**Example 1** Determining the Air–Fuel ratio for Complete Combustion of Octane

Determine the air–fuel ratio on both a molar and mass basis for the complete combustion of octane, C8H18, with **(a)** the theoretical amount of air, **(b)** 150% theoretical air (50% excess air).

**Example 2** Using a Dry product Analysis for Combustion of Methane

Methane, CH4, is burned with dry air. The molar analysis of the products on a dry basis is CO2, 9.7%; CO, 0.5%; O2, 2.95%; and N2, 86.85%. Determine **(a)** the air–fuel ratio on both a molar and a mass basis, **(b)** the percent theoretical air, **(c)** the dew point tem- perature of the products, in °F, if the products are cooled at 1 atm, **(d)** the amount of water vapor present, in mol per mol of fuel consumed, if the products are cooled to 305 K at 1 atm.

**Example 3** Burning Natural Gas with Excess Air

A natural gas has the following molar analysis: CH4, 80.62%; C2H6, 5.41%; C3H8, 1.87%; C4H10, 1.60%; N2, 10.50%. The gas is burned with dry air, giving products having a molar analysis on a dry basis: CO2, 7.8%; CO, 0.2%; O2, 7%; N2, 85%. **(a)** Determine the air–fuel ratio on a molar basis. **(b)** Assuming ideal gas behavior for the fuel mixture, determine the amount of products in kmol that would be formed from 100 m3 of fuel mixture at 300 K and 1 bar. **(c)** Determine the percent of theoretical air.

**Example 4** Analyzing a Gas turbine Fueled with Methane

Methane (CH4) at 25°C enters the combustor of a simple open gas turbine power plant and burns completely with 400% of theoreti- cal air entering the compressor at 25°C, 1 atm. Products of combustion exit the turbine at 730 K, 1 atm. The rate of heat transfer from the power plant is estimated as 3% of the net power devel- oped. Determine the net power developed, in MW, if the fuel mass flow rate is 20 kg/min. For the entering air and exiting combustion products, kinetic and potential energy effects are negligible.

