

Exam  
 lecture N<sup>o</sup> 3  
 Sunday, 11/10/05

Review problem

**Problem One:** 20%

Helium gas at atmospheric pressure of 101 kPa and 500K degrees is heated until its pressure reaches 7.5 MPa at 1750 K degrees. Calculate the change in specific internal energy for this process.

$\Delta u = c_v(\Delta T) = 3.345 \times 1250$   
 $c_p = 5.193$   
 $c_v = c_p - R$

**Problem Two:** 30%

Air treated as ideal gas is compressed in a nearly reversible process (polytropic) from 0.2 liters at 90 kPa and 20°C to final pressure of 845.15 kPa and final volume  $V_2$ . The work of compression is  $-190.17$  kJ per kg of air. It is known that the compression ratio is  $[V_1/V_2] = 6$ . Draw and properly label the p-v diagram for this process.

$w = -190.17$   
 $n = 1.25$   
 $T_2 = \frac{P_2 V_2 T_1}{P_1 V_1} = 958$

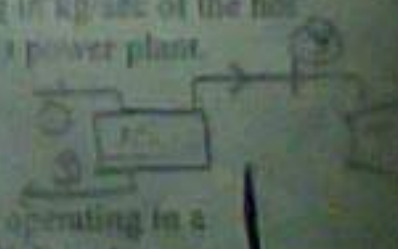
Calculate the value of the polytropic exponent  $n$  for the equation  $PV^n = \text{constant}$  and the heat transfer for the process in kJ per kilograms.

Are the specific heats constant in this problem? Yes or No and how can you find out?

Air Tables  $\Delta = 0.001$   
 $Q = -6$

**Problem Three:** 30%

Hot water in steady flow having an enthalpy of 763.5 kJ/kg and temperature 453.15 Kelvin degrees enters a flash chamber through a throttling valve. A mixture of liquid and vapor in the flash chamber is formed at 400kPa pressure. The liquid is withdrawn and is discarded while the saturated vapor feeds a turbine. Water exits from the turbine at 10 kPa and an enthalpy of 2145.4 kJ/kg. Work output of the turbine is 1000kW. What is the quality of the exiting steam from the turbine? Find the mass flow rate in kg/sec of the hot water that enters the flash chamber. Draw a schematic diagram for this power plant.



**Problem Four:** 20%

Calculate the thermal efficiency and the net work output of an engine operating in a Carnot Cycle mode. The high and low temperatures are 600 and 300 Kelvin degrees. The heat transferred at the high temperature is 250 kJ/kg.

$\eta = \frac{45}{250} = 18\%$