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LS ALLOWED.

NSTRUCTIONS.

R_{air} = 0.287 kJ/kg. ^oK γ= 1.4 M = 28.9 kg/kmol

(20 Marks) Air is reversibly compressed from 100 kPa, 25°C to 800 kPa. If the processes are:

i) Isothermal

ii) Polytropic, n = 1.25

iii) Adiabatic

Sketch the P-v and T-s diagram for each process.

For each process, calculate:

- The compression work.
- The change of entropy.
- The heat transfer.

(30 Marks) A Rankine cycle has the following specifications:

working fluid	water
condenser pressure	50. kPa
boiler pressure	9. Mpa
boiler outlet temperature	350°C
isentropic turbine efficiency	.9

a) Draw a schematic diagram showing the components of the cycle.

b) Draw a T-s diagram and a Ph diagram.

c) Write the energy equations for each process of the cycle.

d) Determine the pressure, temperature, specific volume, entropy, enthalpy and quality if appropriate at each key point in the cycle.

e) Determine the heat transferred and work done for each process of the cycle.

f) Determine the net work output.

g) What mass flow rate of steam is required if the power output of the cycle is 100 kW?

h) Determine the cycle efficiency.

3. (20 Marks) A frictionless piston-cylinder device initially contains 200 litres of saturated liquid refrigerant 12. The piston is free to move, and its mass is such that it maintains a pressure of 800 kPa on the refrigerant. The refrigerant is now heated to 50°C. Calculate the work done, the heat transferred during the process and the entropy change. Draw the process on a P-v and T-s diagram.

4. (30 Marks) An Otto cycle has the following specification:

Induction Pressure	101 kPa
Induction Temperature	20°C
Maximum Temperature of cycle	1600°C
Compression Ratio rv = 8:	Swept volume = 0.003 m^3

a) Draw a P-V diagram and T-S diagram for the cycle. Label all key points.

b) Determine the pressure, temperature, and specific volume of all key points.

c) Determine the entropy change between points.

d) Determine the work and heat transferred for each process in the cycle.

e) Determine the work output and efficiency of the cycle.

f) If the engine runs at 4000 revolutions per minute, what is the power output?

g) What would the efficiency of a Carnot cycle be operating between the maximum and minimum temperatures of this engine.