.001000	129.19	29.302	2355.2	2384.5	29.303	2484.4	2513.7	0.1059	8.8690	8.9749
1.5	13.02	0.001001	87.964	54.686	2338.1	2392.8	54.688	2470.1	2524.7	0.1956	8.6314	8.8270
2.0	17.50	0.001001	66.990	73.431	2325.5	2398.9	73.433	2459.5	2532.9	0.2606	8.4621	8.7227
2.5	21.08	0.001002	54.242	88.422	2315.4	2403.8	88.424	2451.0	2539.4	0.3118	8.3302	8.6421
3.0	24.08	0.001003	45.654	100.98	2306.9	2407.9	100.98	2443.9	2544.8	0.3543	8.2222	8.5765
4.0	28.96	0.001004	34.791	121.39	2293.1	2414.5	121.39	2432.3	2553.7	0.4224	8.0510	8.4734
5.0	32.87	0.001005	28.185	137.75	2282.1	2419.8	137.75	2423.0	2560.7	0.4762	7.9176	8.3938
7.5	40.29	0.001008	19.233	168.74	2261.1	2429.8	168.75	2405.3	2574.0	0.5763	7.6738	8.2501
10	45.81	0.001010	14.670	191.79	2245.4	2437.2	191.81	2392.1	2583.9	0.6492	7.4996	8.1488
15	53.97	0.001014	10.020	225.93	2222.1	2448.0	225.94	2372.3	2598.3	0.7549	7.2522	8.0071

2. Air enters an adiabatic compressor at 300 K. Find the exit temperature for a compression ratio of 3, assuming air to be an ideal gas ($\gamma = 7/5$) and the process to be reversible **(1 P)**
3. A rigid tank contains 4 kg of an ideal gas at 5 atm and 80°C. Now a valve is opened, and half of mass of the gas is allowed to escape. If the final pressure in the tank is 2.2 atm, the final temperature (°C) in the tank is **(1 P)**
4. Carbon dioxide contained in a piston-cylinder device is compressed from 0.3 to 0.1 m³. During the process, the pressure and volume are related by $P = aV^{-2}$, where $a = 8 \text{ kPa} \cdot \text{m}^6$. Calculate the work done on the carbon dioxide during this process. **(1 P)**
5. Steam enters a diffuser steadily at 0.5 MPa, 300°C, and 122 m/s at a rate of 4 kg/s. The inlet area of the diffuser is **(1 point)**

	P = 0.50 MPa (151.83°C)				P = 0.60 MPa (158.83°C)				P = 0.80 MPa (170.41°C)			
Sat.	0.37483	2560.7	2748.1	6.8207	0.31560	2566.8	2756.2	6.7593	0.24035	2576.0	2768.3	6.6616
200	0.42503	2643.3	2855.8	7.0610	0.35212	2639.4	2850.6	6.9683	0.26088	2631.1	2839.8	6.8177
250	0.47443	2723.8	2961.0	7.2725	0.39390	2721.2	2957.6	7.1833	0.29321	2715.9	2950.4	7.0402
300	0.52261	2803.3	3064.6	7.4614	0.43442	2801.4	3062.0	7.3740	0.32416	2797.5	3056.9	7.2345
350	0.57015	2883.0	3168.1	7.6346	0.47428	2881.6	3166.1	7.5481	0.35442	2878.6	3162.2	7.4107

6. Steam at 1000 bar and 300 K undergoes Joule-Thomson expansion to 1 atm. What would be the temperature of steam after expansion? Assume steam to be an ideal gas. **(1 P)**
7. An ordinary egg with a mass of 0.1 kg and a specific heat of 3.32 kJ/kg·°C is dropped into boiling water at 95°C. If the initial temperature of the egg is 5°C, the maximum amount of heat transfer to the egg is **(1 P)**