

CONCORDIA UNIVERSITY
FACULTY OF ENGINEERING AND COMPUTER SCIENCE
DEPARTMENT OF MECHANICAL ENGINEERING

PROBLEM I [30 pts]

2.5 kg of air in a piston-cylinder assembly is initially at 175 kPa and 17°C. It then undergoes an isothermal compression until the pressure reaches 700 kPa.

- Determine the amount of heat rejected during the compression process in kJ.

For air: $R=0.2870 \text{ kJ/kg K}$

PROBLEM II [50 pts]

A piston-cylinder device contains 0.5 kg of saturated water mixture at 75 kPa with a quality of 0.2681. Heat is supplied until the piston just starts moving. At this stage, the temperature of the water reaches 250°C.

- Determine the mass of the piston if its diameter is 0.2 m.

More heat is then provided to the piston-cylinder device until the temperature reaches 700°C.

- Determine, in kJ, the total heat supplied provided to the system and the total work done.

PROBLEM III [20 pts]

1- When can non-ideal gases be considered to behave as ideal gases, specifically what two properties must be considered?

2- Under what conditions will none of the heat supplied to a piston-cylinder device containing air be converted into work?

3- What does the area under a C_p vs T graph represents?

4- What is the name of the state of matter discovered close to zero Kelvin?

(a) Superconductivity; (b) Kelvin-Joule gas; (c) Bose-Einstein condensate