29 September 2016

CHE 260 – Thermodynamics and Heat Transfer

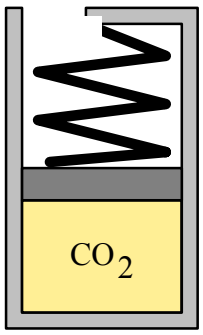
Quiz 1 – 2016

You have 60 minutes to do the following three problems. You may use an aid sheet and any type of non-communicating calculator.

1) A cylinder contains 0.1 kg of nitrogen at 100 kPa, 27°C. The gas is compressed by a piston to a pressure of 250 kPa in a polytropic process for which $PV^{1.25}$ = constant. Calculate the final gas temperature and the work done during compression.

(35 Marks)

2) A cylinder with a piston restrained by a linear spring contains 2 kg of carbon dioxide at 500 kPa and 400°C. It is cooled to 40°C, at which point the pressure is 300 kPa. Calculate the heat transfer for the process.



(35 Marks)

3) A small, high-speed turbine operating on compressed air produces a power output of 100 W. The inlet state is 400 kPa, 50°C, and the exit state is 150 kPa, −30°C. Assuming the velocities to be low and the process to be adiabatic, find the required mass flow rate of air through the turbine.

(30 Marks)

Properties of gases

Gas	R	c_p
Air	0.2870 kJ/kgK	1.004 kJ/kgK
Nitrogen	0.2968 kJ/kgK	1.042 kJ/kgK
Carbon dioxide	0.1889 kJ/kgK	0.842 kJ/kgK