FME 321 THERMODYNAMICS II

TUTORIAL SHEET II

1 Tanks of $5m^3$ are to be used for storing gases at 16.5 bar and 310K. The gases are oxygen, nitroger, helium hydrogen and carbon dioxide.
Assuming all these are ideal gases, find the mass in Kg of each gas that can be stored in the tank.
(106.8kg, 93kg, 13.32kg, 6.66kg, 146kg)

2 1 kg mole of nitrogen is contained in a vessel of volume $2.5m^3$ at 100^oC.

(a) Evaluate the mass, the pressure, the specific volume of the gas.
(b) If the ratio of the specific heats is 1.4, evaluate the values of Cp and Cv.
(c) Subsequently, the gas cools to the atmospheric temperature of 30^oC; evaluate the final pressure of the gas.
(d) Evaluate the increase in specific internal energy, the increase in specific enthalpy, increase in specific entropy and the magnitude and sign of heat transfer.

(28kg, 12.4 x $10^5 N/m^2$, $0.089m^3/kg$, 1.04, $0.743kJ/kg^oC$, 10.07) bar)

3 An engine working the otto cycle is supplied with air at 1 x $10^5 N/m^2$ and 35^oC.
The compression ratio is 8. Heat supplied is 2100kJ/kg.
Determine the following:

(a) the maximum pressure and temperature of the cycle
(b) the cycle efficiency
(c) the mean effective pressure

(For air Cp=1.005, Cv = 0.718 & R = 0.287kJ/KgK)
(Ans 9.426 mPa, 3633K, 56.5%, 1.533mPa)

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4 An air standard Diesel cycle has a compression ratio of 14. The pressure at the beginning of the compression stroke is 1.0 bar and the temperature is 300 K. The maximum temperature is 2773 K.
Determine :

(i) the thermal efficiency
(ii) the mean effective pressure

(53.6%, 12.7 x 10^5N/m²)

5 A gas turbine set takes in air at 16°C, the pressure ratio is 4:1 and the maximum temperature is 560°C.
Assuming efficiencies of 0.86 and 0.83 for the turbine and compressor respectively, determine the overall efficiency :

(i) without heat exchange (27 %)
(ii) with heat exchanges making use of 75% of the available heat.

6 A single acting single stage air compressor with a 150mm bore and 200mm stroke takes in air at 1 x 10^5N/m², 27°C and delivers it at 9 x 10^5N/m².
The compressor operates at 5 rev per second.
Determine the mean effective pressure and the power required to drive the compressor when the compression is:

(i) isothermal
(ii) adiabatic
(iii) polytropic with n = 1.3

Neglect clearance volume

(Ans (i) 2.2 x 10^5N/m², 3.88kw)
(ii) 3.08x 10^5N/m², 5.41kw)
(iii) 2.9 x 10^5N/m², 5.12kw)