ENPE 250: Properties & Phase behavior of Petroleum Systems

Midterm 2– Fall 2000
Closed Book & Notes (60 min)

Problem 1 (20 min, 20 marks)

Argon gas enters steadily an adiabatic turbine at 900 kPa and 450 °C with a velocity of 80 m/s and leaves at 150 kPa with a velocity of 150 m/s. The inlet area of the turbine is 60 cm^2. If the power ouput is 250 kW, determine the exit temperature of the argon.

Problem 2 (10 min, 20 marks)

Refrigerant 134a at 800 kPa and 25 °C is throttled (JT valve) to a temperature of –20 °C. Determine the pressure (5 marks) and the internal energy of the refrigerant at the final state (15 marks).

Problem 3 (10 min, 20 marks)

A University of Regina Engineering Professor claims that, based on his measurements, a heat engine receives 300 BTU of heat from a source of 340 °F, converts 160 BTU of it to work, and rejects the rest as waste to a sink at 80 °F. Are these measurements reasonable? Why?

$\dot{m} = \rho V A$

$R_{Ar} = 0.2081$ kPa.m^3 / kg. K

$C_{P\,Ar} = 0.5203$ kj / kg. °C

$\eta_{th} = W / Q_H$

1 kJ/ kg = 1000 m^2 / s^2

$Q - W = \Delta H + \Delta KE + \Delta PE$

$\eta_{carnot} = 1 - (T_L / T_H)$