SP-26
Gaseous propane (C₃H₈) is burned with 100% dry air at 1 bar. Assume “complete” combustion.

(a) Write the balanced chemical reaction.
(b) Calculate the air-fuel ratio (kg air/kg fuel) for stoichiometric combustion of gaseous propane.
(c) Find the dew point temperature (°C) of the product mixture

Suppose moist air at 25°C with 50% relative humidity is used instead of dry air.

(d) Write the balanced chemical reaction.

Suppose gaseous propane is burned with dry air such that the air-fuel ratio is 31.2 kg air/kg fuel.

(e) Calculate the percent theoretical air (%) in the combustor.
(f) What is the equivalence ratio?
(g) Find the dew point temperature (°C) of the product mixture.

Suppose gaseous propane is burned with 80% dry air and H₂O, CO₂, CO, and N₂ are products.

(h) Find the dew point temperature (°C) of the product mixture.

Answers: (c) 54.6°C; (g) 41.6°C; (h) 57.9°C
SP-27
Gaseous propane (C₃H₈) at 25°C and 1 atm is burned with 100% dry air at 25°C and 1 atm in a combustor operating at steady state. Assume that products of “complete” combustion exit the combustor at 1500 K and 1 atm.

(a) Determine the heat transfer (kJ/kg fuel) for the combustor.

Suppose the products of “complete” combustion exit the combustor at 298 K and 1 atm.

(b) Determine the heat transfer (kJ/kg fuel) for the combustor.

Answers: (a) -21,465 kJ/kg fuel, heat rejected; (b) -49,742 kJ/kg fuel, heat rejected
A mixture of gaseous octane \( (C_8H_{18}) \) and 200\% of theoretical air, initially at 25°C, 1 atm, reacts completely in a rigid vessel.

a. If the vessel were well-insulated, determine the temperature, in °C, and the pressure, in atm, of the combustion products.

b. If the combustion products were cooled at constant volume to 25°C, determine the final pressure, in atm, and the heat transfer, in kJ per kmol of fuel.

Methane gas \( (CH_4) \) reacts completely with the theoretical amount of oxygen \( (O_2) \) in a piston-cylinder assembly. Initially, the mixture is at 77°F, 1 atm. If the process occurs at constant pressure and the final volume is 1.9 times the initial volume, determine the work and the heat transfer, each in Btu per lbmol of fuel.

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**SP-28**

Gaseous propane \( (C_3H_8) \) at 25°C and 1 atm enters an insulated combustor operating at steady state and burns completely with dry air entering at 25°C and 1 atm.

(a) Calculate the adiabatic flame temperature \( (K) \) for 80\%, 100\%, and 200\% theoretical air. For the 80\% case, assume that \( H_2O, CO_2, CO, \) and \( N_2 \) are the products

(b) Provide physical explanation for the variation of the adiabatic flame temperature.

Answers: Not attached

Note:
If you use EES, then include your EES code(s). Assumptions, basic equation(s), system sketch can be either submitted separately or included within the EES code. EES code should contain variable definitions, comments, etc.